



Single Frequency Polarization-Maintaining Fiber Laser Amplifier

Part #: PSFA-15UU-VV-XW-Y-Z



Operator's Manual



www.nufern.com
GXXXDOC — 2/27/09



**DANGER: Class IV Laser Product: Invisible Laser Radiation.
Avoid Eye or Skin Exposure to Direct or Scattered Radiation.**

Your NuAMP Fiber Laser emits invisible infrared CW Class 4 laser radiation (nominally up to ~10 W at 1550 nm). This device should not be operated unless all appropriate safety precautions are taken. These precautions must be observed whenever DC power is supplied to the laser and must be sufficient for the full range of optical parameters described below. Improper use of this device can cause personal injury, permanent eye damage, blindness, and possibly death. The laser beam could be collimated so the hazards apply at short as well as long distances from the aperture. Under no circumstances should your NuAMP laser be pointed at any person, animal, or flammable or explosive materials. Laser radiation, whether direct emissions or scattered and/or reflected light, can be harmful. This light will also generate a significant amount of heat, and care should be taken not to start a fire.

**0.85-1.2 μm (1.064 μm nominal);
1.53-1.6 μm (1.55 μm nominal) Output Wavelengths
 \leq 50 W Average Power Max.**

NOTE: This product is specifically designed to be an OEM laser device for incorporation or integration into other equipment. As such it DOES NOT MEET the full requirements for a complete laser system as defined by 21 CFR 1040.10 and 1040.11 under the Radiation Control for Health and Safety Act of 1968 and EN 60825-1. It is the responsibility of the purchaser to meet all of the regulatory requirements for the complete laser system (IEC 60825-1 Ed. 2 2007-3).



DANGER: Do not operate if the cover or any panels have been removed.

Never operate the laser if the cover or any of the panels have been removed. Doing so may expose you and/or others in the vicinity to laser radiation that can cause serious eye damage and possible vision loss.



CAUTION: NuAMP laser is NOT user serviceable.

Do not remove any of the panels or attempt to service this unit. There are electrical and optical hazards present inside the chassis. Unit should be service only by trained Nufern personnel. Opening of this case will also void the warranty.

PREFACE

Thank you for purchasing the NuAMP™ polarization-maintaining fiber laser amplifier. The NuAMP laser is a continuous-wave narrow-linewidth polarization-maintaining fiber amplifier capable of amplifying a single-frequency laser light with as narrow as ~5kHz linewidth and as low as 1 mW input power. Complete with multiple real-time health monitors and single emitter pump diodes, the system offers long lifetime and maintenance free operation along with reduced cost and complexity.

If you have questions or comments about any section of this manual, please call Nufern's Help Line:

Within the U.S. Call Toll-free:
(888) NU-HELPS
(888) 684-3577

Outside the U.S. Call:
1-860-408-5000

Symbols used in this manual



DANGER: Defines hazards, which, when not avoided, can result in death, serious injury, blindness, or product damage.



CAUTION: Conveys an equipment hazard. Failure to observe such warnings may result in significant damage or destruction of the laser. Ensure safe handling and operation before proceeding.

NOTE: A Note conveys useful information regarding the product.

Acronyms used in this manual

The following acronyms are used in this manual:

PM: Polarization maintaining
FA: Fiber Amplifier
CW: Continuous Wave
OEM: Original Equipment Manufacturer
GUI: Graphical User Interface
GND: Electrical Ground
TTL: Transistor-to-Transistor Logic

Table of Contents

1	SAFETY AND COMPLIANCE	6
1.1	Warnings	6
1.2	Safety Resources.....	8
1.3	Certifications and Compliance	9
1.4	Location of Safety and Other Labels.....	10
2	GETTING STARTED	11
2.1	Unpacking the Laser.....	11
2.1.1	What's in the Box?	12
2.1.2	Initial Inspection.....	12
2.1.3	Shipping Materials.....	12
2.2	NuAMP Laser Details	13
2.2.1	Front Panel View	13
2.2.2	Rear Panel View.....	13
2.2.3	25-Pin Interface Communications	14
2.3	NuControl Details (if option is elected)	14
2.3.1	Front Panel View	15
2.3.2	Rear Panel View.....	16
2.3.3	25-Pin Interface Communications	17
2.4	Laser Installation	17
2.4.1	Mounting the Laser	17
2.4.2	Mounting the output pigtail (if option is elected).....	17
2.4.3	Mounting the fiber-to-free-space isolator (if option is elected).....	17
2.4.4	Electrical Connections.....	18
2.5	NuControl Installation (if option is elected).....	18
2.6	Starting Up the Laser.....	19
2.6.1	Laser Start-Up Using DB25 Interface	19
2.6.2	Laser start up with the NuControl (if option is elected)	20
3	MAINTENANCE	24
4	TROUBLESHOOTING / CUSTOMER SERVICE	24
4.1	NuAMP Help Line.....	24
5	NOTICES	24
6	APPENDIX A: LASER SPECIFICATIONS	23
7	APPENDIX B: MECHANICAL DRAWINGS	24
6	APPENDIX C: WARRANTY	26

LIST OF FIGURES		
Figure	Description	Page
Figure 1	NuAMP Laser	9
Figure 2	NuControl	10
Figure 3	NuAMP Front Panel	12
Figure 4	NuAMP Rear Panel	12
Figure 5	NuControl Front Panel	14
Figure 6	NuControl Real Panel	15
Figure 7	GUI Waiting	19
Figure 8	GUI Ready	20
Figure 9	Amplifier Enabled	20
Figure 10	Fault Condition Display	21
Figure 11	NuAMP Mechanical Drawing	24
Figure 12	NuControl Mechanical Drawing	25

LIST OF TABLES		
Table	Description	Page
Table 1	Maximum Concentration Values of Restricted Substances	9
Table 2	Power Connector Pin-Out	13
Table 3	LED Status Indication	14
Table 4	Specification of the DB25 Control Connector	14
Table 5	LED State Matrix	16
Table 6	Detailed Pin-out for 8-Pin Molex Connector	17
Table 7	Power Supply Requirements	18

1. SAFETY AND COMPLIANCE

1.1 Warnings

NuAMP is a Class IV Laser Product that emits invisible laser radiation. Avoid eye or skin exposure to direct or scattered radiation. NuAMP fiber laser amplifier is a CW laser amplifier with a nominal output wavelength of 1.55 μm and average powers ranging from about 2 W to 10W.



