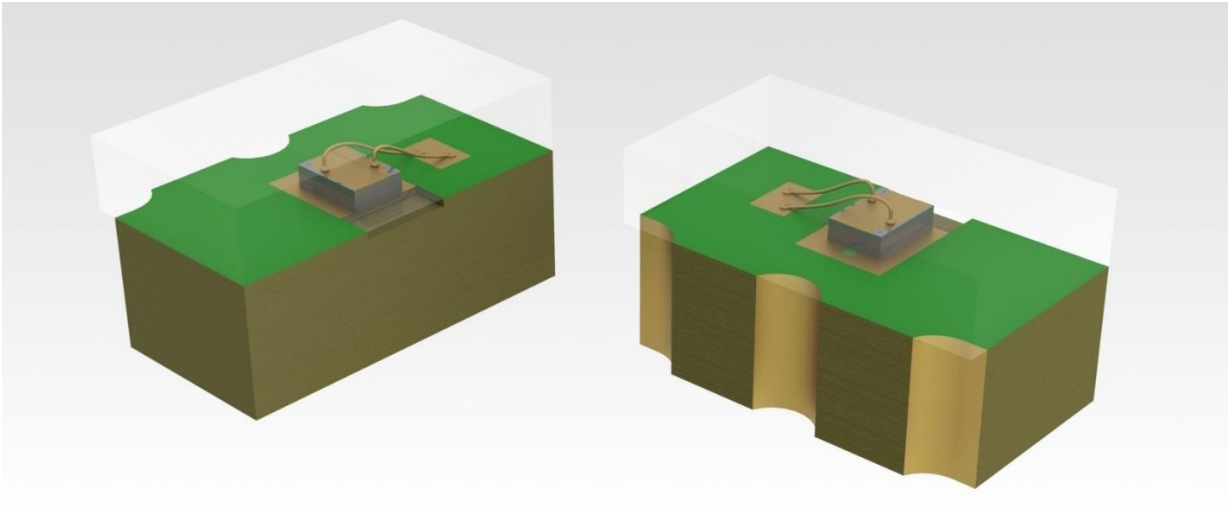
Surface Mount 905 nm Pulsed Semiconductor Lasers

High Power Laser-Diode Family for Commercial Range Finding



Excelitas' pulsed laser diodes produce very high peak optical pulses centered at a wavelength of 905 nm. The package can emit light parallel or perpendicular to the mounting plane.

Key Features

- High Volume Reflow SMD package
- Multi-epi quantum well structure
- Excellent power stability with temperature
- Horizontal and vertical emission possibility
- 75 µm and 225 µm active laser length
- 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, t_p = 100 ns and f_p = 1 kHz, unless otherwise specified.

Table 1: Key parameters

Parameter		Symbol	Minimum	Typical	Maximum	Unit
Peak Optical Power	75 µm, 10 A	P_{75}	18	20		W
	225 µm, 30 A	P_{225}	65	70		
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.

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Table 2: Ordering Information

Parameter	Symbol	TPGAD1S03H	TPGAD1S09H	Unit
Number of stripes	S	3		-
Active Area Size	A	75x10	225x10	μm^2
Emitting width[1,2]	w	86	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 3: Absolute Maximum Ratings

Parameter	Symbol	Value	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

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 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	$\theta_{\parallel}$		7.5		°
Divergence Perpendicular to Junction Plane	$\theta_{\perp}$		25		°

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

Table 5: Electrical Specifications

		TPGAD1S03H			TPGAD1S09H			
Parameter	**Symbol**	**Minimum**	**Typical**	**Maximum**	**Minimum**	**Typical**	**Maximum**	**Unit**
Peak Optical Power[1]	P	18	20		65	70		W
Drive Current	i_F		10			30		A
Forward Voltage[2]	V_F		11			13.5		V
Threshold Current	i_{Th}		0.75			1.75		A
Series Resistance	R_S		0.454			0.23		Ω
Bandgap Voltage Drop	V_g		6.5			6.5		V
Package Inductance	L_P		1.6			1.6		nH

Note 1: at i_F
Note 2: As estimated by $V_F = R_S i_F + V_g$.

