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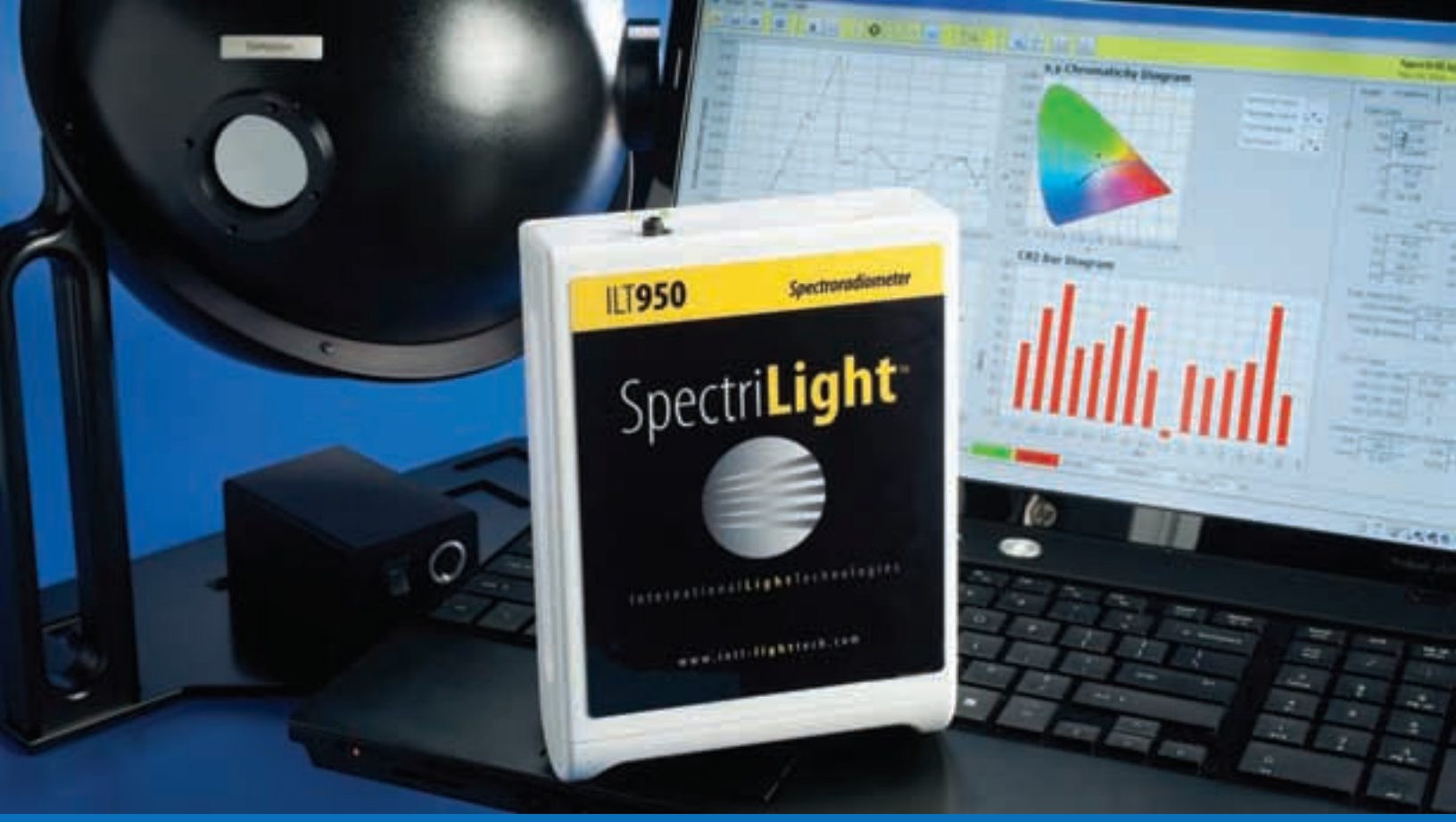

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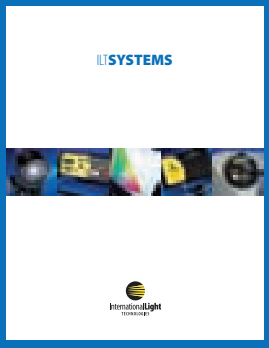

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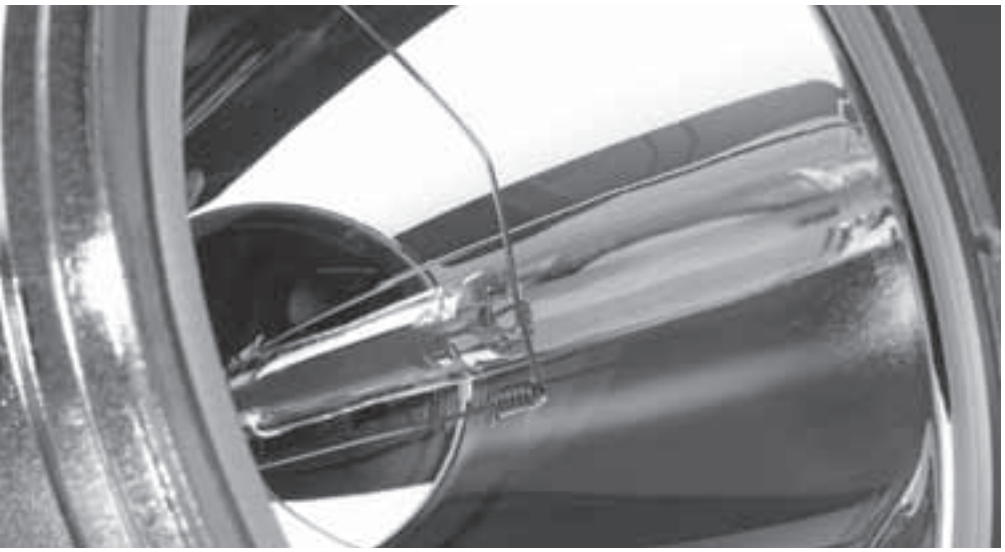


About International Light Technologies.

Since 1965, International Light Technologies (ILT) has been solving the inherent difficulties with technical light sources and light measurement. Our Systems Division has been successful in the design and manufacture of a wide range of light measuring instruments, including the most accurate light meters on the market. Our Sources Division has been providing customers with off-the-shelf and customized solutions across a full spectrum of light sources including high powered LEDs and modules, UV-Visible-IR lamps, specialized replacement lamps and power supplies.

Quality Products.

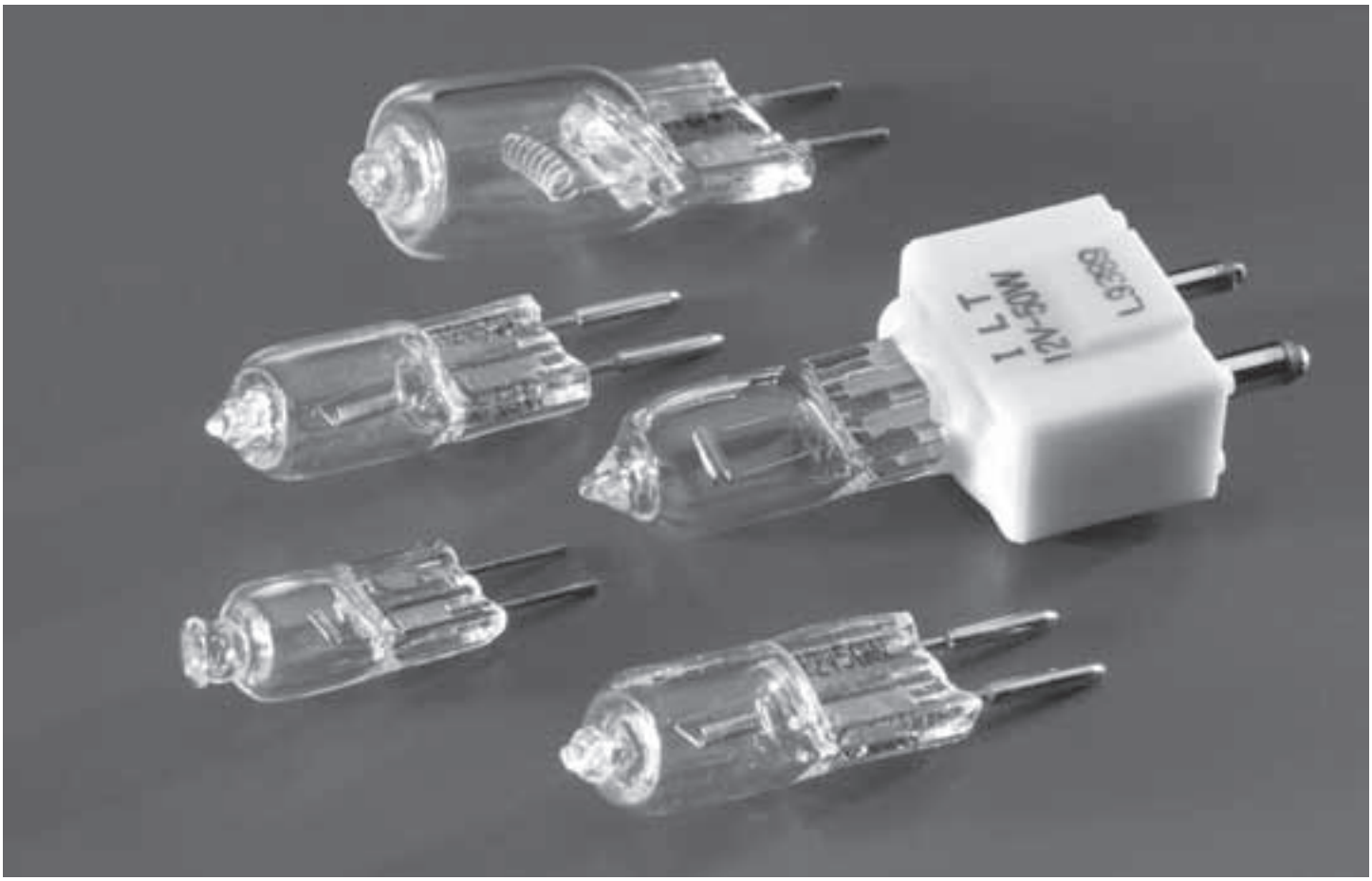
International Light Technologies manufactures light sources for a variety of industries. Precision lamps are used primarily in medical manufacturing applications, miniature lamps are used in gas detection systems and neons are used in areas where a secondary circuit would be required to run an equivalent LED. All of our products are made in environments that adhere to ISO management and manufacturing requirements. International Light Technologies is proud to be an ISO 9001:2008 certified company. In addition, we can build our products to NIST traceable standards, and other standards as required by the customer. All of our products in this catalog are fully compliant with the requirements of RoHS.

Quality People.

International Light Technologies staff has a long and proud reputation for customer service, on-time delivery, and technical expertise. Many members of our staff have been with the company for years and this stability brings with it a tradition of ensuring the customer is the driving force behind our company's success. At our facility in Peabody, MA, we offer unparalleled resources in optical calibration, quality production capabilities, as well as the depth of experience needed to bring the technology of light to contemporary products.

Quality Policy.

It is the policy of International Light Technologies to provide our valued customers with the highest quality products and other services that satisfy or exceed their needs and expectations while effectively utilizing every employee's best efforts to achieve this goal. We will continuously monitor and improve product values, calibration integrity, and service capability through state-of-the-art process and a corporate wide commitment to quality.



Tungsten Filament and Halogen Lamps

International Light Technologies supplies a wide variety of incandescent vacuum, gas-filled and halogen lamps for a broad range of technical and commercial applications. The general characteristics of each lamp type are discussed below as an aid to selecting the most appropriate technology for any application.

Vacuum Lamps

The tungsten filament of a vacuum incandescent lamp is heated to temperatures where visible light is emitted by resistance heating. The filament acts as an electrical resistor, which dissipates power proportional to the voltage applied, times the current through the filament. When that power level is sufficient to raise the temperature to above 1000 degrees Kelvin, visible light is produced. As the power dissipated is increased, the amount of light increases and the peak wavelength of the light shifts to the blue. Typical vacuum lamps may have filament temperatures ranging from 1800 to 2700 degrees Kelvin. The light from the low temperature lamps appears reddish yellow while the high temperature lamps have a whiter appearance.

The tungsten filament evaporates more rapidly as the temperature of the filament goes up. The evaporated tungsten particles tend to deposit on the glass envelope, causing over time, an increase in light output obstruction. Depending on the application, the light output obstruction could be high enough to end the useful life of the lamp. Eventually, the filament material will evaporate enough to cause the filament to break, completely ending the life of the lamp. Both of these effects are strongly dependent on the temperature of the filament, which is why long life vacuum lamps tend to be operated at the low end of the temperature range and the light has a yellowish appearance.

The electrical resistance of the tungsten filament at room temperature is initially quite low. When electrical power is first applied to the lamp, a large in-rush current causes rapid heating of the filament. The resistance of the filament rises to a value five to ten times the cold resistance, which causes the amount of current drawn by the lamp to stabilize and the lamp to emit a stable light output. Depending on the size of the filament, the in-rush period can be from tens of milliseconds to hundreds of milliseconds. This in-rush current requirement should be taken into account in the selection of the power source for a specific lamp application.

Gas-Filled Lamps

Gas filled lamps produce light from an incandescent filament operated in an inert gas atmosphere. The addition of the inert gas suppresses the evaporation

of the tungsten filament, which increases the lifetime of the lamp or allows higher temperature operation for the same life. The normal gases used are Nitrogen, Argon, Krypton and Xenon. The cost rises dramatically as the rarer gases are used, particularly for Xenon, due to their very low natural abundance. The advantage of the higher atomic weight gases is they suppress the evaporation of the tungsten filament more effectively than the lower weight gases. This allows the filament of gas filled lamps to be run at temperatures up to 3,200 degrees Kelvin and achieve reasonable life times. The light from these lamps has a high blue content giving the light a pure white appearance.

Gas-filled lamps require more power to achieve the same filament temperature than vacuum lamps. The surrounding gas cools the filament while suppressing evaporation, and reducing the migration of evaporated tungsten to the wall of the lamp. The higher operating temperature of gas-filled lamps produces more light output per watt of input power, which justifies their use in critical applications.

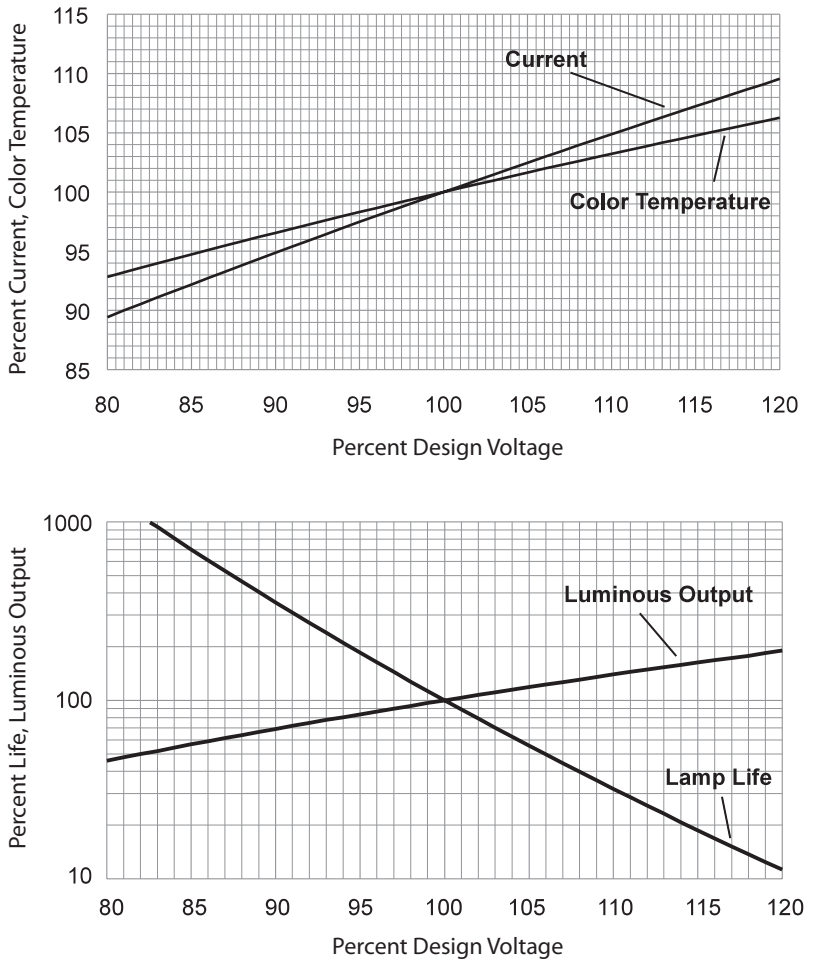
Halogen Lamps

The halogen lamp is similar to an inert gas-filled lamp, except it contains a small quantity of an active halogen gas such as Bromine. The inert gas suppresses the evaporation of the tungsten filament, while the halogen gas acts to reduce the amount of tungsten that plates the interior wall of the lamp. The halogen gas reacts with the tungsten that has evaporated, migrated outward, and been deposited on the lamp wall. When the lamp wall temperature is sufficient, the halogen reacts with the tungsten to form tungsten bromide, which is freed from the wall of the lamp and migrates back to the filament. The tungsten bromide compound reacts at the filament of the lamp where temperatures close to 2500˚C cause the tungsten and halogen to dissipate. The tungsten deposits on the filament and is freed to repeat the cycle again. Unfortunately the tungsten is not deposited in the same zone where the evaporation took place so the filament still becomes thinner and eventually fails.

The filament of a halogen lamp has two purposes. One is to generate light, and the second is to generate the heat necessary to obtain a wall temperature exceeding 250˚C. These lamps have been designed to maintain this required wall temperature when operated at design voltage. A reduction of voltage exceeding 10% from the design voltage will probably result in the wall temperature falling below the required 250˚C. Tests reveal that in most cases this reduced operating condition is not detrimental to the operation of the lamp. By the time the wall temperature drops to a point where the halogen cycle ceases to function, the filament temperature has diminished to a point where the tungsten evaporation is negligible. If wall blackening is noticed, the operating voltage range at which this occurs should be avoided. Burning the lamp at design voltage for a short period of time can usually clean up lamp blackening due to temporary operation in such a voltage range. However, on rare occasions halogen lamps derated more than 10% could experience an adverse reaction of the corrosive halogen attacking the tungsten filament causing premature lamp failure.

The light output of a halogen lamp is more stable than a non-halogen gas lamp due to the cleaning action of the halogen gas on the lamp envelope. This feature coupled with the high color temperature of the light and long-life make these lamps very desirable for many industrial and scientific applications. The restriction on duty cycle due to the requirement to maintain the envelope of the lamp at sufficient temperature to initiate the halogen cycle is a disadvantage. However, in continuous duty applications it is relatively easy to provide correct ventilation to ensure the proper operating temperature.

FIGURE 1: Tungsten lamps, parameter relationships



Operating halogen lamps at voltages exceeding design voltage is not recommended as the lamps are normally designed to their maximum limits. Lamp seal temperatures must not exceed 350˚C or oxidation of the molybdenum ribbon will occur resulting in premature lamp failure.

Halogen lamps are ideal light sources for spectrophotometers as they provide broadband spectral radiation ranging from the ultraviolet, through the visible and into the infrared out to five microns. Some radiation output can be obtained at 320 and 340 nanometers.

Life at Design & Operating Voltages

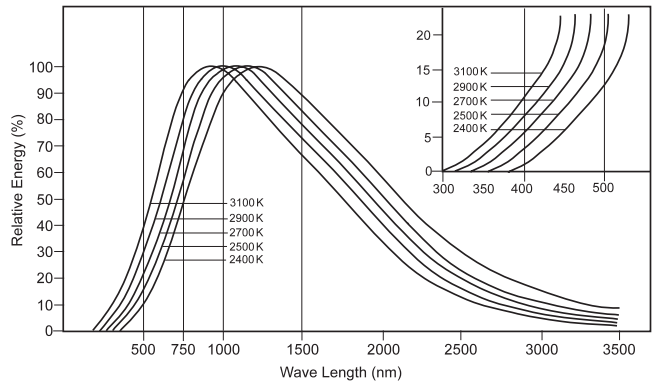
Lamp life expressed in hours is calculated at design voltage and under ideal laboratory conditions. Deviation from design voltage will result in decreased or increased values of lamp life. This deviation will also alter values of current consumption, brightness, and color temperature. These deviations should be used advantageously by the design engineer to enhance the technical lamp specifications for the specific application.

Figure 1 is supplied to express percent variations in current, color temperature, and brightness when operating voltage differs from design voltage.

Rated life as specified here is expressed in terms of hours. Rated life is calculated at design voltage, with alternating current, and under ideal laboratory conditions. In actual use, lifetime may be shortened as a result of hostile environments such as shock, vibration, and extreme temperatures. Life may be substantially increased, by selecting an operating voltage less than the design voltage. This decrease from design voltage will also result in a cooler filament providing increased resistance to shock and vibration.

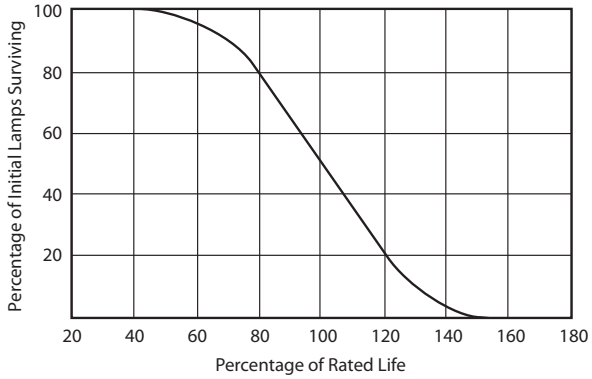
Because of slight variations in miniature lamp manufacturing and in the component parts it is impossible to have each individual lamp operate for exactly the life for which it was designed. Lamp life is rated as the average life of a large group of lamps.

FIGURE 2: Spectral radiation output for Tungsten filament lamps (including halogen lamps & technical lamps)



The spectral radiation of a lamp is a function of the temperature of the filament. These curves give the output versus wavelength over a typical range of temperatures for lamps ranging from vacuum to gas-filled with halogen.

FIGURE 3: Mortality curve for Tungsten filament lamps



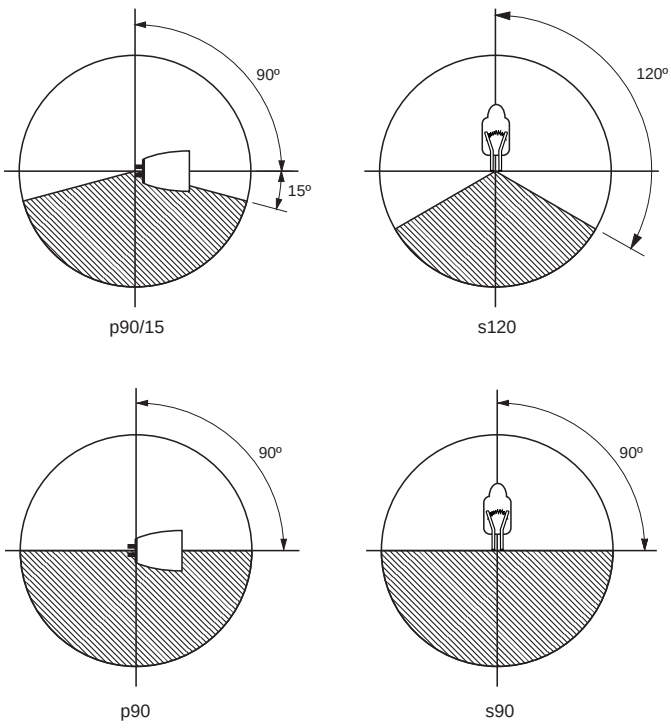
At the end of rated life approximately 50% of the lamps in a large group will have failed and 50% will continue to operate as detailed. Please note that this data pertains to all tungsten filament lamps: gas filled, halogen and vacuum.

Burning Position

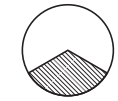
Certain halogen lamps are designed in such a way that their position while operating is critical. This is termed "burning position". Failure to burn the lamps in the designated burning position can result in premature failure due to issues such as intense blackening filament sag or oxidizing foils.

The diagram on the right shows typical burning positions. The letter denotes the optimal burning position and the ensuing numbers denote the permitted variance.

FIGURE 4: Typical burning positions



Key

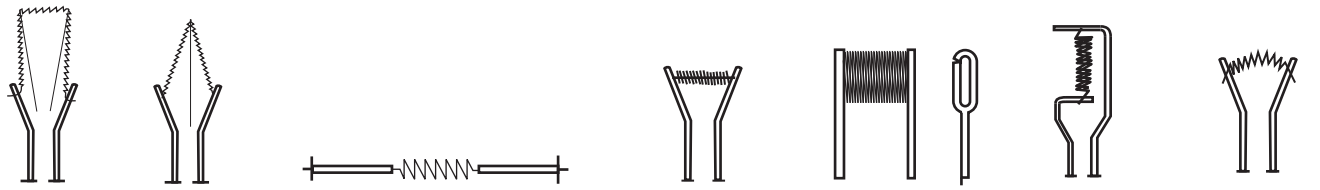


= permitted

= not permitted

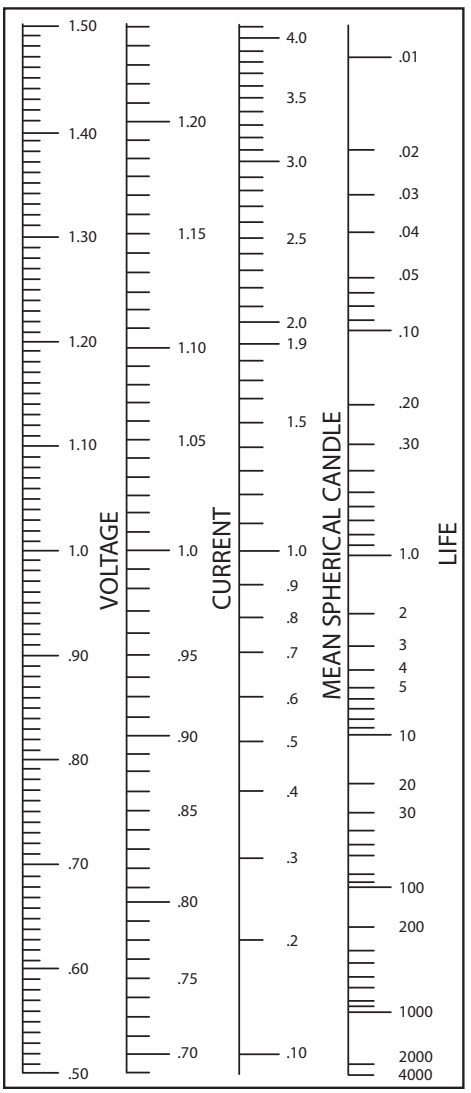
P - horizontal
S - base down

Filament Shapes



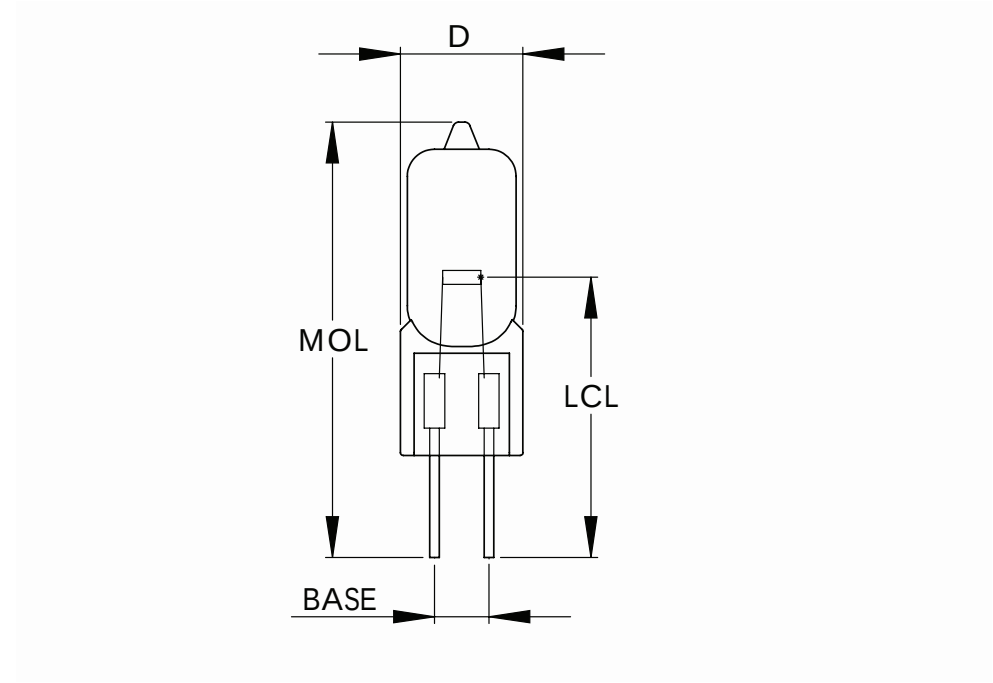
Filament shapes used for lamps are classified into several different forms according to the filament sizes (filament diameter and length) and shock resistance.

