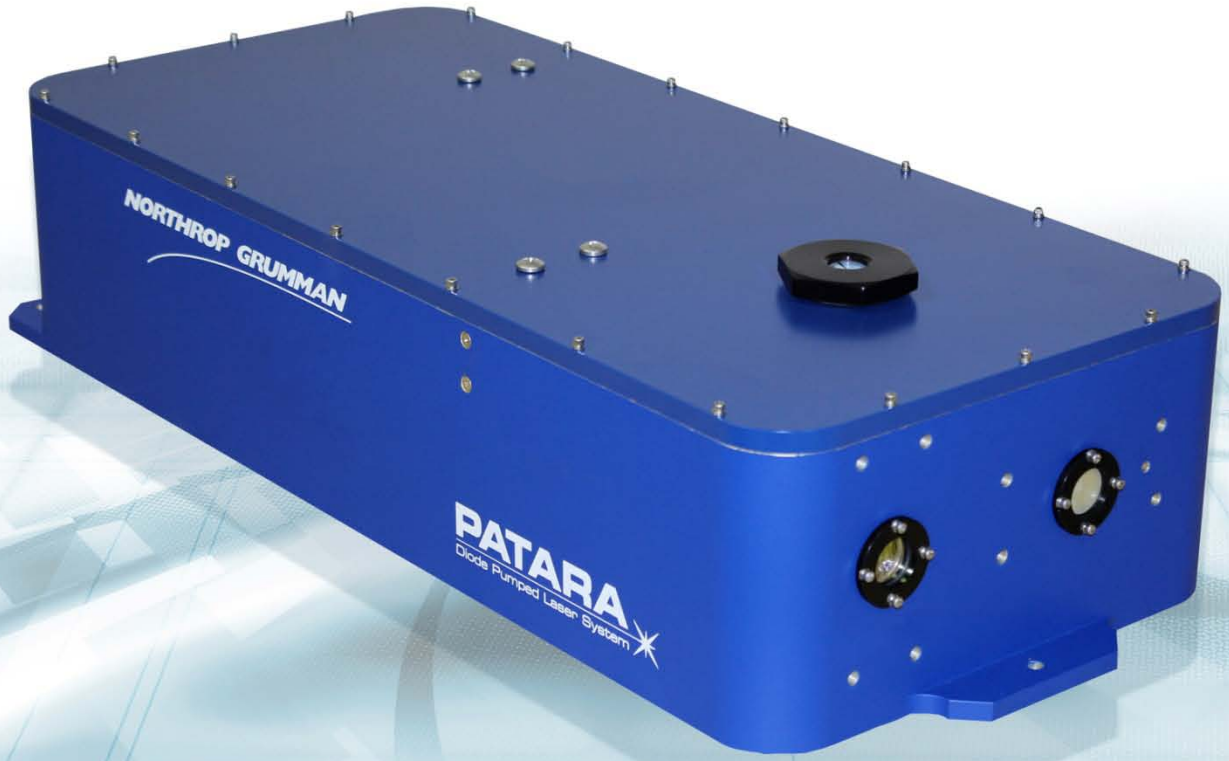
Quick Installation Guide

Patara-IR TEM_{00} Laser
PA-020-QTIP



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NORTHROP GRUMMAN

Worldwide Technical Support and Product Information

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Important Information

Warranty Summary

Northrop Grumman Cutting Edge Optronics (NG CEO) warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of one year from the date of shipment from an NG CEO distributor. If a product proves defective within the respective period, NG CEO will provide repair or replacement as described in the complete warranty statement.

To arrange for service or obtain a copy of the complete warranty statement, please contact your nearest NG CEO sales and service office.

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This laser product is regulated by the Export Administration Regulations (EAR) of the USA. It may not be export/re-export without the prior written approval of the Bureau of Industry and Security, U.S. Department of Commerce.

Safety Information

Product End-of-Life Handling

NG CEO is committed to protecting the environment. In accordance with the Waste Electrical and Electronic Equipment directive (WEEE) and Restriction of Hazardous Substances in the European Union (RoHS EU) directives, NG CEO accepts the return of our products for disposal. When you are ready to reclaim the instrument, you must properly transfer it according to local regulations concerning WEEE equipment. Contact NG CEO or your local distributor for shipping instructions. Please package the products as directed for a return for repair.

ROC ROHS Declaration

In accordance with the Clause 6.2 of Marking for Control of Pollution Caused by Electronic Information Products (SJ/T11364:2006) for Measures for the Administration on Pollution Control of Electronic Information Products No. 39, Order of the Ministry of Information Industry of the Peoples Republic of China, NG CEO includes the following translation about our laser modules.

中华人民共和国，电子讯息产品管理办法：自我声明

生产商	**Northrop Grumman Cutting Edge Optronics**
生产商地址	20 Pointe West Blvd St. Charles, MO 63301 USA
产品名称 / 编号	**Mirus Series Laser Systems** **Models: MI-xxx-xxxx-xxxx and AMI-xxx-xxxx-xxxx**

有毒有害物质或元素标认表

部件编号	部件名称	有毒有害物质或元素					
		铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (CrVI)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
第一组	外壳	O	O	O	O	O	O
第二组	电线/ 连接插头	X	O	X	X	X	X
第三组	安装组件	O	O	O	X	O	O
第四组	开关组件	O	O	O	X	X	X
第五组	电路板/ 开关组件	X	O	O	O	X	X
第六组	阵列前端次模组	O	O	O	O	O	O
第七组	接触板	X	O	O	O	X	X
第八组	热交换组件	O	O	O	O	O	O
第九组	16 进制硬件	O	O	X	O	O	O
第十组	焊锡	X	O	X	O	O	O
第十一组	电线/ 连接插头	X	O	O	O	X	X
第十二组	基部/ 端帽	X	O	O	X	O	O
第十三组	硬件/ 装配	O	O	O	X	O	O
第十四组	时计组件	X	O	O	X	X	X
第十五组	包装物料	O	O	O	O	O	O

