RS

Data Sheet

Laser diode modules

This data sheet covers the following items:

Device	**RS** stock no.
Beta TX series	
1mW modulating	564-504
3mW modulating	194-004
3mW modulating	111-368
Beta CW series	
1mW continuous wave	194-010
1.5mW continuous wave	111-346
3mW continuous wave	111-352
3mW continuous wave	194-026
3mW line generator	194-032
3mW Wide angle line generator	213-3613
Single standard lens	194-048
Line generator lens	194-054
Line generator lens wide angle	213-3629
Laser diode holder	213-3641

Device	**RS** stock no.
Beta Cameo Series	
0.8mW continuous wave	213-3590
1mW continuous wave	213-3562
3mW continuous wave	213-3584
3mW continuous wave	213-3607

Introduction

These devices have been designed as complete laser diode systems for original equipment manufacturer (O.E.M.) use and although their output powers have been set in accordance with BS(EN)60825, they are not certified lasers as defined in the specification. When incorporated in a piece of equipment it may be necessary for additional safety features to be added before equipment complies fully with the standard. Read BS(EN)60825 before using any of these products.

Description

These laser modules consist of a laser diode, lens and driver circuit housed in a metal case. The module body is electrically isolated. Electrical connections are made via flying leads. The lens is a single element of high refractive index glass which produces a high quality collimated beam over a long distance. Its position can be adjusted to bring the beam to a focused spot using the special key provided. The Beta CW and TX series standard collimating lens may be replaced by a line generating lens which produces a fan shaped beam that can be focused to a fine, straight line, (**RS** stock no. 194-032) is supplied with a line generator lens producing a beam angle of 16° fitted, (**RS** stock no. 213-3613) is supplied with a line generator lens producing a beam angle of 106° fitted. The lens on the Beta Cameo series cannot be replaced with a line generating lens.

Continuous wave lasers Beta CW series
General characteristics

Parameter	**RS** stock no./Value				Units
	111-346	**194-010**	194-026 / 213-3613 / 194-032	**111-352**	
Nominal wavelength	635	670	670	785	nm
Maximum power output	1.5	1	3	3	mW
Typical power output stability (@ 20°C)	2				%
Typical power output temperature dependence	15				µW/°C
Operating voltage	+4.5 to +5.5	−8 to −12			Volts
Typical operating current at minimum voltage	30 - 75	25 - 45		50 - 80	mA
Typical operating current at maximum voltage	30 - 75	25 - 50		50 - 85	mA
Power supply rejection ratio (50Hz-100kHz)	1.0	0.6			%/V
TTL disable voltage	–	>4			Volts
Maximum TTL pulse rate	–	10			Hz
Mean time to failure (MTTF) @ 30°C	4,500	80,000	20,000	32,000	Hours
Connections	250mm flying leads				
Red lead	+ve supply	–			
Black lead	–	−ve supply			
Green lead	0	0			Volts
Blue lead	–	TTL disable			

Optical characteristics

Parameter	RS stock no./Value					Units
	111-346	194-010	194-026 194-032 213-3613		111-352	
Beam size	4.5×2.5	3.5×2.5	4.5×2.5 106° Fan	16° Fan	4.5×2.5	mm
Minimum focus (lens extended)	25			–	25	mm
Spot size at minimum focus	>50			–	>50	Micron
Polarisation ratio	90:1	80:1	100:1		60:1	
Pointing stability	<0.05					mRad
Output aperture	6.0	3.5	6.0			mm
Angular deviation of beam to case (front cell)	<5					mRad

The spot size is determined by optical measurement. The relationship of the spot size to illumination is $\left(\frac{1}{EV}\right)^2$ therefore the size to the human eye will appear bigger.

Mechanical details

Focusing key slots

15.25mm (0.6in)

46.0mm (1.81in)

Weight: 30g (1.05oz)
Material: Black finished brass
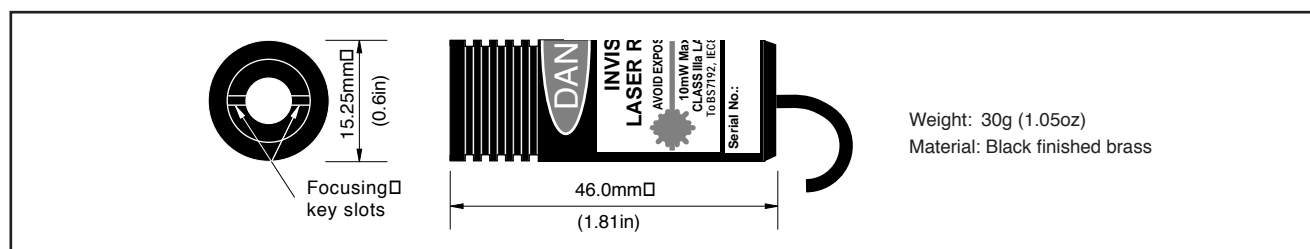
Absolute maximum ratings

Parameter	RS stock no./Value	
	111-346 111-352	194-010 194-026 194-032 213-3613
Supply voltage	+6.0V	–12.7V
TTL disable input voltage	–	–3 to +7V
Operating temperature	–10 to +30°C –10 to +50°C	–10 to + 40°C
Storage temperature	–40 to +85°C	

Power supplies and earthing

Laser modules which operate from a negative voltage can be run from an unregulated supply within the range of –8 to –12V. By operating at the lower (–8V) end of the power supply range, less heat will be dissipated within the device and hence the expected life will increase.

Laser modules which operate from a positive voltage may only be run from a supply which has been regulated to at least 5%, within the limits specified.

For all laser modules the case is isolated from the supply voltages.

It is advisable for any floating power supplies to have the '0' volts connection (and if used, the heatsink) taken to ground. If this is not done, then in electrically noisy environments, the power supply leads can act as aerials. Under these conditions any noise picked up can damage the laser module. If a heatsink is not used, then the barrel of the laser module should be grounded.

TTL disable

This feature is only available on laser modules which operate from a negative supply voltage.
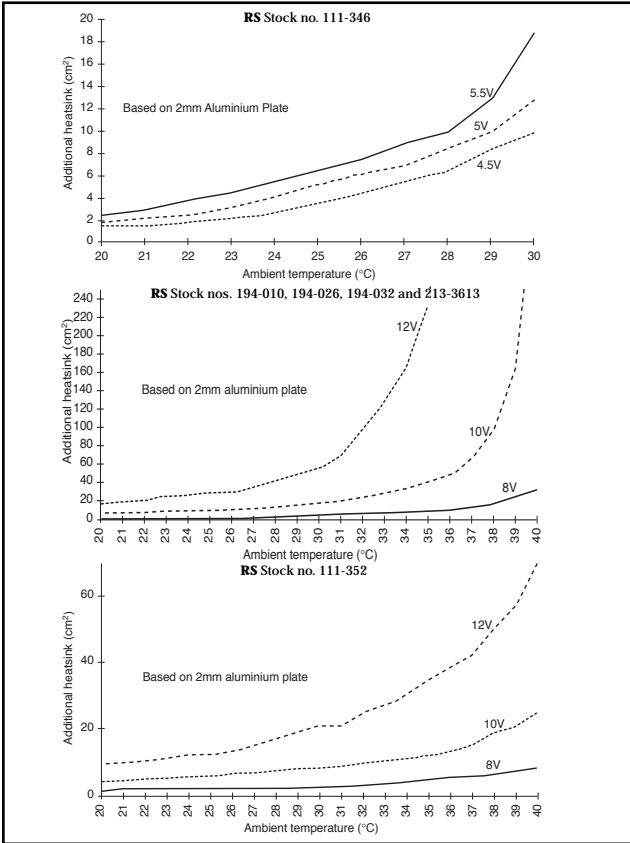
An input of between +4 and +7V applied to the TTL disable input will turn the laser 'off' and an input of 0V will turn it 'on'. If it is not in use it may be left floating. The laser may be pulsed 'on' and 'off' using this input to a frequency of at least 10Hz.

