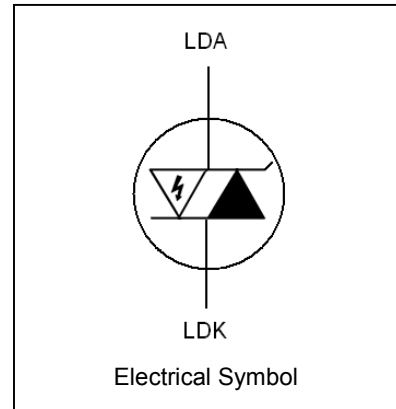


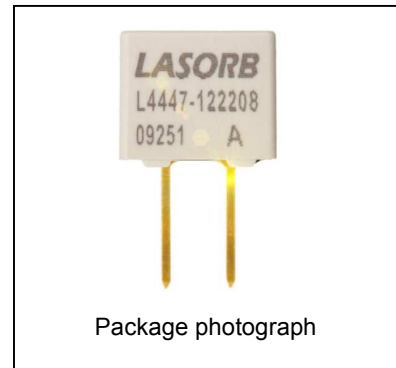
### FEATURES

- Compact 2-pin package
- Optimized for high voltage laser diodes
- Protects against both positive- and negative-ESD, in accordance with ESD standards such as:
  - ANSI/ESD STM5.1
  - MIL-STD 833-c
  - IEC 61340-2-1
  - IEC 61000-4-2
- Protects against reverse bias (reverse polarity)
- Typical capacitance 1200pF ( $V_f = 15\text{ V}$ ;  $f = 10\text{ MHz}$ )
- Lead (Pb)-free component in accordance with RoHS 2002/95/EC and WEEE 2002/96/EC



### APPLICATIONS

- Quantum Cascade Laser protection
- Series-connected laser diode protection



### GENERAL DESCRIPTION

The L44...2000-X series LASORB device is a 2-pin through-hole version of our ESD absorber, designed and tested specifically to protect high voltage laser diodes and other optoelectronic devices that have an operating voltage between 12V and 17V. It provides protection against reverse bias as well as fast-changing forward bias conditions.

LASORB is available in the 2-pin through-hole package described here, and is also available in an SMT package having TSOP6 package outline. Custom sizes and packages can also be manufactured.

### ORDERING INFORMATION

The part number provided on the next page is for the LASORB part optimized for series-connected strings of laser diodes and Quantum Cascade Lasers. See the application notes for additional information. OEMs are encouraged to work directly with Pangolin to select the best part to maximize overall system performance.

**LASORB part number L44-47-121-2000-X ELECTRICAL CHARACTERISTICS @ T<sub>J</sub> = 25° C**

Parameter	Min.	Typ.	Max.	Units	Conditions
Maximum LDA to LDK Voltage <sup>(1)</sup>			20	V	leakage current = 30mA
ESD Event Pulsed Current			50	A	Absolute Maximum
20 microsecond Pulsed Current			30	A	Absolute Maximum
Continuous Power Dissipation			2	W	25 °C
Junction and Storage Temperature Range <sup>(1)</sup>	-55		+150	°C	Absolute Maximum
LDA to LDK impedance when active			0.033	Ω	
LDA to LDK capacitance		1200		pF	LDA to LDK = 15V
Continuous Reverse Bias Current			2.9	A	Absolute Maximum
Reverse Bias Recovery Time		22	29	nS	I = 8A
LDA to LDK leakage current when inactive			6.0	mA	LDA to LDK = 15V

**NOTES**

1. Operating voltages are specified at 25° C. As the temperature increases, the maximum operating voltage must be de-rated, otherwise leakage current will increase. See the datasheet section about operating at elevated temperatures.

## **GENERAL APPLICATION INFORMATION**

LASORB is a patented hybrid component that is specifically designed and tested to protect laser diodes from ESD and power surges. LASORB overcomes the problems of previously-known ESD protection schemes by preventing reverse-bias of the laser diode under all conditions, and also by preventing ESD or other power-related faults from exceeding the maximum forward-bias voltage of the laser diode. LASORB is able to do this while not adding significant resistance or capacitance to the laser system.

