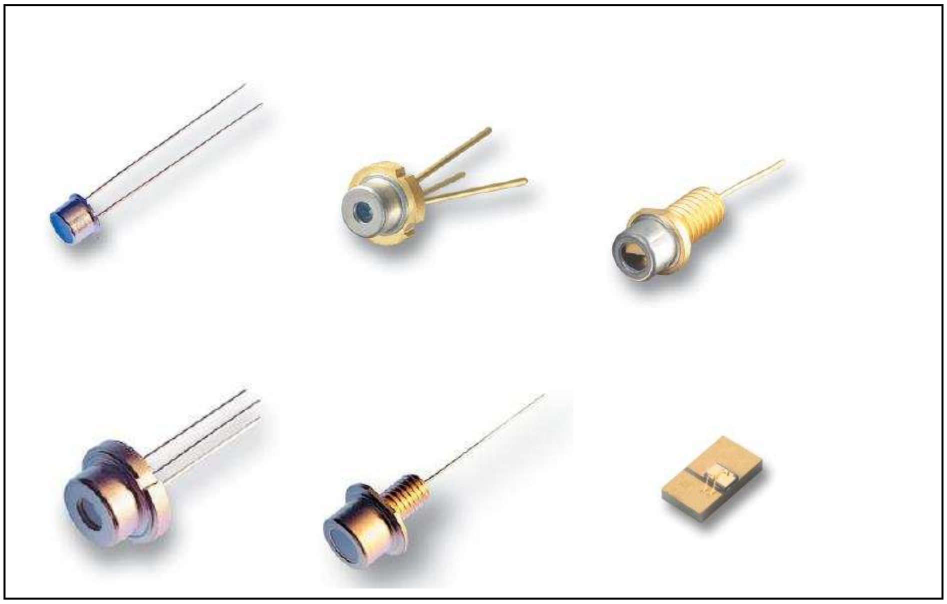
DATASHEET
Photon Detection

PGA Series of Single-epi 905 nm Pulsed Semiconductor Lasers

High Power Laser-Diode Family for Industrial Range Finding



Available in several package types, the PGA series laser chips feature stripe widths of 75 to 600 µm and can be stacked to further increase output power.

Excelitas Technologies' PGA pulsed laser series consists of hermetically packaged devices having a single-active lasing layer, which are epitaxially grown on a single GaAs substrate chip. The laser chips feature stripe widths of 75 to 600 µm and can be stacked to further increase the output power.

The PGA series possesses a 25° beam divergence in the direction perpendicular to chip surface and a 10° beam spread within the junction plane. The power output shows an excellent stability over the full MIL specification temperature range. Structures are fabricated using metal organic chemical vapour deposition (MOCVD).

Recognizing that different applications require different packages, six standard package options are available, including the traditional stud designs as well as 5.6 and 9 mm CD packages and ceramic substrates.

Since pulse widths in applications have decreased and optical coupling has become even more important, the newer packages – boasting reduced inductance and thinner, flatter windows – have gained popularity.

Key Features

- Peak power to 160 Watts
- Range of single element and stacked devices
- Overdrive capability up to 4 X power
- 25° beam divergence for single elements
- 83% power retention at 85°C
- RoHS compliant

Applications

- Laser range finding
- Laser safety curtains (laser scanning)
- Laser speed measurements (LIDAR)
- Automotive adaptive cruise control (ACC)
- Material excitation in medical and other analytical applications
- Weapons simulation

Table 1: Maximum Ratings

Parameter	Symbol	Min	Max	Units
Peak reverse voltage	V_{RM}		2	V
Pulse duration	t_W			
Single Element			1	µs
Multi Element			200	ns
Duty factor	du		0.1	%
Storage temperature	T_S	-55	105	°C
Operating temperature	T_{OP}	-55	85	°C
Soldering for 5 seconds (leads only)			+260	°C

Table 2: Generic Electro Optical Specifications at 23°C

Parameter	Symbol	Min	Typ	Max	Units
Center wavelength of spectral envelope	λ_C	895	905	915	nm
Spectral bandwidth at 50% intensity points	$\Delta\lambda$		5		nm
Wavelength temperature coefficient	$\Delta\lambda/\Delta T$		0.25		nm/°C
Beam spread (50% peak intensity) parallel to junction plane	$\Theta_{\|\|}$		10		degrees
Beam spread (50% peak intensity) perpendicular to junction	$\Theta_{\perp}$				
Single Element			25		degrees
Stacks			30		degrees