O：表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 规定的限量要求以下

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 规定的限量要求

Conventions

The following conventions appear in this manual:

	This icon denotes a caution or a warning, which advise you of precautions to take to avoid injury, data loss, or a system crash.
Initial Capped	The first letter in uppercase refers to menu options, e.g., **Phase Delay**, **Pulse Width**.
CAPS	Front-panel buttons, knobs, and connectors appear in all uppercase letters, e.g., **MENU, CURRENT**.
▸	The ▸ symbol separates a sequence of button pushes, e.g., **MENU** ▸ **CHANNEL SETUP** ▸ **PULSE WIDTH** means that you push the **MENU** button, then push the **CHANNEL SETUP** soft key, and then push the **PULSE WIDTH** soft key.
italic	Italic text denotes references to other resources that may be helpful to you or to bring attention to important information.
	This icon denotes a note, which alerts you to important information.
I **O**	Power Switch Position Symbols I = On O = Off

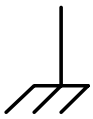
The following conventions may appear on the product:

DANGER	An injury hazard immediately accessible as you read the marking.
WARNING	A hazard not immediately accessible as you read the marking.
CAUTION	A hazard to property including the product.
	ESD: Handle Appropriately

Laser Emission: Use caution.

Shock Hazard: Use caution.

Caution: Risk of danger. Refer to manual.



Chassis Ground

General Safety Summary

The Patara-IR TEM_{00} Laser System emits laser radiation that can permanently damage eyes and skin, ignite fires, and vaporize materials. *Chapter 2: Laser Safety* contains information and guidance about these hazards. To minimize the risk of injury or expensive repairs, carefully follow these instructions.

Do not attempt to operate the laser system before carefully reading this complete operation manual. If you have any questions on the product that have not been discussed sufficiently in this manual, contact the manufacturer for complete instructions. **Failure to heed this warning may result in the destruction or serious damage to the device, and will void the product warranty.**

The *Service* and *Troubleshooting* sections are intended to help guide you to the source of problems. Do not attempt repairs while the unit is under warranty; instead, report all problems to NG CEO for warranty repair.

Use the form in *Appendix A: Customer Service* to describe issues with the laser. We also suggest that you record information about the laser such as power, settings, time and date.

Safety Overview

Safe operation of any laser should be reviewed prior to any new installation of the Patara laser.

CAUTION. This laser is a Class IV, high power laser whose beam is, by definition, a safety hazard. Avoid eye or skin exposure to direct or scattered laser radiation. Avoid direct viewing of the beam or its specular reflection.

Follow the instructions contained in this manual for proper installation and safe operation of your laser. We recommend the use of protective eyewear at all times (the type of eyewear depends on the energy and wavelength of the laser beam and operating conditions). Consult ANSI, ACGIH, or OSHA standards for guidance.

CAUTION. Use of controls, adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

WARNING. At all times during installation, operation, maintenance, or service of your laser, avoid exposure to laser or collateral radiation exceeding the accessible emission limits listed in “Performance Standards for Laser Products,” U.S. Code of Federal Regulations, 21 CFR 1040 10(d).

Precautions for Safe Operation

- Avoid looking directly into the laser beam or at specular reflection, even with protective eye wear on.
- Wear laser safety eyewear that is optically dense at the wavelengths of operation (798-816 nm pump light, 1064 nm).
- Provide a controlled access area for laser operation and limit access to those trained in laser safety principles.
- Post warning signs in prominent locations near the laser operation area.
- Use safety interlocks on all entryways. All NG CEO system control electronics are supplied with interlock inputs that can be used to preclude operation with an open safety door.
- Enclose beam paths wherever possible.
- Set up experiments so the laser beam is below eye level.
- Work in an area that is well lighted to avoid dilation of pupils.
- Set up a target for the beam.
- Set up shields to prevent reflected beams from escaping the laser operation area.
- View an infrared laser beam with a protected image converter at an oblique angle reflecting from a diffuse surface.
- Ensure that all electrical connections are made in a safe manner.
- Position equipment so that electrical connections are shielded from accidental touch.
- Do not smoke, eat, or drink in laser areas.
- Avoid leaving an operating laser unattended.

About This Manual

This manual describes the installation, operation, and service of the Patara-IR TEM_{00} Laser System with the eDrive Nitro Laser Controller. The manual consists of the following chapters:

- *Chapter 1: Laser System Components* provides a description of the system components and unpacking procedures
- *Chapter 2: Laser System Setup* provides information on quick set-up of the laser head
- *Chapter 3: Laser Operation and Tuning* provides information on initial operation and optimizing the laser performance
- *Appendix A: Customer Service* provides information to expedite any service request before contacting NG CEO.

Table of Contents

List of Figures and Tables

1

Chapter 1: Introduction

This introduction provides the following information:

- Laser System Components
- Unpacking the Laser System

Laser System Components

Before installing the laser, be familiar with the components of the laser system (see Figure 1-1).

Laser head

Chiller

eDrive

Diode Power Cable

AC Power Cables

Laser Signal Cable

Q-Switch RF Cable

Filter housing and Filter

Hose for Chiller

Figure 1-1 Components for the Patara-IR TEM_{00} Laser

Unpacking the Laser System

Your NG CEO Patara-IR TEM_{00} laser was carefully packed for shipment. If its carton appears to have been damaged in transit, have the shipper's agent present when you unpack.

