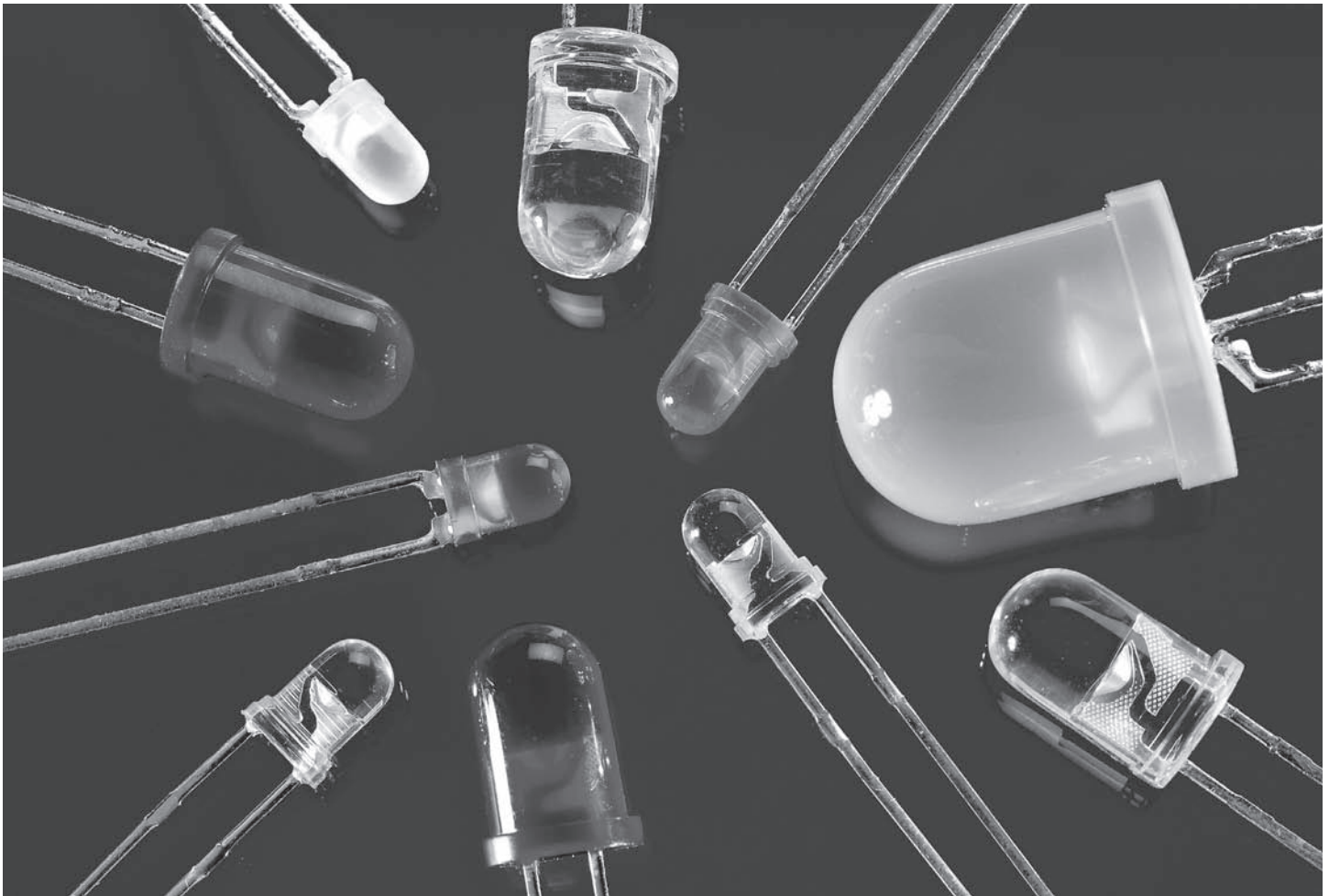


L E D S



Being solid state devices, Light Emitting Diode (LED) Lamps have inherent characteristics assuring high reliability and a compatibility with low current electronic drive circuits. This section contains a selection of our most common LEDs. If your requirement is for a different LED, please contact one of our application engineers for assistance.

LEDs have advantages and disadvantages when compared with other light sources such as incandescent or neon lamps. The advantages are small size, low power consumption, low self-heating, high reliability, they can be switched on and off quickly, and they are resistant to shock and vibration. The features that sometimes can be considered disadvantages are the narrow viewing angle, near monochromatic light, limited wavelength selection, and they require a limiting resistor with a voltage drive.

### Principles of Operation

LEDs are formed from various doped semiconductor materials in the form of a P-N diode junction. When electrical current passes through the junction in the forward direction, the electrical carriers give up energy proportional to the forward voltage drop across the diode junction, which is emitted in the form of light. The amount of energy is relatively low for infrared or red LEDs. For green

and blue LEDs which are produced from higher forward voltage materials, the amount of energy is greater.

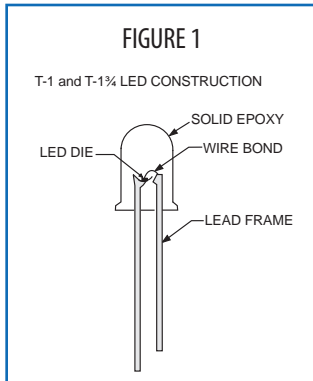
Since the device is being used in the forward biased mode, once the voltage applied exceeds the diode forward voltage; the current through the device can rise exponentially. Very high currents would damage the device which is why a current limiting resistor must be added in series with the LED when driven from a voltage source.

The amount of light emitted by an LED is proportional to the amount of current passing through the device in the forward bias direction. As the current is varied, the output of the light will vary in a similar fashion. By modulating the current flowing through the LED, the light output can be modulated to produce an amplitude modulated optical signal which can be used to communicate information through free space (i.e. TV remote control).

If the voltage source is applied in the reverse direction, the P-N junction will block current flow until the voltage applied exceeds the devices ability to block the current. At that point, the device junction will break down, and if there is no current limit device in the circuit, the LED will be destroyed. The typical value of maximum reverse voltage is five volts.

### Construction and Operation

The semiconductor material is typically a very small chip or die, which is mounted onto a lead frame and encapsulated in a clear or diffused epoxy. The shape of the epoxy and the amount of diffusing material in the epoxy control the light output angle of emission. Figure 1 illustrates the construction of a common LED package.



Many of our LEDs incorporate high efficiency chips mounted into T-1, T-1¼, and SMT (surface mount) packages. However, there are a wide variety of right angle, multi-package and custom packages available to meet your requirements.

The output of LEDs is typically expressed in millicandela (mcd). The candela is defined as the number of lumens per steradian of solid angle. It is usually measured along the projection axis of the device and gives the eye's response to the light. The viewing angle for LEDs is specified as the included angle between the ½ intensity points on either side of the output beam. For T-1 and T-1¼ devices this can be as low as 10 degrees for clear epoxy devices and as high as 60 degrees for highly diffused LEDs. Peak radiation output is available ranging from the infrared through the visible down into the deep blue.

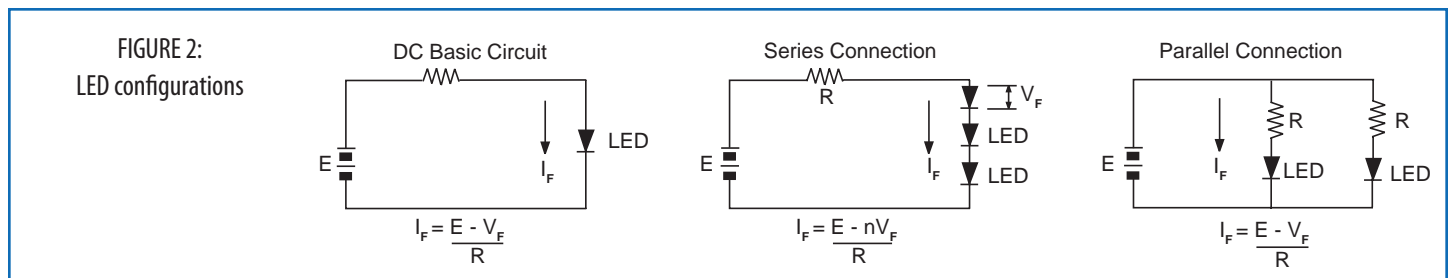
LED lamps may be operated in the pulsed mode. The absolute maximum ratings of LEDs have been determined theoretically but also from extensive reliability testing. Forward current, power dissipation, thermal resistance, and junction temperature are all interrelated in establishing absolute maximum ratings. In the pulsed mode, maximum tolerable limits should not exceed the LED junction temperature that would be reached by operating the LED at specified maximum continuous forward current. This correlation is obtained by establishing combinations of peak current and pulse width for various refresh rates and maintaining the maximum junction temperature as reached by operation at maximum continuous current.

LED lamps may be operated in the pulsed mode. The absolute maximum ratings of LEDs have been determined theoretically but also from extensive reliability testing. Forward current, power dissipation, thermal resistance, and junction temperature are all interrelated in establishing absolute maximum ratings. In the pulsed mode, maximum tolerable limits should not exceed the LED junction temperature that would be reached by operating the LED at specified maximum continuous forward current. This correlation is obtained by establishing combinations of peak current and pulse width for various refresh rates and maintaining the maximum junction temperature as reached by operation at maximum continuous current.



### Drive circuits

The drive circuits for LEDs must provide sufficient voltage to overcome the forward voltage drop of the diode junction, while controlling the current to the correct value for the specific device. The most common circuit to accomplish this is a voltage source which is significantly higher than the diode forward voltage drop and a series current limiting resistor. Several configurations are shown in Figure 2. Use Ohms law to calculate the resistor value depending on the LED chosen, the voltage source, and the maximum continuous current rating.

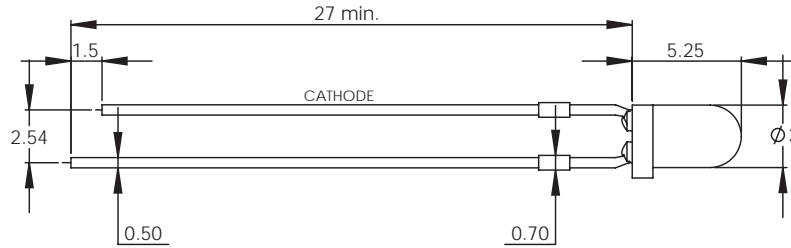


Select the LED Best Suited To Your Application, Then Enter That LED's Part Number in the Search Box on the ILT Web Site Home Page (Upper Right Corner) To Order. [Link to ILT Home Page](#)

LEDs	50-75	>
Thru Hole	52-66	
Phototransistor	67	
SMT	68-75	
Technical Data	76-84	

# LED S

T-1



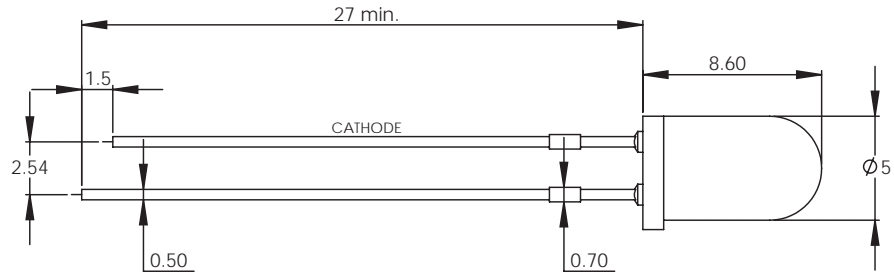
Note: All dimensions are in mm

T-1

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	
				Min	Typical		Typical	Max		
1	E100	Red	Clear	18mcd	80mcd	50°	2.0V	2.5V	627nm	
2	E112	Red	Diffused	8mcd	25mcd	60°	2.0V	2.5V	627nm	
3	E169	Red	Clear	380mcd	400mcd	50°	1.85V	2.5V	660nm	
4	E170	Red	Clear	480mcd	600mcd	50°	1.85V	2.5V	660nm	
5	E171	Red	Clear	650mcd	800mcd	34°	1.85V	2.5V	660nm	
6	E197	Red	Clear	1200mcd	1300mcd	34°	1.85V	2.5V	660nm	
7	E102	Orange	Clear	18mcd	50mcd	50°	2.05V	2.5V	607nm	
8	E103	Orange	Orange	18mcd	50mcd	50°	2.05V	2.5V	607nm	
9	E113	Orange	Diffused	8mcd	30mcd	60°	2.05V	2.5V	607nm	
10	E199	Orange	Orange	480mcd	1300mcd	50°	2.0V	2.5V	610nm	
11	E104	Yellow	Clear	8mcd	20mcd	50°	2.1V	2.5V	590nm	
12	E114	Yellow	Diffused	5mcd	15mcd	60°	2.1V	2.5V	590nm	
13	E105	Yellow	Yellow	8mcd	20mcd	50°	2.1V	2.5V	590nm	
14	E198	Yellow	Yellow	480mcd	1200mcd	34°	2.0V	2.5V	590nm	
15	E253	Yellow	Diffused	480mcd	1200mcd	40°	2.0V	2.5V	590nm	
16	E106	Green	Clear	36mcd	100mcd	50°	2.2V	2.5V	565nm	
17	E116	Green	Diffused	18mcd	60mcd	60°	2.2V	2.5V	565nm	
18	E166	Green	Clear	70mcd	150mcd	34°	2.2V	2.5V	565nm	
19	E196	Green	Diffused	18mcd	40mcd	60°	2.2V	2.5V	565nm	
20	E252	Green	Diffused	480mcd	300mcd	40°	3.3V	4.1V	515nm	
21	E902	Green	Clear	17600mcd	20880mcd	15°	3.5V	4.0V	535nm	
22	E472	Blue	Clear	36mcd	80mcd	20°	3.8V	4.5V	430nm	
23	E482	Blue	Clear	4400mcd	6220mcd	15°	3.2V	3.5V	470nm	
24	E1004	White	Clear	4760mcd	5520mcd	20°	3.6V	4.0V	0.31	0.32
25	E21	Infrared	Clear	7mW/sr	40mW/sr	50°	1.2V	1.6V	940nm	
26	E22	Infrared	Blue	4mW/sr	40mW/sr	50°	1.3V	1.6V	880nm	