Rapid Lamp Calculator Diagram



This diagram allows the user to determine the dependence of Current, Mean Spherical Candela, and Life on the value of voltage applied to the lamp as a percentage of the design voltage for that lamp. Draw a horizontal line through the percent of design voltage to be used and read the value of the calculated parameters on the right side of the diagram.

Bi-Pin

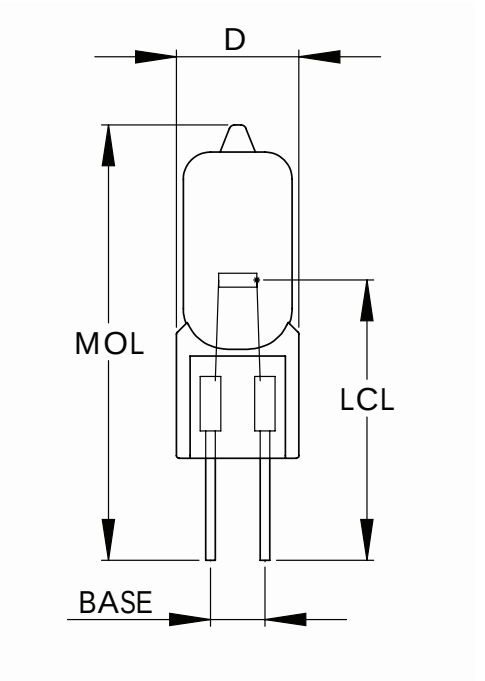


Quartz Halogen Lamps (4mm base)

Line No.	Part No.	ANSI	Volts	Watts	Lumens	CCT	Life Hours	Burning Position	Filament Type	Dimensions D	MOL	LCL	Base Type
1	L6402	—	6	10	130	2850	2000	Any	C-6	9	32	19.5	G4
2	L7387	—	6	10	180	3150	100	Any	C-6	9	32	19.5	G4
3	GTL-OS-54260	ESA/FHD	6	10	200	3200	100	Any	C-6	9	31	19.5	G4
4	L7394	—	6	20	350	3000	2000	Any	C-6	9	32	19.5	G4
5	L7388	—	6	20	420	3200	100	Any	C-6	9	32	19.5	G4
6	GTL-OS-54019	—	6	20	480	3200	100	Any	C-6	9	31	19.5	G4
7	GTL-OS-54258	—	6	35	780	3400	50	Any	C-8I	9	40	26	G4
8	37005-C	—	10.5	27	500	3000	600	Any	C-6	9	32	19.5	G4
9	GTL-OS-54652	—	12	5	60	3000	4000	Any	C-6	9.5	32	22	G4
10	L6415	—	12	10	120	2800	2000	Any	C-6	9	32	19.5	G4
11	L6416	—	12	15	210	2900	1000	Any	C-6	9	32	19.5	G4
12	L7404	—	12	20	350	3000	2000	Any	C-6	9	32	19.5	G4
13	L7401	—	12	20	420	3100	250	Any	C-6	9	32	19.5	G4
14	L7414A	—	12	35	550	2850	3000	Any	C-6	8	28	19.5	G4
15	GTL-OS-54662	—	24	20	320	3000	1000	Any	C-6	9	32	22	G4

For recommended holders refer to pages 40-41

Bi-Pin

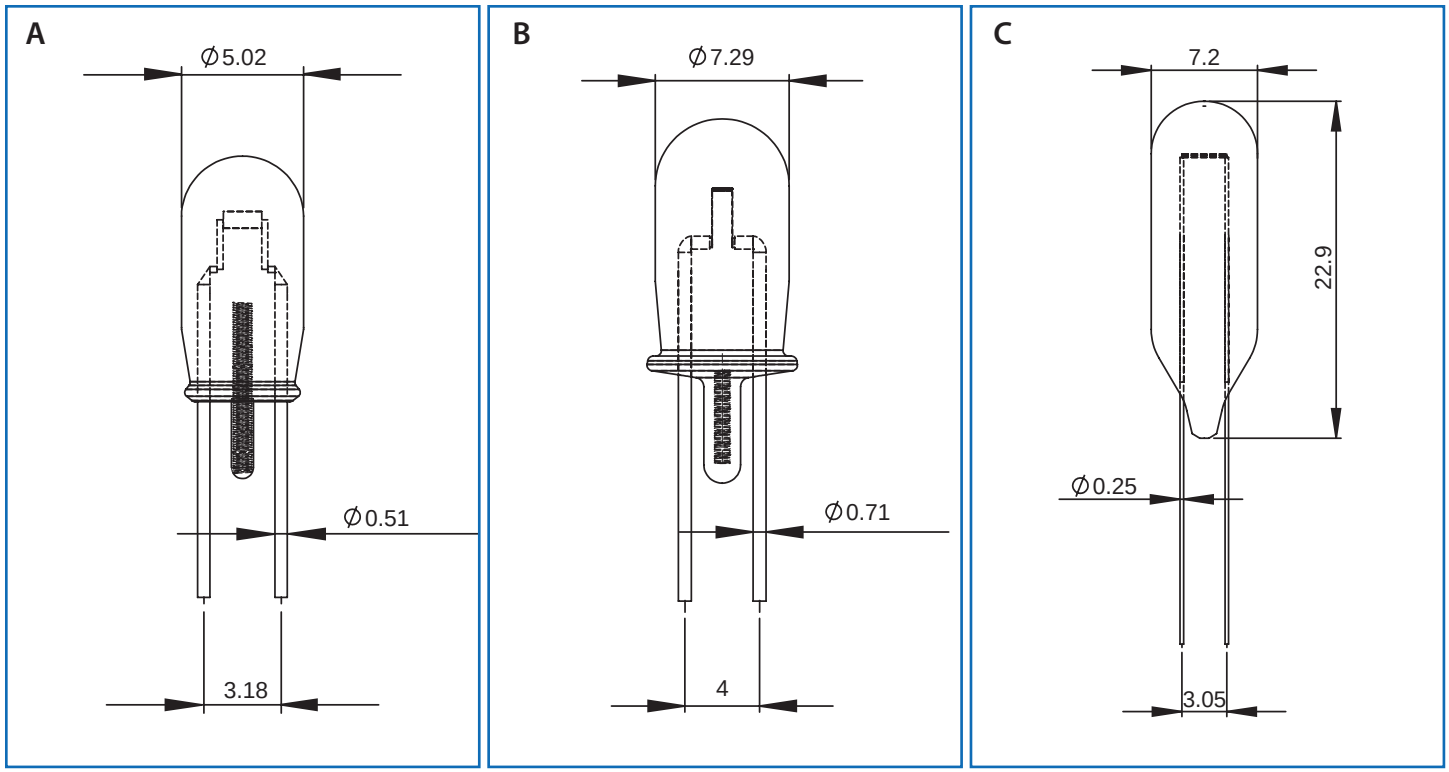


Quartz Halogen Lamps (6.35mm base)

Line No.	Part No.	ANSI	Volts	Watts	Lumens	CCT	Life Hours	Burning Position	Filament Type	Dimensions D	Dimensions MOL	Dimensions LCL	Base Type
1	GTL-OS-58672	—	12	35	600	3000	4000	Any	CC-8	12	44	30	GY6.35
2	L7389A	—	12	50	900	3000	2000	Any	C-6	11	44	30	GY6.35
3	L7417	—	12	50	900	3000	2000	Any	C-Bar-6	11.5	44	30	GY6.35
4	L7411	—	12	50	900	3000	3000	Any	C-8I	10.5	44	28.5	GY6.35
5	GTL-OS-54138	—	12	50	1000	3000	1100	s90	C-6	12	44	29.5	G6.35
6	L7417A	—	12	50	1100	2900	1000	Any	C-6	11	42	30	GY6.35
7	L7386A	—	12	75	1400	3000	2000	Any*	C-6	11	44	30	GY6.35
8	L7390A	—	12	100	2000	3000	2000	Any*	C-6	11.8	44	30	GY6.35
9	L7407	FCR	12	100	3600	3400	50	Any*	C-Bar 6	11	44	30	GY6.35
10	GTL-OS-54054	FDV	24	150	5000	3250	300	s90	C-Bar-6	13.5	50	32	G6.35
11	L6405	FCS	24	150	6000	3400	50	Any*	C-Bar 6	11.5	50	32	G6.35
12	L7421	—	120	100	1900	3000	200	Any*	CC-6	13.5	50	30	GY6.35

* Seal Temperature Must Not Exceed 350°C.

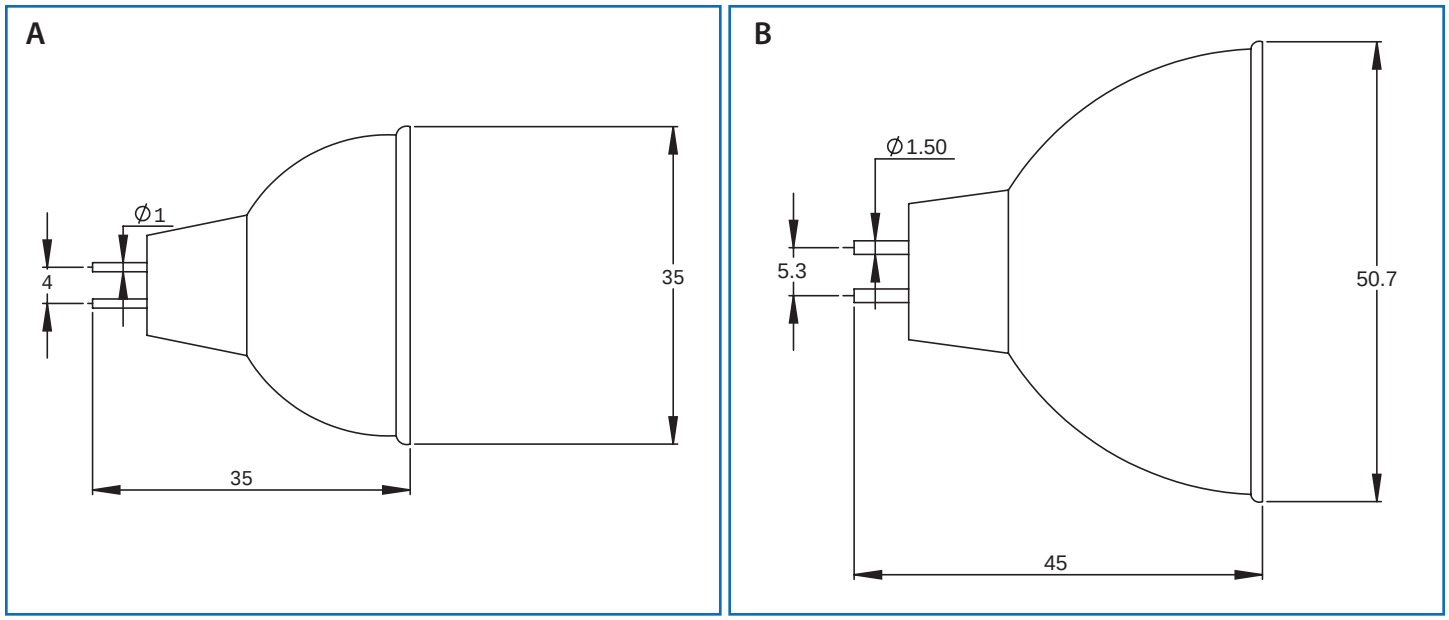
For recommended holders refer to pages 41, 43-44



Note: All dimensions are in mm

Miniature Lamps

Line No.	Part No.	Volts	Amps	Lumens	CCT	Life Hours	Filament Type	Gas	Drawing
1	187	4.2	1.06	49	3000	650	C-6	Krypton	A
2	188	5	0.97	41	2800	10000	C-6	Krypton	A
3	107	12	1.67	314	3000	2000	C-6	Krypton	B
4	127	12	1.67	314	3000	3500	C-6	Krypton	B
5	119	12	0.83	137	2750	4000	C-6	Krypton	C
6	131	12	1.70	415	3070	2500	C-6	Xenon	C



Note: All dimensions are in mm

MR11 Halogen Lamps with Dichroic Reflectors

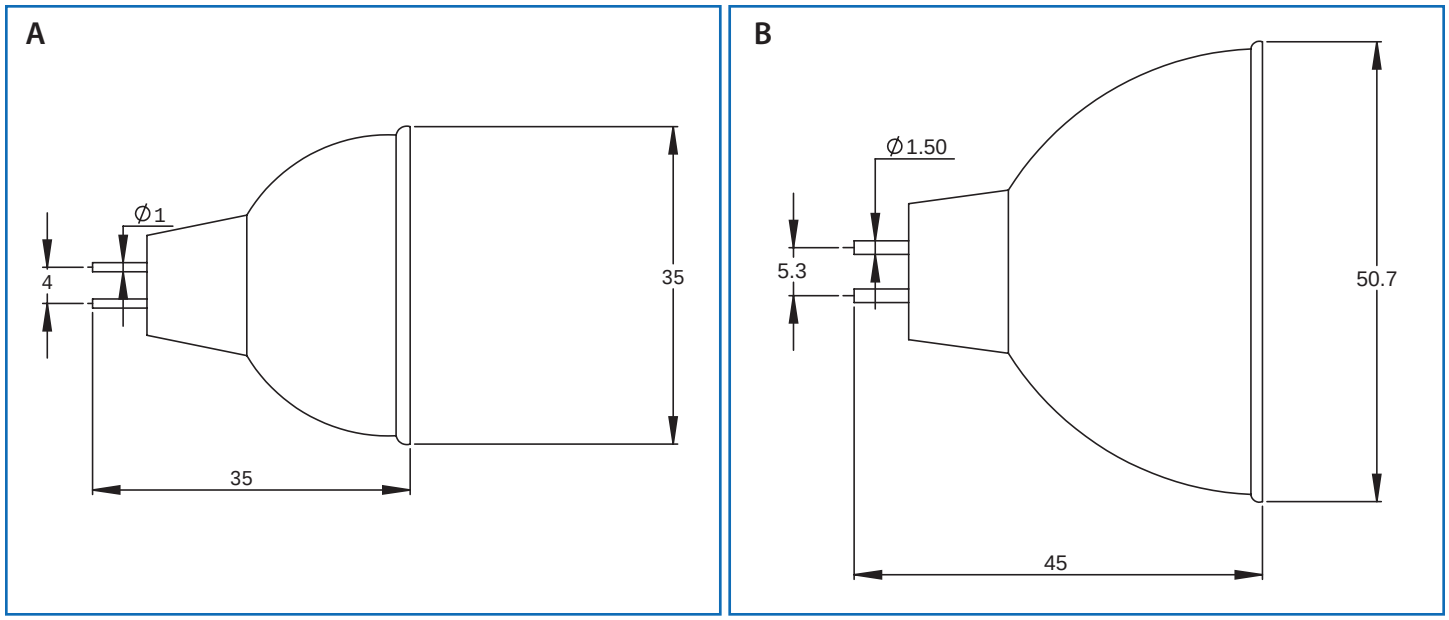
Line No.	Part No.	Volts	Watts	CCT	Life Hours	Burning Position	Filament Type	Beam Angle	Base Type	Drawing
1	L518	6	10	2925	2000	Any	C-6	11°	GZ4	A
2	L524	6	20	2925	2000	Any	C-6	10°	GZ4	A
3	L517A	12	12	2925	2000	Any	C-6	8°	GZ4	A
4	L519	12	20	2925	2000	Any	C-6	11°	GZ4	A
5	L514	12	35	2950	2000	Any	C-6	12°	GZ4	A
6	L526	24	20	2925	2000	Any	CC-6	19°	GZ4	A

For recommended holders refer to pages 40-41

MR16 Halogen Lamps with Dichroic Reflectors

Line No.	Part No.	ANSI	Volts	Watts	CCT	Life Hours	Burning Position	Filament Type	Beam Angle	Base Type	Drawing
7	L515	—	12	20	2925	4000	Any	C-6	11°	GX5.3	B
8	GTL-OS-58325	EXT	12	50	3000	2000	Any	C-8I	10°	GU5.3	B
9	GTL-OS-58319	—	12	50	3000	4000	Any	C-8I	36°	GU5.3	B
10	L521	—	12	50	3050	3000	Any	C-6	12°	GX5.3	B
11	L522	—	12	65	3050	4000	Any	C-6	13°	GX5.3	B
12	L523	—	12	75	3050	5000	Any	C-6	13°	GX5.3	B

For recommended holders refer to pages 41-42



Note: All dimensions are in mm

MR11 Halogen Lamp with Focused Ellipsoidal Dichroic Reflectors

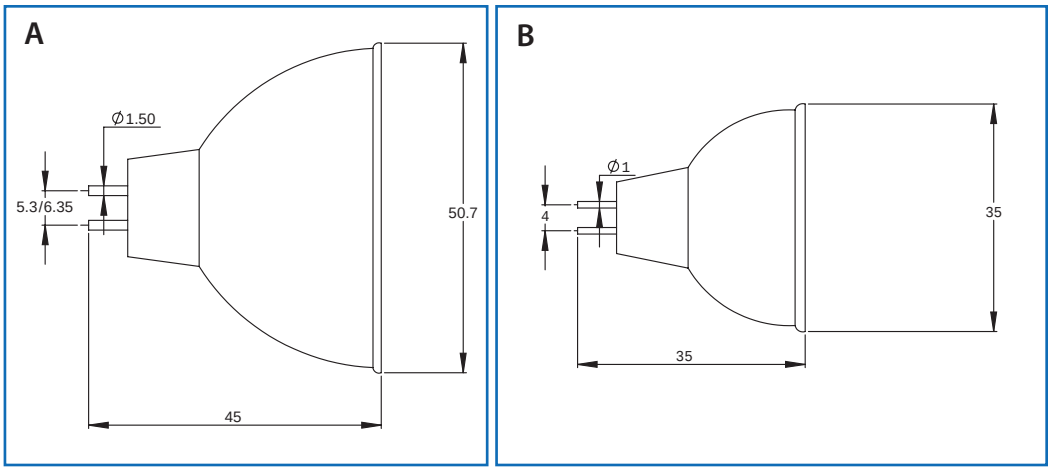
Line No.	Part No.	ANSI	Volts	Watts	CCT	Life Hours	Burning Position	Filament Type	Base Type	Working* Distance	Drawing
1	GTL-OS-54122	—	8	20	3400	50	p90/15	C-8I	GZ4	26mm	A
2	GTL-OS-54121	—	12	75	3200	25	p90/15	C-8I	G5.3-4.8	26mm	A
3	GTL-OS-54125	—	12	100	3300	25	p90/15	C-8I	G5.3-4.8	26mm	A

MR16 Halogen Lamp with Focused Ellipsoidal Dichroic Reflectors

Line No.	Part No.	ANSI	Volts	Watts	CCT	Life Hours	Burning Position	Filament Type	Base Type	Working* Distance	Drawing
4	GTL-OS-54126	EFN	12	75	3350	50	p90/15	C-8I	GZ6.35	32mm	B
5	L6408	—	12	75	3000	1500	Any	C-8I	GZ6.35	32mm	B
6	L6420-F	—	12	75	3050	3000	Any	C-6	GX5.3	45mm	B
7	GTL-OS-54214	EFP-LL	12	100	3100	1500	s120	C-8I	GZ6.35	32mm	B
8	GTL-OS-54189	EFP	12	100	3350	50	p90/15	C-8I	GZ6.35	32mm	B
9	GTL-OS-54210	EFR	15	150	3350	50	p90/15	C-8I	GZ6.35	32mm	B
10	GTL-OS-54737	DDM	19	80	3350	50	Any	CC-6	GX5.3	140mm	B
11	GTL-OS-54660	DDL	20	150	3150	500	Any	CC-6	GX5.3	190mm	B
12	GTL-OS-54944	DDS	21	80	3125	1000	Any	CC-6	GX5.3	208mm	B
13	GTL-OS-58771	EKE/X	21	150	3150	1000	Any	CC-8	GX5.3	44mm	B
14	L6409	EKE	21	150	3250	200	Any	CC-6	GX5.3	44mm	B
15	GTL-OS-54732	EJV	21	150	3350	100	Any	CC-6	GX5.3	38mm	B
16	GTL-OS-54745	ELD	21	150	3350	40	Any	CC-6	GX5.3	28mm	B
17	GTL-OS-54747	EJM	21	150	3400	40	p90	CC-6	GX5.3	38mm	B
18	GTL-OS-54753	EJA	21	150	3400	40	Any	CC-6	GX5.3	28mm	B
19	GTL-OS-54730	EJL	24	200	3400	50	Any	CC-6	GX5.3	32mm	B
20	GTL-OS-54814	ELC-7/X	24	250	3200	700	Any	CC-6	GX5.3	32mm	B
21	GTL-OS-54841	ELC-3/X	24	250	3250	300	Any	C-8I	GX5.3	32mm	B
22	GTL-OS-54840	ELC	24	250	3400	50	Any	C-8I	GX5.3	32mm	B
23	GTL-OS-54928	ETJ	120	250	3150	175	s90	CC-8	GY5.3	152mm	B

*Working Distance is measured from the rim of the reflector.

Several of our lamps are now available in gold and aluminum coated versions. This is a preferred reflector to dichroic in applications where increased emission is needed in the IR. Applications include open field gas detection, local infrared heating and remote testing of flame detectors. Below is a selected list of our most common coated reflector lamps but many more are available.



Note: All dimensions are in mm

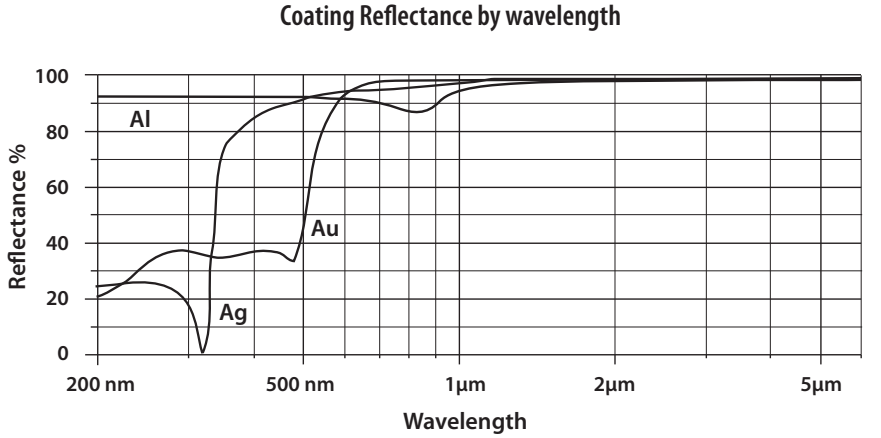
Halogen Lamps with Aluminum Reflectors

Line No.	Part No.	Volts	Watts	CCT	Life Hours	Burning Position	Filament Type	Base Type	Working Distance	Drawing
1	L6430	12	35	3100	1500	Any	C-8I	GU5.3	130mm	A
2	L1090	21	150	3250	200	Any	CC-6	GX5.3	44mm	A

Halogen Lamps with Gold Reflectors

Line No.	Part No.	Volts	Watts	CCT	Life Hours	Burning Position	Filament Type	Beam Angle	Base Type	Drawing
3	L517A-G	12	12	2925	2000	Any	C-6	8°	GZ4	B
4	L519-G	12	20	2925	2000	Any	C-6	11°	GZ4	B
5	L515-G	12	20	2925	4000	Any	C-6	11°	GX5.3	A
6	L514-G	12	35	2950	2000	Any	C-6	12°	GZ4	B
7	GTL-OS-58325-G	12	50	3000	2000	Any	C-8I	10°	GU5.3	A
8	L521-G	12	50	3050	4000	Any	C-6	13°	GX5.3	A
9	L6408-G	12	75	3000	1500	Any	C-8I	32mm*	GZ6.35	A
10	L523-G	12	75	3050	4000	Any	C-6	14°	GX5.3	A
11	GTL-OS-54233	15	150	3400	50	p90	C-Bar-6	19mm*	GZ6.35	A
12	L6409-G	21	150	3250	200	Any	CC-6	44mm*	GX5.3	A
13	GTL-OS-54753-G	21	150	3400	40	Any	CC-6	28mm*	GX5.3	A

*Working Distance



Miniature Lamps

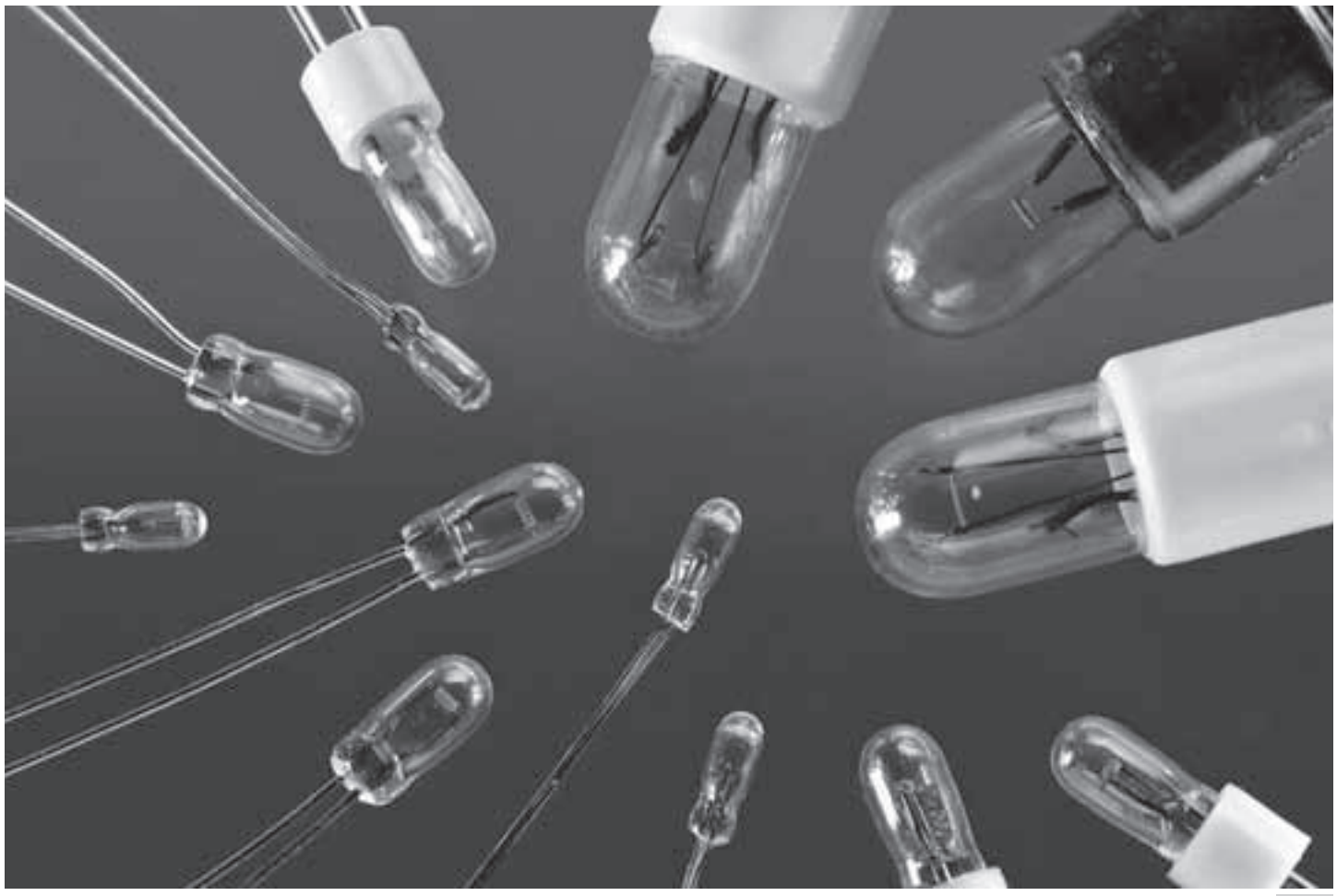
Miniature Lamps have advantages and should be considered by the design engineer for those applications requiring higher light output or higher temperature operation than is available from Light Emitting Diodes (LEDs). Another advantage is their broad band spectral emission, which extends from the visible to the infrared.

Miniature Lamps specified in this catalog are listed by ANSI and MIL standard part numbers. Specifications for each lamp meet or exceed the parameters specified for the lamp number.

These lamps are specified for current, brightness and life at their design voltage. The lamp may be operated at voltages other than design voltage. This variation is called operating voltage. An operating voltage higher than design voltage will result in increased brightness with a decrease in rated life. Rated life may be increased with a decrease in design voltage. Please see the Rapid Lamp Calculator Diagram (page 8).

Design current, measured in amps, is the current flowing through the lamp filament when operated at the design voltage. Normal tolerance for design current is ±10%.