**DANGER: Class IV Laser Product: Invisible Laser Radiation.
Avoid Eye or Skin Exposure to Direct or Scattered Radiation.**

Your NuAMP Fiber Laser emits invisible infrared CW Class 4 laser radiation (nominally up to ~10 W at 1550 nm). This device should not be operated unless all appropriate safety precautions are taken. These precautions must be observed whenever DC power is supplied to the laser and must be sufficient for the full range of optical parameters described below. Improper use of this device can cause personal injury, permanent eye damage, blindness, and possibly death. The laser beam could be collimated so the hazards apply at short as well as long distances from the aperture. Under no circumstances should your NuAMP laser be pointed at any person, animal, or flammable or explosive materials. Laser radiation, whether direct emissions or scattered and/or reflected light, can be harmful. This light will also generate a significant amount of heat, and care should be taken not to start a fire.

**0.85-1.2 μm (1.064 μm nominal);
1.53-1.6 μm (1.55 μm nominal) Output Wavelengths
 \leq 50 W Average Power Max.**



DANGER: Follow all Laser Safety Procedures.

The NuAMP laser should not be supplied with external DC power unless all laser safety precautions are followed. These safety precautions include but are not limited to the following:

- Wearing appropriate safety glasses by all personnel in the vicinity of the laser who could be exposed to direct or indirect radiation within the ranges of optical parameters described above
- Installing appropriate warning signs and using safety curtains or enclosures
- Implementing safety interlocks to avoid accidental exposure laser radiation
- Taking appropriate precautions when using NuAMP with other optical instruments as they may increase eye hazard
- Containing the beam to eliminate or minimize the possibility of exposure to the beam

Use of the NuAMP laser other than as specified herein may result in hazardous radiation exposure.



DANGER: Avoid exposure to potentially hazardous materials.

Laser processing of materials can produce contamination such as vapors, fumes, and particles that can be potentially hazardous (noxious, poisonous, toxic, and even corrosive). Always review the MSDS information for any materials being processed. Make sure to provide adequate ventilation and filtration before venting any byproducts.



DANGER: Do not operate if the cover or any panels have been removed.

Never operate the laser if the cover or any of the panels have been removed. Doing so may expose you and/or others in the vicinity to laser radiation that can cause serious eye damage and possible vision loss.



DANGER: Possible Unexpected Laser Emission

A False Enable could happen on the amplifier in the following instance: when the key is switched to position -1 or -2 and the Emergency Stop button is pulled out, the amplifier could be enabled by itself and emit unexpected laser emission at the ~1W level when one tries to unplug the USB cable or plug the USB cable back into the amplifier. To avoid this occurrence and any potential threat to end users, it is highly recommended to perform the following safety precaution steps:

1. Always follow the operation procedures described in this manual.
2. Always wear protective eyewear in operating the amplifier. When the Emergency Stop button on the front panel lights up (key positions -1 or -2), please assume that laser emission could occur at any moment.
3. If there is any need to unplug or plug-in the USB cable back into the amplifier, please place and keep the Key Switch in the -0 position and push down the Emergency Stop button.
4. In the event that the USB cable gets loose and disconnected from the amplifier, please move the key switch to the -0 position and push down the Emergency Stop button immediately.
5. In the event the control computer has lost power, is shut down or is being restarted, please move the key switch to the -0 position and push down the Emergency Stop button immediately.

Please contact Nufern with any questions regarding this matter.



CAUTION: NuAMP laser is NOT user serviceable.

Do not remove any of the panels or attempt to service this unit. There are electrical and optical hazards present inside the chassis. The unit should be service only by trained Nufern personnel. Opening of this case will also void the warranty.



CAUTION: NuAMP laser is ESD sensitive.

The electronics board in the NuAMP laser has components sensitive to electrostatic discharge (ESD). Please exercise standard ESD mitigation practices while handling the laser and making electrical and interface connections to the laser.

NOTE: American National Standards Institute (ANSI) Z136.1-2000 has created a document entitled “Safe Use of Lasers” for reference. This document should be used as a standard for implementing your own laser safety program. Key points to consider include establishing a Laser Safety Officer (LSO) for your organization, and operating the laser in an area of limited access with proper warning signage and interlocks. Under no circumstances should this device be serviced by anyone other than the trained personnel at Nufern.

1.2 Safety Resources

For additional information the following safety resources are also provided:

American National Standards Institute (ANSI)

Safety Standards for Laser Users

New York, NY

Phone: (212) 642-4900

www.ansi.org

Center for Devices & Radiological Health (CDRH)

CDRH/FDA

1350 Piccard Drive, HFZ-210

Rockville, MD 20850

Phone: (800) 638-2041 or (240) 276-3150

www.fda.gov/cdrh/

Laser Institute of America

Safety Standards for Laser Users

13501 Ingenuity Drive, Suite 128

Orlando, FL 32826

Phone: (800) 345-2737 or (407) 380-1553

Fax: (407) 380-5588

www.laserinstitute.org

Occupational Health & Safety Administration (OSHA)

U.S. Department of Labor

Occupational Safety & Health Administration

200 Constitution Avenue

Washington, D.C. 20210

www.osha.gov

1.3 Certifications and Compliance

NOTE: This product is specifically designed to be an OEM laser device for incorporation or integration into other equipment. As such it DOES NOT MEET the full requirements for a complete laser system as defined by 21 CFR 1040.10 and 1040.11 under the Radiation Control for Health and Safety Act of 1968 and EN 60825-1. It is the responsibility of the purchaser to meet all of the regulatory requirements for the complete laser system (IEC60825-1 Ed.2 2007-3).

Nufern certifies that this device was tested and found to meet the published specifications prior to shipping. Upon receipt of this package, please inspect contents for any possible damage that may have occurred in shipping. Please report any shipping damage immediately to the factory at 1-888-NU-HELPS (1-888-684-3577).

Nufern certifies that it has assessed the NuAMP laser in relation to the requirements of the RoHS Directive¹, and that it conforms in full to the requirements thereof, that the product does not contain any of the following restricted substances in excess of the indicated Maximum Concentration Values².

