

## Device Selection Guide

### IR Emitters

| Part Number | Device Description <sup>[1]</sup> | Device Outline Drawing |
|-------------|-----------------------------------|------------------------|
| HSDL-4400   | LED, Flat Top, 110 deg            | A                      |
| HSDL-4420   | LED, Dome, 24 deg                 | B                      |

### IR Detectors

| Part Number | Device Description <sup>[1]</sup> | Device Outline Drawing |
|-------------|-----------------------------------|------------------------|
| HSDL-5400   | PIN Photodiode, Flat Top, 110 deg | C                      |
| HSDL-5420   | PIN Photodiode, Dome, 28 deg      | D                      |

### Package Configuration Options

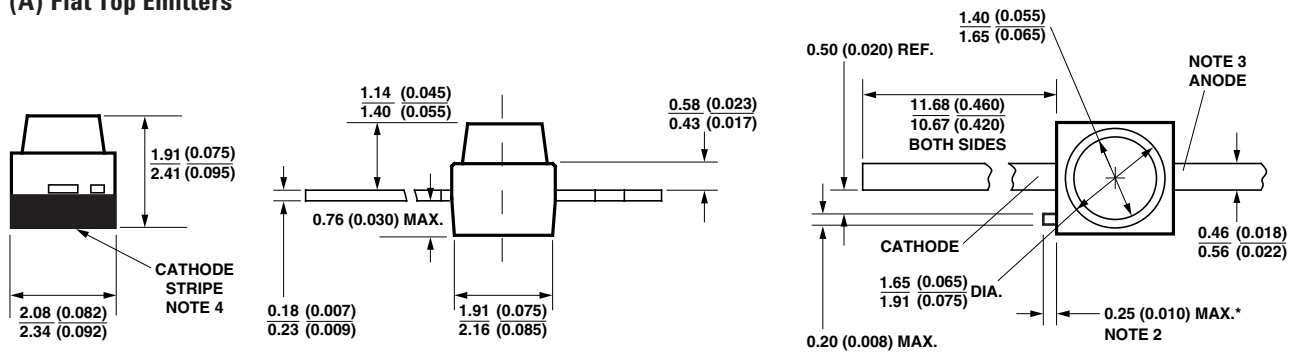
| Option Code | Package Configuration Description            |                                | Package Outline Drawing |
|-------------|----------------------------------------------|--------------------------------|-------------------------|
| 011         | Gull Wing Lead, Tape and Reel <sup>[2]</sup> |                                | E, J, M                 |
| 021         | Yoke Lead, Tape and Reel <sup>[2]</sup>      | Surface Mount Lead             | F, K, M                 |
| 031         | Z-Bend, Tape and Reel <sup>[2]</sup>         |                                | G, L, M                 |
| 1L1         | 2.54 mm (0.100 in) Center                    | Long Leads; 10.4 mm (0.410 in) | Thru Hole Lead          |
| 1S1         | Lead Spacing                                 | Short Leads; 3.7 mm (0.145 in) |                         |
| No Option   | Straight Leads <sup>[3]</sup>                |                                | Prototyping             |
|             |                                              |                                | A, B, C, D              |

#### Notes:

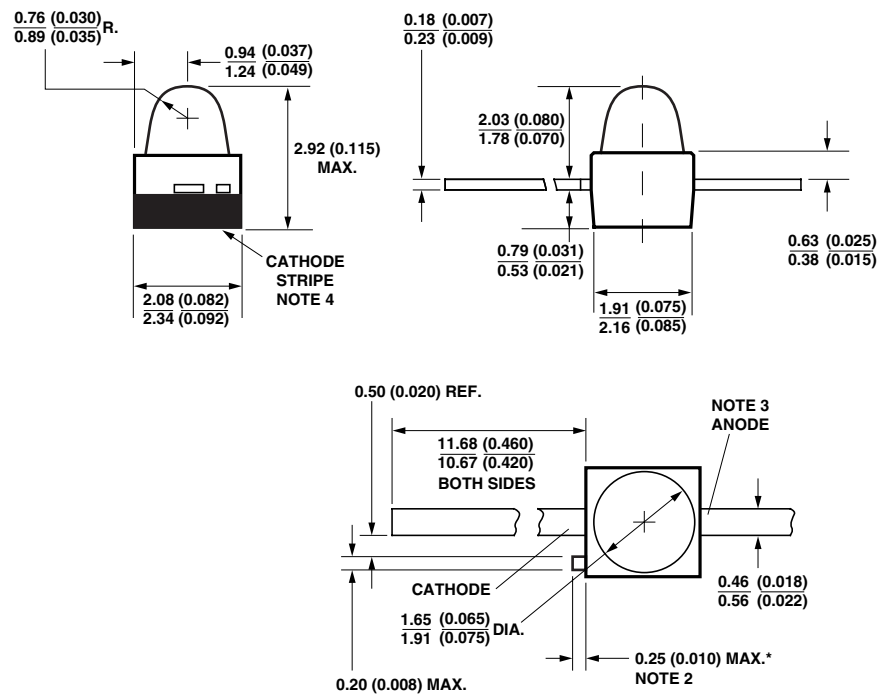
1. IR Emitters have untinted, nondiffused lenses and IR Detectors have black tinted, nondiffused lenses.
2. Emitters and detectors are supplied in 12 mm embossed tape on 178 mm (7 inch) diameter reels, with 1500 units per reel. Minimum order quantity and order increment are in quantity of reels only.
3. Emitters and detectors are supplied in bulk form in bags of 50 units.
4. The HSDL-44xx and HSDL-54xx families are not designed to be used in medical devices with life support functions or in safety equipment (or similar applications where components failures would result in loss of life or physical harm), eg. in automotive, medical or airline industries.