Total luminous flux of miniature lamps is measured using an integrating sphere and other instruments and standards with calibration traceable to NIST. Mean Spherical Candle Power (M.S.C.P.) are lumens per steradian and lumens are units of total luminous flux into the full 4π steradians of solid angle for a sphere.



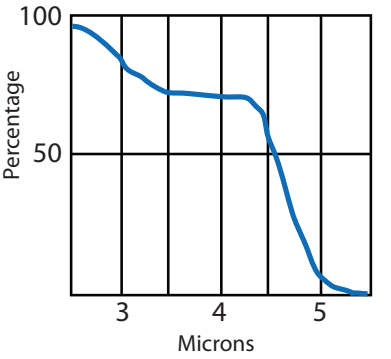
Visible/Infrared Lamps

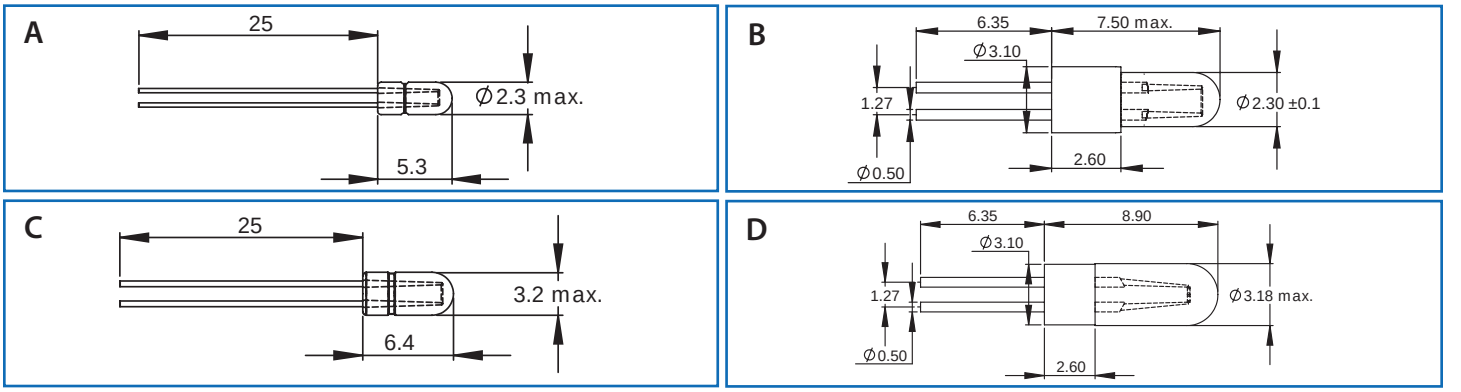
Standard miniature lamps in this section have been selected to a brightness tolerance of ±25%. When required, these lamps may be selected to a closer brightness tolerance of ±15%, ±10%, or ±5%.

Rated life as specified in the Standard Miniature Lamp section of this catalog is expressed in terms of hours. Rated life is calculated at design voltage, with alternating current and under ideal laboratory conditions. In actual use, lifetime may be shortened as a result of hostile environments such as shock, vibration, and extreme temperatures. Life may be substantially increased by selecting an operating voltage less than the design voltage. This decrease from design voltage will also result in a cooler filament providing increased resistance to shock and vibration.

Subjecting the lamp to a burn-in period will improve the stability of light output over time. It is possible to do an accelerated burn-in for these lamps by running them for a specified time at a carefully controlled voltage greater than their design voltage. Our T-¾ and T-1 Visible/Infrared lamps are designed for applications requiring wide spectrum emission, such as gas sensing and detection. These lamps are made with a rugged, compact CC-6 filament that concentrates infrared energy into a small point. The thin glass envelope results in minimum infrared absorption. Peak energy of these lamps occurs at 1.4 microns and extends beyond 4.0 microns. The visible/infrared lamps have been designed for long life and can be supplied with standard wire leads, a bi-pin base, or in an assembly.

Relative Spectral Radiation
Visible-Infrared Lamps





Note: All dimensions are in mm

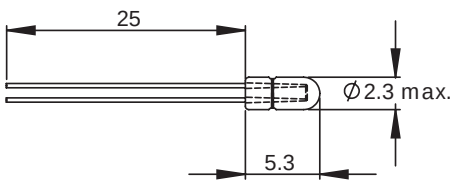
T-¾ Lamps, Visible-Infrared

Line No.	Part No.	Volts	Amps	M.S.C.P.	CCT	Life Hours	Filament Type	Drawing
1	4115	5	0.115	0.150	2110	40,000	CC-6	A
2	4115-2A	5	0.115	0.150	2110	40,000	CC-6	B

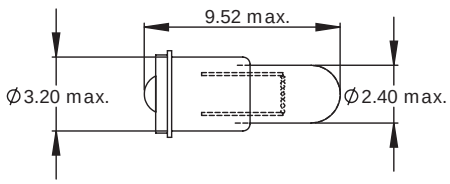
T-1 Lamps, Visible-Infrared

Line No.	Part No.	Volts	Amps	M.S.C.P.	CCT	Life Hours	Filament Type	Drawing
3	1045	5	0.045	0.060	2200	10,000	CC-6	C
4	1045-9A	5	0.045	0.060	2200	10,000	CC-6	D
5	1600	5	0.060	0.050	2050	100,000	CC-6	C
6	1600-9A	5	0.060	0.050	2050	100,000	CC-6	D
7	1150	5	0.115	0.150	2200	40,000	CC-6	C
8	1150-9A	5	0.115	0.150	2200	40,000	CC-6	D
9	1088	5	0.140	0.200	2250	18,000	CC-6	C
10	1088-9A	5	0.140	0.200	2250	18,000	CC-6	D
11	1089	5	0.150	0.350	2450	5,000	CC-6	C
12	1089-9	5	0.150	0.350	2450	5,000	CC-6	D

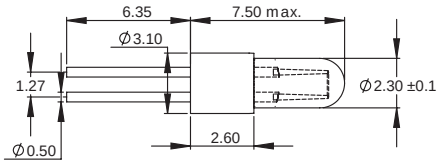
T-¾ Wire Lead



T-¾ Miniature Flanged



T-¾ Bi-Pin



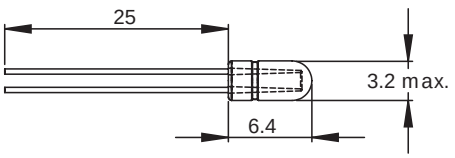
Note: All dimensions are in mm

T-¾ Subminiature Lamps

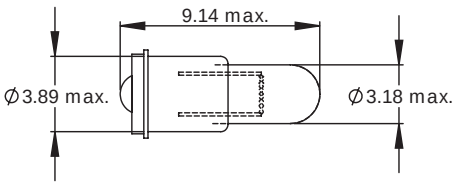
Line No.	Part No. Wire Lead	Part No. Miniature Flanged	Part No. Bi-Pin	Volts	Amps	M.S.C.P.	Filament Type	Life Hours
1	7100	3810	7810	1.5	0.015	0.002	C-2R	2,000
2	7101	3811	7811	1.5	0.015	0.005	C-2R	1,000
3	8534	7121	7111	2.5	0.110	0.060	C-2R	10,000
4	3102	—	—	4.5	0.022	0.018	C-2R	5,000
5	30	—	—	4.5	0.021	0.017	C-2R	5,000
6	8537	8538	7538	5.0	0.021	0.034	C-2R	1,000
7	6803	8587	7113	5.0	0.060	0.03	C-2R	10,000
8	6833	8913	7114	5.0	0.060	0.05	C-2R	100,000
9	6153	6183	7115	5.0	0.060	0.15	C-2R	3,000
10	7133	8828	7116	5.0	0.075	0.09	C-2R	25,000
11	8666	8383	7117	5.0	0.080	0.15	C-2R	15,000
12	7153	8270	7118	5.0	0.115	0.15	C-2R	40,000
13	7102	7123	7119	5.0	0.115	0.20	C-2R	5,000
14	L51	L52	L53	12.0	0.060	0.15	C-2F	16,000
15	L54	L55	L56	14.0	0.050	0.13	C-2F	16,000
16	L57*	L58*	L59*	28.0	0.024	0.10	CC-2F	16,000

*Add 1.4 to MOL

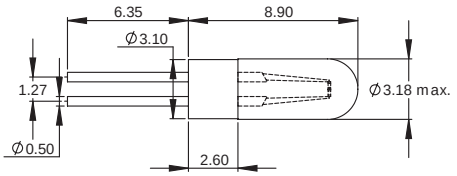
T-1 Wire Lead



T-1 Miniature Flanged



T-1Bi-Pin

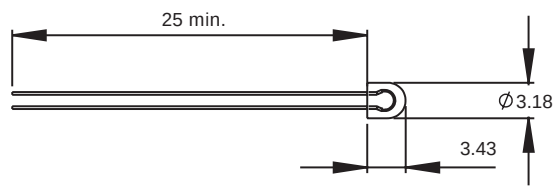


Note: All dimensions are in mm

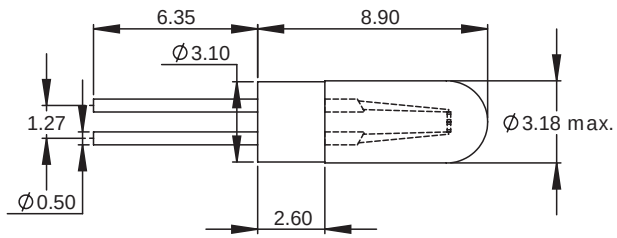
T-1 Subminiature Lamps

Line No.	Part No. Wire Lead	Part No. Miniature Flanged	Part No. Bi-Pin	Volts	Amps	M.S.C.P.	Filament Type	Life Hours
1	8798	7244	7252	1.25	0.012	0.004	C-6	1,000
2	8910	7245	7253	1.35	0.220	0.02	C-2R	10,000
3	7200	7225	3225	1.5	0.010	0.002	C-2R	2,000
4	7201	7226	7254	1.5	0.015	0.005	C-2R	1,000
5	7203	8102	7255	1.5	0.075	0.03	C-2R	16,000
6	801	—	—	2.4	0.145	0.18	C-2R	3,000
7	8601	7246	7256	2.5	0.015	0.001	C-2R	10,000
8	8732	7247	7732	2.5	0.100	0.10	C-2R	10,000
9	8711	7248	7257	2.5	0.320	0.21	C-2R	5,000
10	8846	7249	7258	3.0	0.008	0.001	C-2R	16,000
11	7205	7229	3229	3.0	0.015	0.02	C-2R	5,000
12	7207	7231	7260	3.0	0.060	0.03	C-2R	100,000
13	7208	7232	7261	3.0	0.120	0.15	C-2R	16,000
14	8602	8605	7262	5.0	0.017	0.005	C-2R	10,000
15	6022	8022	7022	5.0	0.021	0.034	C-2R	10,000
16	7210	7234	7263	5.0	0.030	0.03	C-2R	16,000
17	8729	7250	7264	5.0	0.045	0.04	C-2R	10,000
18	680	682	7680	5.0	0.060	0.03	C-2R	100,000
19	683	685	7683	5.0	0.060	0.05	C-2R	100,000
20	6150	6180	7265	5.0	0.060	0.15	C-2R	5,000
21	713	714	7714	5.0	0.075	0.09	C-2R	25,000
22	7211	7235	7266	5.0	0.080	0.16	C-2R	3,000
23	715	718	7715	5.0	0.115	0.15	C-2R	40,000
24	7213	7236	7267	5.0	0.115	0.20	C-2R	5,000
25	7216	7239	7268	5.0	0.125	0.22	C-2R	5,000
26	8096	7251	7269	5.0	0.145	0.16	C-2R	10,000
27	7218	7240	8095	10.0	0.027	0.10	C-2F	10,000
28	7219	32	8097	12.0	0.060	0.15	C-2F	16,000
29	8111	8112	8098	14.0	0.065	0.15	C-2F	16,000
30	7220	7241	8099	18.0	0.026	0.15	C-2F	16,000
31	6838	6839	7839	28.0	0.024	0.15	CC-2F	16,000

T-1 Subminiature Short Type Lamps



T-1 Mini-Max Flashlight Lamps



Note: All dimensions are in mm

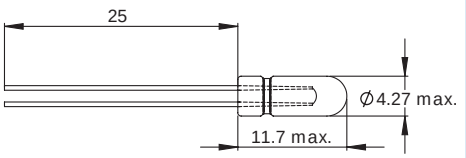
T-1 Subminiature Short Type Lamps

Line No.	Part No.	Volts	Amps	M.S.C.P.	Filament Type	Life Hours
1	6802	5	0.060	0.03	C-2R	200,000
2	6832	5	0.060	0.05	C-2R	100,000
3	7132	5	0.075	0.09	C-2R	40,000
4	7152	5	0.115	0.15	C-2R	40,000
5	7009	28	0.020	0.15	CC-2F	16,000

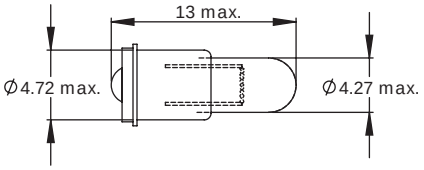
T-1 Mini-Max Flashlight Lamps

Line No.	Part No.	Volts	Amps	M.S.C.P.	Filament Type	Life Hours
6	L135	1.35	0.315	0.16	C-6	4
7	L250	2.5	0.300	0.60	C-6	4
8	L400	4.0	0.300	1.20	C-2R	4

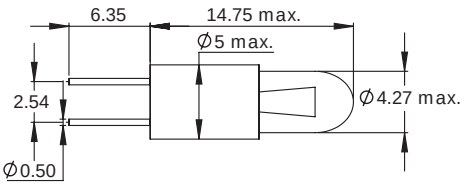
T-1¼ Wire Lead



T-1¼ Miniature Flanged



T-1¼ Bi-Pin

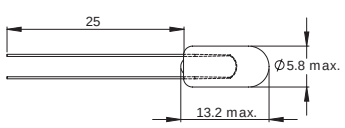


Note: All dimensions are in mm

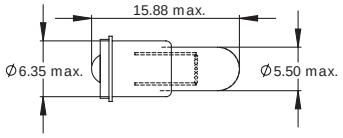
T-1¼ Subminiature Lamps

Line No.	Part No. Wire Lead	Part No. Miniature Flanged	Part No. Bi-Pin	Volts	Amps	M.S.C.P.	Filament Type	Life Hours
1	2135	7302	7306	1.3	0.030	0.006	S-2	100
2	8631	8636	7636	1.35	0.060	0.006	C-2R	500
3	8655	8656	7307	2.5	0.400	0.55	C-2R	30
4	324	8637	7637	3.0	0.190	0.25	C-2R	350
5	8816	7305	7308	4.5	0.285	0.80	C-2R	100
6	580	3582	7580	5.0	0.060	0.03	C-2R	100,000
7	583	3585	7583	5.0	0.060	0.05	C-2R	100,000
8	515	3518	7515	5.0	0.115	0.15	C-2R	40,000
9	8661	8660	7660	6.0	0.040	0.06	C-2R	1,000
10	2114	8541	7309	6.0	0.060	0.13	C-2R	3,000
11	634	8628	7628	6.0	0.200	0.63	C-2R	1,000
12	8610	8551	7310	6.3	0.200	0.55	C-2R	5,000
13	8608	8609	7311	10.0	0.070	0.14	C-2F	10,000
14	8640	8646	7646	14.0	0.080	0.50	C-2F	1,000
15	8627	8632	7632	28.0	0.040	0.32	C-2F	1,000

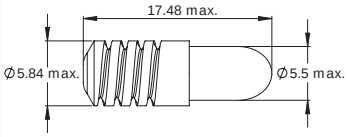
T-1¾ Wire Lead



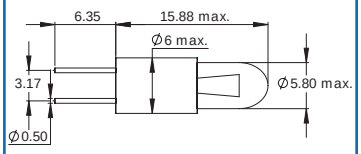
T-1¾ Miniature Flanged



T-1¾ Midget Screw



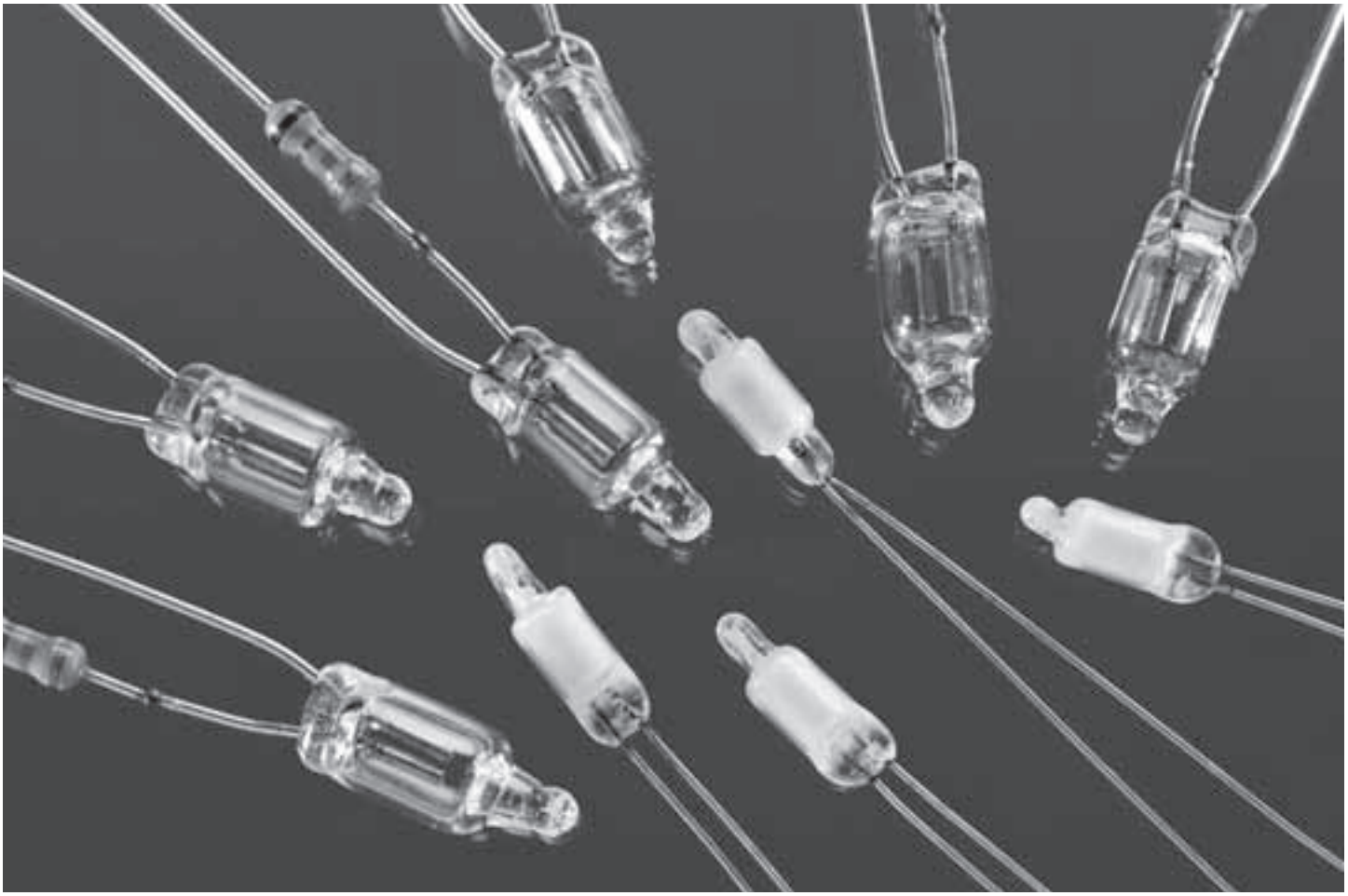
T-1¾ Bi-Pin



Note: All dimensions are in mm

T-1¾ Subminiature Lamps

Line No.	Part No. Wire Lead	Part No. Miniature Flanged	Part No. Midget Screw	Part No. Bi-Pin	Volts	Amps	M.S.C.P.	Filament Type	Life Hours
1	1728	331	8669	7931	1.35	0.06	0.01	C-2R	500
2	1783	368	1769	7968	2.5	0.20	0.22	C-2R	500
3	2169	268	7312	7868	2.5	0.35	0.21	C-2R	10,000
4	8663	343	8671	7357	2.5	0.40	0.55	C-2R	30
5	1738	338	8693	7838	2.7	0.06	0.04	C-2R	6,000
6	2158	375	7313	7375	3.0	0.015	0.003	C-6	10,000
7	2156	7329	7314	7358	3.0	0.03	0.02	C-2R	1,800
8	2171	7331	7315	7359	4.5	0.120	0.05	C-2R	25,000
9	8805	7332	7316	7360	5.0	0.06	0.03	C-2R	100,000
10	2200	7333	7318	7361	5.0	0.06	0.05	C-2R	100,000
11	3151	3150	3153	3149	5.0	0.06	0.15	C-2R	5,000
12	2203	7335	7319	7362	5.0	0.115	0.15	C-2R	40,000
13	8784	7334	7317	7363	5.0	0.19	0.45	C-2R	1,000
14	1730	345	342	7945	6.0	0.04	0.03	C-2R	10,000
15	8664	7336	8687	7364	6.0	0.20	0.10	C-2F	50,000
16	1784	328	1768	7328	6.0	0.20	0.60	C-2R	1,000
17	1784L	7337	1768L	7365	6.0	0.22	0.63	C-2R	3,000
18	2180	380	7320	7380	6.3	0.04	0.03	C-2V	50,000
19	1739	377	1775	7377	6.3	0.075	0.22	C-2R	500
20	8350	350	7321	7368	6.3	0.15	0.45	C-2R	3,000
21	2181	381	378	7381	6.3	0.20	0.40	C-2R	20,000
22	2112	349	7323	7349	6.3	0.20	0.55	C-2R	3,000
23	1869	344	8691	7344	10.0	0.014	0.002	C-2V	10,000
24	2107	367	389	7367	10.0	0.04	0.08	C-2F	5,000
25	8946	7338	7325	7369	11.0	0.022	0.03	C-2F	10,000
26	2174	394	7326	7394	12.0	0.04	0.12	C-2F	10,000
27	2182	382	8362	7382	14.0	0.08	0.30	C-2F	50,000
28	1705	330	373	7330	14.0	0.08	0.50	C-2F	750
29	2162	8918	8162	7373	14.0	0.100	0.50	C-2F	10,000
30	2102	370	8536	7370	18.0	0.04	0.15	C-2F	10,000
31	8425	459	8437	7459	22.0	0.04	0.30	C-2F	2,000
32	2185	385	8384	7374	28.0	0.04	0.20	C-2F	50,000
33	2187	387	399	7387	28.0	0.04	0.30	C-2F	25,000
34	1764	327	335	7327	28.0	0.04	0.34	C-2F	7,000
35	1764LSV	376	335LSV	7876	28.0	0.06	0.34	C-2F	25,000
36	8361	7341	8369	7376	28.0	0.065	0.65	C-2F	5,000
37	—	7018	—	7020	48.0	0.030	0.15	C-2F	5,000



Brightnesses to meet your applications.

Neon lamps are an excellent device when used as an indicator lamp in 110VAC, 220VAC, and DC applications in excess of 90 Volts. The lamps are available in miniature and subminiature sizes. Simpler to use than LEDs in these applications they usually require no additional circuitry providing a lower total cost to implement than LEDs.

A neon lamp is constructed by mounting two electrodes within a small glass envelope. Two wire leads made of tin plated Dumet metal are brought out of the lamp to make electrical connections to the electrodes. Standard brightness lamps are filled with a neon/argon gas mixture, and high brightness lamps are filled with pure neon gas. When a starting voltage (usually 55-110VAC, or 90- 140VDC) is applied, the gas ionizes and starts to glow permitting a very small current to travel from one electrode to the other. Once ionized, a lower voltage will maintain the operation of the lamp. The maintaining voltage is usually 10-20 Volts below the starting voltage, depending on the lamp and the operating current. For lamps operating on AC voltages of 60 Hz or higher frequency, the light output will appear to the eye as continuous.

When the gas ionizes it becomes a conductor, and an external series resistor is required to limit the current. To calculate the value of the series resistor, subtract the maintaining voltage from the supply voltage to obtain the voltage across the resistor, then use Ohm's Law and desired current level to determine resistance value.

$$R(\text{resistor value in Ohms}) = \frac{[Vp(\text{power supply voltage}) - Vn(\text{neon lamp voltage})^*]}{I(\text{current in Amperes})}$$

*Typical neon operating voltage is approximately 90 Volts

Typical resistance values range from 10kΩ to 220kΩ. The power dissipation of the required resistor is small, usually less than ¼ watt, but should be checked for high voltage applications. Typical current for neon lamps is between 0.5 and 3.0 mA. Power dissipation in the resistor can be calculated by the following formula:

$$P(\text{power in watts}) = I^2(\text{current in Amperes}) \times R(\text{resistor in Ohms})$$

Neon lamps are very rugged and not affected by vibration, mechanical shock, or frequent ON/OFF operation. Neon lamps may be operated over a wide temperature range from -40 to +150˚C and are not damaged by voltage transients of high voltage static discharges.

Neon lamps have a special operating characteristic that also allow them to be used as moderately stable, high voltage reference voltage sources. When driven with DC voltage at their design current the voltage across the lamp is stable at a value near 90 Volts.

Neon lamps gradually decline in light output as electrodes evaporate and condense on the inside of the glass envelope. This situation is gradual with failure defined as a 50% decrease from the original brightness. As neon lamps age, the firing voltages slowly increase until reaching the value of the supply voltage. At this point the lamp flickers and becomes erratic, indicating the end of useful lifetime.

Life expectancy of a neon lamp increases considerably as operating current is decreased. For high brightness lamps, there is a 4 to 5 power inverse relationship between current and life, whereas for standard brightness types, the lamp life varies inversely as the 3.5 power of the current. With light output exponentially proportional to current, large increases in rated life can be obtained with small reductions in current and only a small reduction in brightness. For neon lamp applications requiring life ratings of more than 50,000 hours the use of a higher value resistor will reduce lamp current and achieve longer life.

For DC operation, the life of a high brightness lamp is about 50% of a neon lamp operating at the same RMS AC voltage. The life of a standard brightness lamp at DC is about 60% of the life value at AC.

Typical light output color for clear glass neon lamps is in the orange-red range of 600 to 700 nanometers. Other emitted colors such as green, yellow and blue are available through secondary emission by coating the inside surface of the envelope with phosphor.

Neon Terminology

Striking Voltage: The voltage at which the neon lamp ignites is usually between 45 and 65VAC for standard brightness types and between 70 and 95VAC for high brightness types. This is sometimes called the breakdown or ignition voltage.

Maintaining Voltage: The voltage across the lamp after it has ignited. This voltage is a function of the lamp current and is usually quoted at the design current. Nominal values are 80V for standard brightness and 75V for high brightness lamps.

Extinction Voltage: The voltage at which the lamp extinguishes if the supply voltage is reduced. It is normally a few Volts below maintaining voltage.

Design Current: The current at which the lamp has been designed to operate. It will be determined by the supply voltage and the value of series resistance. Operation at lower currents will result in the glow discharge becoming unstable (i.e. flickering) and operation at higher currents can severely reduce the useful life of the lamp. It is therefore important to use only the recommended value of series resistance.