# LED S

## T-1 $\frac{3}{4}$



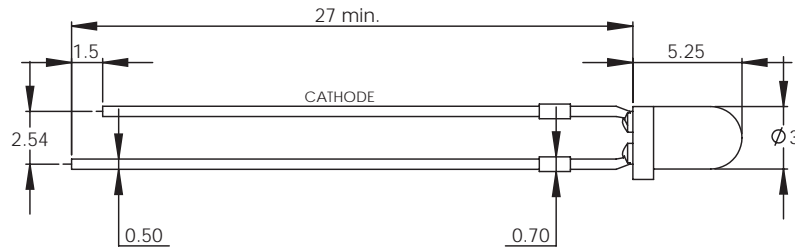
Note: All dimensions are in mm

## T-1 $\frac{3}{4}$

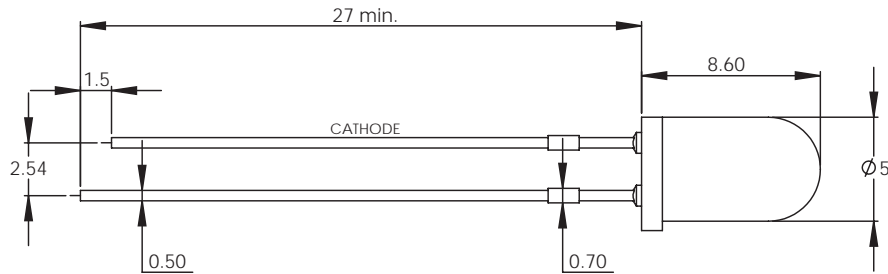
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
1	E118	Red	Diffused	8mcd	45mcd	60°	2.0V	2.5V	627nm
2	E181	Red	Clear	380mcd	400mcd	50°	1.85V	2.50V	660nm
3	E183	Red	Clear	1200mcd	1400mcd	30°	1.85V	2.5V	660nm
4	E184	Red	Clear	1800mcd	2800mcd	30°	1.85V	2.5V	660nm
5	E301	Red	Diffused	110mcd	150mcd	60°	1.85V	2.5V	660nm
6	E303	Red	Diffused	180mcd	250mcd	30°	1.85V	2.5V	660nm
7	E304	Red	Diffused	280mcd	400mcd	30°	1.85V	2.5V	660nm
8	E185	Red	Clear	3300mcd	4000mcd	20°	1.85V	2.5V	660nm
9	E119	Orange	Diffused	12mcd	30mcd	60°	2.05V	2.5V	607nm
10	E194	Orange	Orange	650mcd	2500mcd	30°	2.0V	2.5V	620nm
11	E120	Yellow	Diffused	5mcd	20mcd	60°	2.1V	2.5V	590nm
12	E195	Yellow	Yellow	650mcd	2000mcd	30°	2.0V	2.5V	590nm
13	E121	Green	Diffused	18mcd	40mcd	30°	2.2V	2.5V	565nm
14	E168	Green	Clear	70mcd	200mcd	20°	2.2V	2.5V	565nm
15	E903	Green	Clear	13800mcd	16000mcd	15°	3.5V	4.0V	535nm
16	E905	Green	Clear	7500mcd	15000mcd	20°	3.2V	4.0V	520nm
17	E474	Blue	Clear	50mcd	150mcd	16°	3.8V	4.5V	430nm
18	E484	Blue	Clear	4120mcd	4800mcd	15°	3.6V	4.0V	470nm
19	E1003	White	Clear	11000mcd	12600mcd	20°	3.6V	4.0V	0.31 0.32
20	E23	Infrared	Clear	7mW/sr	30mW/sr	20°	1.2V	1.6V	940nm
21	E24	Infrared	Blue	4mW/sr	20mW/sr	30°	1.3V	1.6V	880nm

# LED S

## T-1 Low Current



## T-1¾ Low Current



Note: All dimensions are in mm

## T-1 Low Current

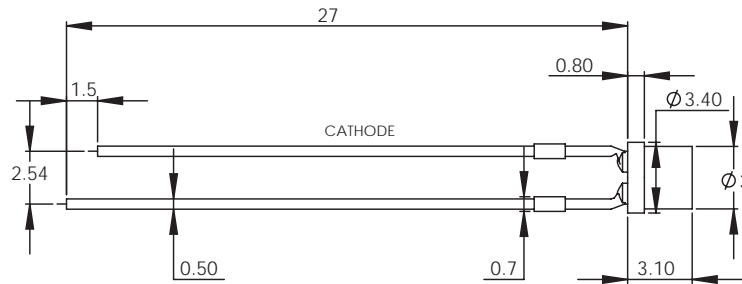
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 2mA		Viewing Angle	Forward Voltage at 2mA		Peak Wave Length at 2mA
				Min	Typical		Typical	Max	
1	E28	Red	Diffused	8.0mcd	20mcd	40°	1.65V	2.50V	660nm
2	E30	Red	Diffused	0.7mcd	3.0mcd	60°	1.7V	2.50V	627nm
3	E31	Yellow	Diffused	0.7mcd	1.5mcd	60°	1.85V	2.50V	590nm
4	E32	Green	Diffused	0.7mcd	2.0mcd	60°	1.9V	2.50V	565nm

## T-1¾ Low Current

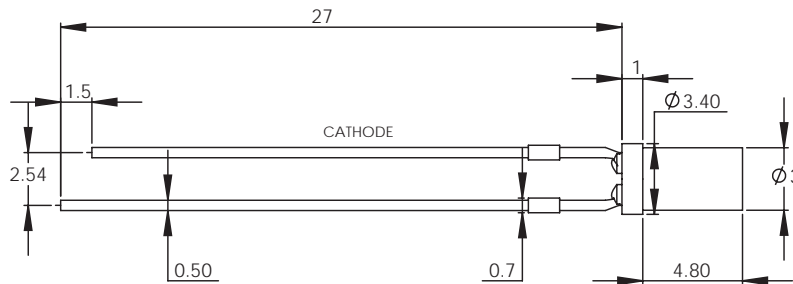
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 2mA		Viewing Angle	Forward Voltage at 2mA		Peak Wave Length at 2mA
				Min	Typical		Typical	Max	
5	E29	Red	Diffused	8.0mcd	20.0mcd	60°	1.65V	2.5V	660nm
6	E33	Red	Diffused	0.7mcd	5.0mcd	60°	1.7V	2.5V	627nm
7	E34	Yellow	Diffused	0.7mcd	2.0mcd	60°	1.85V	2.5V	590nm
8	E35	Green	Diffused	0.7mcd	2.0mcd	60°	1.9V	2.5V	565nm

# LED S

## T-1 Short



## T-1 Flat



Note: All dimensions are in mm

## T-1 Short

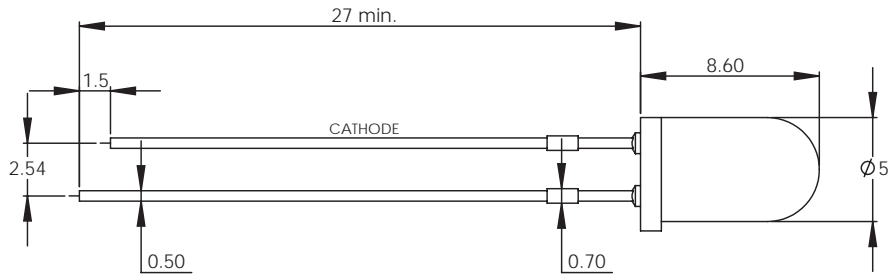
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
1	E260	Red	Red	18mcd	60mcd	130°	1.85V	2.5V	660nm
2	E261	Red	Red	3mcd	5mcd	130°	2.0V	2.5V	627nm
3	E262	Orange	Orange	3mcd	8mcd	130°	2.05V	2.5V	607nm
4	E263	Yellow	Yellow	1mcd	3mcd	130°	2.1V	2.5V	590nm
5	E264	Green	Green	18mcd	60mcd	130°	2.2V	2.5V	565nm

## T-1 Flat

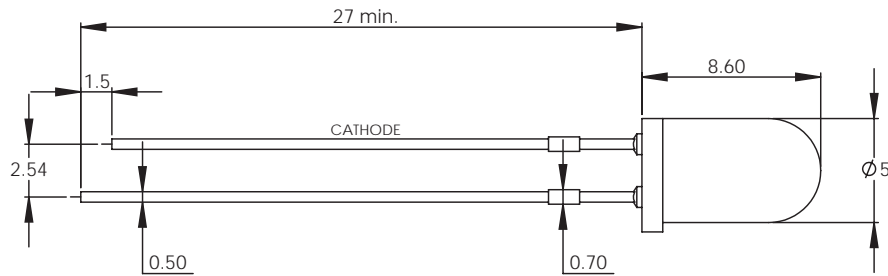
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
6	E265	Red	Diffused	36mcd	100mcd	100°	1.85V	2.5V	660nm
7	E266	Red	Diffused	3mcd	5mcd	100°	2.0V	2.5V	627nm
8	E267	Orange	Diffused	3mcd	7mcd	100°	2.05V	2.5V	607nm
9	E268	Yellow	Diffused	1mcd	4mcd	100°	2.1V	2.5V	590nm
10	E269	Green	Diffused	7mcd	15mcd	100°	2.2V	2.5V	565nm

# LED S

## T-1¾ with Resistor



## T-1¾ Flashing



Note: All dimensions are in mm

## T-1¾ with Resistor - 12V

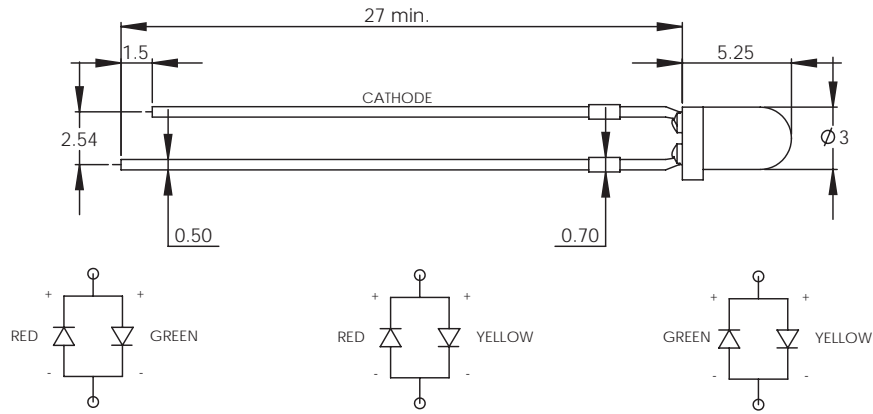
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 12VDC			Viewing Angle	Current Range at 12VDC		Peak Wave Length at 12VDC
				Min	Max	Typical		Max		
1	E304-12V	Red	Diffused	110mcd	180mcd	60°	8.5mA	11.5mA	660nm	
2	E149-12V	Yellow	Diffused	5mcd	20mcd	60°	8.5mA	11.5mA	590nm	
3	E151-12V	Green	Diffused	8mcd	20mcd	60°	8.5mA	11.0mA	565nm	

## T-1¾ Flashing

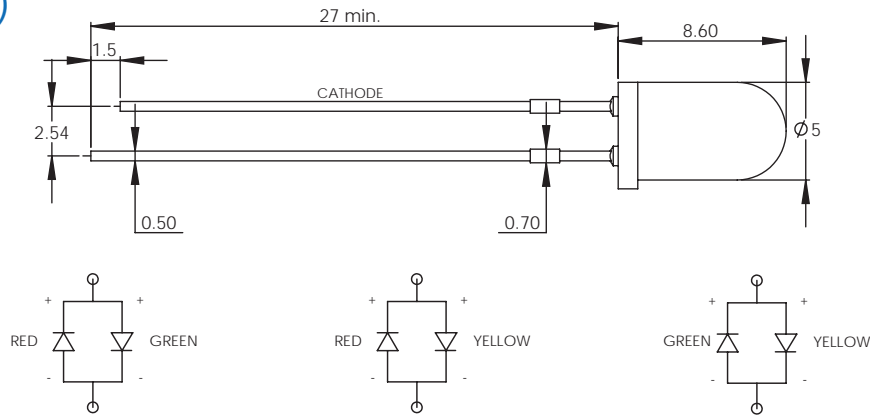
Line No.	Part No.	Color	Lens Type	Forward D.C. Voltage			Luminous Intensity at 9.0 VDC		Viewing Angle	Peak Frequency (Hz)	Wave Length
				Min	Typical	Max	Min	Max			
4	E157	Red	Diffused	3.5	9.0	14.0	110mcd	200mcd	60°	1.5 - 3.0	660nm
5	E158	Red	Clear	3.5	9.0	14.0	480mcd	800mcd	30°	1.5 - 3.0	660nm
6	E159	Red	Diffused	3.5	9.0	14.0	18mcd	40mcd	60°	1.5 - 3.0	627nm

