

# HSMx-A2-xx-xxxxx Bi-Color

## HSMx-A3xx-xxxxx Tri-Color

Surface Mount LED Indicators,  
PLCC-4 SMT LEDs



## Data Sheet



### Description

This family of SMT LEDs is packaged in the industry standard PLCC-4 package. These SMT LEDs have high reliability performance and are designed to work under a wide range of environmental conditions. This high reliability feature makes them ideally suited to be used under harsh interior automotive as well as interior signs application conditions.

To facilitate easy pick and place assembly, the LEDs are packed in EIA-compliant tape and reel. Every reel will be shipped in single intensity and color bin, except red color to provide close uniformity.

These LEDs are compatible with IR and TTW solder reflow process.

This super wide viewing angle at 120° together with the built in reflector pushing up the intensity of the light output makes these LED suitable to be used in the interior electronics signs. The flat top emitting surface makes it easy for these LEDs to mate with light pipes. This is suitable for general backlighting in automotive interior, office equipment, industrial equipment, and home appliances.

### Features

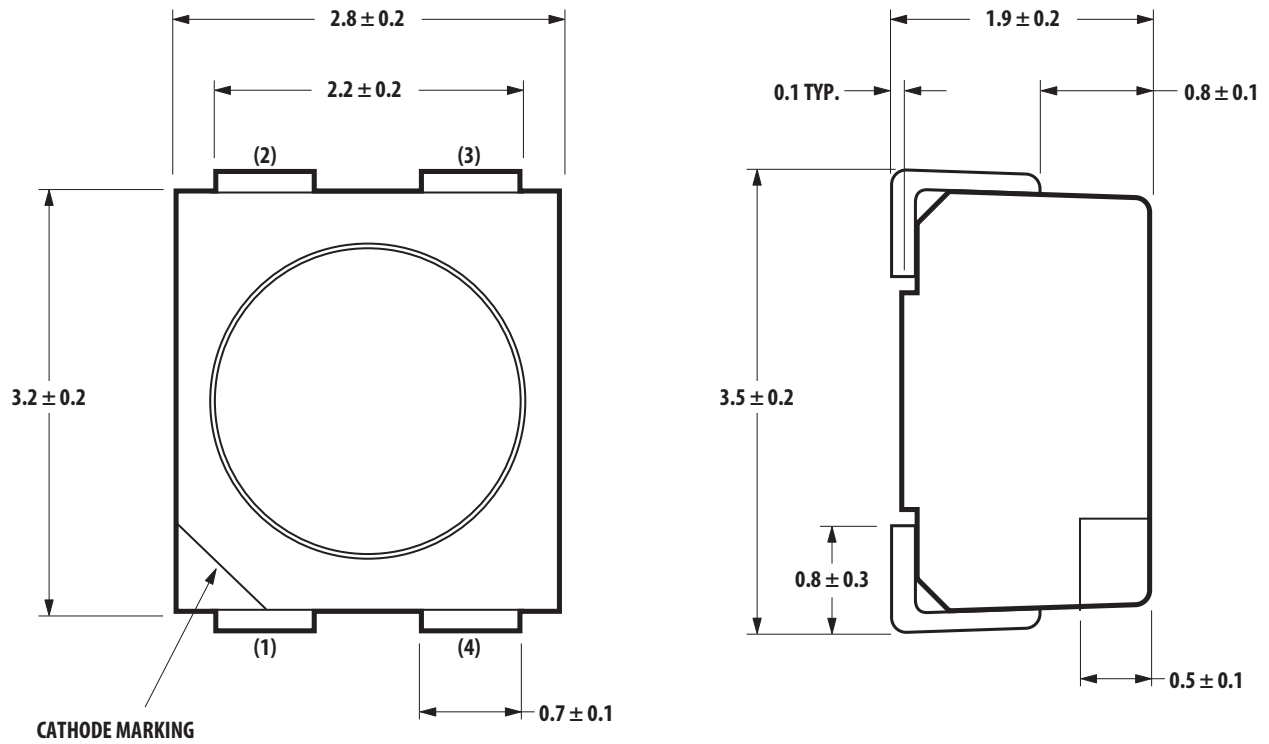
- Industry Standard PLCC-4 package (Plastic Leaded Chip Carrier)
- High reliability LED package due to enhanced silicone resin material
- High brightness using AlInGaP and InGaN dice technologies
- Available in full selection of colors
- Super wide viewing angle at 120°
- Available in 8 mm carrier tape on 7-inch reel
- Compatible with IR soldering process

### Applications

- Electronic signs and signals
  - Interior full color sign
  - Variable message sign
- Interior automotive
  - Instrument cluster backlighting
  - Central console backlighting
  - Cabin backlighting
- Office automation, home appliances, industrial equipment
  - Front panel backlighting
  - Display backlighting

*CAUTION: HSMF-Axxx-xxxxx LEDs are Class 2 ESD sensitive. Please observe appropriate precautions during handling and processing. Refer to Avago Application Note AN-1142 for additional details.*

## Package Dimensions



NOTE:  
1. ALL DIMENSIONS IN mm.

### Tri Color

- 1 Cathode (Color 1)
- 2 Common Anode
- 3 Cathode (Color 3)
- 4 Cathode (Color 2)

### Bi Color

- 1 Cathode (Color 1)
- 2 Anode (Color 1)
- 3 Cathode (Color 2)
- 4 Anode (Color 2)

## Device Selection Guide

### Bi Color

| Part Number     | Color 1       | Color 2              |
|-----------------|---------------|----------------------|
| HSMF-A201-xxxxx | GaP Red       | GaP Yellow Green     |
| HSMF-A202-xxxxx | GaP Red       | GaP Yellow           |
| HSMF-A203-xxxxx | GaP Red       | GaP Emerald Green    |
| HSMF-A204-xxxxx | GaP Orange    | GaP Yellow Green     |
| HSMF-A205-xxxxx | GaP Orange    | GaP Emerald Green    |
| HSMF-A206-xxxxx | GaP Yellow    | GaP Yellow Green     |
| HSMF-A211-xxxxx | AlGaAs Red    | GaP Yellow Green     |
| HSMF-A212-xxxxx | AlGaAs Red    | GaP Yellow           |
| HSMF-A222-xxxxx | AllnGaPRed    | AllnGaP Amber        |
| HSMF-A226-xxxxx | AllnGaP Amber | AllnGaP Yellow Green |

