



CDPS532S
Continuous Wave Frequency-Doubled
Diode-Pumped Solid-State Laser

User's Manual

Contents

Page

Safety Information and Symbols

Add pages

General Information and Specifications

Getting Started

Operating and Maintenance Instructions

External Control

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Safety Information and Symbols

Classification

The unit consists of an exposed metal chassis that is connected directly to earth via a power cord and, therefore, is classified as a Class 1 instrument. Class 1 refers to equipment relying on ground protection as a means of shock protection.

The following symbol is used to indicate a protective conductor terminal in the unit.



Disconnecting from line power

Some of the circuits are powered whenever the unit is connected to the AC power source (line power). To ensure that the unit is not connected to the line power, disconnect the power cord from either the power inlet on the unit or from the AC line-power source (receptacle). The power cord must always be accessible from one of these points. If the unit is installed in a cabinet, the operator must be able to disconnect the unit from the line power by the system's line-power switch.

Line power requirements

The unit is powered by 5 V/9 A DC supplied to the controller. The maximum power consumption is 45 W. A DC power supply can be ordered as an option to operate the unit from a single-phase AC power source. The line requirement is 115 to 230 V at a frequency of 47 to 440 Hz.

Laser specifications

The laser specifications are given in Table 1:

Table 1: Laser specifications

Parameter	Specification
Wavelength	532 nm
Laser Safety Classification	IIIb
Output Power	10 mW
Beam Diameter	1.9 ± 0.2 mm, (1/e ² points, at 250mm from front bezel)

Locations of laser warning signs

The following drawing shows the locations of laser warning signs.

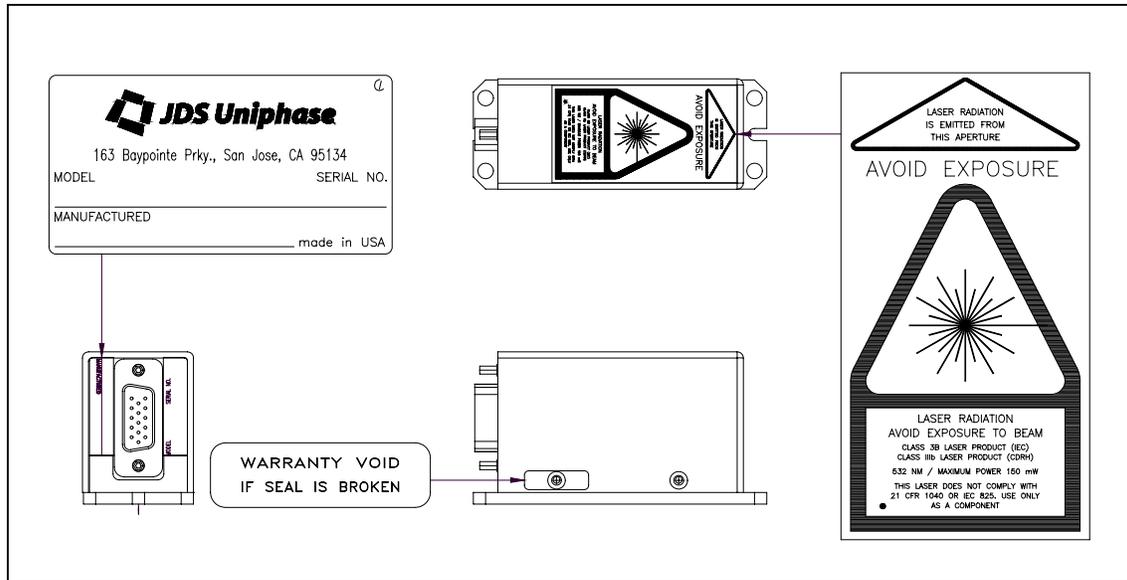


Figure 1: The location of laser warning signs on the unit.

	<p>Warning Class IIIb lasers are hazardous to eyes and skin if viewed directly.</p>
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Safety Instructions

The following safety instructions must be observed whenever the unit is operated, serviced or repaired. Failure to comply with any of these instructions or with any precautions or warnings mentioned in the user's manual is in direct violation of the standards of design, manufacture and intended use of the unit. JDS Uniphase assumes no liability for the customer's failure to comply with any of these safety requirements.