Table 3: Single Element Characteristics at T_{OP} = 23ºC, t_W = 150ns, prr = 1kHz

Parameter		PGAS1S03H	PGAS1S06H	PGAS1S09H	PGAS1S12H	PGAS1S16H	PGAS1S24H	Units
Minimum Optical Power at	P_{Omin}	5.5	13	19	26	35	54	W
Typical Optical Power at i_{FM}	P_{Otyp}	6.2	15	22	30	40	60	W
Number of Elements	-	1	1	1	1	1	1	
Emitting area		75 X 1	150 X 1	225 X 1	300 X 1	400 X 1	600 X 1	µm
Maximum Peak forward Current	i_{FM}	7	15	22	30	40	60	A
Typical lasing threshold current	i_{TH}	0.5	1.0	1.5	2.5	2.5	3.0	A
Series Resistance	R_D	0.160	0.130	0.115	0.110	0.100	0.095	ohms
Preferred Package		S, U	S, U	S, U	S, U	S, U	S	
Package Options		C, F, R, Y	C, F, R, Y	C, F, R, Y	C, F, R, Y	C, F, R, Y	C, F, R, Y	

Table 4: Multi Stacked Element Characteristics at T_{OP} = 23ºC, t_W = 150ns, prr = 1kHz

Parameter		PGAS3S06H	PGAS3S09H	PGAS3S12H	PGAS4S12H	PGAS4S16H	Units
Minimum Optical Power at i_{FM}	P_{Omin}	35	55	75	100	135	W
Typical Optical Power at i_{FM}	P_{Otyp}	42	65	85	120	160	W
Number of Elements	-	3	3	3	4	4	
Emitting area		150 X 225	225 X 225	300 X 225	300 X 340	400 X 340	µm
Maximum Peak forward Current	i_{FM}	15	22	30	30	40	A
Typical lasing threshold current	i_{TH}	1.0	1.5	2.5	2.5	2.5	A
Series Resistance	R_D	0.254	0.217	0.158	0.220	0.176	ohms
Preferred Package		S, U	S, U	S, U	S, U	S, U	
Package Options		C, F, R, Y	C, F, R, Y	C, F, R, Y	C, F, R, Y	C, F, R, Y	