| Part Number     | Color 1                   |                             | Color 2                   |                             |                             |      |
|-----------------|---------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|------|
|                 | Min. Iv @ 20 mA<br>Bin ID | Typical Iv @ 20 mA<br>(mcd) | Min. Iv @ 20 mA<br>Bin ID | Typical Iv @ 20 mA<br>(mcd) | Typical Iv @ 20 mA<br>(mcd) |      |
| HSMF-A201-A00J1 | K2                        | 9.0                         | 16.0                      | L1                          | 11.2                        | 20.0 |
| HSMF-A202-A00J1 | K2                        | 9.0                         | 16.0                      | K1                          | 7.2                         | 12.0 |
| HSMF-A203-A00J1 | K2                        | 9.0                         | 16.0                      | J1                          | 4.5                         | 8.0  |
| HSMF-A204-A00J1 | K2                        | 9.0                         | 16.0                      | L1                          | 11.2                        | 20.0 |
| HSMF-A205-A00J1 | K2                        | 9.0                         | 16.0                      | J1                          | 4.5                         | 8.0  |
| HSMF-A206-A00J1 | K2                        | 9.0                         | 16.0                      | L1                          | 11.2                        | 20.0 |
| HSMF-A211-A00J1 | L2                        | 14.0                        | 25.0                      | L1                          | 11.2                        | 20.0 |
| HSMF-A212-A00J1 | L2                        | 14.0                        | 25.0                      | K1                          | 7.2                         | 12.0 |
| HSMF-A222-A00J1 | P1                        | 45.0                        | 80.0                      | P1                          | 45.0                        | 80.0 |
| HSMF-A226-A00J1 | P2                        | 56.0                        | 100.0                     | M2                          | 22.4                        | 60.0 |

Note:

1. The luminous intensity  $I_v$ , is measured at the mechanical axis of the lamp package. The actual peak of the spatial radiation pattern may not be aligned with this axis.
2.  $I_v$  tolerance =  $\pm 10\%$ .

### Tri Color

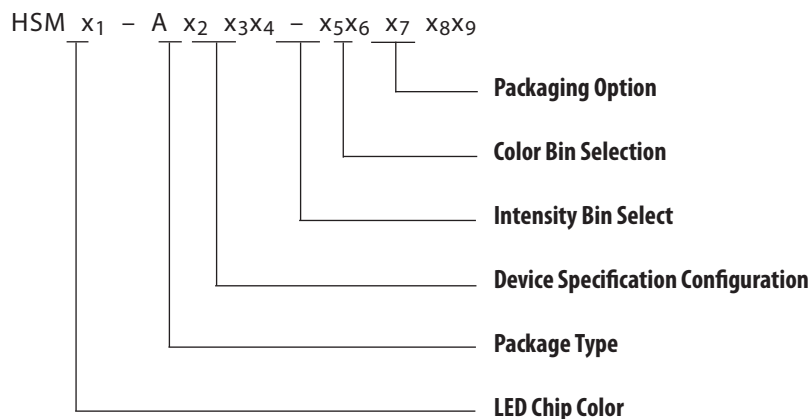
| Part Number     | Color 1      | Color 2     | Color 3    |
|-----------------|--------------|-------------|------------|
| HSMF-A341-xxxxx | AllInGaP Red | InGaN Green | InGaN Blue |

| Part Number     | Color 1                   |                             | Color 2                   |                             |                             | Color 3                   |                             |      |      |
|-----------------|---------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|------|------|
|                 | Min. Iv @ 20 mA<br>Bin ID | Typical Iv @ 20 mA<br>(mcd) | Min. Iv @ 20 mA<br>Bin ID | Typical Iv @ 20 mA<br>(mcd) | Typical Iv @ 20 mA<br>(mcd) | Min. Iv @ 20 mA<br>Bin ID | Typical Iv @ 20 mA<br>(mcd) |      |      |
|                 | K2                        | 9.0                         | 13.0                      | L2                          | 14.0                        | 20.0                      | K2                          | 9.2  | 10.0 |
|                 | P1                        | 45.0                        | 80.0                      | R1                          | 112.5                       | 160.0                     | K2                          | 9.2  | 10.0 |
|                 | P1                        | 45.0                        | 80.0                      | R1                          | 112.5                       | 160.0                     | K2                          | 9.2  | 10.0 |
| HSMF-A341-A00J1 | P1                        | 45.0                        | 80.0                      | R1                          | 112.5                       | 160.0                     | N1                          | 28.5 | 40.0 |
|                 | P1                        | 45.0                        | 80.0                      | R1                          | 112.5                       | 160.0                     | N1                          | 28.5 | 40.0 |

Note:

1. The luminous intensity  $I_v$ , is measured at the mechanical axis of the lamp package. The actual peak of the spatial radiation pattern may not be aligned with this axis.
2.  $I_v$  tolerance =  $\pm 10\%$ .

## Part Numbering System



## Absolute Maximum Ratings (T<sub>A</sub> = 25°C)

| Parameters                          | GaP             | AlGaAs | AlInGaP                |                      | GaN/InGaN |
|-------------------------------------|-----------------|--------|------------------------|----------------------|-----------|
|                                     |                 |        | Red, Amber             | Yellow Green         |           |
| DC Forward Current <sup>[1]</sup>   | 30 mA           | 30 mA  | 30 mA <sup>[3,4]</sup> | 20 mA <sup>[4]</sup> | 20 mA     |
| Peak Forward Current <sup>[2]</sup> | 100 mA          | 100 mA | 100 mA                 | 100 mA               | 100 mA    |
| Power Dissipation                   | 78 mW           | 78 mW  | 72 mW                  | 48 mW                | 120 mW    |
| Reverse Voltage                     | 5 V             |        |                        |                      |           |
| Junction Temperature                | 110°C           |        |                        |                      |           |
| Operating Temperature               | -55°C to +100°C |        |                        |                      |           |
| Storage Temperature                 | -55°C to +100°C |        |                        |                      |           |

### Notes:

1. Derate linearly as shown in figure 4.
2. Duty factor = 10%, Frequency = 1kHz.
3. Drive Current between 10 mA and 30 mA are recommended for best long term performance.
4. Operation at current below 5 mA is not recommended.

## Optical Characteristics (T<sub>A</sub> = 25°C)

| Color                | Peak Wavelength               | Dominant Wavelength                     | Viewing Angle                                    | Luminous Efficacy $\eta_v$    | Luminous Intensity/                                |
|----------------------|-------------------------------|---|--|-------------------------------|--|
|                      | $\lambda_{PEAK}$ (nm)<br>Typ. | $\lambda_D$ (nm) <sup>[1]</sup><br>Typ. | $2\theta_{1/2}$ (Degrees) <sup>[2]</sup><br>Typ. | (lm/W) <sup>[3]</sup><br>Typ. | Total Flux<br>$I_v$ (mcd) / $\Phi_v$ (mIm)<br>Typ. |
| GaP Red              | 635                           | 626                                     | 120  | 120                           | 0.45   |
| AlGaAs Red           | 645                           | 637                                     | 120  | 63                            | 0.45   |
| AllnGaP Red          | 635                           | 626                                     | 120  | 150                           | 0.45   |
| AllnGaP Red Orange   | 621                           | 615                                     | 120  | 240                           | 0.45   |
| GaP Orange           | 600                           | 602                                     | 120  | 380                           | 0.45   |
| AllnGaP Amber        | 592                           | 590                                     | 120  | 480                           | 0.45   |
| GaP Yellow           | 583                           | 585                                     | 120  | 580                           | 0.45   |
| AllnGaP Amber        | 592                           | 590                                     | 120  | 480                           | 0.45   |
| GaP Yellow Green     | 565                           | 569                                     | 120  | 590                           | 0.45   |
| GaP Emerald Green    | 558                           | 560                                     | 120  | 650                           | 0.45   |
| InGaN Green          | 523                           | 525                                     | 120  | 500                           | 0.45   |
| InGaN Blue           | 468                           | 470                                     | 120  | 75                            | 0.45   |
| GaN Blue             | 428                           | 462                                     | 120  | 65                            | 0.45   |
| AllnGaP Yellow Green | 575                           | 571                                     | 120  | 620                           | 0.45   |

### Notes:

1. The dominant wavelength,  $\lambda_D$ , is derived from the CIE Chromaticity Diagram and represents the color of the device.
2.  $\theta_{1/2}$  is the off-axis angle where the luminous intensity is 1/2 the peak intensity.
3. Radiant intensity,  $I_e$  in watts/steradian, may be calculated 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.

