

Quick Installation Guide

Patara Laser Model

- PA-100-QMG
- PA-200-QMG



Worldwide Technical Support and Product Information

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Important Information

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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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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.

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中华人民共和国，电子信息产品管理办法：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识表							
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	○	○	○	○	○	○
第二组	电线/ 连接插头	X	○	X	X	X	X
第三组	安装组件	○	○	○	X	○	○
第四组	开关组件	○	○	○	X	X	X
第五组	电路板/ 开关组件	X	○	○	○	X	X
第六组	阵列前端次模组	○	○	○	○	○	○
第七组	接触板	X	○	○	○	X	X
第八组	热交换组件	○	○	○	○	○	○
第九组	16 进制硬件	○	○	X	○	○	○
第十组	焊锡	X	○	X	○	○	○
第十一组	电线/ 连接插头	X	○	○	○	X	X
第十二组	基部/ 端帽	X	○	○	X	○	○
第十三组	硬件/ 装配	○	○	○	X	○	○
第十四组	時計组件	X	○	○	X	X	X
第十五组	包装物料	○	○	○	○	○	○
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.



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



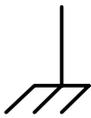
Laser Emission: Use caution.



Shock Hazard: Use caution.



Caution: Risk of danger. Refer to manual.



Chassis Ground

General Safety Summary

The Patara emits laser radiation that can permanently damage eyes and skin, ignite fires, and vaporize substances. Please read the chapters about safety in the laser user manual, eDrive manual, power supply manual, TEC driver manual and chiller manual.

Do not open the factory packaging before carefully reading this complete quick installation guide. If you have any questions on the product which have not been discussed sufficiently within this document, 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.**

Northrop Grumman Aerospace Systems Cutting Edge Optronics (NG CEO) recommends that a technician from NG CEO perform the installation of the laser for the first time. Only qualified technicians should be allowed to perform the installation and maintenance of the laser. If you do plan to install your laser, please use the following procedures.

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 fundamental, 532 nm second harmonic).
- 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 Quick Installation Guide describes the unpacking, set-up, initial operation and optimization of the Patara Laser system. The Guide 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.

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Chapter 1: Laser System Components

This introduction provides the following information:

- System Components
- Unpacking

System Components

Before installation of the laser, it is recommended that you first familiarize yourself with all of the laser components as pictured below. The components for the Patara laser PA-100-QMG and PA-200-QMG are listed in figure 1-1. The power cords for the chiller and DC power supply are not shown in the picture.



Laser head



Chiller



eDrive



DC Power Supply



AC Power Cables



Laser Signal Cable



Diode Power Cable



Q-Switch RF Cable



Hose for Chiller



Filter housing and Filter

Attenuator Controller Parts
(optional)

Power Monitor Parts (optional)

Figure 1-1 Components for the Patara laser PA-100-QMG and PA-200-QMG

Unpacking

Your NG CEO Patara 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 laser system consists of:

PA-100-QMG	PA-200-QMG
PA-100-QMG Laser Head	PA-200-QMG Laser Head
eDrive, P/N ED4C-AXA-XXXXD-0151	eDrive, P/N ED4C-AXA-XXXXD-0151
DC Power supply, P/N DCS60-50E (200-250 VAC Single Phase, 190-250 VAC Three Phase)	DC Power supply, P/N DLM80-50E (180-264 VAC Three Phase)
	DC Power supply, P/N DLM80-50EM1 (345-445 VAC Three Phase)
	DC Power supply, P/N DLM80-50EM2 (432-528 VAC Three Phase)
60 Hz Chiller P/N 6762T41CE30D	60 Hz Chiller P/N 6162T41CE30D
50 Hz Chiller P/N 6152T41CE30E	50 Hz Chiller P/N 6852T66CE70E
Laser Signal Cable	Laser Signal Cable
RF Cables	RF Cables
Hoses and Filter for Chiller	Hoses and Filter for Chiller
US Power Cords for Chiller and Power Supply	US Power Cords for Chiller and Power Supply
US Power Cord for eDrive	US Power Cord for eDrive
Desiccant Cartridge	Desiccant Cartridge
(2) Desiccant Refills	(2) Desiccant Refills
Power Detector Head (Optional)	Power Detector Head (Optional)
Attenuator (Optional)	Attenuator (Optional)