Electro-Optical Characteristics

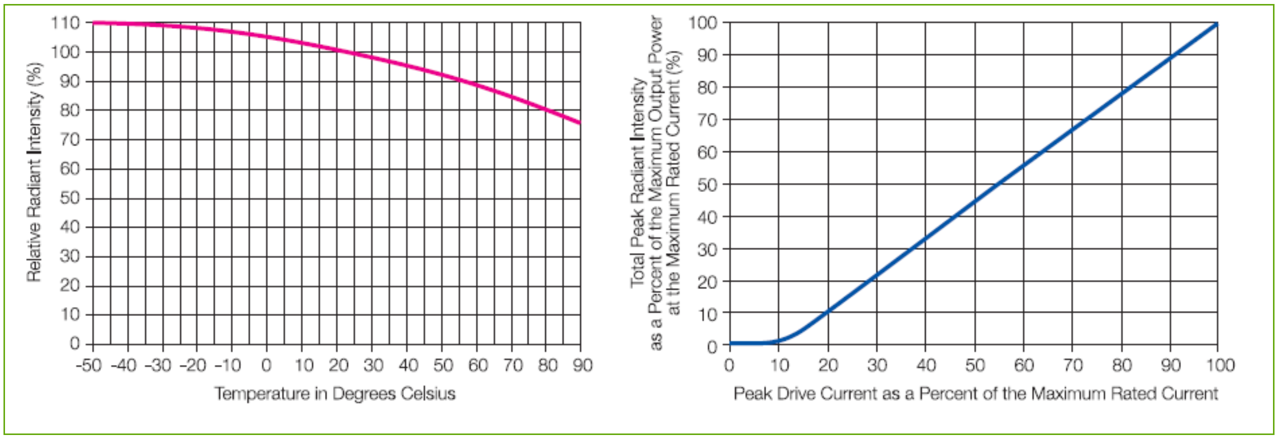


Figure 1

LEFT: Peak Radiant Intensity vs. Temperature

RIGHT: Total Peak Radiant Intensity vs. Peak Drive Current

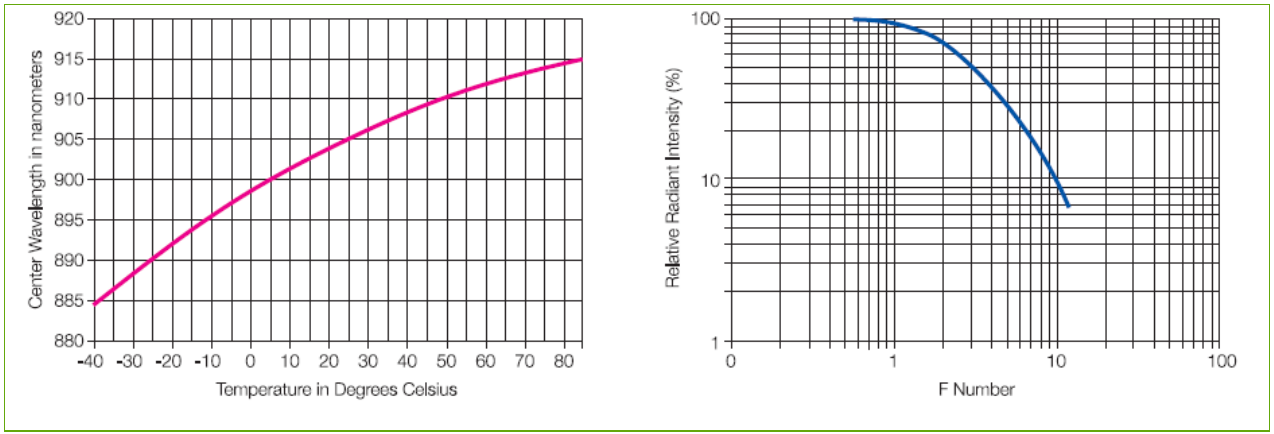


Figure 2

LEFT: Center Wavelength vs. Temperature

RIGHT: Radiant Intensity vs. F Number

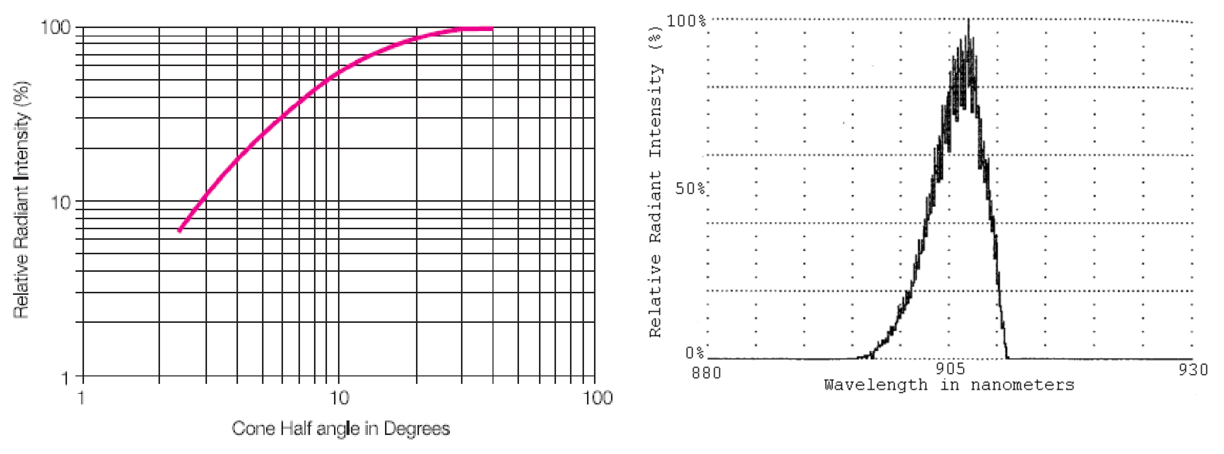


Figure 3

LEFT: Radiant Intensity vs. Half Angle

RIGHT: Spectral Distribution Plot

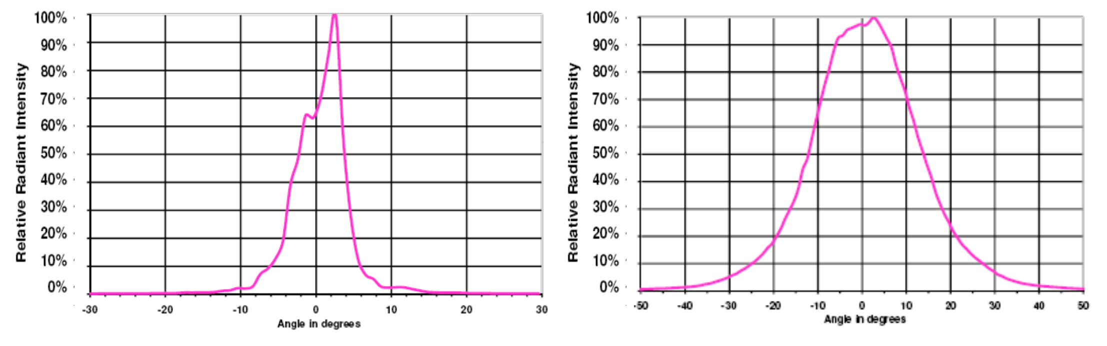


