

APPLICATION NOTE

Handling, Mounting, Testing and Operating Cooled 14-pin & 10-pin

Butterfly Laser Pumps:

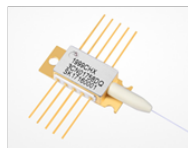
**1064CHP/1999CMB/1999CMX/1999SMX/1999CHB/1999SHB/1999CVB/
1999CHD/1999CVD/1999CHX/1999SHX/1999CVX/1948RMB/1948RHB/
1948RVB/1948RUB**



1064CHP



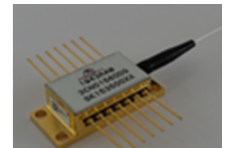
1999CMB, 1999CHB,
, 1999SHB, 1999CVB



1999CMX, 1999SMX,
1999CHX, 1999SHX,
1999CVX



1999CHD, 1999CVD



1948RMB, 1948RHB,
1948RVB, 1948RUB

Overview

3SP Technologies 1064CHP / 1999CHB / 1999SHB / 1999CMB / 1999CVB / 1999CHD / 1999CVD 980nm pump modules are supplied in a cooled 14-pin butterfly package with back facet monitor photodiode as well as 1999CHX, 1999SHX, 1999CVX, 1999CMX & 1999SMX in a cooled 10-pin butterfly package also with back facet monitor photodiode. 1948RMB/RHB/RVB/RUB Raman pump modules are supplied in versions with or without back facet monitoring photodiodes in 14-pin butterfly package.

In order to get the maximum performance from the pump module for its targeted life time mission, handling and testing recommendations as well as the mounting procedure have to be followed closely.

If the requirements described into this document are not properly set-up by customer, its affiliates and sub-contractors during product handling, mounting and operating, 3SP Technologies liability cannot be engaged in case of issues or failures that may be encountered.

Handling recommendations

Prevention against ESD damage

This product is sensitive to electrostatic discharge (ESD) and should not be handled except at a static free workstation.

Take the following precautions to prevent the module against ESD which is the primary cause of unexpected laser diode failure:

- The user must be connected to the ground and use anti-static gloves.
- Use wrist straps in direct contact with skin.
- Use grounded work surfaces and semi-conductive anti-static table material.
- The user's feet must touch the floor.

Unpacking the pump module

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

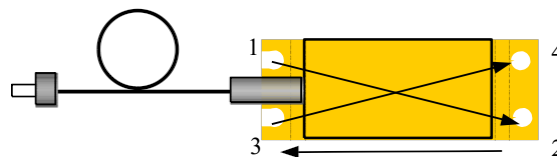
- Handle the laser by its package only.
- Never hold the laser neither by the leads (risk of degradation of ceramics parts in the package) nor by the pigtail.
- The module ferrule (rigid tube used to protect the pigtail at the exiting side of the package) is fragile. Do not handle the module by this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

Mounting procedure

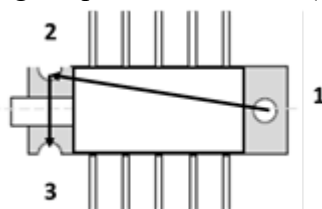
Assembling the module on its board

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 ferrule (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.
- For 14 pin butterfly package 1064CHP, 1999CMB, 1999CHB, 1999CVB, 1999SHB, 1999CHD, 1999CVD, 1948RMB, 1948RHB, 1948RVB, 1948RUB:
 - Apply thermal paste between the pump package bottom and the heat sink
 - Place the pump package on the heat sink holder and fix it first by slightly tightening the 4 screws (C M2 x 4 min, Re 350N/mm²).
 - Tighten the 4 screws following the star sequence shown below (1-2-3-4) with a maximum mounting torque of 150 mN.m.



- For 10 pin butterfly package 1999CMX, 1999CHX, 1999CVX, 1999SMX, 1999SHX:
 - Apply thermal paste between the pump package bottom and the heat sink
 - Place the pump package on the heat sink holder and fix it first by slightly tightening the 3 screws (C M2 x 3 min, Re 350N/mm²).
 - Tighten the 3 screws following the sequence shown below (1-2-3) with a maximum mounting torque of 137 mN.m (1.4 kgfcm).



- Avoid any mechanical compression applied on the module package, including its package ferrule.
- Do not coil the fiber pigtail up with permanent strength or twist.
- Avoid any micro-bends or local compression on the polarization maintaining fiber.
- 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.

Un-assembling and re-packing the module

In case of module return to 3SP Technologies factory, it is recommended to un-assemble 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.
- Make sure the pin out is long enough to allow measurements
- Make sure the fiber is coming with the FBG (no fiber cutting)
- Make sure the pin out is long enough to allow measurements
- Place short cuts on pin out if possible

Testing and operating recommendations

Operating the pump module on its board

3SP Technologies 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:

- If you need to test the pump module by itself, do not operate the pump module if the fiber end is not cleaved with a 8° angle. If you mount a connector at the fiber end to test the module, please make sure it is APC type (8° angle)
- 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 ($> 1 \mu\text{s}$).
- For pulsed operation on fast timescales ($< 1 \mu\text{s}$, DC $< 5 \%$), please contact your sales representative at 3SP Technologies.
- For any other operating mode that might be needed by your application, please contact your 3SP Technologies sales representative for more details.