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

Chapter 2: Laser System Setup

Sections included in this chapter provide the following information:

- Laser Head Setup
- eDrive Setup
- DC Power Supply Setup
- Chiller Setup
- Cable Connections

Laser head setup

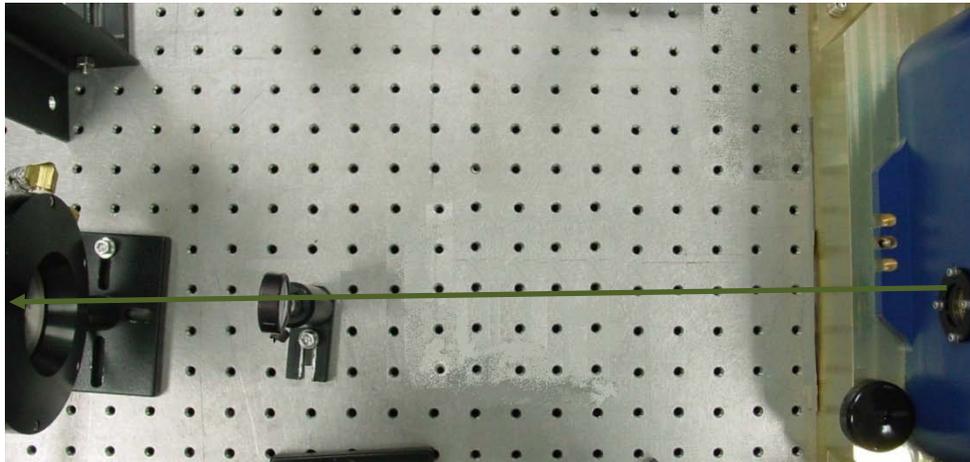


Figure 2-1 Basic setup for the laser power test.

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, place a power meter with the power handling capability of 250W approximately 1.5 feet away from the laser. In order to protect the power meter, a negative lens ($f=-100\text{mm}$) with anti-reflective (AR) coating at 532nm should be installed in front of the power meter as shown in figure 2-1. If a negative lens is not available, the power meter should be at least 2m away from the laser so that the beam size is larger and the power density is below the damage threshold of the power meter.

eDrive setup

Input Power

Use only power cords suitable for your driver. Use a power source that is in the range of 90 to 250 VAC-RMS, 47 to 63 Hz. Power switching is done automatically; there are no configuration switches to set for high or low voltage ranging. Observe recommended fuse selection for each voltage range.

Table 2-1 Input Power Fuse

AC Input		Frequency	Fuse Ratings (F1, F2)
120V $\pm 10\%$	15A	50/60 Hz	T 15A 250V
240V $\pm 10\%$	8A	50/60 Hz	T 8A 250V

Fuse Dimensions: 0.25 x 1.25 inches

Mounting

There are four holes on the front panel of the eDrive designed for the mounting 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.

DC power supply setup

Location, Mounting and Ventilation

The power supply may be used in rack mounted or in bench top applications. In either case, you must allow at least 1U (1.75") clearance for cooling air to reach the ventilation inlets on the top of each unit. You must also allow sufficient space for unobstructed airflow on each side and rear of all units so that the operating ambient temperature is within specification. See Power Supply manual for additional information.



CAUTION. Obstructing the air inlets and/or exhaust may cause fire and irreversible damage to the unit.

Unit Dimensions

The dimension of the DC power supply for the PA-100-QMG is 3.5 in x19 in x18 in (88 mm x482 mm x508 mm). The weight is 35 lbs (16 kg).