## Package Dimensions

### (A) Flat Top Emitters



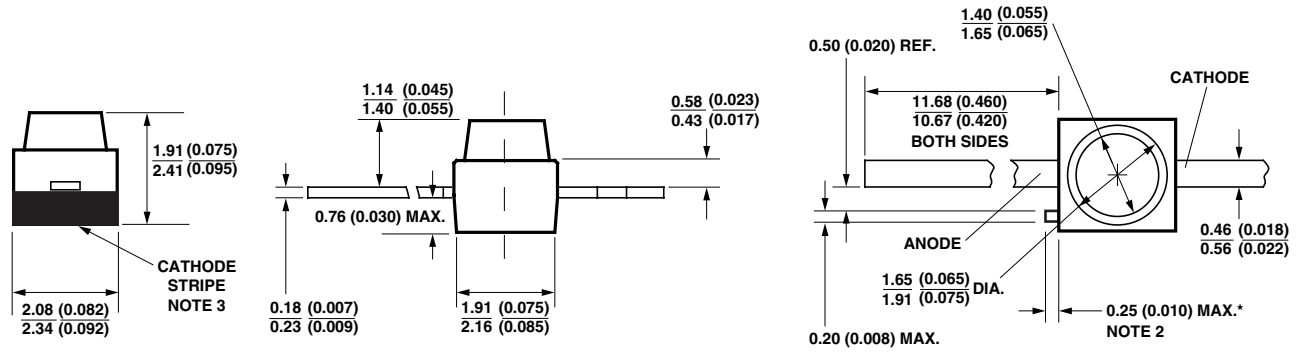
### (B) Dome Emitters



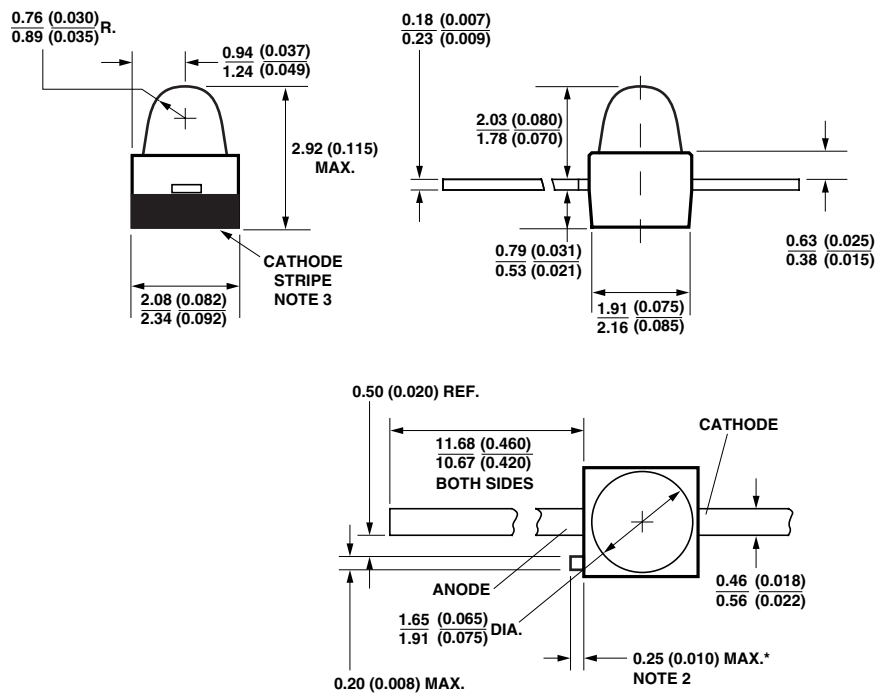
#### NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. PROTRUDING SUPPORT TAB IS CONNECTED TO ANODE LEAD.
3. LEAD POLARITY FOR THESE TS AlGaAs SUBMINIATURE LAMPS IS OPPOSITE TO THE LEAD POLARITY OF SUBMINIATURE LAMPS USING OTHER LED TECHNOLOGIES.
4. CATHODE STRIPE MARKING IS DARK BLUE.

### (C) Flat Top Detectors



### (D) Dome Detectors



#### NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. PROTRUDING SUPPORT TAB IS CONNECTED TO CATHODE LEAD.
3. CATHODE STRIPE MARKING IS DARK BLUE.

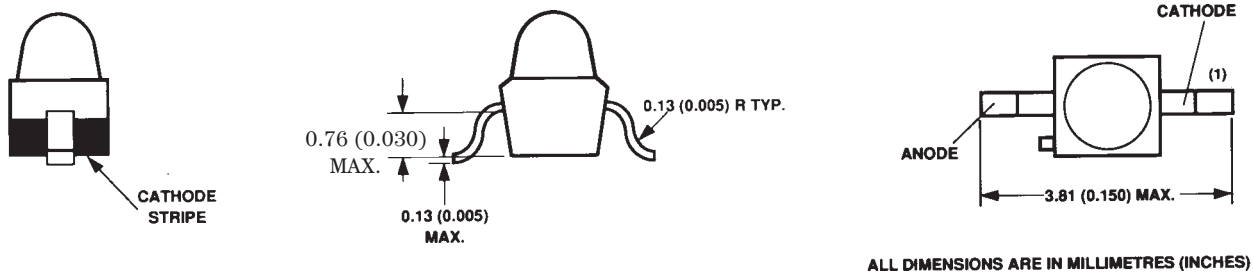
## Package Dimensions

The following notes affect the package outline drawings E through I.

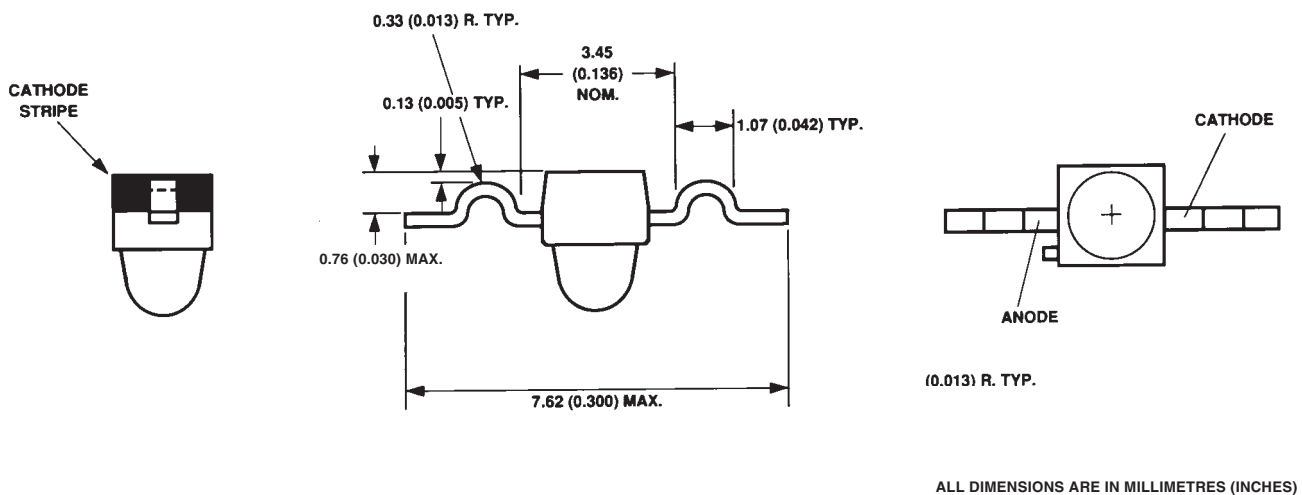
reversed for the HSDL-44xx IR emitters where the protruding support tab is closest to the cathode lead.

1. The pinout represents the HSDL-54xx IR detectors where the protruding support tab is closest to the anode lead. While the pinout is
2. The protruding support tab of the HSDL-54xx is connected to the cathode lead. While the protruding support tab of the HSDL-44xx is connected to the anode lead.

