PRELIMINARY

PbS AND PbSe INFRARED DETECTORS

Handling Recommendation Guide

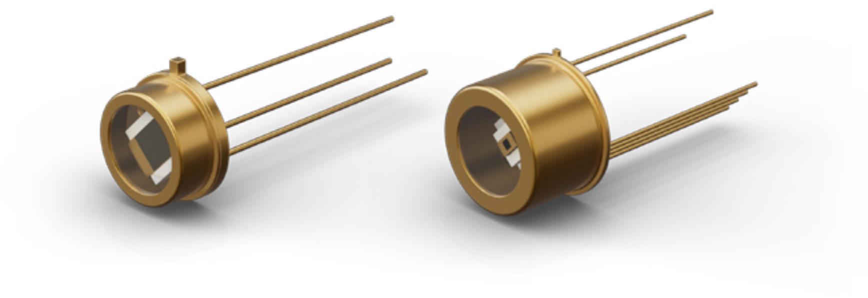


TABLE OF CONTENTS

/ **Germany and Other Countries** LASER COMPONENTS Germany GmbH Tel +49 8142 2864 – 0 info@lasercomponents.com www.lasercomponents.com
/ **France** LASER COMPONENTS S.A.S. Tel +33 1 39 59 52 25 info@lasercomponents.fr www.lasercomponents.fr
/ **United Kingdom** LASER COMPONENTS (UK) Ltd. Tel +44 1245 491 499 info@lasercomponents.co.uk www.lasercomponents.co.uk
/ **Nordic Countries** LASER COMPONENTS Nordic AB Tel +46 31 703 71 73 info@lasercomponents.se www.lasercomponents.se
/ **USA** LASER COMPONENTS USA, Inc. Tel +1 603 821 – 7040 info@laser-components.com www.laser-components.com

12/24 / V1 / FSz-MaL / manuals/lc-lead-salt/pbs-pbse-ir-detector-handling-recommendations

beyond borders

FLAT PLATE DETECTORS

NOTE: For optimum lifetime and consistent performance LASER COMPONENTS recommends that detectors be sealed in hermetic packages. LASER COMPONENTS does not recommend the use of flat plate detectors due to the potential exposure to environmental variables which are known to degrade the detector performance.

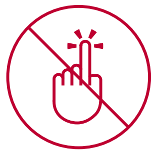
1. Storage

The detectors can be damaged, or have their characteristics changed by exposure to light, moisture, or heat. Ideally, the detectors should be stored in a **dark, dry environment at a temperature between 25 °C and 50 °C**. The storage temperature limits, as specified in the catalog and product datasheets, must not be exceeded. High humidity will damage the electronic components.

PbS detectors that have changed in performance due to moisture absorption may be baked in an oven at 70 °C to 85 °C for 3 – 6 hours followed by a stabilization period of 7 – 10 days in an infrared (IR) dark and dry environment. Please note that this procedure will not recover the detector performance if the cause is due to exposure to conditions other than moisture alone.

2. Handling

Plastic tweezers are recommended when handling detectors and should be used on the edge of the die. Press down using the gold contacts. Avoid making contact with the active surface. Never touch detectors with bar fingers.



3. Cleaning

Remove loosely sticking particles by blowing them off with nitrogen (max. 2 bar). Use of compressed air is not recommended.

NEVER use an **ultrasonic cleaner** to clean detectors or detector assemblies.

4. Attaching Wires

Gold (Au) wires can be attached by using a commercial wire bonder, using minimum power and pressure settings. Tin-Copper (SnCu) wires can also be attached using a conductive adhesive such as a silver-based epoxy resin. Contact LASER COMPONENTS experts for advice and guidance.

Clean properly when completed (see section 3).

5. Detector Power Dissipation

Detectors are typically biased with a series load resistor, and they can be destroyed by excessive bias current. The recommended bias voltage should not be exceeded. As a rule of thumb, detectors will **not dissipate more than 10E-5 watts per square centimeter of sensitive area**.