Figure 1: Laser Package Dimension TPGAD1S03H / TPGAD1S09H

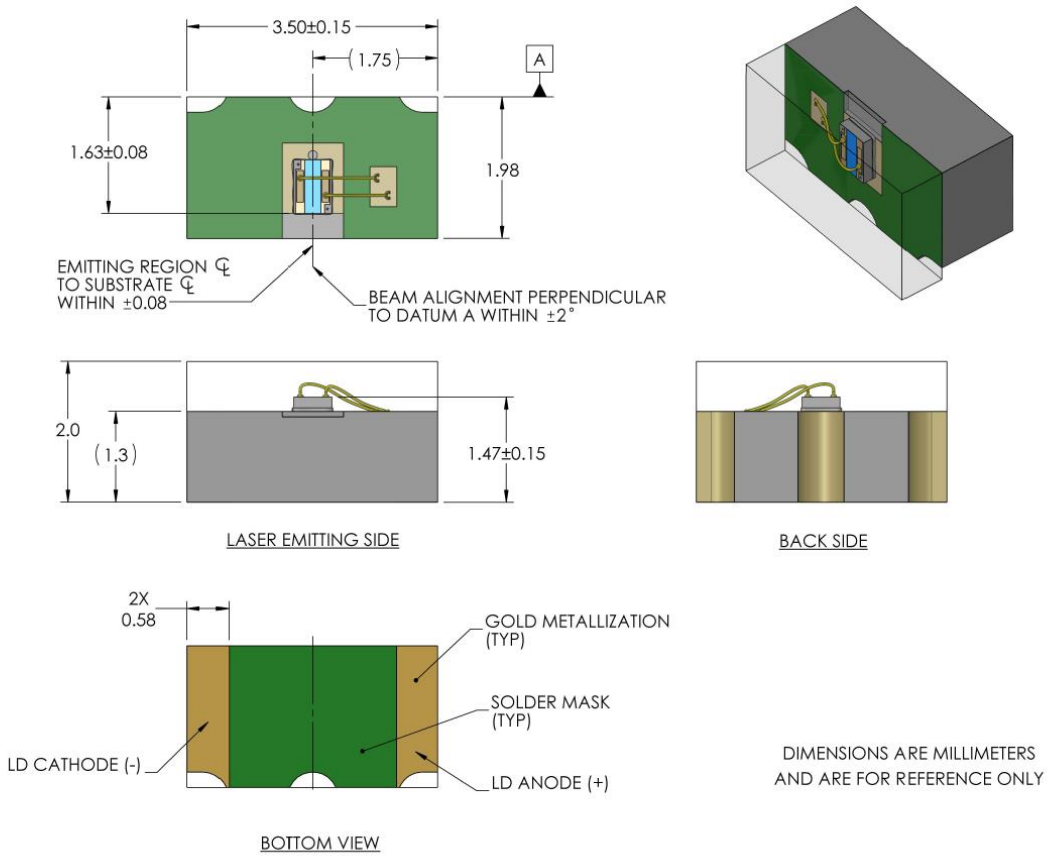


Figure 2: Typical P vs. i_F

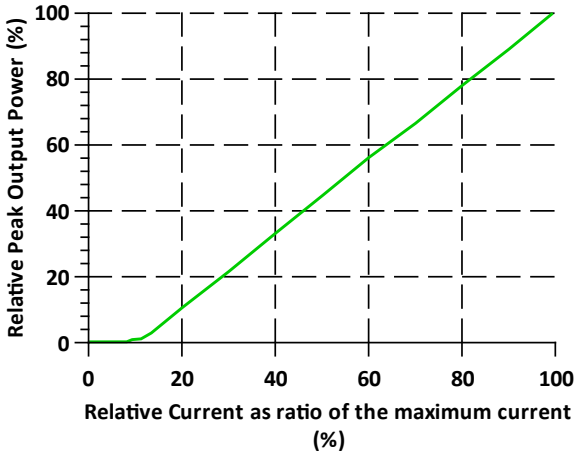


Figure 3: Typical Emission Spectrum

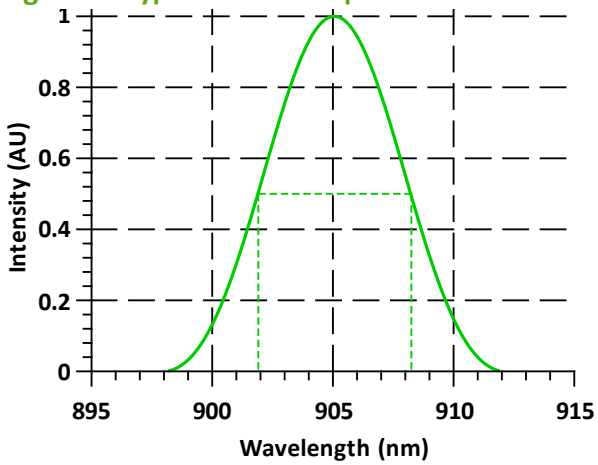


Figure 4: Typical λ vs. T_j

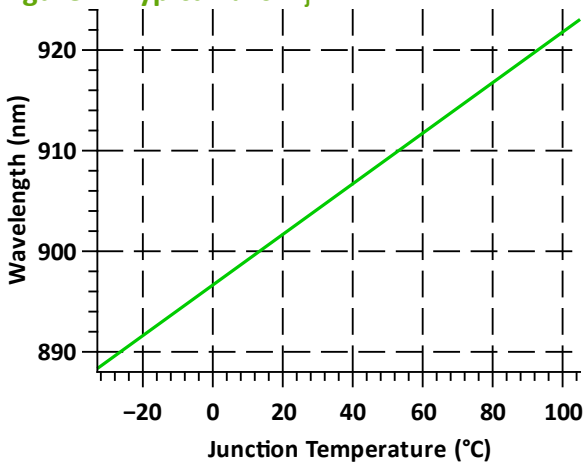


Figure 5: Typical P vs. T_j

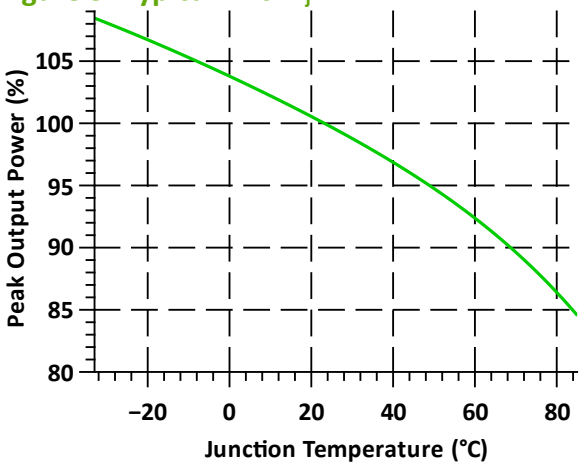


Figure 6: Typical $\theta_{\perp}$

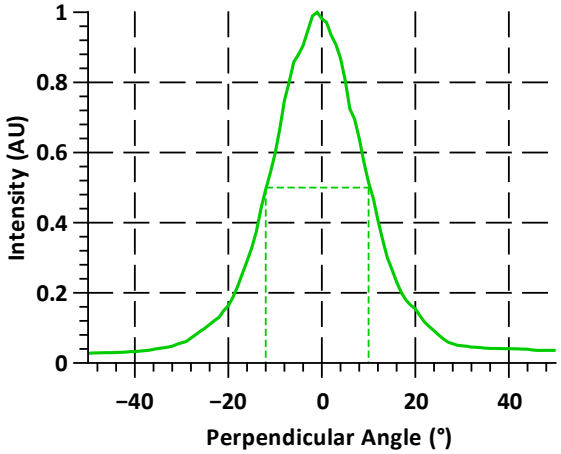
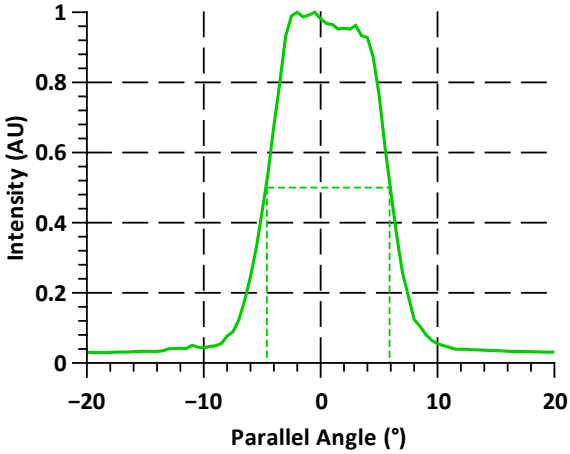


Figure 7: Typical $\theta_{||}$



Information

Excelitas Technologies' pulsed semiconductor laser, emitting at 905nm in the near IR, uses a multi-layer monolithic chip design. The laser diode is mounted on an FR4 substrate leadless laminate carrier (LLC) with excellent thermal management. This is intended for both surface mount applications and hybrid integration. The encapsulate material is an epoxy resin for low cost and high-volume manufacturing.

The package design and assembly processing techniques are such that the die positioning is well controlled to the reference surfaces. This aids in the alignment of optical elements to the package and is superior to many of the commercially available plastic lead frame TO-18 and SMD style packages in the market.

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 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 laser wavelength 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:
  - $t_p = 40\ \text{ns},\ t_r = 20\ \text{ns}$
  - $I_F = 30\ \text{A}, L_P = 1.6\ \text{nH}$
  - $V_P = \frac{1.6\ \text{nH x}\ 30\ \text{A}}{20\text{ns}} = 2.4\ \text{V}$

- 1 ns:
  - $t_p = 1\ \text{ns}, t_r = 0.5\ \text{ns}$
  - $I_F = 30\ \text{A}, L_P = 1.6\ \text{nH}$
  - $V_P = \frac{1.6\ \text{nH x}\ 30\ \text{A}}{0.5\text{ns}} = 96\ \text{V}$

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 ≤ 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