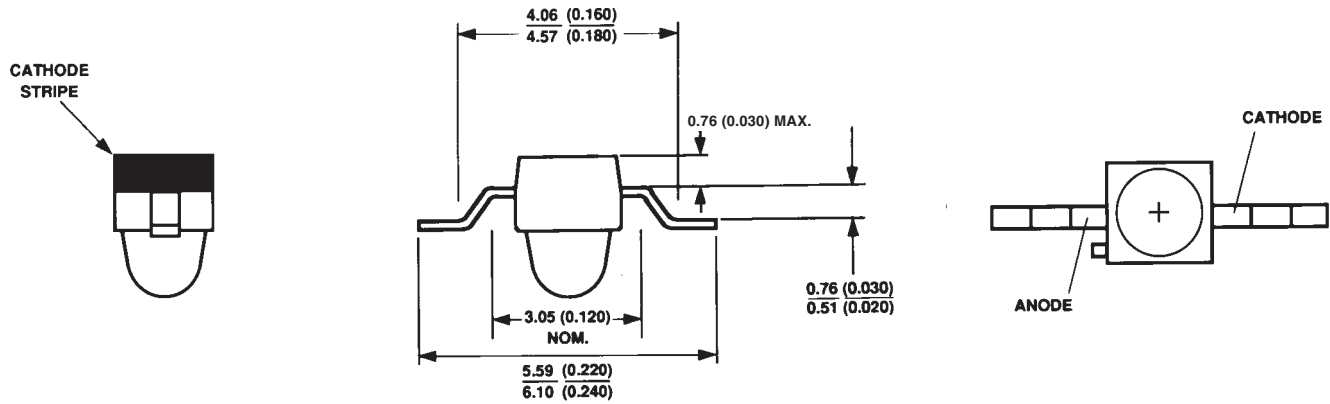
### (E) Gull Wing Lead, Option 011



### (F) "Yoke" Lead, Options 021

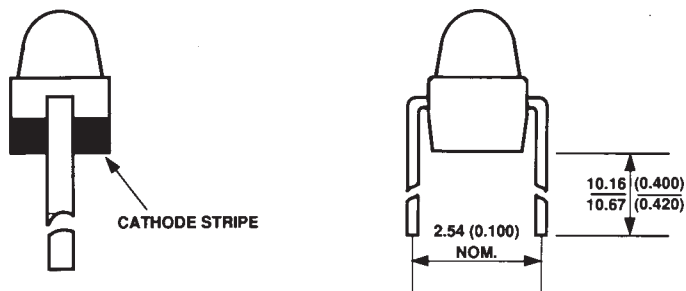


**(G) Z-Bend Lead, Options 031**



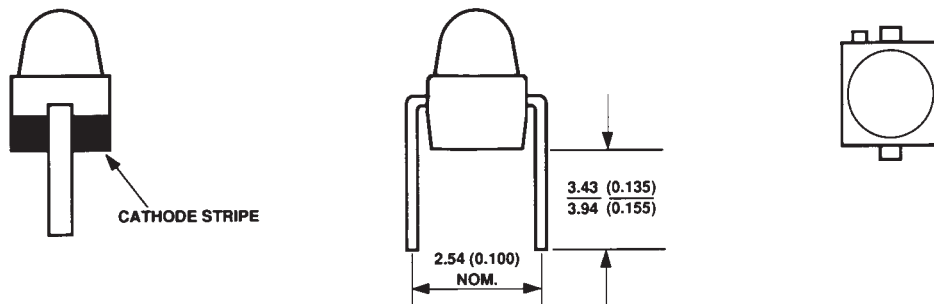
ALL DIMENSIONS ARE IN MILLIMETRES (INCHES)

**(H) Thru Hole Lead Option 1L1**



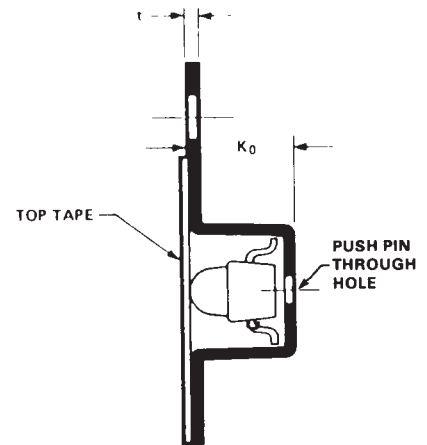
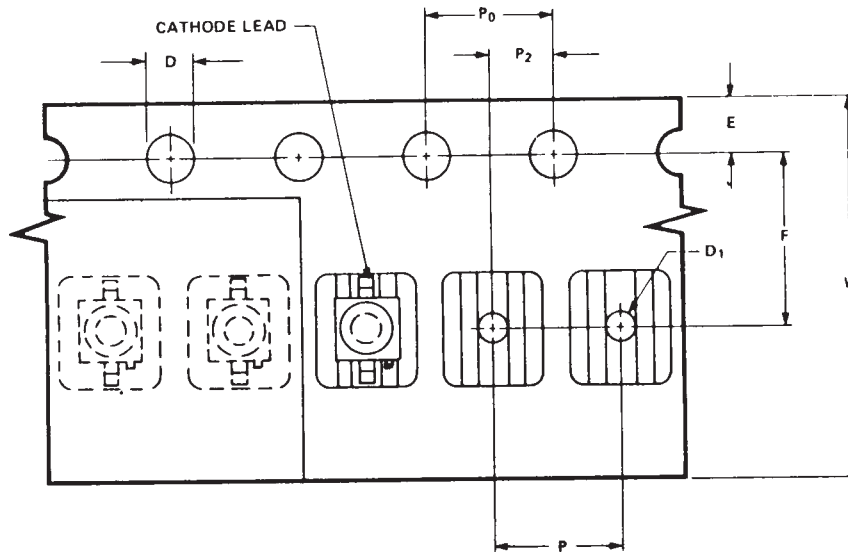
ALL DIMENSIONS ARE IN MILLIMETRES (INCHES)

**(I) Thru Hole Lead Option 1S1**

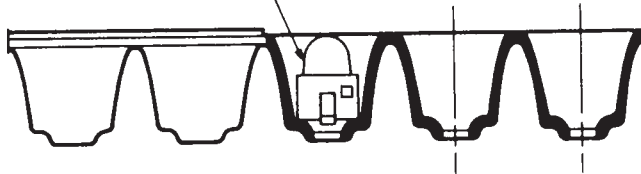


ALL DIMENSIONS ARE IN MILLIMETRES (INCHES)

**Package Dimensions: Surface Mount Tape and Reel Options**  
**(J) 12 mm Tape and Reel, Gull Wing Lead, Option 011**



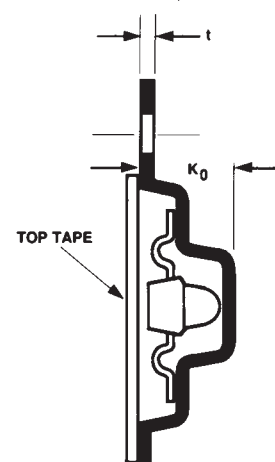
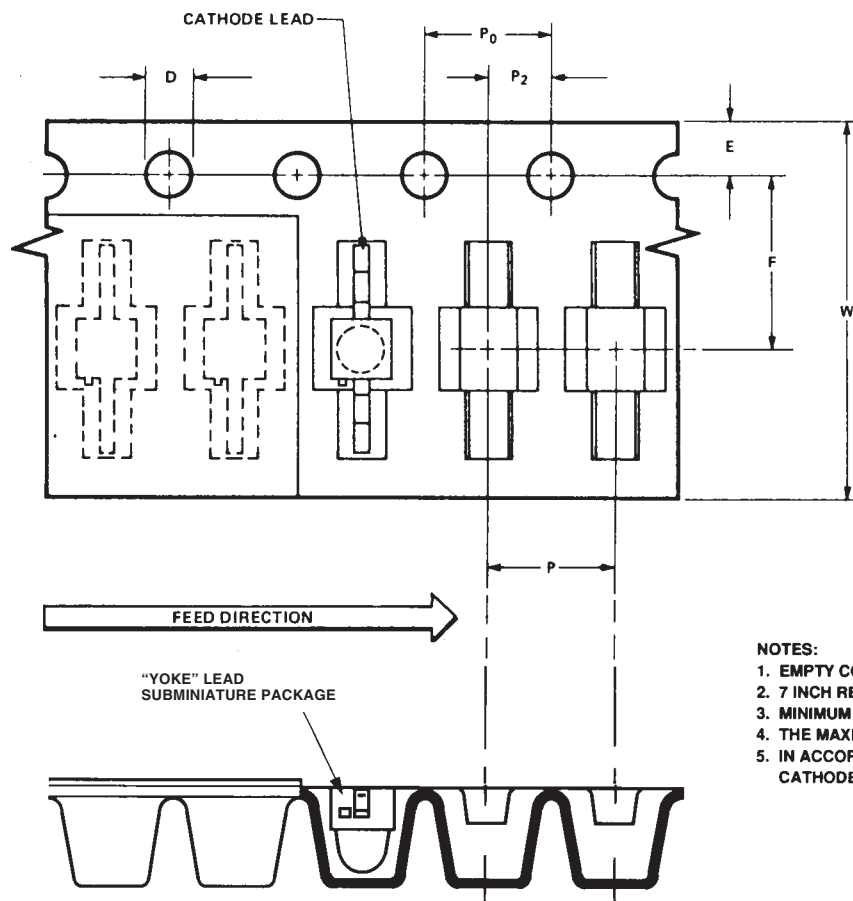
GULL WING LEAD  
SUBMINIATURE PACKAGE



**NOTES:**

1. EMPTY COMPONENT POCKETS SEALED WITH TOP COVER TAPE.
2. 7 INCH REEL - 1500 PIECES PER REEL.
3. MINIMUM LEADER LENGTH AT EITHER END OF THE TAPE IS 500 mm.
4. THE MAXIMUM NUMBER OF CONSECUTIVE MISSING DEVICES IS TWO.
5. IN ACCORDANCE WITH ANSI/EIA RS-481 SPECIFICATIONS, THE CATHODE IS ORIENTED TOWARDS THE TAPE SPROCKETS HOLE.