The dimension of the DC power supply for the PA-200-QMG is 3.5 in x19 in x18 in (88 mm x482 mm x508 mm). The weight is 40 lbs (18.2 kg).

Rack Mounting

The supply is designed to fit in a standard 19" equipment rack. Bolt holes in the chassis sides are provided for rack mount slides such as the ZERO #C300S18 slides. When installing the unit in a rack, be sure to provide adequate support for the rear of the unit

while not obstructing the ventilation on the top, sides and rear of all units. See Power Supply manual for additional information.



CAUTION. Rack mounting bolts must not extend more than 3/16" into the side of the power supply.

AC INPUT POWER Requirements

The AC Input Power Connection section of the power supply manual gives instructions for making connections to three phase AC power sources. Before you can use the power supply, you must determine your AC input power requirements and assemble an appropriate line cord and connector. The power supply is shipped with a kit of connector and strain relief parts which you assemble using the procedures in the section.

The specifications for input voltage, current, and frequency are listed below. The DCS60-50E can be wired in either configuration shown in Table 2-1. The DLM80-50E must be purchased with the correct input voltage option.

Table 2-2 DC Power Supply for PA-100-GMQ, DCS60-50E

Output Power	Input Range (47–63 Hz)	Input Current Maximum
3 kW	200–250 VAC Single-Phase	20A RMS
3 kW	190–250 VAC Three-Phase	14A RMS

Table 2-3 DC Power Supply for PA-200-GMQ, DLM80-50E

Output Power	Nominal Input Voltage	Input Option	Input Range (47–63 Hz)	Input Current Maximum	AC Input Terminals
4 kW	208 VAC Three-Phase	Std	180–264 VAC L-L	15A RMS	L1–L2–L3 (F1–F2–F3)
4 kW	380/400/415 VAC Three-Phase	M1	345–455 VAC L-L	8.5A RMS	L1–L2–L3 (F1–F2–F3)
4 kW	480 VAC Three-Phase	M2	432–528 VAC L-L	6.5A RMS	L1–L2–L3 (F1–F2–F3)

Chiller setup

Ambient Temperature and Relative Humidity

The Chiller is designed for indoor installation in ambient temperatures between 7° and 30°C (45° and 85°F; relative humidity should not exceed 80% (non-condensing).

Location

Select a level location, near the application, free from dripping or spraying moisture and excessive dust. Keeping coolant lines short allows the pump to provide maximum pressure and flow to the application. If the chiller will be placed more than 25 feet from the application, call PolyScience service to discuss placement and how it might affect performance.

Units with non-pressurized reservoirs should never be installed more than 25 feet below the process or overflow may occur. Distances may vary slightly due to elevations above sea level. Call 800-229-7569 for more information.

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

Connect the chiller, in compliance with the National Electric Code (NEMA 6-30R) for American usage and IEC 127 for European usage as well as local codes, to a fused disconnect box. Maximum fuse sizes in the disconnect box must not exceed the maximum ratings specified on the serial tag of the chiller (found on the electrical box). The voltage, phase, and frequency of the power source must also match the requirements specified on the serial tag.



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 Connections

The required water hoses, filters, and fittings are included in the plumbing kit that was shipped with your laser. They should be connected as illustrated in the figures below. The correct water 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 Diagram of Water Hoses and Filter Connections

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

Connect power to the chiller.



Figure 2-3 Power connection on the Chiller

Cables connections

Connections on the laser head



Figure 2-4 Connectors on the back panel of the Patara laser (Model Pa-100-QMG and PA-200-QMG).

Figure 2-4 shows all of the connectors on the back panel of the Patara laser. All of the connectors are clearly labeled. The steps for the installation follow.

1. **Plumbing Connection:** Push the barb fittings of water hoses 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 Laser Head Coolant Lines

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 Laser Head Signal Connection

3. **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 2-7 Laser Head RF Connection

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



Figure 2-8 Laser Head Power Connection

- Power Detector Head:** Follow the steps below to attach the Power Detector Head (Figure 2-9 and 2-10) onto the side of the laser.