## Electrical Characteristics (T<sub>A</sub> = 25°C)

| Dice Technology | Forward Voltage<br>$V_F$ (Volts) @ $I_F = 20\text{mA}$ |      | Reverse Voltage<br>$V_R @ 100 \mu\text{A}$ | Reverse Voltage<br>$V_R @ 10 \mu\text{A}$ |
|-----------------|--|------|--|---|
|                 | Typ.   | Max. | Min.                                       | Min.                                      |
| GaP             | 2.2  | 2.6  | 5  | -   |
| AS AlGaAs       | 1.9  | 2.6  | 5  | -   |
| AllnGaP         | 1.9  | 2.4  | 5  | -   |
| GaN Blue        | 3.9  | 4.3  | -  | 5   |
| InGaN           | 3.4  | 4.05 | -  | 5   |

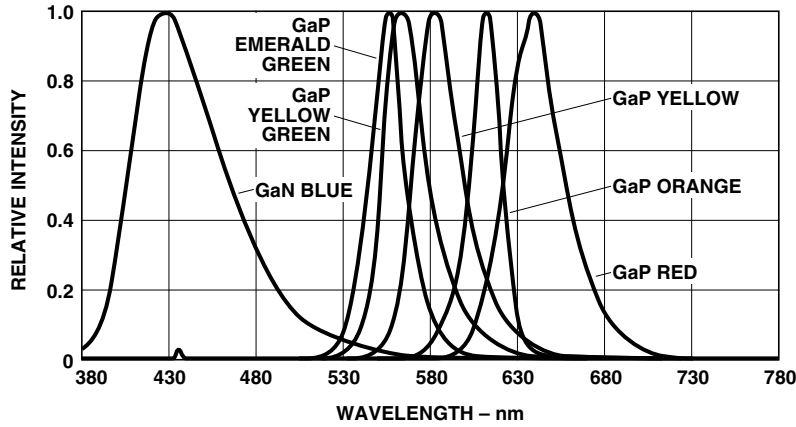
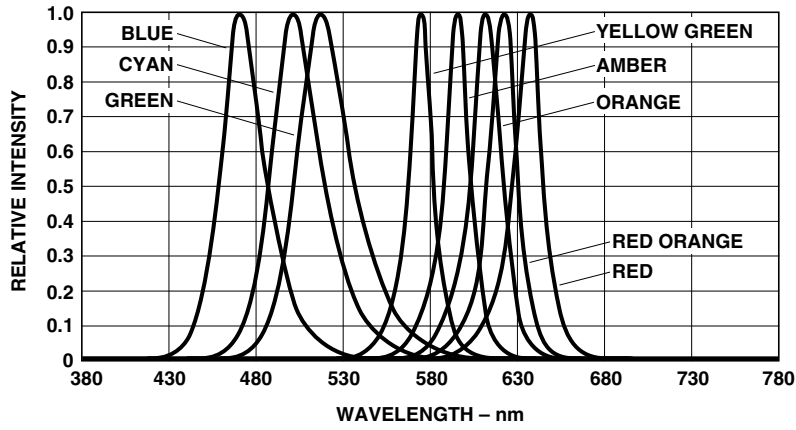


Figure 1. Relative intensity vs. wavelength

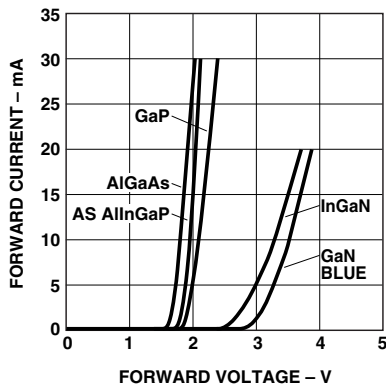


Figure 2. Forward current vs. forward voltage

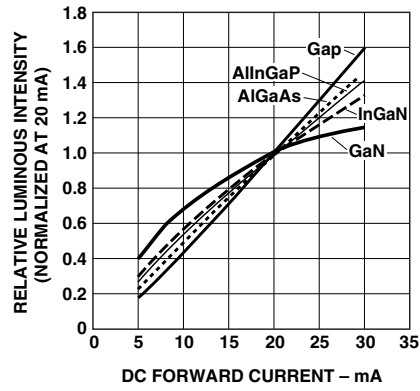


Figure 3. Relative intensity vs. forward voltage

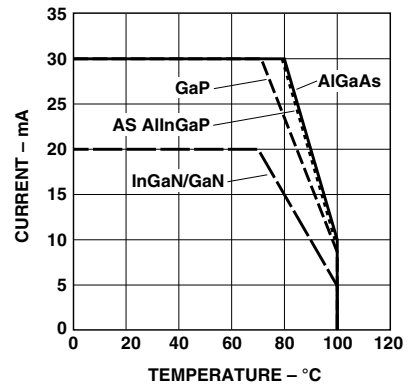


Figure 4a. Maximum forward current vs. ambient temperature. Derated based on  $T_{jMAX} = 110^{\circ}C$ ,  $R_{\theta JA} = 500^{\circ}C/W$  (1 chip on)

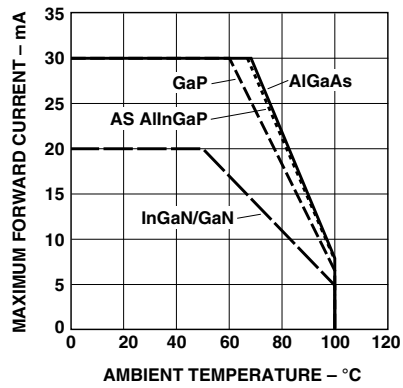


Figure 4b. Maximum forward current vs. ambient temperature. Derated based on  $T_{jMAX} = 110^{\circ}C$ ,  $R\theta_{JA} = 700^{\circ}C/W$  (3 chip on)

