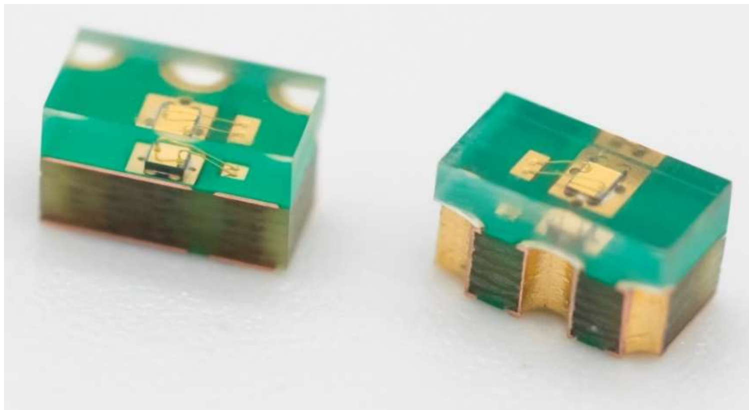
PGAD1S03H – 905 nm Pulsed Semiconductor Laser in SMD Package

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	Typ	Max	Unit
Peak Optical Power	P	7	8		W
Wavelength	λ_C	895	905	925	nm
Operating Temperature[1]	T_{op}	-40		85	°C

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

Table 2: Absolute Ratings

Parameter	Symbol	Minimum	Maximum	Units
Peak Reverse Voltage	V_{RM}		2	V
Pulse Duration	t_W		100	ns
Duty Factor	du		0.1	%
Storage Temperature	T_S	-40	105	°C
Soldering Temperature[3]	T_P		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)	$\Delta\lambda$		10		nm
Wavelength Temperature Coefficient	$\Delta\lambda/\Delta T$		0.25		nm / °C
Divergence Parallel to Junction Plane	$\theta_{\|\|}$		7.5		degrees
Divergence Perpendicular to Junction Plane	$\theta_{\perp}$		25		degrees

Table 5: Electrical Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Units
Forward Voltage[1]	V_F		2.5		V
Drive Current	i_F		10		A
Threshold Current	i_{Th}		0.5		A
Series Resistance	R_S		0.11		Ω
Bandgap Voltage Drop	V_g		1.4		V