Figure 2-9 Power Detector Components

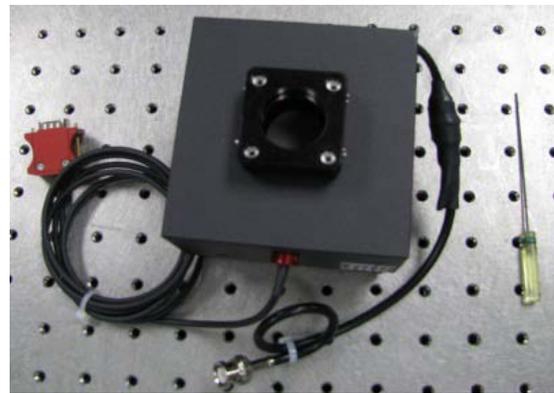
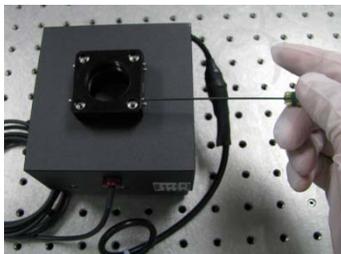


Figure 2-10 Power Detector Head



1. Loosen Screws



2. Remove Connector



3. Remove Cap



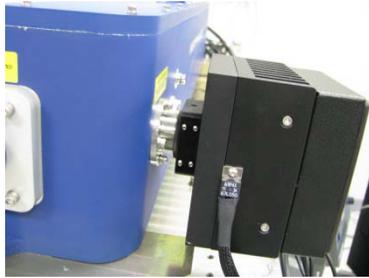
4. Install Connector



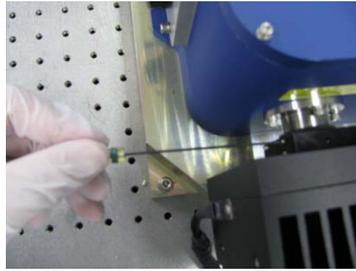
5. Tighten Connector



6. Align Pins



7. Install Detector



8. Tighten Detector Head



9. Connect DC power Cable to Detector Head



10. Connect BNC to Laser Head



11. Connect 9 Pin Connector



12. Connect USB



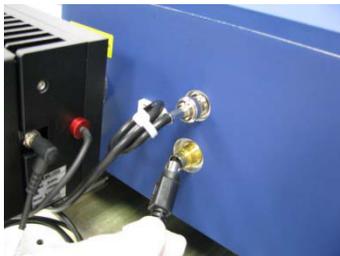
Figure 2-11 Completed Assembly

With installation of the software provided with the kit, and a USB connection to a PC, the power can be read on the computer. Please refer to the Power Detector Head manual on the provided USB thumb drive for details.

6. **Attenuator Controller:** Follow the steps below to attach the attenuator (Figure 2-12)



Figure 2-12 Attenuator Components



1. **Connect to Laser**



2. **Connect to Controller**



3. **Connected Controller**



4. **Connect USB**



5. **Connected USB**



6. **Connect to Power Source**



7. **Connected to Power Source**



8. **Power Monitor and Attenuator Layout**

The controller can be powered by the DC power adapter or a computer. Press the arrow buttons corresponding to the active channel; the output power will be changed. The remaining power is redirected to the fan cooled power meter on the side of the laser. The

maximum power allowed for the side-mounted fan cooled power meter is 200W. If the temperature of the power meter exceeds 60 degree C, the laser will be shut off to protect power meter. Please read the attenuator manual on the provided CD for detailed setup.

Connections on the 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 2-13 Laser Signal Cable

2. **RF Signal Connection:** Connect the QS RF cables to the **RF OUT 1** and **RF OUT 2** connectors as shown below.



Figure 2-14 RF Signal Cables

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



Figure 2-15 Chiller Interlock Connector

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



Figure 2-16 White Interlock Connectors

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



Figure 2-17 BNC Interlock Connection

6. The cables from DC power supply go to the terminals labeled with **INPUT POWER** while the Diode Power cable from the laser head is connected to the terminals of **ARRAY OUTPUT**. Please be careful with the polarity of the terminals.



