231 series

features



- **Direct replacement for BA15s**
- **Bi-polar termination**
- **Internal potting for increased reliability**
- **Warm white LEDs may be used behind coloured lens as a true replacement for a filament lamp**
- **Water clear lens**
- **6 LED cluster**
- **Pack Quantity = 5 Pieces**

specifications

Ordering information and typical characteristics (Ta = 25°C)

Part Number	Colour	Voltage Vac/dc	Current DC (mA)	Luminous Intensity (mcd)	Wave Length (nm)	Operating Temp. (°C)	Storage Temp. (°C)	De-rating Graphs
231-501-23	Red	24-28 Vdc	20	2800	660	-40 - +85	-40 - +85	A
231-521-23	Yellow	24-28 Vdc	20	6100	580-590	-40 - +80	-40 - +120	D
231-532-23	Green	24-28 Vdc	20	34700	525	-30 - +85	-40 - +100	D
231-930-23	Blue	24-28 Vdc	20	9870	468	-30 - +85	-40 - +100	U
231-997-23	White	24-28 Vdc	20	27000	* See pg.2	-30 - +85	-40 - +100	I
231-993-23	Warm White	24-28 Vdc	20	21000	* See pg.2	-30 - +85	-40 - +100	I

^ = Voltage for 20mA product is Vf at 20mA, not Vopr
- Products must be de-rated according to the de-rating information. Each de-rating graph refers to specific LEDs. Please refer to graphs on page 2.
- Luminous intensity is measured at 20mA on a discrete LED unless otherwise stated.

to order

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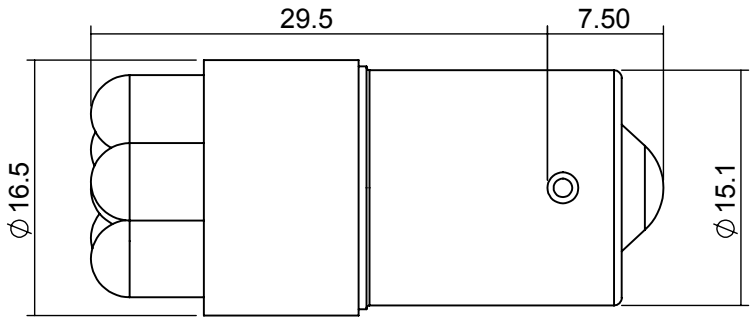
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filament replacement leds

231 series

technical data



Colour dot on product denotes LED colour.

Dimensions in mm (typical)
Not to scale

Lamp Base Style	Series	Metric Equivalent (mm)	Max. Power Dissipation (mW)
BA15s	231	15	825

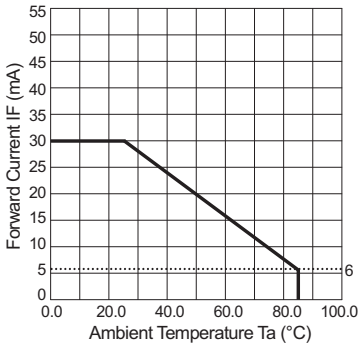
997	*Typical emission colour White			
x	0.4255	0.4390	0.4680	0.4519
y	0.4000	0.4310	0.4385	0.4086

899	*Typical emission colour Warm White			
x	0.4255	0.4390	0.4680	0.4519
y	0.4000	0.4310	0.4385	0.4086

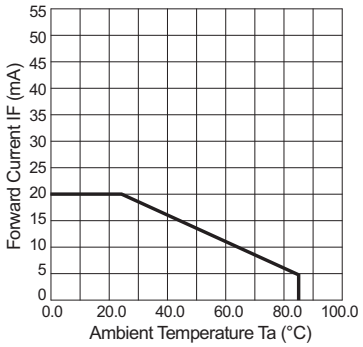
Intensities (Iv) and colour shades of white (x,y co-ordinates) may vary between leds within a batch

de-rating information

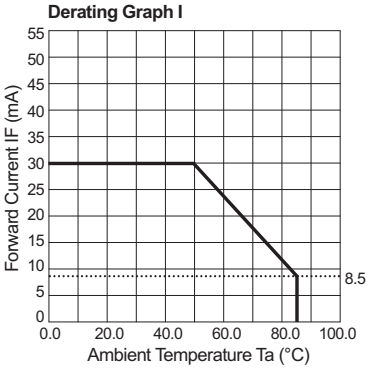
Derating Graph A



Derating Graph D



Derating Graph I



to order

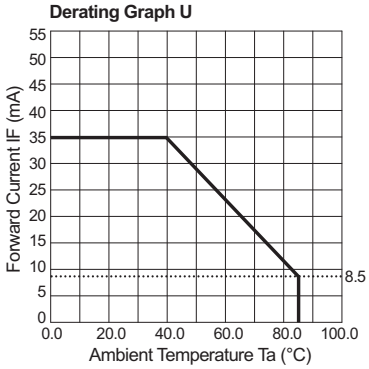
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de-rating information continued



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design considerations

Single-Chip LEDs

All devices feature water clear high intensity LEDs as standard. In devices where discrete LEDs are used, the single chip LED devices have been modified by the removal of the domed portion of the encapsulation (flat-topped) to provide even illumination of switches and annunciators. Non flat topped versions are also available.
Flat-topping does not apply to devices using surface-mounted device (SMD) LEDs.

Product Evaluation

Filament replacement LEDs have been specifically designed to meet the primary objective of providing improved reliability. As this product range is suitable for both new-build and retro-fit, (sometimes in very old systems), a wide range of illuminated push button switches and lamp holders can be encountered. Due to subjectivity, evaluation of the LED type is recommended, (samples of all standard models are available). Care should be taken to correctly simulate operating ambient light conditions to ensure that the correct device has been selected to maximise viewing characteristics such as viewing angle, colour compatibility and on/ off contrast ratio.

Electro-Static Discharge (ESD)

Build up of electro-static discharge occurs in many situations involving people moving and handling products. The range of possible situations is very diverse but voltage levels as high as several thousand volts can and do arise in many individual situations. When an operator charged up to these levels handles a static sensitive device, there is a very probable likelihood that the device will be irreversibly damaged. It is essential that precautions are taken at all stages during manufacture and assembly of these products. Although LEDs were never considered to be static sensitive devices, changes in manufacturing technology and materials used to produce higher intensity products over a large range of the wavelength spectrum have changed this. Marl has an approved system of ESD control from goods in, through production and into final packing and despatch. Marl recommend all users of LED based products follow the guidelines of BS 100015.

Power De-Rating

The forward voltage/ current value of an LED is dependant upon the ambient temperature of the environment in which it is operated. Therefore, care must be taken to operate the LED at the correct voltage/ current values, depending upon the ambient temperature. Consequently, a recommendation regarding operating voltages and currents is given in order to address these temperature effects. This recommendation is termed ‘de-rating’. It is usual for forward voltages and currents to be specified for ambient temperature of 25°C. However, because the values of these qualities vary with temperature, marl should be contacted if the device is to be operated at a temperature significantly higher than 25°C. Marl accept no liability for any product that is operated higher than the stated voltage.

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