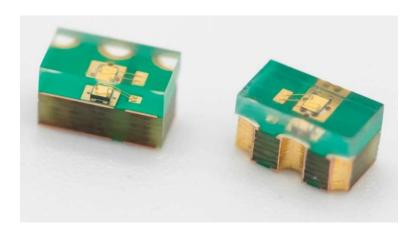
# PGAD1S03H – 905 nm Pulsed Semiconductor Laser in SMD Package High Power Laser-Diode Family for LiDAR and Range Finding



Excelitas' PGAD1S03H is a standard 905 nm laser chip of the PGA series with one emitting stripe, packaged in an Excelitas leadless laminate carrier (LLC) package.

#### **Key Features**

- Small emission size for easy optical coupling
- Single Stripe 75 μm active laser length
- Side and top looking mount possibility
- Concentrated emitting source size for high power into aperture
- Quantum well structure
- Excellent power stability with temperature
- RoHS compliant

#### **Applications**

- LiDAR / ToF measurements
- Laser range finding
- Laser scanning / UGV
- Infrared night illumination
- Laser therapy
- Material excitation in medical and other analytical applications

All specifications are valid for  $T_A$  = 23 °C, pw = 100 ns, prr = 1 kHz and  $i_F$  = 10 A, unless otherwise specified.

#### **Table 1: Key parameters**

Parameter	Symbol	Min	Тур	Max	Unit
Peak Optical Power	Р	7	8		W
Wavelength	λς	895	905	925	nm
Operating Temperature <sup>1</sup>	T <sub>op</sub>	-40		85	°C

**Note 1:** Extended temperature range specification available. Please contact Excelitas Technologies for more information.



## **High-Power Laser Diode Family for LiDAR and Range Finding**

#### **Table 2: Absolute Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Peak Reverse Voltage	$V_{RM}$		2	V
Pulse Duration	tw		100	ns
Duty Factor	du		0.1	%
Storage Temperature	T <sub>S</sub>	-40	105	°C
Soldering Temperature <sup>3</sup>	T <sub>P</sub>		250	°C

**Note 1:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

**Note 2:** Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 3: For detailed reflow information, refer to Table 6

#### **Table 3: Chip and Nearfield Specifications**

The specifications in Table 3 indicate the optical emission characteristics of the PGAD1S03H. Due to current spreading inside the laser junction the emission size of the Near Field is depending on the drive current and will be larger than the active area of the chip.

To ease the optical coupling into the final system, the Emitting Width and Height are defined as FWHM of the Near Field Size.

Parameter	Symbol	Minimum	Typical	Maximum	Units
Number of stripes	S		1		-
Emitting width	W		89		μm
Emitting height	h		1		μm

**Table 4: Emission Specifications** 

Parameter	Symbol	Minimum	Typical	Maximum	Units
Spectral Width (FWHM)	Δλ		10		nm
Wavelength Temperature Coefficient	Δλ/ΔΤ		0.25		nm / °C
Divergence Parallel to Junction Plane	θΠ		7.5		degrees
Divergence Perpendicular to Junction Plane	$\theta_{ m L}$		25		degrees

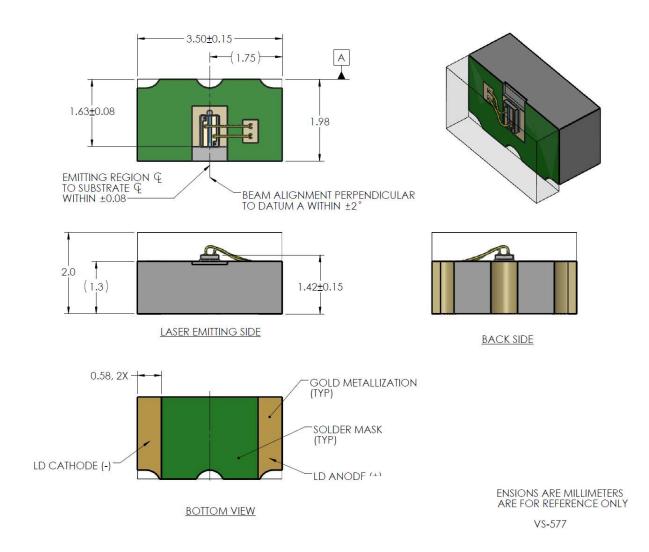
# **High-Power Laser Diode Family for LiDAR and Range Finding**

**Table 5: Electrical Specifications** 

Parameter	Symbol	Minimum	Typical	Maximum	Units
Forward Voltage <sup>1</sup>	V <sub>F</sub>		2.5		V
Drive Current	İ <sub>F</sub>		10		Α
Threshold Current	i <sub>Th</sub>		0.5		Α
Series Resistance	Rs		0.11		Ω
Bandgap Voltage Drop	Vg		1.4		V