Inspect the unit as you unpack it, looking for dents, scratches, or other evidence of damage. If you discover any damage, immediately file a claim against the carrier and

notify NG CEO technical service. NG CEO will arrange for repair without waiting for settlement of your claim.

Keep the shipping container. If you file a damage claim, you may need it to demonstrate that the damage occurred as a result of shipping. If you need to return the unit for service, the specially designed carton assures adequate protection.

A standard Patara-IR TEM_{00} laser system consists of:

PA-020-QTIP
PA-020-QTIP Laser Head
eDrive, P/N ED4C-AXA-2440N
120V Single Phase 60 Hz Chiller P/N 6362T31CE20C OR 208-230V Single Phase 50/60 Hz Chiller P/N 6352T41CE30E
Laser Signal Cable
RF Cables
Hoses and Filter for Chiller
Power Cord for Chiller
Power Cord for eDrive
Desiccant Cartridge

Please check the contents against the packing list and the sales order.

2

Chapter 2: Laser System Setup

Sections included in this chapter provide the following information:

- Laser Head Setup
- eDrive Setup
- Chiller Setup
- Connecting the Chiller

Laser Head Setup

The laser head should be mounted on an optical table or equivalent strong flat surface. There are three mounting holes provided to secure the laser. The laser should be installed in a clean environment.

In the direction of the laser output beam, a power meter with the power scale up to 30W should be installed approximately 1.5 feet away from the laser. In order to protect the power meter, a negative lens (f=-100mm) with AR coating at 1064nm should be installed in front of the power meter as shown in Figure. If a negative lens is not available, the power meter should be at least 2 meters away from the laser so that the beam size is larger and the power density is below the damage threshold of the power meter.

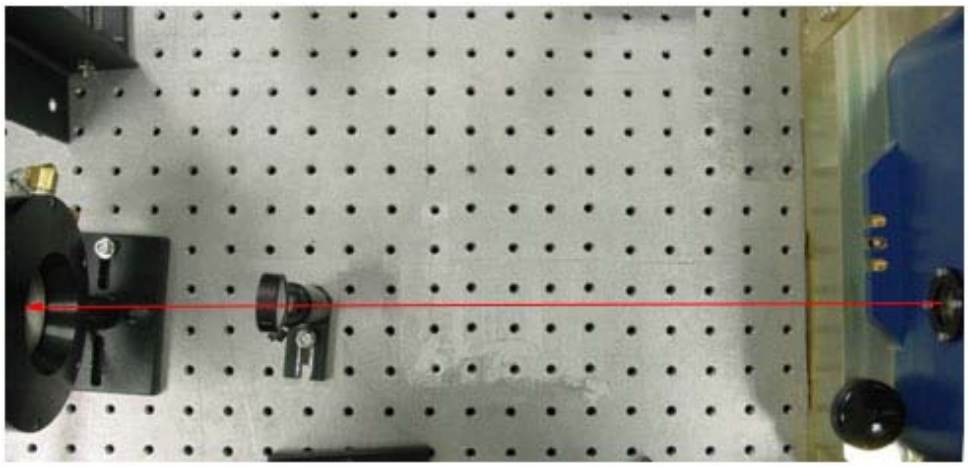


Figure 2-1 Basic Setup for the Laser Power Test

eDrive Setup

Input Power

Use only power cords suitable for your driver. Use a power source that delivers voltage in the range of 100 VAC (RMS) to 240 VAC (RMS) and 47 Hz to 63 Hz. Power switching is performed automatically (i.e., there are no configuration switches to set for high or low voltage ranging). Table 2-1 provides recommended fuse selection for each voltage range.

Table 2-1 Recommended Fuse Ratings

AC Input		Frequency	Fuse Ratings (F1, F2)
120V ±10%	15A	50/60 Hz	T 15A 250V
240V ±10%	8A	50/60 Hz	T 8A 250V
Fuse Dimensions: 0.25 x 1.25 inches			

Mounting

The front panel of the eDrive is designed with four holes to mount into an EIA-310D-compliant rack. If this option is used, the eDrive's weight requires you use extra side supports. If the eDrive is to be used on a desktop or table top, it is recommended that the eDrive be equipped with feet to prevent the driver from marring the surface when it is moved. The eDrive must be secured.

Clearance

Adequate clearance should be allowed on the front, sides, and rear of the eDrive for access to connections and components. The front and rear vents of the eDrive must be a minimum of 24 inches (61 cm) away from walls or vertical surfaces so air flow is not restricted.

Chiller Setup

Ambient Temperature and Relative Humidity

The chiller is designed for indoor installation in ambient temperatures between 5 °C and 30 °C (41 °F and 86 °F). Relative humidity should not exceed 80 percent (non-condensing).

Location

The Chiller should be installed on a strong, level surface and be located as close to possible to the laser. It should not be installed closer than 4 feet (1.4 meters) to a heat generating source, such as heating pipes or boilers. If possible, the chiller should be located near a suitable drain to prevent flooding in the event of leaks. Do not place it where corrosive fumes, excessive moisture or dust, or high room temperatures are present.

For ease of positioning and maneuverability, the chiller is supplied with casters. The front wheels can be locked to keep the chiller in place while in use. To help prevent voltage drops, position the chiller as close as possible to the power distribution panel. Avoid voltage drops by using a properly grounded power outlet wired with 14 gauge or larger diameter wire. The use of an extension cord is not recommended

NOTE: The chiller may be located at a level below that of the equipment being cooled. As long as the process remains closed, overflow will not occur when adding cooling fluid to the chiller reservoir.