Before initializing and operating the unit

Inspect the unit for any sign of damage, and read the user's manual thoroughly. Install the unit as specified in the Getting started section. Ensure that the unit and any devices or cords connected to it are properly grounded.

Operating the unit



Warning

To avoid the risk of injury or death, always observe the following precautions before initializing the unit:

- If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.
- Use only the type of power cord supplied with the unit.
- Connect the power cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.
- Willfully interrupting the protective earth connection is prohibited.
- Never look into the laser beam emitted either from the laser head or the end of an optical cable connected to an operating optical output. Laser radiation can be invisible, and direct exposure can severely injure the human eye.
- Turning off the power to the device does not always block the entire radiation emitted from the output of the unit.
- Do not use the unit outdoors.
- To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.
- Do not operate the unit when its covers or panels have been removed.
- Do not interrupt the protective earth grounding. Any such action can lead to a potential shock hazard that can result in serious personal injury.
- Do not operate the unit if an interruption to the protective grounding is suspected. In this case, ensure that the unit remains inoperative.

	<ul style="list-style-type: none"> • Unless absolutely necessary, do not attempt to adjust or perform any maintenance or repair procedure when the unit is opened and connected to a power source. • Repairs are to be carried out only by a qualified professional. • Do not attempt any adjustment, maintenance or repair procedure to the unit's internal mechanism if immediate first aid is not accessible. • Disconnect the power cord from the unit before adding or removing any components. • Operating the unit in the presence of flammable gases or fumes is extremely hazardous. • Do not perform any operating or maintenance procedure that is not described in the user's manual. • Some of the unit's capacitors can be charged even when the unit is not connected to the power source.
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Safety symbols

The following symbols and messages can be marked on the unit (Table 2). Observe all safety instructions that are associated with a symbol.

Table 2: Safety symbols

Symbol	Description
	Laser safety. See the user's manual for instructions on handling and operating the unit safely
	See the user's manual for instructions on handling and operating the unit safely.
	Electrostatic discharge (ESD). See the user's manual for instruction on handling and operating the unit safely.
	Frame or chassis terminal for electrical grounding within the unit.

	Protective conductor terminal for electrical grounding to the earth.
WARNING	The procedure can result in serious injury or loss of life if not carried out in proper compliance with all safety instructions. Ensure that all conditions necessary for safe handling and operation are met before proceeding.
CAUTION	The procedure can result in serious damage to or destruction of the unit if not carried out in compliance with all instructions for proper use. Ensure that all conditions necessary for safe handling and operation are met before proceeding.

Compliance

The unit has been designed and tested to comply with the following standards:
 Electromagnetic Emissions (EN 50081-1) tested to standard EN 55022
 Electromagnetic Immunity (EN 50082-1) tested to standard EN 61000-4-2 and EN 61000-4-3 and ENV 50204.
 Safety evaluation tested to standard UL 3101.

General information and specifications

General information

The CDPS532S is a continuous-wave, frequency-doubled diode-pumped solid-state laser operating at a wavelength of 532 nm. The laser can provide an output power of 10 mW. The CDPS532S provides a very stable and low noise laser beam in a very compact package, especially designed for original equipment manufacturing and system integration. The low noise operation is achieved via single-longitudinal mode operation.

The laser (Figure 2) consists of a laser head, a controller and an umbilical cable connecting the head and the controller. To prevent electrostatic damage to the pump laser diode mounted in the laser head the controller and the laser head have to stay connected at all times. The laser is powered by supplying 5 V DC to the controller by either an optional DC power supply or by a customer provided DC power supply.



Figure 2: The CDPS532S laser system.

In the laser head lasing is achieved in a two mirror linear cavity containing the Nd:Vanadate (Nd:YVO_4) crystal and the intra-cavity frequency doubling crystal. A KTP crystal is used to convert the fundamental 1064 nm radiation into the 532 nm green output beam. The pump power for the Vanadate crystal is provided via a 808 nm pump laser diode outside the laser cavity. The pump diode wavelength is matched to the Vanadate absorption line. All these components are mounted in a metal structure for mechanical stability. The laser beam exhibits a very good mode quality close to diffraction limit. The output beam from the cavity is not conditioned, resulting in a beam divergence of < 8 mrad. Two side beams are emitted simultaneously together with the main beam but well separated from it. The side beams can easily suppressed outside the laser head.

