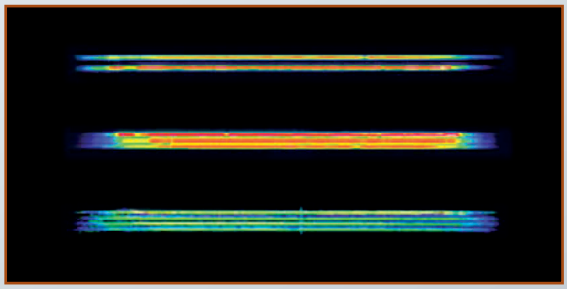
PGA Series of 905 nm Pulsed Semiconductor Lasers

Photon Detection Solutions



High Power Laser-Diode Family for Industrial Range Finding

Introduction

Excelitas' PGA pulsed laser-diode family is proven in security applications since the early 1990s. It consists of hermetically packaged devices having up to four active lasing layers, which are epitaxially grown on a single GaAs substrate. This multi-layer design multiplies the output power by the number of epi-layers. For example, the QPGA quad laser at 225 µm active layer width, which has four epitaxially grown lasing layers, delivers output peak power >100 W and, by additionally stacking three quad chips into a single package, the usable device power exceeds 300 W.

Features and Benefits

- Doubling, tripling or quadrupling of the output power from a single EPI-cavity chip with a small active area: peak power per chip exceeds 100 W at 30 A drive current and 100 ns pulse width
- Peak power >300 W at 30 A drive current and 100 ns pulse width for 3 physically stacked quad EPI-cavity chips
- Extremely high reliability
- Range of single element and stacked devices
- Choice of 6 standard packages
- 80% power retention at 85°C ambient
- Flexibility in customization for different applications
- Small emitting areas allow ease of fiber coupling
- RoHS compliant

Applications

- Laser range finding
- Laser safety curtains (laser scanning)
- Infrared night illumination
- Laser speed measurement (LIDAR)
- Automotive adaptive cruise control (ACC)
- Material excitation in medical and other analytical applications
- Weapon simulation

The laser chips of the PGA family feature stripe widths of 75 and 225 µm and come as single (PGA), double (DPGA), triple (TPGA), or quadruple (QPGA) epi-layer versions, which in addition can be stacked to increase the output power further. Other stripe widths are available on request.

The PGA series possesses a 25° beam divergence in the direction perpendicular to the chip surface and a 10° beam spread parallel to the junction plane. The power output shows an excellent stability over the full MIL specified temperature range. 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.

Additionally where fiber coupling applications are concerned, the transverse spacing of the EPI cavity active areas concentrates more optical power into a smaller geometry allowing for increased optical power coupling into optical fibers.

EXCELITAS TECHNOLOGIES

Table 1

PGA Pulsed Laser Family Selection Table

Device	Description	Total # of emitting stripes	Typical peak power at 10 A, 100 ns 75 µm (3 mils) stripe width	Typical peak power at 30 A, 100 ns 225 µm (9 mils) stripe width
PGAx1	Single chip laser 1 epi-layer	1	8 W	30 W
DPGAx1	Single chip laser 2 epi layers: Double EPI-cavity laser	2	15 W	50 W
TPGAx1	Single chip laser 3 epi-layers: Triple EPI-cavity laser	3	23 W	75 W
QPGAx1	Single chip laser 4 epi-layers: Quad EPI-cavity laser	4	33 W	100 W
TPGAx2	Double chip laser 2 x 3 epi-layers: Double stacked triple EPI-cavity laser	6	45 W	150 W
QPGAx2	Double chip laser 2 x 4 epi-layers: Double stacked quad EPI-cavity laser	8	65 W	200 W
QPGAx3	Triple chip laser 3 x 4 epi-layers: Triple stacked quad EPI-cavity laser	12	95 W	300 W

"x" = package type. Preferred package: S-type

Table 2

Maximum Ratings

Parameter	Symbol	Min	Max	Units
Peak reverse voltage	V_{RM}		2	V
Pulse duration	t_W		100	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 3

Generic Electro-Optic Specifications at 23°C

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

PGA Pulsed Laser Family Selection Table

Table 1 lists the preferred chip and stacking options.
For other configurations please inquire.