# LED S

## T-1 Bi Color (2 lead)



## T-1¾ Bi Color (2 lead)



Note: All dimensions are in mm

## T-1 Bi Color (2 lead)

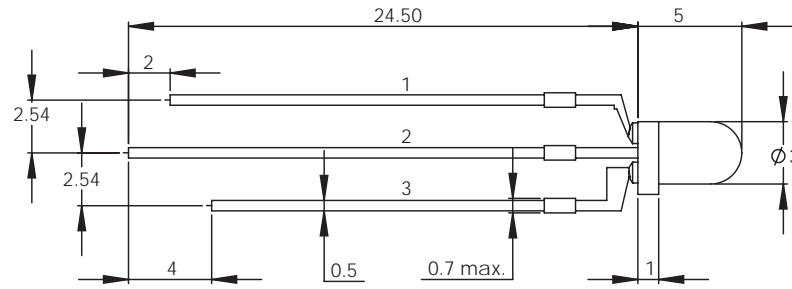
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
1	E207	Red & Green	White	7mcd	20mcd	60°	2.0V	2.5V	627nm
			Diffused	7mcd	16mcd	60°	2.2V	2.5V	565nm
2	E208	Red & Yellow	White	7mcd	20mcd	60°	2.0V	2.5V	627nm
			Diffused	1.6mcd	7mcd	60°	2.1V	2.5V	590nm
3	E209	Green & Yellow	White	7mcd	16mcd	60°	2.2V	2.5V	565nm
			Diffused	1.6mcd	7mcd	60°	2.1V	2.5V	590nm

## T-1¾ Bi Color (2 lead)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
4	E210	Red & Green	White	10mcd	30mcd	60°	2.0V	2.5V	627nm
			Diffused	10mcd	20mcd	60°	2.2V	2.5V	565nm
5	E211	Red & Yellow	White	10mcd	30mcd	60°	2.0V	2.5V	627nm
			Diffused	4mcd	10mcd	60°	2.1V	2.5V	590nm
6	E212	Green & Yellow	White	10mcd	20mcd	60°	2.2V	2.5V	565nm
			Diffused	4mcd	10mcd	60°	2.2V	2.5V	590nm

# LED S

## T-1 Bi Color (3 lead)



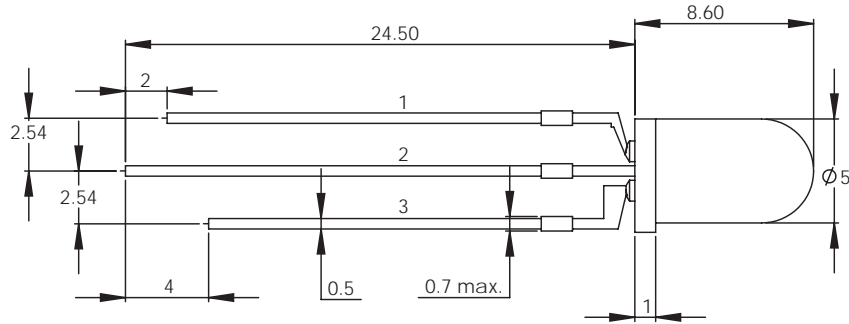
Note: All dimensions are in mm

## T-1 Bi Color (3 lead)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Leads
				Min	Typical		Typical	Max		
1	E219	Red & Green	White	10mcd	40mcd	60°	2.0V	2.5V	627nm	1.Red Anode 2.Cathode 3.Green Anode
			Diffused	10mcd	35mcd	60°	2.2V	2.5V	565nm	
2	E220	Green & Yellow	White	7mcd	35mcd	60°	2.2V	2.5V	565nm	1.Green Anode 2.Cathode 3.Yellow Anode
			Diffused	7mcd	15mcd	60°	2.1V	2.5V	590nm	
3	E293	Red & Green	White	70mcd	150mcd	60°	1.85V	2.5V	660nm	1.Red Cathode 2.Anode 3.Green Cathode
			Diffused	10mcd	25mcd	60°	2.2V	2.5V	565nm	

# LED S

## T-1 $\frac{3}{4}$ Bi Color (3 lead)



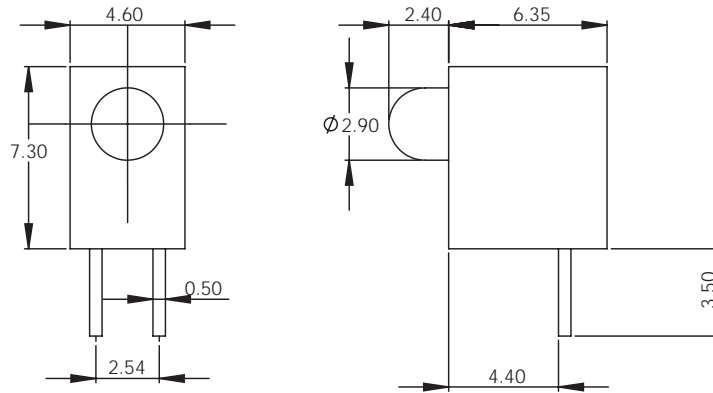
Note: All dimensions are in mm

## T-1 $\frac{3}{4}$ Bi Color (3 lead)

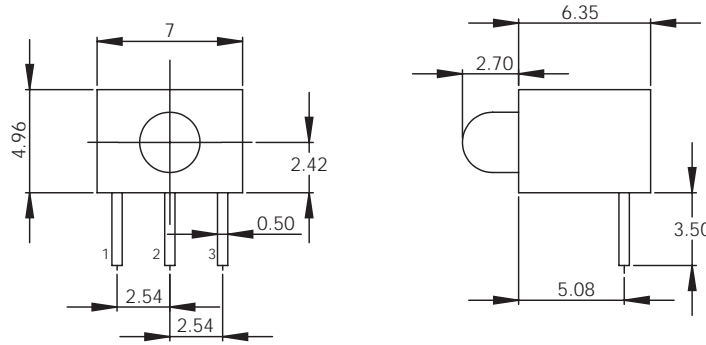
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Leads
				Min	Typical		Typical	Max		
1	E203	Red & Green	White Diffused	18mcd 18mcd	60mcd 50mcd	60° 60°	2.0V 2.2V	2.5V 2.5V	627nm 565nm	1.Red Anode 2.Cathode 3.Green Anode
2	E204	Red & Green	White Diffused	2.6mcd 1.6mcd	5mcd 5mcd	60° 60°	2.0V 2.2V	2.5V 2.5V	627nm 565nm	1.Red Cathode 2.Anode 3.Green Cathode
3	E231	Red & Green	White Diffused	110mcd 18mcd	220mcd 50mcd	60° 60°	1.85V 2.20V	2.5V 2.5V	660nm 565nm	1. Red Anode 2. Cathode 3. Green Anode
4	E232	Red & Green	Clear	280mcd 70mcd	600mcd 200mcd	24° 24°	1.85V 2.20V	2.5V 2.5V	660nm 565nm	1. Red Anode 2. Cathode 3. Green Anode
5	E291	Red & Green	Clear	280mcd 70mcd	600mcd 200mcd	24° 24°	1.85V 2.20V	2.5V 2.5V	660nm 565nm	1. Red Cathode 2. Anode 3.GreenCathode
6	E292	Red & Green	White Diffused	70mcd 18mcd	200mcd 50mcd	24° 24°	1.85V 2.20V	2.5V 2.5V	660nm 565nm	1. Red Cathode 2. Anode 3.GreenCathode
7	E205	Red & Yellow	White Diffused	18mcd 18mcd	60mcd 40mcd	60° 60°	2.0V 2.1V	2.5V 2.5V	627nm 590nm	1.Red Anode 2.Cathode 3.Yellow Anode
8	E206	Green & Yellow	White Diffused	18mcd 18mcd	50mcd 40mcd	60° 60°	2.2V 2.1V	2.5V 2.5V	565nm 590nm	1.Green Anode 2.Cathode 3.Yellow Anode

# LED S

## T-1 Right Angle



## T-1 Right Angle Bi Color short



Note: All dimensions are in mm

## T-1 Right Angle

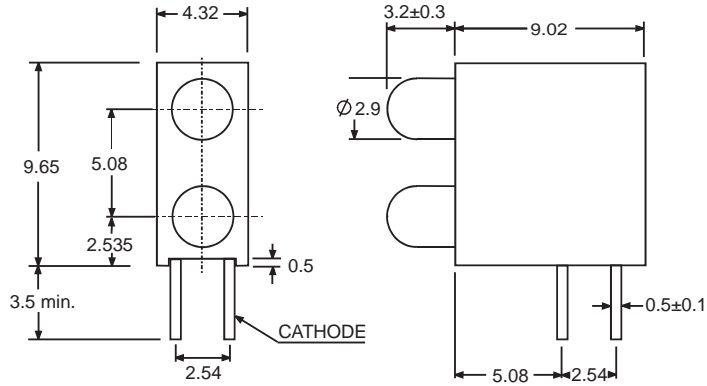
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
1	EA100	Red	Red	380mcd	630mcd	34°	1.85V	2.50V	660nm
2	EA104	Yellow	Yellow	8mcd	30mcd	34°	2.1V	2.5V	590nm
3	EA106	Green	Green	70mcd	150mcd	34°	2.2V	2.5V	565nm

## T-1 Right Angle Bi Color short

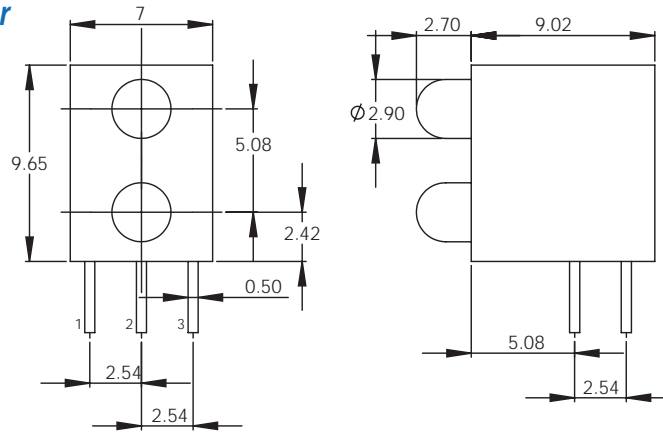
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Leads
				Min	Typical		Typical	Max		
4	EA202	Red & Green	White	7mcd	30mcd	60°	2.0V	2.5V	627nm	1.Red Anode
			Diffused	7mcd	25mcd	60°	2.2V	2.5V	565nm	2.Cathode 3.Green Anode
5	EA208	Red & Yellow	White	7mcd	30mcd	60°	2.0V	2.5V	627nm	1.Red Anode
			Diffused	7mcd	20mcd	60°	2.1V	2.5V	590nm	2.Cathode 3.Yellow Anode
6	EA207	Green & Yellow	White	7mcd	25mcd	60°	2.2V	2.5V	565nm	1.Green Anode
			Diffused	7mcd	25mcd	60°	2.1V	2.5V	590nm	2.Cathode 3.Yellow Anode

# LED S

## T-1 Right Angle Bi Level



## T-1 Right Angle Bi Level Bi Color



Note: All dimensions are in mm

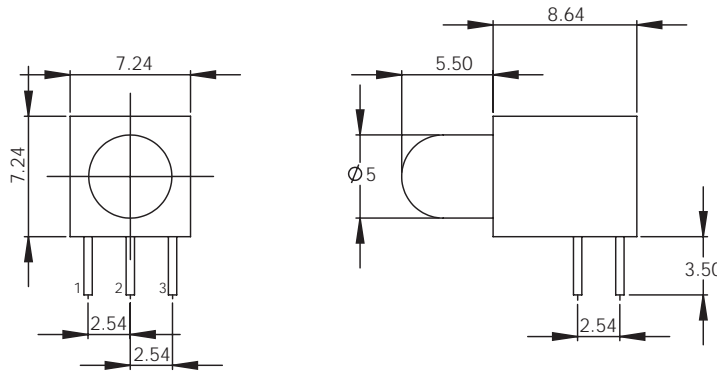
## T-1 Right Angle Bi Level

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
1	EA209	Red	Clear	380mcd	900mcd	50°	1.95V	2.5V	650nm

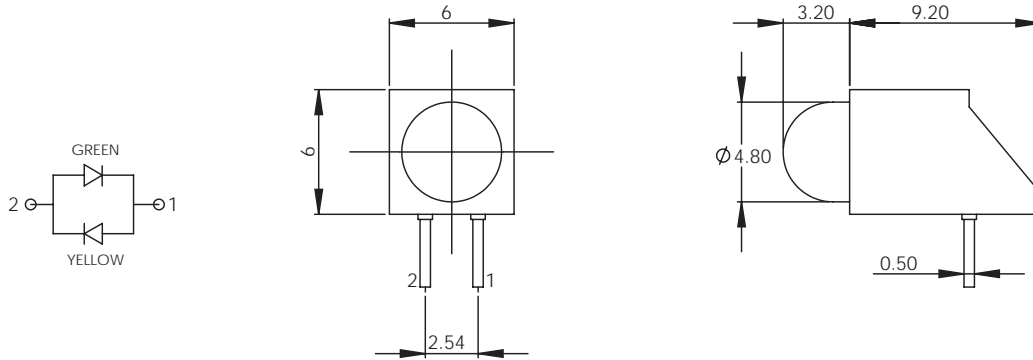
## T-1 Right Angle Bi Level Bi Color

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Leads
				Min	Typical		Typical	Max		
2	EA203	Red & Green	White	7mcd	30mcd	60°	2.0V	2.5V	627nm	1.Red Anode
			Diffused	7mcd	25mcd	60°	2.2V	2.5V	565nm	2.Cathode 3.Green Anode
3	EA205	Red & Yellow	White	7mcd	30mcd	60°	2.0V	2.5V	627nm	1.Red Anode
			Diffused	7mcd	20mcd	60°	2.1V	2.5V	590nm	2.Cathode 3.Yellow Anode
4	EA206	Green & Yellow	White	7mcd	25mcd	60°	2.2V	2.5V	565nm	1.Green Anode
			Diffused	7mcd	20mcd	60°	2.1V	2.5V	590nm	2.Cathode 3.Yellow Anode