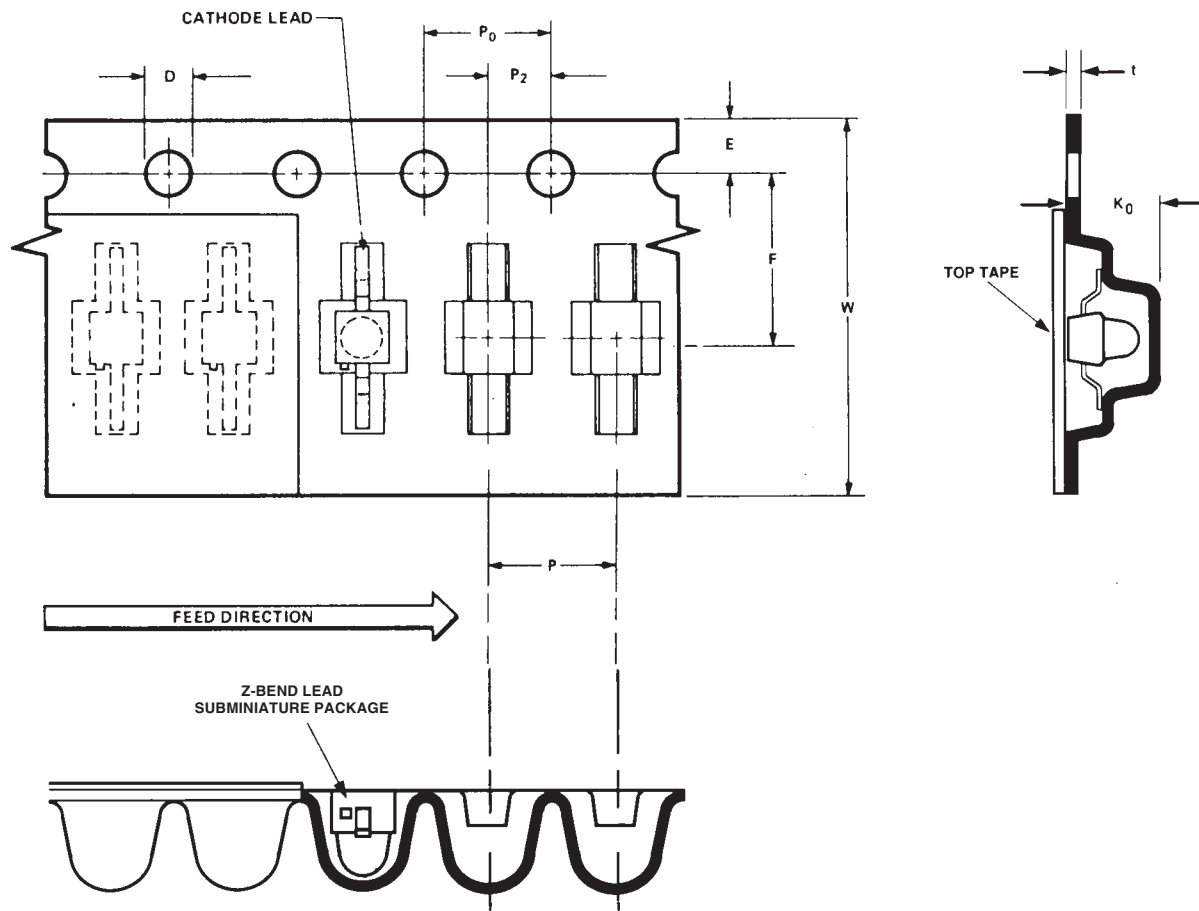
(K) 12 mm Tape and Reel, "Yoke" Lead, Option 021



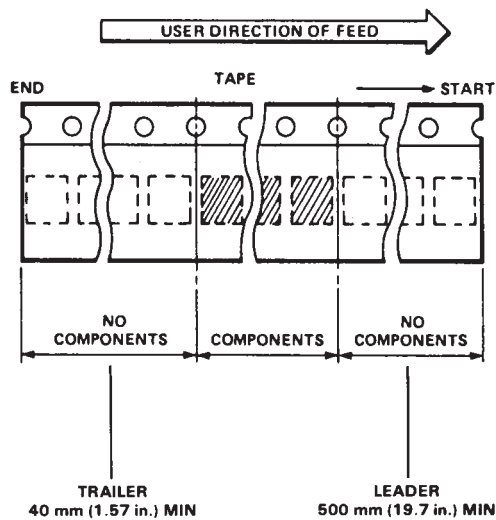
NOTES:

1. EMPTY COMPONENT POCKETS SEALED WITH TOP COVER TAPE.
2. 7 INCH REEL-1500 PIECES PER REEL.
3. MINIMUM LEADER LENGTH AT EITHER END OF THE TAPE IS 500 mm.
4. THE MAXIMUM NUMBER OF CONSECUTIVE MISSING LAMPS IS TWO.
5. IN ACCORDANCE WITH ANSI/EIA RS-481 SPECIFICATIONS, THE CATHODE IS ORIENTED TOWARDS THE TAPE SPROCKET HOLE.

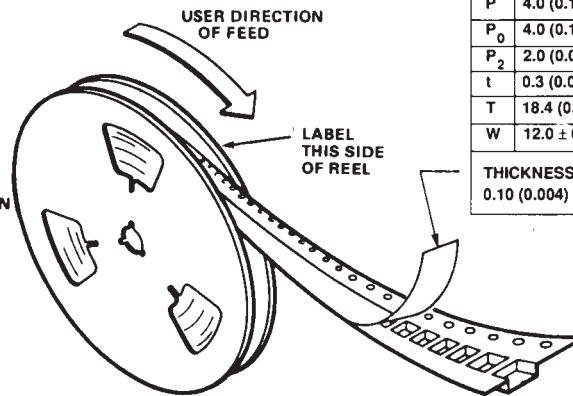
(L) 12 mm Tape and Reel, Z-Bend Lead, Option 031



## (M) 12 mm Tape and Reel



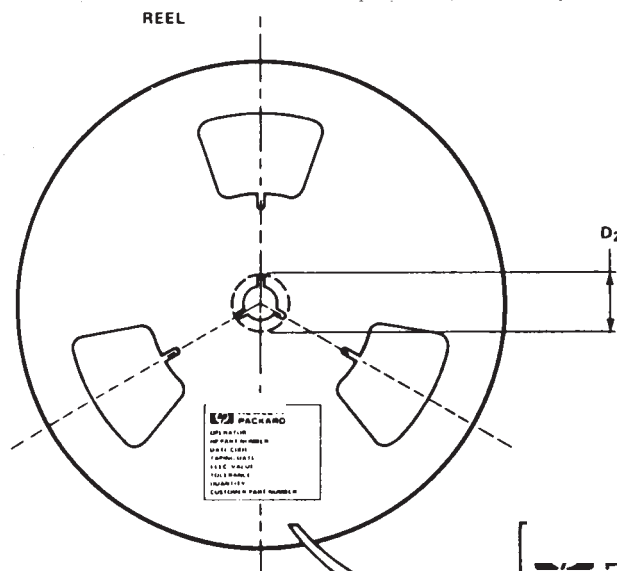
TOLERANCES (UNLESS OTHERWISE SPECIFIED):  
 $.X \pm .1$ ;  $.XX \pm .05$  ( $.XXX \pm .004$ )