The whole cavity is temperature stabilized for long term stability using a thermoelectric cooler. The heat dissipation takes place through the base plate of the laser head. For proper operation the laser head has to be mounted on a heat sink. The base plate temperature has to be kept below 45°C by the heat sink.

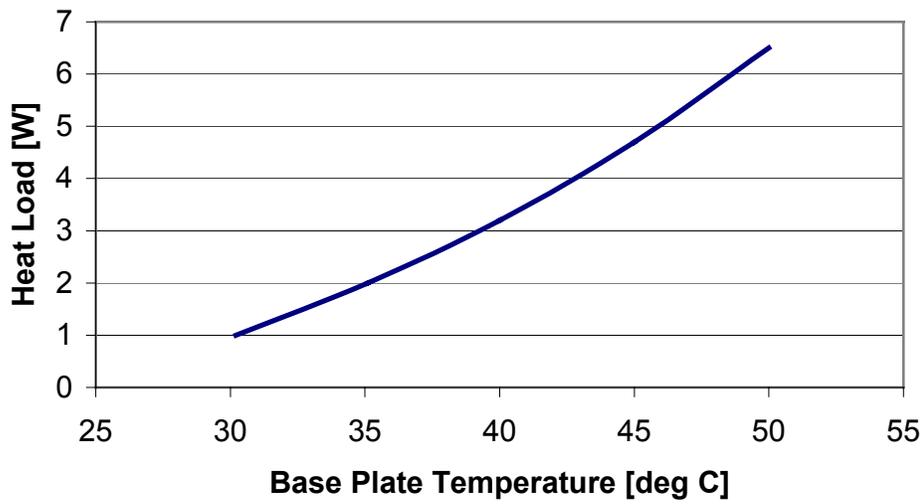


Figure 3: Cooling power requirement for the heat sink.

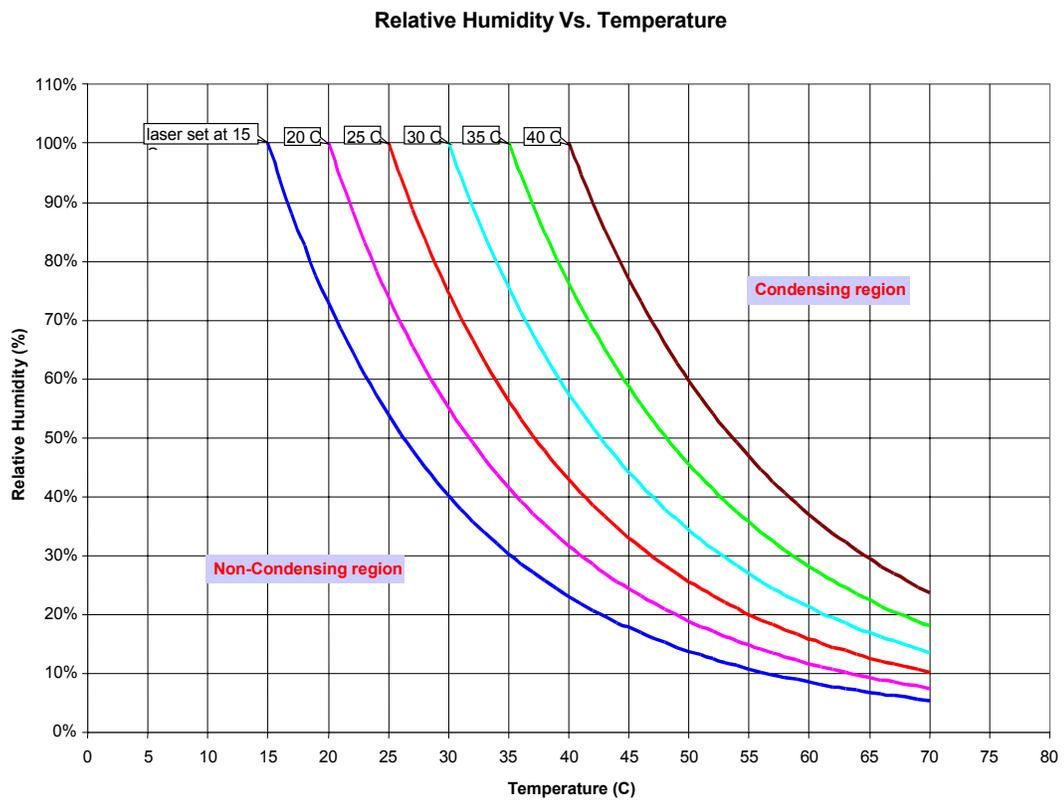


Figure 4: Relative humidity vs. temperature for a non-condensing environment.