Figure 2-18 Input Power and Array Output Power

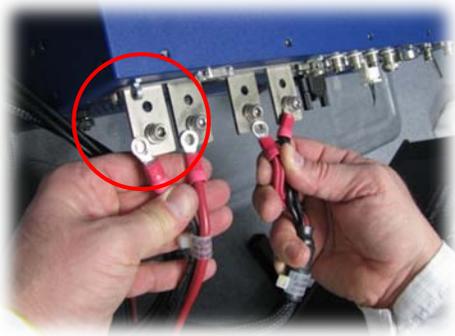


Figure 2-19 Input Power from Power Supply

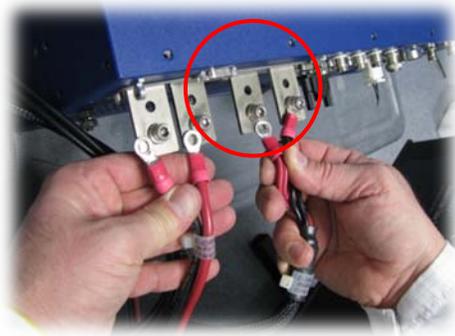


Figure 2-20 Array Output to Laser

7. **Protection Cover:** Once all the power cables are connected, the protection cover has to be installed as shown below.



Figure 2-21 Protection Cover

Connections on the Power Supply

1. **Power to eDrive Connection:** Connect the positive (red) and negative (black) cables from the eDrive to the power supply as shown below. Prior to making the connection, place heat shrink over the cable and slide it down the cable.



Figure 2-22 Positive and negative connections

2. **Heat shrink:** Slide the heat shrink pieces over the connections.

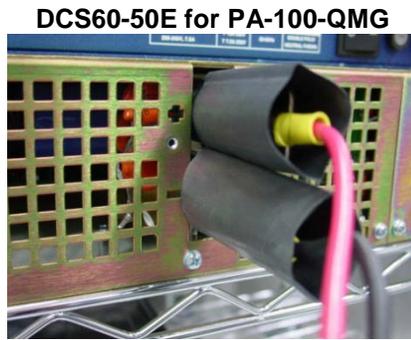


Figure 2-23 Heat shrink over connections

3. **Incoming Power:** With the power cable disconnected from the wall, attach the 4 wires from the power cable as shown below. Refer to the DC Power Supply manual for details.



Figure 2-24 Incoming power connections

Chapter 3: Laser Operation and Tuning

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

- Initial Turn on
- Internal Trigger
- External Q-switch Trigger
- Laser Performance Optimization
- Laser Turn off

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.
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. There is a test report attached for each Patara laser. The operational temperature of coolant is written on the report. The temperature setting of the chiller 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 minimum flow rate for the Patara laser is 2 GPM. Check the flow rate to make sure it meets the requirement. If it does not, open the valve inside the chiller until it matches the flow rate recorded in the test report.
5. Run the chiller for a period of time (approximately ½ hour) and wait for the chiller to stabilize at the set temperature.

DC power supply

After installing the power supply and connecting the load as described in *Chapter 2: Laser System Setup*, the required output voltage and current limit have to be set according to the following front panel procedure:

1. Turn both the voltage and current controls fully counter-clockwise.
2. Turn the AC power **ON**.
3. Press the **STANDBY** switch to its **IN** position to disable the power supply output.
4. Press and hold the **V & I CHECK** button to display the voltage and current control settings on the voltmeter and ammeter displays.
5. Adjust the voltage control to the required voltage (the compliance voltage for applications using current mode operation). The required voltage is shown on the data sheet.
6. Adjust the current control to the required current limit setting. The current limit is shown on the data sheet.
7. Release the **V & I CHECK** button.
8. Press the **STANDBY** switch to its **OUT** position to apply power to the load.