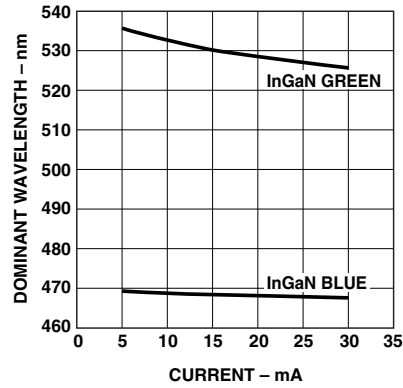


Figure 5. Dominant wavelength vs. forward current – InGaN

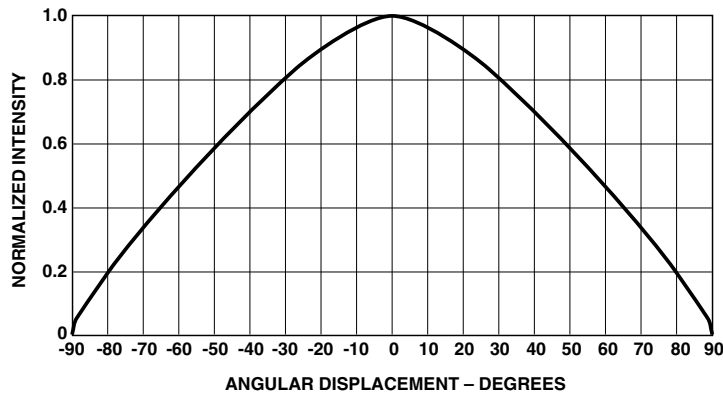


Figure 6. Radiation pattern

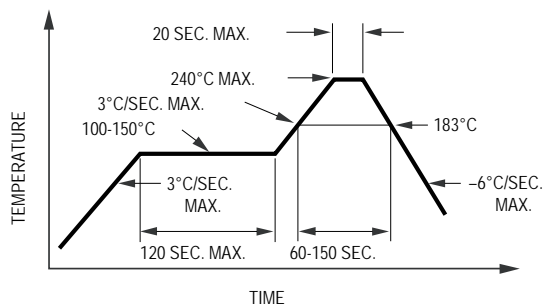


Figure 7. Recommended SnPb reflow soldering profile

Note: For detail information on reflow soldering of Avago surface mount LEDs, do refer to Avago Application Note AN 1060 Surface Mounting SMT LED Indicator Components.