Oxygen Depletion Risk

In the event of a refrigerant leak, refrigerant gas may displace oxygen that could result in suffocation and death. Never place the chiller in a room that is smaller than the minimum room volume requirement as defined below. If the room is ventilated, the air distribution system must be analyzed to determine the worst case distribution of leaked refrigerant. A leak detector alarm device is always required in a ventilated room that does not meet the minimum room volume given below. Assure adequate and sufficient room volume and ventilation before placing a chiller that contains refrigerant in a room. Contact Polyscience at 800-229-7569 if you have any concerns or questions.

Pounds of refrigerant charge can be read directly from the nameplate on your chiller. Remember to include in your calculation any refrigerant that may be stored in any other containers.

Minimum Room Volume = Pounds of refrigerant x 110 cubic feet

Example: Two chillers are placed in a room, each containing 6 pounds of refrigerant. The minimum room volume shall be 12 x 110 cubic feet, or 1,320 cubic feet.

Clearance

Adequate clearance should be allowed on the front, sides, and rear of the chiller for access to connections and components. The cabinet of the chiller is designed to vent air. Maintain free space, equal to the height of the chiller, for flow of air on the condenser side of the chiller (opposite to where the coolant lines connect). The two sides or the top must have an equal amount of free space. When air flow becomes impeded, cooling capacity decreases and electrical efficiency drops as motor load increases.

Electrical Power

An IEC power cord is provided with the Chiller. It should be attached to the receptacle on the rear of the enclosure. Make sure that the power outlet used for the Chiller is properly grounded and matches the voltage and frequency indicated on the identification label on the back of the Chiller.

For 208-230V/60 Hz Polyscience chillers with less than 1.5 horsepower, the supplied power cord will be for connection to a NEMA 6-20 (North America) receptacle, in accordance with local electrical codes. A Euro cord will be supplied with 50Hz models.

The use of an extension cord is not recommended. However, if one is necessary, it must be properly grounded and capable of handling the total wattage of the unit. The extension cord must not cause more than a 10% drop in voltage to the Chiller.

CAUTION. The chiller has been set 208-230 Volts at the factory for 60-Hertz single phase or 200 volts for 50-Hertz single phase. High voltages out of the specified range could damage the chiller.

WARNING. DO NOT plug the Chiller into the electrical outlet until the unit is ready for Startup.

Chiller Cleaning Procedures

Please follow the proper procedures to clean the chiller before it is connected to the laser head. Refer to section “Clean and Maintain Chiller” in *Chapter 5: Maintenance* of the Laser User Manual for details. Chiller maintenance procedures are also available through the NG CEO Knowledge Center.

WARNING. Make sure that the chiller will not contaminate the laser head.

Connecting the Chiller

Coolant Hoses and Filter Connections

The required coolant hoses, filters, and fittings are included in the plumbing kit that was shipped with your laser. They should be connected as illustrated in Figure 2-3. The correct coolant flow path starts with the supply port of the chiller ▸ filter ▸ coolant in port of laser head ▸ laser head ▸ coolant out port of laser head ▸ return port of the chiller. Please be aware of the flow direction of the filter.

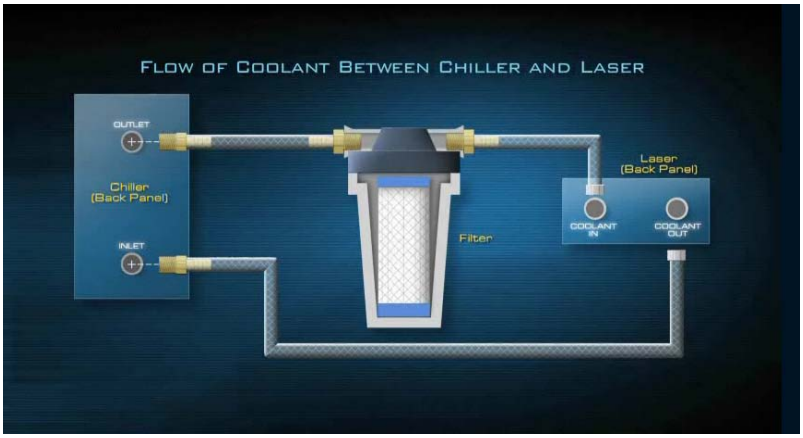


Figure 2-2 Filter Hoses and Coolant Connections

The filter may be attached to the back of the chiller, customer's equipment or a wall using the provided L-bracket.

NOTE: Threaded hose barbs and adapters should have threads wrapped 3-4 times with Teflon tape.

Figure 2-3 depicts the chiller with connected coolant hoses.

Figure 2-3 Chiller Assembled with Coolant Hoses and Filter

Connections on Laser Head

Figure 2-4 depicts the connectors on the rear panel of the Patara-IR TEM_{00} laser. All of the connectors are clearly labeled.

Figure 2-4 Connectors on the rear panel of the Patara-IR TEM_{00} laser

1. **Plumbing Connection**: Push the barb fittings of coolant hose connectors gently into the **COOLANT IN** and **COOLANT OUT** ports by following the flow patch direction. Wetting the o-rings of the quick disconnect fittings and receptacles can prevent the o-ring from being cut by the mating piece during insertion. Make sure that the quick disconnect fittings are locked. A click is heard once it is locked.

Figure 2-5 Plumbing Connection

2. **Signal Connection**: Align the female connector of the laser signal cable to the **J1** connector on the laser head. Once it is aligned, the connector can be pushed in. Turn the locking ring of the connector in the clockwise direction until it is locked.