Heat sink requirements

When operating above their minimum supply voltage and/or at elevated temperatures above 30°C ambient, an additional heat sink must be used. If the case temperature of the embedded laser diode should exceed its maximum specification, premature or even catastrophic failure may occur.

To help dissipate heat from the laser modules the following graphs have been provided which show the additional **surface area** of 2mm thick aluminium plate required by each model when operated from different supply voltages and in different ambient temperatures. It has been assumed that good contact exists between the module and the additional heat sink to ensure low thermal resistance.

For maximum effect position, the heat sink so that it contacts the module just to the rear of the fluted front section (this may require peeling back the label) and use thermally conductive cream between surfaces.

When using a proprietary heat sink, the following equation may be used:

$$\emptyset h \sim \frac{Tc - Ta}{Iop \times Vop} - (\emptyset m + \emptyset c)$$

Where:

$\emptyset h$ = Thermal resistance of additional heat sink (°C/W)

$\emptyset m$ = Thermal resistance of laser module (°C/W)

$\emptyset c$ = Thermal resistance of contact, module to heat sink (°C/W)

Tc = Maximum operating case temperature for laser diode (°C)

Ta = Maximum expected ambient temperature (°C)

Vop = Operating voltage of laser module (V)

Iop = Operating current @ Vop (A)

$\emptyset m + \emptyset c$ for these laser modules is typically 10°C/W assuming a good thermal contact between module and heat sink.

Tc is specified for each module as follows:

RS stock no.	°C
111-352	60
111-346	40
194-026	50
194-010	50
194-032	50
213-3613	50

Example:

If:

$\emptyset m + \emptyset c = 10$, Tc = 50°C, Ta = 35°C, Vop = 10V, Iop = 78mA

Then:

$$\emptyset h \sim \frac{50 - 35}{0.078 \times 10} - 10$$

$$\sim \underline{9.2°C/W}$$

Expected life

The laser diode device contained within each module, while being a semiconductor, is a complex electro-optical material, the structure of which determines the wavelength of the light emitted. The mechanism which ultimately causes the laser diode to fail is the formation of dislocations or gaps in the material structure. Laser devices which operate in the visible region of the spectrum have a more brittle structure than those that operate in the infra-red and in consequence produce dislocations at a faster rate.

The rate at which dislocations form during normal use is related to the temperature at which the laser diode operates. Where possible every means should be used to minimise temperature, such as working at lower voltage levels, reducing operating ambients and providing adequate heat sinking, all of which will contribute to maximise the operating life. The figures quoted for 'mean time to failure' (MTTF) reflect the differences in device structure and operating power.

Continuous wave lasers Beta Cameo series

General characteristics

Parameter	RS stock no./Value				Units
	213-3562	213-3590	213-3584	213-3607	
Nominal wavelength	635	670	635	670	nm
Maximum power output	1	0.8	3	3	mW
Typical power output stability (@20°C)	<3				%
Typical power output temperature dependence	15				μW/°C
Operating voltage	+4.5 to 5.5				Volts
Typical operating current at minimum voltage	65				mA
Typical operating current at maximum voltage	68				mA
Power supply rejection ratio (50Hz-100kHz)	1				%/V
Mean time to failure (MTTF) @ 30°C	4,500	20,000	4,500	20,000	Hours
Connections	2 pin socket (Pre wired plug supplied)				
Red lead	+ve supply				
Green lead	0				Volts

Optical characteristics

Parameter	RS stock no./Value				Units
	213-3562	213-3590	213-3584	213-3607	
Beam size	4.5 × 2.5				mm
Minimum focus (lens extended)	25				mm
Spot size at minimum focus	>50				Micron
Polarisation ratio	10:1				
Pointing stability	<0.05				mRad
Output aperture	2.0		5.2		mm
Angular deviation of beam to case (front cell)	<5				mRad

The spot size is determined by optical measurement. The relationship of the spot size to illumination is $\left(\frac{1}{EV}\right)^2$ therefore the size to the human eye will appear bigger.

Mechanical details

Focussing key slots M12 x 1.0   10.0   13.0   1.8   14.0   14.0

Weight: 15g (0.53oz)
Material: Nickel plated brass barrel and black plastic rear cap

Absolute maximum ratings

Parameter	RS stock no./Value	
	215-3562 215-3584	215-3590 215-3607
Supply voltage	+8V	
Operating temperature	-10 to +30°C	-10 to +40°C
Storage temperature	-40 to +85°C	

Power supplies and earthing

The Beta Cameo must be operated from a regulated, positive supply of 5 volts. The case, which may be connected externally to earth, is isolated from the supply.

Connections are made via the two pin latching connector, the mating half is supplied pre-wired, with 500mm of 7 × 0.2mm PVC insulated wire (red is positive and green is 0V).

Heat sink requirements

When operating above their minimum supply voltage and/or at elevated temperatures above 30°C ambient, an additional heat sink must be used. If the case temperature of the embedded laser diode should exceed its maximum specification, premature or even catastrophic failure may occur.

The module should be mounted into a metal bracket or bulkhead using the threaded barrel. Thermal transfer cream can be used to improve contact and heat dissipation.

When using a proprietary heat sink, the following equation may be used:

$$\text{Øh} \sim \frac{Tc - Ta}{Iop \times Vop} - (\text{Øm} + \text{Øc})$$

Where:

Øh = Thermal resistance of additional heat sink (°C/W)

Øm = Thermal resistance of laser module (°C/W)

Øc = Thermal resistance of contact, module to heat sink (°C/W)

Tc = Maximum operating case temperature for laser diode (°C)

Ta = Maximum expected ambient temperature (°C)

Vop = Operating voltage of laser module (V)

Iop = Operating current @ Vop (A)

Øm + Øc for these laser modules is typically 10°C/W assuming a good thermal contact between module and heat sink.

Tc is specified for each module as follows:

RS stock no.	°C
213-3562	40
213-3590	50
213-3584	40
213-3607	50

Example:

If:

Øm + Øc = 10, Tc = 50°C, Ta = 35°C, Vop = 5V,

Iop = 68mA

Then:

$$\text{Øh} \sim \frac{50 - 35}{0.068 \times 5} - 10$$

$$\sim \underline{34.1°C/W}$$

Modulated lasers Beta TX series
General characteristics

Parameter	RS stock no./Value			Units
	564-504	194-004	111-368	
Nominal wavelength	670	670	785	nm
Maximum power output	1	3	3	mW
Typical power output stability (@ 20°C)	2			%
Typical power output temperature dependence	15			µW/°C
Operating voltage	−8 to −12			Volts
Typical operating current at minimum voltage	75		85	mA
Typical operating current at maximum voltage	110		115	mA
Power supply rejection ratio (50Hz-100kHz)	0.6			%/V
TTL disable voltage	>4			Volts
Maximum TTL pulse rate	10			Hz
Interlock 'enable'	−5 to +2.5			Volts
Modulation type	Analogue or digital			
Modulation signal levels into 50Ω for linear response	500mV pk to pk			
Maximum modulation signal levels into 50Ω (see also maximum ratings)	8V pk to pk			
Modulation frequency band width (−3dB points)	100Hz to 50MHz			
Frequency range	100Hz to 100MHz			
Modulation depth (Pulse)	90			%
Mean time to failure (MTTF) @ 30°C	80,000	20,000	32,000	Hours
Connections	250mm flying leads			
Black lead	−ve supply			
Green lead	0			Volts
Blue lead	TTL disable			
White lead	Interlock			
Yellow and green twisted pair	Modulation input			

Optical characteristics

Parameter	RS stock no./Value			Units
	564-504	194-004	111-368	
Beam size	3.5 × 2.5	4.5 × 2.5		mm
Minimum focus (lens extended)	25			mm
Spot size at minimum focus	>50			Micron
Polarisation ratio	80:1	100:1	60:1	
Pointing stability	<0.05			mRad
Output aperture diameter	3.5	6.0		mm
Angular deviation of beam to case (front cell)	<5			mRad

The spot size is determined by optical measurement. The relationship of the spot size to illumination is $\left(\frac{1}{EV}\right)^2$ therefore the size to the human eye will appear bigger.