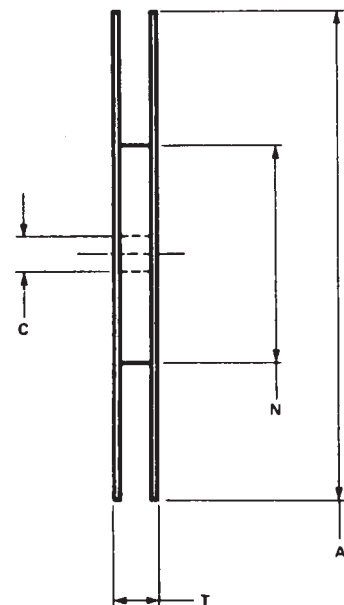
DIMENSIONS PER ANSI/EIA  
 STANDARD RS-481.  
 ALL DIMENSIONS ARE IN  
 MILLIMETRES (INCHES).

|                |                                       |
|----------------|---------------------------------------|
| A              | $178.0 \pm 2.0$ (7.0 $\pm$ 0.08) DIA. |
| C              | 13.0 (0.512) DIA. TYP.                |
| D              | $1.55$ (0.061 $\pm$ 0.002) DIA.       |
| D <sub>1</sub> | 1.0 (0.039) DIA. MIN.                 |
| D <sub>2</sub> | 20.2 (0.795) DIA. MIN.                |
| E              | $1.75 \pm 0.1$ (0.069)                |
| F              | $5.50$ (0.127 $\pm$ 0.002)            |
| K <sub>0</sub> | $3.05 \pm 0.1$ (0.120) TYP.           |
| N              | 50.0 (1.970) MIN.                     |
| P              | 4.0 (0.157) TYP.                      |
| P <sub>0</sub> | 4.0 (0.157) TYP.                      |
| P <sub>2</sub> | $2.0$ (0.079 $\pm$ 0.002) TYP.        |
| t              | 0.3 (0.012) TYP.                      |
| T              | 18.4 (0.72) MAX.                      |
| W              | $12.0 \pm 0.3$ (0.472 $\pm$ 0.012)    |

THICKNESS OF TOP COVER TAPE  
 0.10 (0.004) MAX.



OPERATOR \_\_\_\_\_  
 HP PART NUMBER \_\_\_\_\_  
 DATE CODE \_\_\_\_\_  
 TAPING DATE \_\_\_\_\_  
 ELEC. VALUE \_\_\_\_\_  
 TOLERANCE \_\_\_\_\_  
 QUANTITY \_\_\_\_\_  
 CUSTOMER PART NUMBER \_\_\_\_\_



## Convective IR Reflow Soldering

For information on IR reflow soldering, refer to Application Note 1060, Surface Mounting SMT LED Components.

**HSDL-44xx Absolute Maximum Ratings**

| Parameter                                                           | Symbol     | Min. | Max.      | Unit        | Ref.      |
|---------------------------------------------------------------------|------------|------|-----------|-------------|-----------|
| Peak Forward Current (Duty Factor = 20%, Pulse Width = 100 $\mu$ s) | $I_{FPK}$  |      | 500       | mA          | Fig. 7, 8 |
| DC Forward Current                                                  | $I_{FDC}$  |      | 100       | mA          | Fig. 6    |
| Power Dissipation                                                   | $P_{DISS}$ |      | 100       | mW          |           |
| Reverse Voltage ( $I_R = 100 \mu A$ )                               | $V_R$      | 5    |           | V           |           |
| Transient Forward Current (10 $\mu$ s Pulse)                        | $I_{FTR}$  |      | 1.0       | A           | [1]       |
| Operating Temperature                                               | $T_O$      | -40  | 85        | $^{\circ}C$ |           |
| Storage Temperature                                                 | $T_S$      | -55  | 100       | $^{\circ}C$ |           |
| Junction Temperature                                                | $T_J$      |      | 110       | $^{\circ}C$ |           |
| Lead Solder Temperature<br>[1.6 mm (0.063 in.) from body]           |            |      | 260/5 s   | $^{\circ}C$ |           |
| Reflow Soldering Temperatures                                       |            |      |           |             |           |
| Convection IR                                                       |            |      | 235/90 s  | $^{\circ}C$ | Fig. 20   |
| Vapor Phase                                                         |            |      | 215/180 s | $^{\circ}C$ |           |

**Note:**

1. The transient peak current in the maximum nonrecurring peak current the device can withstand without damaging the LED die and the wire bonds.

**HSDL-44xx Electrical Characteristics at  $T_A = 25^{\circ}C$** 

| Parameter                                  | Symbol                  | Min. | Typ.         | Max. | Unit            | Condition                                               | Ref.   |
|--------------------------------------------|-------------------------|------|--------------|------|-----------------|---------------------------------------------------------|--------|
| Forward Voltage                            | $V_F$                   | 1.30 | 1.50<br>2.15 | 1.70 | V               | $I_{FDC} = 50 \text{ mA}$<br>$I_{FPK} = 250 \text{ mA}$ | Fig. 2 |
| Forward Voltage<br>Temperature Coefficient | $\Delta V_F / \Delta T$ |      | -2.1<br>-2.1 |      | mV/ $^{\circ}C$ | $I_{FDC} = 50 \text{ mA}$<br>$I_{FDC} = 100 \text{ mA}$ | Fig. 3 |
| Series Resistance                          | $R_S$                   |      | 2            |      | $\Omega$        | $I_{FDC} = 100 \text{ mA}$                              |        |
| Diode Capacitance                          | $C_O$                   |      | 50           |      | pF              | 0 V, 1 MHz                                              |        |
| Reverse Voltage                            | $V_R$                   | 5    | 20           |      | V               | $I_R = 100 \mu A$                                       |        |
| Thermal Resistance,<br>Junction to Pin     | $R\theta_{jp}$          |      | 170          |      | $^{\circ}C/W$   |                                                         |        |

**HSDL-44XX Optical Characteristics at  $T_A = 25^\circ\text{C}$** 

| Parameter                                            | Symbol                     | Min. | Typ.           | Max. | Unit                 | Condition                                                                          | Ref.      |
|------------------------------------------------------|----------------------------|------|----------------|------|----------------------|------------------------------------------------------------------------------------|-----------|
| Radiant On-Axis Intensity                            |                            |      |                |      |                      |                                                                                    |           |
| HSDL-4400                                            | $I_E$                      | 1    | 3<br>6<br>15   | 8    | mW/sr                | $I_{FDC} = 50\text{ mA}$<br>$I_{FDC} = 100\text{ mA}$<br>$I_{FPK} = 250\text{ mA}$ | Fig. 4, 5 |
| HSDL-4420                                            | $I_E$                      | 9    | 17<br>32<br>85 | 30   | mW/sr                | $I_{FDC} = 50\text{ mA}$<br>$I_{FDC} = 100\text{ mA}$<br>$I_{FPK} = 250\text{ mA}$ | Fig. 4, 5 |
| Radiant On-Axis Intensity<br>Temperature Coefficient | $\Delta I_E / \Delta T$    |      | -0.35<br>-0.35 |      | %/ $^\circ\text{C}$  | $I_{FDC} = 50\text{ mA}$<br>$I_{FDC} = 100\text{ mA}$                              |           |
| Viewing Angle                                        |                            |      |                |      |                      |                                                                                    |           |
| HSDL-4400                                            | $2\theta_{1/2}$            |      | 110            |      | deg                  | $I_{FDC} = 50\text{ mA}$                                                           | Fig. 9    |
| HSDL-4420                                            | $2\theta_{1/2}$            |      | 24             |      | deg                  | $I_{FDC} = 50\text{ mA}$                                                           | Fig. 10   |
| Peak Wavelength                                      | $\lambda_{PK}$             | 850  | 875            | 900  | nm                   | $I_{FDC} = 50\text{ mA}$                                                           | Fig. 1    |
| Peak Wavelength<br>Temperature Coefficient           | $\Delta\lambda / \Delta T$ |      | 0.25           |      | nm/ $^\circ\text{C}$ | $I_{FDC} = 50\text{ mA}$                                                           |           |
| Spectral Width at FWHM                               | $\Delta\lambda$            |      | 37             |      | nm                   | $I_{FDC} = 50\text{ mA}$                                                           | Fig. 1    |
| Optical Rise and Fall<br>Times, 10%-90%              | $t_r / t_f$                |      | 40             |      | ns                   | $I_{FPK} = 50\text{ mA}$                                                           |           |
| Bandwidth                                            | $f_c$                      |      | 9              |      | MHz                  | $I_{FDC} = 50\text{ mA}$<br>$\pm 10\text{ mA}$                                     | Fig. 11   |