The laser has to be operated in a non-condensing environment. The temperature/relative humidity condition can be estimated by using the following graph (Figure 4).

The controller drives the pump laser diode, the thermoelectric cooler and uses a photo-diode and thermistor signal for feedback loops. After warm-up the controller switches to constant power operation. A photo diode signal is used to keep the output power of the laser stable via adjustment of the pump laser diode power. This is done via controlling the pump diode driving current.

To operate the laser a 5 V DC supply has to be connected to the controller. The laser can be controlled remotely via an interlock loop connector. Basic system control is possible via an analog interface. A 8-pin RJ-45 connector provides different signals like pump diode current and laser output power.

The following table summarizes the specifications for the CDPS532S.

Table 3: Laser specifications

Optical	
Wavelength [nm]	532 ± 1
Output Power [mW] CDPS532S-010	10
Power Stability (1 hour, 25 ± 3 °C) [%]	<1.5
Mode Quality M ²	<1.3
Beam Diameter (1/e ² point, at distance of 250 mm) [mm]	1.9 ± 0.2
Beam Divergence (full angle) [mrad]	<8
Polarization Ratio (E-vector is vertical)	>100:1
Noise (rms, 20 Hz – 1 MHz) [%]	<0.5
Ellipticity [%]	<10
Pointing Stability (after 2 hour warm-up, 25 ± 3 °C) [μrad]	± 30
Static Alignment	
Beam position [mm]	± 1.0
Beam angle [°]	± 1.5
Environmental	
Base Plate Temperature [°C]	
Operating	10 - 45
Non-operating	0 - 60
Shock (11 msec duration) [g]	
Operating	1
Non-operating	25
Vibration (sinusoidal, 5 – 500 Hz) [g]	
Operating	0.3
Non-operating	2
Heat Sink Requirements	
Surface Flatness [μm]	25
Torque Specification [Nm]	0.5

Getting started

Before initializing and operating the laser

- Check that the unit was shipped with all parts
- Check that there is no obvious damage to the unit.
- Read the user's manual thoroughly, and become familiar with all safety symbols and instructions to ensure that the unit is operated and maintained safely

Initial Inspection

	<p>Warning</p> <ul style="list-style-type: none">• To avoid electrical shock, do not initialize or operate the unit if it bears any sign of damage to any portion of its exterior surface, such as the outer cover or panel.• Never look into the laser beam emitted either from the laser head or the end of an optical cable connected to an operating optical output. Laser radiation can be invisible, and direct exposure can severely injure the human eye.• Do not use the unit outdoors.• To prevent potential fire or shock hazards, do not expose the unit to any source of excessive moisture.
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	<p>Caution</p> <ul style="list-style-type: none">• Always have the laser head and laser controller connected before applying power to the unit.
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Check that the unit and contents are complete:

1. Wear an anti-static wrist strap and work in an electrostatic discharge (ESD) controlled area.
2. Inspect the shipping container for any indication of excessive shock to the contents, and inspect the contents to ensure that the shipment is complete.
3. Inspect the unit for structural damage that can have occurred during shipment.
4. Ensure that the laser head is connected to the controller.
5. Keep the packaging.

Immediately inform JDS Uniphase and, if necessary, the carrier if the contents of the shipment are incomplete, if the unit or any of its components are damaged or defective, or if the unit does not pass the initial inspection.

**Caution**

- For environmental operating conditions see **General information** and **Mounting the laser**

Storing and Shipping

To maintain optimum operating reliability, do not store the unit in locations where the temperature falls below 0°C or rises above 60°C. Avoid any environmental condition that can result in internal condensation. Ensure that these temperature and humidity requirements can also be met whenever the unit is shipped.

Claims and Repackaging

Immediately inform JDS Uniphase and, if necessary, the carrier, about a claim. In the event of carrier responsibility, JDS Uniphase will allow for the repair or replacement of the unit while the claim against the carrier is being processed.