Mechanical details

Weight: 55g (1.94oz)
Material: Black finished brass

15.25mm (0.6in)

Focusing key slots

75.0mm (2.95in)
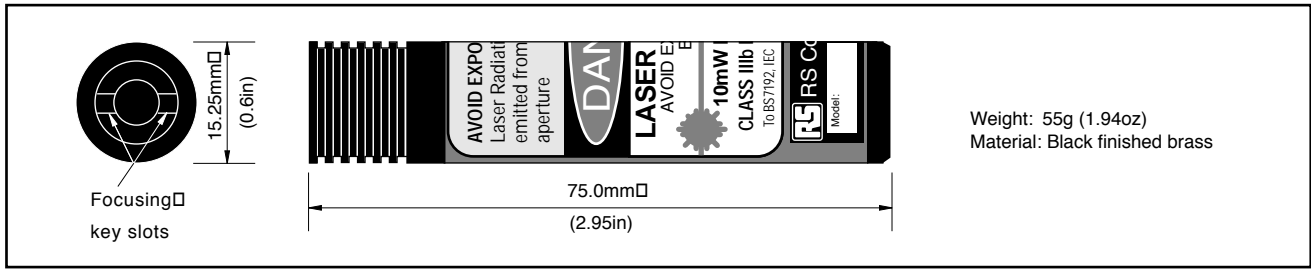
Absolute maximum ratings

Parameter	RS stock no./Value	
	564-504 194-004	111-368
Supply voltage	–12.7V	
TTL disable input voltage	–3 to +7V	
Modulation input voltage	–1 to +7V	
Interlock input voltage	–5 to +2.5V	
Operating temperature	–10 to +40°C	–10 to +50°C
Storage temperature	–40 to +85°C	

Power supplies and earthing

These laser modules can be run from an unregulated supply within the range of –8 to –12V. By operating at the lower (–8V) end of the power supply range, less heat will be dissipated within the device and hence the expected life will increase. This may be particularly necessary for applications where they operate in a high ambient temperature.

For all laser modules the case is isolated from the supply voltages.

It is advisable for any floating power supplies to have the '0' volts connection (and if used, the heatsink) taken to ground. If this is not done, then in electrically noisy environments, the power supply leads can act as aerials. Under these conditions any noise picked up can damage the laser module. If a heatsink is not used, then the barrel of the laser module should be grounded.

Heat sink requirements

When operating above their minimum supply voltage and/or at elevated temperatures above 30°C ambient, an additional heat sink must be used. If the case temperature of the embedded laser diode should exceed its maximum specification, premature or even catastrophic failure may occur.

To help dissipate heat from the laser modules the following graphs have been provided which show the additional **surface area** of 2mm thick aluminium plate required by each model when operated from different supply voltages and in different ambient temperatures. It has been assumed that good contact exists between the module and the additional heat sink to ensure low thermal resistance.

Additional heat sink vs ambient temperature
RS stock no. 194-004 and 564-504

Additional heat sink vs ambient temperature
RS stock no. 111-368

For maximum effect position the heat sink so that it contacts the module just to the rear of the fluted front section (this may require peeling back the label) and use thermally conductive cream between surfaces.

When using a proprietary heat sink, the following equation may be used:

$$\varnothing h \sim \frac{T_c - T_a}{I_{op} \times V_{op}} - (\varnothing m + \varnothing c)$$

Where:

∅h = Thermal resistance of additional heat sink (°C/W)

∅m = Thermal resistance of laser module (°C/W)

∅c = Thermal resistance of contact, module to heat sink (°C/W)

Tc = Maximum operating case temperature for laser diode (°C)

Ta = Maximum expected ambient temperature (°C)

Vop = Operating voltage of laser module (V)

Iop = Operating current @ Vop (A)

∅m + ∅c for these laser modules is typically 10°C/W assuming a good thermal contact between module and heat sink.

Tc is specified for each module as follows:

RS stock no.	°C
564-504	50
194-004	50
111-368	60

Example:

If:

∅m + ∅c = 10, Tc = 50°C, Ta = 30°C, Vop = 10V, Iop = 93mA

Then: $\quad \varnothing h \quad \sim \quad \dfrac{50-30}{0.093 \times 10} \quad - 10$

$$\sim \quad \underline{11.5°C/W}$$

Expected life

The laser diode device contained within each module, while being a semiconductor, is a complex electro-optical material, the structure of which determines the wavelength of the light emitted. The mechanism which ultimately causes the laser diode to fail is the formation of dislocations or gaps in the material structure. Laser devices which operate in the visible region of the spectrum have a more brittle structure than those that operate in the infra-red and in consequence produce dislocations at a faster rate.

The rate at which dislocations form during normal use is related to the temperature at which the laser diode operates. Where possible every means should be used to minimise temperature, such as working at lower voltage levels, reducing operating ambients and providing adequate heat sinking, all of which will contribute to maximise the operating life. The figures quoted for 'mean time to failure' (MTTF) reflect the differences in device structure and operating power

Modulation

The modulation signal applied may be of any waveform, sinusoidal, digital or a mixture of both. It is essential, however, that its voltage does not exceed +7V or goes below –1V relative to the 0V connection. If the 500mV peak to peak signal is exceeded then premature failure could occur due to thermal effects.

The modulation input is ac coupled.

The efficiency of modulation drops below 100Hz and above 50MHz due to the electronics circuit. These frequencies are approximately where the amplitude of the laser light modulation drops by 3dB (0.7) of the mid-band amplitude for a constant modulation voltage. The total frequency range however extends beyond 100MHz.

The impedance of the modulation input is 50Ω. Ideally at all frequencies a 50Ω co-axial cable should be used, driven from a signal source with a 50Ω output impedance. At frequencies below 1MHz however, this is not always necessary.

Figure 1 shows a typical digital 50Ω modulation drive giving approximately 250mV peak to peak input signal.
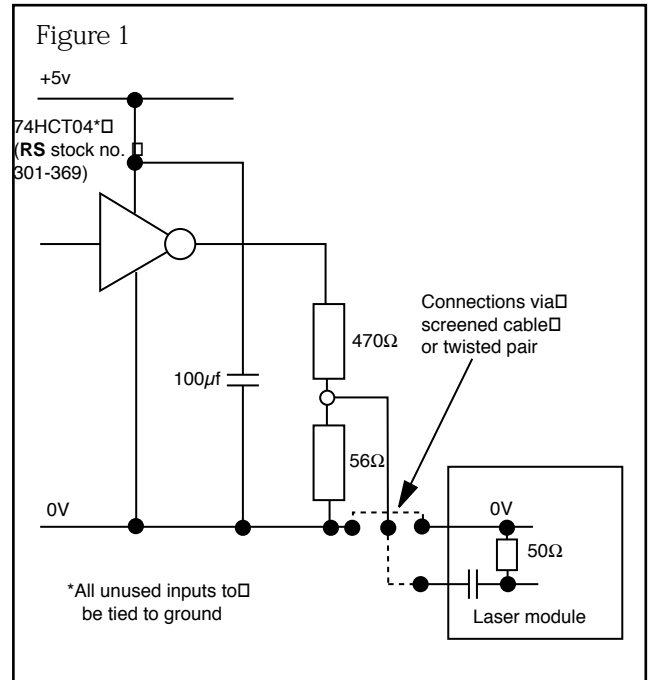
Figure 1

An alternative scheme using any TTL gate to obtain a modulation input of 500mV peak to peak is shown in Figure 2.