Table 1: Maximum Concentration Values of Restricted Substances

Restricted Substance	Maximum Concentration Value
Lead	0.1%
Mercury	0.1%
Hexavalent Chromium	0.1%
Polybrominated Biphenyls, PBBs	0.1%
Polybrominated Diphenylethers, PDBEs	0.1%
Decabromodiphenylether, DecaBDE	0.1%
Cadmium	0.01%

¹ "RoHS Directive" means Directive 2002/95/EC of the European Parliament and the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment with April 1 2008 European Court of Justice annulment of DecaBDE exemption to the RoHS Directive

² Maximum Concentration Value by weight in homogeneous material is set by the Commission decision of 18 August 2005 amending Directive 2002/95/EC of the European Parliament and of the Council for the purpose of establishing maximum concentration values for certain hazardous substances in electrical and electronic equipment

1.4 Location of Safety and Other Labels

1.4.1 Laser Unit

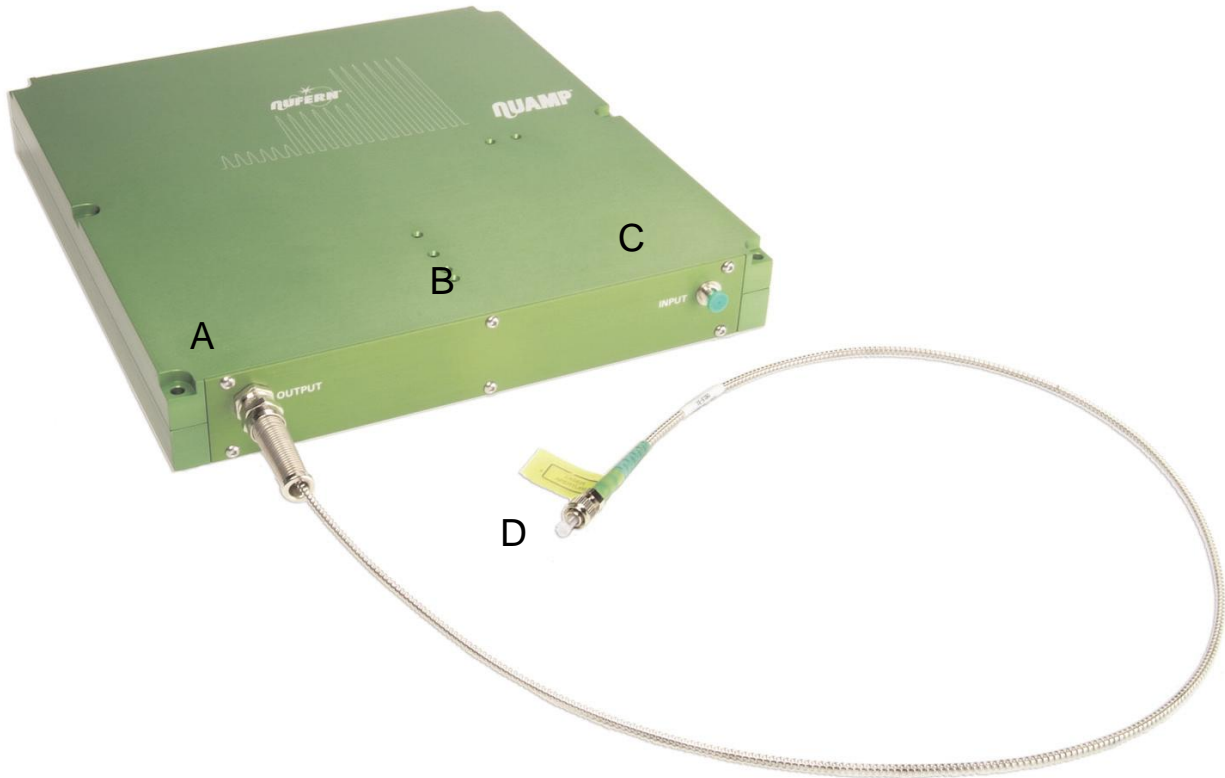
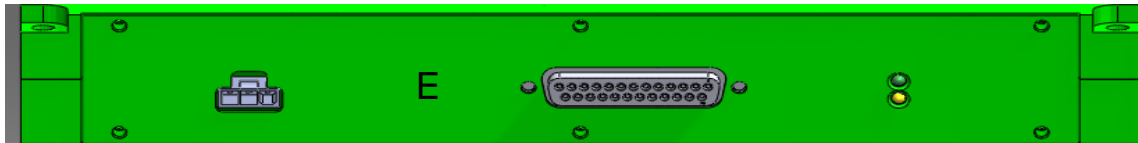


Figure 1



	A	B	C
	D		E
			<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> <p>Nufern 7 Airport Park Rd., East Granby, CT 06026</p> <p>Date of Manufacture: Model No.: NuAMP Part No.: PSFA-15UU-VV-XW-Y Serial No.:</p> </div>