Neon Lamps **22-25** >

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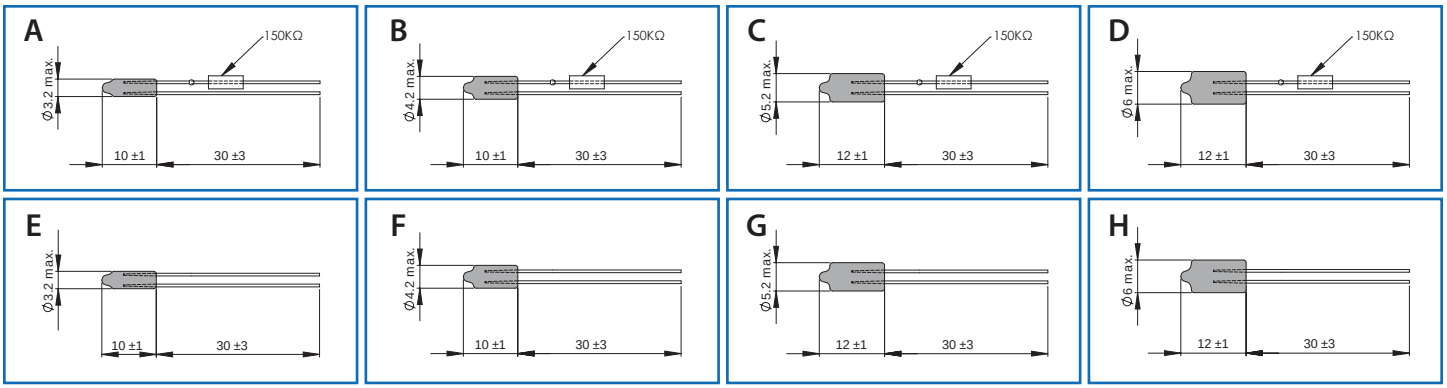


Note: All dimensions are in mm

Neon Glow Lamps (Standard Brightness)

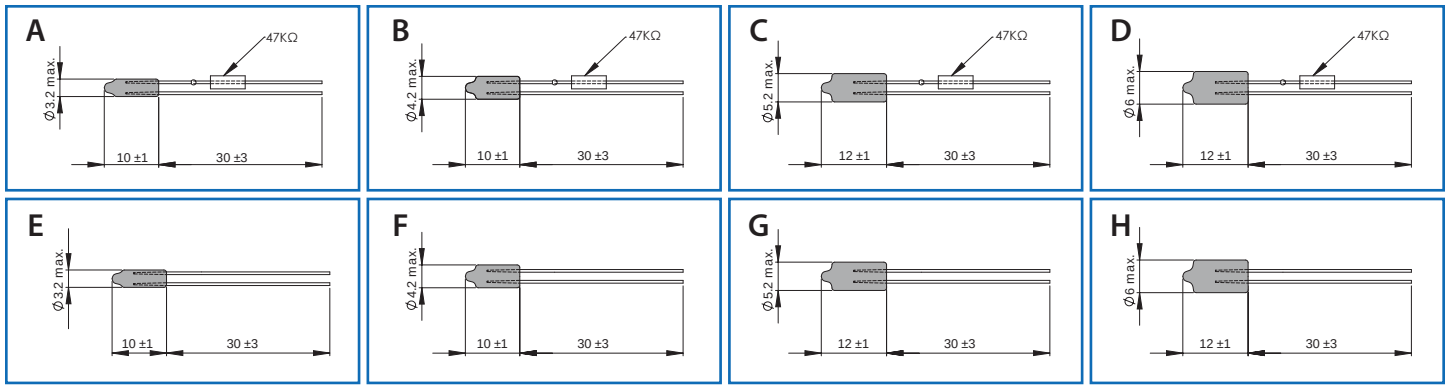
Line No.	Part No.	Color Off	Color On	Circuit Voltage	Breakdown V Maximum AC	DC	Current mA	Series Resistor 115V	220V	Average Life (hours)	mcd	Drawing
1	N513	Clear	Red	90-115/220	65	90	0.3	150kΩ	480kΩ	30,000	1.4	A
2	N515	Clear	Red	90-115/220	65	90	0.3	150kΩ	480kΩ	40,000	1.4	B
3	N516	Clear	Red	90-115/220	65	90	0.3	150kΩ	480kΩ	50,000	1.4	C
4	N526	Clear	Red	90-115/220	65	90	0.3	150kΩ	480kΩ	50,000	1.4	D

Neon Glow Lamps (High Brightness) with Dark Effect

Line No.	Part No.	Color Off	Color On	Circuit Voltage	Breakdown V Maximum AC	DC	Current mA	Recommended Series Resistor 115V	220V	Average Life (hours)	mcd	Drawing
5	N517	Clear	Red	90-115/220	95	135	1.0	47kΩ	150kΩ	20,000	5.0	E
6	N519	Clear	Red	90-115/220	95	135	1.0	47kΩ	150kΩ	20,000	5.0	F
7	N520A	Clear	Red	90-115/220	95	135	1.0	47kΩ	150kΩ	25,000	5.0	G
8	N522	Clear	Red	90-115/220	95	135	1.0	47kΩ	150kΩ	25,000	5.0	H

Neon Glow Lamps (Standard Brightness) with Resistor

Line No.	Part No.	Color Off	Color On	Circuit Voltage	Breakdown V Maximum AC	DC	Current mA	Series Resistor 115V	Average Life (hours)	mcd	Drawing
9	N513R1	Clear	Red	90-115	65	90	0.3	150kΩ	30,000	1.4	A
10	N515R1	Clear	Red	90-115	65	90	0.3	150kΩ	40,000	1.4	B
11	N516R1	Clear	Red	90-115	65	90	0.3	150kΩ	50,000	1.4	C
12	N526R1	Clear	Red	90-115	65	90	0.3	150kΩ	50,000	1.4	D



Note: All dimensions are in mm

Neon Glow Lamps (High Brightness) with Dark Effect & Resistor

Line No.	Part No.	Color Off	Color On	Circuit Voltage	Breakdown V Maximum AC	Breakdown V Maximum DC	Current mA	Series Resistor 115V	Average Life (hours)	mcd	Drawing
1	N517R1	Clear	Red	90-115	95	135	1.0	47kΩ	20,000	5.0	A
2	N519R1	Clear	Red	90-115	95	135	1.0	47kΩ	20,000	5.0	B
3	N520R1	Clear	Red	90-115	95	135	1.0	47kΩ	25,000	5.0	C
4	N522R1	Clear	Red	90-115	95	135	1.0	47kΩ	25,000	5.0	D

Green Glow Lamps

Line No.	Part No.	Color Off	Color On	Circuit Voltage	Breakdown V Maximum AC	Breakdown V Maximum DC	Current mA	Recommended Series Resistor 115V	Recommended Series Resistor 220V	Average Life (hours)	mcd	Drawing
5	N507	White	Green	90-115/220	80	—	0.6	82kΩ	120kΩ	20,000	3.0	E
6	N527	White	Green	90-115/220	85	110	1.2	47kΩ	120kΩ	15,000	3.0	F
7	N521	White	Green	90-115/220	85	110	1.2	47kΩ	120kΩ	15,000	3.0	G
8	N523	White	Green	90-115/220	85	110	1.2	47kΩ	120kΩ	15,000	3.0	H

Green Glow Lamps with Resistor

Line No.	Part No.	Color Off	Color On	Circuit Voltage	Breakdown V Maximum AC	Breakdown V Maximum DC	Current mA	Series Resistor 115V	Average Life (hours)	mcd	Drawing
9	N527R1	White	Green	90-115	85	110	1.2	47kΩ	15,000	3.0	B
10	N521R1	White	Green	90-115	85	110	1.2	47kΩ	15,000	3.0	C
11	N523R1	White	Green	90-115	85	110	1.2	47kΩ	15,000	3.0	D

Precision Lamps

The addition of a lens end to a technical lamp is an important development in miniature lamps as it allows the use of lower wattage lamps while maintaining light output. The lens gathers light resulting in an intensity increase of up to 10 times at the end of the lamp, compared to the output of an equivalent lamp without a lens, measured at this same point. Most popular lens end lamps are those types mounted in a smooth or threaded type base as illustrated in this catalog.

The purpose of the lens end lamp is to gather light and project it into a useful direction. These lens end lamps by themselves cannot satisfy all requirements of an optical system. The lamps have both a focal length and working plane. The working plane is that area where light distribution is optimized for intensity, uniformity and consistency of light pattern between lamps. The working plane is typically located perpendicular to the lamp mechanical axis and at a distance of 0.5-3 millimeters from the lens end. Due to variations in the manufacturing process for these lamps the light pattern will vary slightly from lamp to lamp. A sample of lamps should be tested in any new design to ensure proper operation.

To best utilize these lens end lamps it is recommended that the area to be illuminated (fiber optics aperture, or light guide) be placed directly into the working plane. For projection of the light at distances exceeding the distance of the working plane, the addition of an external lens is recommended. Using the working plane with an aperture as the source for a larger transfer lens can provide a uniform well-defined beam for illumination of a distant object.

Lens end lamps are designed and constructed for those critical optical applications, which require a miniature light source with high quality glass envelopes and precisely positioned compact tungsten filaments. Preferred filaments for technical lamps are of C-6 style. These filaments are designed to operate at low voltage and high current providing for rugged construction, miniature size, and high light output. Many of the subminiature lamps are equipped with sturdy coiled, coil filaments (CC-6 style). Each filament is carefully positioned and secured to the electrodes.

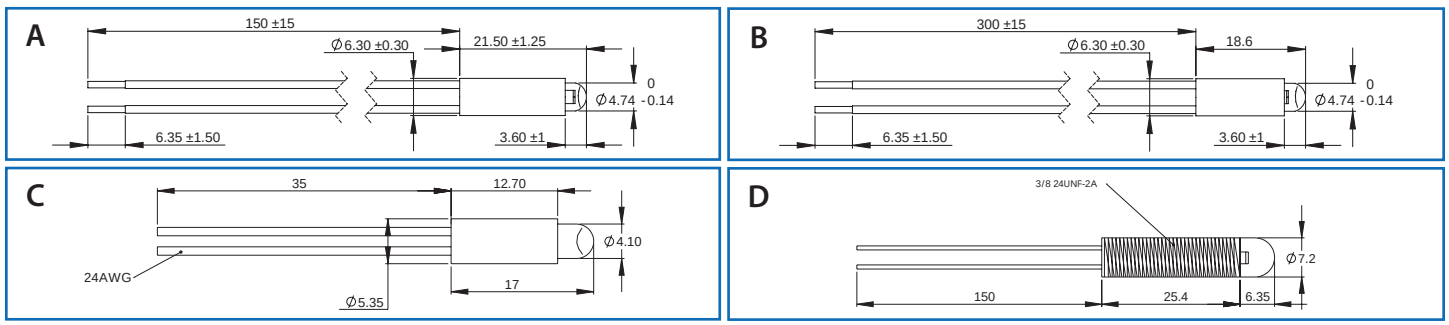
Typical color temperatures for lamps in this section range between 1,800 Kelvin for long life lamps and 3,000 Kelvin for shorter life lamps.

Fabrication of these lamps occurs in atmospherically controlled environments, incorporating rigid production control. Inspection of each unit to stringent quality control standards is mandatory. The end results are quality glass bulbs free of contamination, filaments of consistent shape, and quality bases manufactured to extremely close tolerances.

These stringent manufacturing processes, coupled with quality glass, and compact filaments allow for the addition of an optical lens placed directly onto the lamp. This lens increases light output up to 10 times compared to an equivalent lamp without lens. This phenomenon makes possible a reduction in operational voltage of the lamp resulting in prolonged lamp life. Lens end lamps can be vacuum or, more commonly, filled with a gas such as argon, krypton, or a halogen mixture. Vacuum lamps have a lower surface temperature than gas filled lamps. Maximum current rating for vacuum lamps is approximately 400 milliamps. Gas-filled lamps minimize tungsten filament evaporation and make possible the unique combination of high brightness, high color temperature and long life in a miniature lamp size. Current draw of gas filled lamps exceeds 400 milliamps.

The ¼ inch diameter smooth side based lamps and the ½-20 threaded base lamps provide an optical axis aligned to the mechanical axis of the base within a tolerance of ±3°. These lamps also allow for axial adjustment necessary to optimize light distribution and light pattern.

Mounting these lamps must be done carefully to ensure the sleeve is not distorted which can cause premature lamp failure. The smooth sided sleeve lamps are typically mounted in a bored hole of matching diameter and held in place by the use of a setscrew on the rear portion of the lamp. It is recommended that the setscrew only contact the rear one third of the sleeve and that the torque be limited to prevent distortion of the sleeve. Any sign of indentation on the sleeve indicates excessive pressure from the setscrew.

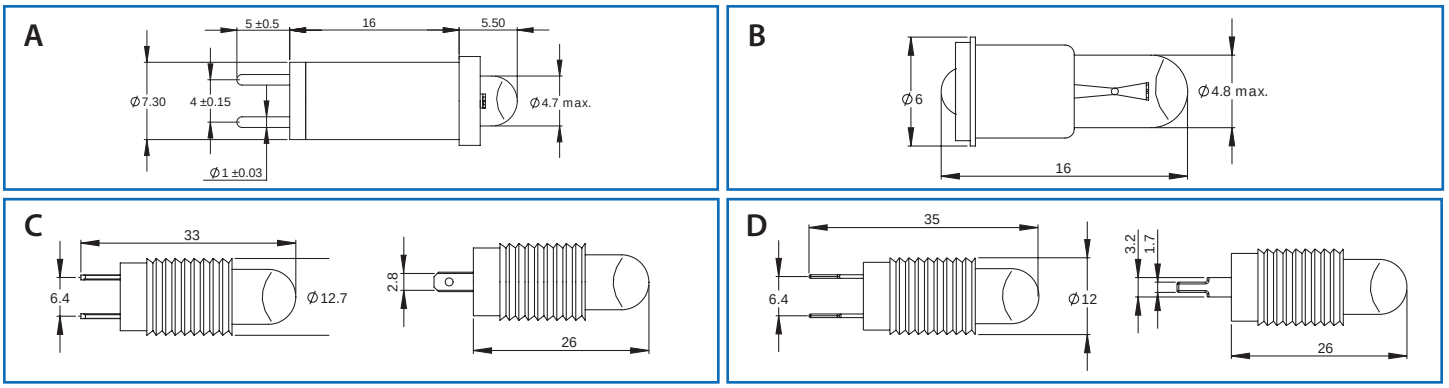


Note: All dimensions are in mm

Focused Lens End Lamps

Line No.	Part No.	Volts	Amps	Lux*	CCT	Life Hours	Vacuum Or Gas	Filament Type	Base Type	Drawing
1	L1005	2.5	0.350	1550	2200	25000	V	C-6	Brass	A
2	L1005A	2.5	0.350	1550	2200	25000	V	C-6	Brass	B
3	L1026A	2.5	0.350	2000	2250	10000	V	C-2R	Brass	B
4	L103	2.5	0.350	2000	2250	10000	V	C-6	Sleeve	C
5	L1023	2.5	0.350	2100	2250	15000	V	C-6	Brass	A
6	L102	2.5	0.800	0.08 MSCP	2250	5000	V	C-2R	Sleeve	A
7	L1006	3.5	0.450	1600	2230	30000	G	C-6	Brass	A
8	L1024	3.5	0.560	3800	2490	4500	Krypton	C-6	Brass	A
9	L1024A	3.5	0.560	3800	2490	4500	G	C-6	Brass	B
10	L1021	3.5	0.600	12000	2850	100	Krypton	C-6	Brass	A
11	L1030	3.5	1.200	16000	2950	150	Halogen	C-6	Brass	A
12	L1007	5	0.160	880	2300	12500	V	C-2R	Brass	A
13	L1025	5	0.240	1200	2450	10000	V	C-2R	Brass	A
14	L105	5	0.180	1200	2250	10000	V	C-2R	Sleeve	C
15	L1041	5	1.31	75	2700	3300	Halogen	C-6	Brass	A
16	L1051-C	6	1.9	50000	2900	1000	Halogen	C-6	3/8 24 UNF-2A	D

* Lux measured at 50mm



Note: All dimensions are in mm

Cartridge Lens End Lamps

Line No.	Part No.	Volts	Amps	CCT	Life Hours	Filament Type	Base Type	Drawing
1	L4038	2.50	0.350	2240	10000	C-6	Cartridge	A
2	L4075	5.00	0.170	2300	12500	C-2R	Cartridge	A

Midget Grooved Base Lens End Lamps

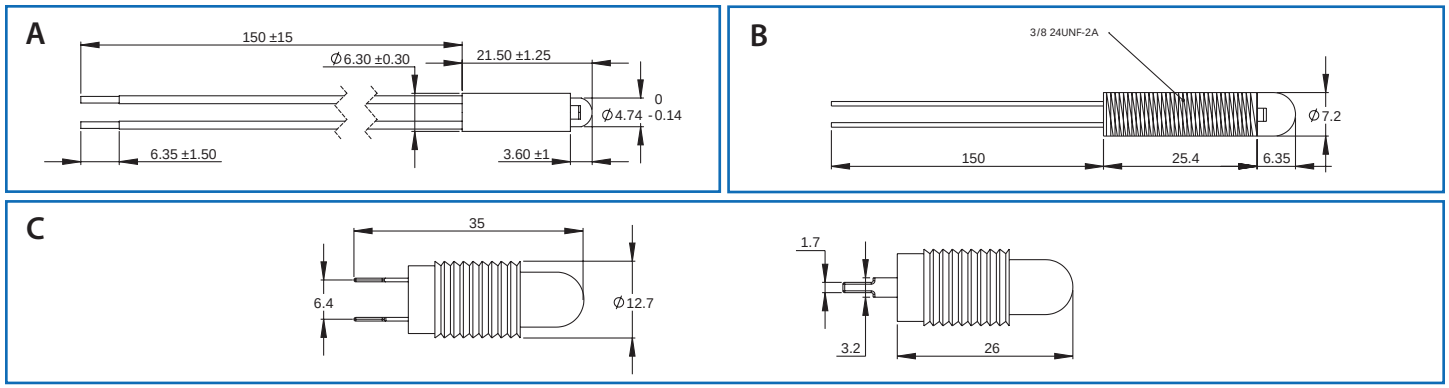
Line No.	Part No.	Volts	Amps	Lux*	CCT	Life Hours	Vacuum Or Gas	Filament Type	Drawing
3	L4044	2.5	0.350	1600	2250	10000	V	C-6	B

* Lux at 50mm

Focused Lens End Lamps

Line No.	Part No.	Volts	Amps	Lumens	Min. Lux*	CCT	Life Hours	Vacuum Or Gas	Filament Type	Base Type	Drawing
4	L8006	5	0.750	18	7000	2420	15000	G	C-6	½-20 UNF-2A	C
5	L8035	5	0.770	7000	7000	2420	15000	G	C-6	½-20 UNF-2A	D
6	L8008	5	0.750	8000	7000	2420	15000	G	C-6	½-20 UNF-2A	C
7	L8050	5	0.810	3000	3000	2140	20000	G	C-6	½-20 UNF-2A	D
8	L8017	6	1.600	109	38000	2860	500	G	C-6	½-20 UNF-2A	C

* Lux at 50mm



Note: All dimensions are in mm

Precision Half Spherical Lamps

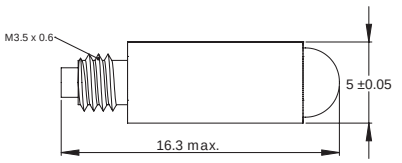
Line No.	Part No.	Volts	Amps	Lumens	CCT	Life Hours	Vacuum Or Gas	Filament Type	Filament Dimensions Lgth. x Dia.	Base Type	Drawing
1	L1008	2.5	0.340	2.7	2230	30000	V	C-6	1.2 x 0.4	Brass	A
2	L1009	3.5	0.450	4.5	2230	30000	Argon	C-6	1.2 x 0.4	Brass	A
3	L1027	3.5	0.600	24.0	2850	100	Krypton	C-6	1.2 x 0.4	Brass	A
4	L1031	3.5	1.200	40.0	2950	150	Halogen	C-6	1.2 x 0.6	Brass	A
5	L1010	5	0.160	3.5	2300	12500	V	C-2R	—	Brass	A
6	L1040	5	1.31	75	2700	3300	Halogen	C-6	1.6 x 0.7	Brass	A
7	L1050-C	6	1.9	180	2900	1000	Halogen	C-6	1.6 x 0.85	3/8 24 UNF-2A	B

Precision Half Spherical Lamps (Threaded)

Line No.	Part No.	Volts	Amps	Lumens	CCT	Life Hours	Vacuum Or Gas	Filament Type	Filament Dimensions Lgth. x Dia.	Base Type	Drawing
8	L8013	5	0.300	1.51	1800	100000	G	C-6	1.2 x 1.1	½-20 UNF-2A	C
9	L8029	5	0.450	5.65	1900	25000	G	C-6	1.2 x 1.1	½-20 UNF-2A	C
10	L8010	5	0.750	23*	2420	20000	V	C-6	1.2 x 1.1	½-20 UNF-2A	C
11	L8015	6	1.600	109	2900	500	G	C-6	1.2 x 1.1	½-20 UNF-2A	C

* Unbased

A



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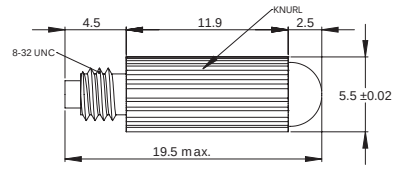

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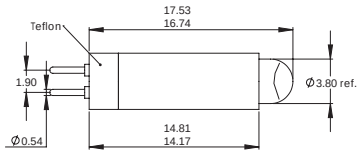

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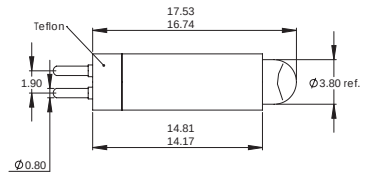
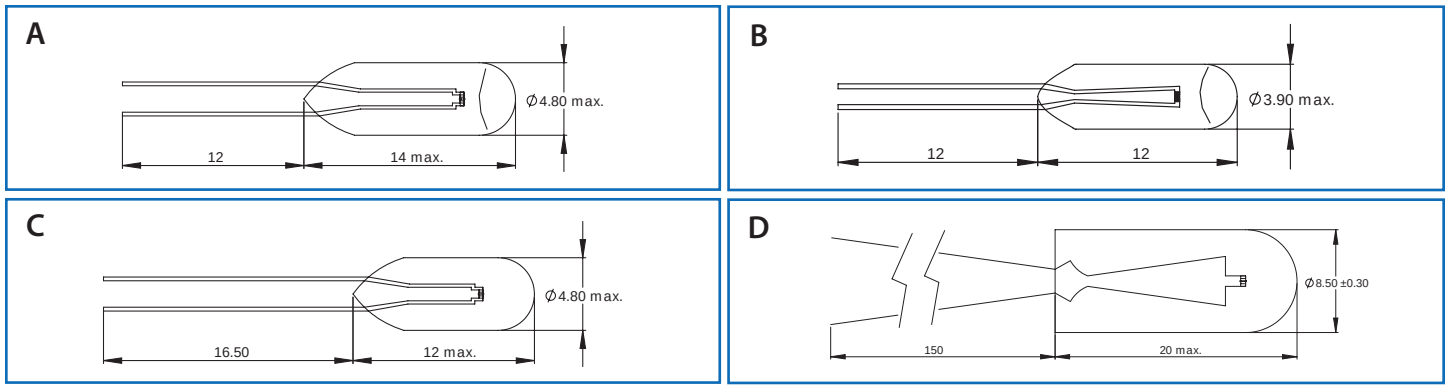


Note: All dimensions are in mm

Medical Instrument Lens End Lamps

Line No.	Part No.	Volts	Amps	Lumens	CCT	Life Hours	Filament Type	Vacuum Or Gas	Drawing
1	ML2	2.5	0.280	7	2650	20	C-6	V	A
2	ML3	2.5	0.310	3500 lux*	2700	20	C-6	V	B
3	ML4	2.5	0.670	16	2950	15	C-6	Krypton	B
4	ML4H	2.5	0.690	18	3000	25	C-6	Halogen	B
5	ML7	3.5	0.600	24	2850	100	C-6	Krypton	B
6	ML11	3.5	0.740	30	3000	40	C-6	Krypton	C
7	ML11-K1	3.5	0.740	30	3000	40	C-6	Krypton	D

* Lux at 50mm



Note: All dimensions are in mm

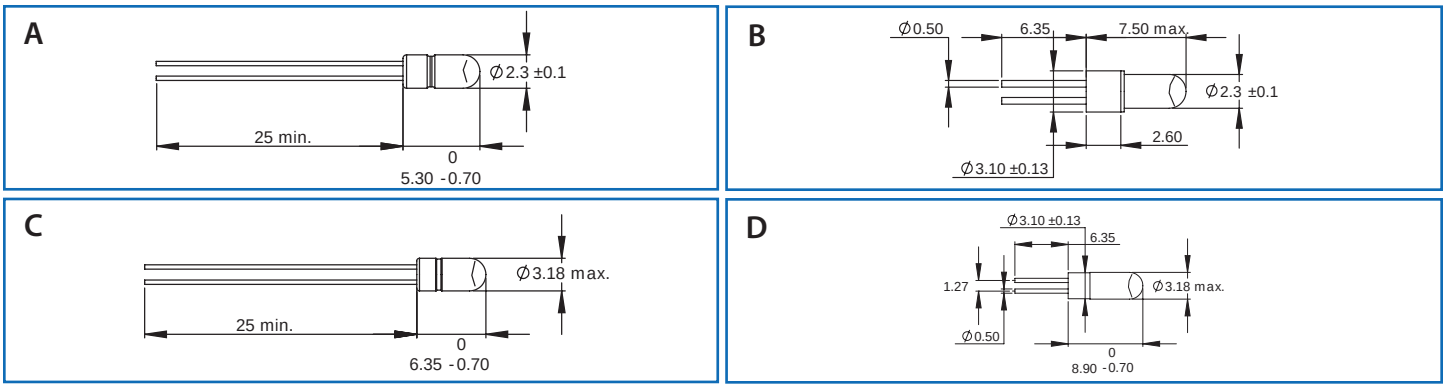
Unbased Lens End Lamps

Line No.	Part No.	Volts	Amps	Lux*	Color Temp. Degrees Kelvin	Life Hours	Vacuum Or Gas	Filament Type	Drawing
1	169-1	2.5	0.350	1550	2170	30000	V	C-6	A
2	180-1	2.5	0.350	2100	2250	15000	V	C-6	A
3	172-1	3.5	0.450	1600	2230	30000	G	C-6	A
4	185-1	3.5	0.740	13000	3050	40	G	C-6	B
5	179-1	3.5	0.740	13000	3000	35	G	C-6	A

* Lux at 50mm

Unbased Lamps

Line No.	Part No.	Volts	Amps	M.S.C.P.	Lumens	Color Temp. Degrees Kelvin	Life Hours	Vacuum Or Gas	Filament Type	Filament Dimensions Lgth. x Dia.	Drawing
6	161X	3.5	0.450	0.36	4.5	2230	30000	G	C-6	1.2 x 0.4	C
7	165	6	0.850	2.60	33.0	2340	15000	G	C-6	1.7 x 1.1	D



Note: All dimensions are in mm

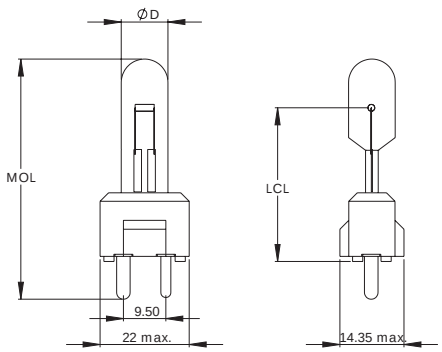
T-¾ Lens End Lamps

Line No.	Part No.	Volts	Amps	M.S.C.P.	CCT	Filament Life Hours	Type	Drawing
1	4560-1	5	0.060	0.050	2050	100000	CC-6	A
2	4560-12A	5	0.060	0.050	2050	100000	CC-6	B
3	4575-1	5	0.075	0.090	2150	40000	CC-2R	A
4	4575-12A	5	0.075	0.090	2150	40000	CC-2R	B
5	4115-1B	5	0.115	0.150	2110	40000	CC-6	A
6	4115-12A	5	0.115	0.150	2110	40000	CC-6	B

T-1 Lens End Lamps

Line No.	Part No.	Volts	Amps	M.S.C.P.	CCT	Filament Life Hours	Type	Drawing
7	1045-1	5	0.045	0.060	2200	10000	CC-6	C
8	1045-19A	5	0.045	0.060	2200	10000	CC-6	D
9	1600-1	5	0.060	0.050	2050	100000	CC-6	C
10	1600-19A	5	0.060	0.050	2050	100000	CC-6	D
11	1150-1	5	0.115	0.150	2200	40000	CC-6	C
12	1150-19A	5	0.115	0.150	2200	40000	CC-6	D
13	1088-1	5	0.140	0.200	2250	18000	CC-6	C
14	1088-19A	5	0.140	0.200	2250	18000	CC-6	D
15	1089-1	5	0.150	0.350	2450	5000	CC-6	C
16	1089-19A	5	0.150	0.350	2450	5000	CC-6	D

Prefocused Lamp



Note: All dimensions are in mm

Prefocused Lamp

Line No.	Part No.	Volts	Amps	Lumens	CCT	Burning Position	Filament Type	D	MOL	LCL	Base
1	L9404	12	20	300	2900	Any	C-6	11	55	30.3	GY9.5
2	L9389	12	50	900	3000	Any	C-6	12	60	33.3	GY9.5
3	L9390	12	100	2275	2990	s90*	C-Bar-6	11	60	33.3	GY9.5

* Cooling required

Lamp Assemblies

Reflector lamps are an excellent choice when lighting applications require directional control of emitted light. The use of a reflector can increase light output two to five times. Ellipsoidal reflectors collect the lamp output and focus it forward into an intense pattern. Dichroic reflectors allow most of the light with wavelengths longer than 700 nanometers to pass through the reflector. This effectively selects only the visible portion of the light to form the beam. These lamps are recommended for fiber optic illumination, machine vision, and other optical systems requiring high output. These reflectors are available in MR11 and MR16 sizes. For more on these see pages 12-13.

Our aluminum reflector assemblies are available in sizes ranging from 9.5mm to 25mm diameter. These assemblies produce a small, uniform, high intensity light spot and are ideal for use in fiber optic illumination and gas sensing applications. Unlike the dichroic reflector, the aluminum reflector projects all light forward, including the UV and the infrared portions. Some of these assemblies are available with a threaded lamp holder allowing for easy manipulation of the light beam and focal distance. We can also permanently bond the lamps into the reflector to create a prefocused spot.