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 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 test report	
			Set Window Width	5 μ s	
			Set Q-Switch Power	100%	
Channel Setup	Q-Switch	Set FPS Settings		FPS	Enabled
			FPS Mode	Standard	
			FPS Delay	refer to test report	
			Start Power	refer to test report	
			FPS Widow Length	refer to test report	
			FPS Modulation Type	refer to test report	
			PPK Open Offset	0	
			PPK Closed Offset	0	
Channel Setup	Channel 1		Channel 1	Enabled	
			Set Current	refer to test report	
			Set Standby Current	refer to test report	
			Set Slew Rate	refer to test report	
			Slew Control	Enabled	
			Set Current Limit	refer to test report	
Channel Setup	Channel 1	Fault Setup		Set Voltage Dropout	20 V
			Set Current Tolerance	Enabled	
			Set Current Tolerance	4 A	

Menu 1	Menu 2	Menu 3	Parameter	Setting or Value
Comm Setup	Channel 0 Setup	Set Function	Function	Oven TEC
Channel Setup	Comm 0		Set Temp	See Test Report
			Set Tolerance Range	+1.5C
			Set output voltage	refer to test report
			Set Min Temp	+22.0C
			Set Max Temp	+45.0C
			Set P Const.	refer to test report
			Set I Const	refer to test report
			Set D Const	refer to test report
			Set Control Function	H-BRIDGE
			Set Heat Mult.	1.000
			Set Cool Mult	1.000
			Sensor Type	TS67
			Sensor Offset	0
	TEC Enabled (Note: must be done last)	Enabled		
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
Utility Functions	Humidity Options		Measured Current Humidity	(reads out measured humidity)
			Adjust Humidity Threshold	refer to test report

- 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.

- Once all the parameters are set correctly, and temperature of the chiller is stabilized, set the current to 10A and press the **EMISSION** button.
- 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. Set current to achieve 30W. The current required for 30W is shown on the laser test report

7. Once the laser has reached output power around 30W, and the TEC and chiller temperatures have stabilized, gradually increase the current set point to the operating current specified in the 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 to 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

During installation, it is advised that the performance of the laser be checked according to the factory's default settings. Check that all of the eDrive settings are correct.

The water flow rate and coolant temperature have a significant impact on the laser performance. Make sure that the flow rate is above 2.0 GPM and the temperature of the chiller is correct according to the test report.

3. Peak up the laser power by adjusting the temperature of the TEC controller

The phase matching of the second harmonic generation (SHG) crystal is crucial for the Patara laser. The phase matching is controlled by setting the proper temperature on the SHG crystal. The temperature is controlled by the software of the eDrive.

Figure 3-2 shows an example of the dependence of laser power on the temperature of SHG crystal. As shown in the example, the midpoint of the temperature band is around 34.2 °C.