1.4.2 NuControl

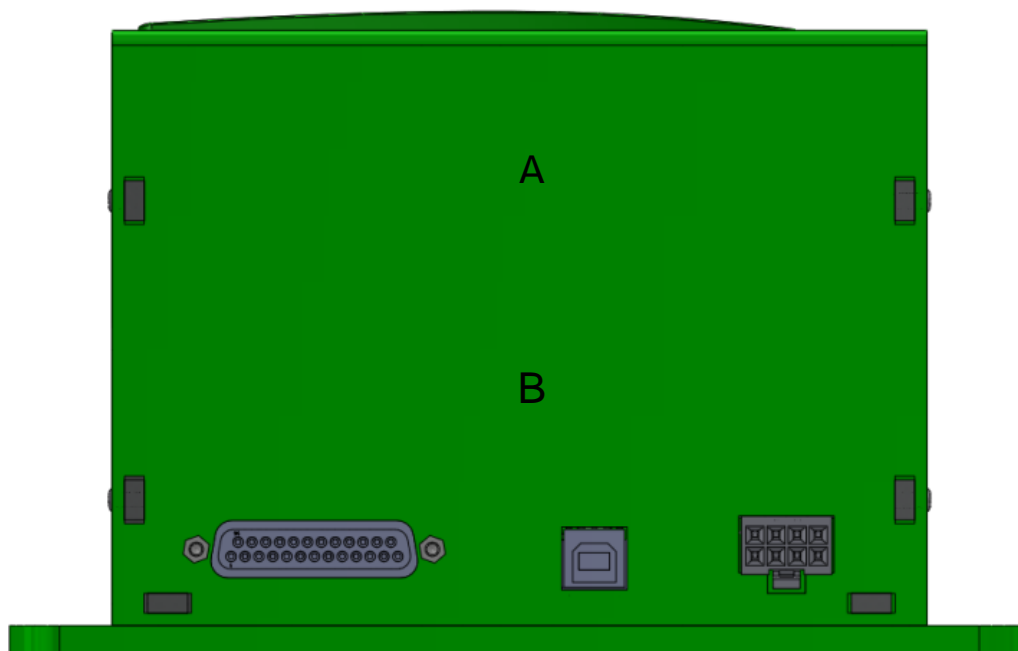
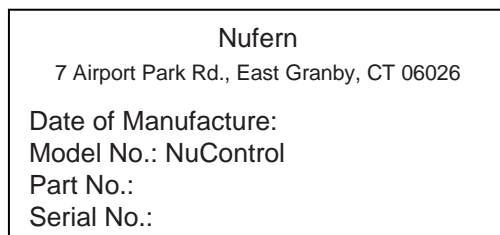


Figure 2

A



B



2. GETTING STARTED



DANGER: Use of controls or adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure and damage to the laser.

The NuAMP™ fiber laser amplifier from Nufern is a CW narrow-linewidth PM fiber amplifier capable of amplifying single-frequency laser light with as narrow as ~5kHz linewidth and as low as 1 mW input power to as much as 10W amplified output. The NuAMP fiber laser amplifier offers wide amplification wavelength range around 1.55 μm along with single-mode output beam quality. The unit offers multiple real-time health monitors and single emitter pump diodes, which offer long lifetime and maintenance free operation. A 25-pin D shell connector is provided to match the industry standard for simple drop-in replacement.

2.1 Unpacking the Laser

2.1.1 What's in the Box?

Please check the shipping container to make sure you have identified each of the following items. Please report any omissions immediately to Nufern.

- NuAMP Laser
- Power cable
- Operator's Manual
- Final Test Report
- NuControl with accessories (provided if the option is elected)
 - NuControl with Key-Switch and E-Stop
 - DB25 male-to-male cable
 - Software CD

2.1.2 Initial Inspection

Upon delivery of your NuAMP laser, please inspect all packaging for evidence of mishandling or damage. If you find any evidence of mishandling, please photograph these findings and save the damaged shipping materials. Carriers do not accept claims for damage during transit without the original shipping material. All shipping damage is the responsibility of the shipping company. Please report this information to the shipping company and Nufern.

Inspect the laser for any physical damage. Check the fiber delivery cable for any kinks, tight bend radii (minimum static bend radius for the cable is 100mm) or other damage. Check the output isolator or FC/APC connector for any damage. Inspect the laser housing for dents or damage to connectors. If more than cosmetic damage is observed, please contact the Nufern Help Line at 1-888-NU-HELPS for an exchange unit.

2.1.3 Shipping Materials

It is recommended that you do not discard the shipping containers, as they will be necessary if you ever need to ship this unit or send it to Nufern for service at some later date.

2.2 NuAMP Laser Details

This section provides detailed information about the front panel connections, rear panel connections, electrical connections, DB25 interfaces and pin descriptions and functions.

2.2.1 Front Panel View

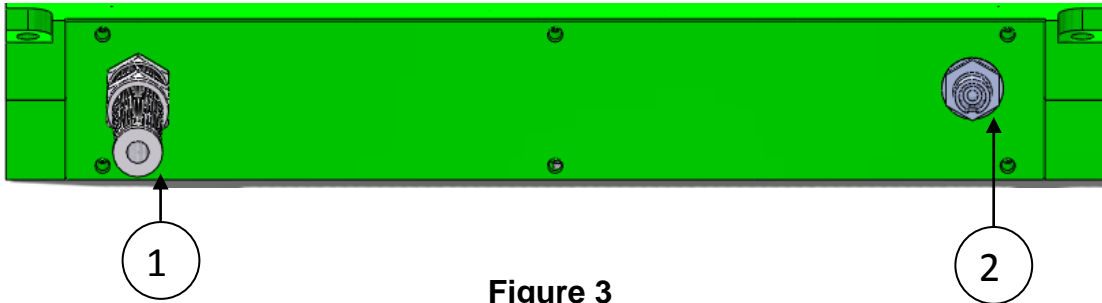


Figure 3

1. **Strain-relief for the output pigtail:** Depending on the output option ordered, either an output pigtail with FC/APC connector will exit the amplifier unit through the strain-relief or a fiber-pigtailed fiber-to-free-space isolator will exit the amplifier unit through the strain-relief.
2. **Input FC/APC bulkhead:** The input FC/APC bulkhead with a narrow-key accepts FC/APC connectorized fiber to couple the input signal light into the amplifier unit.

2.2.2 Rear Panel View

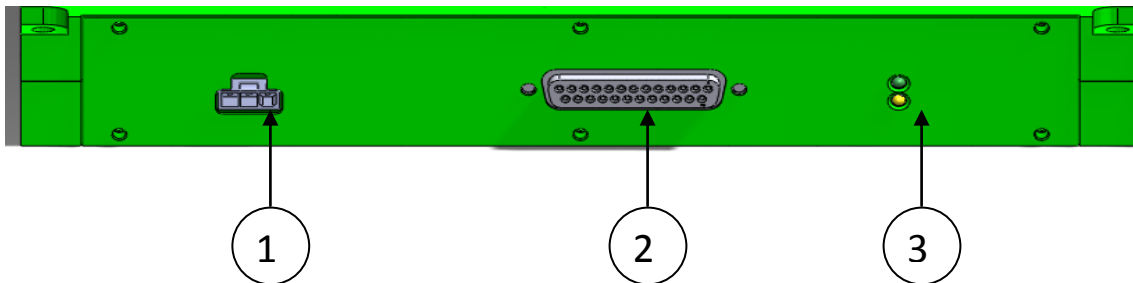


Figure 4

1. **24 Volt DC Input:** The laser power connections are an FCI part (#DA3W3SA00LF) 3-pin D Sub connector with FCI contacts (#8638PSS2005LF) and shell (#86303638BLF). As supplied, the 16 gauge 3 conductor cable is 2 meters in length. Longer cables may be available upon request.