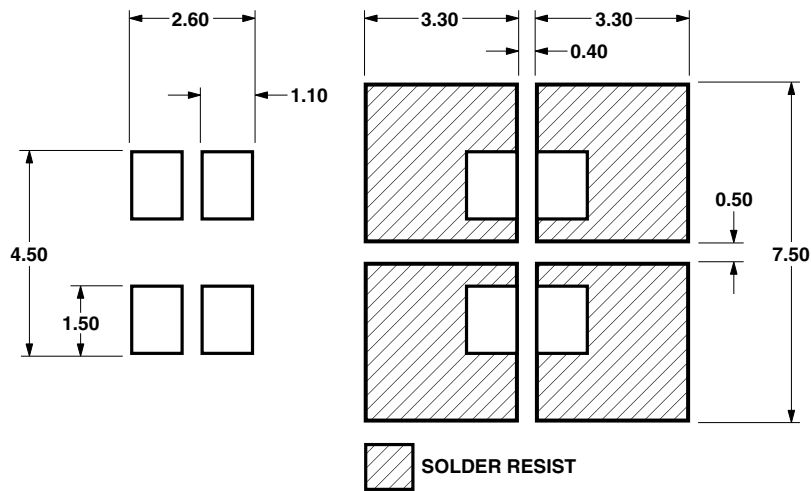


Figure 8. Recommended soldering pad pattern

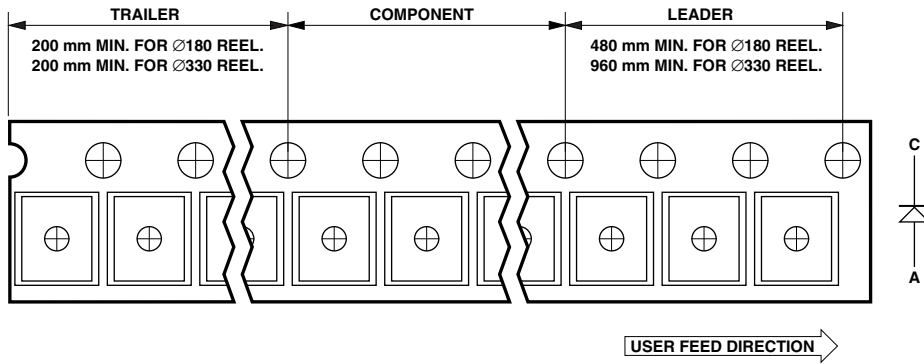


Figure 9. Tape leader and trailer dimension

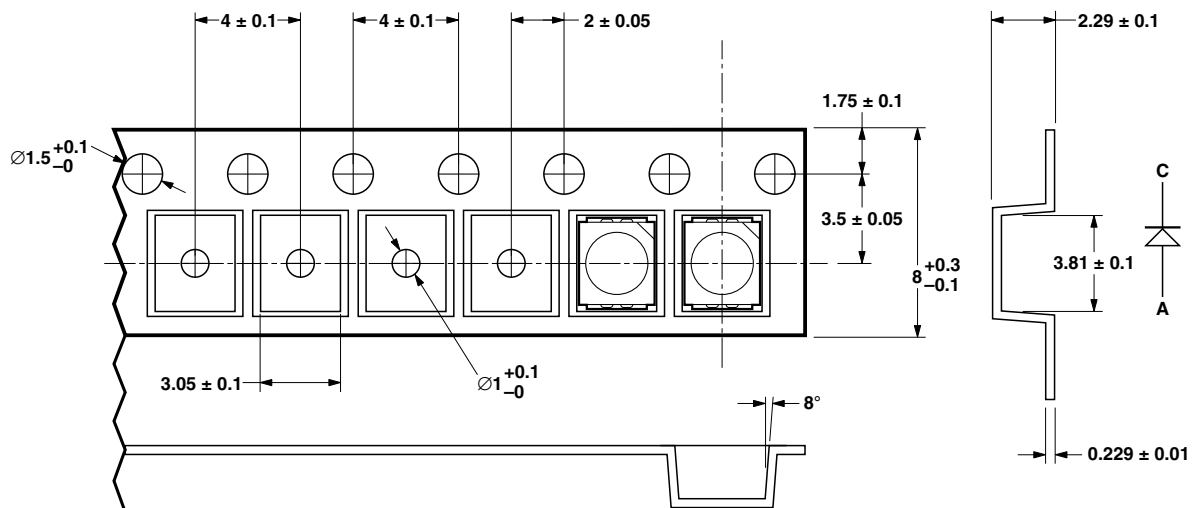


Figure 10. Tape leader and trailer dimension



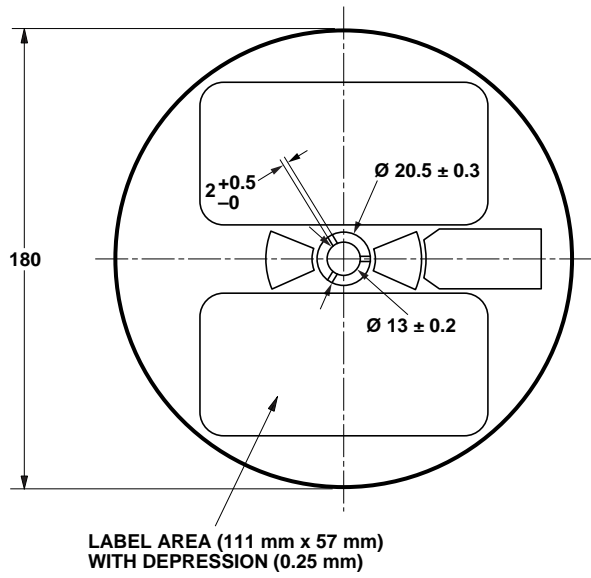
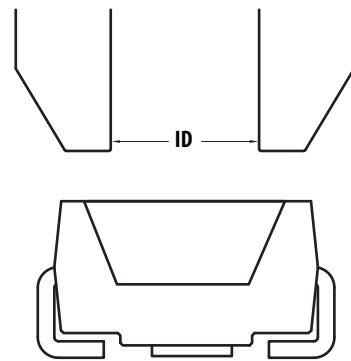
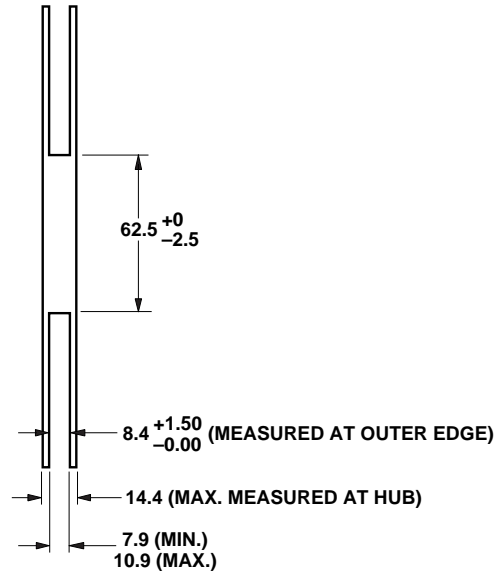


Figure 11. Reel dimension



Note : Diameter "ID" should be bigger than 2.3mm

Figure 13. Recommended Pick and Place Nozzle Size

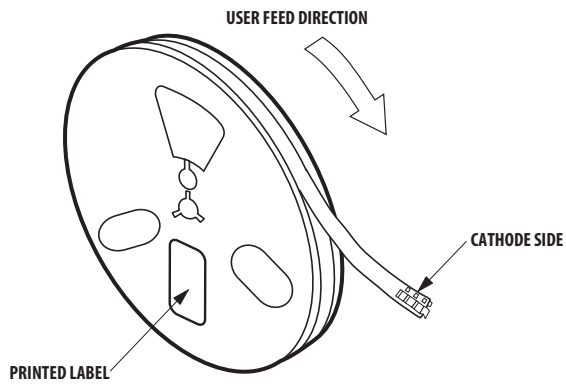


Figure 12. Reeling Orientation

## Handling Precaution

The encapsulation material of the product is made of silicone for better reliability of the product. As silicone is a soft material, please do not press on the silicone or poke a sharp object onto the silicone. These might damage the product and cause premature failure. During assembly or handling, the unit should be held on the body only. Please refer to Avago Application Note AN 5288 for detail information.

## Moisture Sensitivity

This product is qualified as Moisture Sensitive Level 2a per Jecdec J-STD-020. Precautions when handling this moisture sensitive product is important to ensure the reliability of the product. Do refer to Avago Application Note AN5305 Handling of Moisture Sensitive Surface Mount Devices for details.

### A. Storage before use

- Unopen moisture barrier bag (MBB) can be stored at  $<40^{\circ}\text{C}/90\%RH$  for 12 months. If the actual shelf life has exceeded 12 months and the HIC indicates that baking is not required, then it is safe to reflow the LEDs per the original MSL rating.
- It is not recommended to open the MBB prior to assembly (e.g. for IQC).

### B. Control after opening the MBB

- The humidity indicator card (HIC) shall be read immediately upon opening of MBB.
- The LEDs must be kept at  $<30^{\circ}\text{C} / 60\%RH$  at all time and all high temperature related process including soldering, curing or rework need to be completed within 672 hours.

### C. Control for unfinished reel

- For any unused LEDs, they need to be stored in sealed MBB with desiccant or desiccator at  $<5\%RH$ .

### D. Control of assembled boards

- If the PCB soldered with the LEDs is to be subjected to other high temperature processes, the PCB need to be stored in sealed MBB with desiccant or desiccator at  $<5\%RH$  to ensure no LEDs have exceeded their floor life of 672 hours.

### E. Baking is required if:

- "10%" or "15%" HIC indicator turns pink.
- The LEDs are exposed to condition of  $>30^{\circ}\text{C} / 60\%RH$  at any time.
- The LEDs floor life exceeded 672 hours.

Recommended baking condition:  $60\pm 5^{\circ}\text{C}$  for 20 hours.

### Iv Bin Select (X<sub>5</sub>X<sub>6</sub>)

Individual reel will contain parts from 1 half bin only.

| X <sub>5</sub>               | Min. Iv Bin Selection              |                    |
|------------------------------|------------------------------------|--------------------|
| <b>For</b>                   |                                    |                    |
| HSMF-A201-xxxxxx             |                                    |                    |
| HSMF-A204-xxxxxx             |                                    |                    |
| HSMF-A206-xxxxxx             |                                    |                    |
| <b>Minimum Intensity Bin</b> |                                    |                    |
|                              | Color 1<br>(Red/Yellow/<br>Orange) | Color 2<br>(Green) |
| A                            | K2                                 | L1                 |
| B                            | K2                                 | L2                 |
| C                            | K2                                 | M1                 |
| D                            | K2                                 | M2                 |
| E                            | K2                                 | N1                 |
| F                            | L1                                 | L1                 |
| G                            | L1                                 | L2                 |
| H                            | L1                                 | M1                 |
| J                            | L1                                 | M2                 |
| K                            | L1                                 | N1                 |
| L                            | L2                                 | L1                 |
| M                            | L2                                 | L2                 |
| N                            | L2                                 | M1                 |
| P                            | L2                                 | M2                 |
| Q                            | L2                                 | N1                 |
| R                            | M1                                 | L1                 |
| S                            | M1                                 | L2                 |
| T                            | M1                                 | M1                 |
| U                            | M1                                 | M2                 |
| V                            | M1                                 | N1                 |
| W                            | M2                                 | L1                 |
| X                            | M2                                 | L2                 |
| Y                            | M2                                 | M1                 |
| Z                            | M2                                 | M2                 |
| 1                            | M2                                 | N1                 |