/ **Germany and Other Countries** LASER COMPONENTS Germany GmbH Tel +49 8142 2864 – 0 info@lasercomponents.com www.lasercomponents.com
/ **France** LASER COMPONENTS S.A.S. Tel +33 1 39 59 52 25 info@lasercomponents.fr www.lasercomponents.fr
/ **United Kingdom** LASER COMPONENTS (UK) Ltd. Tel +44 1245 491 499 info@lasercomponents.co.uk www.lasercomponents.co.uk
/ **Nordic Countries** LASER COMPONENTS Nordic AB Tel +46 31 703 71 73 info@lasercomponents.se www.lasercomponents.se
/ **USA** LASER COMPONENTS USA, Inc. Tel +1 603 821 – 7040 info@laser-components.com www.laser-components.com

12/24 / V1 / FSz-MaL / manuals/lc-lead-salt/pbs-pbse-ir-detector-handling-recommendations

PRELIMINARY

6. ESD Sensitivity

Photodetectors 1x1mm in area or larger are not particularly sensitive to Electro-Static Discharge (ESD). However, the same cautions should be taken as in handling other electronic components. Detectors are not immune from ESD damage. Detectors smaller than 1x1 mm in area are quite vulnerable to ESD damage and full ESD precautions should be taken when handling small area detectors or detector arrays.

7. Detector Mounting

Use a flexible, low stress, thermally conductive epoxy, or other similar type adhesive material. A **material with 100 % solids is preferred** to minimize the occurrence of voids between the detector substrate and mounting surface. Flexible adhesives reduce or eliminate problems with mismatched coefficients of thermal expansion. Bond line thickness should not exceed 2 – 3 mils to maximize thermal transfer and temperature uniformity.

12/24 / V1 / FSz-MaL / manuals/lc-lead-salt/pbs-pbse-ir-detector-handling-recommendations

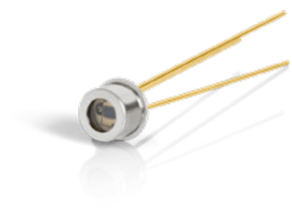
/ **Germany and Other Countries** LASER COMPONENTS Germany GmbH Tel +49 8142 2864 – 0 info@lasercomponents.com www.lasercomponents.com
/ **France** LASER COMPONENTS S.A.S. Tel +33 1 39 59 52 25 info@lasercomponents.fr www.lasercomponents.fr
/ **United Kingdom** LASER COMPONENTS (UK) Ltd. Tel +44 1245 491 499 info@lasercomponents.co.uk www.lasercomponents.co.uk
/ **Nordic Countries** LASER COMPONENTS Nordic AB Tel +46 31 703 71 73 info@lasercomponents.se www.lasercomponents.se
/ **USA** LASER COMPONENTS USA, Inc. Tel +1 603 821 – 7040 info@laser-components.com www.laser-components.com

PRELIMINARY

DETECTORS MOUNTED ON HEADERS WITH OR WITHOUT CAP AND WITHOUT WINDOW

1. Storage

The detectors can be damaged, or have their characteristics changed by exposure to light, moisture, or heat. They should be stored in a **dark, dry environment at a temperature between 25 °C and 50 °C.**



PbS detectors that have changed in performance due to moisture absorption may be baked in an oven at 70 °C to 85 °C for 3 – 6 hours followed by a stabilization period of 7 – 10 days in an IR dark and dry environment. Please note that this procedure, will not recover the detector performance if the cause is due to exposure to conditions other than moisture alone.

2. Handling

Do not touch the wires or the detector with anything that could damage the wires or the active surface of the detector.

3. Cleaning

Clean outside edge of header and cap (if applicable) with a **50/50 mixture of isopropyl alcohol and water.** Use light strokes with a cotton tipped applicator. Avoid getting mixture inside of housing. Do not touch the wires or the surface of detector. Do **not use acetone or halogenated solvents**. Remove loosely sticking particles by blowing them off with nitrogen (max. 2 bar). Use of compressed air is not recommended.

NEVER use an **ultrasonic cleaner** to clean detectors or detector assemblies.

4. Detector Power Dissipation

Detectors are typically biased with a series load resistor, and they can be destroyed by excessive bias current. The recommended bias voltage should not be exceeded. As a rule of thumb, detectors will not dissipate more than 10E-5 watts per square centimeter of sensitive area.

5. ESD Sensitivity

Photodetectors 1x1mm in area or larger are not particularly sensitive to Electro-Static Discharge. However, the same precautions should be taken as in handling other electronic components. Detectors are not immune from ESD damage. Detectors smaller than 1x1mm in area are quite vulnerable to ESD damage and full ESD precautions should be taken when handling small area detectors or detector arrays.