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

Figure 1: Package Mechanical Dimension

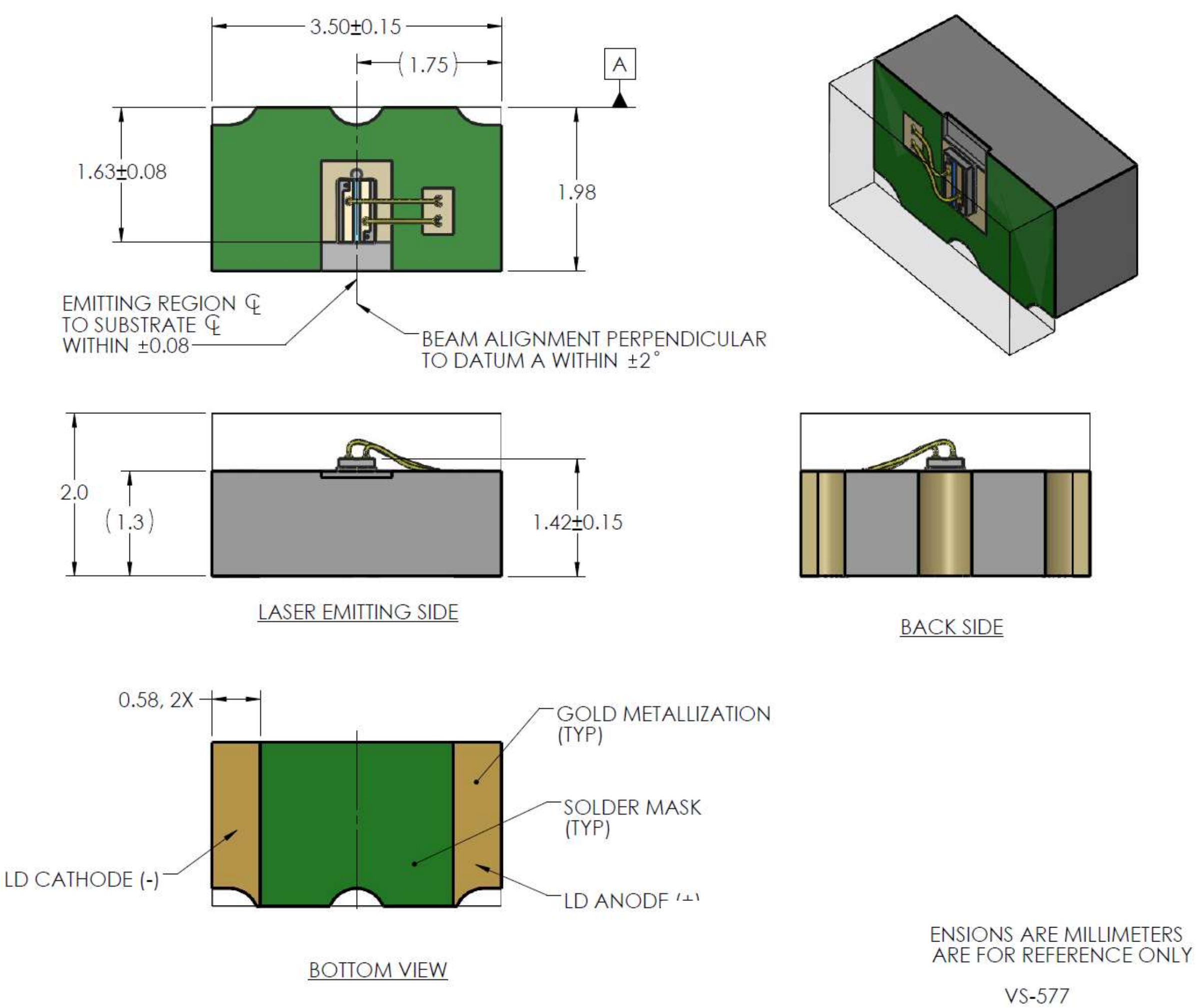


Figure 2: Typical P vs. i_F

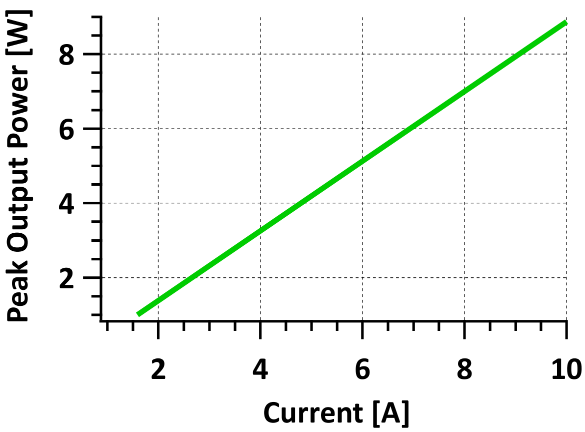


Figure 3: Typical Emission Spectrum

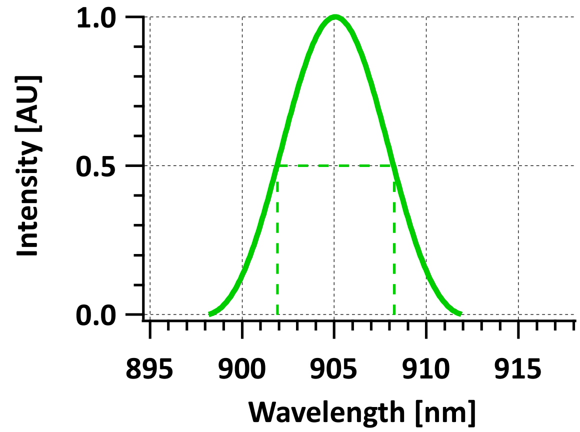


Figure 4: Typical λ vs. T_j

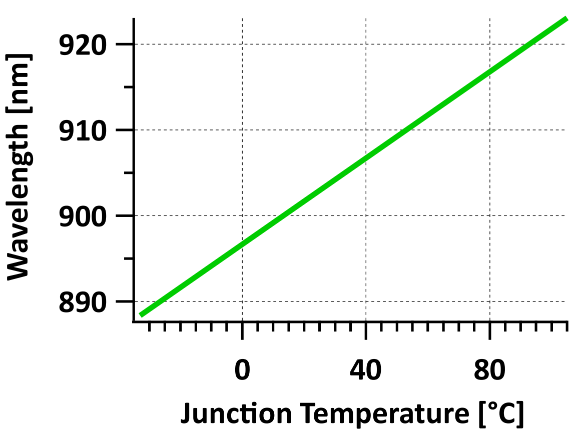


Figure 5: Typical P vs. T_j

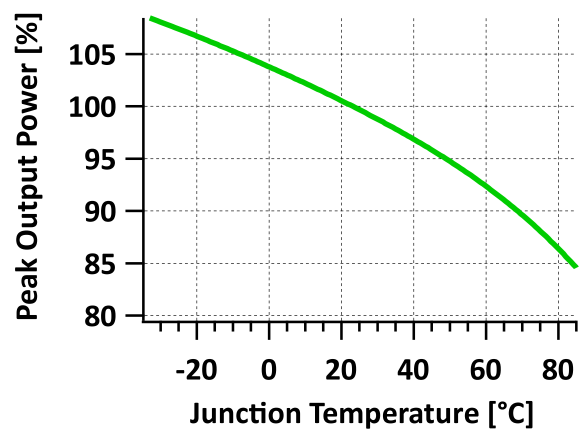


Figure 6: Typical $\theta_{\perp}$

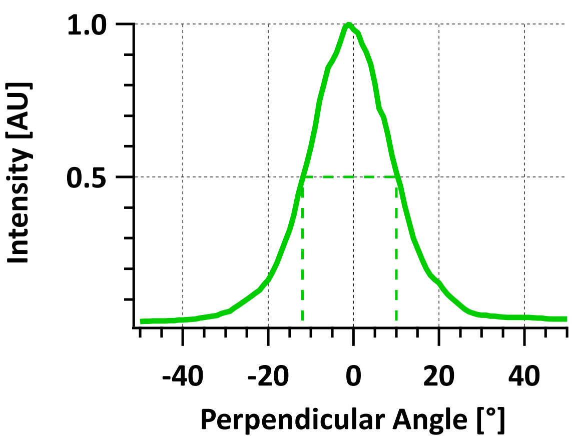
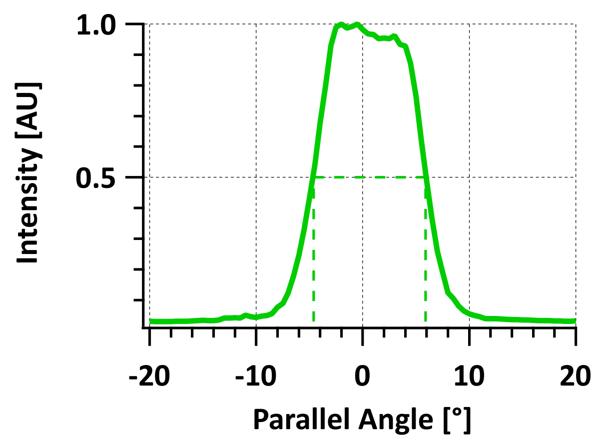


Figure 7: Typical $\theta_{||}$



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 x 1) µm 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.

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
  - t_p = 40 ns, t_r = 20 ns
  - I_F = 10 A, L_{PKG} = 1.6 nH
  - $V_{PKG} = L_{PKG}\frac{dI_F}{dt} = 1.6 \text{ x } 10^{-9}H\frac{10\ A}{20*10^{-9}s} = 0.8\ V$
- 1 ns Pulse Width
  - t_p = 1 ns, t_r = 0.5 ns
  - I_F = 10 A, L_{PKG} = 1.6 nH
  - $V_{PKG} = L_{PKG}\frac{dI_F}{dt} = 1.6 \text{ x } 10^{-9}H\frac{10\ A}{0.5*10^{-9}s} = 32\ V$