| <b>For</b>                   |                  |                     |
|------------------------------|------------------|---------------------|
| HSMF-A202-xxxxxx             |                  |                     |
| <b>Minimum Intensity Bin</b> |                  |                     |
|                              | Color 1<br>(Red) | Color 2<br>(Yellow) |
| A                            | K2               | K1                  |
| B                            | K2               | K2                  |
| C                            | K2               | L1                  |
| D                            | K2               | L2                  |
| E                            | K2               | M1                  |
| F                            | L1               | K1                  |
| G                            | L1               | K2                  |
| H                            | L1               | L1                  |
| J                            | L1               | L2                  |
| K                            | L1               | M1                  |
| L                            | L2               | K1                  |
| M                            | L2               | K2                  |
| N                            | L2               | L1                  |
| P                            | L2               | L2                  |
| Q                            | L2               | M1                  |
| R                            | M1               | K1                  |
| S                            | M1               | K2                  |
| T                            | M1               | L1                  |
| U                            | M1               | L2                  |
| V                            | M1               | M1                  |
| W                            | M2               | K1                  |
| X                            | M2               | K2                  |
| Y                            | M2               | L1                  |
| Z                            | M2               | L2                  |
| 1                            | M2               | M1                  |

| <b>For</b>                   |                         |                    |
|------------------------------|-------------------------|--------------------|
| HSMF-A203-xxxxxx             |                         |                    |
| HSMF-A205-xxxxxx             |                         |                    |
| <b>Minimum Intensity Bin</b> |                         |                    |
|                              | Color 1<br>(Red/Orange) | Color 2<br>(Green) |
| A                            | K2                      | J1                 |
| B                            | K2                      | J2                 |
| C                            | K2                      | K1                 |
| D                            | K2                      | K2                 |
| E                            | K2                      | L1                 |
| F                            | L1                      | J1                 |
| G                            | L1                      | J2                 |
| H                            | L1                      | K1                 |
| J                            | L1                      | K2                 |
| K                            | L1                      | L1                 |
| L                            | L2                      | J1                 |
| M                            | L2                      | J2                 |
| N                            | L2                      | K1                 |
| P                            | L2                      | K2                 |
| Q                            | L2                      | L1                 |
| R                            | M1                      | J1                 |
| S                            | M1                      | J2                 |
| T                            | M1                      | K1                 |
| U                            | M1                      | K2                 |
| V                            | M1                      | L1                 |
| W                            | M2                      | J1                 |
| X                            | M2                      | J2                 |
| Y                            | M2                      | K1                 |
| Z                            | M2                      | K2                 |
| 1                            | M2                      | L1                 |

| For<br>HSMF-A211-xxxxx |                  |                    |
|------------------------|------------------|--------------------|
| Minimum Intensity Bin  |                  |                    |
|                        | Color 1<br>(Red) | Color 2<br>(Green) |
| A                      | L2               | L1                 |
| B                      | L2               | L2                 |
| C                      | L2               | M1                 |
| D                      | L2               | M2                 |
| E                      | L2               | N1                 |
| F                      | M1               | L1                 |
| G                      | M1               | L2                 |
| H                      | M1               | M1                 |
| J                      | M1               | M2                 |
| K                      | M1               | N1                 |
| L                      | M2               | L1                 |
| M                      | M2               | L2                 |
| N                      | M2               | M1                 |
| P                      | M2               | M2                 |
| Q                      | M2               | N1                 |
| R                      | N1               | L1                 |
| S                      | N1               | L2                 |
| T                      | N1               | M1                 |
| U                      | N1               | M2                 |
| V                      | N1               | N1                 |
| W                      | N2               | L1                 |
| X                      | N2               | L2                 |
| Y                      | N2               | M1                 |
| Z                      | N2               | M2                 |
| 1                      | N2               | N1                 |

| For<br>HSMF-A212-xxxxx |                  |                     |
|------------------------|------------------|---------------------|
| Minimum Intensity Bin  |                  |                     |
|                        | Color 1<br>(Red) | Color 2<br>(Yellow) |
| A                      | L2               | K1                  |
| B                      | L2               | K2                  |
| C                      | L2               | L1                  |
| D                      | L2               | L2                  |
| E                      | L2               | M1                  |
| F                      | M1               | K1                  |
| G                      | M1               | K2                  |
| H                      | M1               | L1                  |
| J                      | M1               | L2                  |
| K                      | M1               | M1                  |
| L                      | M2               | K1                  |
| M                      | M2               | K2                  |
| N                      | M2               | L1                  |
| P                      | M2               | L2                  |
| Q                      | M2               | M1                  |
| R                      | N1               | K1                  |
| S                      | N1               | K2                  |
| T                      | N1               | L1                  |
| U                      | N1               | L2                  |
| V                      | N1               | M1                  |
| W                      | N2               | K1                  |
| X                      | N2               | K2                  |
| Y                      | N2               | L1                  |
| Z                      | N2               | L2                  |
| 1                      | N2               | M1                  |

| For<br>HSMF-A222-xxxxx |                  |                    |
|------------------------|------------------|--------------------|
| Minimum Intensity Bin  |                  |                    |
|                        | Color 1<br>(Red) | Color 2<br>(Amber) |
| A                      | P1               | P1                 |
| B                      | P1               | P2                 |
| C                      | P1               | Q1                 |
| D                      | P1               | Q2                 |
| E                      | P1               | R1                 |
| F                      | P2               | P1                 |
| G                      | P2               | P2                 |
| H                      | P2               | Q1                 |
| J                      | P2               | Q2                 |
| K                      | P2               | R1                 |
| L                      | Q1               | P1                 |
| M                      | Q1               | P2                 |
| N                      | Q1               | Q1                 |
| P                      | Q1               | Q2                 |
| Q                      | Q1               | R1                 |
| R                      | Q2               | P1                 |
| S                      | Q2               | P2                 |
| T                      | Q2               | Q1                 |
| U                      | Q2               | Q2                 |
| V                      | Q2               | R1                 |
| W                      | R1               | P1                 |
| X                      | R1               | P2                 |
| Y                      | R1               | Q1                 |
| Z                      | R1               | Q2                 |
| 1                      | R1               | R1                 |
| 2                      | R2               | P1                 |
| 3                      | R2               | P2                 |
| 4                      | R2               | Q1                 |
| 5                      | R2               | Q2                 |
| 6                      | R2               | R1                 |

Note: 0 represents no maximum bin limit.

