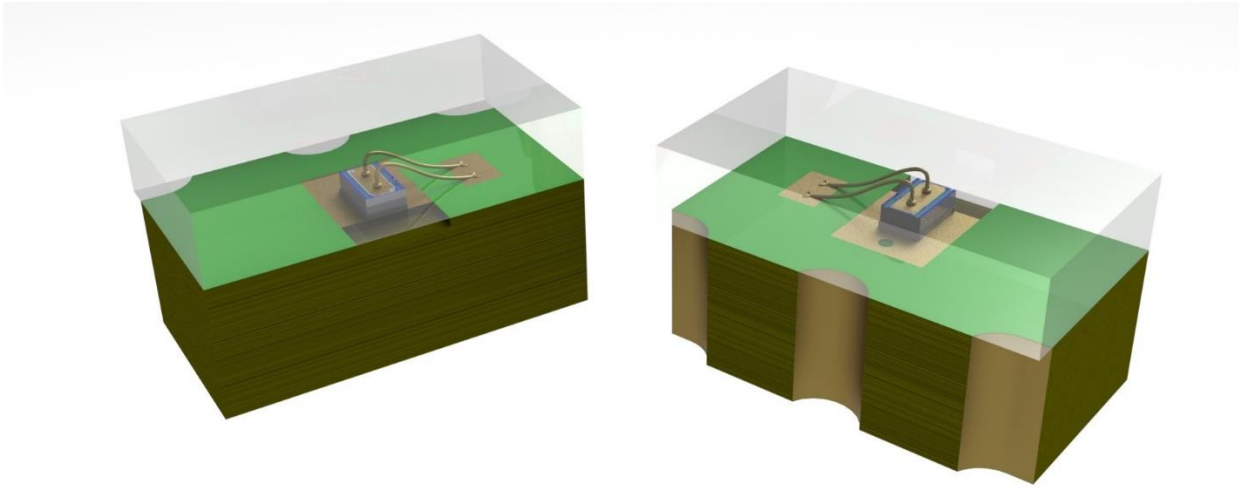
TPG3AD1S09 – "Generation 3" Pulsed Laser Diode in SMD package

High Reliability Edge Emitting Laser Diode at 905 nm



Excelitas' "Generation3" PG3 lasers produce very high peak optical pulses of 120 W with an optimized forward voltage of 11.6 V.

Key Features

- High Reliability
- Low Forward Voltage for higher efficiency
- High output power of typical 120 W
- Typical 3 W/A power slope
- 225 µm active laser length
- Horizontal and vertical emission options
- High volume reflow SMD package

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, t_p = 100 ns, f_p = 1 kHz and i_F = 40 A, unless otherwise specified.

Table 1: Key parameters

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Peak Optical Power	P		120		W
Wavelength	λ_C	895	905	925	nm
Power Slope above threshold current	$\Delta P/\Delta I$		3		W/A
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 Maximum Ratings

Parameter	Symbol	Value	Units
Peak Reverse Voltage	V_{RM}	2	V
Peak Forward Current	i_F	40	A
Duty Factor	du	0.1	%
Storage Temperature	T_S	-40 … 105	°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.

Table 3: Chip and Nearfield Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Units
Number of stripes	S		3		-
Active Area Size	A		225 x 10		µm²
Emitting width[1,2]	w		263		µm
Emitting height[1,2]	h		10		µm

Note 1: The emitting area is defined as FWHM(w) x FWHM(h) of the nearfield size at i_F.

Note 2: Parameter depending on drive current. Please contact Excelitas Technologies for more information.

Table 4: Emission Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Units
Spectral Width (FWHM)	$\Delta\lambda$		10		nm
Wavelength junction Temperature Coefficient	$\Delta\lambda/\Delta T_j$		0.25		nm/°C
Package Thermal Resistance[1]	R_{th}		70		°C/W
Divergence Parallel to Junction Plane	$\theta_{\|\|}$		10		degrees
Divergence Perpendicular to Junction Plane	$\theta_{\perp}$		25		degrees

Note 1: Simulated from the Chip Junction to the cathode PCB connection pad.