Removal of either the laser head cover or controller cover voids the warranty.

Warranty

JDS Uniphase diode-pumped solid-state lasers are warranted to be free of defects in material and workmanship for twelve months from date of shipment or 5,000 h, whichever occurs first.

Returning Shipments to JDS Uniphase

JDS Uniphase only accepts returns for which an approved Return Material Authorization (RMA) has been issued by JDS Uniphase. This number must be obtained prior to shipping any material back to JDS Uniphase. The owner's name and address, the model number and full serial number of the unit, the RMA number, and an itemized statement of claimed defects must be included with the return material.

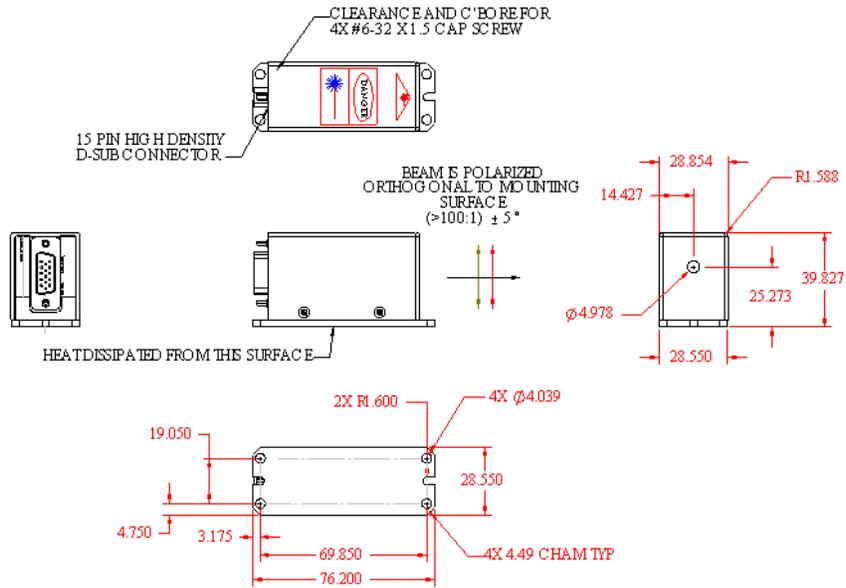
Ship return material in the original shipping container and packing material. If these are not available, typical packaging guidelines are as follows:

- Wear an anti-static wrist strap and work in an ESD controlled area.
- Cover the front panel, if applicable, with lens cleaning tissue taped to the front panel.
- Wrap the unit in anti-static packaging. Use anti-static connector covers, as applicable.
- Pack the unit in a reliable shipping container.
- Use enough shock-absorbing material (10 to 15 cm on all sides) to cushion the unit and prevent it from moving inside the container. Anti-static foam material is the best material.
- Seal the shipping container securely.
- Clearly mark FRAGILE on the outside of the container.
- Always provide the model and serial number of the unit and the RMA number on any accompanying documentation.
- Ship the unit only to the address given at the beginning of this document.

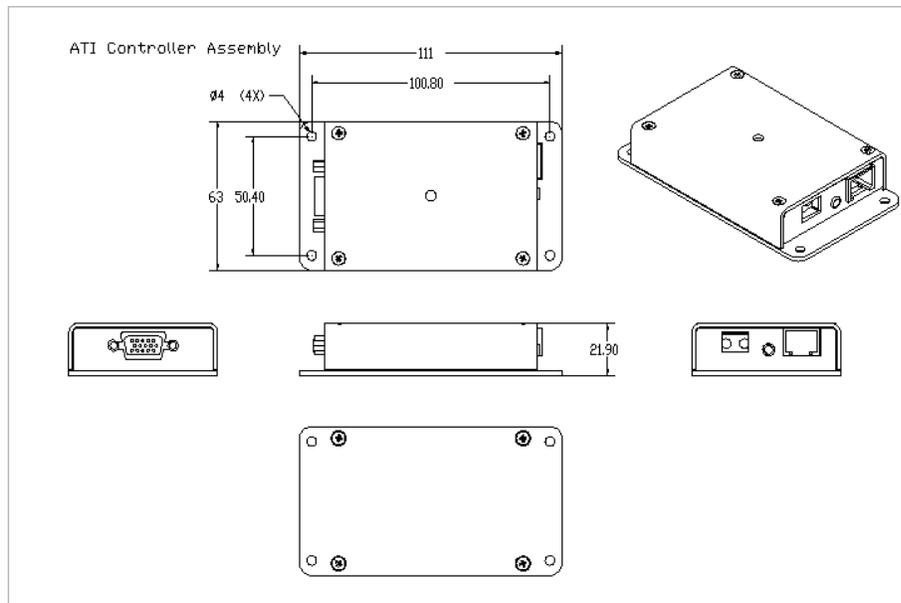
Operating and Maintenance Instructions

External Dimensions

The laser head is shown in figure 5 (dimensions are in mm):