| For HSMF-A341-xxxxx   |                                |                    |                   |
|-----------------------|--------------------------------|--------------------|-------------------|
| Minimum Intensity Bin |                                |                    |                   |
|                       | Color 1<br>(Red/Red<br>Orange) | Color 2<br>(Green) | Color 3<br>(Blue) |
| A                     | P1                             | R1                 | N1                |
| B                     | P1                             | R1                 | N2                |
| C                     | P1                             | R1                 | P1                |
| D                     | P1                             | R2                 | N1                |
| E                     | P1                             | R2                 | N2                |
| F                     | P1                             | R2                 | P1                |
| G                     | P1                             | S1                 | N1                |
| H                     | P1                             | S1                 | N2                |
| J                     | P1                             | S1                 | P1                |
| K                     | P2                             | R1                 | N1                |
| L                     | P2                             | R1                 | N2                |
| M                     | P2                             | R1                 | P1                |
| N                     | P2                             | R2                 | N1                |
| P                     | P2                             | R2                 | N2                |
| Q                     | P2                             | R2                 | P1                |
| R                     | P2                             | S1                 | N1                |
| S                     | P2                             | S1                 | N2                |
| T                     | P2                             | S1                 | P1                |
| U                     | Q1                             | R1                 | N1                |
| V                     | Q1                             | R1                 | N2                |
| W                     | Q1                             | R1                 | P1                |
| X                     | Q1                             | R2                 | N1                |
| Y                     | Q1                             | R2                 | N2                |
| Z                     | Q1                             | R2                 | P1                |
| 1                     | Q1                             | S1                 | N1                |
| 2                     | Q1                             | S1                 | N2                |
| 3                     | Q1                             | S1                 | P1                |
| 4                     | Q2                             | R1                 | N1                |
| 5                     | Q2                             | R1                 | N2                |
| 6                     | Q2                             | R1                 | P1                |
| 7                     | Q2                             | R2                 | N1                |
| 8                     | Q2                             | R2                 | N2                |
| 9                     | Q2                             | R2                 | P1                |

| X <sub>6</sub>      | Number of Half bins from X <sub>5</sub> |         |
|---------------------|---|---------|
| For HSMF-A2xx-xxxxx |   |         |
|                     | Color 1                                 | Color 2 |
| 0                   | 0                                       | 0       |
| A                   | 0                                       | 5       |
| B                   | 0                                       | 4       |
| C                   | 0                                       | 3       |
| D                   | 0                                       | 2       |
| E                   | 5                                       | 0       |
| F                   | 5                                       | 5       |
| G                   | 5                                       | 4       |
| H                   | 5                                       | 3       |
| J                   | 5                                       | 2       |
| K                   | 4                                       | 0       |
| L                   | 4                                       | 5       |
| M                   | 4                                       | 4       |
| N                   | 4                                       | 3       |
| P                   | 4                                       | 2       |
| Q                   | 3                                       | 0       |
| R                   | 3                                       | 5       |
| S                   | 3                                       | 4       |
| T                   | 3                                       | 3       |
| U                   | 3                                       | 2       |
| V                   | 2                                       | 0       |
| W                   | 2                                       | 5       |
| X                   | 2                                       | 4       |
| Y                   | 2                                       | 3       |
| Z                   | 2                                       | 2       |

Note: 0 represents no maximum bin limit.

| For HSMF-A3xx-xxxxx |                                |                    |                   |
|---------------------|--------------------------------|--------------------|-------------------|
|                     | Color 1<br>(Red/Red<br>Orange) | Color 2<br>(Green) | Color 3<br>(Blue) |
| 0                   | 0                              | 0                  | 0                 |
| A                   | 5                              | 5                  | 5                 |
| B                   | 5                              | 5                  | 4                 |
| C                   | 5                              | 5                  | 3                 |
| D                   | 5                              | 4                  | 5                 |
| E                   | 5                              | 4                  | 4                 |
| F                   | 5                              | 4                  | 3                 |
| G                   | 5                              | 3                  | 5                 |
| H                   | 5                              | 3                  | 4                 |
| J                   | 5                              | 3                  | 3                 |
| K                   | 4                              | 5                  | 5                 |
| L                   | 4                              | 5                  | 4                 |
| M                   | 4                              | 5                  | 3                 |
| N                   | 4                              | 4                  | 5                 |
| P                   | 4                              | 4                  | 4                 |
| Q                   | 4                              | 4                  | 3                 |
| R                   | 4                              | 3                  | 5                 |
| S                   | 4                              | 3                  | 4                 |
| T                   | 4                              | 3                  | 3                 |
| U                   | 3                              | 5                  | 5                 |
| V                   | 3                              | 5                  | 4                 |
| W                   | 3                              | 5                  | 3                 |
| X                   | 3                              | 4                  | 5                 |
| Y                   | 3                              | 4                  | 4                 |
| Z                   | 3                              | 4                  | 3                 |
| 1                   | 3                              | 3                  | 5                 |
| 2                   | 3                              | 3                  | 4                 |
| 3                   | 3                              | 3                  | 3                 |

Note: 0 represents no maximum bin limit.

**Intensity Bin Limits**

| <b>Bin ID</b> | <b>Min. (mcd)</b> | <b>Max. (mcd)</b> |
|---------------|-------------------|-------------------|
| J1            | 4.50              | 5.60              |
| J2            | 5.60              | 7.20              |
| K1            | 7.20              | 9.00              |
| K2            | 9.00              | 11.20             |
| L1            | 11.20             | 14.00             |
| L2            | 14.00             | 18.00             |
| M1            | 18.00             | 22.40             |
| M2            | 22.40             | 28.50             |
| N1            | 28.50             | 35.50             |
| N2            | 35.50             | 45.00             |
| P1            | 45.00             | 56.00             |
| P2            | 56.00             | 71.50             |
| Q1            | 71.50             | 90.00             |
| Q2            | 90.00             | 112.50            |
| R1            | 112.50            | 140.00            |
| R2            | 140.00            | 180.00            |
| S1            | 180.00            | 224.00            |
| S2            | 224.00            | 285.00            |
| T1            | 285.00            | 355.00            |
| T2            | 355.00            | 450.00            |
| U1            | 450.00            | 560.00            |
| U2            | 560.00            | 715.00            |
| V1            | 715.00            | 900.00            |
| V2            | 900.00            | 1125.00           |

Tolerance of each bin limit =  $\pm 10\%$ .

### Color Bin Select (X<sub>7</sub>)

Individual reel will contain parts from 1 full bin only.

| X <sub>7</sub>  | Color Bin Combinations |  |
|---|------------------------|--|
| For<br>HSMF-A202-xxxxx<br>HSMF-A203-xxxxx<br>HSMF-A212-xxxxx<br>HSMF-A222-xxxxx | Color 1<br>(Red)       | Color 2<br>(Emerald Green/<br>Yellow/Blue) |
| 0   | 0                      | 0  |
| A   | 0                      | ABC  |
| B   | 0                      | ABCD                                       |
| C   | 0                      | ABCDE                                      |
| D   | 0                      | BCD  |
| E   | 0                      | BCDE                                       |
| F   | 0                      | BCDEF                                      |
| G   | 0                      | CDE  |
| H   | 0                      | DEF  |
| J   | 0                      | CDEF                                       |
| K   | 0                      | AB   |
| L   | 0                      | BC   |
| M   | 0                      | CD   |
| N   | 0                      | DE   |
| P   | 0                      | EF   |

Note: 0 represents full distribution.

| For<br>HSMF-A201-xxxxx<br>HSMF-A211-xxxxx | Color 1<br>(Red) | Color 2<br>(Yellow Green) |
|---|------------------|---------------------------|
| 0   | 0                | 0                         |
| A   | 0                | EFG                       |
| B   | 0                | FGH                       |
| C   | 0                | EF                        |
| D   | 0                | FG                        |
| E   | 0                | GH                        |