**T-1¾ Right Angle Bi Color (3 lead)**



**T-1¾ Right Angle Bi Color (2 lead)**



Note: All dimensions are in mm

**T-1¾ Right Angle Bi Color (3 lead)**

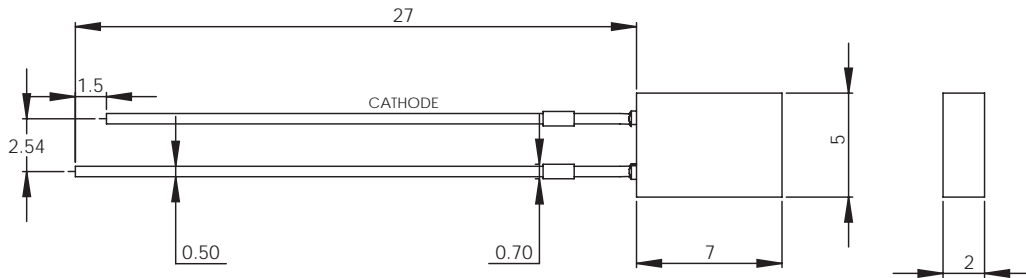
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Leads
				Min	Typical		Typical	Max		
1	E249	Red & Green	White	110mcd	220mcd	60°	1.85V	2.5V	660nm	1. Red Anode
			Diffused	18mcd	50mcd	60°	2.2V	2.5V	565nm	2. Cathode 3. Green Anode
2	E250	Red & Green	White	18mcd	60mcd	60°	2.0V	2.5V	627nm	1. Red Anode
			Diffused	18mcd	50mcd	60°	2.2V	2.5V	565nm	2. Cathode 3. Green Anode
3	E247	Red & Yellow	White	18mcd	60mcd	60°	2.0V	2.5V	627nm	1. Red Anode
			Diffused	18mcd	40mcd	60°	2.1V	2.5V	590nm	2. Cathode 3. Yellow Anode
4	E248	Yellow & Green	White	18mcd	40mcd	60°	2.1V	2.5V	590nm	1. Yellow Anode
			Diffused	18mcd	50mcd	60°	2.2V	2.5V	565nm	2. Cathode 3. Green Anode

**T-1¾ Right Angle Bi Color (2 lead)**

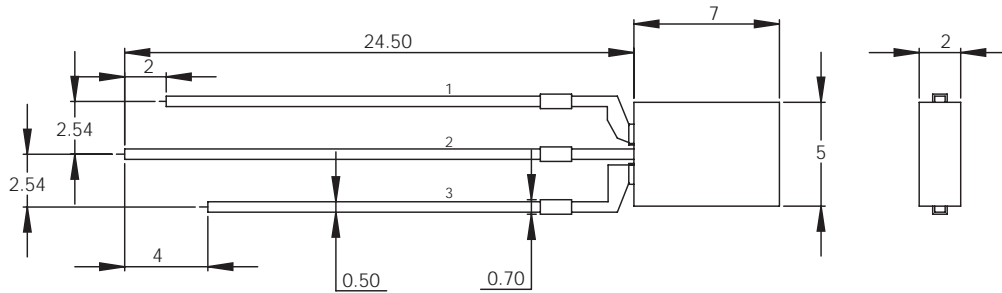
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Max		Typical	Max	
5	EA300	Green & Yellow	White	7mcd	25mcd	60°	2.2V	2.5V	565nm
			Diffused	2.6mcd	10mcd	60°	2.1V	2.5V	590nm

# LED S

## Rectangular (2x5)



## Rectangular (2x7) Bi Color (3 lead)



Note: All dimensions are in mm

## Rectangular (2x5)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 10mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
1	E222	Red	Diffused	0.4mcd	1mcd	110°	2.25V	2.5V	700nm
2	E226	Red	Diffused	36mcd*	80mcd*	110°	1.85V	2.5V	660nm
3	E233	Red	White Diffused	36mcd*	70mcd*	110°	1.85V	2.5V	660nm
4	E236	Orange	Diffused	3mcd	5mcd	110°	2.05V	2.5V	607nm
5	E224	Yellow	Diffused	1mcd	4mcd	110°	2.1V	2.5V	590nm
6	E234	Yellow	White Diffused	1mcd	3mcd	110°	2.1V	2.5V	590nm
7	E235	Green	White Diffused	7mcd*	13mcd*	110°	2.2V	2.5V	565nm

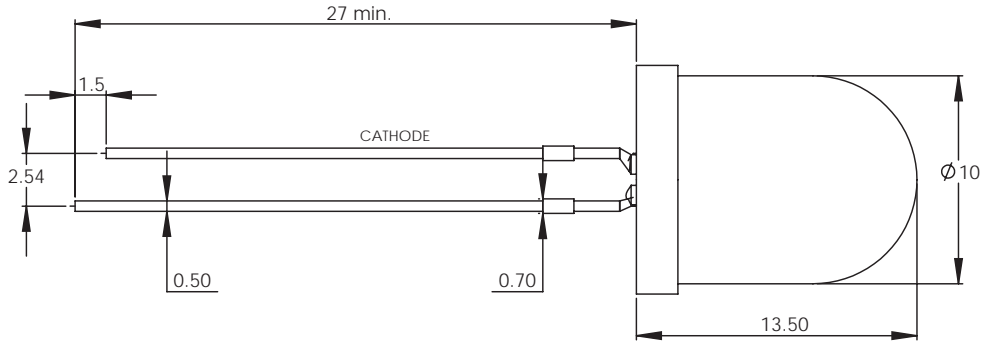
\* @20mA

## Rectangular (2x7) Bi Color (3 lead)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Leads
				Min	Typical		Typical	Max		
8	E214	Red & Green	White Diffused	18mcd	60mcd	110°	1.85V	2.5V	660nm	1. Red Anode
				4mcd	12mcd	110°	2.2V	2.5V	565nm	2. Cathode
										3. Green Anode

# LED S

## T-3¼



Note: All dimensions are in mm

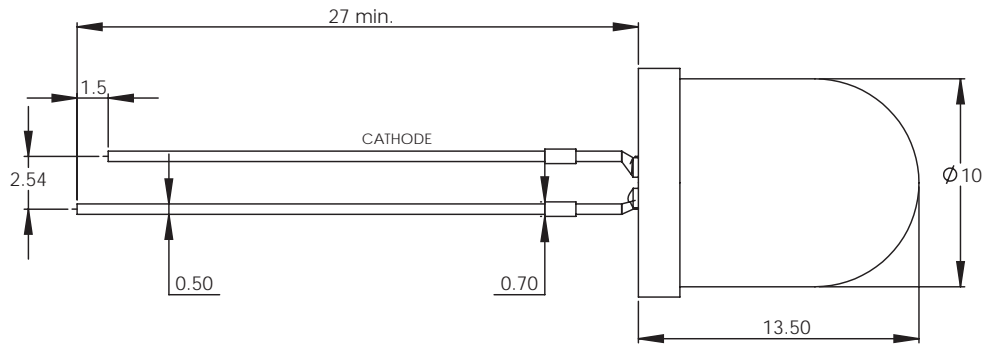
## T-3¼

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Typical		Typical	Max	
1	E186	Red	Diffused	480mcd	600mcd	30°	1.85V	2.5V	660nm
2	E176	Red	Diffused	36mcd	100mcd	30°	2.0V	2.5V	627nm
3	E179	Orange	Diffused	380mcd	850mcd	30°	2.0V	2.5V	610nm
4	E177	Yellow	Diffused	10mcd	50mcd	30°	2.1V	2.5V	590nm
5	E178	Green	Diffused	18mcd	60mcd	30°	2.2V	2.5V	565nm



# LED S

## T-3¼ Flashing



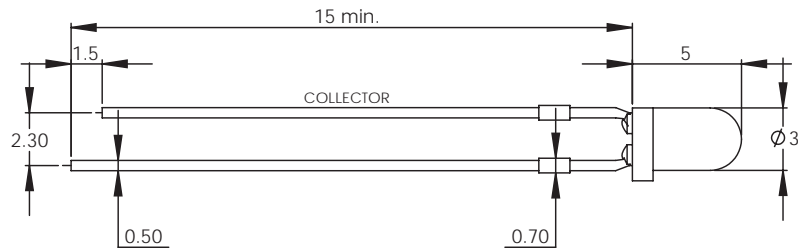
Note: All dimensions are in mm

## T-3¼ Flashing

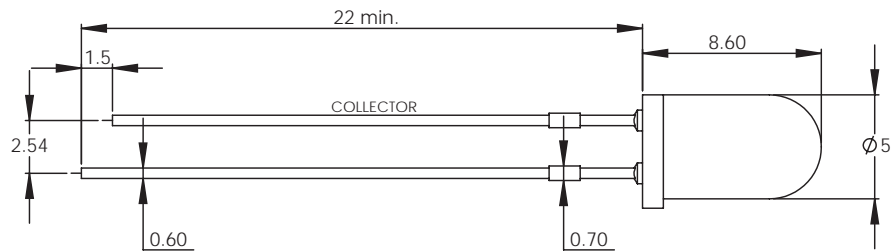
Line No.	Part No.	Color	Lens Type	Forward D.C. Voltage			Luminous Intensity at 9VDC		Viewing Angle	Frequency (Hz)	Peak Wave Length
				Min	Typical	Max	Min	Typical			
1	E162	Red	Diffused	3.5V	9V	14V	110mcd	300mcd	60°	1.5 - 3.0	660nm
2	E163	Yellow	Diffused	3.5V	9V	14V	10mcd	40mcd	60°	1.5 - 3.0	590nm
3	E164	Green	Diffused	3.5V	9V	14V	10mcd	50mcd	60°	1.5 - 3.0	565nm

# LED S

## T-1 Phototransistor



## T-1 $\frac{3}{4}$ Phototransistor



Note: All dimensions are in mm

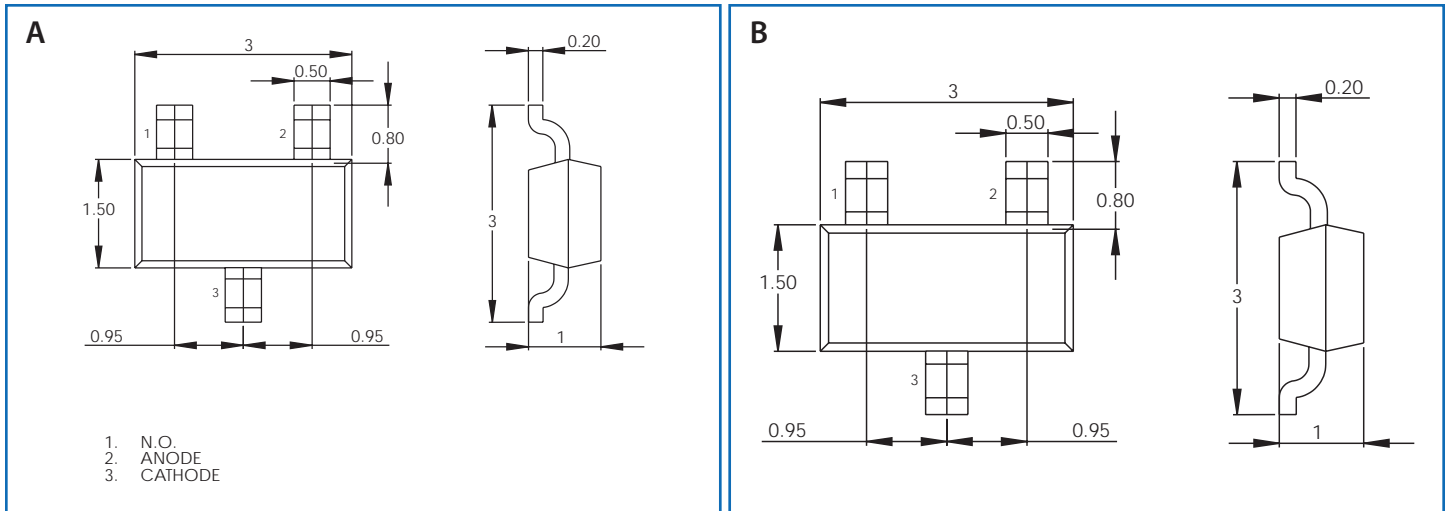
## T-1 Phototransistor

Line No.	Part No.	Viewing Angle	I <sub>(ON)</sub> at 5V		I <sub>CEO</sub> at 10V Maximum	V <sub>BR CEO</sub> Minimum	V <sub>BR ECO</sub> Minimum	V <sub>CE (SAT)</sub> Maximum
			Min	Max				
1	D40	50°	0.3mA	0.8mA	100nA	30V	5V	0.8V

## T-1 $\frac{3}{4}$ Phototransistor

Line No.	Part No.	Viewing Angle	I <sub>(ON)</sub> at 5V		I <sub>CEO</sub> at 10V Maximum	V <sub>BR CEO</sub> Minimum	V <sub>BR ECO</sub> Minimum	V <sub>CE (SAT)</sub> Maximum
			Min	Max				
2	D41	20°	0.1mA	0.5mA	100nA	30V	5V	0.8V

# LED S



Note: All dimensions are in mm

## Surface Mount, SOT-23 Package

Line No.	Part No.	Color	Lens Type	Luminous Intensity	Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Drawing
				at 20mA Typical		Typical	Maximum		
1	E40	Red	Clear	5mcd	100°	2.1V	2.8V	635nm	A
2	E41	Yellow	Clear	4.5mcd	100°	2.1V	2.8V	585nm	A
3	E42	Green	Clear	10mcd	100°	2.1V	2.8V	570nm	A

Tape & Reel packaging is standard.