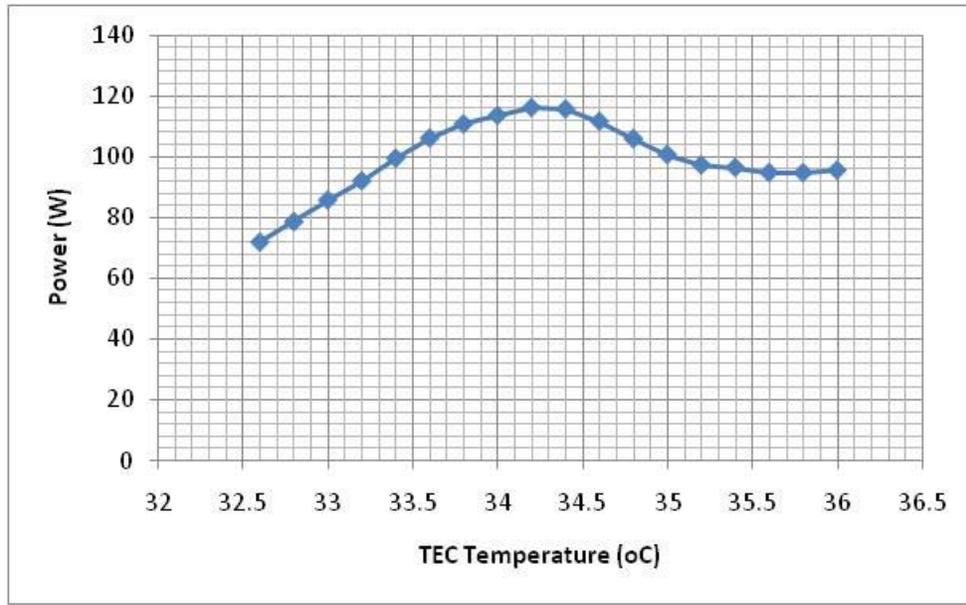


Figure 3-2. Example of Power Dependence of the PA-100-QMG to SHG Crystal Temperature

4. Peak the laser power by adjusting the current and chiller temperature

An increase in operating current can also compensate for the aging of the laser diodes inside the Patara laser. Adjust the current in steps of 0.1A around the operating current. The 2 sigma degradation rate of the laser diodes is 2% per thousand hours of operation. A good guideline for the laser is a 0.6A increase in current per one thousand operation hours.

The slight difference between the actual operating current and the test report value may be due to the performance difference of the chillers. This can be done by performing a chiller temperature optimization. As the laser diodes age, the chiller set temperature may be shifted. It is recommended to optimize the chiller temperature every two thousand hours.

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 harmonic mirrors (HM). Notice the positions of HR and HM mirrors with respect to the direction of the laser output in Figure 3-3
- 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 2 A. 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
- e. Always make sure that the TEC temperature is stabilized.

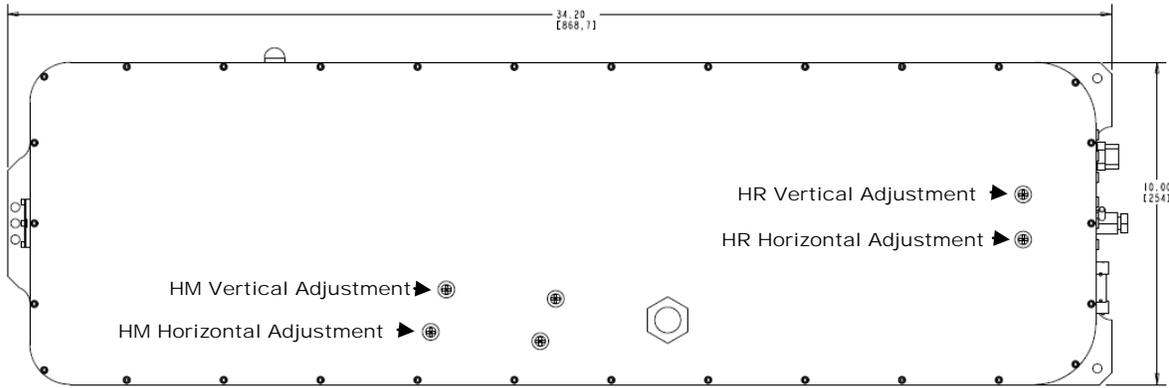


Figure 3-3. Accessible Holes for HR and HM Cavity Mirror Adjustment

f. Optimize Power:

- Make small adjustments to the horizontal angle of HM mirror and observe the output power.
- Once a maximum is found, adjust the vertical control of HM mirror to maximize 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.
- Repeat the optimization steps with both the HR and HM until there is no significant performance improvement.
- If the laser is still not within 5% of the original power or not stable, repeat the steps of TEC optimization, eDrive current optimization, and HM, HR 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 and SHG crystal temperature adjustments.
 - Reduce current by 2 A while making coarse adjustments. Return current to normal when making fine adjustments.
 - Make a horizontal adjustment to the HM mount. Recover the laser power by making a similar adjustment to the horizontal control of the HR mount. Check and adjust the temperature of SHG crystal.