Figure 2-6 Signal Connection

3. **Diode Power Connection**: Connect the female connector of the diode power cable to the **J2** connector on the laser head.

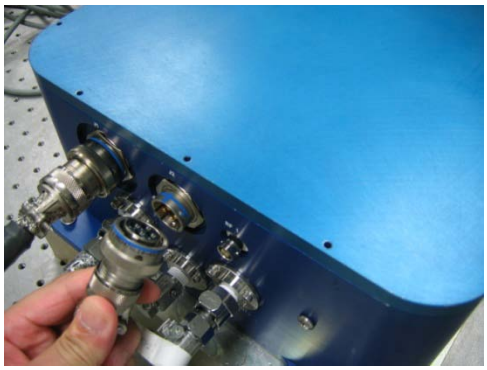


Figure 2-7 Diode Power Connection

4. **RF Connection**: Connect the Q-switch RF cables to the BNC connectors on the laser head accordingly. The connector should be locked as well by turning it clockwise until it stops.

Figure 2-8 RF Connection

Connections on eDrive

1. **Laser Signal Connection**: Connect the male connector of laser signal cable to the receptacle labeled **LASER INTERFACE** on the back of eDrive.

Figure 2-9 Laser Signal Cable

2. **Diode Power Connection:** Connect the male connector of the diodes power cable to the receptacle labeled **ARRAY POWER** on the back of the eDrive

Figure 2-10 Diode Power Cable

3. **RF Signal Connection**: Connect the QS RF cables to the **RF OUT 1** connectors as shown below.

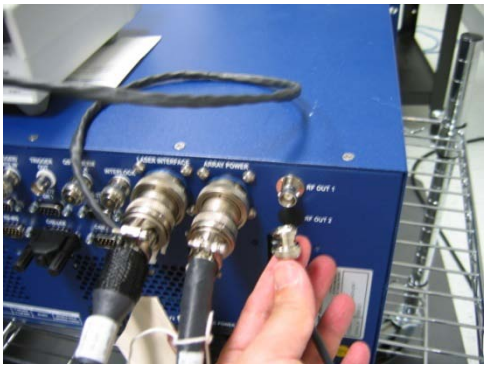


Figure 2-11 RF Signal Cables

4. **Chiller Interlock Connection**: Connect the 9 pin chiller interlock shorting connector as shown below.

Figure 2-12 Chiller Interlock Connector

5. **White Interlock Connection**: Connect the 2 pin white interlock shorting connector as shown below.

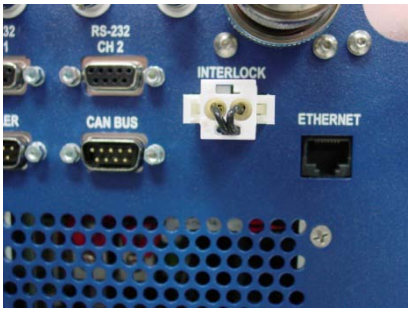


Figure 2-13 White Interlock Connectors

6. **Interlock Shorting BNC Connection**: Connect the 3 BNC shorting connectors to **TRIGGER/GATE IN**, **QSW THERM INTLK**, and **INTERLOCK** as shown below.

Figure 2-14 BNC Interlock Connection

3

Chapter 3: Laser Operation and Tuning

This chapter describes the initial operation and tuning of your Laser system. This chapter discusses:

- First Time Chiller Turn on Procedure
- First Time Laser Turn on Procedure
- Laser Performance Optimization
- Daily Operation

First-time chiller turn-on procedure

The first-time turn-on procedure should be similar for use with other chillers.

Filling the Reservoir

1. Remove the filler cap from the reservoir
2. Using a funnel, add Optishield Plus mixture (90% distilled water, 10% Optishield Plus) until it reaches the MAX line on the reservoir's fluid level gauge. If Optishield Plus is not allowed due to local regulations, use Optishield.
3. When full, remove the funnel, but do not replace the cap at this time.

Electrical Power

4. Plug the Chiller's power cord into an appropriate electrical outlet. Place the **Circuit Breaker/Power Switch** on the rear of the instrument enclosure to the **On** position.
5. Three decimal points will appear on the Temperature display

Starting Process Fluid Flow

6. Press the **Power** Button on the front panel. The system startup sequence will begin and proceed as follows:
7. The pump will turn on and fluid will begin circulating through the system. The set point temperature will appear briefly on the Temperature display; after a few seconds, it will be replaced by the actual fluid temperature.

Check for leaks

8. Once the pump is turned on, check all of the connectors to see if there is any leakage. If a leak is observed, turn off the pump immediately and fix the leak.
9. The reservoir's fluid level will drop as the process and/or process cooling lines fill with fluid. Slowly add fluid to the reservoir until the liquid level remains stable.
10. Replace the reservoir cap

First time laser turn-on procedure

1. Ensure the cap that protects laser output window is removed and make sure the output window is clean.

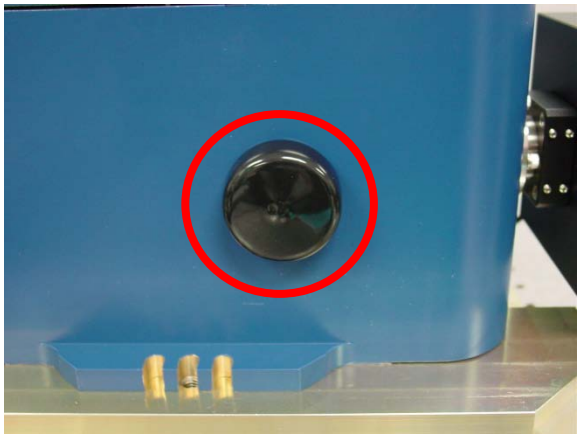


Figure 3-1 Output Window Cover

2. Turn on the chiller.
3. Check the temperature setting of the chiller. Refer to the ATP test report data summary included in your Patara-IR TEM_{00} laser shipment for the coolant operational temperature. The chiller's temperature setting should be the same as in the report. If it is set to a different temperature, change it to match the setting on the report.
4. The flow rate for Patara-IR TEM_{00} laser is 1.5 GPM. Ensure the flow rate meets the requirement. If it does not, open the valve inside the chiller until it matches the flow rate recorded in the ATP test report data summary. When adjusting and setting the flow rate, do not allow the coolant pressure to exceed 70 psi.