## **CONNECTING LASORB TO THE LASER DIODE**

LASORB is connected directly to the terminals of a laser diode. The LDA terminal is connected to the Laser Diode Anode, and the LDK terminal is connected directly to the Laser Diode Cathode. LASORB should be connected as closely as possible to the laser diode – certainly no greater than one centimeter away, thus preventing stray inductance in between the laser diode and the ESD protection means.

## **NEGATIVE-ESD AND REVERSE-BIAS PROTECTION**

LASORB includes a fast-acting diode – the cathode of which is connected to the LDA terminal. The fast-acting diode within LASORB has been proven to be generally more robust than a Schottky diode, which is typically used in an attempt to protect a laser diode. The fast-acting diode within LASORB is able to protect a laser diode against ESD whose polarity would tend to reverse bias the laser diode, and also protect the laser diode against pulsed or continuous reverse bias (also known as reverse polarity) conditions. Normally reverse bias only occurs during an ESD event, or when the power supply is turned off. As long as the reverse bias condition does not exceed 2.9 amps RMS or 50 amps peak, no additional reverse bias protection will be needed.

## **POSITIVE-ESD AND POWER SURGE PROTECTION**

LASORB also includes a slew-rate detector, which monitors the voltage between the LDA and LDK terminals. If the slew-rate is faster than a limit that is predetermined for each specific LASORB part number, LASORB will conduct current between the LDA and LDK terminals, thus conducting current away from the laser diode. Using the slew-rate detector, LASORB is able to discern between normal laser diode operation, and a power surge or ESD event. LASORB also includes other circuitry to enhance its ability to discern between normal drive conditions and ESD and, because of this additional circuitry, LASORB is able to protect the laser diode whether power is applied or not.

## **LEAKAGE CURRENT WHILE INACTIVE**

The LASORB device has several degrees of freedom that Pangolin can optimize for a particular type of laser diode and application. One of the degrees of freedom is the leakage current apparent when LASORB is inactive (not responding to an ESD event). Generally speaking, higher levels of leakage current will allow LASORB to better-protect the laser diode while it is lasing. When operated well below the “Maximum LDA to LDK Voltage” found on Page 2 of this datasheet, the leakage current is not temperature dependent and it appears almost purely resistive. However, when operated within around 5 volts of the “Maximum LDA to LDK Voltage”, the leakage current increases as temperature increases. (See the datasheet section on operating at elevated temperatures below.) If desired, Pangolin can minimize this leakage current to levels so low, that it appears like a 5 Gig-ohm resistor (1 nA leakage at 5 volts). In such cases, the ESD protection offered by LASORB is reduced while the laser is lasing. Nevertheless, ESD protection is still present and very impressive, even though it is reduced when compared to LASORB models with higher levels of leakage current.

## **OPERATION AT ELEVATED TEMPERATURES**

These specifications found on Page 2 of this datasheet are made at a junction temperature of 25° C. As the junction temperature increases, the “Maximum LDA to LDK Voltage” must be de-rated, otherwise higher “LDA to LDK leakage current when inactive” will be experienced. For example, at 25° C the L44-47-121-392-X can comfortably be operated at voltages up to 4V, and the Maximum LDA to LDK Voltage is 4.8V. At 100C the L44-47-121-392-X should not be operated at voltages much above 3V, and the Maximum LDA to LDK Voltage becomes 4V. Please contact Pangolin if LASORB will be operated at temperatures well above 25° C, to make sure that the proper LASORB part is designed in.

## **MODULATION CONDITIONS AND PART NUMBER RECOMMENDATIONS**

Within this datasheet, we use to the term “current-modulation” to indicate those drivers that maintain a continuous voltage bias across the laser diode, and only change this voltage slightly during modulation. We use the term “voltage-modulation” to mean indicate drivers that completely remove and re-apply the nominal terminal voltage across the laser diode during modulation.