The laser controller is shown in figure 6 (dimensions are in mm):



Laser head and controller are connected via the umbilical cable with a 15-pin D-sub connector at each end (figure 7). The umbilical cable is installed at the factory and the warranty is void if the cable is disconnected on either the laser head or controller side. The standard length of the umbilical cable is 413 mm.

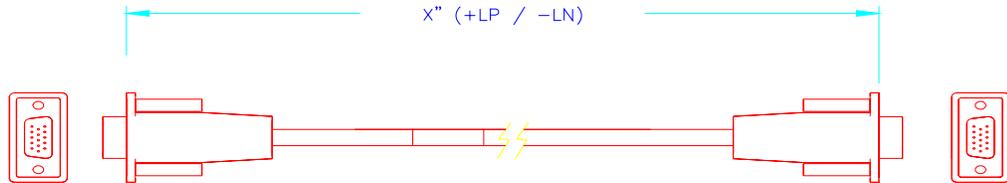


Figure 7: The umbilical cable connects laser head and controller.

An optional 5V DC power supply is available for the unit (see figure 8). The laser system is compliant with CDRH, if the CDRH version of the 5V power supply is used. An adapter cable (not shown in figure 8) to connect the power supply to the laser controller is shipped with the power supply. The dimensions of the power supply are 164 x 82 x 55 mm.

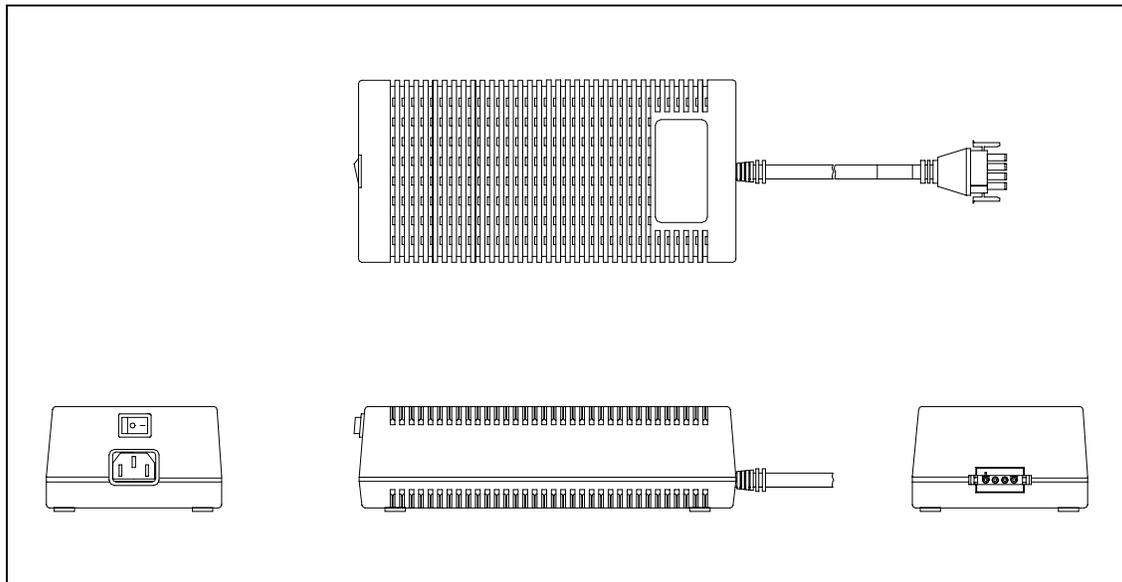


Figure 8: The optional 5V DC power supply

Mounting the Laser (Cooling Requirements)

	<p>Caution</p> <ul style="list-style-type: none">• The laser head must be properly cooled to avoid damage to the system.• The laser has to be operated in a non-condensing environment.
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For proper operation the laser head has to be mounted to a heat sink that is capable to dissipate 10 W of heat load while maintaining a temperature below 45°C (refer to figure 2 for heat sink requirements).