NOTE. Chiller flow rate calibration may be required. Please refer to the chiller user manual for instructions on calibration.

5. Run the chiller for approximately ½ hour to allow the coolant temperature to stabilize at the set point.

Turn on and check the settings of the eDrive

1. Flip the power switch on the back panel of the eDrive to the **ON** or **I** position.
2. Make sure that the red **EMERGENCY** button is released. Turn on the eDrive by turning the key to **ON** position and pressing the **POWER** button to power up the eDrive.
3. Check all the laser parameters in the eDrive. The menu designations will help locate the settings. Use the following values for the Patara-IR TEM_{00} laser

Table 3-1 eDrive Settings

Menu 1	Menu 2	Menu 3	Parameter	Setting or Value
Channel Setup			Internal Trigger	Enabled
Channel Setup	**Q-Switch**		Q Switch (QS)	Enabled
			Set Frequency	refer to ATP test report
			Set Window Width	5 µs
			Set Q-Switch Power	100%
Channel Setup	**Q-Switch**	**Set FPS Settings**	FPS	Enabled
			FPS Mode	Standard
			FPS Delay	refer to ATP test report
			Start Power	refer to ATP test report
			FPS Widow Length	refer to ATP test report
			FPS Modulation Type	refer to ATP test report
			PPK Open Offset	0
			PPK Closed Offset	0

Menu 1	Menu 2	Menu 3	Parameter	Setting or Value
Channel Setup	**Channel 1**		Channel 1	Enabled
			Set Current	refer to ATP test report
			Set Standby Current	refer to ATP test report
			Set Slew Rate	refer to ATP test report
			Slew Control	Enabled
			Set Current Limit	refer to ATP test report
Channel Setup	**Channel 1**	**Fault Setup**	Set Voltage Dropout	20 V
			Set Current Tolerance	Enabled
			Set Current Tolerance	4 A
Interface Setup	**Set Trig Out Mode**		Trig out mode	QSW Active High
Interface Setup	**Shutter Setup**		Shutter FPS	Enabled
			Shutter Speed	14 ms
			Closed to Standby	Enabled
Interface Setup	**Marking Mode Setup**		LM Active	Low
			Gate Active	High
			FPS Active	High
Utility Functions			Manual Lockout	Disabled

4. Verify that there are no objects in the laser beam path except for the negative lens and power meter.

WARNING. Wear proper laser safety eyewear to protect your eyes.

5. Once all the parameters are set correctly, and temperature of the chiller is stabilized, set the current to 10A and press the **EMISSION** button.
6. Press the **SHUTTER** button to open the laser shutter. Gradually increase the current up to slightly above the threshold. Move the negative lens and power meter so that the beam is going through the center of the lens and hitting the center of the power meter.
7. Gradually increase the current set point to the operating current specified in the ATP test report. Don't touch any part of the laser and wait for the laser to stabilize for 1 hour (usually the laser takes around 20 minutes to reach 95% of the maximum power). Then check if the power is close to the result on the test report.

Often the laser needs optimization for the first installation due to the slight differences of environments, chiller settings, and transportation vibration.

Laser Performance Optimization

At this time, there should be green light coming out of the laser. If not, contact NG CEO technical service for assistance. To reach the best performance, the laser may need slight adjustments to optimize the alignment.

1. Wait for the laser reach thermal stabilization.

Both the laser bench temperature and environmental temperature significantly impact the laser power. Wait for the laser to be thermally stabilized before attempting any adjustment.

2. Check the settings of the eDrive and chiller.

Check the performance with all items set to the values on the laser ATP test report data summary. Verify that all of the eDrive settings are correct.

The coolant flow rate and temperature have a significant impact on the laser performance. Make sure that the flow rate is approximately 1.5 GPM and the temperature of the chiller matches results from the original test report.

3. Peak the laser power by adjustment of chiller temperature.

The laser diode wavelength will slowly drift as the laser diodes age. In order to match the diode wavelength to the absorption wavelength of Nd:YAG crystal, the chiller temperature has to be adjusted. Chiller temperature adjustment should be stopped when the temperature may cause the condensation inside the laser.

4. Peak the laser power by increasing the current.

Figure 3-2 illustrates an example of the dependence of the output power of the Patara-IR TEM_{00} laser to operating current. Notice that the laser power increases as the operating current is increased. The laser had maximum power around 24.5 A. The laser had slope efficiency of 4 W/A around the operating current. The power will change ~.4W by changing the current 0.1 A increments. The laser diodes have an aging rate less than 2% over 1,000 hours which means the laser would be considered normal if the power is maintained over 250 hours by increasing the operating current 0.1A.

The laser has an unstable zone, where the laser doesn't have stable output power due the cavity design and variable YAG thermal lensing. Therefore, it is suggested to use Q-switch power or use an external power attenuator to have desirable stable output power.