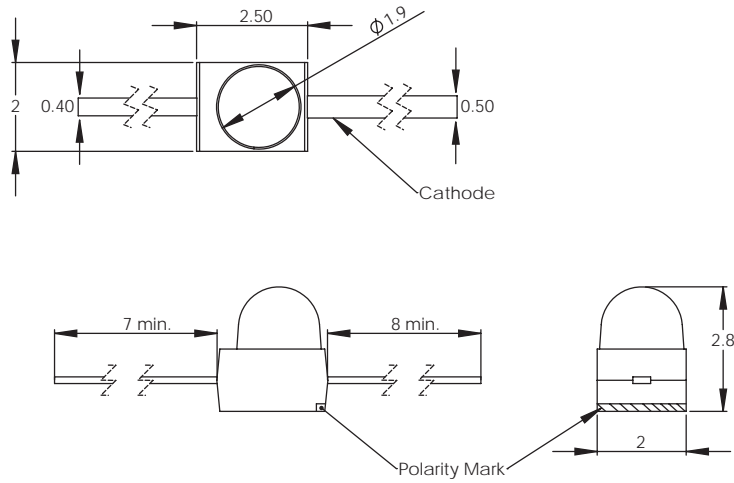
## Surface Mount, SOT-23 Package

Line No.	Part No.	Color	Luminous Intensity	Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Terminals	Drawing
			at 20mA Typical		Typical	Maximum			
4	E43	Red & Green	10mcd	100°	2.1V	2.8V	635nm	1.Red Cathode	B
			5mcd	100°					
5	E44	Red & Yellow	10mcd	100°	2.1V	2.8V	635nm	1.Red Cathode	B
			5mcd	100°					
6	E45	Green & Yellow	10mcd	100°	2.1V	2.8V	570nm	1.Yellow Cathode	B
			4.5mcd	100°					

Tape & Reel packaging is standard.

# LED S

## Surface Mount, Gull Wing



Note: All dimensions are in mm

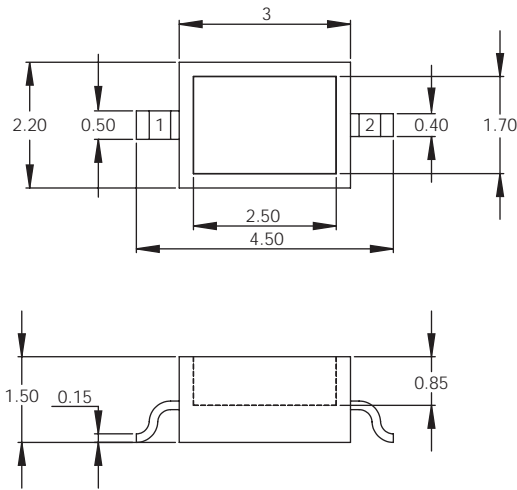
## Surface Mount, Gull Wing

Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Minimum	Typical		Typical	Maximum	
1	E90*	Red	Clear	110mcd	600mcd	20°	1.85V	2.5V	660nm
2	E91	Red	Clear	10mcd	70mcd	20°	2V	2.5V	627nm
3	E92	Yellow	Clear	10mcd	50mcd	20°	2.1V	2.5V	590nm
4	E95	Yellow	Clear	900mcd	2300mcd	20°	2.V	2.5V	595nm
5	E93	Green	Clear	36mcd	80mcd	20°	2.2V	2.5V	565nm
6	E94	Green	Clear	7mcd	20mcd	20°	2.25V	2.5V	555nm

\*Anode and cathode are reversed.

# LED S

## Surface Mount (Rectangular Lens)



1. Cathode
2. Anode

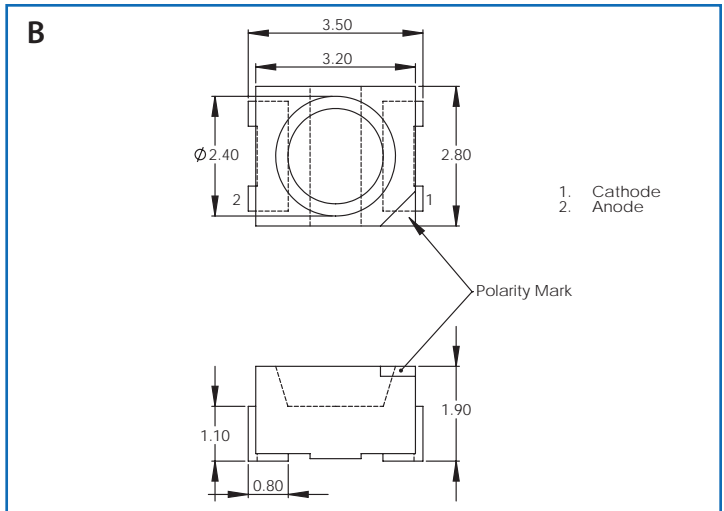
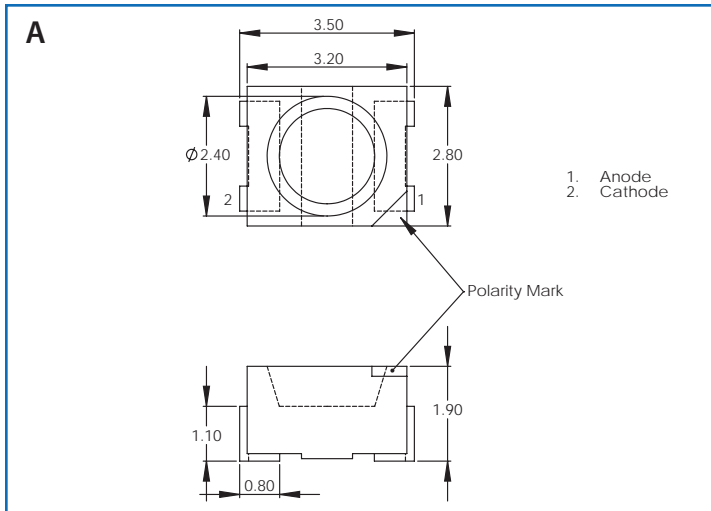
Note: All dimensions are in mm

## Surface Mount (Rectangular Lens)

Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Minimum	Typical		Typical	Maximum	
1	E80*	Red	Red	36mcd	150mcd	90°	1.85V	2.5V	660nm
2	E81	Red	Red	7mcd	24mcd	90°	2V	2.5V	627nm
3	E82	Yellow	Yellow	4mcd	10mcd	90°	2.1V	2.5V	590nm
4	E83	Green	Green	7mcd	18mcd	90°	2.2V	2.5V	565nm

\*Anode and cathode are reversed.  
Tape & Reel packaging is standard.

# LED S



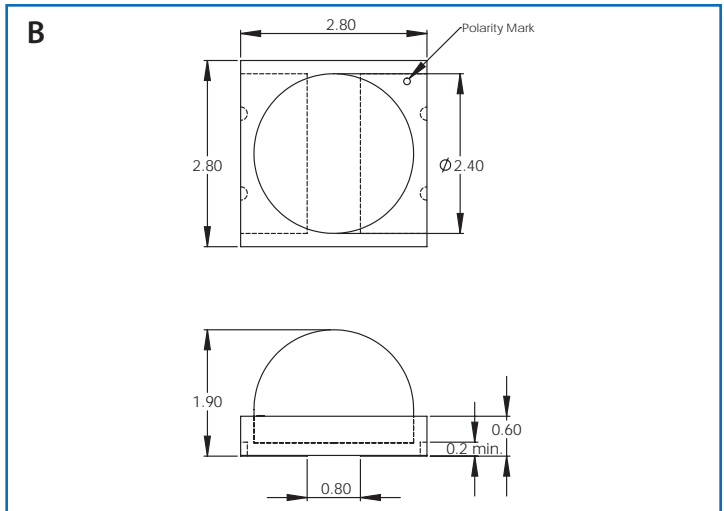
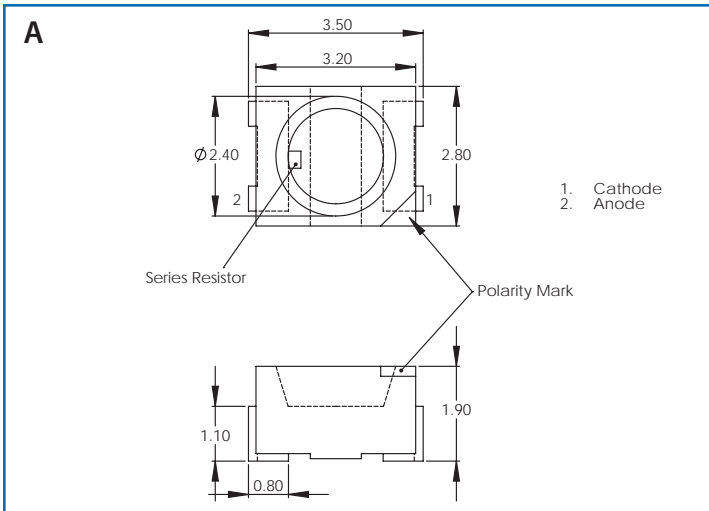
Note: All dimensions are in mm

## Surface Mount (Round Lens)

Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Drawing
				Minimum	Typical		Typical	Maximum		
1	E70	Red	Red	50mcd	150mcd	120°	1.85V	2.5V	660nm	A
2	E71	Red	Red	10mcd	30mcd	120°	2V	2.5V	627nm	B
3	E72	Yellow	Yellow	4mcd	15mcd	120°	2.1V	2.5V	590nm	B
4	E73	Green	Green	7mcd	18mcd	120°	2.2V	2.5V	565nm	B
5	E74	Green	Clear	1.6mcd	8mcd	120°	2.25V	2.5V	555nm	B
6	E75	Blue	Blue	5mcd	12mcd	120°	3.8V	4.5V	430nm	B
7	E77	Yellow	Yellow	36mcd	120mcd	120°	2V	2.5V	590nm	B
8	E78	Orange	Orange	10mcd	30mcd	120°	2.05V	2.5V	607nm	B

Tape & Reel packaging is standard.

# LED S



Note: All dimensions are in mm

## Surface Mount with Resistor - 5V

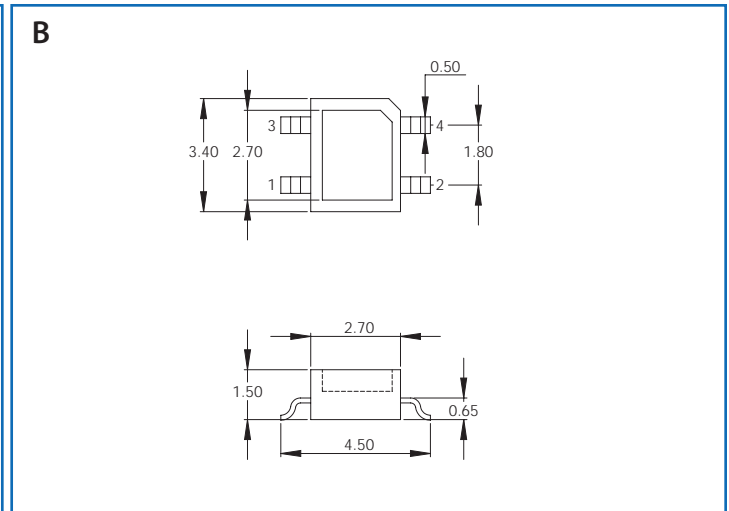
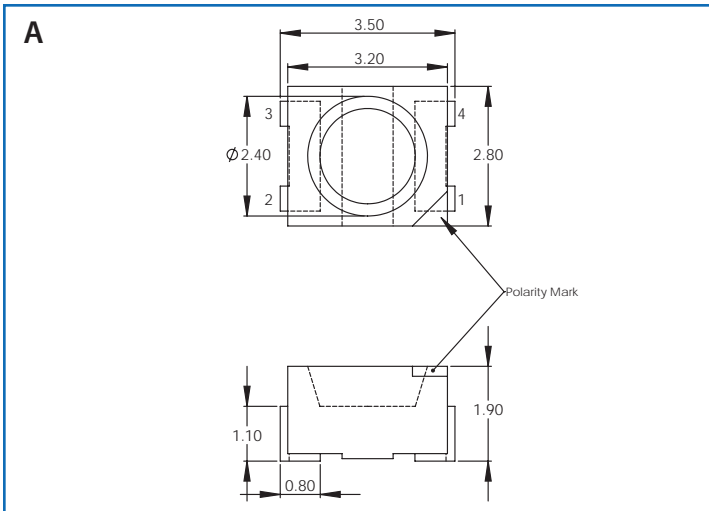
Line No.	Part No.	Color	Lens	Luminous Intensity at 5VDC		Viewing Angle	Current Range at 5VDC		Peak Wave Length at 5VDC	Drawing
				Min	Max		Typ	Max		
1	E70-5V*	Red	Red	55mcd	110mcd	120°	13mA	17.5mA	660nm	A
2	E71-5V	Red	Red	12mcd	20mcd	120°	13mA	17.5mA	627nm	A
3	E72-5V	Yellow	Yellow	4mcd	8mcd	120°	13mA	17.5mA	590nm	A
4	E73-5V	Green	Green	5mcd	10mcd	120°	11.5mA	17.5mA	565nm	A

\*Anode and cathode are reversed.  
Tape & Reel packaging is standard.