In typical laser diode drivers (ones which use current-modulation), the voltage across the laser diode terminals typically changes very little even during modulation. However, some laser diode drivers (ones which use voltage-modulation) effectively remove, and then re-apply the nominal terminal voltage (typically 2.2 to 5.0 V, but much higher for laser diode strings and Quantum Cascade Lasers) across the laser diode over and over again. This 100% voltage-modulation may fool LASORB into believing that there is a power surge condition, and when this happens, LASORB will conduct current for a brief time, potentially interfering with modulation. To avoid this, we recommend performing only current modulation, or leaving a nominal amount of voltage across the laser diode even when it is not lasing. Pangolin is happy to examine your laser diode driver schematic and make recommendations to get the best protection with LASORB and also maximum bandwidth and lifetime from the laser system. Regarding modulation rates, since the dynamic impedance of most high power lasers is well under 1 ohm, the maximum modulation rate is greater than 100 MHz when using current-modulation techniques. For best results and part number recommendations, it is recommended that OEMs contact Pangolin for applications advice and laser diode driver review.

## **INFORMATION ABOUT ESD STANDARDS AND TESTING**

There are several relevant standards for ESD testing and compliance. Each standard has an associated human body model. For example, the IEC 61000-4-2 standard uses a 150pF capacitor in series with a 330-ohm resistor to represent the human body model. The newer ANSI/ESD STM5.1 and IEC 61340-3-1 standards use a 100pF capacitor in series with a 1500-ohm resistor. Normally the ANSI/ESD STM5.1 and IEC 61340-3-1 are standards used to test the ESD performance of electrical components, while the IEC 61000-4-2 standard is used to test the performance of an entire consumer end-product.

At Pangolin, we have tested the ability for LASORB to protect a laser diode when subjected to direct discharges of ESD, using the standards mentioned above. Semiconductor companies generally agree that the IEC 61000-4-2 standard is not realistic for components themselves, which is why the newer ANSI/ESD STM5.1 and IEC 61340-3-1 were developed for testing components. Moreover, it could be argued that subjecting a laser diode to direct discharges of ESD is also not a realistic scenario, since ESD normally only comes in contact with an end-product, and not necessarily the laser diode itself. Nevertheless, at Pangolin our testing is very rigorous, and generally exceeds the requirements of the standards as well as realistic discharge scenarios.

In our testing we have found LASORB to be 100% effective at protecting most laser diodes from positive-ESD events up to 15kV, when using the human body model associated with ANSI/ESD STM5.1 and IEC 61340-3-1. We have also found that LASORB is able to protect all laser diodes from negative-ESD up to 15kV when using the human body model associated with ANSI/ESD STM5.1 and IEC 61340-3-1 as well as IEC 61000-4-2.

Of course in order to achieve a high level of ESD protection, it is required to place the LASORB as closely as possible to the laser diode. In our testing we have connected the LASORB pins directly to the laser diode pins, and the total (round trip) lead length did not exceed 1 centimeter.

### **SMALL-SIGNAL SPICE MODEL**

The behavior of LASORB depends on whether it is operated in the small-signal regime or the large-signal regime. Typically the large-signal regime is only experienced during an ESD event or power surge and laser diode drivers will operate with LASORB in the small-signal regime. Since the large-signal circuit model is quite complex, and since the large-signal regime is experienced only rarely, we only present a simplified small-signal SPICE model within this datasheet.

Note that LASORB has a complex impedance. At very low frequencies, LASORB will appear purely resistive. At frequencies around 10MHz and higher, LASORB will appear as a 1200pF capacitance.

```
* Spice Subcircuit small-signal model of LASORB L44-47-121-2000-X
*
.SUBCKT LASORB 2 1

R1 2 3 120
R2 3 1 2400
C1 2 3 1.6N
C2 3 1 4.7N

.ENDS LASORB
```

### **OTHER LASORB PART NUMBER FORMULATIONS**

As mentioned above, the LASORB device has several degrees of freedom that can be optimized for particular laser diodes and applications. The degrees of freedom allow us to adjust the maximum and typical operating voltage of the laser diode, as well as modulation rate, surge-conduction time, device capacitance and inactive leakage current.