Table 2: Power Connector Pin-Out

Power Cable Wire Color	Circuit Connection
BLACK	+24 V DC
WHITE	0 V DC
GREEN	Safety Ground

2. **25-Pin Interface Connector:** The 25-pin connector is used to control and monitor the laser via the direct analog and digital interface. This interface primarily requires or provides TTL and analog signals at the individual pins. This is discussed in Sections 2.2.3 and 2.3.3.
3. **Status LEDs (Yellow/Green):** The LED bank consists of two stacked multicolor LEDs.

Table 3 summarizes the information conveyed by these two LEDs

Table 3: LED Status Indication

Diode Status	Laser Status	Action
Yellow Diode ON	1 st on-board pump stage on	None
Green Diodes ON	2 nd on-board pump stage on	None

2.2.3 25-Pin Interface Communications

The 25-pin connector can be used to control and monitor the amplifier unit with TTL or analog voltages at the individual pins. Table 4 outlines the functions of the connector pins.

Table 4: Specification of the DB25 Control Connector

DB25 Pin	Signal	Definition
1	Master Fault	Output, TTL, Low = Fault (Latched)
2	Seed Power Fault	Output, TTL, Low = Fault (Latched)
3	Back Reflection Fault	Output, TTL, Low = Fault (Latched)
4	Temperature Fault	Output, TTL, Low = Fault (Latched)
5	Power Supply Fault	Output, TTL, Low = Fault
6	N/C	N/A
7-8	Reserved	N/A
9-10	N/C	N/A
11	Power Level Control	Input, Analog, 5V = 100% of the maximum optical output power
12	N/C	N/A
13	Laser Enable (Fire)	Input, TTL, High = Enabled
14-18	N/C	N/A
19-21	Reserved	N/A
22	Ground	GND
23-24	N/C	N/A
25	Ground	GND

2.3 NuControl Details (if the NuControl option is selected)

This section provides detailed information about the front panel connections, rear panel connections, electrical connections, DB25 interfaces and pin descriptions, and functions of the NuControl.

2.3.1 Front Panel View

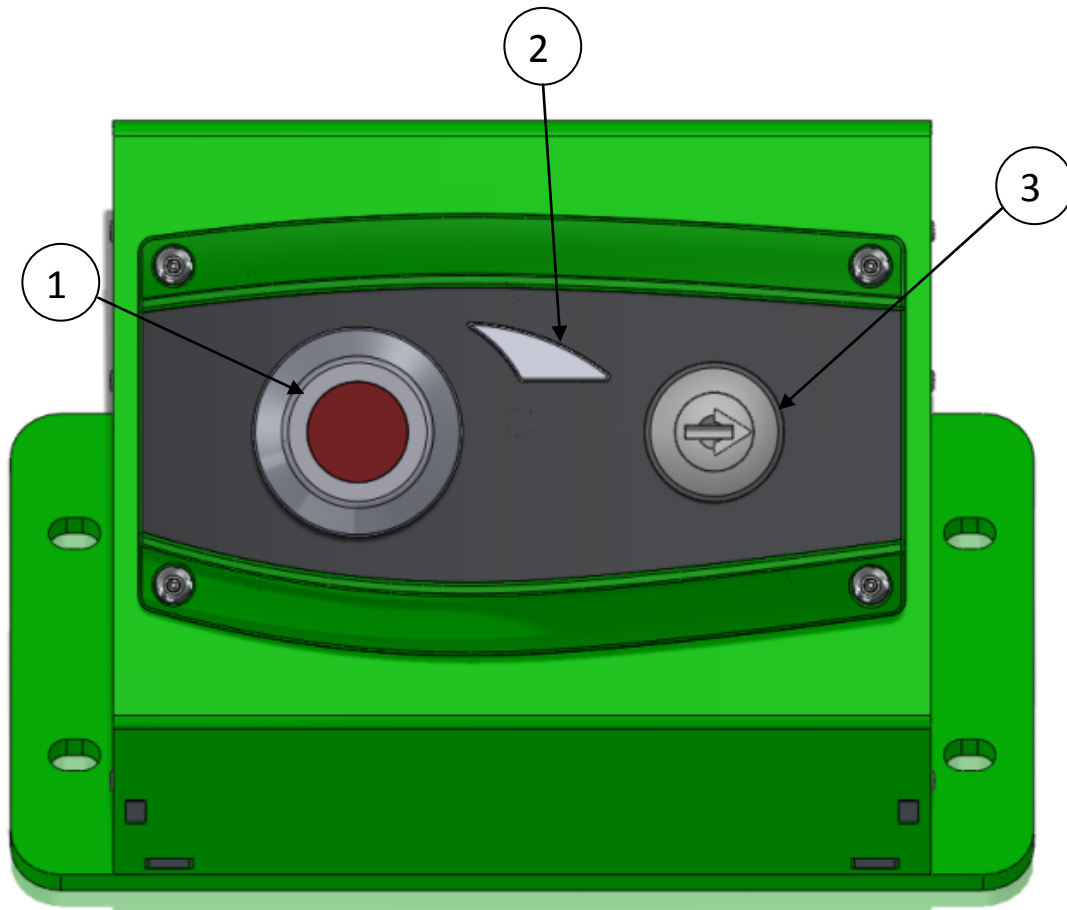


Figure 5

1. **E-Stop button with LED:** The E-stop button provides a way to shut off the amplifier unit in an emergency situation. When the E-stop button is pushed in (STOP), the power supply to the amplifier unit will be shut off and laser emission from the amplifier unit will be immediately stopped. When the E-stop is pulled up (RUN), the amplifier can be turned on. The LED on the E-Stop button facilitates users to locate the button and trigger prompt response in an emergency. When power is applied to the system, this LED is lit red. For detailed LED light conditions refer to Table 5.
2. **Emission Indicator:** This LED is a warning to users that laser light may be emitted. It will be lit red whenever the amplifier is powered with a DC power supply and the laser is ready to use or in use. When this LED is lit, users are advised to wear laser safety goggles all the time. For detailed Emission Indicator light conditions refer to Table 5.
3. **Three-position Key Switch:** The Key Switch controls the operation of the amplifier unit and the control Graphical User Interface (GUI). There are three positions on the Key Switch, labeled as 0, 1 and 2. When the Key Switch is at position 0, no power is available to the NuControl or the amplifier. When the Key Switch is at position 1, the NuControl is powered and DC voltage is applied to power the amplifier. When the Key Switch is at position 2, a ready signal is sent to the NuControl to allow the amplifier operation and laser radiation can be emitted from the laser aperture.