/ Germany and Other Countries LASER COMPONENTS Germany GmbH Tel +49 8142 2864 – 0 info@lasercomponents.com www.lasercomponents.com
/ France LASER COMPONENTS S.A.S. Tel +33 1 39 59 52 25 info@lasercomponents.fr www.lasercomponents.fr
/ United Kingdom LASER COMPONENTS (UK) Ltd. Tel +44 1245 491 499 info@lasercomponents.co.uk www.lasercomponents.co.uk
/ Nordic Countries LASER COMPONENTS Nordic AB Tel +46 31 703 71 73 info@lasercomponents.se www.lasercomponents.se
/ USA LASER COMPONENTS USA, Inc. Tel +1 603 821 – 7040 info@laser-components.com www.laser-components.com

6. Soldering

The same limitations apply as for soldering transistors. When hand soldering, observe the following precautions:

/ Use a low wattage microelectronic soldering iron:
250 °C temperature max.
Recommended duration: 5 seconds max.

/ Use heat sink clips or pliers on the package pins between solder joint and base of package. If heat sinking is not possible, then use minimum soldering iron tip temperature and time to form solder joint.

/ DO NOT BEND wires at sharp angles near base of package as this may damage the hermetic seals. No sharp bends should be performed at less than 2 mm distance from the base of the header. No mechanical force should be applied to the pins at the glass-to-metal seal.

/ Clean properly as required after soldering (See Section 3).

PRELIMINARY

PACKAGED DETECTORS

1. Storage

The detectors can be damaged, or have their characteristics changed by exposure to light, moisture, or heat. They should be stored in a **dark and dry environment at a temperature between 25 °C and 50 °C**.

PbS detectors that have changed in performance due to moisture absorption may be baked in an oven at 70 – 85 ºC for 3 – 6 hours followed by a stabilization period of 7 – 10 days in an IR dark, dry environment. Please note that this procedure, will not recover the detector performance if the cause is due to exposure to conditions other than moisture alone.

2. Handling

Do not touch the wires or the detector with anything that could damage the wires or the active surface of the detector.

3. 3. CLEANING:

Clean the package window with a **50/50 mixture of isopropyl alcohol and water**.
Do not use acetone or halogenated solvents. Gently rinse the package or use light strokes with a cotton tipped applicator. Avoid using excessive pressure on the window as the hermetic seal may be compromised. No mechanical pressure should be exerted on the window.

NEVER use an **ultrasonic cleaner** to clean detectors or detector assemblies.

4. Detector Power Dissipation

Detectors are typically biased with a series load resistor, and they can be destroyed by excessive bias current. The recommended bias voltage should not be exceeded. As a rule of thumb, detectors will **not dissipate more than 10E-5 watts per square centimeter of sensitive area**.

5. ESD Sensitivity

Photodetectors 1x1mm in area or larger are not particularly sensitive to Electro-Static Discharge. However, the same precautions should be taken as in handling other electronic components. Detectors are not immune to ESD damage. Detectors smaller than 1x1mm in area are quite vulnerable to ESD damage and full ESD precautions should be taken when handling small area detectors or detector arrays

/ Germany and Other Countries LASER COMPONENTS Germany GmbH Tel +49 8142 2864 – 0 info@lasercomponents.com www.lasercomponents.com
/ France LASER COMPONENTS S.A.S. Tel +33 1 39 59 52 25 info@lasercomponents.fr www.lasercomponents.fr
/ United Kingdom LASER COMPONENTS (UK) Ltd. Tel +44 1245 491 499 info@lasercomponents.co.uk www.lasercomponents.co.uk
/ Nordic Countries LASER COMPONENTS Nordic AB Tel +46 31 703 71 73 info@lasercomponents.se www.lasercomponents.se
/ USA LASER COMPONENTS USA, Inc. Tel +1 603 821 – 7040 info@laser-components.com www.laser-components.com

6. Thermistor Power Dissipation

The standard thermistor used by LASER COMPONENTS have high negative temperature coefficients. Power to the thermistor should not exceed 15 mW. Accurate temperature readings require low and constant power to the thermistor.

7. Soldering

The same limitations apply as for soldering transistors. When hand soldering, observe the following precautions:

- Use a low wattage microelectronic soldering iron:
  250 °C temperature max. Recommended duration: 5 seconds max.
- Use heat sink clips or pliers on the package pins between solder joint and base of package. If heat sinking is not possible then use minimum soldering iron tip temperature and time to form solder joint.
- DO NOT BEND wires at sharp angles near base of package as this may damage the hermetic seals. No sharp bends should be performed at less than 2 mm distance from the base of the header. No mechanical force should be applied to the pins at the glass-to-metal seal.

- Clean properly as required after soldering (See Section 3).