**HSDL-54xx Absolute Maximum Ratings**

| Parameter                                              | Symbol     | Min. | Max.      | Unit |
|--------------------------------------------------------|------------|------|-----------|------|
| Power Dissipation                                      | $P_{DISS}$ |      | 150       | mW   |
| Reverse Voltage ( $I_R = 100 \mu A$ )                  | $V_R$      |      | 40        | V    |
| Operating Temperature                                  | $T_O$      | -40  | 85        | °C   |
| Storage Temperature                                    | $T_S$      | -55  | 100       | °C   |
| Junction Temperature                                   | $T_J$      |      | 110       | °C   |
| Lead Solder Temperature [1.6 mm (0.063 in.) from body] |            |      | 260/5 s   | °C   |
| Reflow Soldering Temperatures                          |            |      |           |      |
| Convection IR                                          |            |      | 235/90 s  | °C   |
| Vapor Phase                                            |            |      | 215/180 s | °C   |

**HSDL-54xx Electrical Characteristics at  $T_A = 25^\circ C$** 

| Parameter                              | Symbol                   | Min. | Typ. | Max. | Unit     | Condition                                                                 | Ref.    |
|----------------------------------------|--------------------------|------|------|------|----------|---------------------------------------------------------------------------|---------|
| Forward Voltage                        | $V_F$                    |      | 0.8  |      | V        | $I_{FDC} = 1 \text{ mA}$                                                  |         |
| Breakdown Voltage                      | $V_{BR}$                 |      |      | 40   | V        | $I_R = 100 \mu A$ ,<br>$E_e = 0 \text{ mW/cm}^2$                          |         |
| Reverse Dark Current                   | $I_D$                    |      | 1    | 5    | nA       | $V_R = 5 \text{ V}$ ,<br>$E_e = 0 \text{ mW/cm}^2$                        | Fig. 12 |
| Series Resistance                      | $R_S$                    |      | 2000 |      | $\Omega$ | $V_R = 5 \text{ V}$ ,<br>$E_e = 0 \text{ mW/cm}^2$                        |         |
| Diode Capacitance                      | $C_0$                    |      | 5    |      | pF       | $V_R = 0 \text{ V}$ ,<br>$E_e = 0 \text{ mW/cm}^2$<br>$f = 1 \text{ MHz}$ | Fig. 16 |
| Open Circuit Voltage                   | $V_{OC}$                 |      | 375  |      | mV       | $E_e = 1 \text{ mW/cm}^2$<br>$\lambda_{PK} = 875 \text{ nm}$              |         |
| Temperature Coefficient of $V_{OC}$    | $\Delta V_{OC}/\Delta T$ |      | -2.2 |      | mV/K     | $E_e = 1 \text{ mW/cm}^2$<br>$\lambda_{PK} = 875 \text{ nm}$              |         |
| Short Circuit Current                  | $I_{SC}$                 |      |      |      |          | $E_e = 1 \text{ mW/cm}^2$<br>$\lambda_{PK} = 875 \text{ nm}$              |         |
| HSDL-5400                              |                          |      | 1.6  |      | $\mu A$  |                                                                           |         |
| HSDL-5420                              |                          |      | 4.3  |      | $\mu A$  |                                                                           |         |
| Temperature Coefficient of $I_{SC}$    | $\Delta I_{SC}/\Delta T$ |      | 0.16 |      | %/K      | $E_e = 1 \text{ mW/cm}^2$<br>$\lambda_{PK} = 875 \text{ nm}$              |         |
| Thermal Resistance,<br>Junction to Pin | $R\theta_{jp}$           |      | 170  |      | °C/W     |                                                                           |         |

**HSDL-54xx Optical Characteristics at  $T_A = 25^\circ\text{C}$** 

| Parameter                            | Symbol                   | Min. | Typ.                  | Max. | Unit                                    | Condition                                                                           | Ref.     |
|--------------------------------------|--------------------------|------|-----------------------|------|-----------------------------------------|-------------------------------------------------------------------------------------|----------|
| Photocurrent                         |                          |      |                       |      |                                         | $E_e = 1 \text{ mW/cm}^2$                                                           | Fig. 14, |
| HSDL-5400                            | $I_{PH}$                 | 0.8  | 1.6                   |      | $\mu\text{A}$                           | $\lambda_{PK} = 875 \text{ nm}$                                                     | 15       |
| HSDL-5420                            |                          | 3.0  | 6.0                   |      |                                         | $V_R = 5 \text{ V}$                                                                 |          |
| Temperature Coefficient of $I_{PH}$  | $\Delta I_{PH}/\Delta T$ |      | 0.1                   |      | $\%/K$                                  | $E_e = 1 \text{ mW/cm}^2$<br>$\lambda_{PK} = 875 \text{ nm}$<br>$V_R = 5 \text{ V}$ | Fig. 13  |
| Radiant Sensitive Area               | A                        |      | 0.15                  |      | $\text{mm}^2$                           |                                                                                     |          |
| Absolute Spectral Sensitivity        | S                        |      | 0.5                   |      | $\text{A/W}$                            | $E_e = 1 \text{ mW/cm}^2$<br>$\lambda_{PK} = 875 \text{ nm}$<br>$V_R = 5 \text{ V}$ |          |
| Viewing Angle                        |                          |      |                       |      |                                         |                                                                                     |          |
| HSDL-5400                            | $2\theta_{1/2}$          |      | 110                   |      | deg                                     |                                                                                     | Fig. 18  |
| HSDL-5420                            |                          |      | 28                    |      |                                         |                                                                                     | Fig. 19  |
| Wavelength of Peak Sensitivity       | $\lambda_{PK}$           |      | 875                   |      | nm                                      | $E_e = 1 \text{ mW/cm}^2$<br>$V_R = 5 \text{ V}$                                    | Fig. 17  |
| Spectral Bandwidth                   | $\Delta\lambda$          |      | 770-<br>1000          |      | nm                                      | $E_e = 1 \text{ mW/cm}^2$<br>$V_R = 5 \text{ V}$                                    | Fig. 17  |
| Quantum Efficiency                   | $\eta$                   |      | 70                    |      | %                                       | $E_e = 1 \text{ mW/cm}^2$<br>$\lambda_{PK} = 875 \text{ nm}$<br>$V_R = 5 \text{ V}$ |          |
| Noise Equivalent Power               | NEP                      |      | $6.2 \times 10^{-15}$ |      | $\text{W/Hz}^{1/2}$                     | $V_R = 5 \text{ V}$<br>$\lambda_{PK} = 875 \text{ nm}$                              |          |
| Detectivity                          | D                        |      | $6.3 \times 10^{12}$  |      | $\text{cm}^* \text{ Hz}^{1/2}/\text{W}$ | $V_R = 5 \text{ V}$<br>$\lambda_{PK} = 875 \text{ nm}$                              |          |
| Optical Rise and Fall Times, 10%-90% | $t_r/t_f$                |      | 7.5                   |      | ns                                      | $V_R = 5 \text{ V}$<br>$R_L = 1 \text{ k}\Omega$<br>$\lambda_{PK} = 875 \text{ nm}$ |          |
| Bandwidth                            | $f_c$                    |      | 50                    |      | MHz                                     | $V_R = 5 \text{ V}$<br>$R_L = 1 \text{ k}\Omega$<br>$\lambda_{PK} = 875 \text{ nm}$ |          |

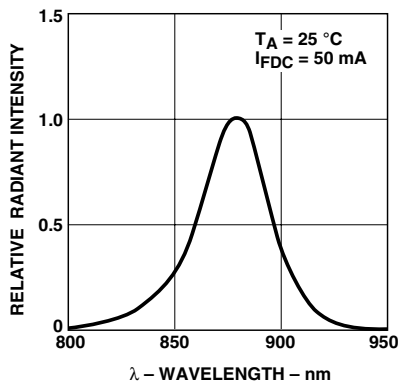


Figure 1. Relative radiant intensity vs. wavelength.