**Note 1:** As estimated by  $V_F = R_S i_F + V_g$ .

**Figure 1: Package Mechanical Dimension** 



## **High-Power Laser Diode Family for LiDAR and Range Finding**

Figure 2: Typical P vs. i<sub>F</sub>

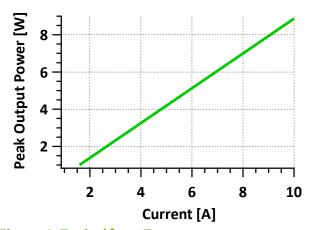


Figure 4: Typical λ vs. T<sub>j</sub>

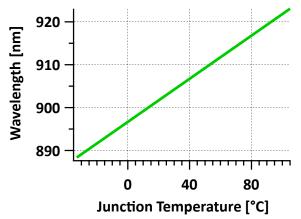
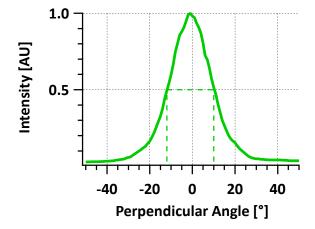


Figure 6: Typical  $\theta_{\perp}$ 



**Figure 3: Typical Emission Spectrum** 

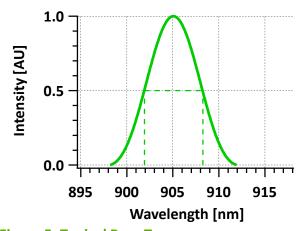


Figure 5: Typical P vs. T<sub>j</sub>

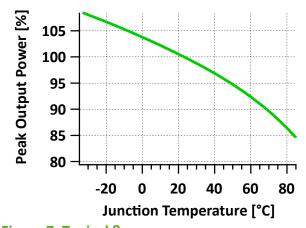
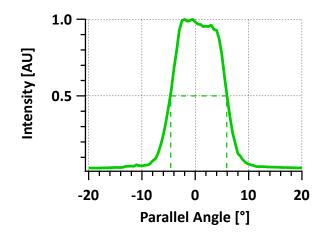


Figure 7: Typical  $\theta_{11}$ 



# **High-Power Laser Diode Family for LiDAR and Range Finding**

#### Information:

Excelitas Technologies' PGAD1S03H semiconductor pulsed laser diode in SMD package, emitting at 905 nm in the near IR, uses a multi-layer monolithic chip design. Its improved structure of GaAs substrate is offering 8 W pulsed peak power when driven at 10 A. The multi-layer chip design features an active laser size of  $(75 \times 1) \mu m$  by emission of one laser line, offering high output power out of a small aperture. The laser chips are fabricated by using metal organic chemical vapor deposition (MOCVD).

The Excelitas LLC epoxy encapsulated package complements Excelitas' PGA series epi-cavity lasers in hermetic metal or T1¾ (TO-like) plastic packages and are ideally suited for high volume applications.

The beam propagation possesses a 25° divergence in the direction perpendicular to the chip surface and 7.5° divergence parallel to the chip surface. The output power shows an excellent stability over the full MIL specification temperature range.

Our quantum well laser design offers rise and fall times of << 1 ns. However, the drive circuit layout and mounting inductance play a dominant role and should be designed in accordance with the desired optical pulse width.

The peak wavelength at 905 nm is centered near the maximum responsivity of most silicon photodiodes. The PGAD1S03H laser matches especially well with devices from the Excelitas EPI-APD C30737 family.

This laser diode is ideally suited for applications where cost is a primary concern and high-volume production capacity is required.

An unconnected laser die as shipped cannot emit light. Light emission requires an installation into an electrical driver circuit.

#### **Principle of operation**

The light output for a laser diode is proportional to the current running through the laser by pulsing in the forward bias direction. A simple way of allowing a large current to flow within nanoseconds through the laser is to discharge a large capacitor into the laser by closing a GaN-FET.

Excelitas recommends the usage of a low-side driver to operate the laser. A detailed description of the circuitry to recharge the capacitors is omitted here since many options are available on the market. The voltage on the capacitors and discharge time will dictate the current flow in the laser.

Optimum long term reliability will be attained with the laser at or below room temperature. Adequate heat sinking should be employed, particularly when operated at maximum duty cycle.