Power Supply and TEC Controller

Before utilizing a laser diode (LD) module power supply, one should refer to the specified Absolute Maximum Ratings in the datasheet of each series of high power laser modules. Electrical Overstress (EOS) damage occurs when a pump module is subjected to voltage or current levels beyond the maximum ratings.

Our recommendations for preventing EOS of pump module are:

- Confirm pump module is mounted with the specified electrical pin-out.
- Transient electrical stress to the pump module should be avoided or minimized through operational life. The maximum specified transient current value and time for a pump module should never be exceeded while operating the laser diode. Please refer to the Absolute Maximum Ratings specified within the pump module specifications.
- Use transient suppression for power supplies.
- Use over voltage protection for power supplies and fuses.
- Ensure that all operational and assembly equipment is properly grounded with no loose connections, which can lead to intermittent connections.
- Ensure that the TEC controller is enabled and that the pump module is actively cooled prior to turning on the laser diode controller.
 - For 1999CHB, 1999CVB, 1999CHX, 1999CVX, 1999CMB, 1999CMX, 1064CHP: allow the internal temperature of the pump module to stabilize at $25 \pm 2 \text{ }^\circ\text{C}$ before turning on the LD.
 - For 1999SHB and 1999SHB: allow the internal temperature of the pump module to stabilize at $40 \pm 2 \text{ }^\circ\text{C}$ before turning on the LD.
 - For 1948RMB/RHB/RVB/RUB: allow the internal temperature of the pump module to stabilize at $35 \pm 2 \text{ }^\circ\text{C}$ before turning on the LD.

TEC control and operation

Large capacity Thermoelectric Coolers (TECs) are used to control cooled pump module temperature for high power operation. Proper operational procedures for the TEC are critical for reliable pump module performance during its lifetime. Pump module TECs typically are operated with closed-loop temperature controllers/power supply circuits.

Closed-loop circuits allow maintaining internal temperature of the pump module at the specified chip temperature depending from module type (refer to above Power Supply &

TEC controller section) for varying ambient temperatures. The TEC can be switched from a cooling mode to a heating mode by reversing the direction of current flow.

The TEC operates from a DC power source. An important criterion for reliable high power pump module operation is to use a filtered

DC current. DC ripple affects the TEC performance and, as consequently subsequent pump module performance and lifetime.

The TEC power supply should be limited to the absolute maximum TEC current as specified for each model of pump module. The TEC can run at the absolute maximum TEC current only for a very limited duration without impacting module reliability. Pump module TECs operate with closed-loop temperature controller/power supply circuits. A thermistor is used to control the LD temperature within the pump module to the specified chip temperature depending from module type (refer to above Power Supply & TEC controller section) through the specified operational ambient temperature range.

When the pump module is first turned on, there will be a transient current supplied to the TEC as it stabilizes via the feedback circuit. It is also important to note that the absolute maximum TEC current is different from the maximum operating current. The maximum operating current, is the current at which a TEC can operate at, for an unlimited time through the lifetime of the module. The EOL TEC Operating Current should not exceed 70 % of absolute maximum current. The maximum operating current is specified for each series of pump modules.

- Make sure that all 14-pin & 10-pin butterfly package leads have electrical contact to avoid controller/power supply open circuits.
- Ensure the TEC leads are connected to the proper electrical polarity, and ensure that the TEC power supply is turned off prior to mounting or un-mounting the pump module.
- Operate the TEC in constant temperature mode with temperature feedback from the LD chip thermistor. The thermistor leads have to be electrically contacted when the pump module is operating in order to prevent the temperature controller / power supply loop from opening. An opened loop TEC will run at its maximum available power supply current and can result in permanent module damage.
- Limit TEC power supply ripple factor to less than 10 %.
- Limit the TEC controller power supply to the absolute maximum TEC current rating.
- Do not operate the TEC at its rated maximum current except as transient applied current during module start-up.
- Limit the TEC operating current to about 70 % of the specified TEC maximum current.
- Wait until the internal temperature has stabilized to to the specified chip temperature depending from module type (refer to above Power Supply & TEC controller section) after turning the LD on before making any TEC control changes.
- For a reliable pump module operation, make sure that the LD chip temperature is maintained at to the specified chip temperature depending from module type (refer to above Power Supply & TEC controller section).

Eye safety recommendation

This product is a high-power semiconductor laser (according to the class defined on the product specification sheet) and precautions must be taken to avoid eye damage or skin burns.

The use of optical instrument with this product will increase eye hazard.

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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 test the pump module by itself if the fiber end is not cleaved with a 8° angle or equipped with APC type connector (8° angle).

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