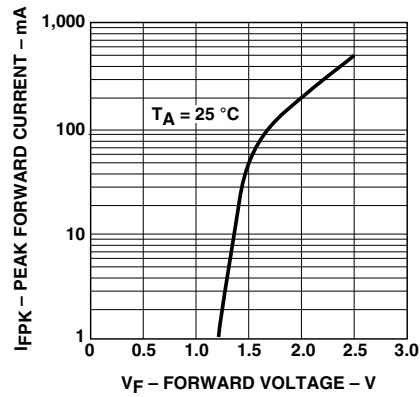


Figure 2. Peak forward current vs. forward voltage.

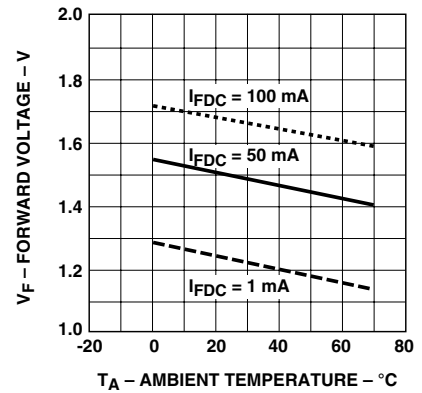


Figure 3. Forward voltage vs. ambient temperature.

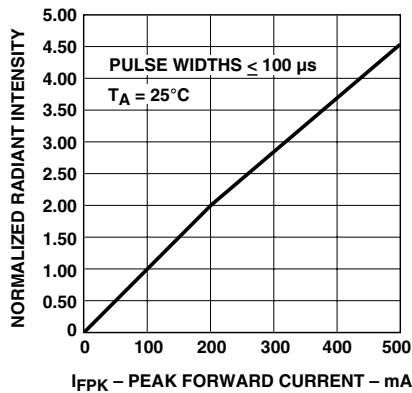


Figure 4. Normalized radiant intensity vs. peak forward current.

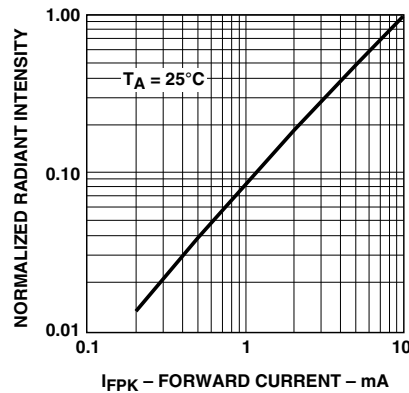


Figure 5. Normalized radiant intensity vs. peak forward current (0 to 10 mA).

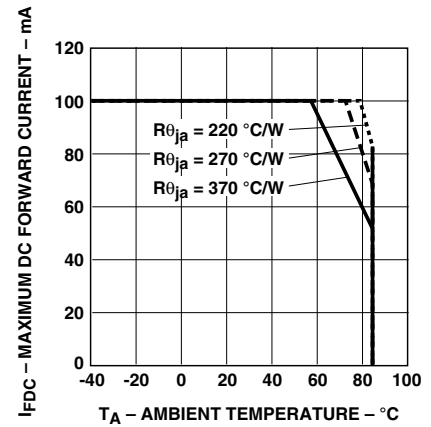


Figure 6. Maximum DC forward current vs. ambient temperature. Derated based on  $T_{JMAX} = 110^{\circ}\text{C}$ .

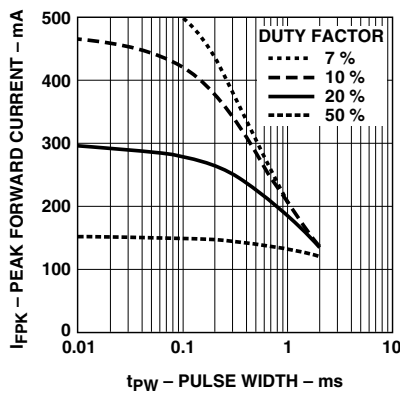


Figure 7. Maximum peak forward current vs. duty factor.

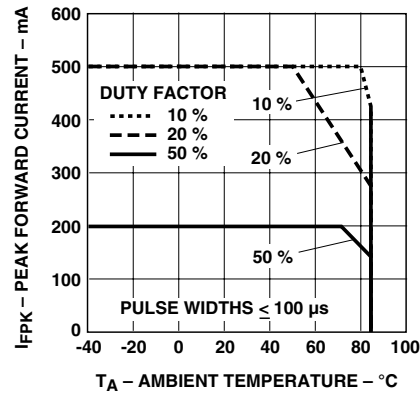


Figure 8. Maximum peak forward current vs. ambient temperature. Derated based on  $T_{JMAX} = 110^{\circ}\text{C}$ .

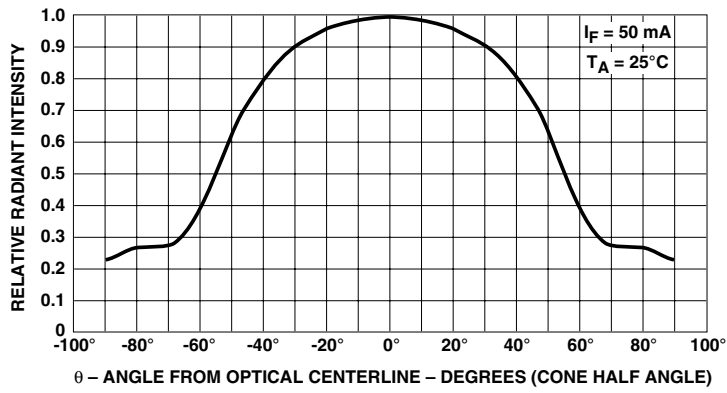


Figure 9. Relative radiant intensity vs. angular displacement HSDL-4400.

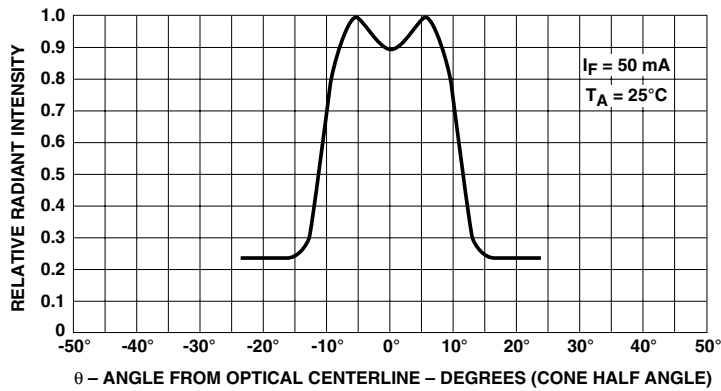


Figure 10. Relative radiant intensity vs. angular displacement HSDL-4420.

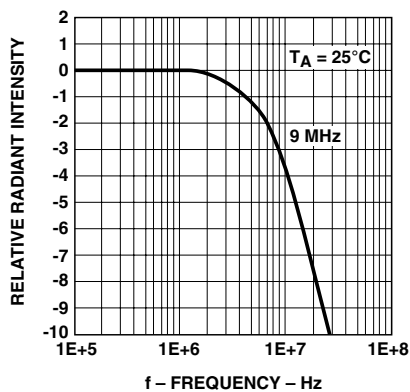


Figure 11. Relative radiant intensity vs. frequency.