Table 5: Electrical Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Units
Forward Voltage[1]	V_F		11.6		V
Threshold Current	i_{Th}		1.5		A
Series Resistance	R_s		0.18		Ω
Bandgap Voltage Drop	V_g		3.5		V
Package Inductance	L_P		1.6		nH

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

Figure 1: Laser Package Dimension TPG3AD1S09

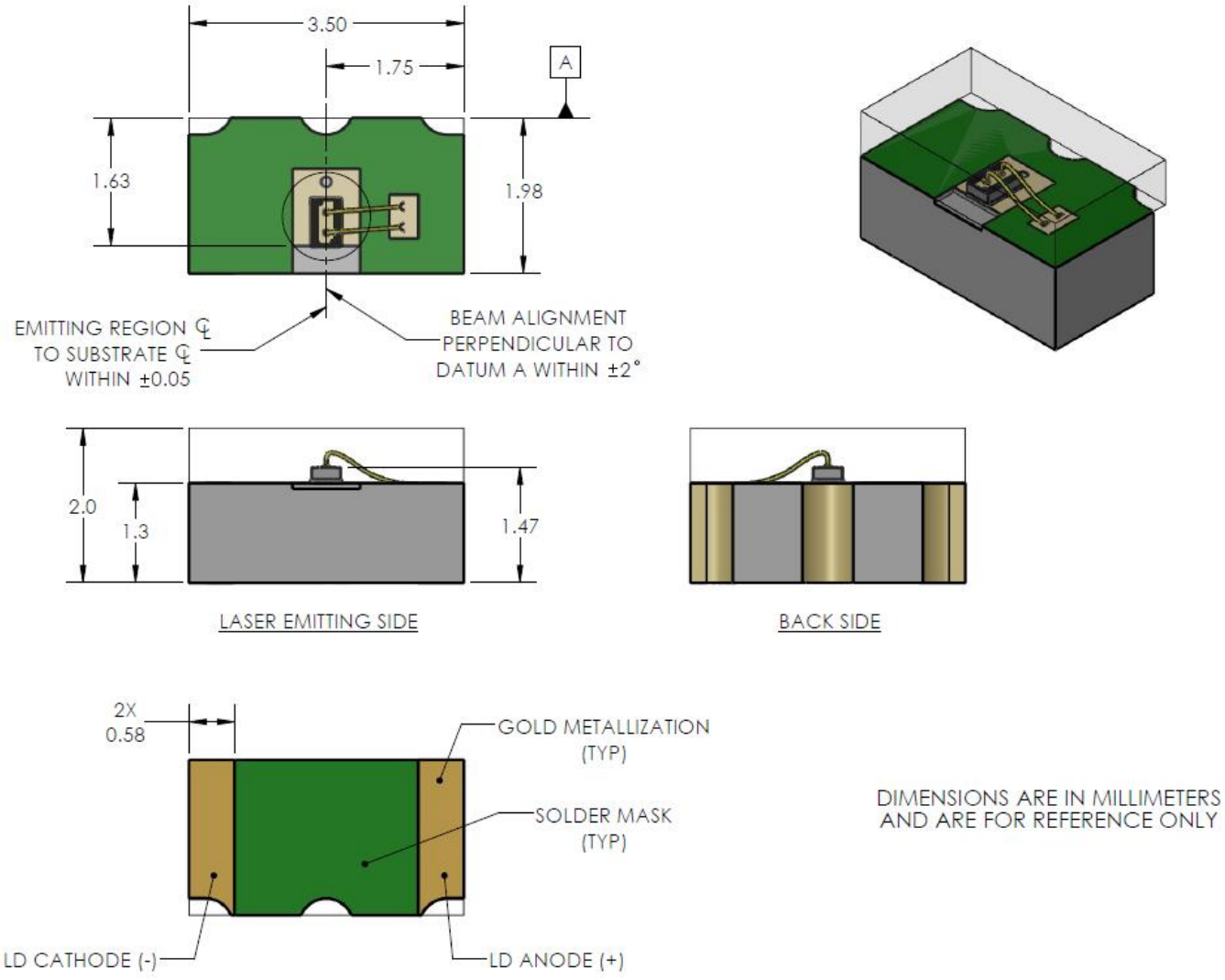


Figure 2: Typical P vs. i_F