Table 5: LED State Matrix

Key Position	E-Stop Position	Emission Indicator	E-Stop LED
0	RUN	OFF	OFF
	STOP	OFF	OFF
1	RUN	ON - RED	ON - RED
	STOP	OFF	OFF
2	RUN	ON - RED	ON - RED
	STOP	OFF	OFF

2.3.2 Rear Panel View

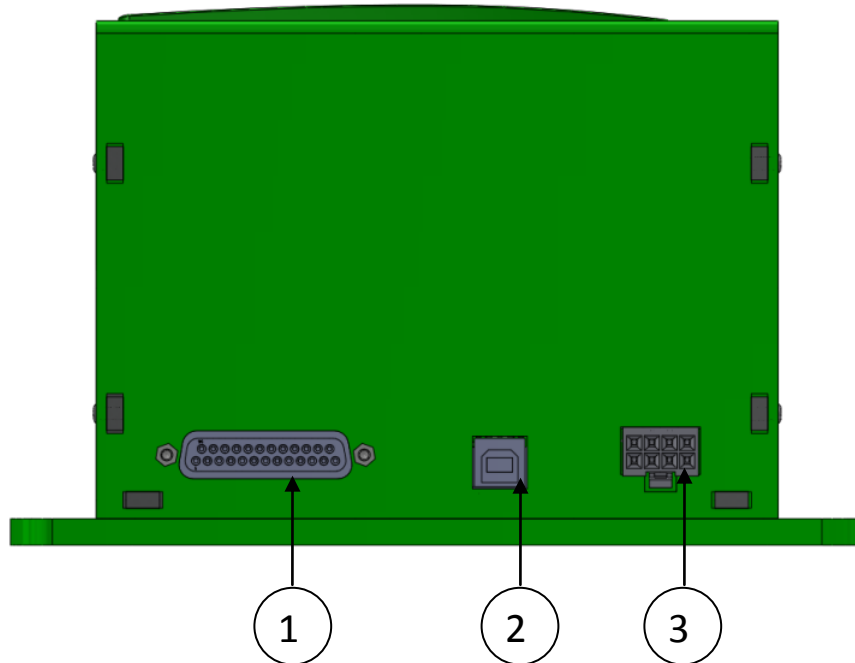


Figure 6

- 1. DB25 interface connector:** The 25-pin connector provides communication between the NuControl and the amplifier unit.
- 2. USB Interface:** The USB interface provides communication between the NuControl and the computer which has the control GUI running.
- 3. 8-PIN Molex connector:** The 8-PIN Molex connector consists of DC power IN, DC power OUT and a Remote Interlock. The detailed PIN-out is shown in the Table 6. The remote interlock can be configured by the user to sense an open door to a room or a process cabinet. When the remote interlock is connected, power is allowed to be applied to the system. When remote interlock is disconnected, power is disabled.

Table 6: Detailed Pin-out for 8-Pin Molex Connector

Molex Pin	Signal	Definition
1	Ground	GND
2	Remote Interlock	Input, TTL, Low = defeated
3	Ground	GND
4	Ground	GND
5	Power In (Anode)	Input (from Power Supply)
6	Power In (Cathode)	Input (from Power Supply)
7	Power Out (Cathode)	Output (to amplifier unit)
8	Power Out (Anode)	Output (to amplifier unit)

2.3.3 25-Pin Interface Communications

The 25-pin connector can be used to control and monitor the amplifier unit with TTL or analog voltages at the individual pins. Table 4 outlines the functions of the connector pins.

2.4 Laser Installation

2.4.1 Mounting the Laser

Mount the NuAMP laser as desired using the bolt holes to firmly attach the unit to an appropriate cooling surface. The bottom surface of the amplifier unit should be maintained at 23 ± 3 °C for effective operation of the unit. A water cooled cold plate is recommended. For reference, the typical heat rejection for a 10 W unit operating at full power is about 75 W. Provide adequate clearances around the front and back panels to access the various connections.

2.4.2 Mounting the output pigtail (if option is elected)

For units having an output pigtail, the output pigtail has a high power FC/APC connector and should be mounted to the customer-desired fixture with a FC/APC receptacle. When mounting the output pigtail, please carefully remove the dust-cap and insert the connector to the FC/APC receptacle with care. Dust or scratches on the fiber end face could introduce excessive back-reflection to the unit and cause the amplifier to malfunction or become damaged. The output pigtail should be mounted in a manner such that there is minimal stress on the fiber delivery cable. The fiber delivery cable should be laid out to avoid excessive twisting and tight bend radii. The output pigtail should be mounted such that the laser output is directed in a manner that ensures no danger to personnel or property in the vicinity of the laser.

2.4.3 Mounting the fiber-to-free-space isolator (if option is elected)

For units having a fiber-to-free-space isolator, the output from the isolator is collimated and the isolator should be mounted in a manner that ensures minimal stress on the fiber delivery cable. The fiber delivery cable should be laid out to avoid excessive twisting and tight bend radii. The termination head should be mounted such that the laser output is directed in a manner that ensures no danger to personnel or property in the vicinity of the laser.

2.4.4 Electrical Connections

Connect the power cable per the pin-out provided in Table 2. Next, connect the 25-pin Sub-D interface. Power supply requirements are given below in Table 7.

Table 7: Power Supply Requirements

Parameter	Specification
Input Voltage	24 ± 5% Volt DC
Noise and Ripple	<50mV Peak-to-Peak
Current Capacity	6 A

2.5 NuControl Installation (if the NuControl option is selected)

Mount the NuControl in a convenient and accessible location.