The slight difference between the actual operating current and the ATP test report value may be due to the performance difference of the chillers. An increase in the operating

current or a change in chiller temperature can compensate for the aging of the Patara-IR TEM_{00}'s laser diodes. In order to protect the laser, the current limit of the eDrive is set at the maximum operating current. The limits need to be increased as the laser diodes age.

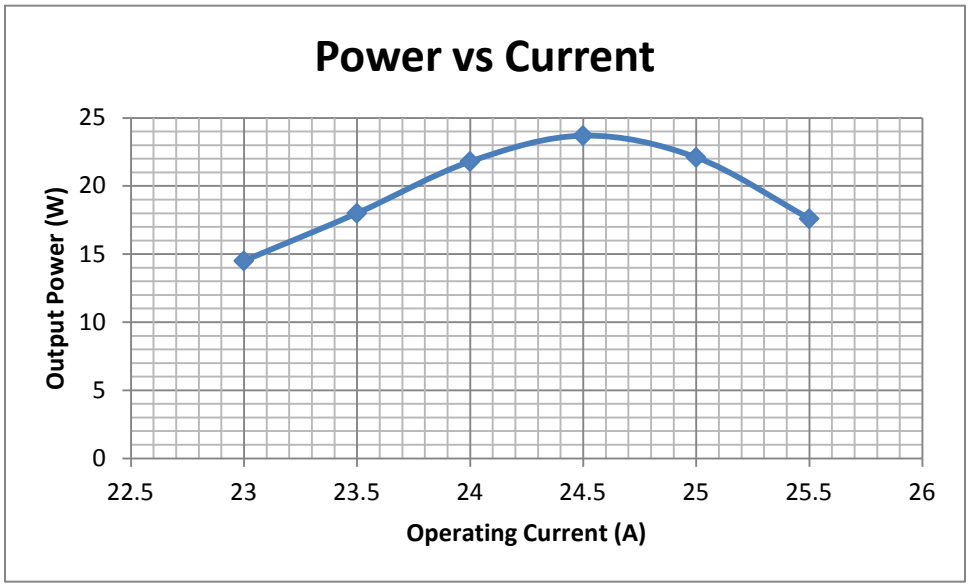


Figure 3-2 Example of Laser Performance Dependence on the Operating Current

5. Peak up the laser with adjustment of the cavity mirrors.

WARNING. Making mirror adjustments can be non-reversible. Do this step only when all the steps above have been completed and the laser does not meet the specifications with the correct settings.

a. Locate the access holes for high-reflection (HR) and Output Coupler mirrors (OC). Notice the positions of HR and OC mirrors with respect to the direction of the laser output in Figure 5-7

b. Remove screws from access holes only in a dust free environment.

c. Use a 1/8 inch ball driver to make adjustments. A fine adjustment is a 1 degree or less rotation. A small adjustment is about a 2 degree rotation. A coarse adjustment is 15 degrees to 20 degrees rotation. If coarse adjustments are needed to obtain performance, reduce operating current by 1A. Return to normal operating current when making small and fine adjustments.

d. The screws for the adjustments of the vertical tilt angle and the horizontal tilt angle are illustrated in Figure 3-3.

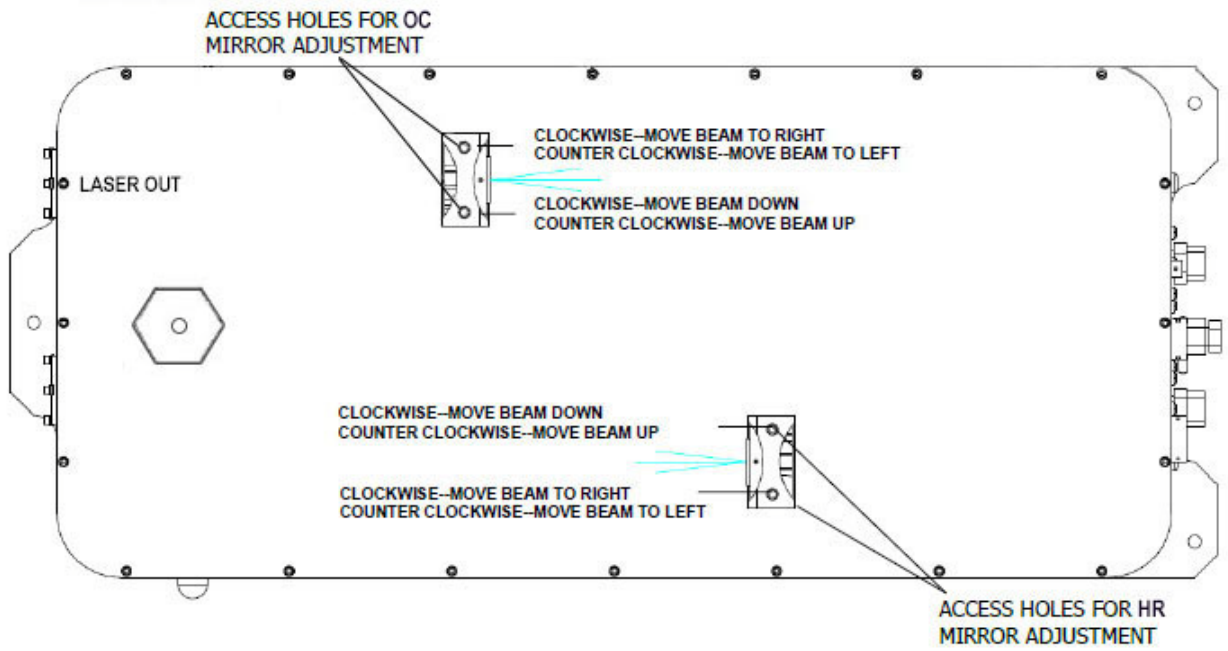


Figure 3-3 Accessible Holes for HR and OC Mirror Adjustment

e. Optimize power:

- Make small adjustments to the horizontal angle of HR mirror and observe the output power.
- Once a maximum is found, adjust the vertical control of HR mirror to maximize power.
- Make small adjustments to the horizontal angle of OC mirror and observe the output power.
- Once a maximum is found, adjust the vertical control of OC mirror to maximize power.
- Repeat the optimization steps with both the HR and OC until there is no significant performance improvement.
- If the laser is still not within 5% of the original power or not stable, repeat the eDrive current optimization, and HR / OC adjustment until there is no significant performance improvement.
- If the laser power can't be restored to the specification, or the laser is not stable, then the "walking the cavity" procedure can be tried. Walking the cavity is sometimes required to optimize the laser and involves combining mirror mount adjustments.
  - Reduce current by 1A while making coarse adjustments. Return current to normal when making fine adjustments.
  - Make a horizontal adjustment to the HR mount. Recover the laser power by making a similar adjustment to the horizontal control of the OC mount.

- Continue if improvement is noted. If there is no improvement, try the opposite direction.
- Perform the same procedure with the vertical adjustments of the HR and OC mount.
- Periodically check for hold off when making these adjustments (see *Check Hold Off* section in *Chapter 5: Maintenance* of the Laser User Manual).
- If laser power is within +/-5 percent of nominal (typical power meter accuracy), and it has good beam shape and stability, stop and replace the access screws in the cover.

Daily Operation

Output energy and repetition rate of the Patara-IR TEM_{00} laser system are adjustable over a wide range. However, operating protocols must be observed to assure operation without risking internal damage to optical components.

CAUTION. The output beam of this system is a safety hazard. Avoid viewing the beam directly.

Turn On Procedure

1. Switch the chiller to the **ON** position. Verify correct flow rate and temperature setting to value specified on laser ATP test report data summary. Wait until the chiller has achieved proper temperature, which may take 5 to 10 minutes.
2. Turn the eDrive power enable key switch to the **ON** position.
3. Press the eDrive **POWER** switch. LCD panel illuminates.
4. Press **MENU** to verify the current and Q-switch settings.

NOTE: Make sure the eDrive trigger signals are properly set if the laser uses external triggering.

5. Check and set the operational current.
6. Press **EMISSION** to fire the laser diode. The **EMISSION** and **LASER ON** indicators will begin to blink.
7. Press the **SHUTTER** button. The **EMISSION** and **LASER ON** indicators will become steady. The laser will automatically ramp the current to the set point with the preset slew rate. Wait for about 20 minutes to reach 95 percent of nominal output power.

Manual Interrupt Procedure

1. Press **SHUTTER** button on the eDrive front panel. The button will blink indicating the shutter is closed and the current is reduced to the standby current level.
2. Resume operation by pressing **SHUTTER** again. The laser will resume operation with no audible warning and the button will be illuminated.

NOTE: The laser diodes are operated at set standby current while the shutter is closed.

Interlock Interrupt

There is an interlock connector (white) at back panel of eDrive. If the continuity of the interlock is broken, the laser will stop lasing by closing the shutter and decreasing the current to standby. Once the continuity of the interlock is satisfied, the laser will ramp up the power automatically. For other interlock configurations, please contact NG CEO.

CAUTION. Never look at the laser beam even it is off because the laser beam will ramp up the power automatically.

Shut Down Procedure

1. Press **SHUTTER** button to stop lasing.
2. Gradually decrease operating current to zero.
3. Press **EMISSION** on the eDrive to cease diode emission.
4. Press and hold **POWER** on the eDrive for 5 seconds until the display turns dark.
5. Turn the eDrive power enable key switch to **OFF**.
6. Let chiller run for 1 to 2 minutes.
7. Turn off the chiller.

For detailed operating instructions, please refer the eDrive User Manual.

A

Appendix A: Customer Service

This form has been provided to encourage you to tell us about any difficulties you may have experienced while using your NG CEO instruments or user manuals. Call or write our customer service department to bring attention to problems that you may not have personally experienced. We are always interested in improving our products and manuals, and we appreciate all suggestions.

Date:
Name:
Company or Institution:
Department:
Address:

Laser Model Number:	Serial Number:
Chiller Model Number:	Serial Number:
eDrive Model Number:	Serial Number:
Laser Manufacture Date:	Total Laser Lifetime (hours):

Questions

What is the coolant flow rate (GPM)?

What is the set temperature on the chiller (^{o}C)?

What is the coolant pressure on chiller (PSI)?

What are the set current and actual current from eDrive (A)?

Is Q-switch enabled (yes/no)?

Is Q-switch triggered internally or externally?

What is the Q-switch power (percent)?

Is FPS enabled (yes/no)?

What are the FPS parameters?

What is the pulse repetition frequency (kHz)?

Is the output power measured directly from the laser (yes/no)?

What is the measured power (W)?

When did the problem happen?

Have you changed any settings recently (yes/no)?

Have you adjusted the laser to try to fix the problem (yes/no)?

What are the changes made recently to the system?

Please describe the problem or laser behavior as detailed as possible:

Suggestions

Email or fax to:

Northrop Grumman
Cutting Edge Optronics, Inc.
20 Point West Boulevard
Saint Charles, MO 63301 USA
Phone: (636) 916-4900
Fax: (636) 916-4994
Email: ngceoservice@ngc.com