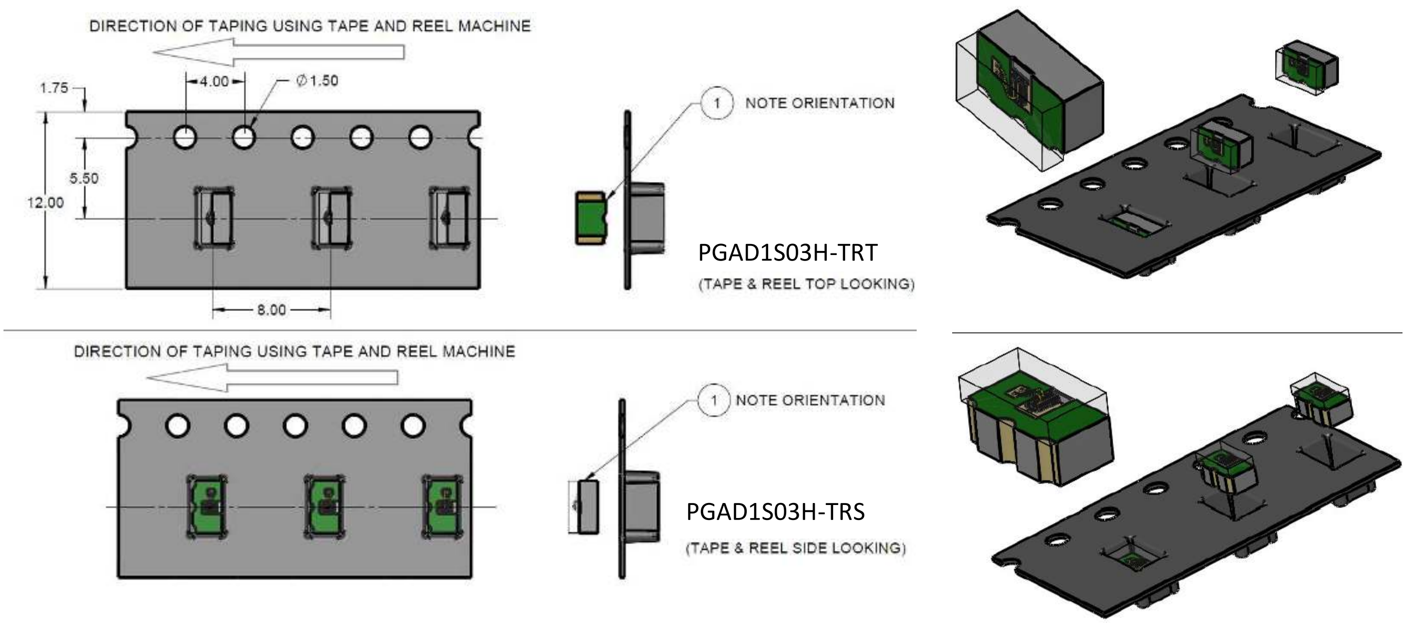
Testing methods

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.

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

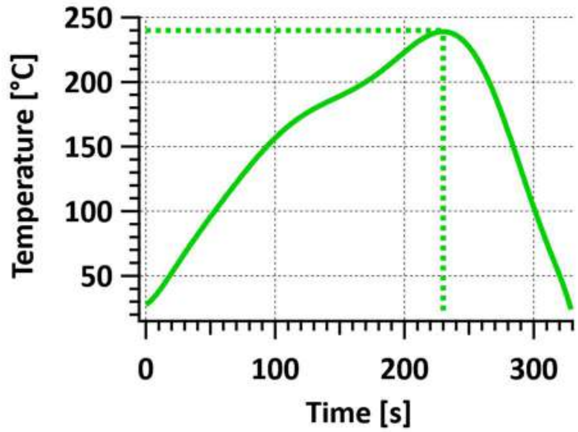
Excelitas highly recommends following the below notes:

- Keep lasers in a humidity-controlled environment until final assembly, best in a N_2 purged cabinet.
- If a manual picking method is necessary, use a non-marring tweezer to pick the laser by the short sides only.

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_L	65	s
Time within T_P - 5°C	t_P	25	s
Ramp Down Rate	ΔT_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"

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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