- a. Carefully unpack the NuControl and place it on a flat surface.
- b. Use the applied power cord to connect the NuControl, the amplifier unit and a 24VDC DC power supply operating at constant voltage mode.

NOTE: The remote interlock as shipped is disabled. To use the feature, remove the shorting cable and connect to your remote interlock device.

- c. Use the provided DB25 cable to connect the NuControl and the amplifier unit for control.
- d. Install the USB driver for the NuControl on a computer that will be used to run the GUI and to control the amplifier.
 - I. The computer must be running a MS Windows operating system newer than Windows 2000 and have a spare USB port.
 - II. The user must have administrator rights on that computer in order to install the USB driver and GUI.
 - III. Unzip the NI_Driver.zip to your desired folder (if downloaded from Nufern website).
 - IV. Click on the setup.exe file in the folder and it will start the installation for the NI DAQMX which contains the USB driver for the NuControl.
- e. Install the control GUI for the NuControl on the same computer which has the USB driver installed.
 - I. Unzip the NuAmp_GUI.zip to your desired folder (if downloaded from Nufern website).
 - II. Go to NuAmp_GUI\NuAMP_GUI_Installer\Volume subfolder, click on the setup.exe file to start the installation of the GUI for the NuControl.
 - III. Copy the entire sub folder NuAMP_GUI/NuAMP_GUI from the CD to your desired location in the same computer where the USB driver and the control GUI were installed (if install from a CD).
- f. Use a USB data cable to connect the NuControl to a computer that will be used to run the control GUI.
- g. Upon plugging the USB cable into the NuControl and the computer, the computer should recognize the USB device and install it.

2.6 Starting Up the Laser

2.6.1 Laser Start-Up Using DB25 Interface

Once the laser module and termination assembly are properly mounted and the correct electrical connections are made, the laser amplifier is almost ready to run. In order to get the amplifier to produce output, the following steps need to be completed.

1. Remove the dust-cap on the input FC/APC bulkhead on the amplifier unit.
2. Remove the dust-cap from the output pigtail or protective sticker from the output isolator, whichever applicable.
3. Apply appropriate cooling to the unit and maintain the unit within the working temperature range.
4. Couple an appropriate amount of linearly-polarized input signal into the amplifier unit. Please check the datasheet for the minimum and maximum power required to run the amplifier.
5. Apply the appropriate DC voltages to the power cable, as described in Tables 2 and 7.
6. Check the TTL signal on pins 1-5 (Table 4) to determine if there is any fault.
7. When there is no fault detected, apply a TTL high to pin 13 to enable the amplifier.
8. Apply an appropriate DC voltage on pin 11 to set the output power at the desired level. The maximum acceptable voltage on pin 11 is 5VDC.



Applying voltage over 5V on pin 11 could cause the amplifier to malfunction or become damaged.

9. During operation, pins 1-5 can be used to monitor the health status of the amplifier.
10. To turn off the amplifier, first to set the voltage on pin 11 to 0 and then apply a TTL low on pin 13 to turn off the amplifier.

2.6.2 Laser start up with the NuControl (if NuControl option is selected)



DANGER: Possible Unexpected Laser Emission

A False Enable could happen on the amplifier in the following instance: when the key is switched to position -1 or -2 and the Emergency Stop button is pulled out, the amplifier could be enabled by itself and emit unexpected laser emission at the ~1W level when one tries to unplug the USB cable or plug the USB cable back into the amplifier. To avoid this occurrence and any potential threat to end users, it is highly recommended to perform the following safety precaution steps:

1. Always follow the operation procedures described in this manual.
2. Always wear protective eyewear in operating the amplifier. When the Emergency Stop button on the front panel lights up (key positions -1 or -2), please assume that laser emission could occur at any moment.
3. If there is any need to unplug or plug-in the USB cable back into the amplifier, please place and keep the Key Switch in the -0 position and push down the Emergency Stop button.
4. In the event that the USB cable gets loose and disconnected from the amplifier, please move the key switch to the -0 position and push down the Emergency Stop button immediately.
5. In the event the control computer has lost power, is shut down or is being restarted, please move the key switch to the -0 position and push down the Emergency Stop button immediately.

Please contact Nufern with any questions regarding this matter.

Operation of the amplifier unit with the NuControl can be categorized into four operational states: Off, Ready, Emission and Fault.

1. **Off:** The system is in the *Off* state when the following conditions are met:
 - Emergency Stop Button is in pulled position.
 - Remote Interlock is connected.
 - Key switch is at position 0.
2. **Ready:** The system is in the state of *Ready* when the following conditions are met:
 - Emergency Stop Button is in pulled position.
 - Remote Interlock is connected.
 - Key switch is at position 1 (with the NuControl connected to a power supply).
3. **Emission:** The system is in the state of *Emission* when the following conditions are met:
 - Emergency Stop Button is pulled.
 - Remote Interlock is connected.
 - Key switch is at position 2.
 - This state is entered from *Ready* state.
4. **Fault:** All scenarios that are not *Off*, *Ready* or *Emission* fall into this category. In *Fault* state, no laser emission is available. Any one of the following conditions can trigger the system to *Fault*:
 - Emergency Stop Button is pressed.
 - Remote Interlock is disconnected.
 - Key Switch is at position 2 when power is applied.

Once the amplifier, the NuControl and the termination assembly are properly mounted and the correct electrical connections are made, the laser amplifier is almost ready to run. In order to get the amplifier to produce output, the following steps need to be completed.

1. Remove the dust-cap on the input FC/APC bulkhead.
2. Remove the dust-cap from the output pigtail or protective sticker from the output isolator if applicable.
3. Apply appropriate cooling to the unit and maintain case of the unit within the proper working temperature range.
4. Couple an appropriate linearly-polarized input signal through the FC/APC connector into the amplifier unit. Please check the datasheet for the minimum and maximum input signal power required to run the amplifier.
5. Turn on the DC power supply connected to the NuControl.
6. Go to NuAMP_GUI\ NuAMP_GUI, click on the NuAMP_GUI.exe file to start the GUI. The GUI should show up as shown below in Figure 7. If a message window pops up saying: "The NuControl not found. Please check the hardware connection.", please check the USB connection between the NuControl and the computer.