PRELIMINARY

THERMO-ELECTRIC COOLING

Thermo-electric (TE) coolers are often used to cool devices for increased sensitivity or stability. Packages with integrated TE coolers require some careful consideration to insure maximum life and performance. This section is intended to provide information for proper system design.

A TE cooler uses the Peltier effect to convert DC current into a differential temperature (ΔT) and is sometimes referred to as a Solid-State Heat Pump. As the name implies, the device »pumps« heat from one place to another.

Heat (Q) is typically pumped from the object that is being cooled to the atmosphere. It is very important that the thermal resistance in this path be low enough to dissipate both the heat being pumped and the heat generated by the cooler itself. If it is not, the cooler and the device will overheat and be damaged. Therefore, when designing and using a thermoelectrically cooled package, some important items to consider are the heat sink selection, the mounting method, and the current limit of the control electronics.

1. Heat Sink Selection:

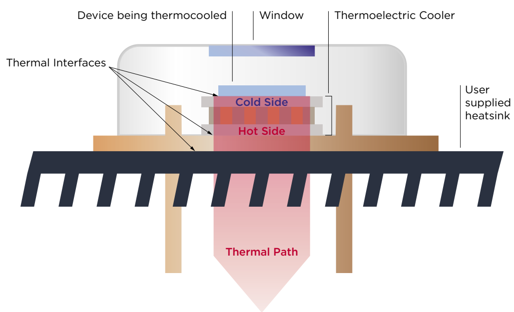
A proper heat sink must be used. Heat can be generated by the device being cooled, as well as by the TE cooler itself, totaling several watts. The selected heat sink must be adequate to dissipate the heat being generated by and pumped by the cooler. The heat sink represents the final thermal resistance to the atmosphere, so its design is critical to the performance and longevity of the device. Inadequate heat sink design, mounting, or size will reduce detector performance and could lead to early failure of the device and cooler.

/ A heat sink MUST ALWAYS BE USED to remove the heat generated by the cooler. The ambient temperature of the detector package base directly limits the maximum cooling that can be achieved at the detector. Heat sinks using some combination of conduction, convection, and radiation should be used.

2. Mounting

As shown in Figure 1, the thermal path is directly out of the bottom side of the package.

Figure 1 - Typical TO Style Package



RECOMMENDATION:

Use a heat sink of less than 3 °C/W for one and two stage TE coolers, and less than 2 °C/W for three stage TE coolers.

The package material is designed to provide a hermetic seal, not necessarily low thermal resistance. Since the goal is to minimize the thermal resistance in the thermal path, it is important that the heat sink is mounted directly to the back of the package (on the side where the pins protrude). Attach the heat sink tight-fitting to the package base so that the base is efficiently heat-radiated. **Mounting to any other surface on the package increases the thermal resistance, compromises thermal performance, and reduces reliability.**

/ The heat sink must interface the TO-package base and not the circumference of the cap.

To reduce the thermal resistance at the heat sink/package thermal interface, the mounting surfaces must be flat and free of any pits, voids, burrs, or any »casting« surface. Reducing the thermal resistance at this interface is promoted by using an interface material (such as Thermal Compound from Wakefield Engineering) between the entire surface of the package base and the heat sink. To maintain a consistent thermal path beyond five (5) years, a thermal pad must be used in place of the thermal compound. This will increase the thermal resistance and thereby reduce the cooler ΔT by as much as ten (10) percent but can increase the device lifetime if properly assembled and tightened when installed into the heat sink assembly.

/ The use of a Thermal Interface Material (TIM), between the base of the device and the heat sink, is essential. NOTE: Grease and paste compounds provide superior heat transfer compared with pre-formed pads as they provide a thinner bond line and therefore lower thermal resistance.

The assembly and torque are always very critical, but even more so when using a thermal pad in place of the thermal compound. The connecting pins or wires that protrude from the back of the package are hermetically sealed with a glass filled feed through. Complete the assembly of the heat sink, including the final torque of the mounting screws prior to soldering these pins into place. Failure to mount the heat sink before soldering the pins, can put stress onto the glass joint as the heat sink is tightened and lead to a hermetic seal failure. Hermetic seal failure can cause device failure.

Avoid bending the pins. If they must be bent, use a pair of bending pliers or tweezers to isolate the bend area from the glass-filled seal. **No sharp bends should be performed at less than 2 mm distance from the base of the header. No mechanical force should be applied to the pins at the glass-to-metal seal.** Multiple bends of the pins will lead to pin failure.