Figure 4

LEFT: Far Field Pattern Parallel to Junction Plane

RIGHT: Far Field Pattern Perpendicular to Junction Plane

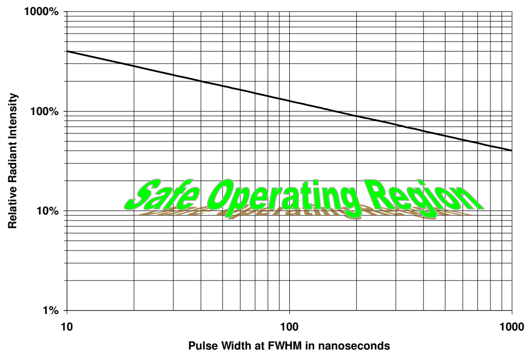
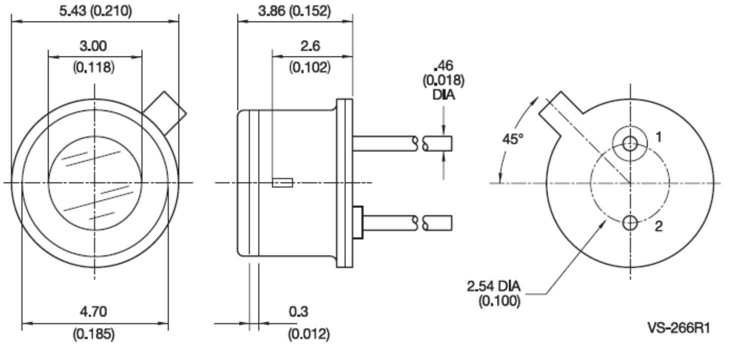
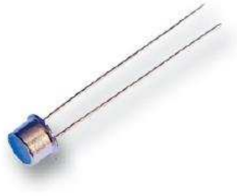


Figure 5

Radiant Intensity vs. Pulse Width for Safe Operation

Package Drawings



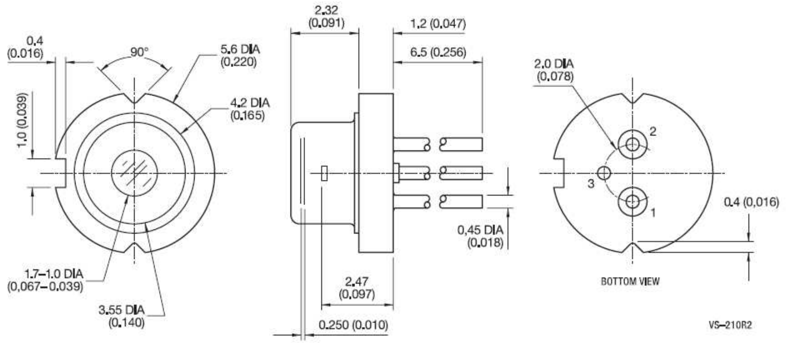


Package S:

Pin out 1. LD Anode (+), 2. LD Cathode (-) Case, Inductance 5.2 nH

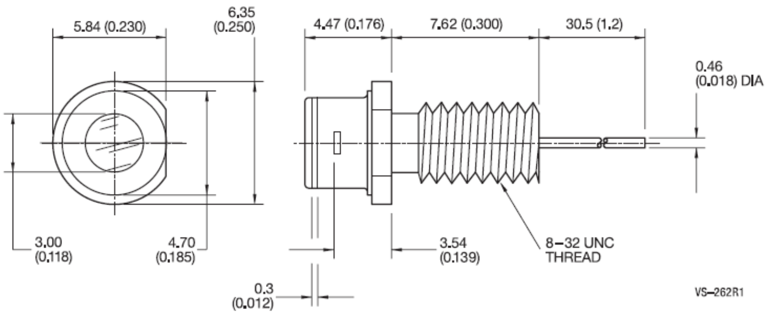
Package U:

