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APPLICATION NOTE

Handling, Mounting, Testing and Operating Uncooled 8-pin mini-DIL Laser Pumps: 1999PLU series

OVERVIEW

This Application Note overviews requirements for the mounting and operation of the 1999PLU Mini-DIL uncooled Pump Modules to ensure optimum device performance and reliable operation. This application note addresses Handling, Mounting and Operation of the 1999 PLU Mini-DIL uncooled Pump Module

DESCRIPTION

The 1999PLU Mini-DIL uncooled pump module from 3SP Technologies has been specifically designed for applications where a compact size and low power consumption are required. The 1999PLU features a mini-DIL package incorporating a new laser chip internally developed for uncooled operation over a wide temperature range from 0 to 75°C; chip is fully qualified exceeding Telcordia recommendations. Available kink-free power exceeds 275mW.
The wavelength is "locked" utilizing a Fiber Bragg Grating (FBG) located in a single mode polarization maintaining fiber (PMF) pigtail.
The exact thermal performance is dependent on the amplifier and PCB design and component installation.

HANDLING RECOMMENDATIONS

Prevention against ESD damage

The uncooled Mini-DIL 1999PLU pumps are highly sensitive to electrostatic discharge. The typical ESD damage threshold (standard human body model) for 3SP Technologies pump laser products is 5kV.
To avoid ESD damage, the following precautions are suggested for the handling, storage, and transportation of 3SP Technologies pumps:

- Workbenches should be grounded (through 1MΩ resistor) to prevent sudden discharge.
- Conductive wrist straps (grounded through 1MΩ resistor) should be worn when handling devices.
- Protective clothing (nylon overalls, for example) should contain conductive material.
- Devices should be transported and stored in conductive bags or boxes.
- Paper should not be put in containers and common plastic materials should be avoided.
- Conductive pin savers should remain intact when devices are not in use.

Hermetic Seal Integrity

Package hermiticity is critical to preserving component performance and reliability. Some suggestions include the following:

- Never deform the component package in any way.
- Do not apply excessive force to the package/fiber interface or strain relief assembly.
- Avoid repeated deformation or application of excessive force to the device contact pins.

Unpacking the pump module

The following recommendations must be used for taking out the module from its packing:

- Handle the laser by its package only.
- Never hold the laser neither by the leads (risk of degradation of ceramics parts in the package) nor by the pigtail.
- The module ferrule (rigid tube used to protect the pigtail at the exiting side of the package) is fragile. Do not handle the module by this part.
- Never pinch the fiber pigtail or apply an instantaneous traction on it which could generate micro-cracks in fiber silica.

MOUNTING PROCEDURE

Assembling the module on its board

In order to achieve the best performance in term of optical output power and a long term stable operation of the pump module, it is highly recommended to fulfil the following mounting procedure:

- Avoid any shock on the package ferule (snout).
- Do not apply any mechanical force on the package ferrule.
- Do not apply any liquid (flux, solvent) or grease on the ferrule.
- Use a large enough heat sink holder with a surface flatness better than 30 µm and a roughness better than 1 µm.
- Carefully clean both mechanical holder (or heat sink) and bottom package surfaces to prevent any spurious particles or dust.
- Place the pump package on the heat sink holder and insert the 8 pins into the PCB through holes for electrical connection using soldering process (please refer to “Soldering of Pump Module Leads “paragraph).
- When soldering the package leads to the PCB board, do not use a soldering temperature higher than 350 °C during a maximum soldering time of 5 s at 3.0 mm distance from the leads tip.

- When applying pressure on package for clamping, please refer to the clamping recommended force in the “Clamping” paragraph to avoid damaging the module..
- Do not coil the fiber pigtail up with permanent strength or twist.
- Avoid any micro-bends or local compression on the polarization maintaining fiber.

Unassembling and re-packing the module

In case of module return to 3SPGroup factory, it is recommended to unassemble and to re-pack the pump module according to the following conditions:

- Use a dedicated tool for unsoldering the leads.
- Use a specific tool for extracting the module body from the PCB board, avoiding any mechanical stress on the package ferrule and on the fiber pigtail.
- For re-packing the module, use as much as possible the original packing or a similar one.
- Carefully place the module on its location.
- Carefully coil the fiber pigtail in the box, avoiding any stress or strength on it and mainly on the FBG section.