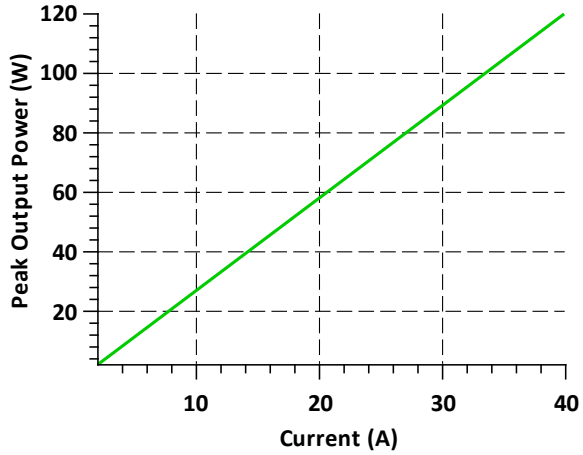


Figure 3: Typical Emission Spectrum

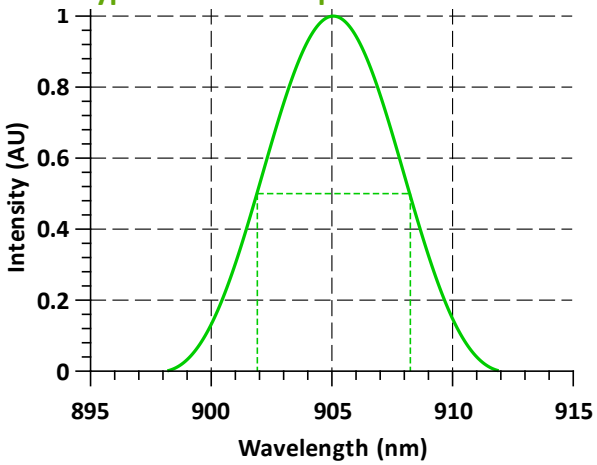


Figure 4: Typical λ vs. T_j

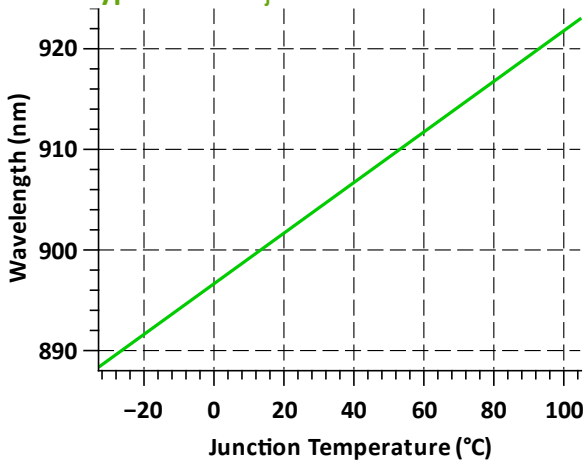


Figure 5: Typical P vs. T_j

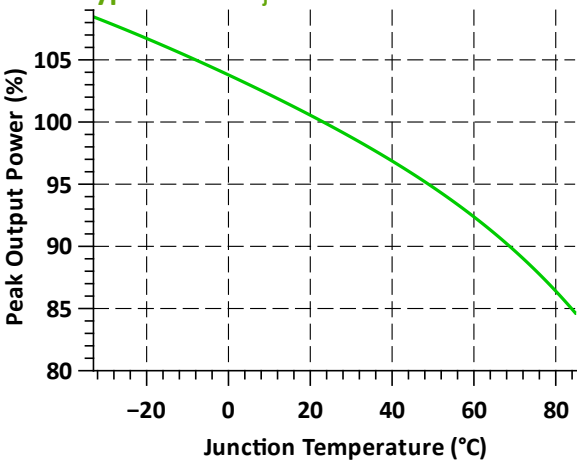


Figure 6: Typical $\theta_{\perp}$

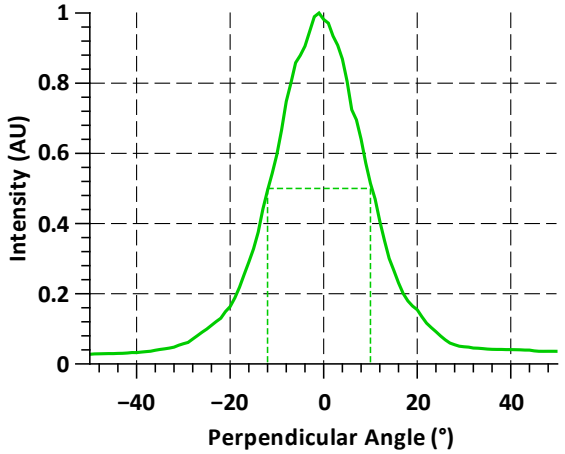
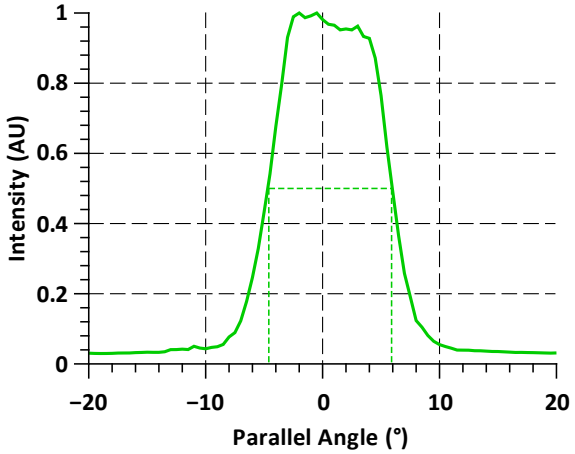