When applying modulation to the laser module it is important to understand how the laser emission occurs.

Figure 2
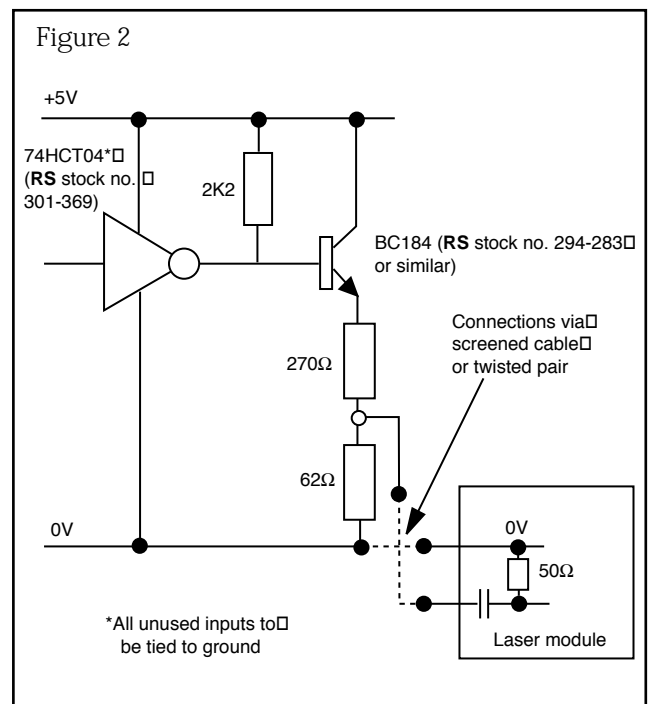
As current is applied light starts to be emitted, the intensity of which increases as the current increases. At a threshold level laser light starts to be emitted, the intensity of which increases with increasing current at a far greater rate. Modulation should be restricted to that part of the light due to laser emission (i.e. above the threshold). It is possible to modulate about 90% of the laser emission using a square wave signal and keeping within the specified input voltage limits. Within the range 0 to 500mV peak to peak, modulation is linear, above that there is a linearity error which varies from diode to diode. The modulation factor is typically −7.7μW/mV above the threshold. The minus sign indicates that a rise in modulation voltage produces a fall in laser intensity.

Interlock

The interlock input is provided to allow a keyswitch or some other contacts to be used to turn the laser on or off. The 'enable' time is approximately 40mS. The interlock input must be connected to 0V to 'enable' the

Figure 3 **A typical schematic showing external contacts connected**
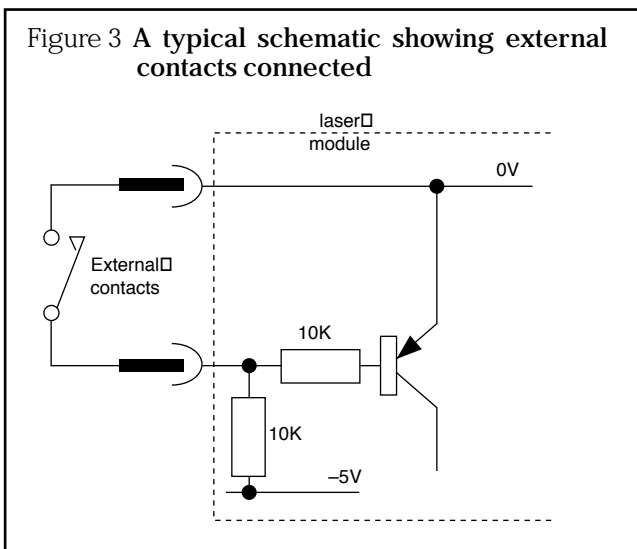
laser.

Any voltage applied to this input must not exceed +2.5V or be less than −5V.

TTL disable

A TTL disable function is provided which can be used to turn the laser off and on. The 'enable' time for this input

Figure 4
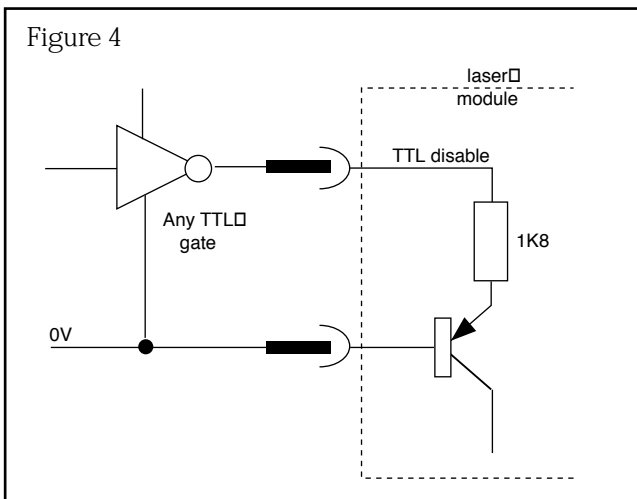
is the same as the interlock, approximately 40mS.

An input voltage above 4V will turn the laser off. When not in use, this input can be left floating or if preferred, connected to 0V.

Any voltage applied to this input should not exceed +7V or be less than −3V.

Operation data

When the laser module is switched on there is an 'enable' time of approximately 40mS. This slow start limits the possibility of any spikes reaching the diode and causing catastrophic failure.

The lens will have been adjusted to give the optimum output beam. The standard collimator for instance will have been set to give a well collimated beam over a 10 metre range. If the lens needs to be adjusted, insert the tabs of the key in the lens slots so that the beam passes through the centre of the key uninterrupted. Rotate the
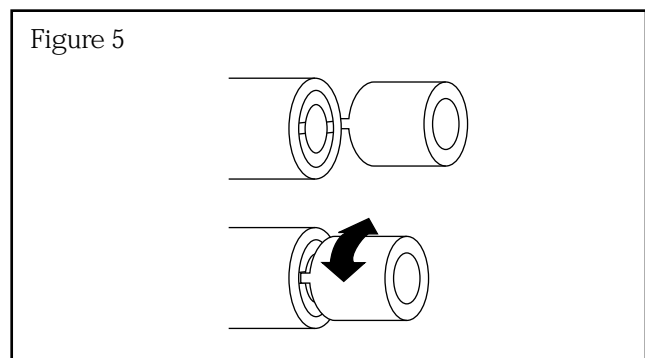
Figure 5

lens with the key to produce the desired spot.

The wavelength of the laser output varies with temperature as shown in Figure 6.