Note: 0 represents full distribution.

| For<br>HSMF-A205-xxxxx | Color 1<br>(Yellow/Amber/<br>Orange) | Color 2<br>(Emerald<br>Green/Blue) |
|------------------------|--------------------------------------|------------------------------------|
| 0                      | 0                                    | 0                                  |
| A                      | ABC                                  | ABC                                |
| B                      | BCD                                  | ABC                                |
| C                      | CDE                                  | ABC                                |
| D                      | ABC                                  | BCD                                |
| E                      | BCD                                  | BCD                                |
| F                      | CDE                                  | BCD                                |
| G                      | ABC                                  | CDE                                |
| H                      | BCD                                  | CDE                                |
| J                      | CDE                                  | CDE                                |
| K                      | DEF                                  | ABC                                |
| L                      | DEF                                  | BCD                                |
| M                      | DEF                                  | CDE                                |
| N                      | AB                                   | AB                                 |
| P                      | BC                                   | AB                                 |
| Q                      | CD                                   | AB                                 |
| R                      | DE                                   | AB                                 |
| S                      | AB                                   | BC                                 |
| T                      | BC                                   | BC                                 |
| U                      | CD                                   | BC                                 |
| V                      | DE                                   | BC                                 |
| W                      | AB                                   | CD                                 |
| X                      | BC                                   | CD                                 |
| Y                      | CD                                   | CD                                 |
| Z                      | DE                                   | CD                                 |
| 1                      | AB                                   | DE                                 |
| 2                      | BC                                   | DE                                 |
| 3                      | CD                                   | DE                                 |
| 4                      | DE                                   | DE                                 |
| 5                      | EF                                   | AB                                 |
| 6                      | EF                                   | BC                                 |
| 7                      | EF                                   | CD                                 |

Note: 0 represents full distribution.

| For<br>HSMF-A204-xxxxx<br>HSMF-A206-xxxxx | Color 1<br>(Yellow/<br>Amber/<br>Orange) | Color 2<br>(Yellow Green) |
|---|--|---------------------------|
| 0   | 0  | 0                         |
| A   | ABC                                      | EFG                       |
| B   | BCD                                      | EFG                       |
| C   | CDE                                      | EFG                       |
| D   | DEF                                      | EFG                       |
| E   | ABC                                      | FGH                       |
| F   | BCD                                      | FGH                       |
| G   | CDE                                      | FGH                       |
| H   | DEF                                      | FGH                       |
| J   | AB                                       | EF                        |
| K   | BC                                       | EF                        |
| L   | CD                                       | EF                        |
| M   | DE                                       | EF                        |
| N   | EF                                       | EF                        |
| P   | AB                                       | FG                        |
| Q   | BC                                       | FG                        |
| R   | CD                                       | FG                        |
| S   | DE                                       | FG                        |
| T   | EF                                       | FG                        |
| U   | AB                                       | GH                        |
| V   | BC                                       | GH                        |
| W   | CD                                       | GH                        |
| X   | DE                                       | GH                        |
| Y   | EF                                       | GH                        |

Note: 0 represents full distribution.

For  
HSMF-A3xx-xxxxx

|   | Color 1 | Color 2 | Color 3 |
|---|---------|---------|---------|
| 0 | 0       | 0       | 0       |
| A | 0       | 0       | ABC     |
| B | 0       | 0       | BCD     |
| C | 0       | 0       | AB      |
| D | 0       | 0       | BC      |
| E | 0       | 0       | CD      |
| F | 0       | ABC     | 0       |
| G | 0       | ABC     | ABC     |
| H | 0       | ABC     | BCD     |
| J | 0       | ABC     | AB      |
| K | 0       | ABC     | BC      |
| L | 0       | ABC     | CD      |
| M | 0       | BCD     | 0       |
| N | 0       | BCD     | ABC     |
| P | 0       | BCD     | BCD     |
| Q | 0       | BCD     | AB      |
| R | 0       | BCD     | BC      |
| S | 0       | BCD     | CD      |
| T | 0       | AB      | ABC     |
| U | 0       | AB      | BCD     |
| V | 0       | AB      | AB      |
| W | 0       | AB      | BC      |
| X | 0       | AB      | CD      |
| Y | 0       | BC      | ABC     |
| Z | 0       | BC      | BCD     |
| 1 | 0       | BC      | AB      |
| 2 | 0       | BC      | BC      |
| 3 | 0       | BC      | CD      |
| 4 | 0       | CD      | ABC     |
| 5 | 0       | CD      | BCD     |
| 6 | 0       | CD      | AB      |
| 7 | 0       | CD      | BC      |
| 8 | 0       | CD      | CD      |

Note: 0 represents full distribution.

### Color Bin Limits

| Blue | Min. (nm) | Max. (nm) |
|------|-----------|-----------|
| A    | 460.0     | 465.0     |
| B    | 465.0     | 470.0     |
| C    | 470.0     | 475.0     |
| D    | 475.0     | 480.0     |

| Green | Min. (nm) | Max. (nm) |
|-------|-----------|-----------|
| A     | 515.0     | 520.0     |
| B     | 520.0     | 525.0     |
| C     | 525.0     | 530.0     |
| D     | 530.0     | 535.0     |

| Emerald Green | Min. (nm) | Max. (nm) |
|---------------|-----------|-----------|
| A             | 552.5     | 555.5     |
| B             | 555.5     | 558.5     |
| C             | 558.5     | 561.5     |
| D             | 561.5     | 564.5     |

| Yellow Green | Min. (nm) | Max. (nm) |
|--------------|-----------|-----------|
| E            | 564.5     | 567.5     |
| F            | 567.5     | 570.5     |
| G            | 570.5     | 573.5     |
| H            | 573.5     | 576.5     |

### Packaging Option (X<sub>8</sub>X<sub>9</sub>)

| X <sub>8</sub> X <sub>9</sub> |  |
|-------------------------------|--|
| J1                            | 20 mA test current, Top Mount, 7 inch Reel |

| Amber/ Yellow | Min. (nm) | Max. (nm) |
|---------------|-----------|-----------|
| A             | 582.0     | 584.5     |
| B             | 584.5     | 587.0     |
| C             | 587.0     | 589.5     |
| D             | 589.5     | 592.0     |
| E             | 592.0     | 594.5     |
| F             | 594.5     | 597.0     |

| Orange | Min. (nm) | Max. (nm) |
|--------|-----------|-----------|
| A      | 597.0     | 600.0     |
| B      | 600.0     | 603.0     |
| C      | 603.0     | 606.0     |
| D      | 606.0     | 609.0     |
| E      | 609.0     | 612.0     |

| Red Orange | Min. (nm) | Max. (nm) |
|------------|-----------|-----------|
| A          | 611.0     | 616.0     |
| B          | 616.0     | 620.0     |

| Red               | Min. (nm) | Max. (nm) |
|-------------------|-----------|-----------|
| Full Distribution |           |           |

Tolerance of each bin limit = ±1 nm.

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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