Figure 7: Typical $\theta_{||}$



TPG3AD1S09 – “Generation 3” Pulsed Laser Diode in SMD Package

High Reliability Edge Emitting Laser Diode at 905 nm

Information:

Excelitas Technologies’ TPG3AD1S09 “Generation 3“ pulsed semiconductor laser, emitting at 905 nm in the near IR, uses a multi-layer monolithic chip design. Its improved structure on GaAs substrate is offering 120 W pulsed peak power at a reduced forward voltage. The multi-layer chip design features an emitting area of (225 x 10) µm by emission of three laser lines, offering high output power in a small emitting area. The laser chips are fabricated by using metal organic chemical vapor deposition (MOCVD).

The Excelitas LLC epoxy encapsulated package complements Excelitas’ PG3 series epi-cavity lasers in bare die form or hermetic metal can package and are ideally suited for high volume applications.

The SMD package can be mounted with laser beam propagation horizontally or vertically to the PCB surface.

The beam propagation possesses a 25° divergence in the direction perpendicular to the chip surface and 10° 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 TPG3AD1S09 laser matches especially well with devices from the Excelitas EPI-APD C30737 family.

The devices are ideally suited for applications where cost is a primary concern and high-volume production capacity is required.

Unconnected laser dies as shipped cannot emit light. Light emission requires an installation into an electrical driver circuit.

Principle of operation

The light output of a laser diode is proportional to the current running through the laser by pulsing it 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.
Electrical circuits should be designed to protect the diodes from high current and reverse voltage transients. Optimum long-term reliability will be attained with the semiconductor 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. Using a low inductance package will reduce the peak voltage required to obtain the desired drive current.
For example, to obtain approximate Gaussian pulse shapes of 40 ns and 1 ns, the below voltage should be considered in addition to the typical forward voltage:

- 40 ns:
  - $t_p = 40\ \text{ns},\ t_r = 20\ \text{ns}$
  - $I_F = 40\ \text{A}, L_P = 1.6\ \text{nH}$
  - $V_P = \frac{1.6\ \text{nH x}\ 40\ \text{A}}{20\text{ns}} = 3.2\ \text{V}$

- 1 ns:
  - $t_p = 1\ \text{ns}, t_r = 0.5\ \text{ns}$
  - $I_F = 40\ \text{A}, L_P = 1.6\ \text{nH}$
  - $V_P = \frac{1.6\ \text{nH x}\ 40\ \text{A}}{0.5\text{ns}} = 128\ \text{V}$

Automotive Applications

For requests on automotive applications and more information, please contact our experts or visit our website.

Testing methods

Excelitas verifies the electro optical specifications on every shipped unit.
Visual inspection during fabrication is performed as per our 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, according to Figure 8.
Orientation (vertical or horizontal) needs to be specified upon order in T&R.

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

This laser is a static-sensitive device. Therefore, Excelitas highly recommends following the below notes:

- Keep unused devices in ESD-safe material
- Protect devices from static discharge and static fields
- Keep Reels inside their moisture barrier bags until assembly. Respect the MSL rating.
- If a manual picking method is necessary, use a non-marring tweezer to pick the laser by the short sides only.
- Precautions should be taken to avoid reverse polarity of power supply. Reversed polarity of power supply above the breakdown voltage listed under “Absolute Maximum Ratings” results in a destroyed unit.