## **High-Power Laser Diode Family for LiDAR and Range Finding**

#### **Package inductance**

When narrow pulse widths are required, the system designer must take care that circuit inductance is kept to a minimum. Keeping the inductance low will reduce the peak voltage required to obtain the desired drive current. The below example shows the impact of different pulse widths on the necessary forward voltage to obtain an approximate Gaussian pulse shape:

- 40 ns Pulse Width
  - o  $t_p = 40 \text{ ns}, t_r = 20 \text{ ns}$
  - $\circ$  I<sub>F</sub> = 10 A, L<sub>PKG</sub> = 1.6 nH

$$O V_{PKG} = L_{PKG} \frac{dI_F}{dt} = 1.6 \times 10^{-9} H \frac{10 A}{20*10^{-9} s} = 0.8 V$$

- 1 ns Pulse Width
  - o  $t_p = 1 \text{ ns}, t_r = 0.5 \text{ ns}$
  - $\circ$  I<sub>F</sub> = 10 A, L<sub>PKG</sub> = 1.6 nH

$$OV_{PKG} = L_{PKG} \frac{dI_F}{dt} = 1.6 \times 10^{-9} H \frac{10 A}{0.5 \times 10^{-9} s} = 32 V$$

#### **Testing methods**

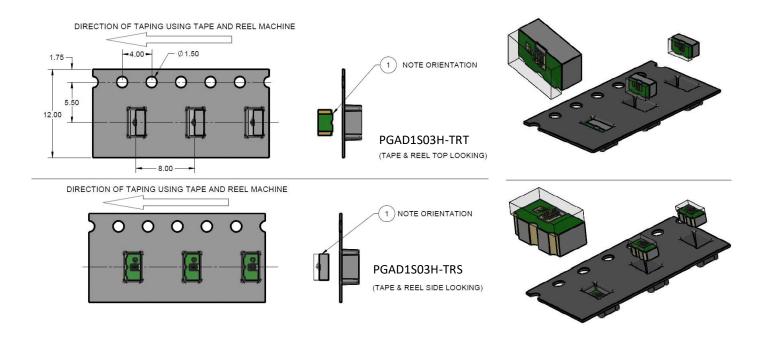
Excelitas verifies the electro optical specifications on a sample only basis per lot. Bare laser dies shipped to customers do not undergo any electrical testing. Visual inspection during fabrication is performed as per our quality standard and failed lasers are removed.

#### Packaging and shipping

For sampling quantities, lasers are placed in Waffle Packs. For production quantities, lasers are placed in tape & reel.

## **High-Power Laser Diode Family for LiDAR and Range Finding**

Figure 8: Tape & Reel specification – ordering code



#### **MSL Rating**

This series of laser diodes comply with a Moisture Sensitivity Level (MSL) rating of 3 as defined in IPC/JEDEC- J-STD-033C. This allows for up to 168 hour floor life at  $\leq$  30°C / 60%RH once removed from the sealed reel packaging. For complete details refer to the IPC/JEDEC- J-STD-033C specification.

#### Storage and handling

Excelitas highly recommends following the below notes:

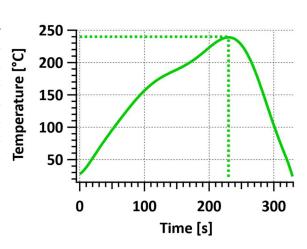
- Keep lasers in a humidity-controlled environment until final assembly, best in a N<sub>2</sub> purged cabinet.
- If a manual picking method is necessary, use a non-marring tweezer to pick the laser by the short sides only.

## **High-Power Laser Diode Family for LiDAR and Range Finding**

#### **Table 6: Reflow Solder Profile**

The following reflow solder profile is a typical used profile for SAC305 solder alloys. Specific solder parameters depend on the solder alloy used.

Profile Feature	Symbol	Typical	Units
Minimum Sparkling Temperature	$T_{Smin}$	150	°C
Maximum Sparkling Temperature	$T_{Smax}$	200	°C
Sparkling Time	$t_{S}$	75	S
Minimum Reflow Temperature	$T_L$	217	°C
Peak Temperature	$T_P$	244	°C
Reflow Time	$t_{\scriptscriptstyleL}$	65	S
Time within T <sub>P</sub> - 5°C	$t_{P}$	25	S
Ramp Down Rate	$\Delta T_c$	2	°C/s



#### 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 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"

# **High-Power Laser Diode Family for LiDAR and Range Finding**

#### **RoHS Compliance**

This series of laser diodes are designed and built to be fully compliant with the European Union Directive on restrictions of the use of certain hazardous substances in electrical and electronic equipment.



#### Warranty

A standard 12-month warranty following shipment applies.

#### **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.

Excelitas has a long and rich history of serving our OEM customer base with optoelectronic sensors and modules for more than 45 years beginning with PerkinElmer, EG&G, and RCA. The constant throughout has been our innovation and commitment to delivering the highest quality solutions to our customers worldwide.

From aerospace and defense to analytical instrumentation, clinical diagnostics, medical, industrial, and safety and security applications, Excelitas Technologies is committed to enabling our customers' success in their specialty end-markets. Excelitas Technologies has approximately 7,000 employees in North America, Europe and Asia, serving customers across the world.

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