Pin out 1. LD Anode (+), 2. NC, 3. LD Cathode (-) Case, Inductance 5.0 nH



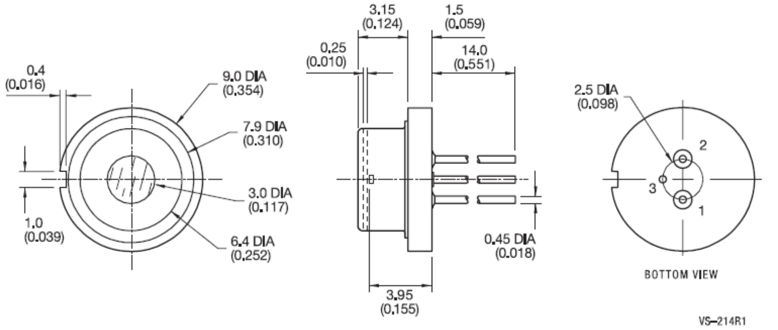
Package C:

Pin out: LD Cathode (-) Case, Pin LD Anode (+), Inductance 12 nH



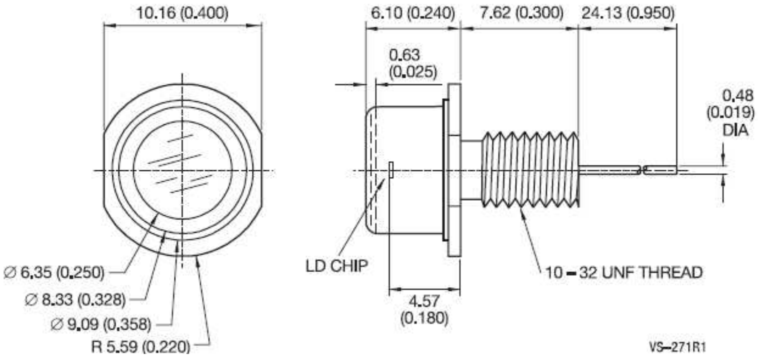
Package R:

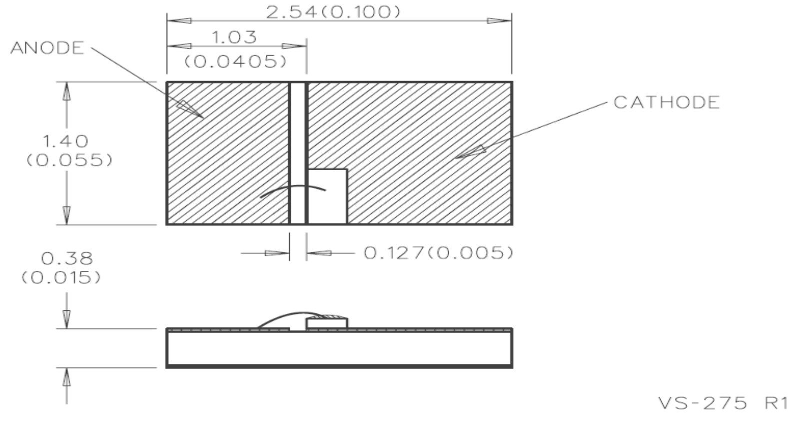
Pin out 1. LD Anode (+), 2. NC, 3. LD Cathode (-) Case, Inductance 6.8 nH

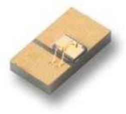


Package F:

Pin out: LD Cathode (-) Case, Pin LD Anode (+), Inductance 11 nH







Package Y:

Pin out 1. LD Cathode (-) chip bottom, 2. LD Anode (+) chip top, Inductance 1.6 nH

Ordering Guide

	P	G	A	X	X	S	XX	H
Pulsed	P							
905 nm nominal centre wavelength		G						
+/-10 nm centre wavelength tolerance			A					
Preferred S package				S				
Preferred U package				U				
Optional Y package				Y				
Optional C package				C				
Optional R package				R				
Optional F package				F				
Single chip stack					1			
Triple chip stack					3			
Quadruple chip stack					4			
Stackable chip						S		
0.003” wide laser stripe (75 µm)							03	
0.006” wide laser stripe (150 µm)							06	
0.009” wide laser stripe (225 µm)							09	
0.012’’ wide laser stripe (300 µm)							12	
0.016’’ wide laser stripe (400 µm)							16	
0.024’’ wide laser stripe (600 µm)							24	
RoHS compliance								H

For Your Safety

Laser Radiation:

Under operation, these devices produce invisible electromagnetic radiation that may be harmful to the human eye. To ensure that these laser components meet the requirements of Class IIIb laser products, they must not be operated outside their maximum ratings. Power supplies used with these components must be such that the maximum peak forward current cannot be exceeded. It is the responsibility of the user incorporating a laser into a system to certify the Class of use and ensure that it meets the requirements of the ANSI or appropriate authority.