Figure 8: Tape and Reel Packaging Dimensions

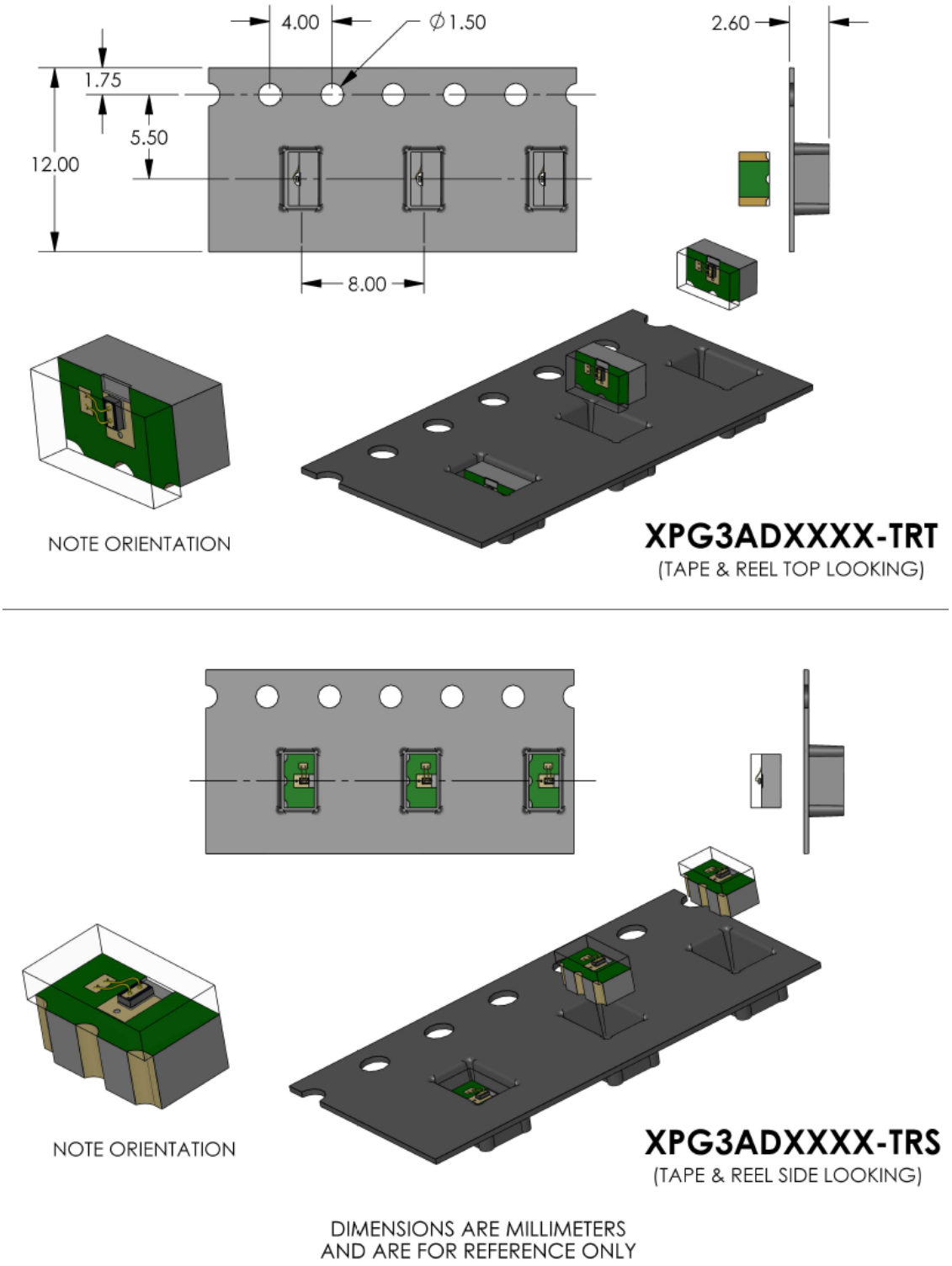
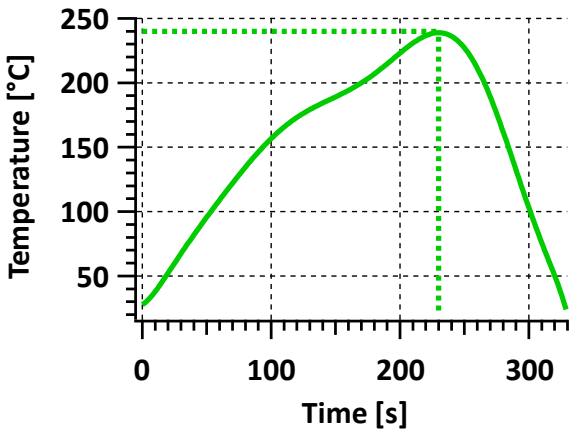


Table 6: Reflow Solder Profile

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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