Operating Conditions

The laser is operated by pulsing 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.

For additional information on driving the laser diode, please refer to Excelitas' driver application note.

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 feasible to operate the diodes within Class I laser operation, but 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 may 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".

Table 4

PGA 75 µm Stripe Width Family

Characteristics at 23°C, 10 A, 100 ns, 1 KHz

Parameter		Symbol	PGA S1S03H	DPGA S1S03H	TPGA S1S03H	QPGA S1S03H	TPGA S2S03H	QPGA S2S03H	QPGA S3S03H	Units
Po at i_{FM}	min typical	Po_{min} Po_{typ}	8 9	15 17	22 25	29 33	44 50	58 65	85 95	W W
# of emitting stripes			1	2	3	4	6	8	12	
# of laser chips			1	1	1	1	2	2	3	
Emitting area	typical		75 x 1	75 x 5	75 x 10	75 x 15	75 x 175	75 x 225	75 x 450	µm
Maximum peak forward current		i_{FM}	10	10	10	10	10	10	10	A
Threshold current	typical	i_{th}	0.75	0.75	0.75	0.75	0.75	0.75	0.75	A
Forward voltage[1] @ i_{FM}	typical	V_f	4.5	7	10	13	20	26	39	V
Preferred packages			S,Y	S,Y	S,Y	S,Y	S,Y	S,Y	S,Y	
Optional packages			U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	

1. Excluding the voltage drop contribution due to the inductive element of the package.

Table 5

PGA 225 µm Stripe Width Family

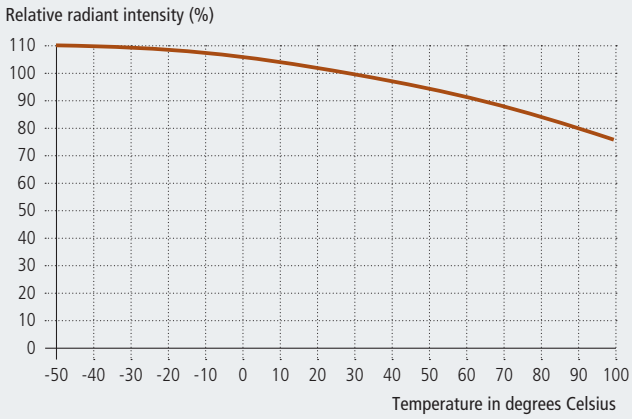
Characteristics at 23°C, 30 A, 100 ns, 1 KHz

Parameter		Symbol	PGA S1S09H	DPGA S1S09H	TPGA S1S09H	QPGA S1S09H	TPGA S2S09H	QPGA S2S09H	QPGA S3S09H	Units
Po at i_{FM}	min typical	Po_{min} Po_{typ}	24 30	46 50	70 75	95 100	140 150	180 200	275 300	W W
# of emitting stripes			1	2	3	4	6	8	12	
# of laser chips			1	1	1	1	2	2	3	
Emitting area	typical		225 x 1	225 x 5	225 x 10	225 x 15	225 x 175	225 x 225	225 x 450	µm
Maximum peak forward current		i_{FM}	30	30	30	30	30	30	30	A
Threshold current	typical	i_{th}	2.0	2.0	2.0	2.0	2.0	2.0	2.0	A
Forward voltage[1] @ i_{FM}	typical	V_f	4.5	8.5	13	19	26	38	57	V
Preferred packages			S,Y	S,Y	S,Y	S,Y	S,Y	S,Y	S,Y	
Optional packages			U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	U,C,F,R	