Figure 6 **Temperature dependence – Lasing spectrum**
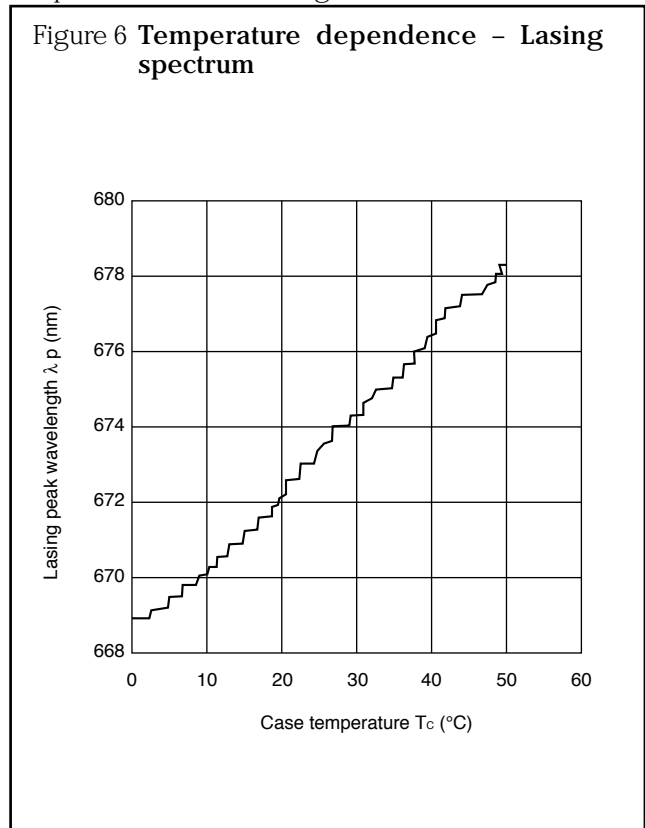
Temperature also affects the laser diode by altering the threshold current. An increase of 25°C increases the threshold current and therefore the supply current of the laser module by about 10mA. Operating at the higher current reduces the life of the diode and therefore every effort should be made to maintain the operating temperature of the laser module at the minimum practicable for the application.

Controlling output power

The drive circuit used in these modules employs thick film surface mount technology to achieve its small size and high reliability. Incorporated within it are two potentiometers which control the intensity of the output beam. Neither of these should be adjusted as they may result in the power exceeding the limits stipulated for its safety classification, or even the failure of the laser diode.

The output power is set at the factory using a highly accurate laser power meter, the calibration of this instrument is traceable to international standards. The power set is the total light emitted through the lens. If the lens is removed, a higher power will be emitted but, due to the natural divergence of the laser diode, the power density will be lower.

Line generating optics may be fitted as an alternative lens system but these generally are less efficient than a standard collimator and have such a large divergence, that the power density when integrated over a circular aperture of 7mm diameter will be much less.

Polarisation

The light emitted from a laser diode module is linearly polarised and has a polarisation ratio which varies with output power. The polarisation ratio also varies across the beam in relation to the intensity distribution. The table of optical characteristics shows the polarisation ratios for the different modules. For applications where a high polarisation ratio is required, a module with a higher power should be used together with an aperture placed co-axially which reduces the beam diameter.

Beam position and pointing stability

The position of the laser beam with respect to the laser housing depends on a number of factors including the position of the laser die within its mount, the concentricity of the mechanics of the housing and the eccentricity in the lens mount and focusing system. Change any one and the position of the laser spot is likely to move.

These modules have been designed to minimise such variations so that the emitted laser beam remains parallel to the case within 5m Radians.

However, variations in operating temperature can also cause mechanical movements which can alter the beam position during operation. Measurements carried out on these modules show that such movements (beam pointing stability) are less than 5μRadians per °C.

Applications

Figure 7 **RS** stock no. 194-379 configured as an ambient light compensated modulated detector
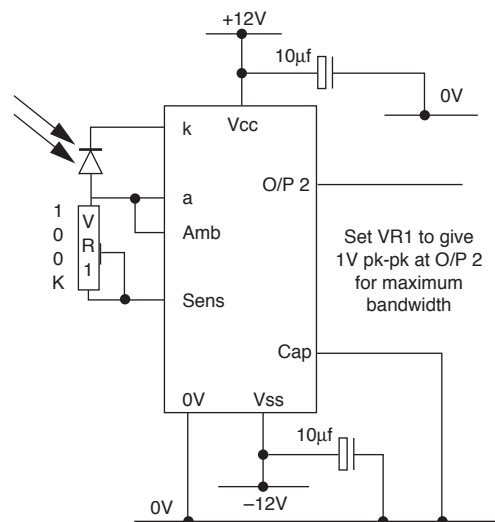
Notes:

1. Resistor VR1 alters the sensitivity of the circuit, increasing the value increases the sensitivity.

2. **RS** stock no. 194-379 configured in this way rejects ambient and low frequency (50 and 100Hz) variations in light falling on the photodiode.

3. Other configurations are possible with this device including synchronous detection systems.

4. When using a small area PIN diode, light collection can be greatly improved by using a lens to focus the beam onto the surface. This lens need not be of any special quality and can even be a Fresnel lens made from moulded plastic.

Densitometer

In the application shown in Figure 8, the output beam of a laser module is modulated by some frequency F_{MOD}. This is also fed to the lock-in amplifier (or phase sensitive rectifier/demodulator) as the reference signal. The lock-in amplifier demodulates the detector output rejecting noise signals not in phase synchronism with the reference frequency. This system obviates the need for mechanical chopper wheels and their associated control electronics normally required with other types of laser. This type of system is capable of working with a beam attenuation of at least 1000.

Figure 8
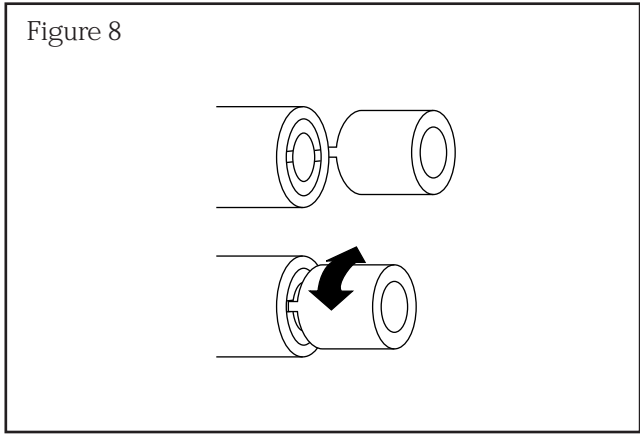
Proximity measurement

In this application the laser projects a beam of light onto the surface or object being detected, the photometric centre of the return beam is detected by a linear position sensing detector. The laser and detector are configured so that they are effectively one unit. As the distance between laser and surface changes, the return beam travels across the linear PSD. The distance between laser and object can either be calculated by triangulation, or set specifically by varying the distance until the return beam is centred on the detector.
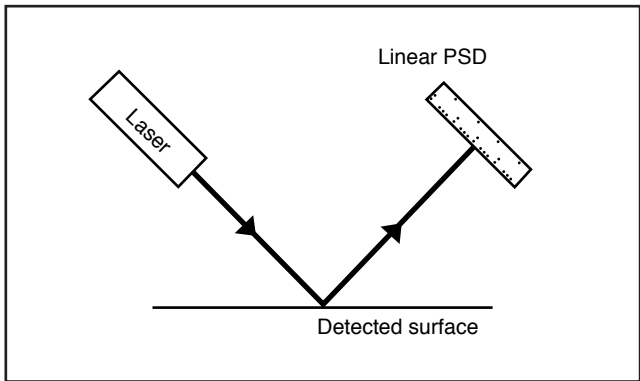
Data transmission or beam break safety application for medium distances