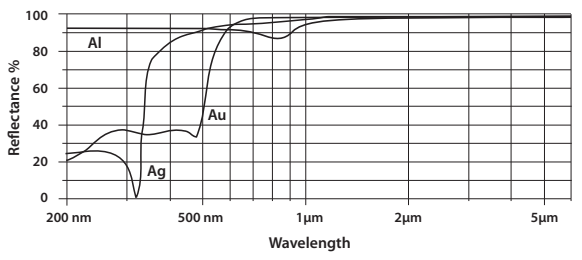
The dichroic reflector lamps and the aluminum reflectors mentioned above can also be supplied with a gold coating. This layer of gold provides for increased reflection in the infrared (see figure to right). Applications of gold coated reflectors include open field IR gas detection, local infrared heating, and remote testing of flame detectors. For more on aluminum and gold reflectors see page 14.

Our T-¾ and T-1 visible/infrared lamps are designed for applications requiring wide spectrum emission, such as gas sensing and detection.

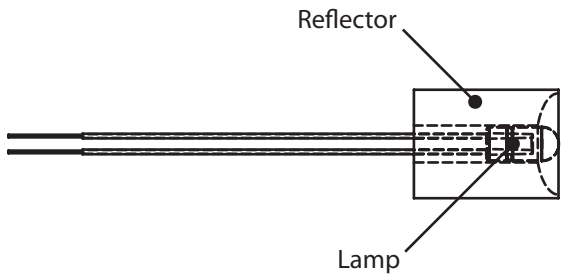
These lamps are made with a rugged, compact CC-6 filament that concentrates infrared energy into a small point. The thin glass envelope results in minimal infrared absorption. Peak energy of these lamps occurs at 1.4 microns and extends beyond 4.0 microns. The visible/infrared lamps have been designed for long life and can be supplied with standard wire leads or a bi-pin base.

In addition to the lamp holders described previously in this catalog we offer a rugged cast aluminum housing for use with MR11 and MR16 lamps. This housing makes it easy to mount these lamps in a safe protective enclosure.

Coating Reflectance by wavelength



MR3 & MR4 Lamp Assemblies



For reflector dimensions, see page 37

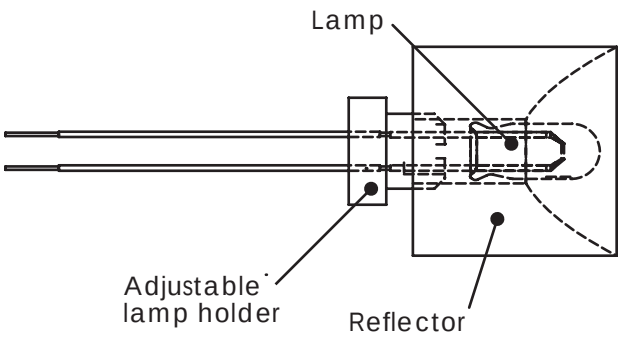
MR3 Reflector Lamp Assemblies

Line No.	Part No.	Volts	Amps	M.S.C.P.	Life Hours	Filament Type	Vacuum or Gas	Reflector Finish
1	MR3-4115	5.0	0.115	0.150	40,000	CC-6	V	Polished Aluminum
2	MR3-1600	5.0	0.060	0.050	100,000	CC-6	V	Polished Aluminum
3	MR3-1150	5.0	0.115	0.150	40,000	CC-6	V	Polished Aluminum
4	MR3-1088	5.0	0.140	0.200	18,000	CC-6	V	Polished Aluminum
5	MR3-1089	5.0	0.150	0.350	5,000	CC-6	V	Polished Aluminum

MR4 Reflector Lamp Assemblies

Line No.	Part No.	Volts	Amps	M.S.C.P.	Life Hours	Filament Type	Vacuum or Gas	Reflector Finish
6	MR4-4115	5.0	0.115	0.150	40,000	CC-6	V	Polished Aluminum
7	MR4-1600	5.0	0.060	0.050	100,000	CC-6	V	Polished Aluminum
8	MR4-1150	5.0	0.115	0.150	40,000	CC-6	V	Polished Aluminum
9	MR4-1088	5.0	0.140	0.200	18,000	CC-6	V	Polished Aluminum
10	MR4-1089	5.0	0.150	0.350	5,000	CC-6	V	Polished Aluminum
11	MR4-187	4.2	1.05	3.98	650	C-6	G	Polished Aluminum
12	MR4-188	5.0	1.00	3.34	10,000	C-6	G	Polished Aluminum

MR6 & MR8 Reflector Lamp Assemblies



For reflector dimensions, see page 37

MR6 Reflector Lamp Assemblies

Line No.	Part No.	Volts	Amps	M.S.C.P.	Life Hours	Filament Type	Vacuum or Gas	Reflector Finish
1	MR6-187	4.2	1.06	3.90	650	C-6	G	Polished Aluminum
2	MR6-188	5.0	0.97	3.26	10,000	C-6	G	Polished Aluminum

MR8 Reflector Lamp Assemblies

Line No.	Part No.	Volts	Amps	M.S.C.P.	Life Hours	Filament Type	Vacuum or Gas	Reflector Finish
3	MR8-187	4.2	1.06	3.90	650	C-6	G	Polished Aluminum
4	MR8-188	5.0	0.97	3.26	10,000	C-6	G	Polished Aluminum

Adjustable Focus Reflector Assemblies

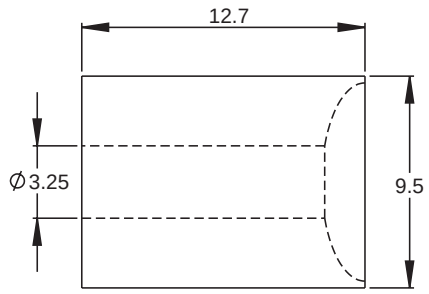
These assemblies do not come with lamps. Lamps can be purchased separately. For a selection of lamps see pages 16-17.

Line No.	Part No.	Reflector Finish
5	MR3-K	Polished Aluminum
6	MR3G-K	Gold Coated
7	MR4-K	Polished Aluminum
8	MR4G-K	Gold Coated

Reflectors are NOT sold separately - only with lamps mounted as part of an assembly (pages 35-36). They are listed separately here for reference. Reflectors are also available with a gold coating for increased IR output - add "G" to the part number. i.e. a gold coated eliptical MR6 reflector has a model number "MR6EG".

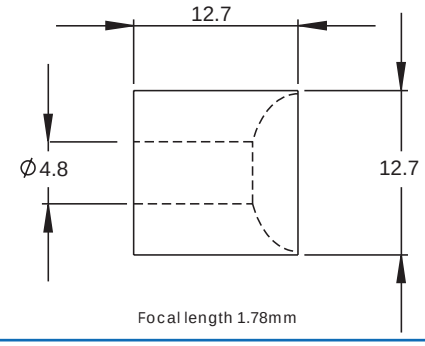
Parabolic

MR3



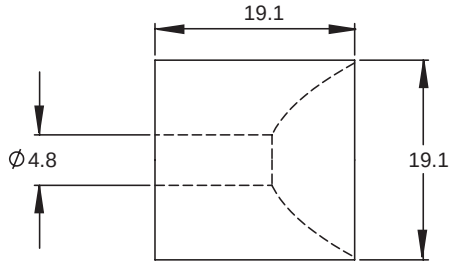
Focal length 1.78mm

MR4



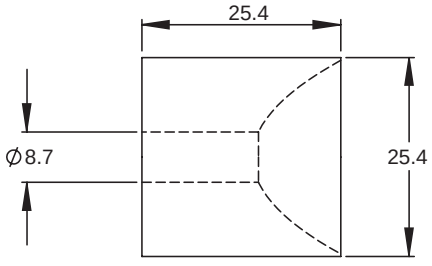
Focal length 1.78mm

MR6



Focal length 2.54mm

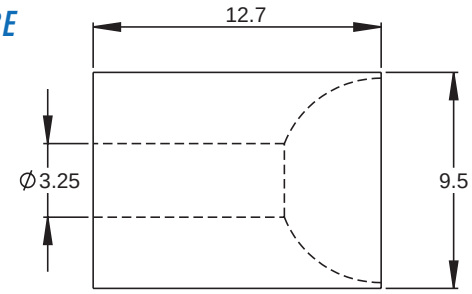
MR8



Focal length 3.05mm

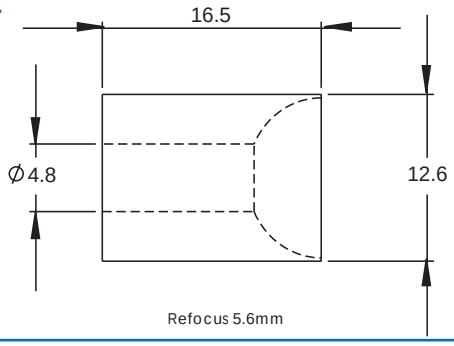
Eliptical

MR3E



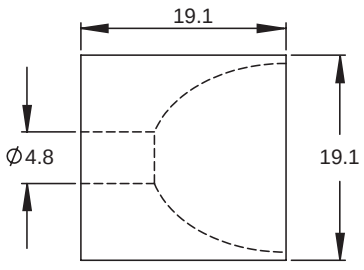
Refocus 4.6mm

MR4E



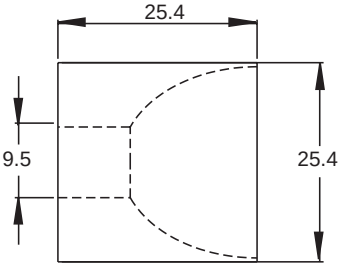
Refocus 5.6mm

MR6E



Refocus 9.4mm

MR8E



Refocus 12.4mm

Note: All dimensions are in mm

Halogen Illuminators

International Light Technologies offers two sizes of Halogen Illuminators which accommodate the majority of lamps used as lighting fixtures for OEM applications. The smaller of the two, the MR1100, is designed for MR11 reflector lamps which are typically 35mm in diameter. The larger unit is the MR1600 which can accommodate the MR16 reflector lamps, typically 50mm diameter reflectors.

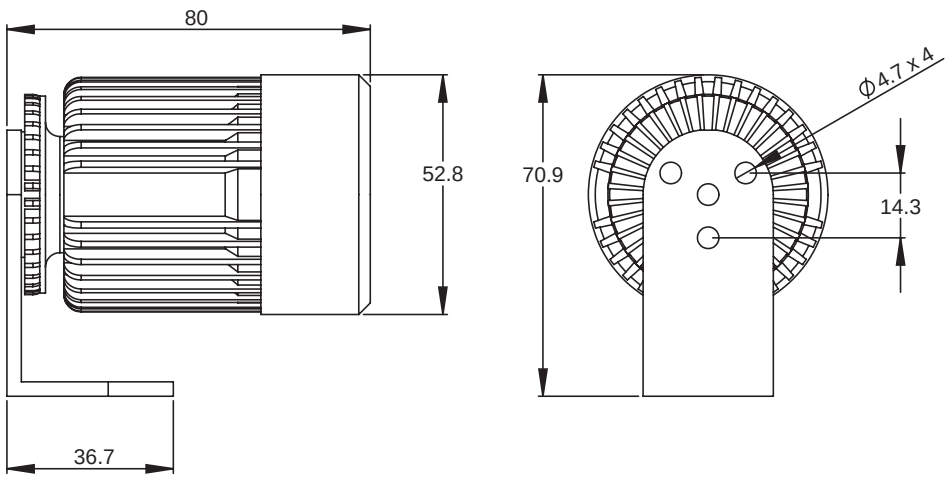
The Illuminators are made from cast aluminum and are anodized black as standard. The illuminators come with a mounting bracket which can adopt multiple positions for best angling of the lamp beam. There is a cover glass on the illuminator to protect the lamp from dust and debris. The illuminators are designed for an indoor application such as a trade show booth or as fixtures for directional lighting.

The lamps comes with 18AWG lead wire for easy hook up to a power supply. The lamp does not need venting as the aluminum body doubles as a heat dissipater. In larger quantities other colors may be requested.

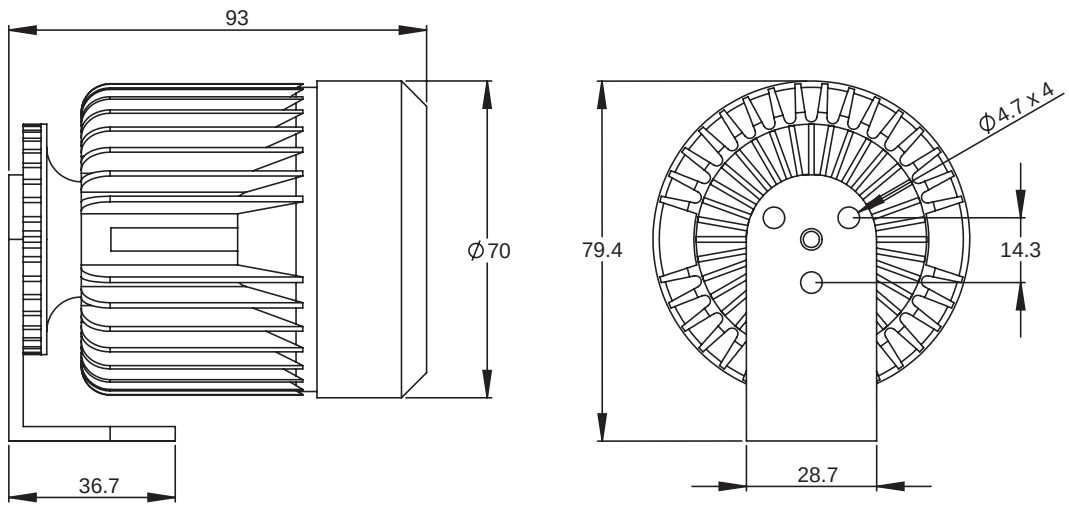
FEATURES

- Rugged aluminum construction.
- Muti-position mounting bracket.
- Cover glass.
- 370mm, 18AWG black Teflon insulated lead wires.
- 8 degree adjustment capabilities.
- Threaded bezel for easy lamp replacement.
- Will work with any MR11 or MR16 lamp from our catalog (pages 12-13)

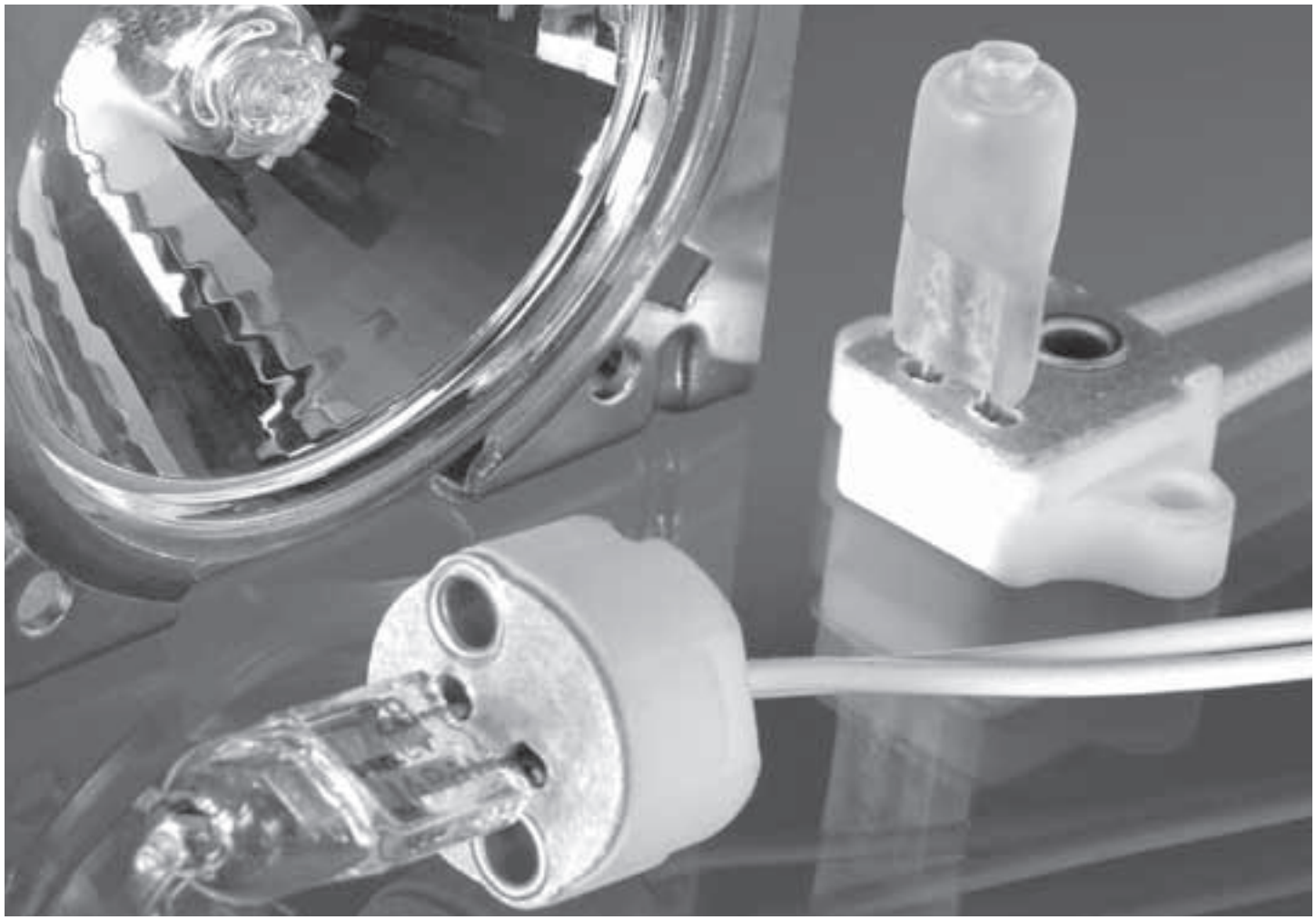
MR1100



MR1600



Note: All dimensions are in mm



In order for any system to operate at maximum efficiency all of the parts must be in good working order and reliable. International Light Technologies offers a range of lampholders to complement the lamps we offer.

Lampholders are an essential part of a lighting system and the wrong choice can lead to lost power and lamps not working effectively. All lamps are listed with a rated voltage and wattage and it is essential the means provided to get the power to the lamp from the power source is a good and effective one. Under powering or over powering a lamp can have a large impact on the life of the lamp as well as it's spectral output.

In this section you will see some of the more common lampholders used with our lamps along with readily available options that we stock for immediate delivery. These options include different wire lengths and threaded mounting holes.

The lampholders maximum ratings are listed so you will know if your lamp can be safely installed in each lampholder. Please note that the maximum temperatures listed apply both to the wire used and also the ceramic upon which the lamp sits. The temperature at the ceramic will be much higher than along the wire.

If the lampholder you are looking for is not listed in this section, please contact our technical support department and an engineer will be able to assist you. Basic changes such as wire length or type or complicated changes such as a new design are well within our scope of work at ILT.

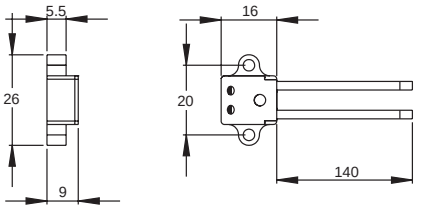
4mm base: G4[1], GY4[2] GZ4[3]

Key

Ⓐ *UL3122 – 200°C, Braided Silicon, 300V, white*
Ⓑ *UL10362 – 250°C, PTFE, 600V, white*
Ⓒ *11596 – 18AWG, 180°C, Silicon, 300V, brown*

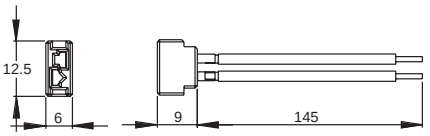
H971[1,2,3]

Maximum ratings: 250V, 6A, 250°C
Wire options: M3&140mm Ⓒ, M3&220mm Ⓒ



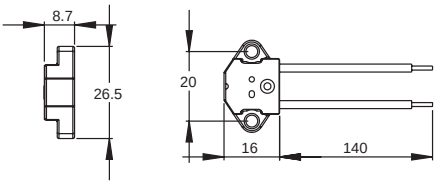
H973[1]

Maximum ratings: 24V, 4A, 180°C
Wire options: 145mm Ⓒ, no wire



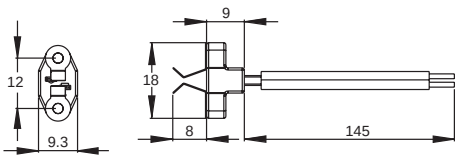
H977[1,2,3]

Maximum ratings: 250V, 10A, 350°C
Wire options: 140mm Ⓒ, 395mm Ⓒ



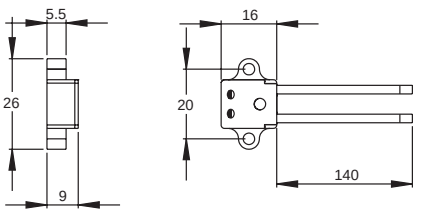
H997[1]

Maximum ratings: 24V, 4A, 180°C
Wire options: 145mm Ⓒ



H9901[1]

Maximum ratings: 250V, 100W, 4A, 200°C
Wire options: 140mm Ⓐ, 180mm Ⓐ, 317mm Ⓑ



Note: All dimensions are in mm

Universal Base: 4/5.3/6.35

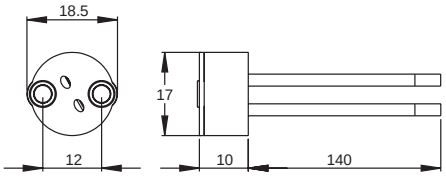
This includes all variations of these bases G, GU, GX, GY and GZ

Key

Ⓐ UL3122 – 200°C, Braided Silicon, 300V, white
Ⓑ UL10362 – 250°C, PTFE, 600V, white
Ⓒ 11596 – 18AWG, 180°C, Silicon, 300V, brown

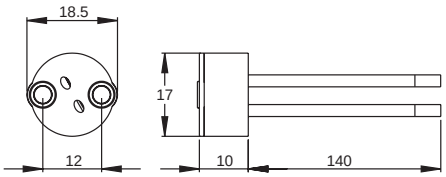
H912

Maximum ratings: 50V, 10A, 250°C
Wire options: 140mm Ⓑ, 460mm Ⓑ, M3&255mm Ⓑ

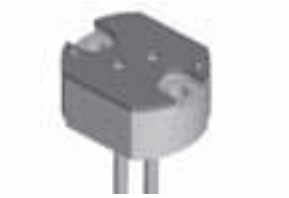


HT456

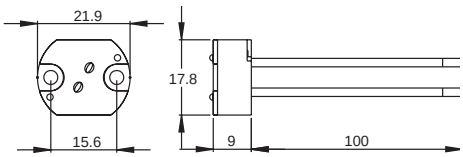
Maximum ratings: 50V, 10A, 200°C
Wire options: 100mm Ⓐ, 220mm Ⓐ



HT458

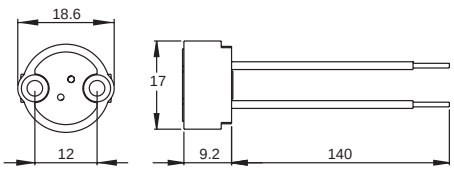


Maximum ratings: 25V, 100W, 200°C
Wire options: 205mm Ⓐ, 460mm Ⓑ



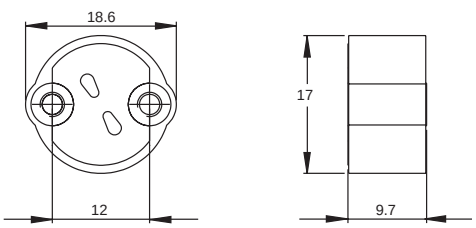
H9941

Maximum ratings: 50V, 10A, 250°C
Wire options: 140mm Ⓑ



HX814

Maximum ratings: 24V, 10A, 230°C
Wire options: none



Note: All dimensions are in mm

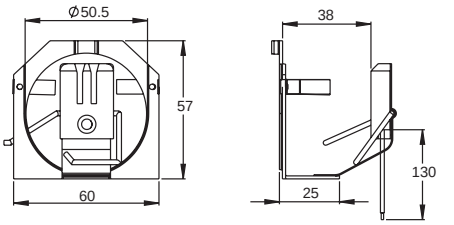
5.3mm base: G3.9[1], G5.3[2], GU5.3[3], GX5.3[4], G5.3-4.8[5] and GY5.3[6]

Key

- Ⓒ 11596 – 18AWG, 180°C, Silicon, 300V, brown
- Ⓓ 14731 – 18AWG, 250°C, PTFE, 300V, black
- Ⓔ 11642 – 16AWG, 250°C, PTFE, 300V, blue
- Ⓕ 11603 – 18AWG, 250°C, PTFE, 300V, transparent white

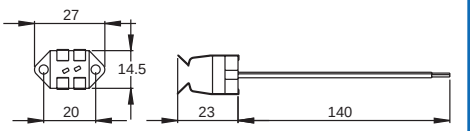
H706[3,4]

Maximum ratings: 250V, 10A, 250°C
Wire options: 130mm Ⓒ



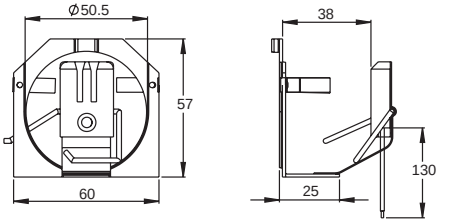
H850[3]

Maximum ratings: 12.5A, 350°C
Wire options: 140mm Ⓒ, 510mm Ⓓ



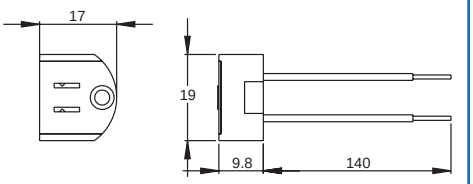
H867[6]

Maximum ratings: 250V, 10A, 250°C
Wire options: 130mm Ⓒ



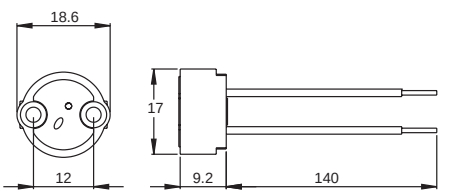
H885[5]

Maximum ratings: 250V, 10A, 250°C
Wire options: 140mm Ⓒ



H989[1,2,3,4]

Maximum ratings: 250V, 12.5A, 350°C
Wire options: 140mm Ⓓ, M3&140mm Ⓕ, M3&395mm Ⓓ, 1000mm Ⓔ



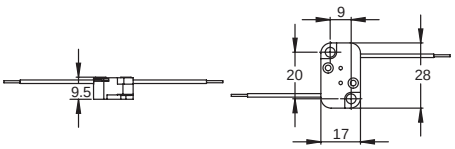
Note: All dimensions are in mm

6.35mm base: G6.35[1], GY6.35[2], GX6.35[3], GZ6.35[4]

Key Ⓒ 11596 – 18AWG, 180°C, Silicon, 300V, brown
Ⓓ 14731 – 18AWG, 250°C, PTFE, 300V, black

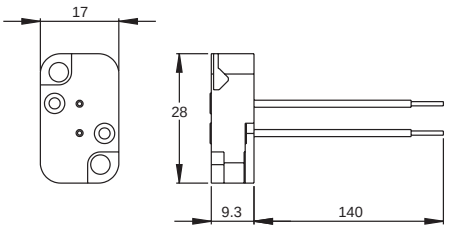
H7010A[2]

Maximum ratings: 250V, 12.5A, 350°C
Wire options: 220mm Ⓓ



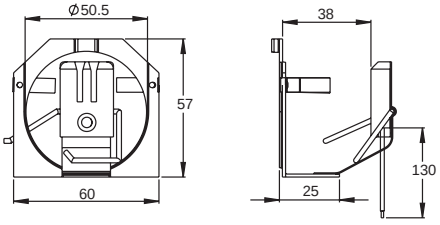
H701A[1,2,3,4]

Maximum ratings: 250V, 12.5A, 350°C
Wire options: 140mm Ⓓ



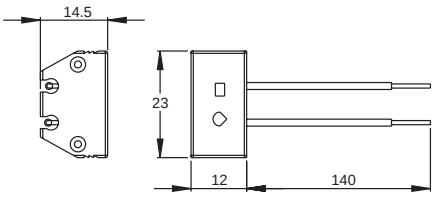
H705[4]

Maximum ratings: 250V, 10A, 250°C
Wire options: 130mm Ⓓ



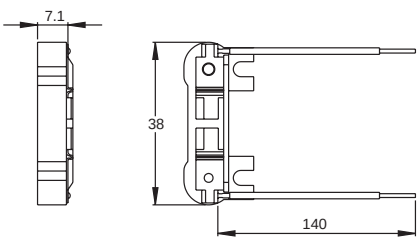
H881[1,4]

Maximum ratings: 250V, 12.5A, 250°C
Wire options: 140mm Ⓒ



H902[1, 2]

Maximum ratings: 24V, 10A, 180°C
Wire options: 140mm Ⓒ



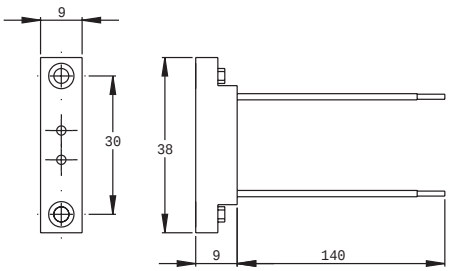
Note: All dimensions are in mm

6.35mm base: G6.35[1], GY6.35[2], GX6.35[3], GZ6.35[4]

Key Ⓒ 11596 – 18AWG, 180°C, Silicon, 300V, brown
Ⓓ 14731 – 18AWG, 250°C, PTFE, 300V, black

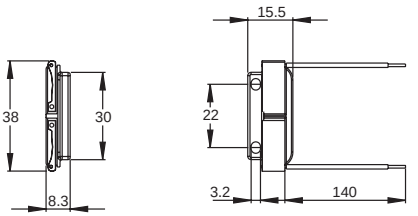
H918[1,2,3,4]

Maximum ratings: 250V, 6A, 250°C
Wire options: 140mm Ⓓ, 460mm Ⓓ



H998[1,2]

Maximum ratings: 24V, 10A, 180°C
Wire options: 140mm Ⓒ, 395mm Ⓒ



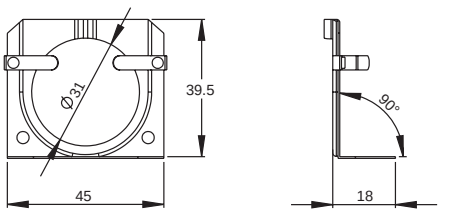
Reflector Holders

Reflector holders can be combined with any compatible lamp holder to give a reflector lamp more stability.