1. Excluding the voltage drop contribution due to the inductive element of the package.

Figure 1

Peak Radiant Intensity vs. Temperature



Total Peak Radiant Intensity vs. Peak Drive Current

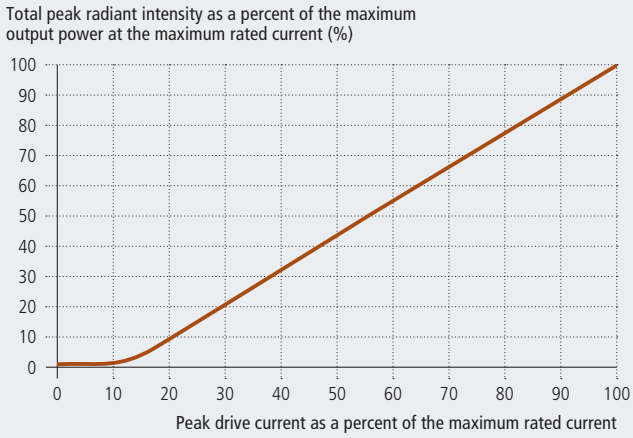
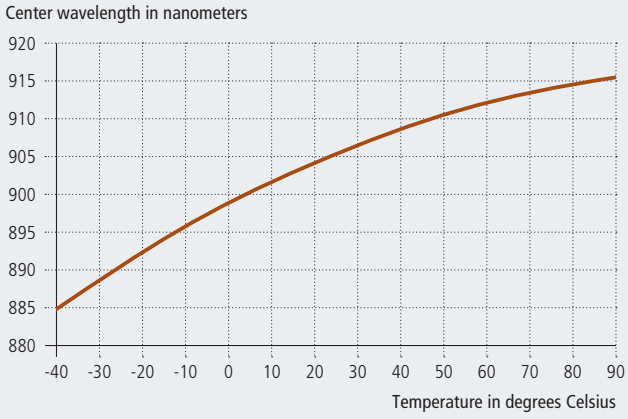


Figure 2

Center Wavelength vs. Temperature



Radiant Intensity vs. F Number

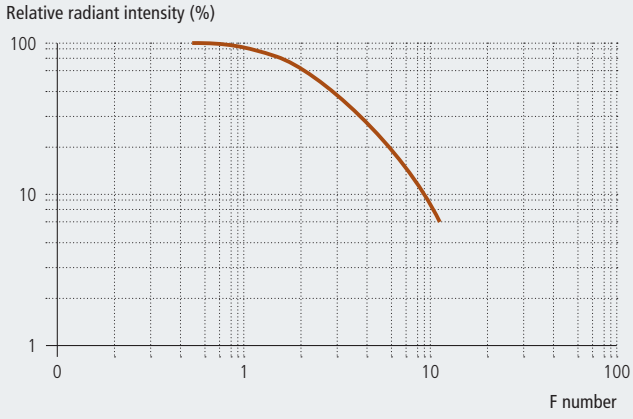
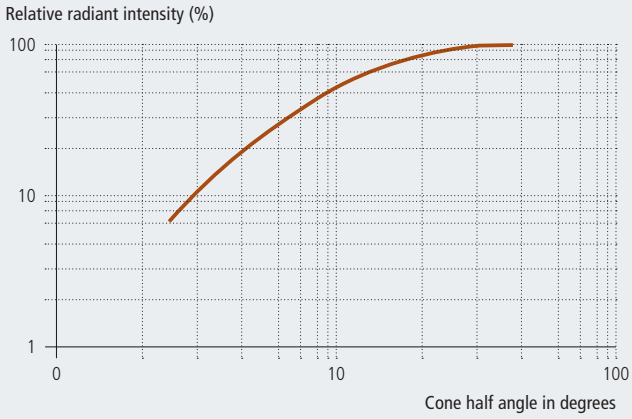


Figure 3

Radiant Intensity vs. Half Angle



Spectral Plot Distribution

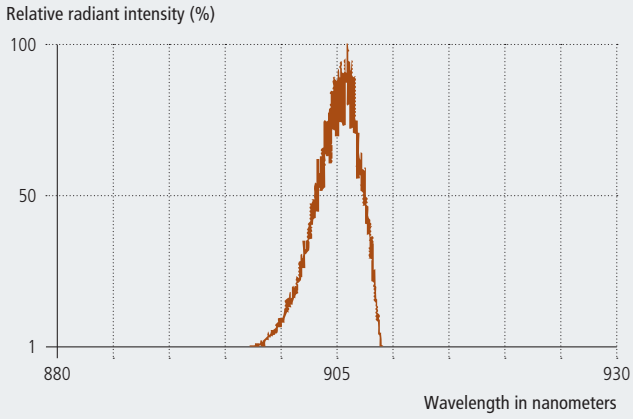
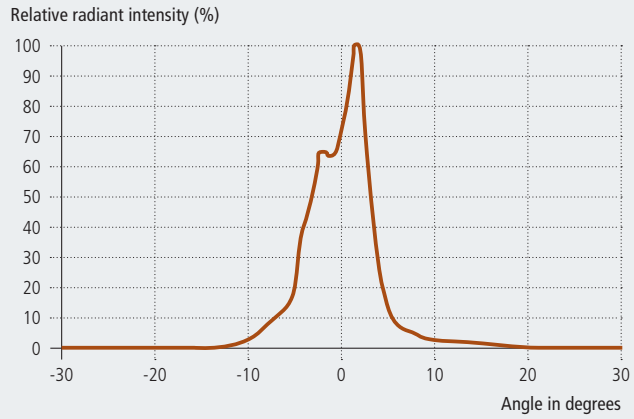