- Continue if improvement is noted. If there is no improvement, try the opposite direction.
- Perform the same procedure with the vertical adjustments of the HM and HR mount.
- Typically, SHG temperature adjustment is not needed when adjusting vertically. Periodically check for hold off when making these adjustments (see Check Hold Off section in Chapter 5: Maintenance of the 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.

Laser Operation Considerations

For the high power Nd:YAG laser with intra-cavity doubling, there is a significant thermal response or relaxation time for the laser crystal as well as the doubling crystal. Any large, transient pump current change has an impact on the energy storage in the laser crystal as well as thermal properties on both crystals. The extra stored energy can cause a giant Q-switch pulse that can be suppressed by the FPS feature of our eDrive. However, both laser crystal and SHG crystal need longer time to reach thermal equilibrium. This time lag can cause damage to the mirrors or the SHG crystal. To combat this problem, the ramp rate of the pump current is controlled by the eDrive, once the shutter is opened. If the application needs to stop lasing more than several seconds, it is advised that the laser beam should be directed to the place other than on the work piece or an external shutter is needed to dump the laser beam.

For the standalone laser system, the eDrive controls the ramp rate of the pump current. Therefore, one can set the laser to the operational current.

Every laser application needs a particular laser power for the best results. In some cases, the output power has to be changed at different stages even in the same laser process. Typically, the output power of a laser can be varied by changing the pump current. However, the active laser crystals can exhibit strong thermal lensing, which is related to the pump current. Variation of the pump current results in the change of the thermal lensing. Therefore, the position of the focal point moves as the pump current is varied. This is not desirable for the most of laser applications especially laser micro-machining.

The output power of Patara laser can be changed either by changing the pump current or by changing the Q-switch Power. This unique, patented technology allows users to adjust the laser output power continuously without changing the pump current. The focal point is kept at the same position regardless the power level. This feature is very useful for precision micro-machining when different power levels are required for the process. For applications that require power variation from 0%-100%, it is recommended to use an external power attenuator, for example the use of a half wave plate and a polarizer.

The optional external power attenuation has some advantages such as controlling output power from a few percent to full power while the pulse width, pulse stability and beam characteristic are kept the same. The side power meter works as beam dump as well as laser power monitor.

Please refer to the eDrive manual for setting the Q-switch power.

Daily Operation



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 test report. Wait until chiller has achieved proper temperature, which may take 5 to 10 minutes.
2. Turn the TEC controller (if not included in eDrive Nitro) and wait for the temperature to stabilize.
3. Turn on AC power of the DC power supply and check the voltage and current limit
4. Turn the eDrive power enable key switch to **ON** position.
5. Press the eDrive **POWER** switch. LCD panel illuminates.
6. Press **MENU** to verify the current and Q-switch settings.
7. Press **EMISSION** to fire the laser diode.
8. Press **SHUTTER** to begin laser output.

Wait for about 20 minutes to reach 95 percent of nominal output power.

Manual Interrupt Procedure

1. Press **SHUTTER** key on eDrive front panel.
2. Resume operation by pressing **SHUTTER** again. Laser will resume operation with no audible warning.



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

Shut Down Procedure

1. Press **SHUTTER** key to stop lasing.
2. Press **EMISSION** on the eDrive. The laser diodes cease emission.
3. Press **POWER** on the eDrive and hold for 5 seconds until display turns dark.
4. Turn the eDrive power enable key switch to **OFF**.
5. Turn off AC power of DC power supply
6. Let chiller run for 1 to 2 minutes.
7. Turn off TEC controller (if not included in eDrive Nitro).
8. Turn off chiller.

Please refer to the separate eDrive User Manual for detailed operating instructions.

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 Northrop Grumman Cutting Edge Optronics 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 water flow rate (GPM)?

What is the set temperature on the chiller (°C)?

What is the water pressure on chiller (PSI)?

What are the temperature set and actual reading from TEC controller (°C)?

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)?