These are made from plated alloy steel

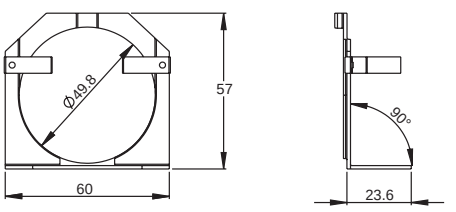
H708

Reflector: MR11



H707

Reflector: MR16



Note: All dimensions are in mm

R7 base:

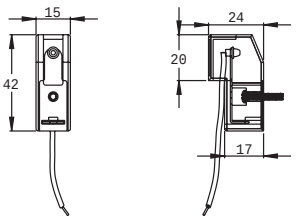
Key

- Ⓐ *UL3122 – 200°C, Braided Silicon, 300V, white*
- Ⓔ *11642 – 16AWG, 250°C, PTFE, 300V, blue*
- Ⓗ *ULSF216 – 16AWG, 200°C, Braided Silicon, 600V, white*
- Ⓘ *11636 – 16AWG, 180°C, Braided Silicon, 300V, white*

H9432

Maximum ratings: 250V, 500W, 200°C

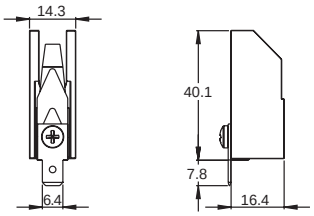
Wire options: 110mm Ⓐ



H944

Maximum ratings: 600V, 1500W, 350°C

Wire options: None, 300mm Ⓗ, 580mm Ⓗ, 1210mm Ⓗ

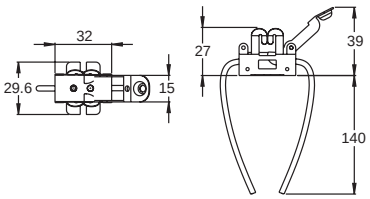


9.5mm base: GY9.5[1], GZ9.5[2]

H9971[1,2]

Maximum ratings: 500V, 10A, 250°C

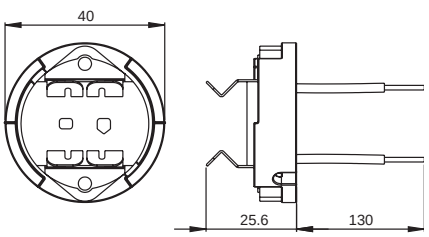
Wire options: 140mm Ⓘ



H999[1,2]

Maximum ratings: 300V, 10A, 250°C

Wire options: 130mm Ⓔ



Note: All dimensions are in mm

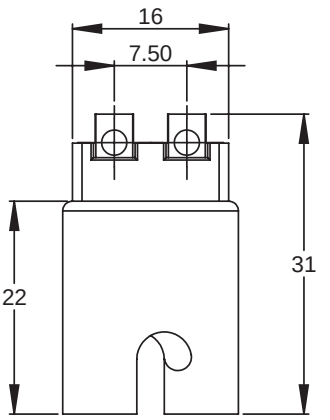
Ba15 base: Ba15s[1], Ba15d[2]

Key Ⓙ *W-2844-19 – 28AWG, 200°C, PTFE, 250V, black*

H257[1,2]

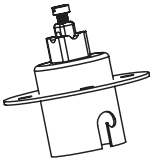
Maximum ratings: 250V, 10A, 250°C

Wire options: none

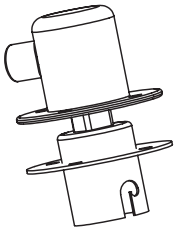


H257 options:

Standard



with flange



with silicone boot

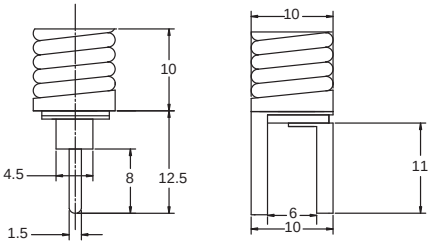
Miniature Lampholders

This is a collection of various lampholders that fit into the miniature range, i.e. the pin spacing is less than four mm.

Screw

H110

Base type: E10

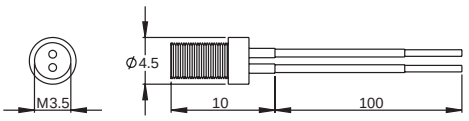


BiPin

H127

Base type: G1.27/T1

Wire options: none, 100mm Ⓙ, 300mm Ⓙ



Note: All dimensions are in mm

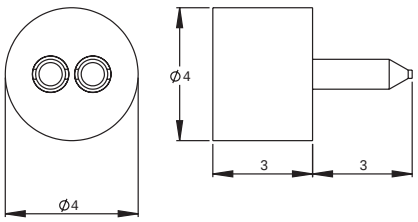
Miniature Lampholders

Key Ⓙ *W-2844-19 – 28AWG, 200°C, PTFE, 250V, black*

BiPin

H716

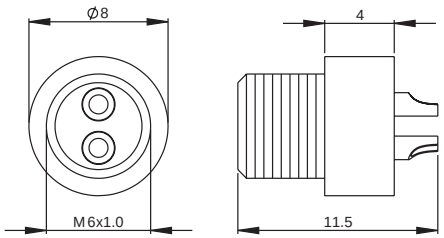
Base type: G1.27/T1



H250

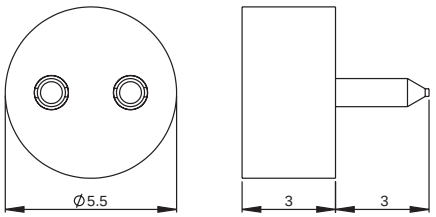
Base type: G2.54/T1¼

Wire options: none, 150mm Ⓙ, 250mm Ⓙ



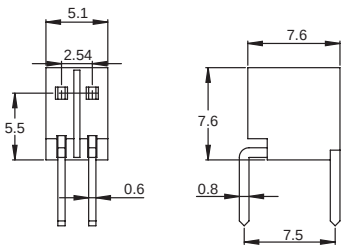
H714

Base type: G2.54/T1¼



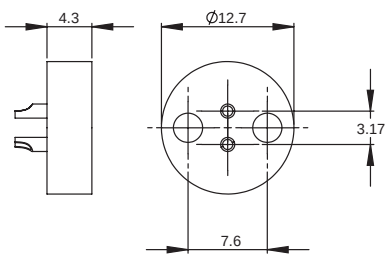
H719

Base type: G2.54/T1¼



H720

Base type: G3.17/T1¾



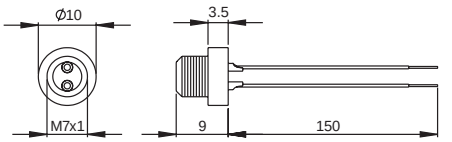
Note: All dimensions are in mm

Miniature Lampholders - BiPin

Key Ⓙ *W-2844-19 – 28AWG, 200°C, PTFE, 250V, black*
Ⓚ *UL1015 – 18AWG, 105°C, PVC, 600V, black*

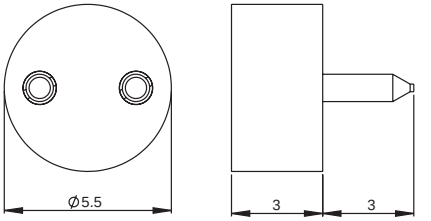
H320

Base type: G3.17/T1¾
Wire options: none, 150mm Ⓙ, 250mm Ⓙ



H715

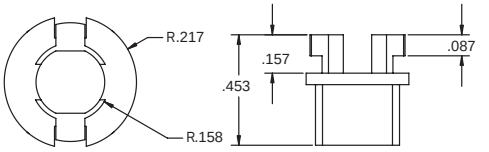
Base type: G3.17/T1¾



Miniature Lampholders - Wedge

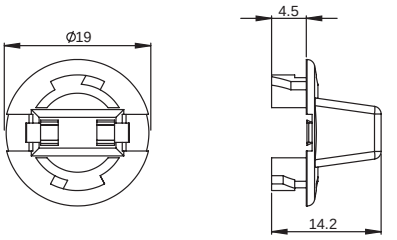
H710A

Base type: T3¼



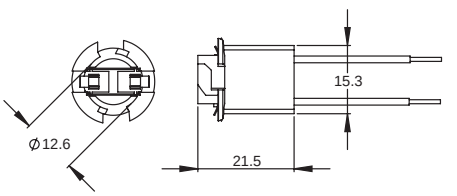
H711

Base type: T3¼



H718

Base type: T3¼
Wire options: 200mm Ⓚ



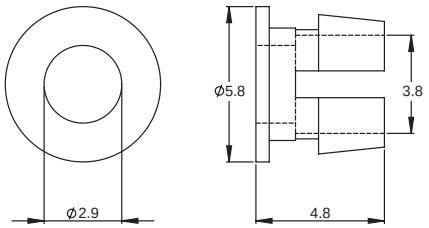
Note: All dimensions are in mm

Mounting Clips

Mounting clips are used to hold a miniature lamp or a LED in a panel.
These are the grommets which the lamp fits into and have no contacts/lead wires attached.

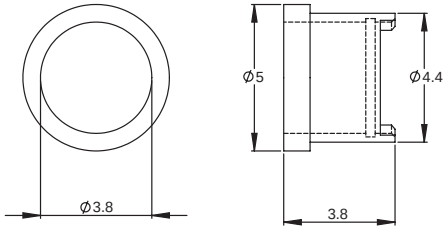
H767

Lamp size: T1



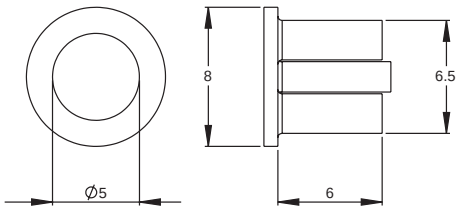
H772

Lamp size: T1



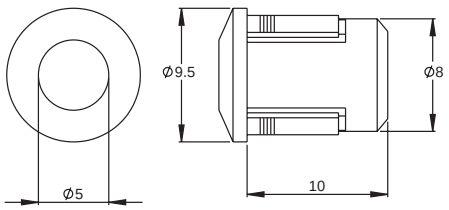
H768

Lamp size: T1¾

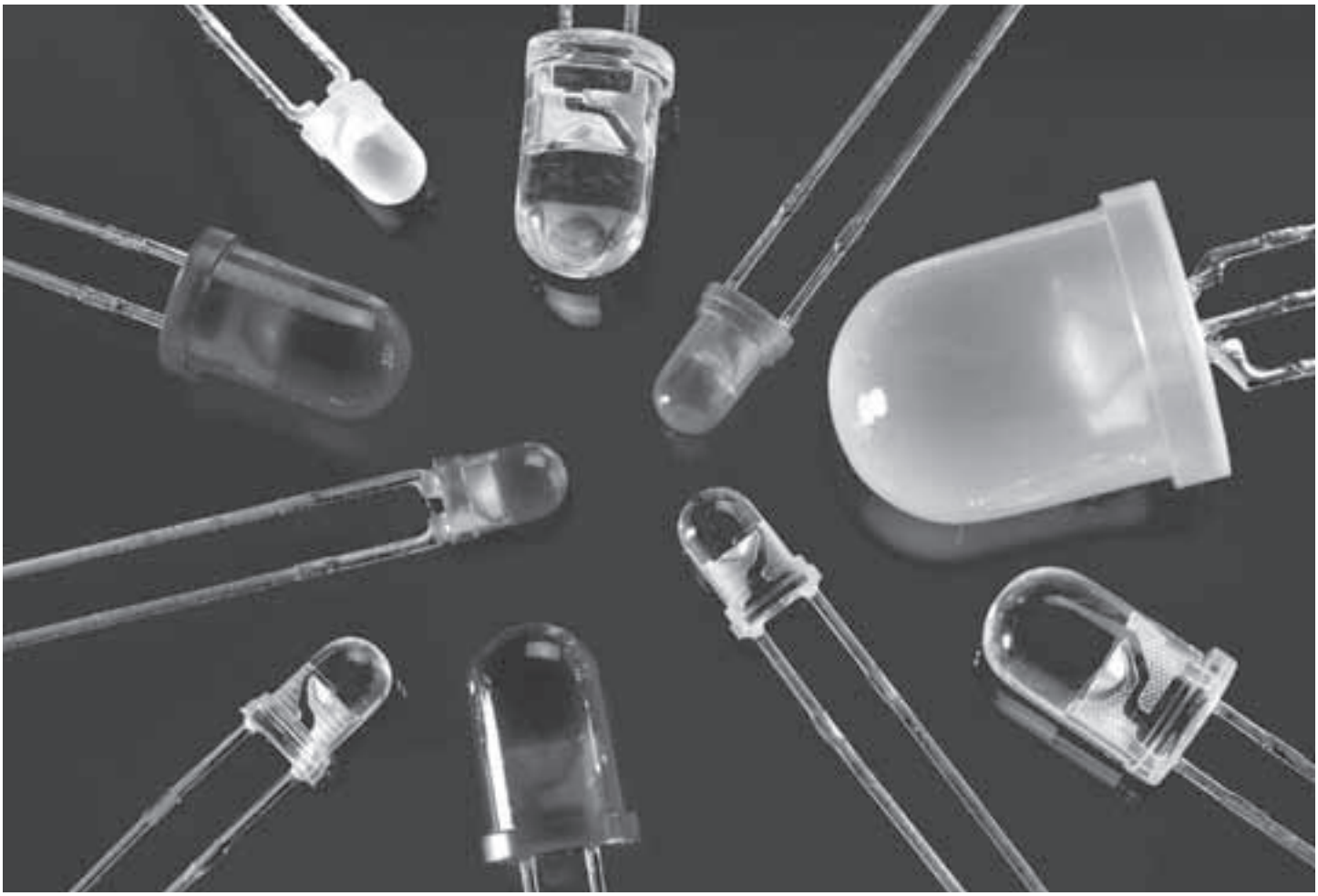


H769

Lamp size: T1¾



Note: All dimensions are in mm



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).

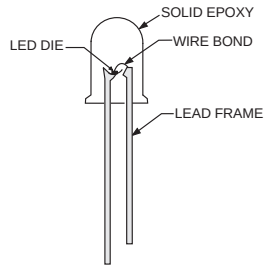
If the voltage source is applied in the reverse direction, the P-N junction will block current flow until the voltage applied exceeds the devices ability to block the current. At that point, the device junction will break down, and if there is no current limit device in the circuit, the LED will be destroyed.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

FIGURE 1

T-1 and T-1¾ LED CONSTRUCTION



Many of our LEDs incorporate high efficiency chips mounted into T-1, T-1¾, and SMT (surface mount) packages. However, there are a wide variety of right angle, multi-package and custom packages available to meet your requirements.

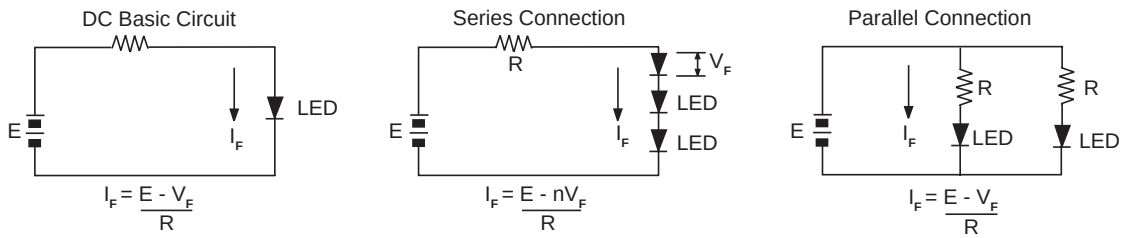
The output of LEDs is typically expressed in millicandela (mcd). The candela is defined as the number of lumens per steradian of solid angle. It is usually measured along the projection axis of the device and gives the eye's response to the light. The viewing angle for LEDs is specified as the included angle between the ½ intensity points on either side of the output beam. For T-1 and T-1¾ 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.

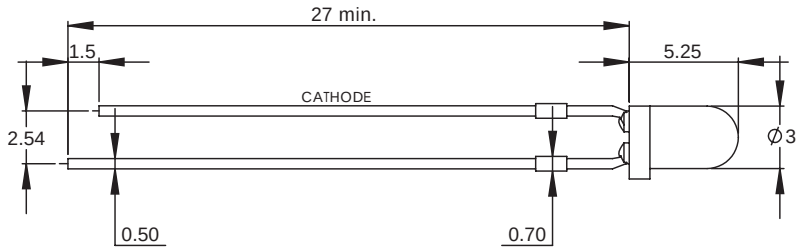
Drive circuits

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.

FIGURE 2:
LED configurations



T-1

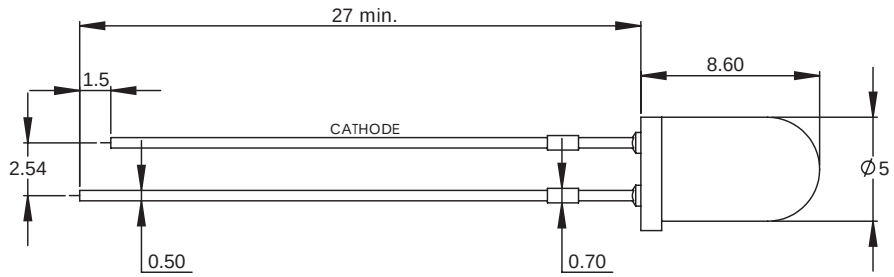


Note: All dimensions are in mm

T-1

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

T-1¾

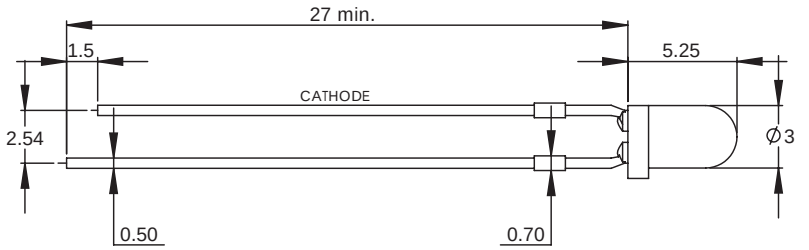


Note: All dimensions are in mm

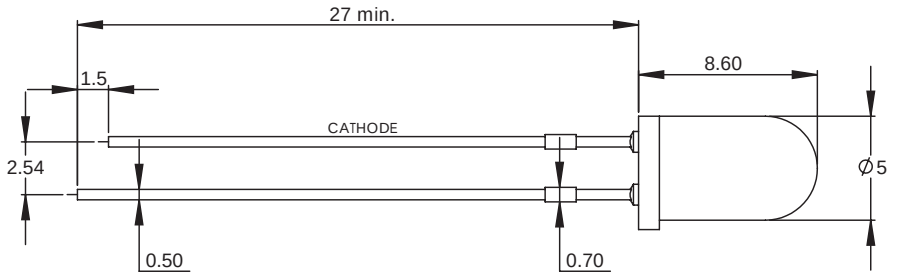
T-1¾

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

T-1 Low Current



T-1¾ Low Current



Note: All dimensions are in mm

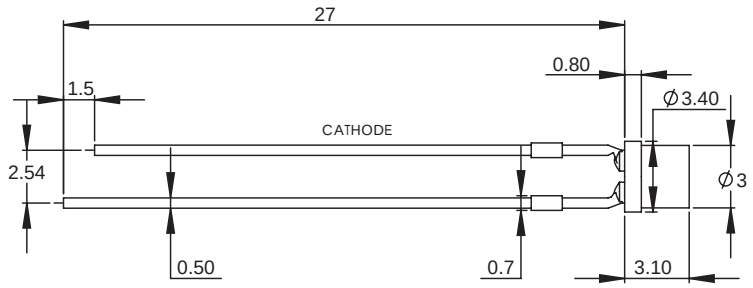
T-1 Low Current

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 2mA Min	Luminous Intensity at 2mA Typical	Viewing Angle	Forward Voltage at 2mA Typical	Forward Voltage at 2mA Max	Peak Wave Length at 2mA
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

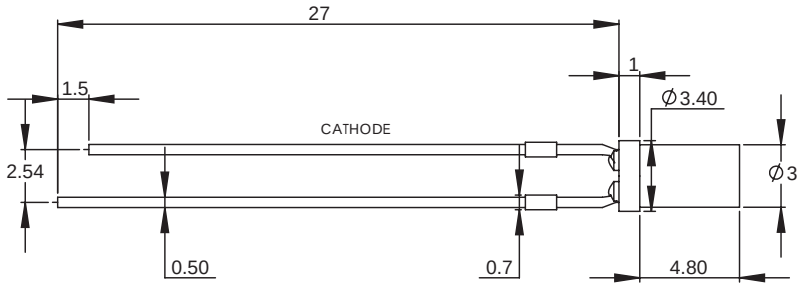
T-1¾ Low Current

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 2mA Min	Luminous Intensity at 2mA Typical	Viewing Angle	Forward Voltage at 2mA Typical	Forward Voltage at 2mA Max	Peak Wave Length at 2mA
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

T-1 Short



T-1 Flat



Note: All dimensions are in mm

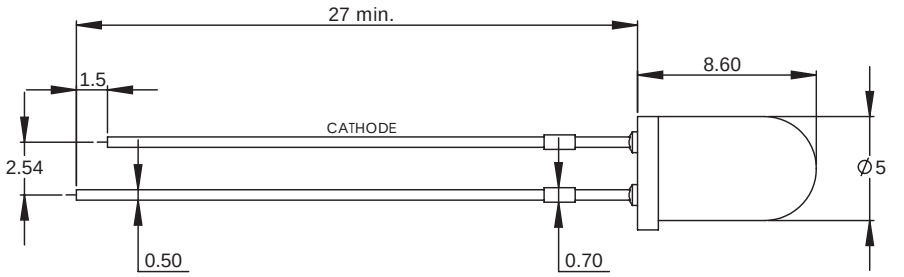
T-1 Short

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

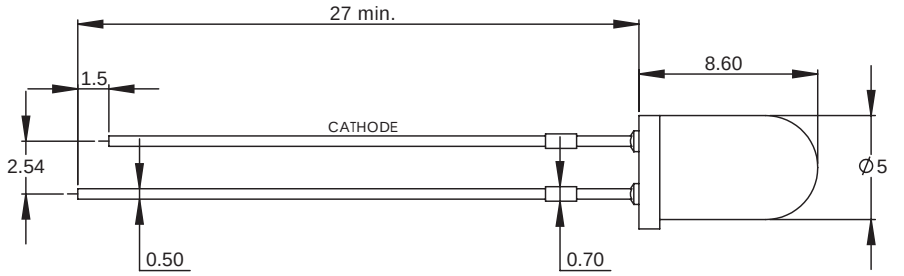
T-1 Flat

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

T-1¾ with Resistor



T-1¾ Flashing



Note: All dimensions are in mm

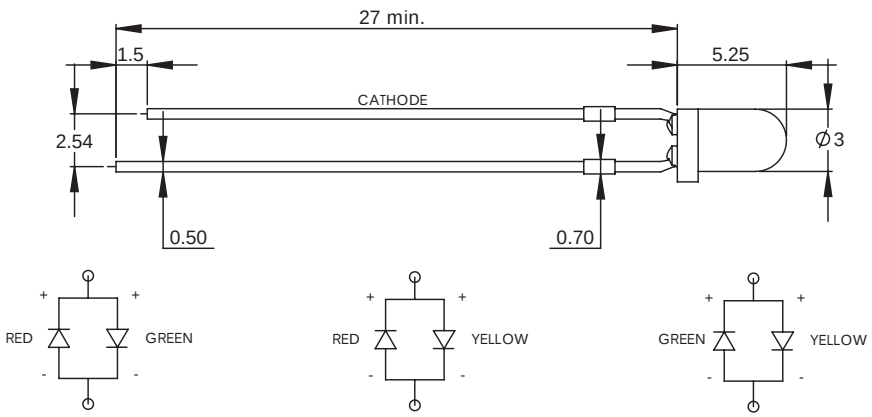
T-1¾ with Resistor - 12V

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 12VDC Min	Luminous Intensity at 12VDC Max	Viewing Angle	Current Range at 12VDC Typical	Current Range at 12VDC Max	Peak Wave Length at 12VDC
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

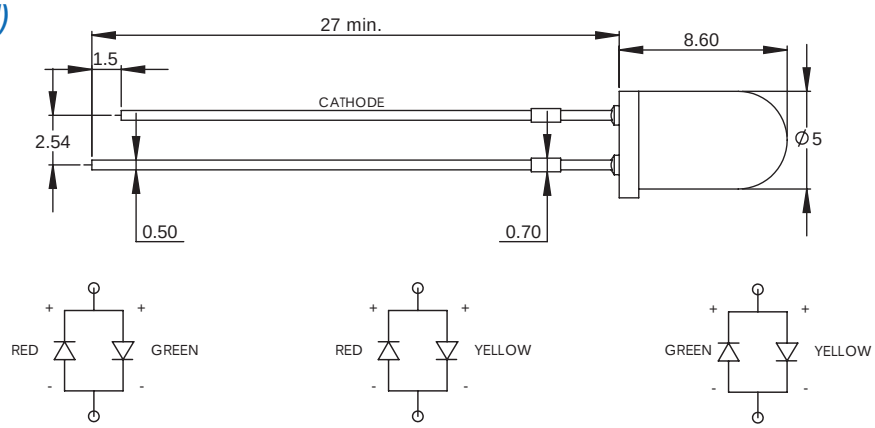
T-1¾ Flashing

Line No.	Part No.	Color	Lens Type	Forward D.C. Voltage Min	Forward D.C. Voltage Typical	Forward D.C. Voltage Max	Luminous Intensity at 9.0 VDC Min	Luminous Intensity at 9.0 VDC Max	Viewing Angle	Peak Frequency (Hz)	Wave Length
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

T-1 Bi Color (2 lead)



T-1¾ Bi Color (2 lead)



Note: All dimensions are in mm

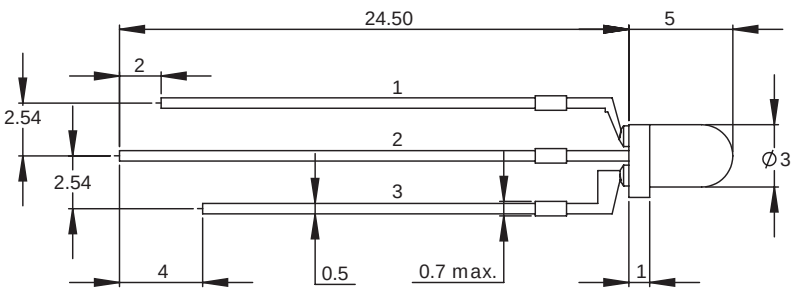
T-1 Bi Color (2 lead)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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 Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

T-1 Bi Color (3 lead)