Figure 4

PGA & DPGA Far Field Pattern Parallel to Junction Plane



PGA & DPGA Far Field Pattern Perpendicular to Junction Plane

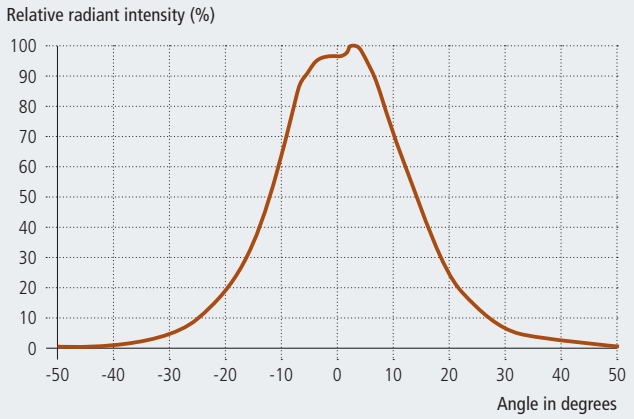
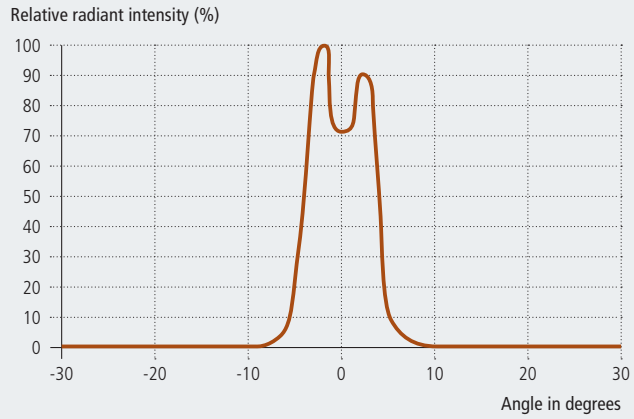