Further details can be obtained in the following publications:

21CFR 1040.10 – "Performance Standards for Light Emitting Products (Laser Products)"

ANSI Z136.1 – "American National Standard for Safe Use of lasers"

IEC 60825-1 – "Safety of Laser Products"

Operating Conditions

The laser is operated by pulsing current in the forward bias direction.

The Excelitas warranty applies only to devices operated within the maximum rating, as specified. Exceeding these conditions is likely to cause permanent "burn off" damage to the laser facet and consequently a significant reduction in optical power.

Operating the devices at increased duty cycles will ultimately and irreparably damage the crystal structure due to internal heating effects. Diodes are static sensitive and suitable precautions should be taken when removing the units from their antistatic containers. Circuits should be designed to protect the diodes from high current and reverse voltage transients. Voltages exceeding the reverse breakdown of the semiconductor junction are particularly damaging and have been shown to cause degradation of power output. Although the devices will continue to perform well at elevated temperatures for some thousands of hours, defect mechanisms are accelerated.

Optimum long term reliability will be attained with the semiconductor at or below room temperature. Adequate heat sinking should be employed, particularly for the larger stacks and when operated at maximum duty factor.

Forward Voltage

The forward voltage of the device is a combination of: a static voltage drop resulting from band gaps and material characteristics, a dynamic series resistance resulting from the contact area dimensions, the resistivity of the contact layers, and the inductive voltage drop of the package. Voltages due to the inductive elements are additional and, therefore, are considered separately since they depend on the package inductance, the pulse rise time and the peak current.

Package Inductance

When narrow pulse widths are required, the system designer must take care that circuit inductance is kept to a minimum (note inductance on package list). Using the lower inductance packages will reduce the peak voltage required to obtain the desired drive current.

For example, to obtain approximate Gaussian pulse shapes for the "C" and "U" packages:

1. DPGAC1S12H:

t_w = 40 ns P_{rr} = 25 kHz, t_r = 20 ns,

i+ = 60 A, L_{CPKG} = 12 nH

VL = L_{PKG} X di/dt

V_{CPKG} = 12 x 10-9 X 60/20 X 10-9 =36 V

2. DPGAU1S12H:

t_w = 40 ns P_{rr} = 25 kHz, t_r = 20 ns,

i_r = 60 A, L_{UPKG} = 5 nH

VL = L_{PKG} X di/dt

V_{UPKG} = 5 x 10-9 X 60/20 X 10-9 =15 V

Note: These voltage drops are merely to overcome the inductance of the package and do not include the series package and chip static resistances.

Other circuit elements typically increase voltage requirements to 3 X V_{PKG}, therefore the location of components to minimize lead length is critical.

Ordering Information

The "preferred package" options on the list will normally be offered at lower cost and with shorter delivery times. To keep the costs down the standard devices are tested and burned-in under standard conditions. While the devices are warranted over the entire specification, for a quantity purchase, customers are advised to discuss their requirements in advance so that any special test needs can be accommodated and yields optimized.

Excelitas has been routinely supplying lasers for military applications since the early 1990s. These diodes benefit from long years of experience from screened laser diodes to European and North American military specifications. Though the commercial products are not continuously screened, they are designed to meet demanding environmental conditions.

Typical qualification of these parts would include:

- High Temperature Storage
- Hermetic Seal
- Thermal Shock
- Random Vibration
- Acceleration
- Mechanical Shock

Excelitas is pleased to assist with advice and test procedures for your specific environmental needs.

RoHS Compliance

This series of laser diodes are designed and built to be fully compliant with the European Union Directive 2002/95EEC – Restriction of the use of certain Hazardous Substances in Electrical and Electronic equipment.

Warranty

A standard 12-month warranty following shipment applies. Any warranty is null and void if the package window has been opened.

About Excelitas Technologies

Excelitas Technologies is a global technology leader focused on delivering innovative, customized solutions to meet the lighting, detection and other high-performance technology needs of OEM customers.

From analytical instrumentation to clinical diagnostics, medical, industrial, safety and security, and aerospace and defense applications, Excelitas Technologies is committed to enabling our customers' success in their specialty end-markets. Excelitas Technologies has approximately 3,000 employees in North America, Europe and Asia, serving customers across the world.

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