The heat is dissipated through the bottom surface of the laser head. Four screws in the bottom plate of the laser head are used to mount the laser head to the heat sink. A torque of 0.5 Nm has to be used to mount the screws.

For proper heat contact a surface flatness of the mounting surface of the heat sink of 25 µm is required. Alternatively a thermal pad (part number 02-000773) can be used between laser head and heat sink. The usage of thermal compound or grease is forbidden.

Using the Laser

	<p>Warning</p> <ul style="list-style-type: none">• Never look into the laser beam emitted either from the laser head or the end of an optical cable connected to an operating optical output. Laser radiation can be invisible, and direct exposure can severely injure the human eye.• Never leave the laser on, unattended.• Always have the power supply cover, the controller cover and the laser head cover in place when the laser is connected to line power.• When the laser is on and the output beam is not being terminated in an experiment or optical system, block the beam.• Set up experiments so that the laser beam is not at eye level.
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	<p>Caution</p> <ul style="list-style-type: none"> The laser controller has been factory adjusted to operate the CDSP532S laser. Do not attempt to operate the laser with any other equipment.
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To use the laser:

Mount the laser head to a heat sink.

A 5V DC power supply is needed to operate the laser. The 5V DC can be supplied either by an optional JDS Uniphase power supply or by a customer supplied unit. The 5V power supply has to comply with the following specifications:

Table 3: Electrical parameters

Parameter	Specification
Input voltage	5V DC
Line regulation	± 0.1%
Noise and ripple	1% peak-to-peak
Load regulation	± 5%
Current	10A
Power	50W

The power is supplied to the controller via a 2 pin AMP 2P 794120-1 connector (see figure 9).

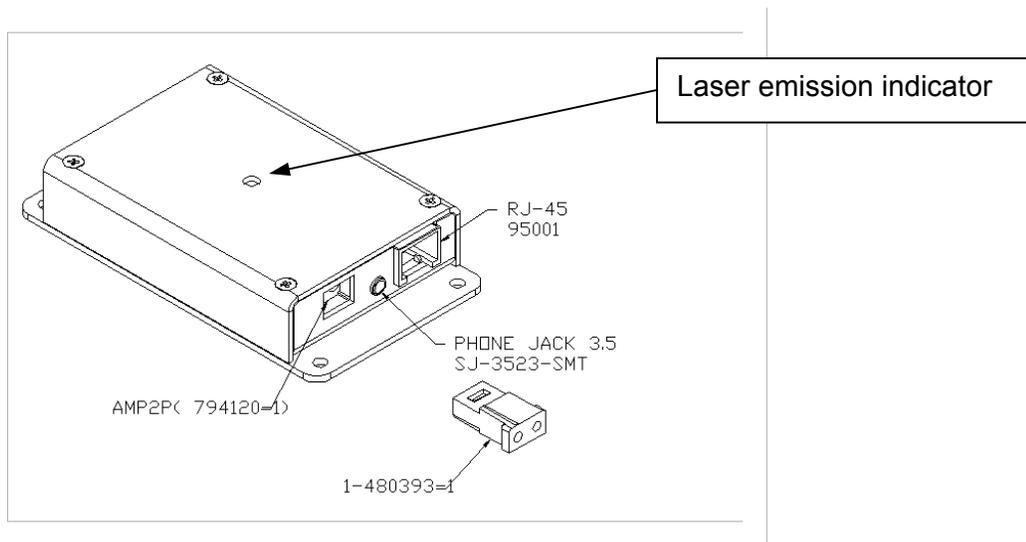


Figure 9: Laser controller connections

**Caution**

- Always have the laser head and laser controller connected before applying power.
- Do not connect the 5V power supply to the controller while the 5V DC is present. Apply and remove the 5V only after switching of the 5V DC power.

The laser will only turn on if:

The interlock connector (phone jack 3.5, SJ-3523-SMT) is shorted and Laser Emission ON/OFF (pin 5, RJ-45 connector) is shorted to digital ground (pin 4, RJ-45 connector) or driven to TTL logic low.