Figure 5

TPGA & QPGA Far Field Pattern Parallel to Junction Plane



TPGA & QPGA Far Field Pattern Perpendicular to Junction Plane

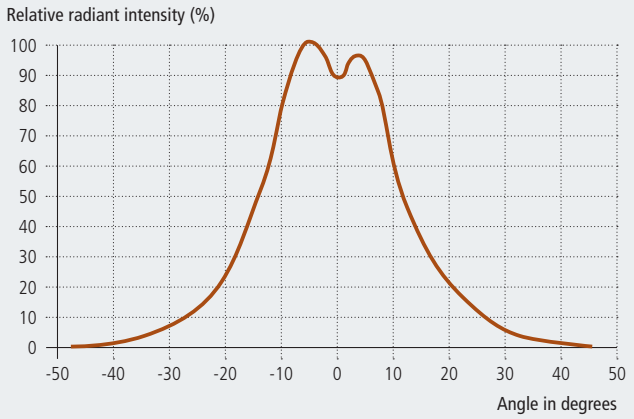
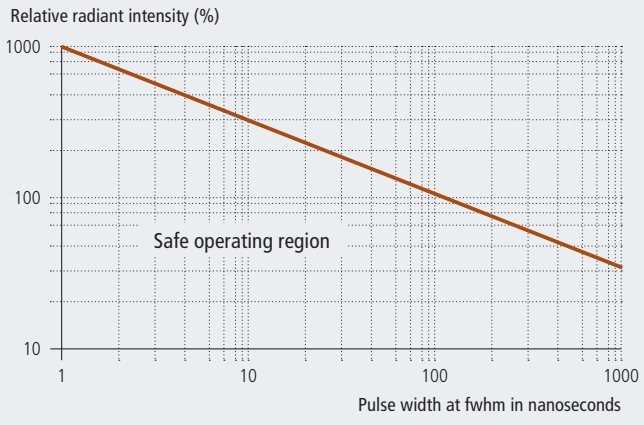
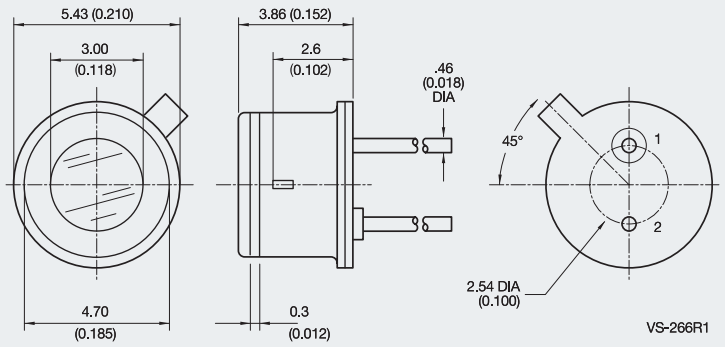


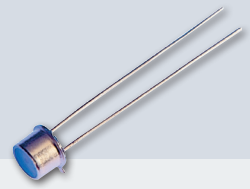
Figure 6

Radiant Intensity vs. Pulse Width for Safe Operation



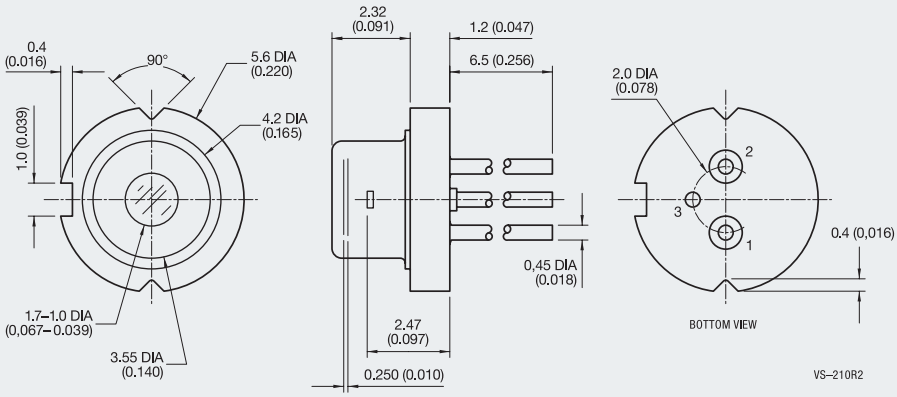
Package Drawings

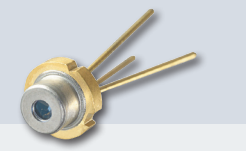




Package S (TO-18)

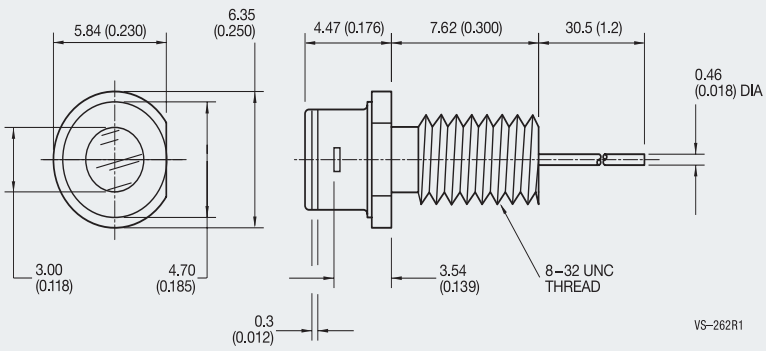
Pin out 1.
LD Anode (+),
2. LD Cathode (-) Case,
Inductance 5.2 nH