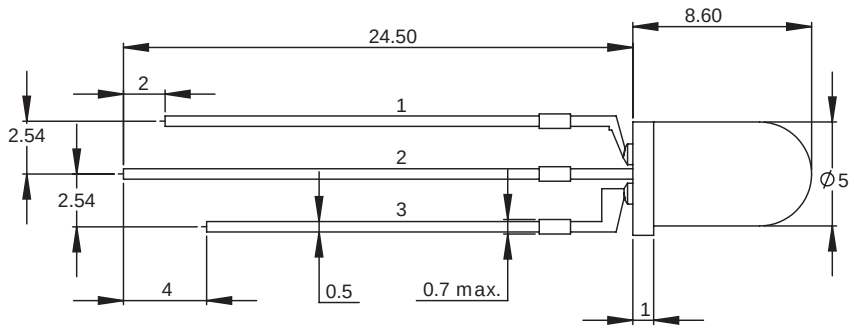


Note: All dimensions are in mm

T-1 Bi Color (3 lead)

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

T-1¾ Bi Color (3 lead)

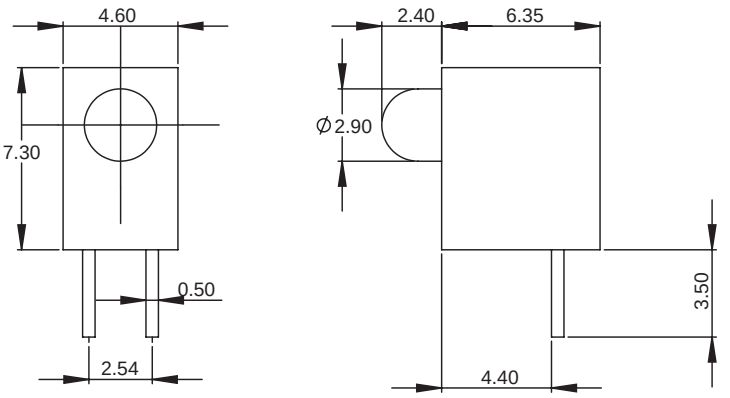


Note: All dimensions are in mm

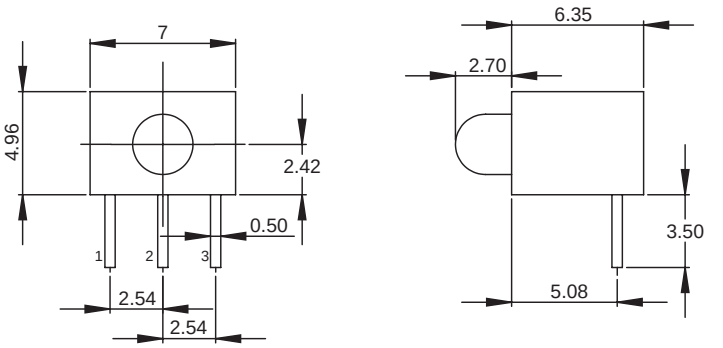
T-1¾ Bi Color (3 lead)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA	Leads
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.Green Cathode
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.Green Cathode
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

T-1 Right Angle



T-1 Right Angle Bi Color short



Note: All dimensions are in mm

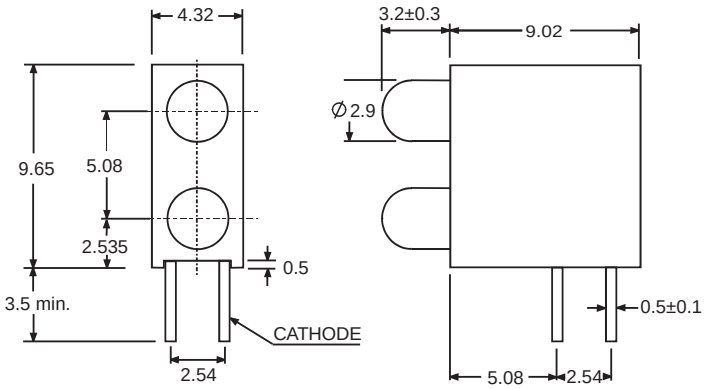
T-1 Right Angle

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

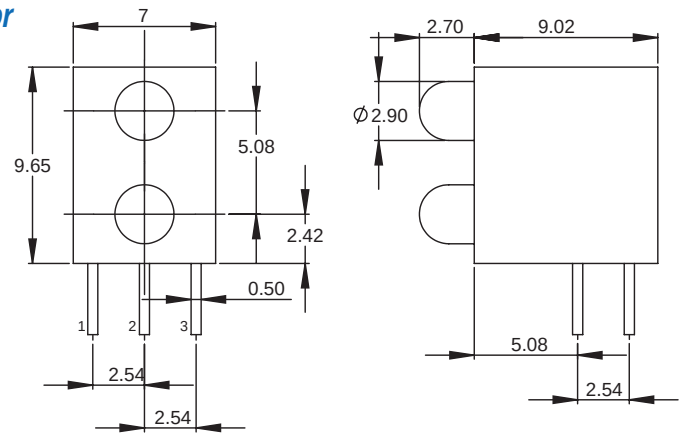
T-1 Right Angle Bi Color short

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

T-1 Right Angle Bi Level



T-1 Right Angle Bi Level Bi Color



Note: All dimensions are in mm

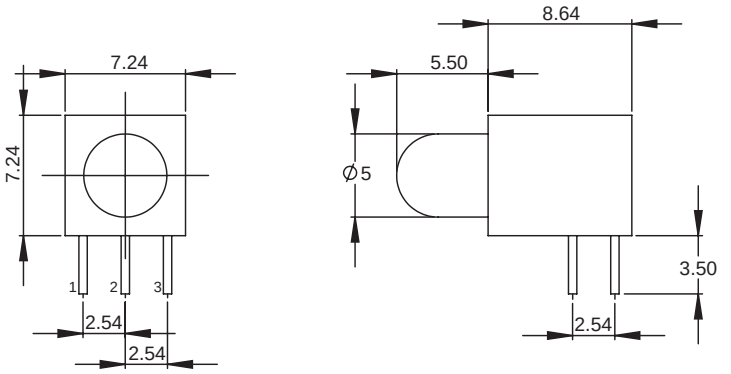
T-1 Right Angle Bi Level

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

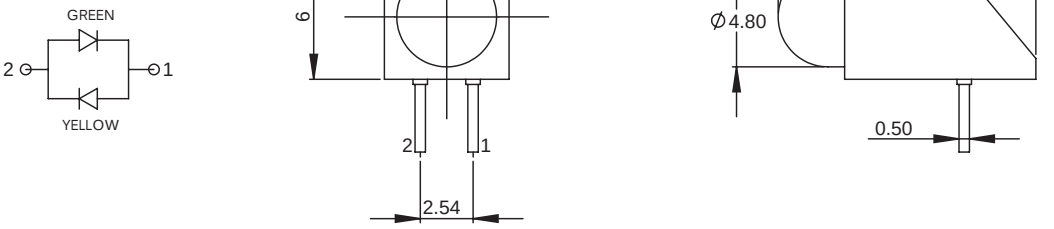
T-1 Right Angle Bi Level Bi Color

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

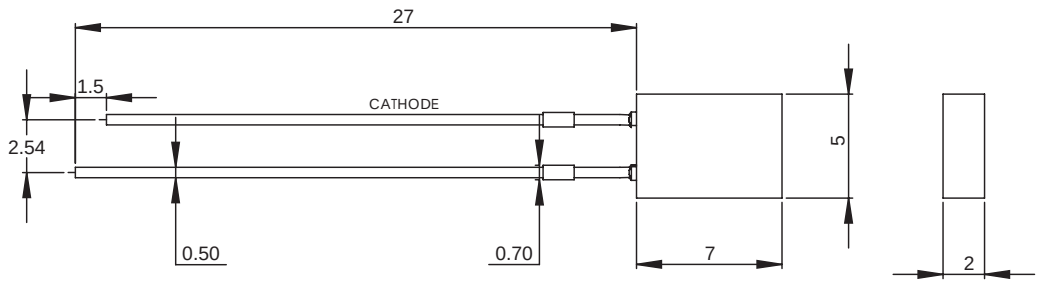
T-1¾ Right Angle Bi Color (3 lead)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA	Leads
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

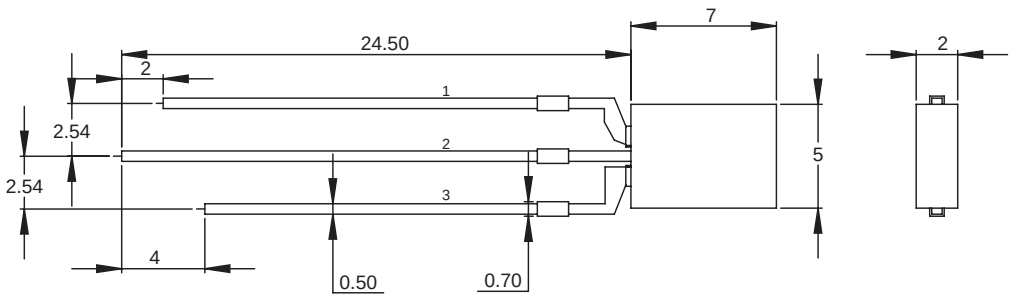
T-1¾ Right Angle Bi Color (2 lead)

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

Rectangular (2x5)



Rectangular (2x7) Bi Color (3 lead)



Note: All dimensions are in mm

Rectangular (2x5)

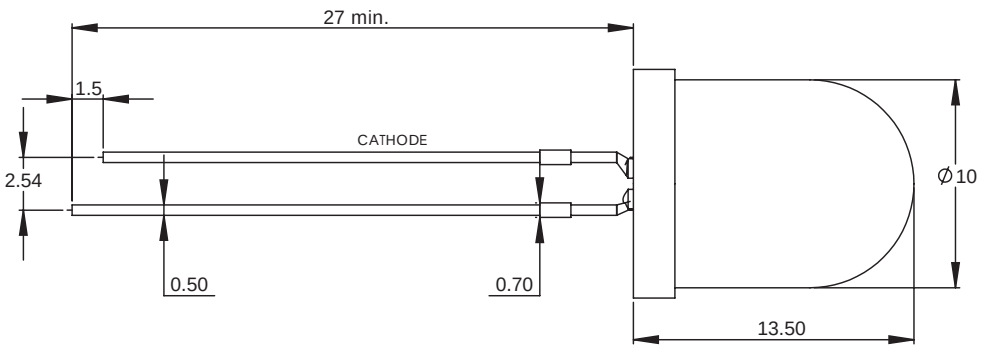
Line No.	Part No.	Color	Lens Type	Luminous Intensity at 10mA Min	Luminous Intensity at 10mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
1	E222	Red	Diffused	0.4mcd	1mcd	110°	2.25V	2.5V	700nm
2	E226	Red	Diffused	36mcd*	80mcd*	110°	1.85V	2.5V	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 Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA	Leads
8	E214	Red & Green	White	18mcd	60mcd	110°	1.85V	2.5V	660nm	1. Red Anode
			Diffused	4mcd	12mcd	110°	2.2V	2.5V	565nm	2. Cathode
										3. Green Anode

T-3¼

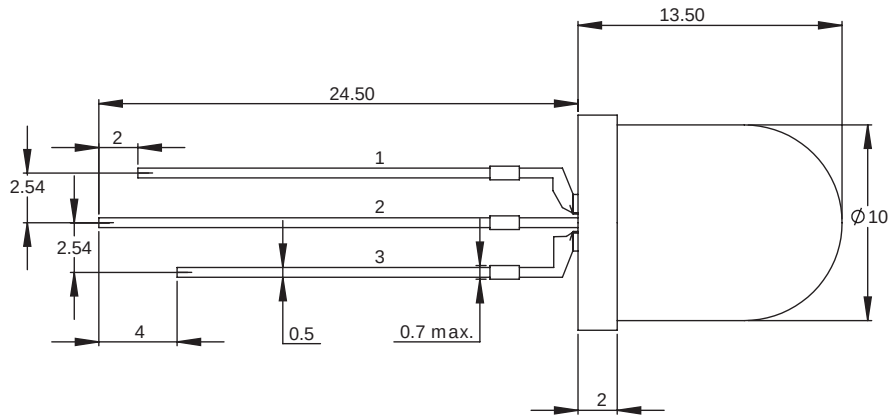


Note: All dimensions are in mm

T-3¼

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

T-3¼ Bi Color (3 lead)

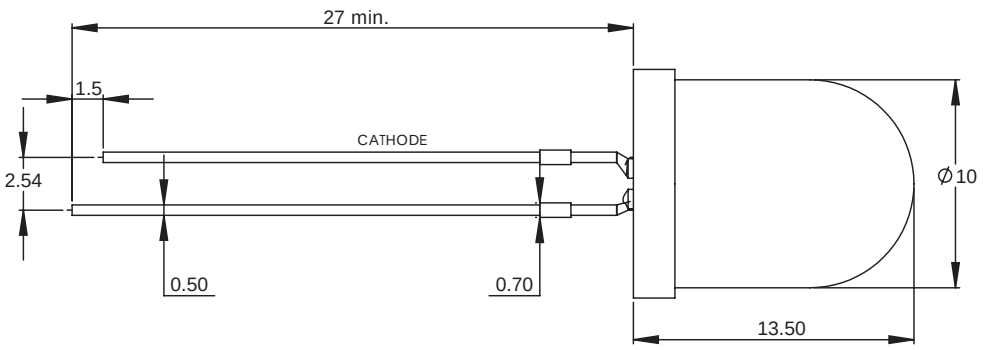


Note: All dimensions are in mm

T-3¼ Bi Color (3 lead)

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Min	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA	Leads
1	E187	Red & Green	White	110mcd	300mcd	50°	1.85V	2.5V	660nm	1.Red Anode
			Diffused	36mcd	50mcd	50°	2.2V	2.5V	565nm	2.Cathode
										3.Green Anode
2	E188	Red & Green	White	36mcd	80mcd	50°	2.0V	2.5V	627nm	1.Red Anode
			Diffused	18mcd	50mcd	50°	2.2V	2.5V	565nm	2.Cathode
										3.Green Cathode
3	E189	Green & Yellow	White	18mcd	50mcd	50°	2.2V	2.5V	565nm	1.Green Anode
			Diffused	10mcd	30mcd	50°	2.1V	2.5V	590nm	2.Cathode
										3.Yellow Anode

T-3¼ Flashing

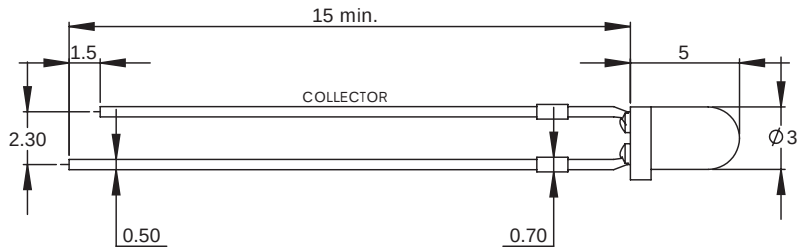


Note: All dimensions are in mm

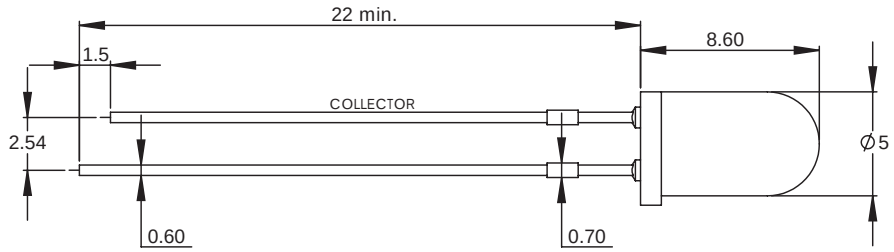
T-3¼ Flashing

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

T-1 Phototransistor



T-1¾ Phototransistor



Note: All dimensions are in mm

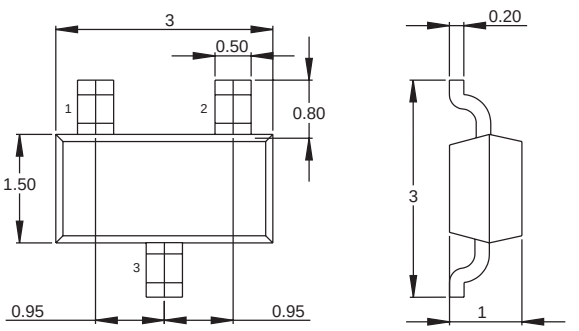
T-1 Phototransistor

Line No.	Part No.	Viewing Angle	$I_{(ON)}$ at 5V Min	$I_{(ON)}$ at 5V Max	I_{CEO} at 10V Maximum	$V_{BR\ CEO}$ Minimum	$V_{BR\ ECO}$ Minimum	$V_{CE\ (SAT)}$ Maximum
1	D40	50°	0.3mA	0.8mA	100nA	30V	5V	0.8V

T-1¾ Phototransistor

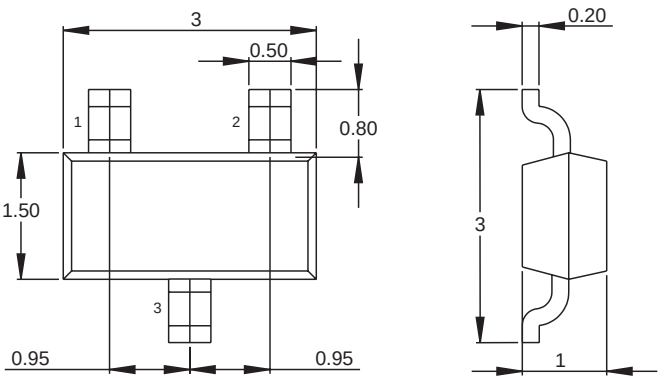
Line No.	Part No.	Viewing Angle	$I_{(ON)}$ at 5V Min	$I_{(ON)}$ at 5V Max	I_{CEO} at 10V Maximum	$V_{BR\ CEO}$ Minimum	$V_{BR\ ECO}$ Minimum	$V_{CE\ (SAT)}$ Maximum
2	D41	20°	0.1mA	0.5mA	100nA	30V	5V	0.8V

A



1. N.O.
2. ANODE
3. CATHODE

B



Note: All dimensions are in mm

Surface Mount, SOT-23 Package

Line No.	Part No.	Color	Lens Type	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Maximum	Peak Wave Length at 20mA	Drawing
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

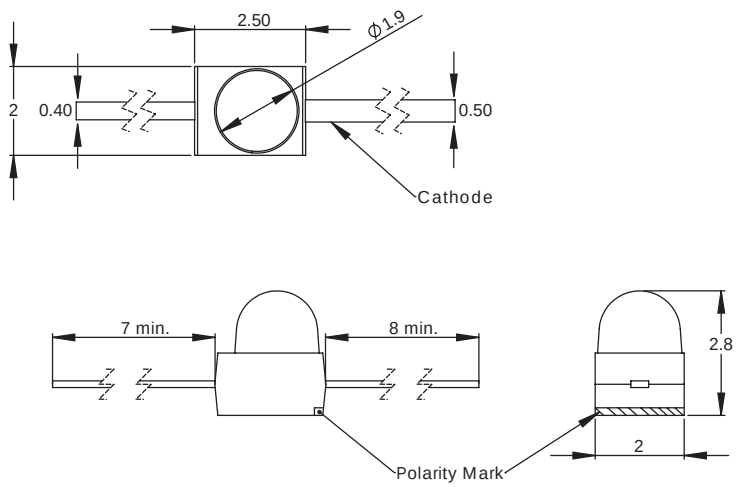
Tape & Reel packaging is standard.

Surface Mount, SOT-23 Package

Line No.	Part No.	Color	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Maximum	Peak Wave Length at 20mA	Terminals	Drawing
4	E43	Red & Green	10mcd 5mcd	100° 100°	2.1V	2.8V	635nm 570nm	1.Red Cathode 2.Green Cathode 3.Anode	B
5	E44	Red & Yellow	10mcd 5mcd	100° 100°	2.1V	2.8V	635nm 585nm	1.Red Cathode 2.Yellow Cathode 3.Anode	B
6	E45	Green & Yellow	10mcd 4.5mcd	100° 100°	2.1V 2.2V	2.8V 2.5V	570nm 585nm	1.Yellow Cathode 2.Green Cathode 3.Anode	B

Tape & Reel packaging is standard.

Surface Mount, Gull Wing



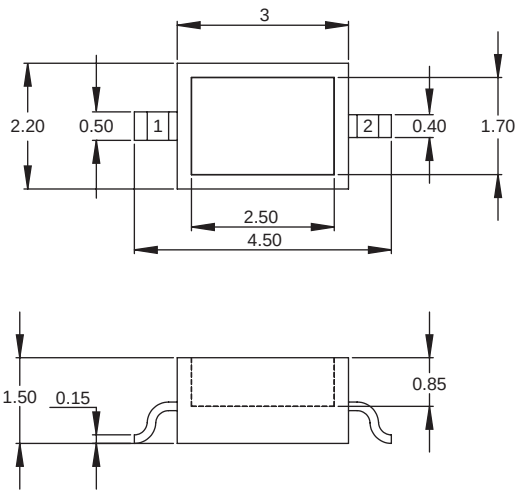
Note: All dimensions are in mm

Surface Mount, Gull Wing

Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA Minimum	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Maximum	Peak Wave Length at 20mA
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.

Surface Mount (Rectangular Lens)



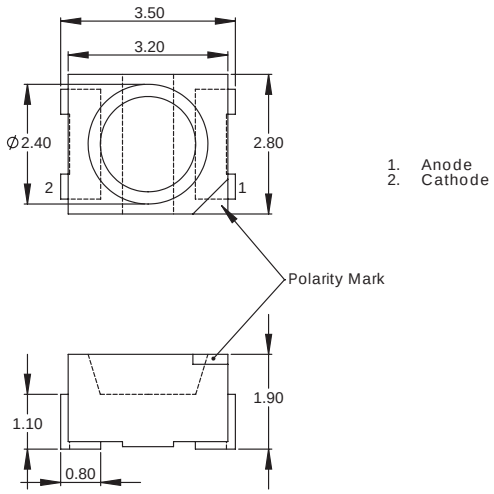
Note: All dimensions are in mm

Surface Mount (Rectangular Lens)

Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA Minimum	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Maximum	Peak Wave Length at 20mA
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.

A



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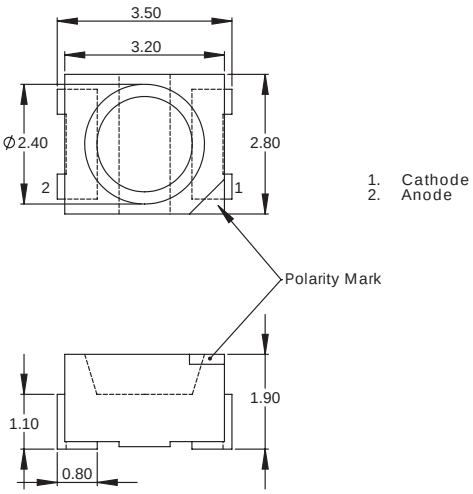


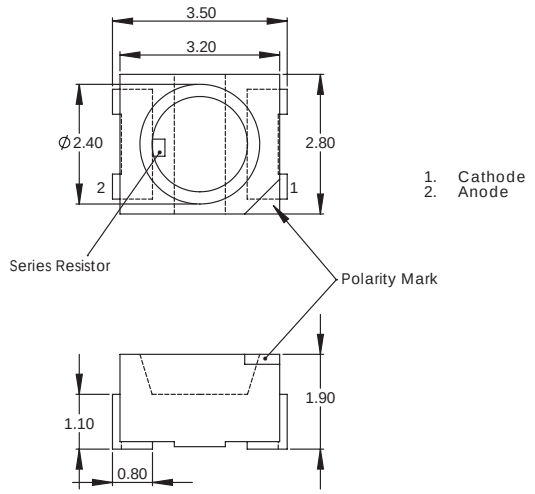
Note: All dimensions are in mm

Surface Mount (Round Lens)

Line No.	Part No.	Color	Lens	Luminous Intensity at 20mA Minimum	Luminous Intensity at 20mA Typical	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Maximum	Peak Wave Length at 20mA	Drawing
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	120º	2.25V	2.5V	555nm	B
6	E75	Blue	Blue	5mcd	12mcd	120º	3.8V	4.5V	430nm	B
7	E77	Yellow	Yellow	36mcd	120mcd	120º	2V	2.5V	590nm	B
8	E78	Orange	Orange	10mcd	30mcd	120º	2.05V	2.5V	607nm	B

Tape & Reel packaging is standard.

A



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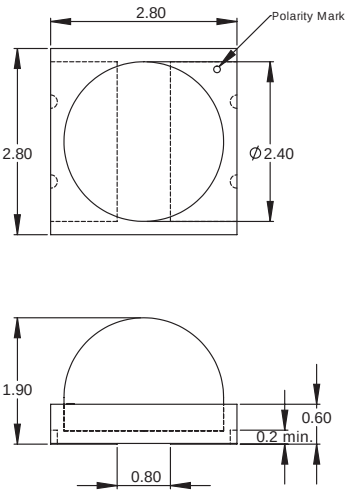


Note: All dimensions are in mm

Surface Mount with Resistor - 5V

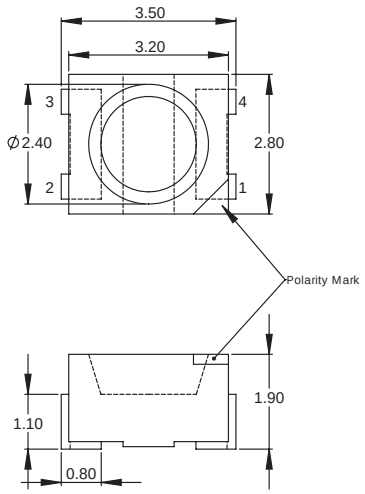
Line No.	Part No.	Color	Lens	Luminous Intensity at 5VDC Min	Luminous Intensity at 5VDC Max	Viewing Angle	Current Range at 5VDC Typ	Current Range at 5VDC Max	Peak Wave Length at 5VDC	Drawing
1	E70-5V*	Red	Red	55mcd	110mcd	120°	13mA	17.5mA	660nm	A
2	E71-5V	Red	Red	12mcd	20mcd	120°	13mA	17.5mA	627nm	A
3	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 @100mA	Luminous Intensity @140mA	CCT	Typical Voltage	Viewing Angle	Chroma coords.	Drawing
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

A



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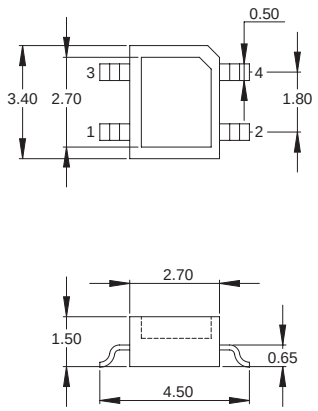
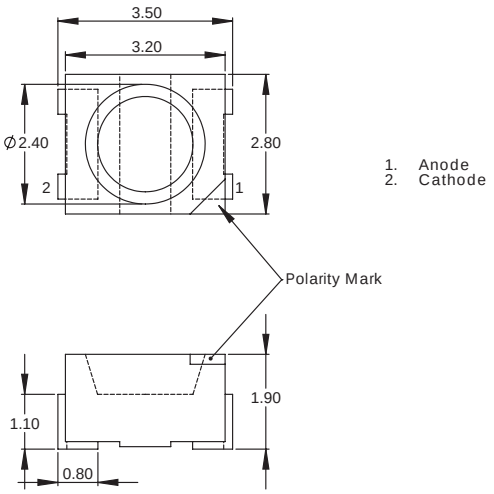


Note: All dimensions are in mm

Surface Mount, Bi-Color

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

A



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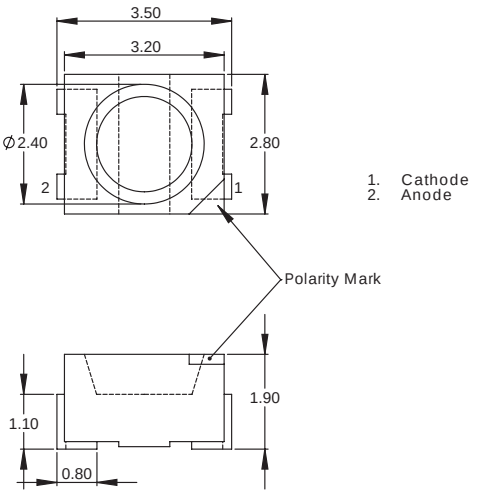


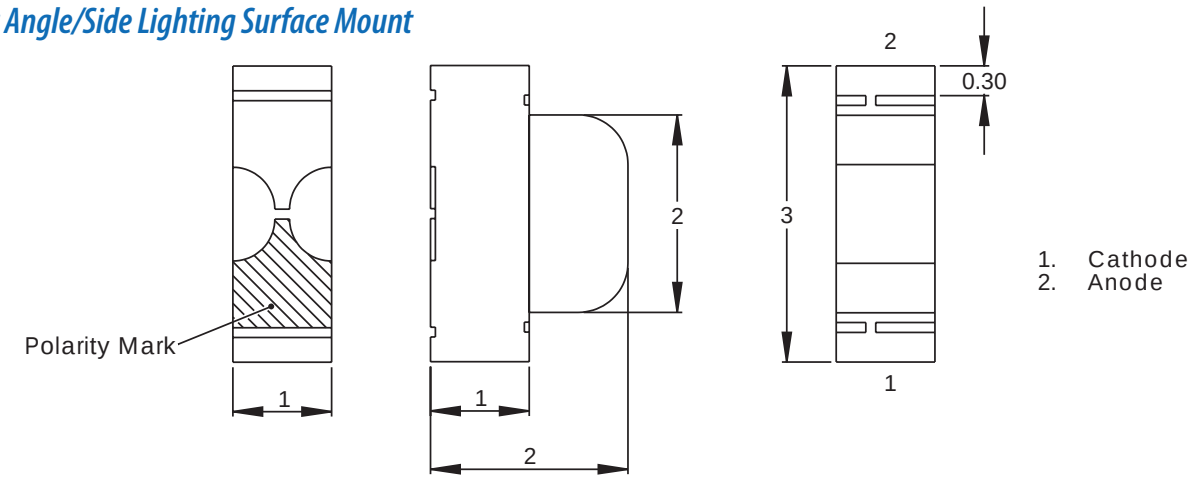
Note: All dimensions are in mm

Surface Mount Infrared 880nm, 940nm

Line No.	Part No.	Color	Lens	Radiant Power at 20mA Min	Max	Forward Voltage Viewing Angle	Peak at 20mA Typical	Max	Wave Length at 20mA	Drawing
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.