Connect the 5V power supply and apply power. The laser is now active.

Laser Input/Output Interface

The laser controller provides limited diagnostics via the RJ-45 connector. The functions are summarized in the following table.

Table 4: Laser Interface

Function	Pin Numbers	Comments
Laser Output Power	Pin 1, RJ-45	Analog Output. 0-5 V analog output, 5V corresponds to 30 mW power. Signal is proportional to the laser output power.
Power Supply Out	Pin 2, RJ-45	Digital Output. If the power supply is operating normally and the voltage is between 4.75 and 5.25 VDC the pin will be held at TTL logic low, or digital ground. Pin 2 will flash, alternating between TTL logic level low and high if the power supply is over or under voltage.
Laser Out	Pin 3, RJ-45	Digital Output. If the laser is operating correctly and is turned on, then pin 3 will be held to TTL logic level high, 5 V. Pin 3 will be held to TTL logic level low, or digital ground, if the laser is turned off. Pin 3 will flash, alternating between high and low if a fault has been activated, such as interlock, temperature out of range.
Ground	Pin 4, RJ-45	Connect to ground
Laser Emission ON/OFF	Pin 5, RJ-45	Digital Input. If pin is shorted to digital ground, or driven to TTL logic low level by external hardware, the laser is enabled and emission will occur. If the pin is driven to TTL logic level high by external hardware, then the laser will be disabled. If left unconnected, laser emission will be inhibited. The laser will not operate if the TEC current is not enabled or the cavity temperature is not at the set point.
TEC Current ON/OFF	Pin 6, RJ-45	Digital Input. If pin is shorted to digital ground, or driven to TTL logic low level by external hardware, then the TEC will operate to control the cavity temperature. If the pin is driven to TTL logic level high by external hardware, then the TEC will be turned off. If left unconnected the TEC will operate to control the temperature.

Laser Diode Current	Pin 7, RJ-45	Analog Output. 0-5 V analog output, corresponding to 0-3 A current. The signal is proportional to the laser diode current.
Laser Output Noise	Pin 8, RJ-45	Analog Output. 0-5 V analog output, corresponding to 0-2% average deviation.

Disconnecting the Umbilical cable between Head and Controller

The laser is shipped with the umbilical cable installed at the factory. Laser heads and controllers are NOT interchangeable, so disconnecting the unit is not recommended. The warranty is void if the umbilical cable is disconnected without clearance from JDS Uniphase.

	<p>Caution</p> <ul style="list-style-type: none"> Only work in an ESD controlled area and wear an anti-static wrist strap.
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If absolutely necessary, use the following instructions to disconnect the umbilical cable:

Wear an anti-static wrist strap and work in an ESD controlled area.

Disconnect the cable from either the laser head or the controller. For the laser head, immediately reconnect a shorting plug to the D-sub connector or immediately shorten the pins of the D-sub connector using conductive foam, to prevent ESD damage to the pump laser diode inside the laser head.

Troubleshooting

Laser system faults can be checked via the RJ-45 connector

Table 5: Faults indicated via the RJ-45 connector

Pin Number	Fault
#2	5V DC power supply fault
#3	Laser fault

Table 6: Troubleshooting tips

Problem	Probable Cause(s)	Solution
Laser does not turn on (no light emitted from aperture)	5V DC is not supplied Interlock loop (phone jack 3.5 connector) open Pin 5, RJ-45 is not grounded or at TTL logic low	Turn on 5V DC supply Remove interlock condition, close interlock loop Ground pin 5, RJ-45 or drive to TTL logic low
Low output power	Pump laser diode current at maximum Laser miss-aligned Laser mounting stress Output window dirty	Check pin 7, RJ-45, if at maximum contact factory for RMA Contact factory for RMA Remount laser head using proper torque specifications. Mount to flat heat sink surface. Clean window with lens cleaning tissue and methanol.
Laser turns off after warm-up	Laser head not properly cooled	Mount laser head to proper heat sink. Ensure proper heat contact.
Optical noise out of specification	Operation outside of specified temperature range Laser head not properly cooled	Operate in proper temperature environment Mount laser head to proper heat sink. Ensure proper heat contact.
Laser turns on, but no output beam	Obstruction in laser aperture Laser miss-aligned	Remove obstruction Contact factory for RMA