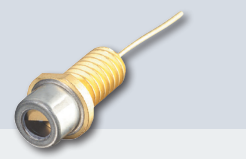




Package U (5 mm CD)

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

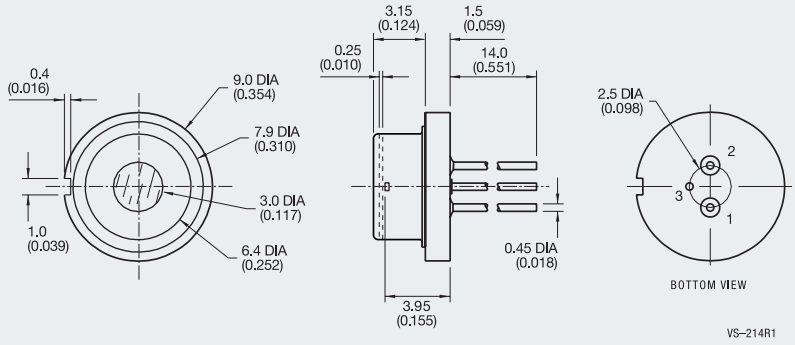


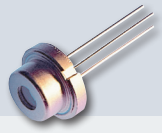


Package C (8–32 coax)

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

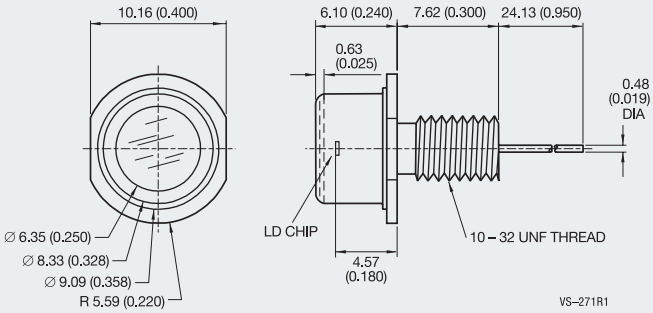
Package Drawings

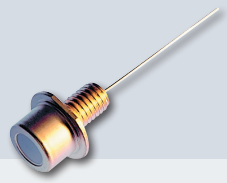




Package R (9 mm CD)

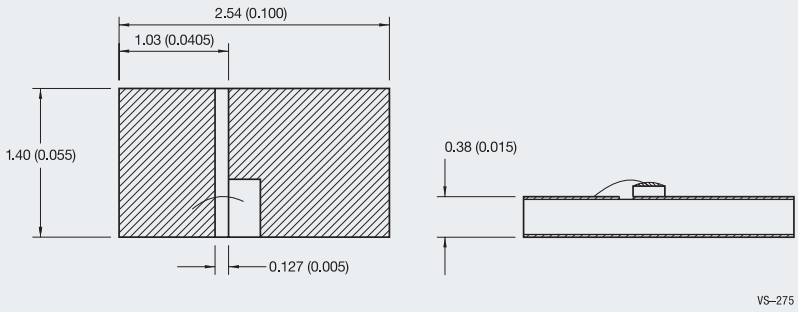
Pin out 1.
LD Anode (+)
2. NC, 3. LD Cathode (-) Case
Inductance 6.8 nH

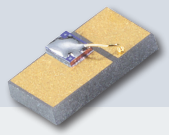




Package F (10 –32 coax)

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





Package Y (chip on carrier)

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

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 multi active EPI-cavity 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 2002/95/EEC – Restriction of the use of certain Hazardous Substances in Electrical and Electronic equipment.

Table 6

Ordering Guide

	X	P	G	A	X	X	S	XX	H
Double active area	D								
Triple active area	T								
Quadruple active area	Q								
Pulsed		P							
905 nm wavelength			G						
+/-10 nm spectral width				A					
S package (TO-18)					S				
Y package (chip on carrier)					Y				
U package (5 mm CD)					U				
C package (8 – 32 coax)					C				
R package (9 mm CD)					R				
F package (10 – 32 coax)					F				
Single chip stack						1			
Douple chip stack						2			
Triple chip stack						3			
Stackable chip							S		
0.003'' wide laser stripe (75 µm)								03	
0.009'' wide laser stripe (225 µm)								09	
RoHS compliance									H

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