In this system, Lens 1 increases the beam size so that even when air turbulence is present, some light will always fall onto the detector. Lens 2 improves capture of the beam onto the detector. A lens of 60mm focal length instead of the standard collimating lens would produce a beam of about 25mm diameter. If the beam is broken, transmission will be interrupted, it is therefore essential in data transmission applications that the equipment is sited where there is little chance of this happening. For safety and security applications beam break is used to detect the presence of people or objects passing through the beam, in this case the data being transmitted by the laser would be in the form of a coded 'word'.
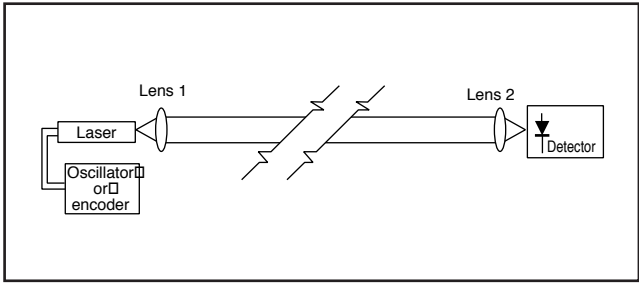
Smoke or fog detector

This type of detector consists of a laser module which projects a beam of modulated light through the atmosphere and a detector which receives the signal. The presence of fog or smoke will attenuate the beam reducing the amplitude of the signal. The use of a reference beam eliminates any change in the output intensity of the laser.
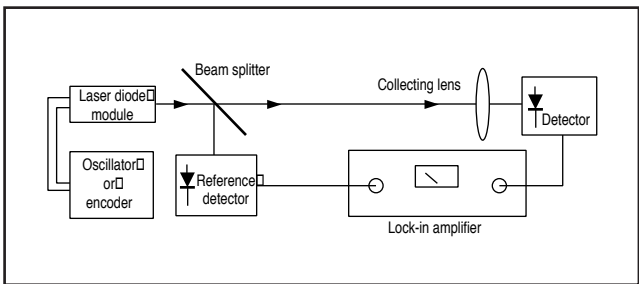

Alternatively the laser and detector can be mounted side by side so that the system responds to back scattered light. In this configuration the detector is looking for the laser signal and will only see it when there is sufficient fog or smoke present. As this system does not operate by changes in amplitude, the need for a reference beam is eliminated for most applications.
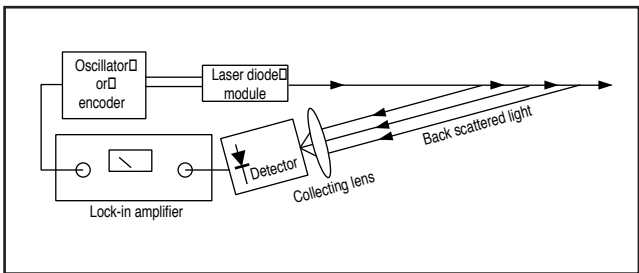
Alignment

There are many applications for devices to align objects or position objects to a given point. The aligner described is ideal where there are changes in ambient light which could otherwise affect the accuracy of the result. By using the diametrically opposite quadrants of a quadrant detector, the position of a spot of light falling on the detector can be accurately identified. When the signal in each quadrant is equal, the spot is aligned with the centre of the detector. Any extraneous light falling on part of the diode would register as a shift in position but by using a modulated laser beam to produce the spot, it has no effect.
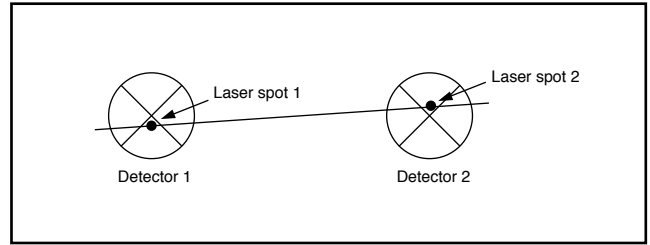
Two such systems used side by side on the item to be aligned not only give greater accuracy in the XY position, but also registers rotational errors. The spots of light from lasers 1 and 2 show not only vertical and horizontal position, but as the spot from laser 1 is below the centre of detector 1 and that from laser 2 is above the centre of detector 2, there is an element of rotation illustrated by the line joining the two spots.
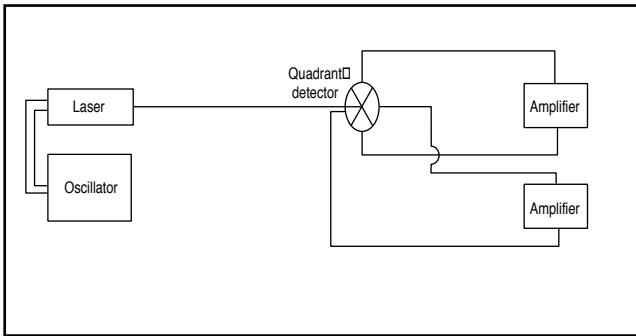
Line generating lens (**RS** stock no. 194-054 and 213-3629)
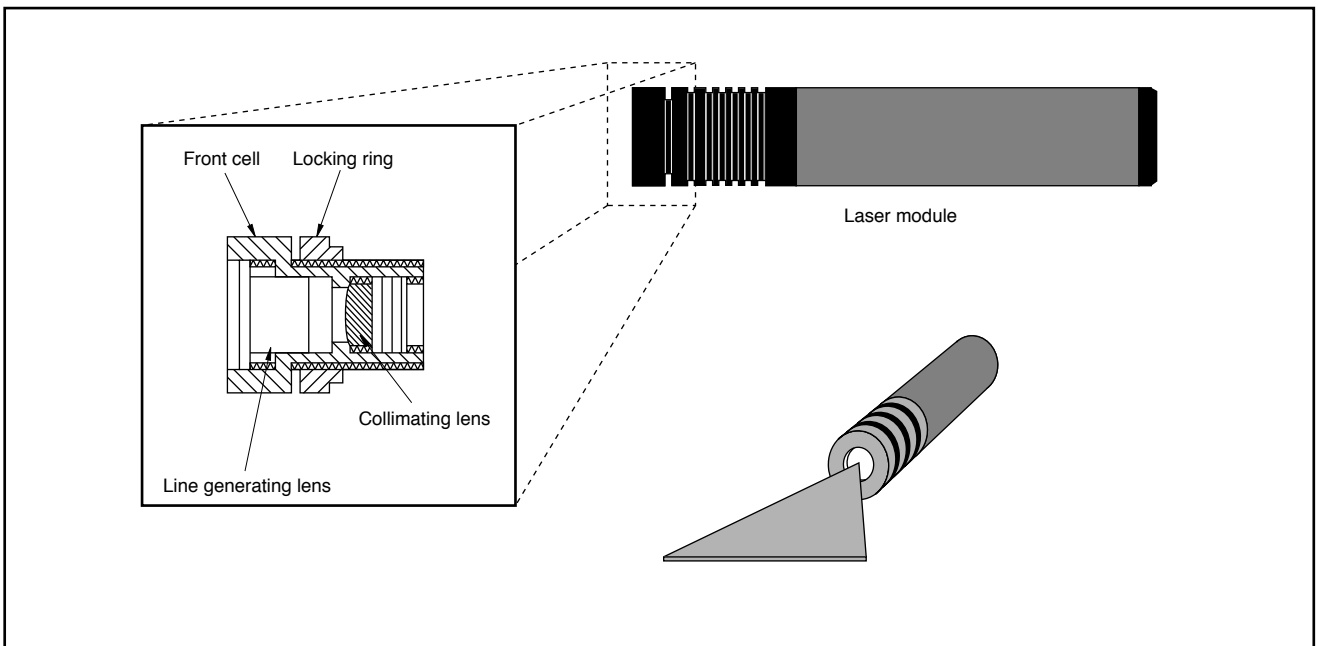
Description

The line generator is a combination system consisting of a spherical lens to focus or collimate the light emitted from the laser diode and a cylindrical lens which generates the line. By rotating the front cell assembly the beam can be focussed or collimated, a locking ring is used to secure the final position. The line generator is rotated using the key supplied with the laser diode module in order to produce the best line.