## White Surface Mount

Line No.	Part No.	Color	CRI (typical)	Luminous Intensity		CCT	Typical Voltage	Viewing Angle	Chroma coords.	Drawing
				@100mA	@140mA					
5	GTL-SH-35K22	White	85	22	30	3500K	3.45	110°	x=.4073 y=.3917	B
6	GTL-SH-40K23	White	85	23	30	4000K	3.45	110°	x=.3818 y=.3797	B
7	GTL-SH-50K25	White	85	25	32	5000K	3.45	110°	x=.3447 y=.3553	B

# LED S

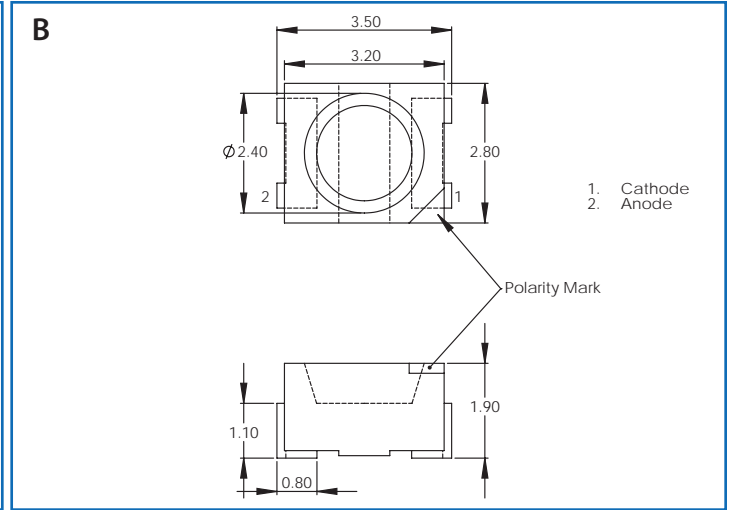
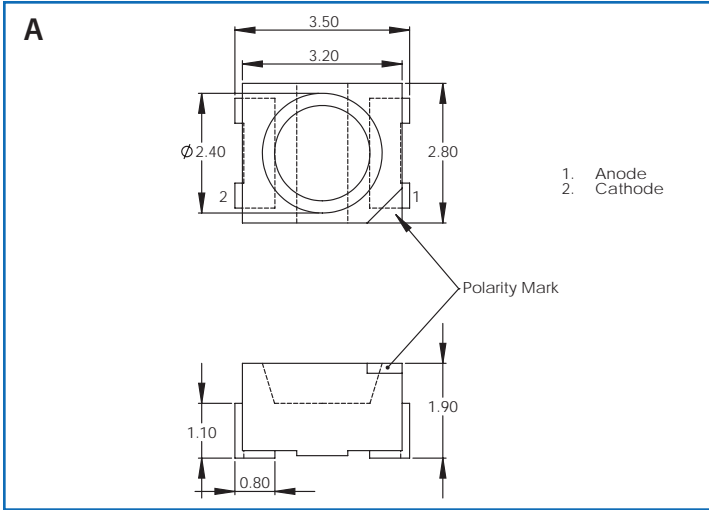


Note: All dimensions are in mm

## Surface Mount, Bi-Color

Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA	Leads	Drawing
				Minimum	Typical		Typical	Maximum			
1	E76	Red & Green	Clear	10mcd 4mcd	30mcd 20mcd	120° 120°	2.0V 2.2V	2.5V 2.5V	627nm 565nm	1.Red Cathode 2.Red Anode 3.Green Cathode 4.Green Anode	A
2	E86	Red & Green	White Diffused	7mcd 7mcd	30mcd 30mcd	120° 120°	2.0V 2.2V	2.5V 2.5V	627nm 565nm	1.Red Cathode 2.Red Anode 3.Green Cathode 4.Green Anode	B

# LED S



Note: All dimensions are in mm

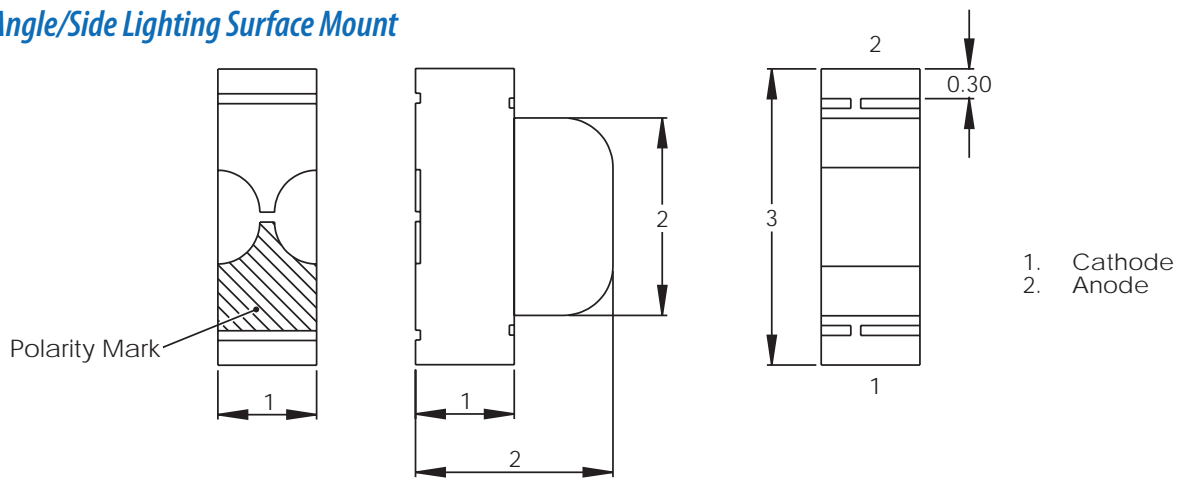
## Surface Mount Infrared 880nm, 940nm

Line No.	Part No.	Color	Lens	Radiant Power at 20mA		Forward Voltage Viewing Angle	Peak at 20mA		Wave Length at 20mA	Drawing
				Min	Max		Typical	Max		
1	E25A	Infrared	Clear	1.6mW/sr	3mW/sr	120°	1.2V	1.6V	940nm	A
2	E26A	Infrared	Blue	0.7mW/sr	1.8mW/sr	120°	1.3V	1.6V	880nm	B

Tape & Reel packaging is standard.

# LED S

## Right Angle/Side Lighting Surface Mount



Note: All dimensions are in mm

## Right Angle/Side Lighting Surface Mount

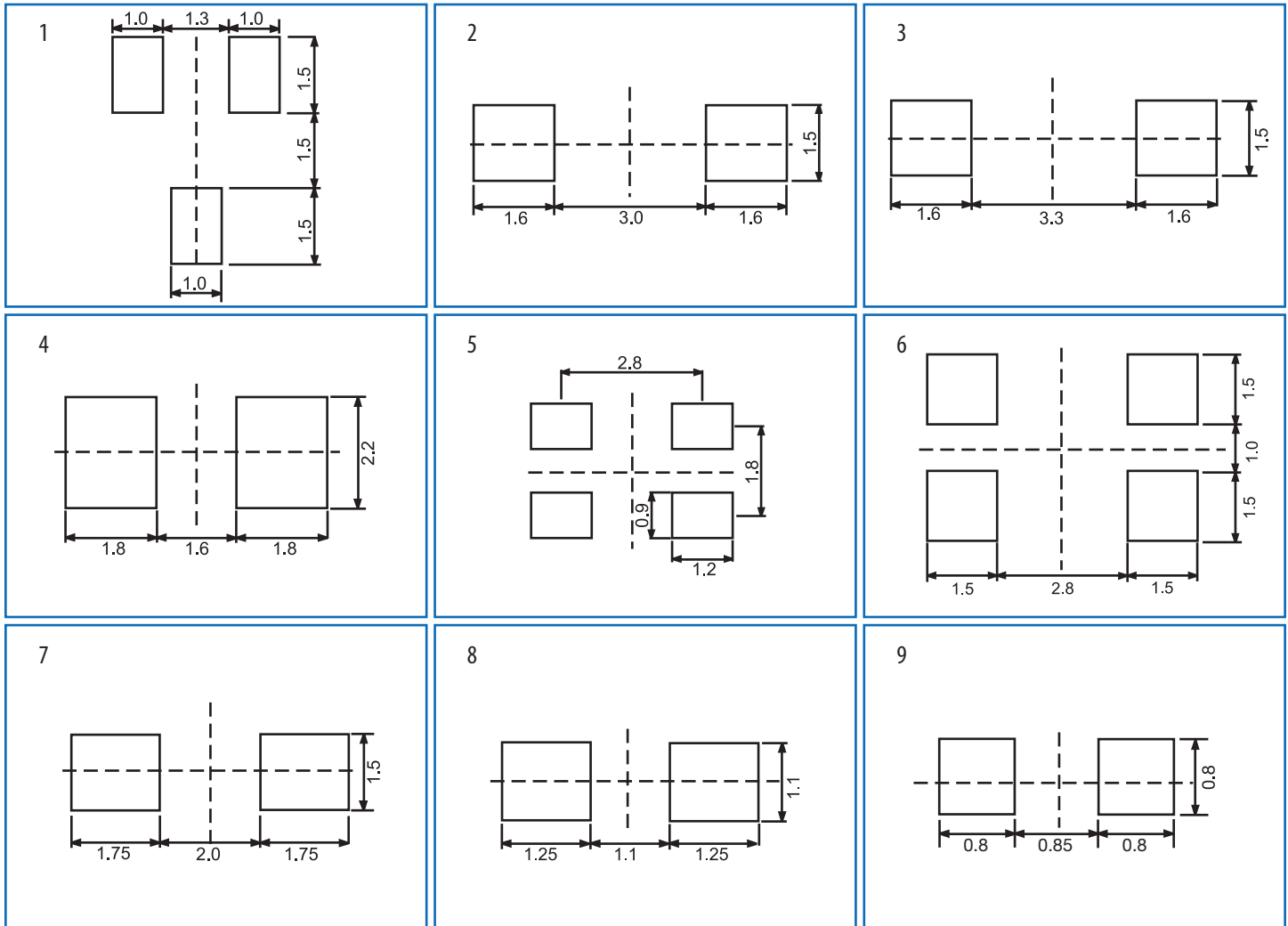
Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA		Viewing Angle	Forward Voltage at 20mA		Peak Wave Length at 20mA
				Min	Max		Typical	Max	
1	E541	Red	Red	4mcd	10mcd	120°	2V	2.5V	627nm
2	E542	Yellow	Yellow	2.6mcd	5mcd	120°	2.1V	2.5V	590nm
3	E543	Green	Green	4mcd	10mcd	120°	2.2V	2.5V	565nm

Tape & Reel packaging is standard.

Soldering instructions for through hole LEDs

DIP AND WAVE SOLDERING			IRON SOLDERING (with 1.5mm IRON TIP)		
Temperature of the Soldering Bath	Maximum Soldering Time	Distance from Solder Joint to Case	Temperature of the Soldering Iron	Maximum Soldering Time	Distance From Solder Joint to Case
≤260°C	3s	>2mm	≤260°C	3s	>2mm
≤260°C	5s	>4mm	≤260°C	5s	>4mm

Recommended soldering pattern for SMT LEDs



Note: All dimensions are in mm

Soldering instructions for SMT LEDs

Surface Mount LEDs are temperature sensitive and must be handled with extreme care. IR Reflow Soldering and Vapor Phase Reflow Soldering are recommended. Wave Soldering is not recommended for surface mount LEDs.

Note: All dimensions in millimeters

## LED TECHNICAL DATA

Absolute Maximum Ratings (TA=25°C)	430nm (GaN)	470nm (GaN)	525nm (GaN)	555nm (GaP)	565nm (GaP)	590nm (GaAsP/GaP)	595nm (InGaAlP)	Unit
Reverse Voltage	5	5	5	5	5	5	5	V
Forward Current	30	30	25	30	25	30	25	mA
Forward Current (Peak) t ≤ 10μs	100	100	150	100	150	150	150	mA
Power Dissipation	105	120	105	120	105	105	105	mW
Operating Temperature	-20 to +80	-30 to +85	-40 to +85	-30 to +85	-40 to +85	-40 to +85	-40 to +85	°C
Storage Temperature	-30 to +100	-40 to +100	-40 to +85	-40 to +100	-40 to +85	-40 to +85	-40 to +85	°C

Operating Characteristics (TA=25°C)	430nm (GaN)	470nm (GaN)	525nm (GaN)	555nm (GaP)	565nm (GaP)	590nm (GaAsP/GaP)	595nm (InGaAlP)	Unit
Forward Voltage (typ.) I <sub>F</sub> =20mA	4.5	3.6	3.5	2.25	2.2	2.1	2.0	V
Forward Voltage (max.) I <sub>F</sub> =20mA	5.5	4.0	4.0	2.6	2.5	2.5	2.5	V
Reverse Current V <sub>R</sub> =5V	100	50	50	10	10	10	10	μA
Wavelength at Peak Emission I <sub>F</sub> =20mA	430	470	525	555	565	590	595	nm
Spectral line half-width I <sub>F</sub> =20mA	65	30	40	30	30	35	15	nm
Capacitance V <sub>F</sub> =0V, f=1MHz	100	50	50	45	45	10	33	pF

## LED TECHNICAL DATA

Absolute Maximum Ratings (TA=25°C)	610nm (GaAsP/ GaP)	620nm (InGaAlP)	625nm (GaAsP/ GaP)	660nm (GaAlAs)	700nm (GaP)	880nm (GaAlAs)	940nm (GaAs)	Unit
Reverse Voltage	5	5	5	5	5	5	5	V
Forward Current	30	30	30	30	25	50	50	mA
Forward Current (Peak) t ≤ 10μs	150	150	150	150	150	1200	1200	mA
Power Dissipation	105	75	105	100	120	100	100	mW
Operating Temperature	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85	°C
Storage Temperature	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85	°C

Operating Characteristics (TA=25°C)	610nm (GaAsP/ GaP)	620nm (InGaAlP)	625nm (GaAsP/ GaP)	660nm (GaAlAs)	700nm (GaP)	880nm (GaAlAs)	940nm (GaAs)	Unit
Forward Voltage (typ.) I <sub>F</sub> =20mA	2.0	1.95	2.0	1.85	2.0	1.4	1.2	V
Forward Voltage (max.) I <sub>F</sub> =20mA	2.6	2.5	2.5	2.5	2.5	1.7	1.5	V
Reverse Current V <sub>R</sub> =5V	10	10	10	10	10	10	10	μA
Wavelength at Peak Emission I <sub>F</sub> =20mA	610	620	625	660	700	880	940	nm
Spectral line half-width I <sub>F</sub> =20mA	35	15	45	20	45	50	50	nm
Capacitance V <sub>F</sub> =0V, f=1MHz	15	40	12	95	40	90	90	pF