In addition to the parts described in this document, we also offer the following part number formulations as standard off-the-shelf parts:

TSOP6/4G-20V – our SMT part whose operating parameters are user-customizable  
L44-47-122-208-X – optimized for very low power, single-mode red, and some IR laser diodes  
L44-47-122-228-X – optimized for low power red laser diodes (100mW or lower) and some IR diodes  
L44-47-121-392-X – optimized for high power red laser diodes  
L44-47-121-683-X – optimized for moderate-to-high power blue laser diodes  
L44-47-122-833-X – optimized for low power BLU-RAY and blue-violet laser diodes (100mW or lower)  
L44-47-121-916-X – optimized for direct diode green laser diodes  
L44-47-121-833-X – optimized for moderate-to-high power BLU-RAY and blue-violet laser diodes

### **CUSTOM SIZES AND PACKAGES**

The LASORB device described in this datasheet is packaged in a 2-pin, through-hole package. However, an SMT version is available, and Pangolin has also designed custom packages for specific OEMs. If the standard LASORB package shown here is not convenient and if you have a moderate- to high-volume requirement, Pangolin can make a custom LASORB part as a special shape component or board-mounted configuration. Please contact Pangolin if you are interested in this.

### **MORE INFORMATION**

More information about LASORB, including additional application hints and tips can be found on the LASORB web site at [www.lasorb.com](http://www.lasorb.com).

In addition, OEMs are strongly encouraged to work with Pangolin to make sure that the most appropriate LASORB part number is chosen and designed-in.

### **PATENT AND TRADEMARK INFORMATION**

Australia Patent Number: 2009268619  
Chinese Patent Number: ZL200980126761.9  
United States Patent Number: 8,902,557  
International Patent Application Number: PCT/US2009/049999

LASORB is a trademark of Pangolin Laser Systems, Inc.

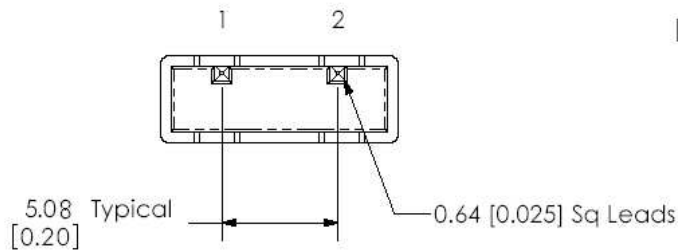
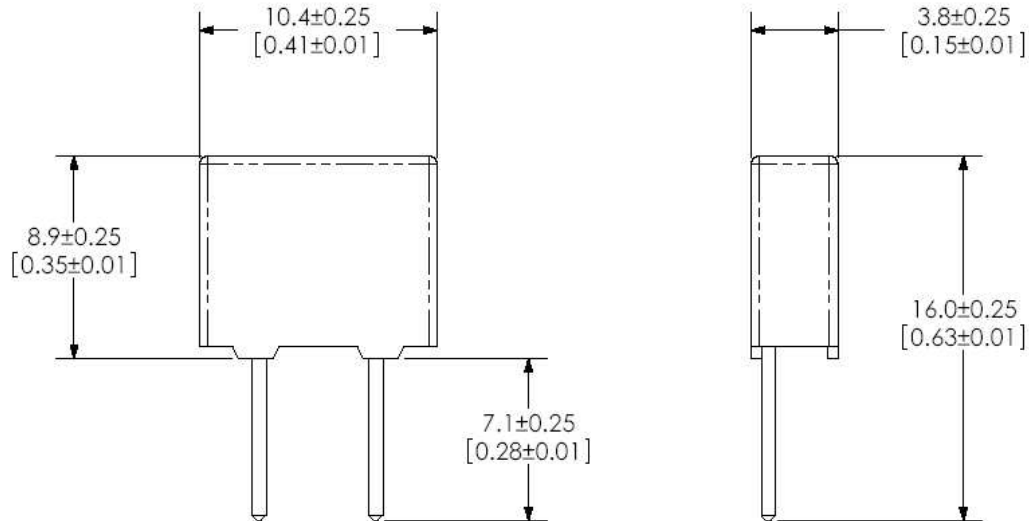
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### LASORB PACKAGE OUTLINE



### Lead Assignments

1 - LDK

2 - LDA

#### Notes:

1. Dimensions include Mold Flash
2. Controlling Dimensions are in Inches
3. Dimensions are shown in mm [inch]

Pins are flash gold plated over nickel, with no exact plating thickness specification.

For applications requiring a smaller package or different soldering requirements, consider our SMT LASORB component, available in TSOP6 package.

More information can be found at <http://www.lasorb.com/lasorb-datasheets/>

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