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 Min	Luminous Intensity at 20mA Max	Viewing Angle	Forward Voltage at 20mA Typical	Forward Voltage at 20mA Max	Peak Wave Length at 20mA
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

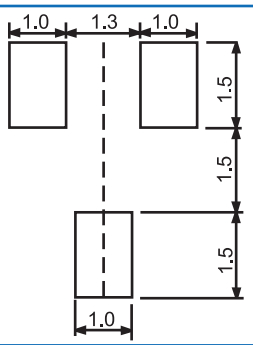
Tape & Reel packaging is standard.

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

1



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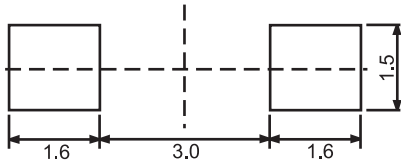

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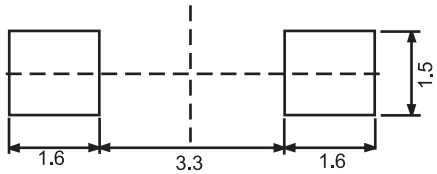

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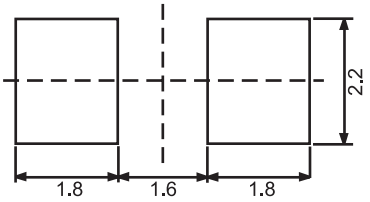

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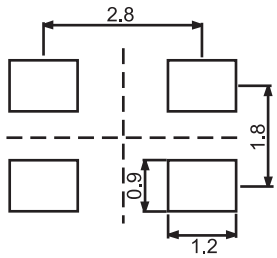

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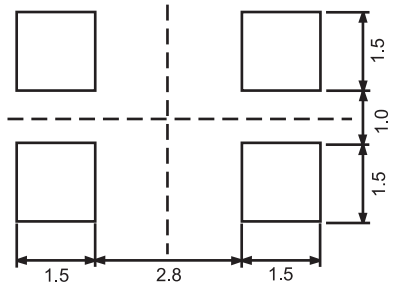

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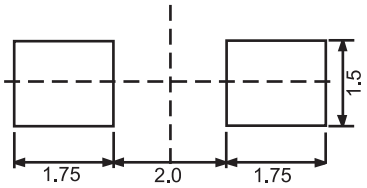

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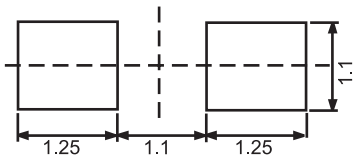

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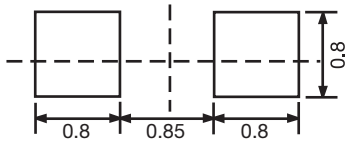
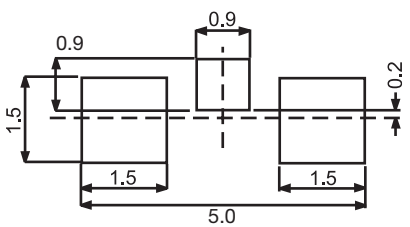


Note: All dimensions are in mm

10



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

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_F=20mA	4.5	3.6	3.5	2.25	2.2	2.1	2.0	V
Forward Voltage (max.) I_F=20mA	5.5	4.0	4.0	2.6	2.5	2.5	2.5	V
Reverse Current V_R=5V	100	50	50	10	10	10	10	uA
Wavelength at Peak Emmission I_F=20mA	430	470	525	555	565	590	595	nm
Spectral line half-width I_F=20mA	65	30	40	30	30	35	15	nm
Capacitance V_F=0V, f=1MHz	100	50	50	45	45	10	33	pF

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) $t \leq 10\mu s$	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

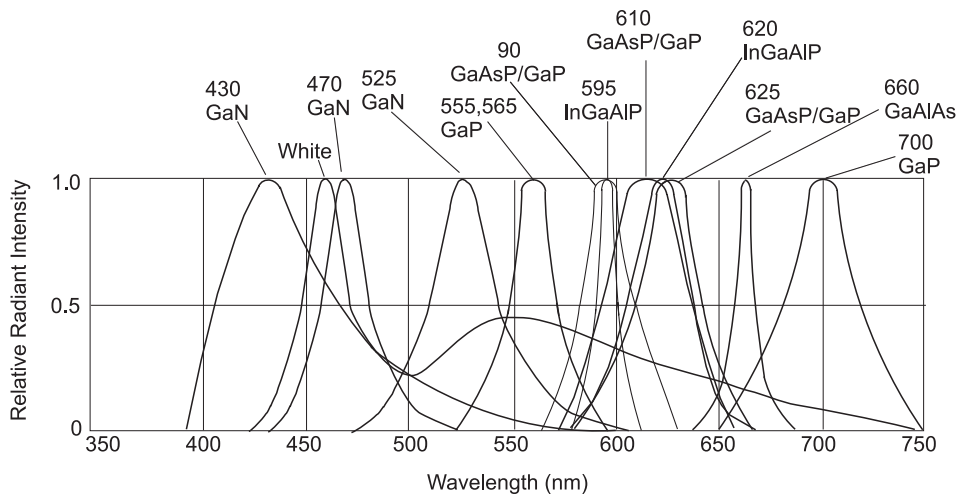
Operating Characteristics (TA=25°C)	610nm (GaAsP/ GaP)	620nm (InGaAlP)	625nm (GaAsP/ GaP)	660nm (GaAlAs)	700nm (GaP)	880nm (GaAlAs)	940nm (GaAs)	Unit
Forward Voltage (typ.) I_F=20mA	2.0	1.95	2.0	1.85	2.0	1.4	1.2	V
Forward Voltage (max.) I_F=20mA	2.6	2.5	2.5	2.5	2.5	1.7	1.5	V
Reverse Current V_R=5V	10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

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

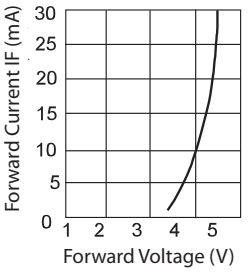
Operating Characteristics (TA=25°C)	565nm (GaP)	590nm (GaAsP/GaP)	625nm (GaAsP/GaP)	660nm (GaAlAs)	Unit
Forward Current (typ)					
V_F=5V	12	12	12	13	mA
V_F=12V	11	11	11	10	mA
Reverse Current V_R=5v	10	10	10	10	uA
Wavelength at Peak Emmission I_F=20mA	565	590	625	660	nm
Spectraline half-width I_F=20mA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

Relative intensity vs. wavelength

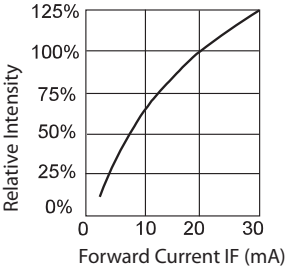


430nm (GaN)

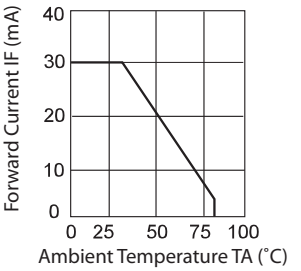
FORWARD CURRENT VS. FORWARD VOLTAGE



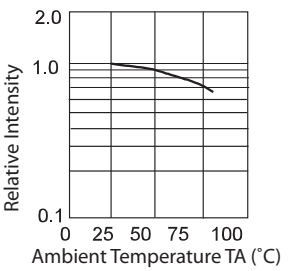
RELATIVE INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

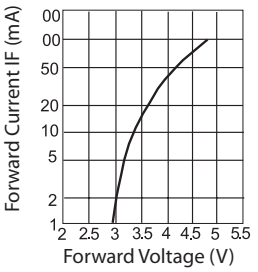


LUMINOUS INTENSITY VS. AMBIENT TEMP.

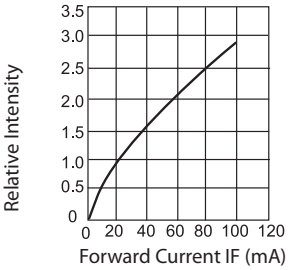


470nm (GaN)

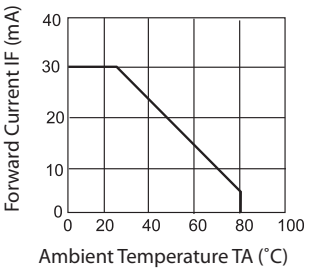
FORWARD CURRENT VS. FORWARD VOLTAGE



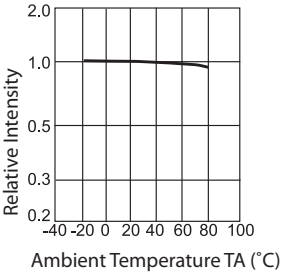
RELATIVE INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

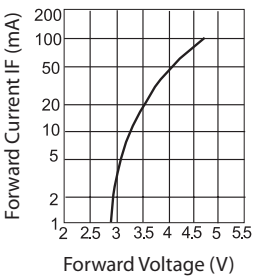


LUMINOUS INTENSITY VS. AMBIENT TEMP.

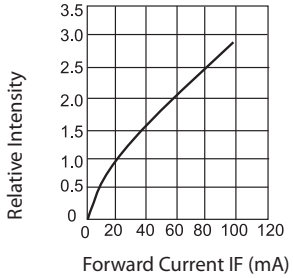


525nm (GaN)

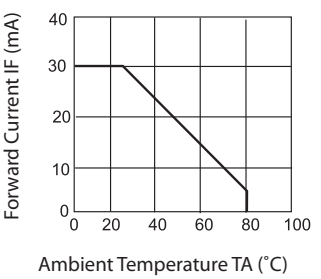
FORWARD CURRENT VS. FORWARD VOLTAGE



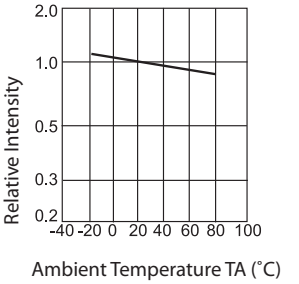
RELATIVE INTENSITY VS FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

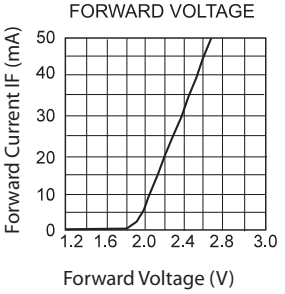


LUMINOUS INTENSITY VS. AMBIENT TEMP.

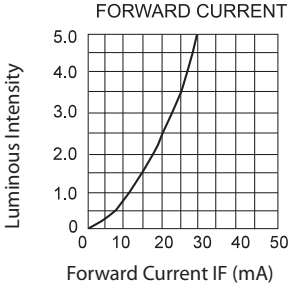


555nm (GaP)

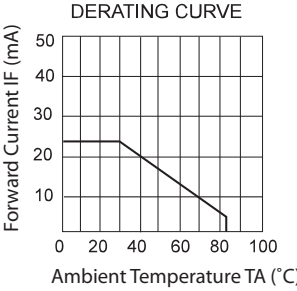
FORWARD CURRENT VS. FORWARD VOLTAGE



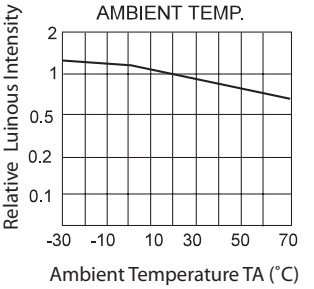
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

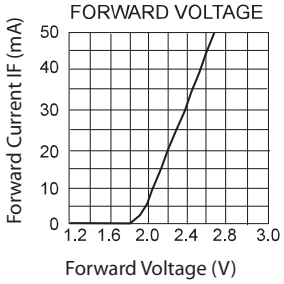


LUMINOUS INTENSITY VS. AMBIENT TEMP.

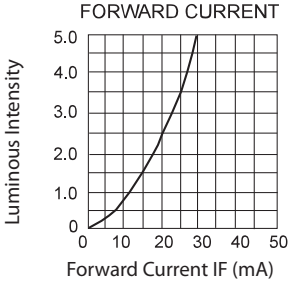


565nm (GaP)

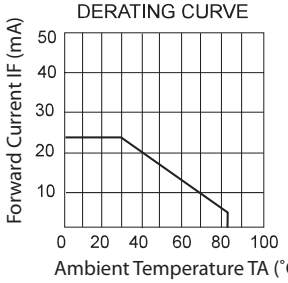
FORWARD CURRENT VS. FORWARD VOLTAGE



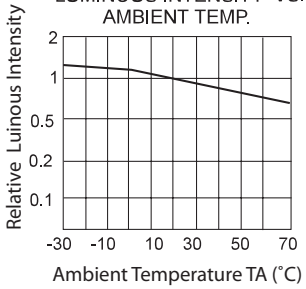
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

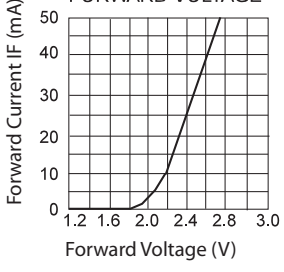


LUMINOUS INTENSITY VS. AMBIENT TEMP.

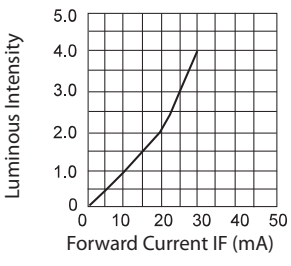


590nm (GaAsP/GaP)

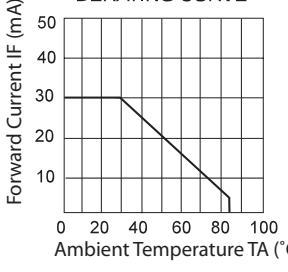
FORWARD CURRENT VS. FORWARD VOLTAGE



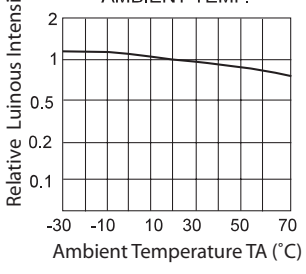
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

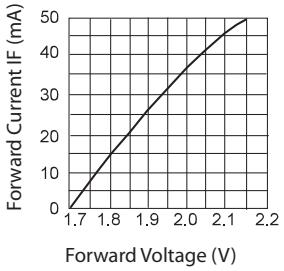


LUMINOUS INTENSITY VS. AMBIENT TEMP.

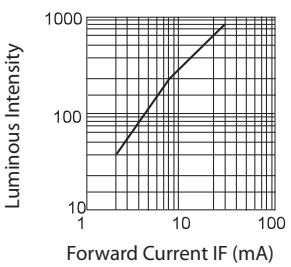


595nm (InGaAlP)

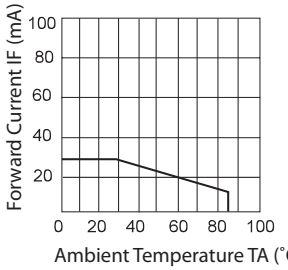
FORWARD CURRENT VS. FORWARD VOLTAGE



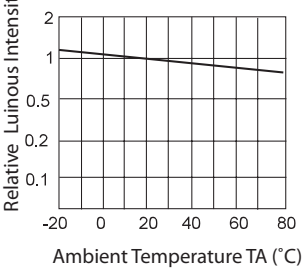
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

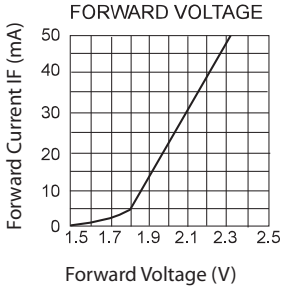


LUMINOUS INTENSITY VS. AMBIENT TEMP.

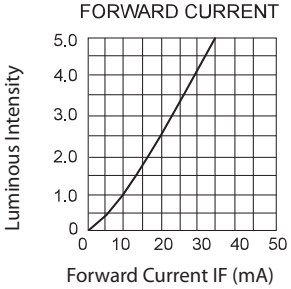


610nm (GaAsP/GaP)

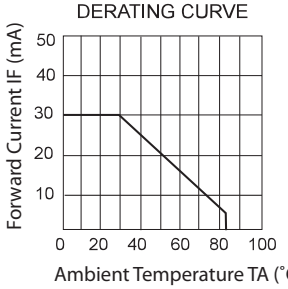
FORWARD CURRENT VS. FORWARD VOLTAGE



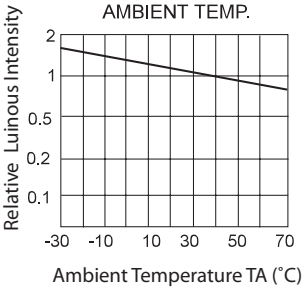
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

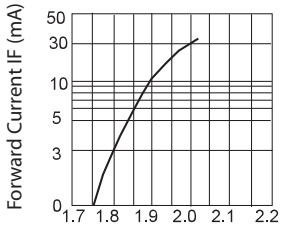


LUMINOUS INTENSITY VS. AMBIENT TEMP.

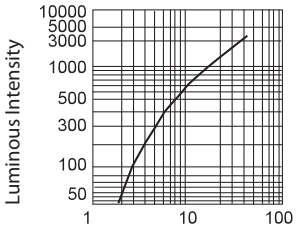


620nm (InGaAlP)

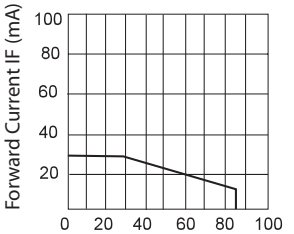
FORWARD CURRENT VS. FORWARD VOLTAGE



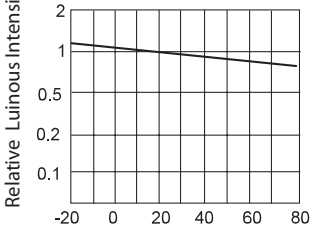
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

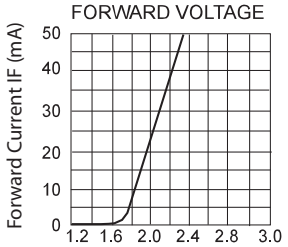


LUMINOUS INTENSITY VS. AMBIENT TEMP.

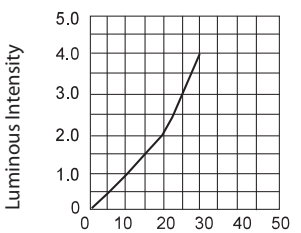


625nm (GaAsP/GaP)

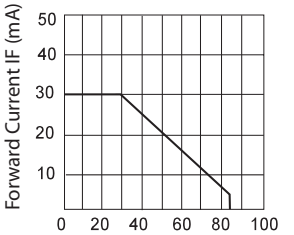
FORWARD CURRENT VS. FORWARD VOLTAGE



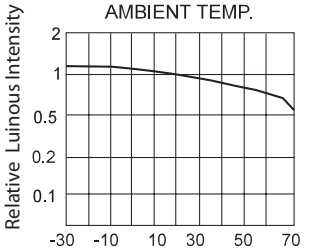
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

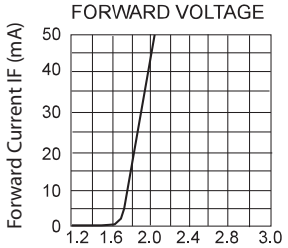


LUMINOUS INTENSITY VS. AMBIENT TEMP.

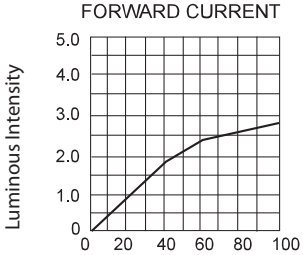


660nm (GaAlAs)

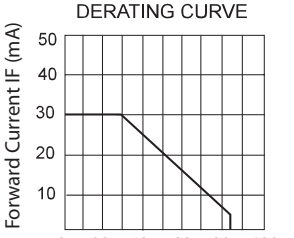
FORWARD CURRENT VS. FORWARD VOLTAGE



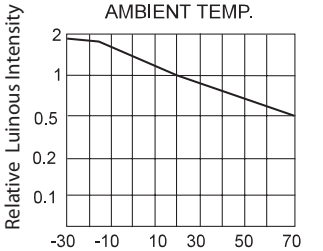
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

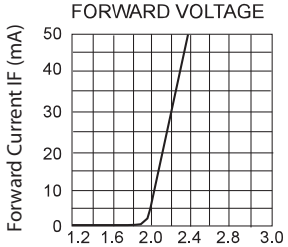


LUMINOUS INTENSITY VS. AMBIENT TEMP.

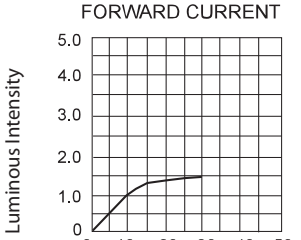


700nm (GaP)

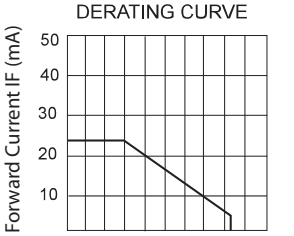
FORWARD CURRENT VS. FORWARD VOLTAGE



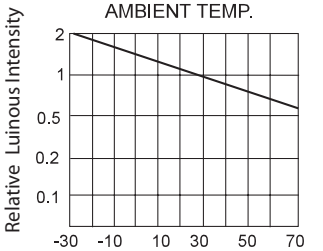
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

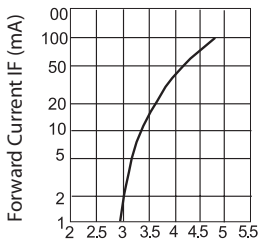


LUMINOUS INTENSITY VS. AMBIENT TEMP.

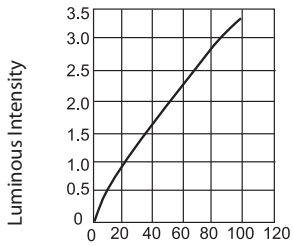


WHITE

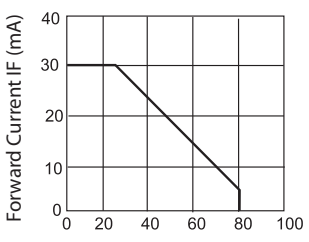
FORWARD CURRENT VS. FORWARD VOLTAGE



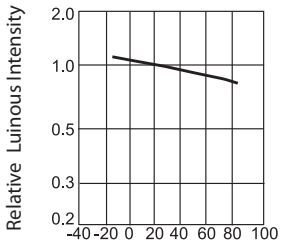
LUMINOUS INTENSITY VS. FORWARD CURRENT



FORWARD CURRENT VS. DERATING CURVE

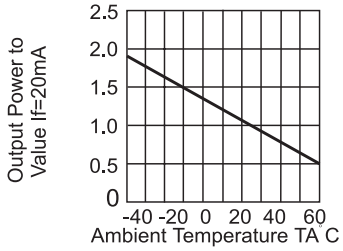


LUMINOUS INTENSITY VS. AMBIENT TEMP.

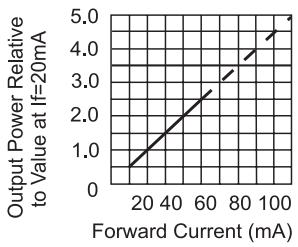


880nm (GaAlAs)

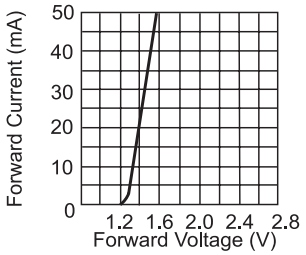
RELATIVE RADIANT INTENSITY VS. AMBIENT TEMPERATURE



LUMINOUS INTENSITY VS. FORWARD CURRENT

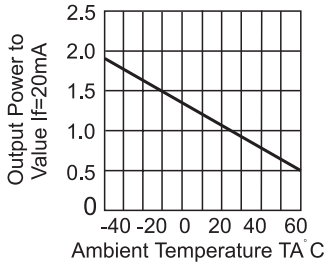


FORWARD CURRENT VS. FORWARD VOLTAGE

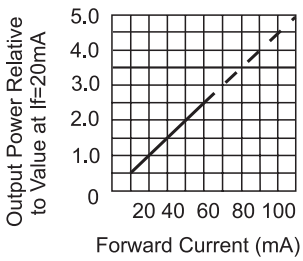


940nm (GaAs)

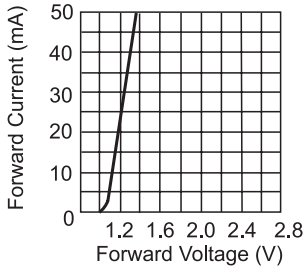
RELATIVE RADIANT INTENSITY VS. AMBIENT TEMPERATURE



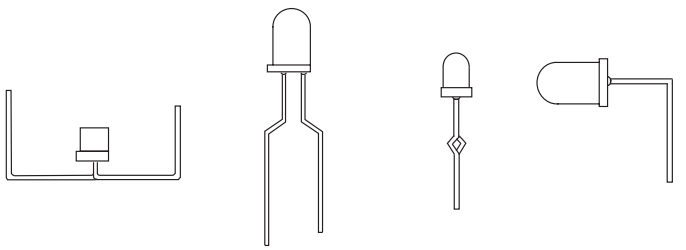
LUMINOUS INTENSITY VS. FORWARD CURRENT

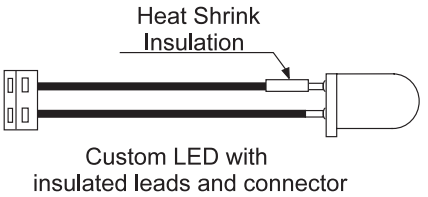


FORWARD CURRENT VS. FORWARD VOLTAGE



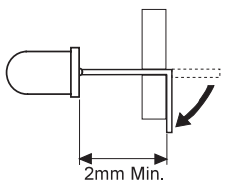
Custom Lead Options - Contact us with your requirements and specifications.



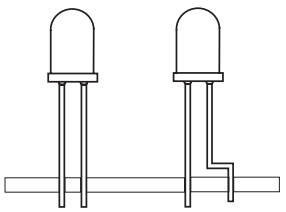


Custom LED with
insulated leads and connector

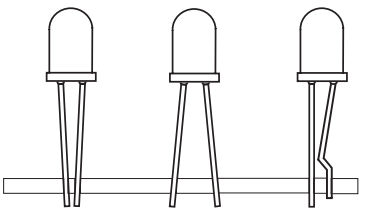
Lead Forming Guidelines



Leads must be held firmly when bending.
Do not bend closer than 2mm from LED.



Printed Circuit Board mounting holes must be of same spacing as LED Leads or as alternative shown above.



DO NOT apply physical stress to LED Leads.

LED Cleaning

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

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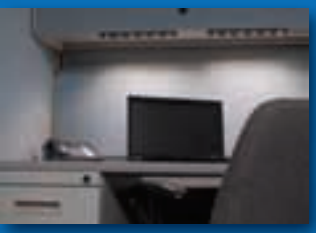
All product descriptions and specifications in this catalog are current at the time of printing. However, ILT is continually involved in product improvement, testing, and evaluation which may cause changes to be made to products in this catalog. We reserve the right to make changes to all products and specifications, and to discontinue any product in this catalog, without prior notice.

Please refer to our web site, www.intl-lighttech.com, for details regarding order placement, terms and conditions, warranty, returning goods and other business policies.









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Applied Lighting Technology

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