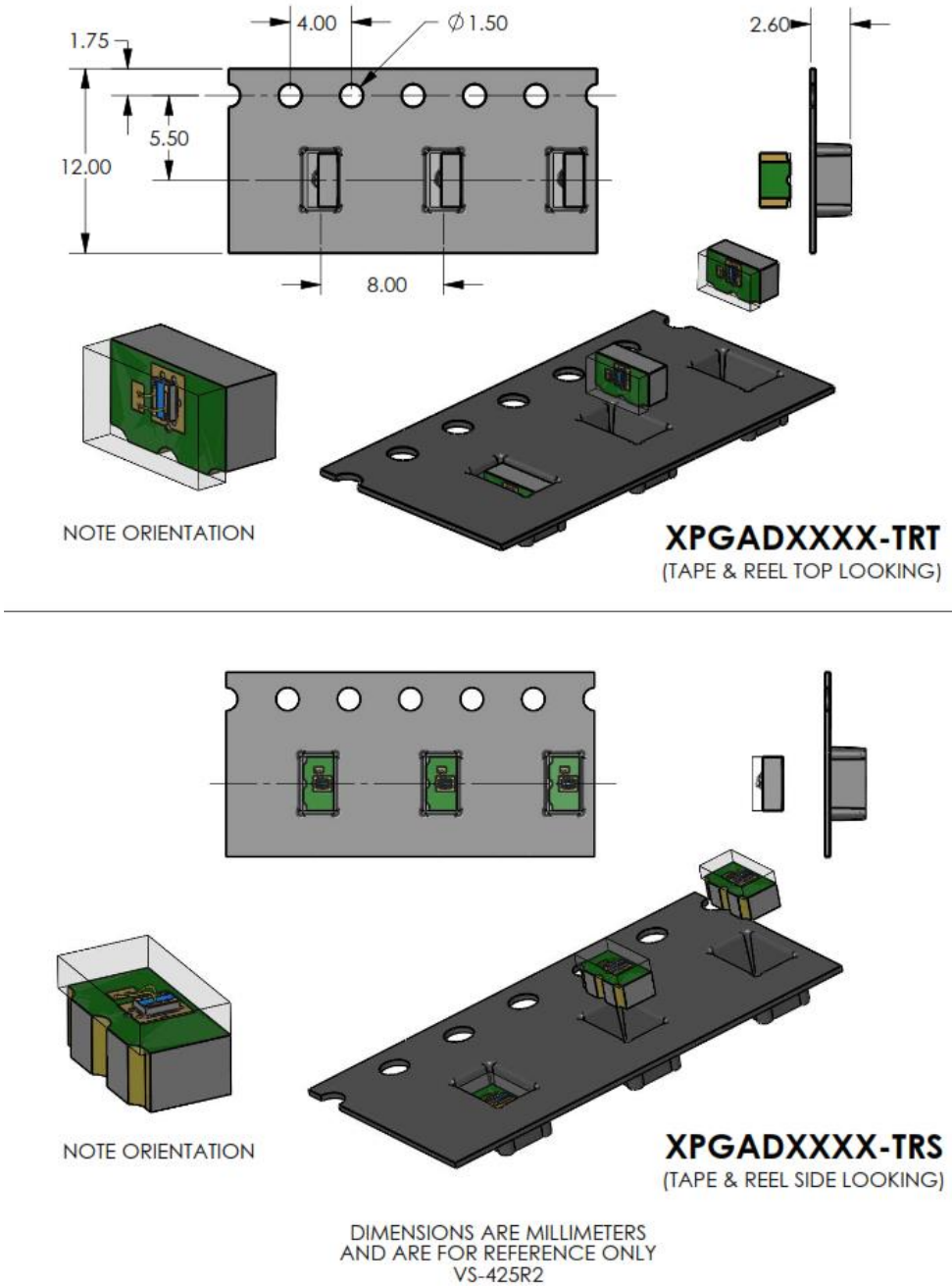
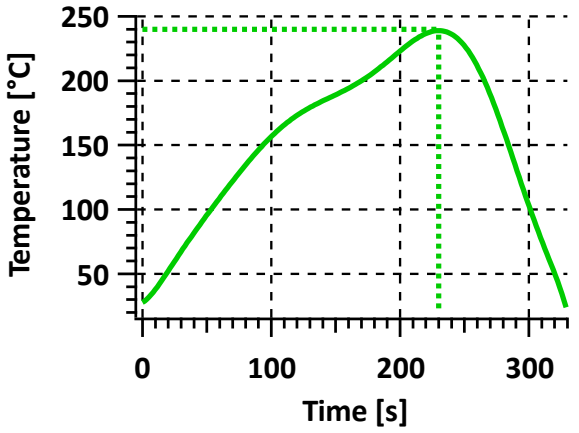


Table 6: Reflow Solder Profile

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 APD 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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