The length of the line produced by the line generator is dependent on the focal length of the cylindrical lens while the thickness is dependent on the size of the focussed spot produced by the spherical lens. The greater the operating distance, the larger and thicker the line.

Adjustment

Remove the line generator lens by unscrewing it from the front using the key provided. Focus the output beam to a spot at the distance required and tighten the locking ring against the main body. Replace the line generator lens so that it sits flush with the end of the front cell, then rotate it to achieve the best straight line.

Specification

Length (extending beyond laser) _____ approx. 9mm

Diameter _____ 15.0mm

Angle of fan _____ 16° (**RS** stock no. 194-054)
                               106° (**RS** stock no. 213-3629)

Collimating lens (RS stock no. 194-048)
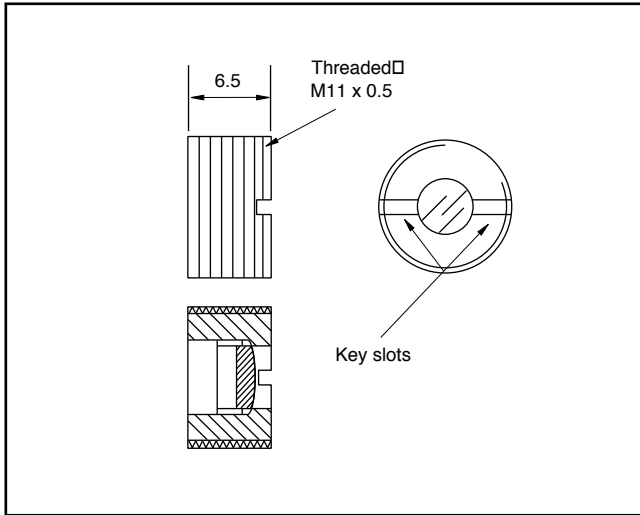
The collimating lens consists of a single element of high index glass with a laser quality anti-reflection coating on both surfaces. This design is simple yet highly efficient, producing very low divergence coupled with well defined spots of light at short, medium and long range.

Specification

Number of elements _____ 1
Focal length _____ 10.0mm
Numerical aperture _____ 0.175
Working distance _____ 7.9mm
Minimum clear aperture _____ 3.5mm

Replacing lenses

Lenses may be replaced by simply unscrewing one and screwing in another. It is necessary to use the 'key' supplied with the laser diode unit when removing or fitting the collimating lens.

Laser diode holder (RS stock no. 213-3641)
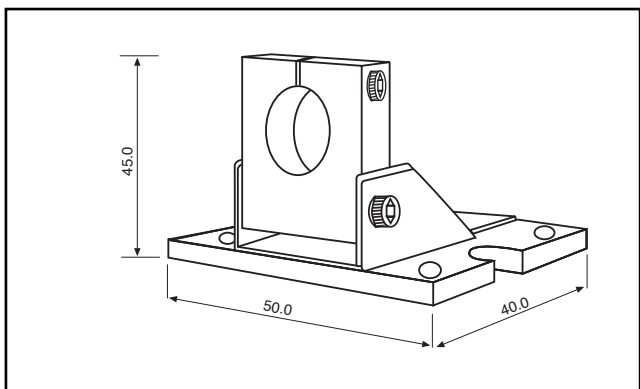
This laser diode holder has been designed for use with the Beta CW and TX series laser diodes combining a simple method of directing the laser beam with an additional heatsink. The laser diode unit is clamped into the holder by an M3 bolt while two M4 screws and an M4 bolt provide the means for pointing and locking the laser beam in the direction required. On the rear of the main block are two M3 threaded holes which enable heatsink fins to be attached. In the base plate there is a choice of mounting hole configurations by which the unit may be secured.

Laser classification
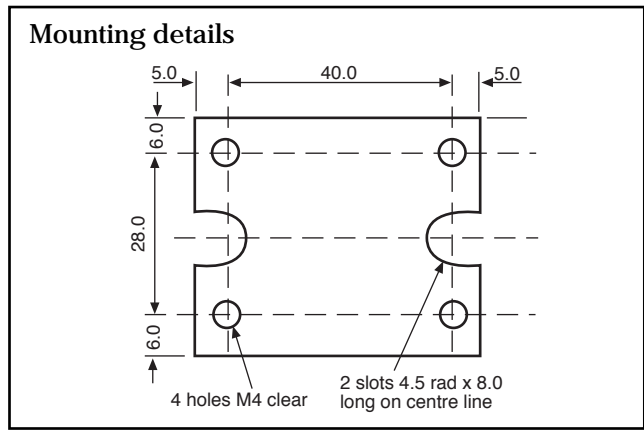
All laser devices produce beams of intense monochromatic light which can present potential biological hazards. These hazards depend on a number of factors including the wavelength, the power or energy of the beam and the emission duration. The eye is the most vulnerable organ as it will tend to focus light from the laser on to the retina, thereby increasing the energy density many times. If the irradiance of the laser is high enough, skin damage can also result from exposure to the beam.

RS stock nos. 111-368 and 111-352 produce infra-red radiation of a power and wavelength equivalent to a Class IIIb laser product which could cause retina burns, cataracts and even skin burns if the correct safety procedures are not followed.

Laser safety is covered by BS(EN)60825 which requires laser products to be classified according to their beam characteristics. This standard is essential reading for all laser users.

Depending on the version the laser diode modules produce continuous wave radiation with a nominal wavelength of between 635 and 785nm. While they are classified as O.E.M. devices, they conform to the wavelength and output power conditions of either Class II, Class IIIa or Class IIIb laser products.

For an O.E.M. laser diode module to comply with the full requirements of a certified laser product as described in BS(EN)60825, it may need the addition of a visible 'on' indicator, a beam shutter and a key switch. However, any product which incorporates a laser must be certified in its own right, irrespective of whether the incorporated laser is certified or not. The way in which the laser is used within the product may also alter its original classification. It is therefore the responsibility of the manufacturer of the product to ensure compliance with the relevant standards.

Class II laser products emit visible light and while they are not inherently safe, eye protection is normally afforded by the aversion responses, including the blink response. Accidental viewing is not hazardous even if optical aids* are used, but the user should avoid staring into the beam. No skin damage will result from exposure to the beam. RS stock no. 194-010, 213-3562 and 213-3590 conforms to the wavelength and power limits of a Class II product.

Class IIIa laser products emit visible light and while they are not inherently safe, eye protection is normally afforded by the aversion responses, including the blink response. However, accidental viewing may be hazardous if optical aids* are used. The user should not stare into the beam and a safety officer's approval should be obtained before using any form of optical instrument. No skin damage will result from exposure to the beam. **RS** stock nos. 111-346 and 194-032 conform to the wavelength and power limits of a Class IIIa product.

Class IIIb laser products may emit visible or invisible radiation, they are potentially hazardous if a direct beam or a specular reflection is viewed by an unprotected eye (intrabeam viewing). **RS** stock no. 111-352, 194-026, 194-004, 111-368, 213-3613, 213-3584 and 213-3607 conforms to the wavelength and power limits of a Class IIIb product.

The following precautions should be taken to avoid direct beam viewing and to control specular reflections:

1. The laser should only be operated in a controlled area.

2. Care should be taken to prevent unintentional specular reflections.

3. The laser beam should be terminated where possible at the end of its useful path by a material that is diffuse and of such a colour and reflectivity as to make beam positioning possible while still minimising reflection hazards.

4. Eye protection is required if there is any possibility of viewing the direct or specularly reflected beam, or of viewing a diffuse reflection not complying with the conditions of item (3).