3. Control Electronics:

External electronics are responsible for controlling the temperature and protecting the package from overheating. ΔT increases with increasing current (I) up to the point that the internal heating is greater than the heat pumping capacity. Increasing I beyond that point will heat the device, possibly to destruction. A thermistor should be used to provide feedback to controller/power supply circuitry, which regulates the input power and maintains the appropriate set-point temperature. A current limit must be set on the cooler power supply which is less than Imax which also prevents overheating for the model cooler being used. Note that the point at which a cooler overheats, depends directly on the thermal resistance to the atmosphere and the ambient temperature.

/ **Germany and Other Countries** LASER COMPONENTS Germany GmbH Tel +49 8142 2864 – 0 info@lasercomponents.com www.lasercomponents.com
/ **France** LASER COMPONENTS S.A.S. Tel +33 1 39 59 52 25 info@lasercomponents.fr www.lasercomponents.fr
/ **United Kingdom** LASER COMPONENTS (UK) Ltd. Tel +44 1245 491 499 info@lasercomponents.co.uk www.lasercomponents.co.uk
/ **Nordic Countries** LASER COMPONENTS Nordic AB Tel +46 31 703 71 73 info@lasercomponents.se www.lasercomponents.se
/ **USA** LASER COMPONENTS USA, Inc. Tel +1 603 821 – 7040 info@laser-components.com www.laser-components.com

PRELIMINARY

- Do not operate the cooler in reverse polarity. This can result in a cooler heating, which can lead to melting of the low temperature alloys of the TE cooler. Improper heat sinking or overdriving the TE cooler can also destroy the detector.
- The operating voltage and current shown in the Test Data Sheet reflect optimum cooling conditions, using 25 degrees °C heat sink. Operating at a heat sink temperature other than 25 °C may require a different optimum power value. Operating the TE cooler beyond a critical current value will result in less net cooling, because the Joule heating is increasing at a faster rate than the Peltier cooling. If using a closed loop temperature controller, take care not to over-drive the TE cooler.

4. Summary:

The performance of detector packages with thermoelectric coolers is directly related to the adequate heatsinking of the package. Thermal resistance is minimized by proper heatsink selection and mounting using a thermal interface material. Overall control and protection are the responsibility of the system cooler control electronics. Proper thermal and electronic design will prevent damage and optimize the performance of the detector. Failure to use proper handling, heatsinking, thermal path, mounting methods, and/or power limits will void any expressed or implied warranty by LASER COMPONENTS.

SYSTEM BURN-IN FOR THERMO-ELECTRIC COOLED DETECTORS

Final calibration of an instrument should not be performed until a detector burn-in operation is completed. The following procedure is typical and only a recommendation. The actual procedure needed will be dependent on the detector installation procedure and the instrument operation criteria. This burn-in process will generally eliminate the normal settling that occurs after installing PbS/PbSe detectors into instruments.

A **ten-day burn-in of the detector is recommended for all PbS/PbSe detectors**, however, in most cases a much shorter burn-in period will be sufficient. This burn-in should be at system voltage bias and system load resistance. The detector temperature should be 23 °C or warmer, but not exceeding the recommended operating temperature (See detector data sheet). Operating the TE cooler and reducing the detector temperature will increase the time required for the device to settle.

After such a burn-in, detector resistance, responsivity, and D* should not reduce by greater than 10 % during the balance of the warranty period.

NOTE 1: PbS is subject to change due to exposure to ultraviolet light. This is a temporary change, and complete recovery will occur by extended storage under no light (dark) conditions.

NOTE 2: The dark resistance of PbS and PbSe drops at a rate of approximately 4 % per degree Celsius as the element temperature is increased. A resulting drop in responsivity will also be seen under a constant bias voltage. Therefore, to properly compare test data, the temperature of the element must remain constant.

/ Germany and Other Countries LASER COMPONENTS Germany GmbH Tel +49 8142 2864 – 0 info@lasercomponents.com www.lasercomponents.com
/ France LASER COMPONENTS S.A.S. Tel +33 1 39 59 52 25 info@lasercomponents.fr www.lasercomponents.fr
/ United Kingdom LASER COMPONENTS (UK) Ltd. Tel +44 1245 491 499 info@lasercomponents.co.uk www.lasercomponents.co.uk
/ Nordic Countries LASER COMPONENTS Nordic AB Tel +46 31 703 71 73 info@lasercomponents.se www.lasercomponents.se
/ USA LASER COMPONENTS USA, Inc. Tel +1 603 821 – 7040 info@laser-components.com www.laser-components.com