Operating the pump module on its board

3SPGroup’s pump modules are designed and built for CW (Continuous Wave) operation. All other operating modes are not guaranteed for a statistically meaningful lifetime. Specifically, all the following restrictions must be respected to avoid any damage to the device:

- Care should be taken to avoid any electrical power supply transient and voltage overload.
- In any case, respect the absolute maximum ratings given in the absolute maximum rating table in the specification document.
- Never connect the device to already polarized leads.
- Always use controlled current ramps to adjust the injection level to the set-point.
- Current ramps towards the desired operating values must not exceed the following values:
  - positive current ramp: 200 mA/s
  - negative current ramp: 500 mA/s
- When using fast current ramps, carefully check that:
  - overshoots do not exceed 5 % of the current set point or the absolute maximum ratings and that stabilization occurs within 3 s.
  - no negative current or bias undershoot is recorded when switching-off the device.
- No ON-OFF operation is allowed! ON-OFF operation is defined as any repeated switching ON and OFF of the device on a timescale that allows thermal stabilization of some or all parts of the pump module (> 1 µs).
- For pulsed operation on fast timescales (< 1 µs, DC < 5 %), please contact your sales representative at 3SPGroup.
- For any other operating mode that might be needed by your application, please contact your 3SPGroup sales representative for more details.

Eye safety recommendation

This Mini-DIL uncooled 1999 PLU pump should be handled observing certain precautions in order to avoid personal injury and component damage. Laser products emit invisible radiation which may be harmful to the human eye. Be sure to follow standard safety protocol for eye and skin for Class IV IR lasers. Avoid direct or reflected contact with light emitted from the device or fiber. Optical fiber is subject to breakage and the thin glass fiber may easily pierce human skin or cause eye damage. Wear eye protection, use caution when processing optical fiber, and dispose of any fiber fragments or clippings with care.
The 1999 PLU uncooled pump is a class 3B laser and precautions must be taken to avoid eye damage or skin burns. Take appropriate precautions to prevent undue exposure of naked eye, as the beam emitted from the laser diode is harmful to human eye. Avoid any possibility of looking into the laser package or the collimated beam along its optical axis when the device is operating. Try to limit fiber movement. Do not operate the pump module if the fiber end is not cleaved with a 9° angle.

Thermal Interface Materials

The thermal interface materials are typically preforms. When thermal interface material is used as the attachment mechanism, the effective attachment area is 100% of the thermal pad area.
The thermal resistance is minimized by making the interface layer as thin as possible, while still ensuring that the interstitial air gaps are eliminated. Typical thermal conductivities of interface materials are in the range of 0.6 - 3.0 W/m-K.

Heat Sink for Module Mounting

A well-designed heat sink in combination with a high-performance thermal interface and package mounting technique should guarantee that the case temperature of the module does not exceed the maximum temperature specified for each series (typically 75°C; refer to the maximum ratings in the datasheet).

A failure to keep the package base below the specified maximum temperature will lead to laser module overheating and result in a module damage. The following general heat sink guidelines are recommended:

- Mount the pump module on a heat sink with flatness of 50 microns or less over the entire mating surface to the module.
- Mount the pump module on a heat sink with a surface finish of 0.8 µm or less.
- The heat sink should be design to handle at least maximum module heat dissipation through the life of the product. For total module power dissipation refer to the module specifications. Maximum module heat dissipation can be as high as about 1W.
- Design a heat sink that is capable of keeping the pump module case temperature below the maximum rated temperature for all operating conditions. For maximum package base temperature refer to the pump module specification.

Clamping

Contact pressure reduces the interfacial resistance by helping mate surfaces and by physically thinning the thermal-interface material. Physical attachment methods include spring clips, screws, and spring-loaded push-pins. The amount of pressure required to reduce thermal resistance is a function of the interface material's compressibility and surface properties.

For a Mini-DIL pump module, the maximum load on top of the module is ~300psi (200N). Any higher load could lead to ceramic cracking. The higher load could also cause warping of the PCB (if applicable). For the Mini-DIL pump module, the recommended clamping pressure is 80 psi (54N). The clamping force should pass over the opposite edges of the lid to avoid lid deformation. It is critical to ensure that any clamping mechanism does not deform the lid, which would result in a potential compromise to the hermetic weld of the lid to the pump module body.

Soldering of Pump Module Leads

Mini-DIL pump module has side brazed leads that require through hole mounting of the pump module to the PCB for electrical connection. Care should be taken when handling the leads to avoid any twisting or tight radius bending of the leads, which may result in metallization cracks exposing the underlying kovar material. IPC standard J-STD-001 provides guidelines for acceptable levels of cracking.

Hand Held Iron Soldering

The pump module can be attached to the PCB using localized heating. The tips should be small enough to achieve reflow in less than 3 seconds without damaging the component. Peak temperature should not exceed 260°C for more than 5 seconds. To avoid thermal shock, the module should be preheated to 150°C before soldering and after soldering the module, must be cooled at ambient room conditions.

Hot Gas Soldering

With this method, a small gun with a nozzle diameter of about 2.5 mm issues air, nitrogen or other suitable gas at a temperature of around 400°C and a flow rate of 1.5 liters/min. To avoid thermal shock, the module should be preheated to 150°C before soldering and after soldering the module must be cooled at ambient room conditions. During soldering, the temperature of the module must be kept below 260°C to limit thermal stresses in the pump module.

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