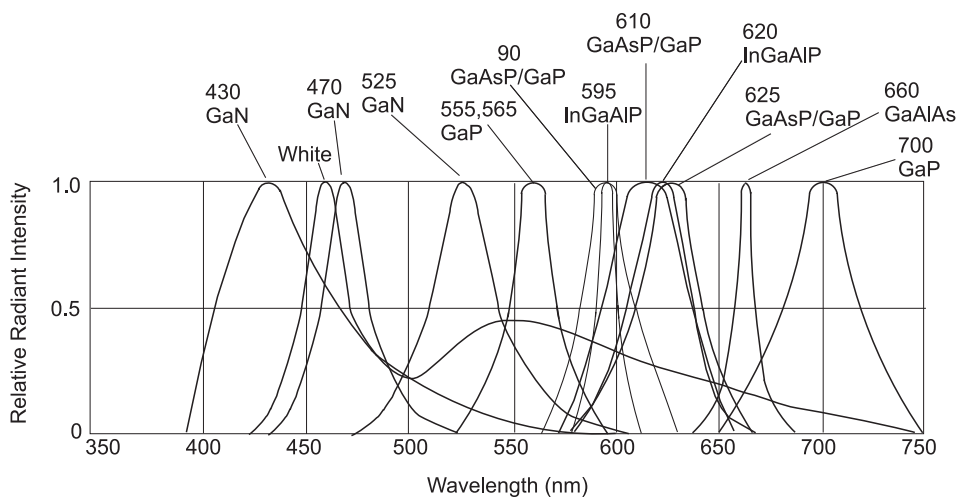
# LED TECHNICAL DATA

## Technical data 5V/12V LED with internal resistance

Absolute Maximum Ratings (TA=25°C)	565nm (GaP)	590nm (GaAsP/GaP)	625nm (GaAsP/GaP)	660nm (GaAlAs)	Unit
Reverse Voltage	5	5	5	5	V
Forward Current (Peak) t≤10μs	150	150	150	200	mA
Derating linear from 50°C	0.7	0.7	0.7	0.35	mA
Power Dissipation	310	310	310	300	mW
Operating/Storage Temperature	-40 to +85	-40 to +85	-40 to +85	-40 to +85	°C

Operating Characteristics (TA=25°C)	565nm (GaP)	590nm (GaAsP/GaP)	625nm (GaAsP/GaP)	660nm (GaAlAs)	Unit
Forward Current (typ) VF=5V	12	12	12	13	mA
VF=12V	11	11	11	10	mA
Reverse Current VR=5v	10	10	10	10	uA
Wavelength at Peak Emission IF=20mA	565	590	625	660	nm
Spectraline half-width IF=20mA	30	35	45	20	nm

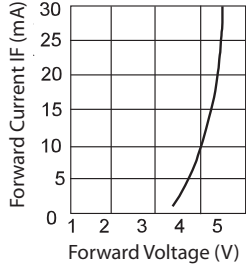
## Relative intensity vs. wavelength



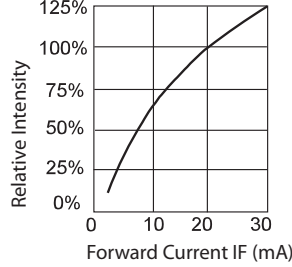
# LED TECHNICAL DATA

## 430nm (GaN)

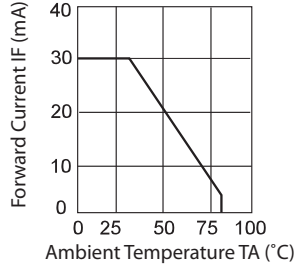
FORWARD CURRENT VS. FORWARD VOLTAGE



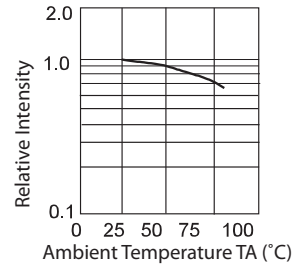
RELATIVE INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

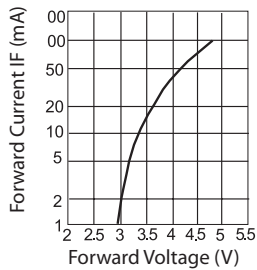


LUMINOUS INTENSITY VS. AMBIENT TEMP.

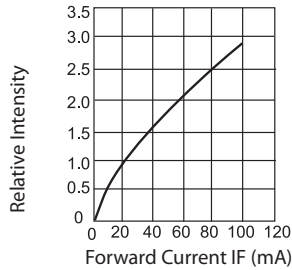


## 470nm (GaN)

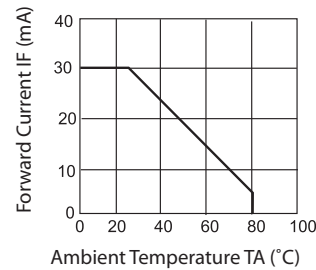
FORWARD CURRENT VS. FORWARD VOLTAGE



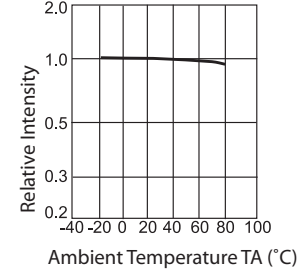
RELATIVE INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

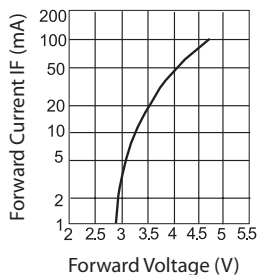


LUMINOUS INTENSITY VS. AMBIENT TEMP.

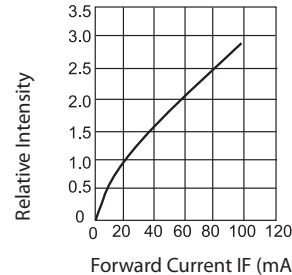


## 525nm (GaN)

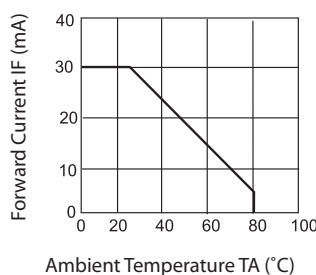
FORWARD CURRENT VS. FORWARD VOLTAGE



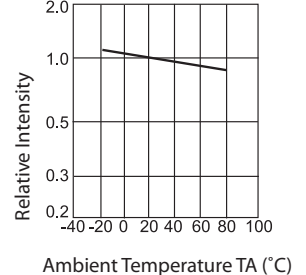
RELATIVE INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

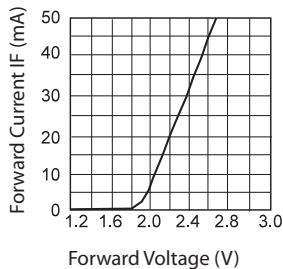


LUMINOUS INTENSITY VS. AMBIENT TEMP.

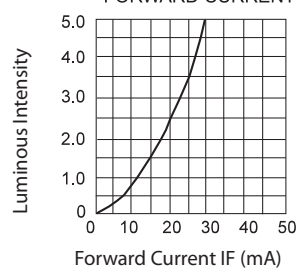


## 555nm (GaP)

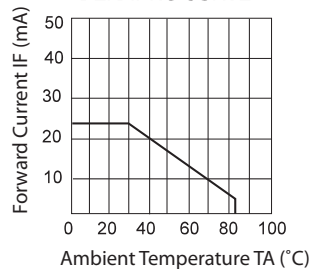
FORWARD CURRENT VS. FORWARD VOLTAGE



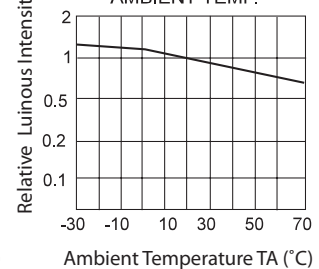
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

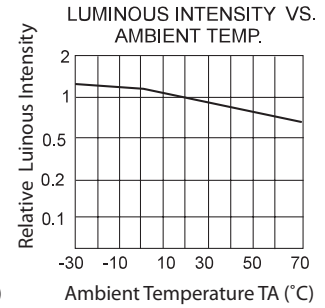
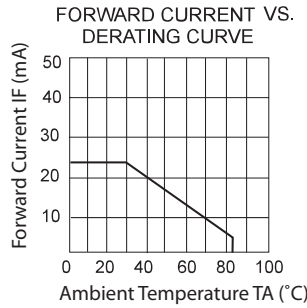
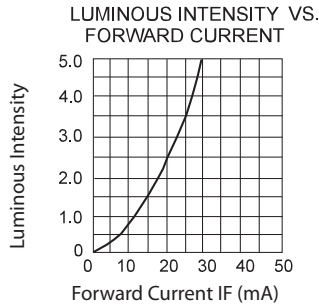
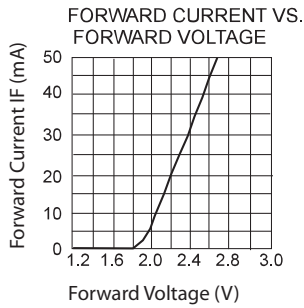


LUMINOUS INTENSITY VS. AMBIENT TEMP.

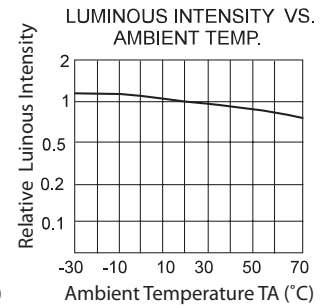
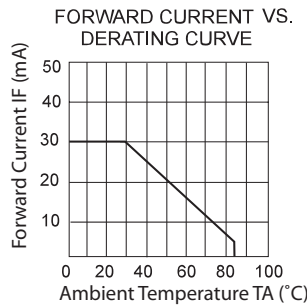
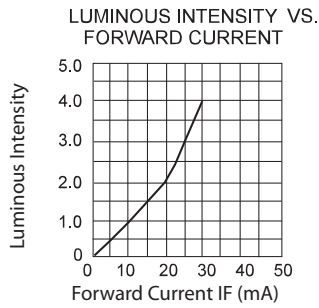
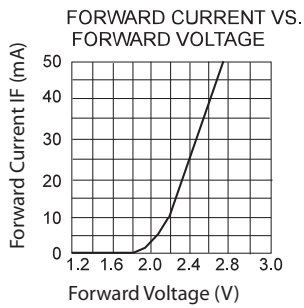


# LED TECHNICAL DATA

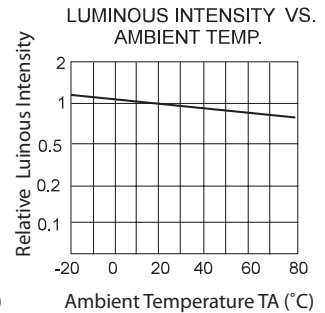
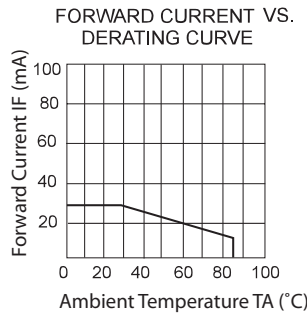
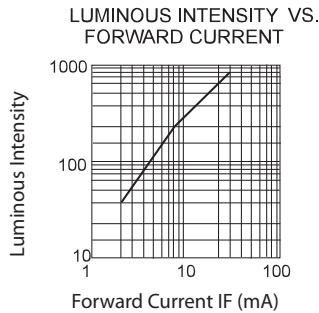
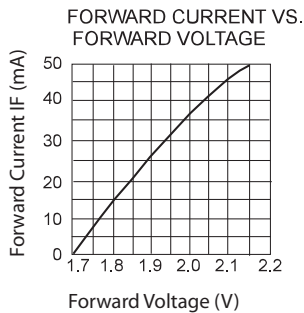
## 565nm (GaP)



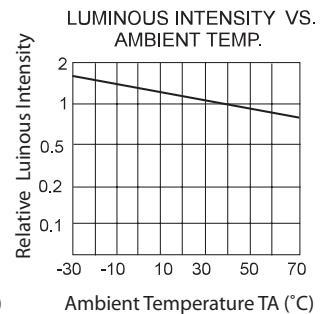
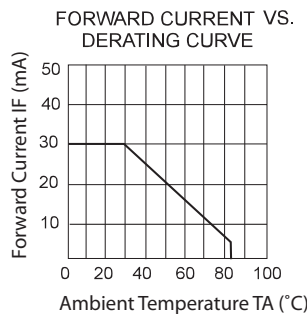
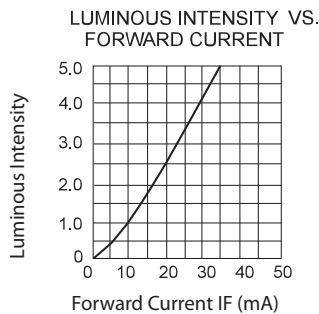
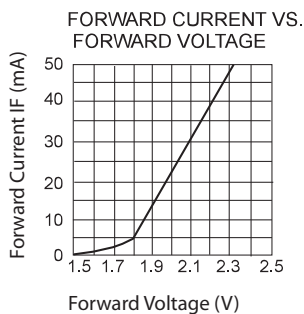
## 590nm (GaAsP/GaP)



## 595nm (InGaAlP)



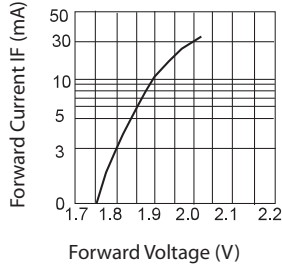
## 610nm (GaAsP/GaP)



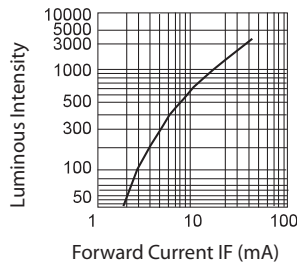
# LED TECHNICAL DATA

## 620nm (InGaAlP)

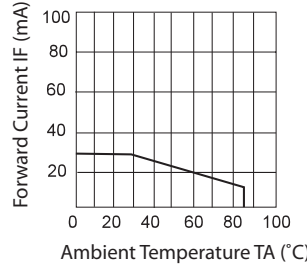
FORWARD CURRENT VS. FORWARD VOLTAGE



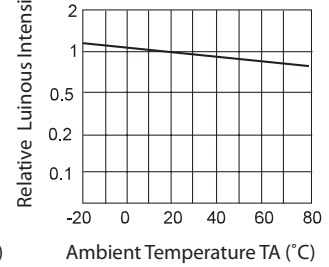
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

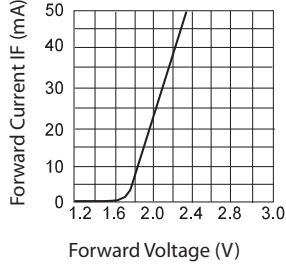


LUMINOUS INTENSITY VS. AMBIENT TEMP.