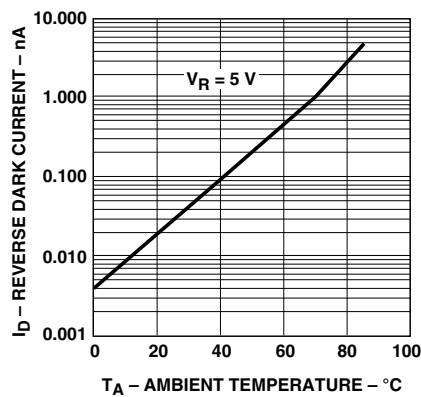


Figure 12. Reverse dark current vs. ambient temperature.

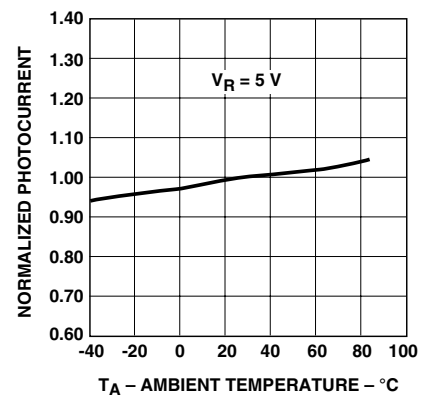


Figure 13. Relative reverse light current vs. ambient temperature.

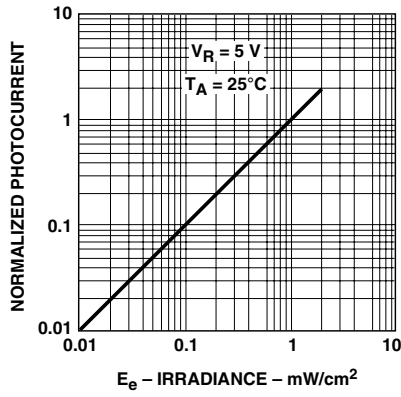


Figure 14. Reverse light current vs. irradiance

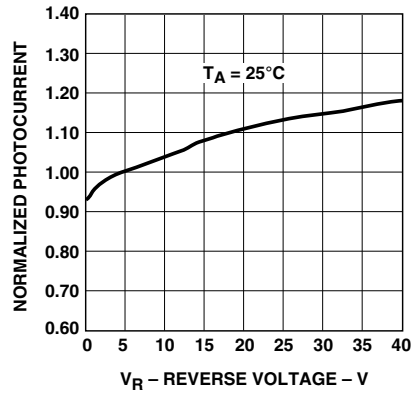


Figure 15. Reverse light current vs. reverse voltage.

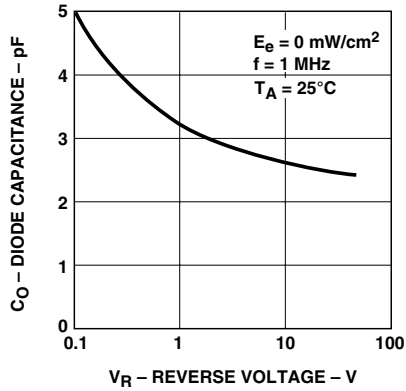


Figure 16. Diode capacitance vs. reverse voltage.

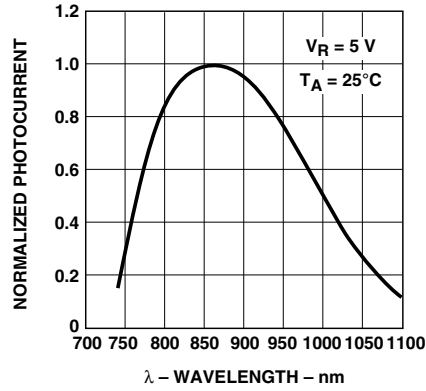


Figure 17. Relative spectral sensitivity vs. wavelength.

At the time of this publication, Light Emitting Diodes (LEDs) that are contained in this product are regulated for eye safety in Europe by the Commission for European Electrotechnical Standardization (CENELEC) EN60825-1. Please refer to Application Brief I-008 for more information.

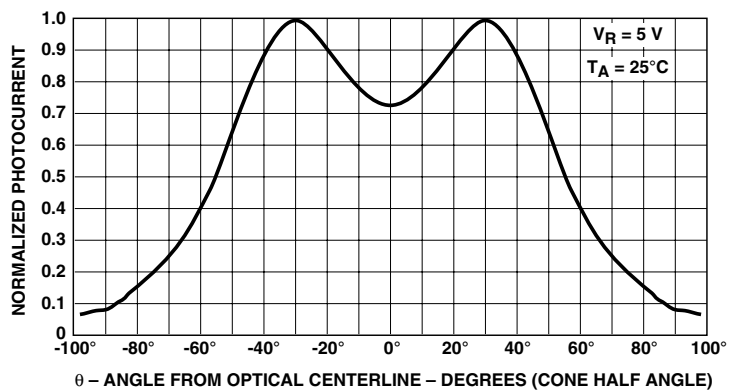


Figure 18. Relative radiant intensity vs. angular displacement.  
HSDL-5400.

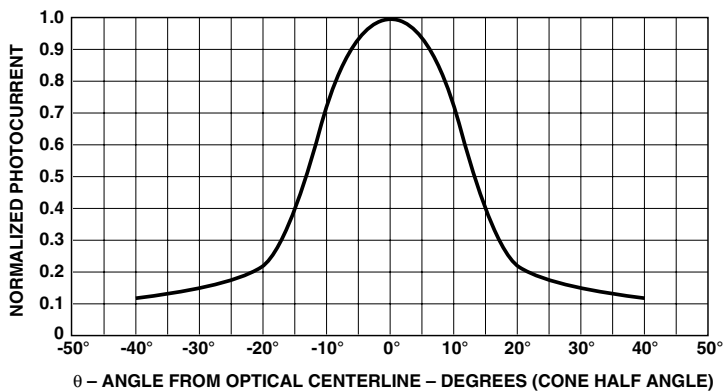
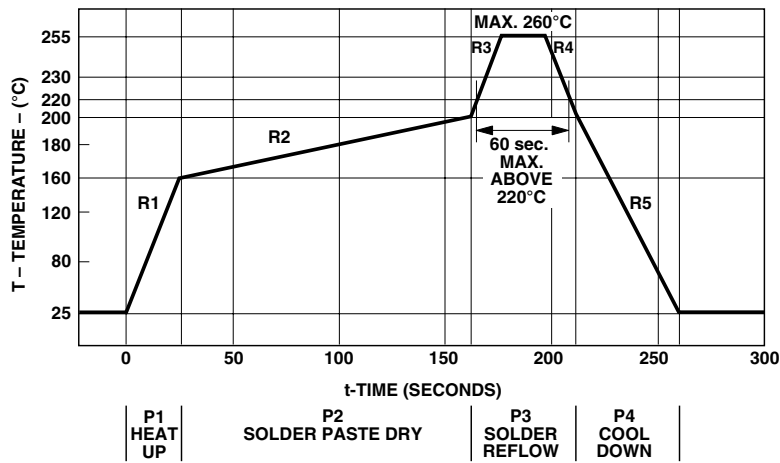


Figure 19. Relative radiant intensity vs. angular displacement.  
HSDL-5420.



| Process Zone     | Symbol | $\Delta T$                               | Maximum $\Delta T / \Delta \text{time}$ |
|------------------|--------|------------------------------------------|-----------------------------------------|
| Heat Up          | P1, R1 | 25°C to 160°C                            | 4°C/s                                   |
| Solder Paste Dry | P2, R2 | 160°C to 200°C                           | 0.5°C/s                                 |
| Solder Reflow    | P3, R3 | 200°C to 255°C (260°C at 10 seconds max) | 4°C/s                                   |
|                  | P3, R4 | 255°C to 200°C                           | -6°C/s                                  |
| Cool Down        | P4, R5 | 200°C to 25°C                            | -6°C/s                                  |

Figure 20. Evaluation soldering profiles (polyled).

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