5. The entrances to controlled areas should be posted with laser warning signs.

Any company or organisation which intends using Class IIIb lasers, or lasers which have comparable output powers and wavelengths, should appoint a safety officer whose duty is to ensure that the correct safety procedures are followed at all times.

General

All laser diode modules are supplied with adjustable and removable optics for which the special key supplied with each unit is required. Focusing the beam to a small intense spot will not increase the risk of intrabeam viewing**.

Removal of the entire optical assembly will subject the user to the full radiated power of the laser diode. However, the divergence of the laser beam from the diode surface is such that the energy density is low and will not subject the user to any hazard greater than that normally associated with its classification.

Any modification or alteration which may affect any aspect of the performance or intended function of these products will require to be examined and re-classified if necessary. The person or organisation performing any such modification or alteration is responsible for ensuring the re-classification and re-labelling of the product in accordance with BS(EN)60825 in total.

It is good practice to ensure that whenever possible, the laser beam from the laser diode module is terminated at the end of its useful path by diffusely reflecting material. It is also good practice to ensure that if the laser system is to be left switched on when not in use, the supplied plastic cap is used to terminate the beam at the laser aperture.
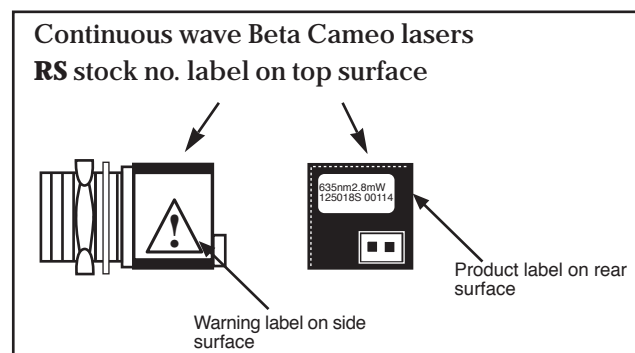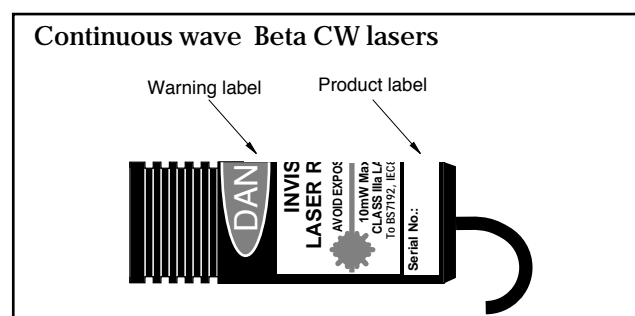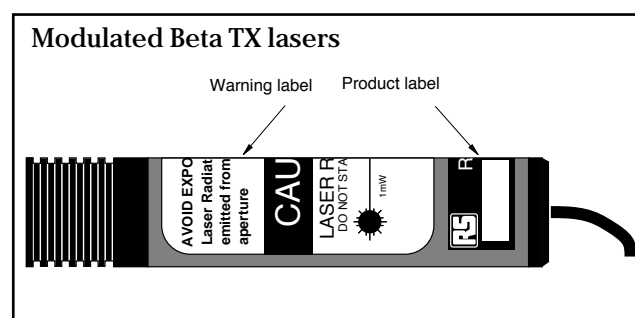
The laser diode modules, while being O.E.M. products, are supplied with labels showing their classification for wavelength and output power conforming to BS(EN)60825 and 21 CFR Part 1040.10. Reproductions of these labels are shown opposite.
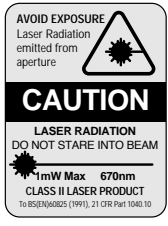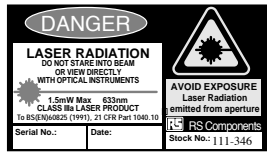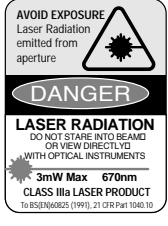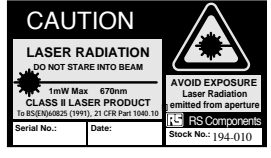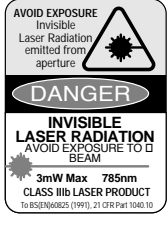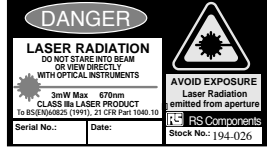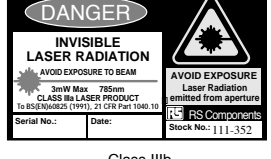
Notes:

* Optical aids are, spectacles, binoculars, telescopes, magnifiers and similar devices.

**Intrabeam viewing means all viewing conditions whereby the eye is exposed to laser radiation, other than extended source viewing.

Label positions

Modulated Beta TX lasers

Continuous wave Beta CW lasers

Continuous wave Beta Cameo lasers
RS stock no. label on top surface

Warning and product labels

Modulated lasers	Continuous wave lasers

Modulated lasers

AVOID EXPOSURE
Laser Radiation
emitted from
aperture

CAUTION

LASER RADIATION
DO NOT STARE INTO BEAM

1mW Max   670nm
CLASS II LASER PRODUCT
To BS(EN)60825 (1991), 21 CFR Part 1040.10

Class II

AVOID EXPOSURE
Laser Radiation
emitted from
aperture

DANGER

LASER RADIATION
DO NOT STARE INTO BEAM
OR VIEW DIRECTLY
WITH OPTICAL INSTRUMENTS

3mW Max   670nm
CLASS IIIa LASER PRODUCT
To BS(EN)60825 (1991), 21 CFR Part 1040.10

Class IIIa

AVOID EXPOSURE
Invisible
Laser Radiation
emitted from
aperture

DANGER

**INVISIBLE
LASER RADIATION**
AVOID EXPOSURE TO
BEAM

3mW Max   785nm
CLASS IIIb LASER PRODUCT
To BS(EN)60825 (1991), 21 CFR Part 1040.10

Class IIIb

RS **RS Components**
Stock No.: XXX-XXX   Serial No.:   Date:

Continuous wave lasers

DANGER

LASER RADIATION
DO NOT STARE INTO BEAM
OR VIEW DIRECTLY
WITH OPTICAL INSTRUMENTS

1.5mW Max   633nm
CLASS IIIa LASER PRODUCT
To BS(EN)60825 (1991), 21 CFR Part 1040.10

AVOID EXPOSURE
Laser Radiation
emitted from aperture

Serial No.:   Date: **RS** RS Components
Stock No.: 111-346

Class IIIa

CAUTION

LASER RADIATION
DO NOT STARE INTO BEAM

1mW Max   670nm
CLASS II LASER PRODUCT
To BS(EN)60825 (1991), 21 CFR Part 1040.10

AVOID EXPOSURE
Laser Radiation
emitted from aperture

Serial No.:   Date: **RS** RS Components
Stock No.: 194-010

Class II

DANGER

LASER RADIATION
DO NOT STARE INTO BEAM
OR VIEW DIRECTLY
WITH OPTICAL INSTRUMENTS

3mW Max   670nm
CLASS IIIa LASER PRODUCT
To BS(EN)60825 (1991), 21 CFR Part 1040.10

AVOID EXPOSURE
Laser Radiation
emitted from aperture

Serial No.:   Date: **RS** RS Components
Stock No.: 194-026

Class IIIa

DANGER

**INVISIBLE
LASER RADIATION**
AVOID EXPOSURE TO BEAM

3mW Max   785nm
CLASS IIIb LASER PRODUCT
To BS(EN)60825 (1991), 21 CFR Part 1040.10

AVOID EXPOSURE
Laser Radiation
emitted from aperture

Serial No.:   Date: **RS** RS Components
Stock No.: 111-352

Class IIIb