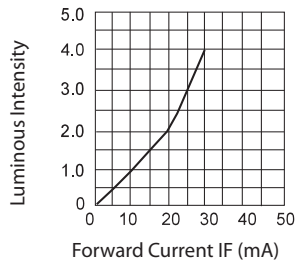


## 625nm (GaAsP/GaP)

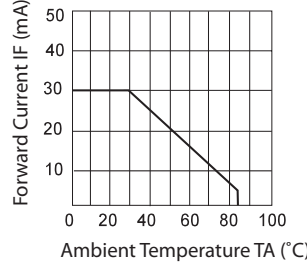
FORWARD CURRENT VS. FORWARD VOLTAGE



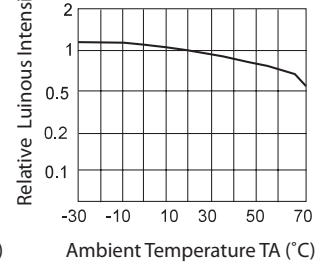
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

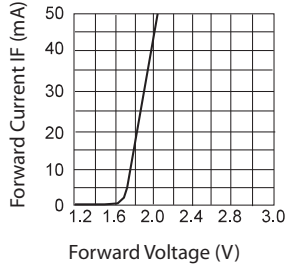


LUMINOUS INTENSITY VS. AMBIENT TEMP.

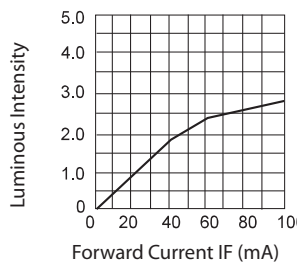


## 660nm (GaAlAs)

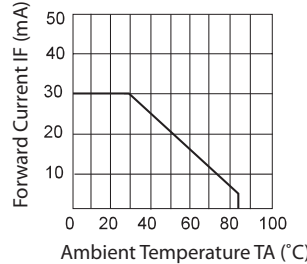
FORWARD CURRENT VS. FORWARD VOLTAGE



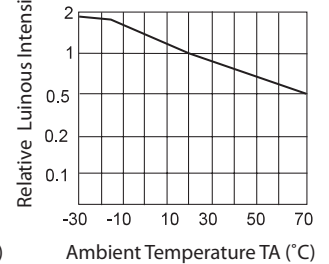
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

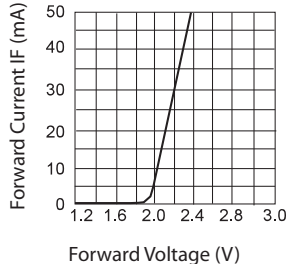


LUMINOUS INTENSITY VS. AMBIENT TEMP.

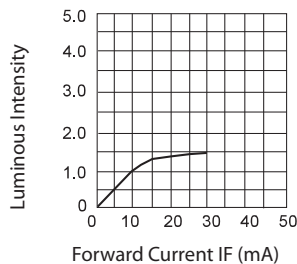


## 700nm (GaP)

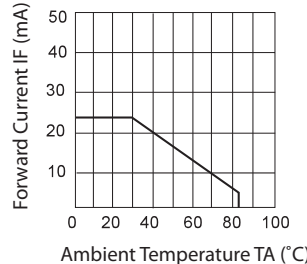
FORWARD CURRENT VS. FORWARD VOLTAGE



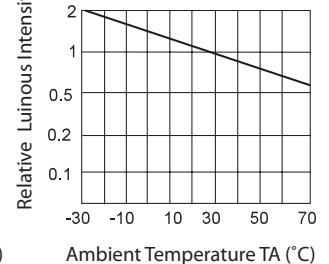
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE



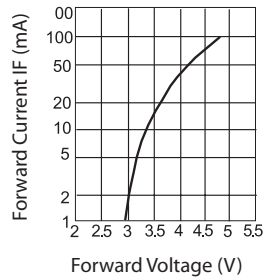
LUMINOUS INTENSITY VS. AMBIENT TEMP.



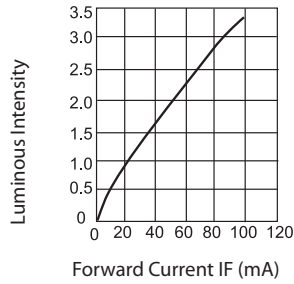
# LED TECHNICAL DATA

## WHITE

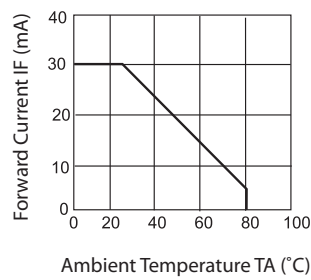
FORWARD CURRENT VS. FORWARD VOLTAGE



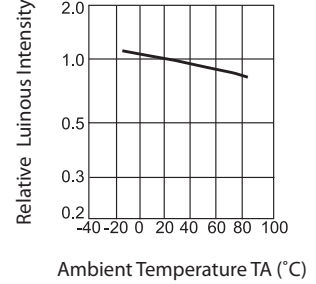
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

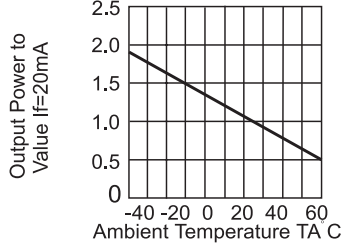


LUMINOUS INTENSITY VS. AMBIENT TEMP.

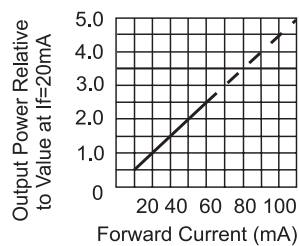


## 880nm (GaAlAs)

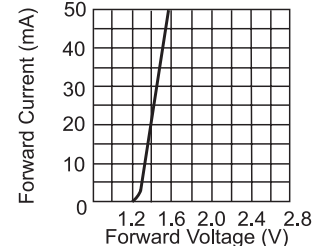
RELATIVE RADIANT INTENSITY VS. AMBIENT TEMPERATURE



LUMINOUS INTENSITY VS. FORWARD CURRENT

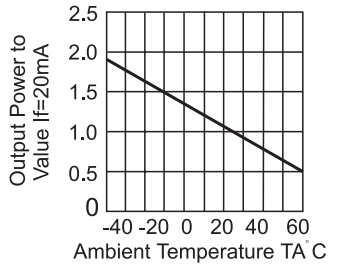


FORWARD CURRENT VS. FORWARD VOLTAGE

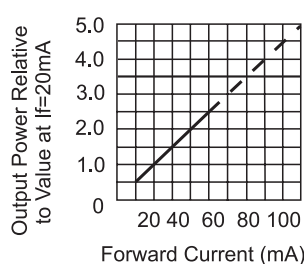


## 940nm (GaAs)

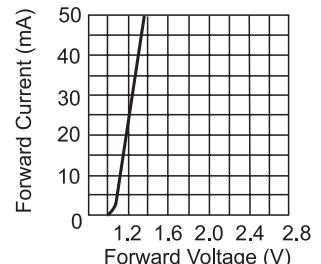
RELATIVE RADIANT INTENSITY VS. AMBIENT TEMPERATURE



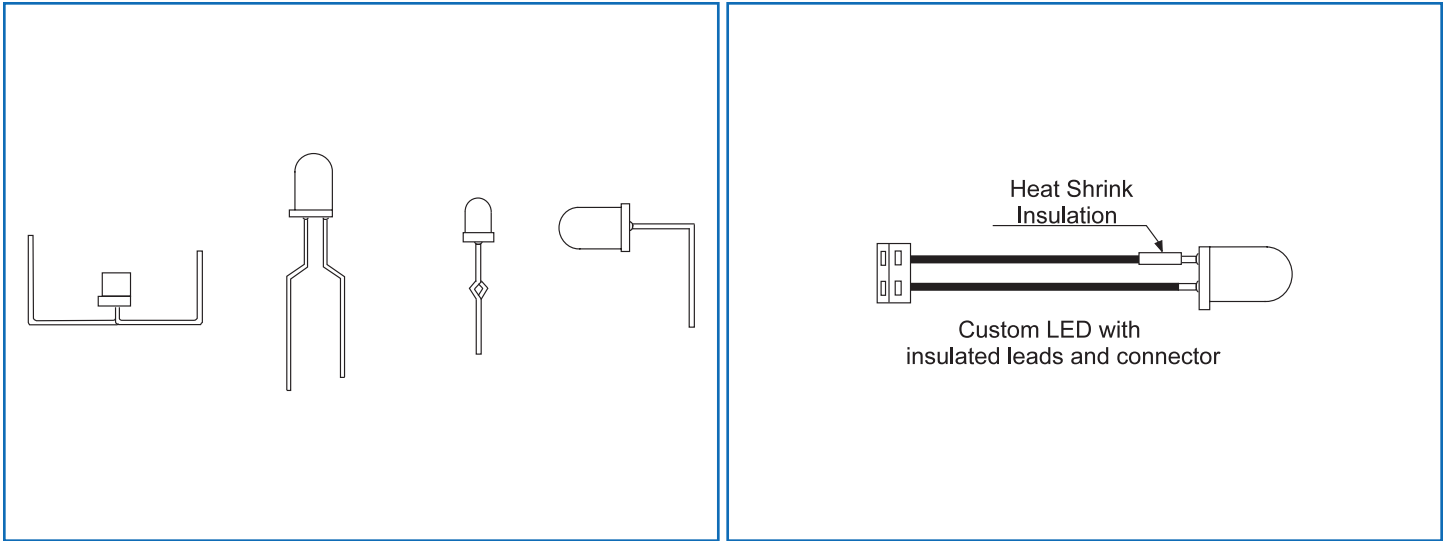
LUMINOUS INTENSITY VS. FORWARD CURRENT



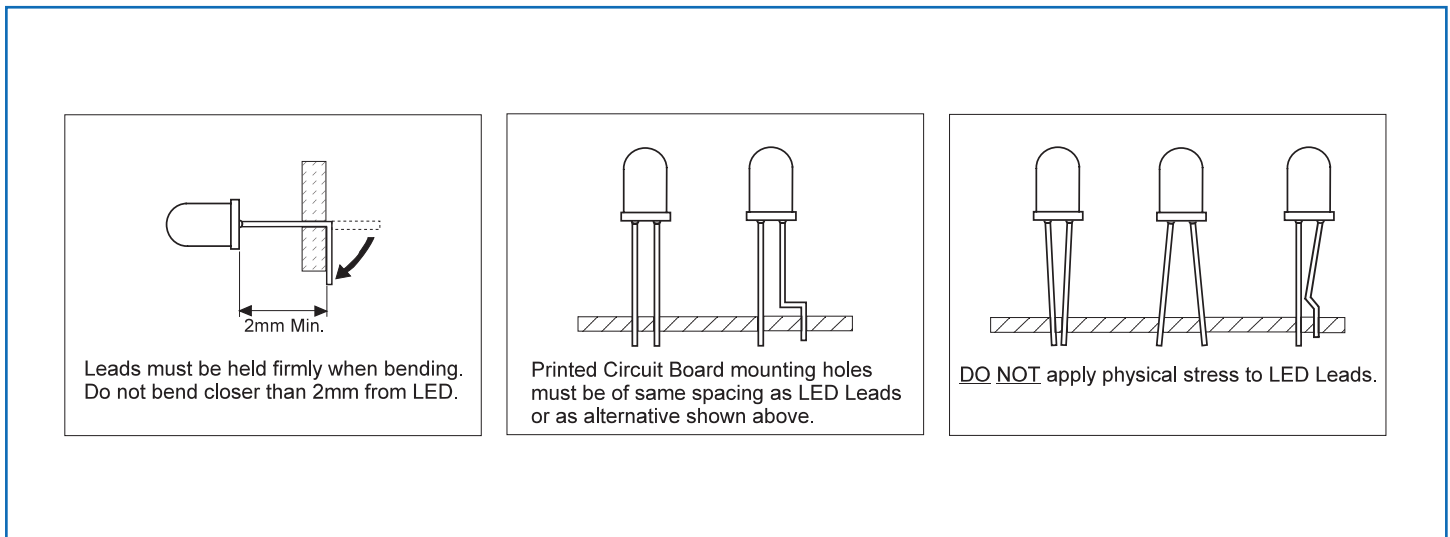
FORWARD CURRENT VS. FORWARD VOLTAGE



**Custom Lead Options** - Contact us with your requirements and specifications.



**Lead Forming Guidelines**



**LED Cleaning**

- ◆ We recommend using isopropyl alcohol to clean our LEDs.
- ◆ Avoid using any unspecified chemical solvent such as Trichloroethylene, Chlorosen or Acetone.
- ◆ If cleaning is required, perform in one minute or less under normal temperature conditions.