If you have any questions, please contact Nufern for immediate help.

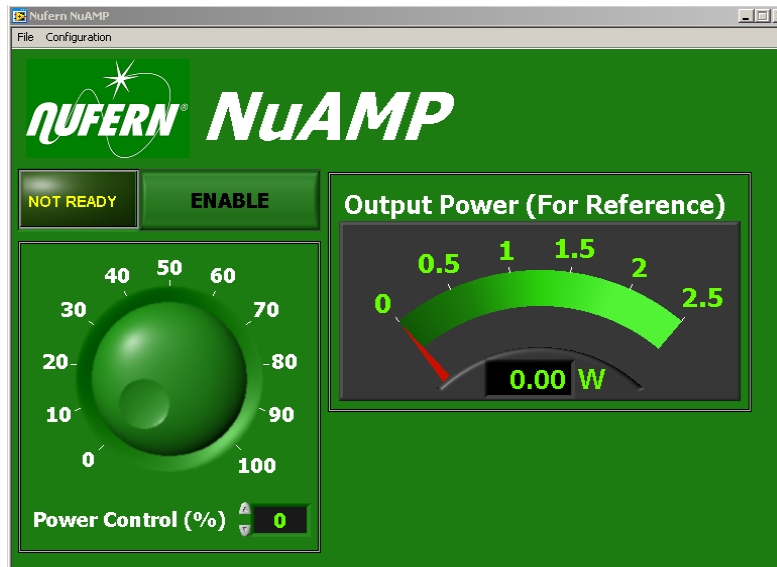


Figure 7: GUI Waiting

7. When the GUI is running, turn the Key Switch from position 0 to position 1 to allow the DC power supply to power the amplifier. Pull up the E-stop button or keep the E-stop button at the up position, the red light on the E-stop and the Emission Indicator should light up red. If the LEDs do not light up, please check whether the power cable is properly connected to a power supply with the appropriate DC voltage and current rating.



If you have any questions, please contact Nufern for immediate help.

8. Turn the Key Switch from position 1 to position 2. The GUI then changes to READY state and is ready to control the amplifier as shown in Figure 8. The output power monitor of the amplifier unit will also become active.

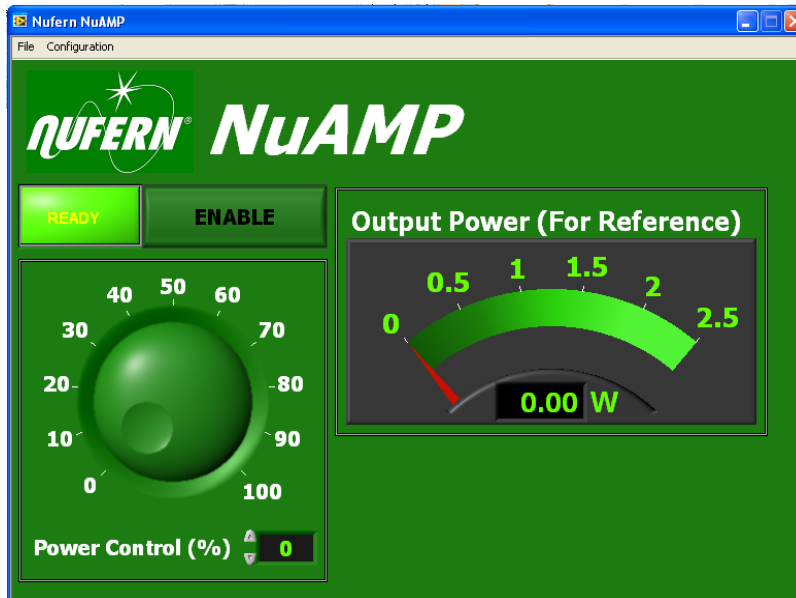


Figure 8: GUI Ready

- When the GUI is ready, one can click on the ENABLE button on the GUI to enable the amplifier.



Before enabling the unit, make sure the power control is set at 0.

When the amplifier is enabled, a flashing warning sign “LASER ON” appears on the GUI as shown in Figure 9.

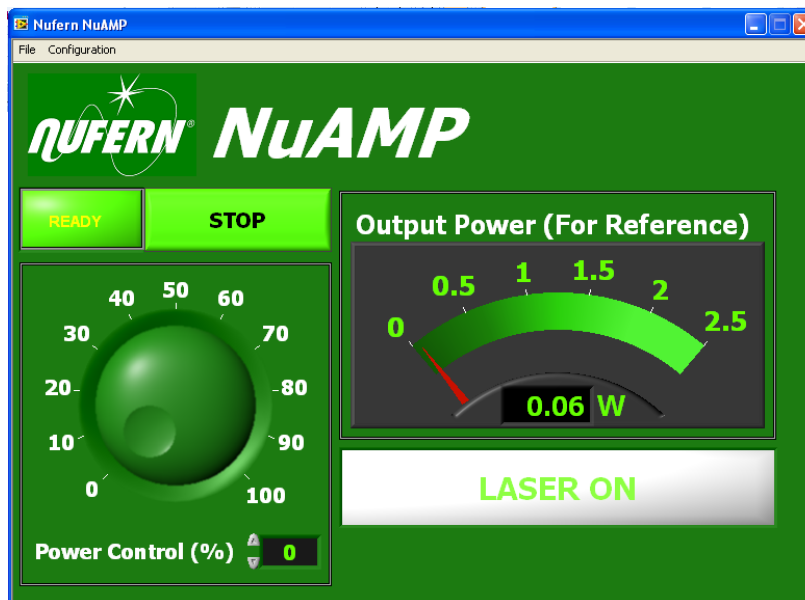


Figure 9: Amplifier Enabled

- To change the output power, use either the mouse to rotate the Power Control Dial or type a value (between 0 and 100%) in the input box of the Power Control. If any fault gets triggered during the operation, the amplifier will be disabled automatically and an error message will display in the GUI as shown in Figure 10. Record the error message as a

reference to identify the cause of the fault. Click on the “File” in the menu to open the pull-down menu and click on “Exit” to exit the GUI.



Before turning the amplifier back on again, be sure to clear any fault condition first.

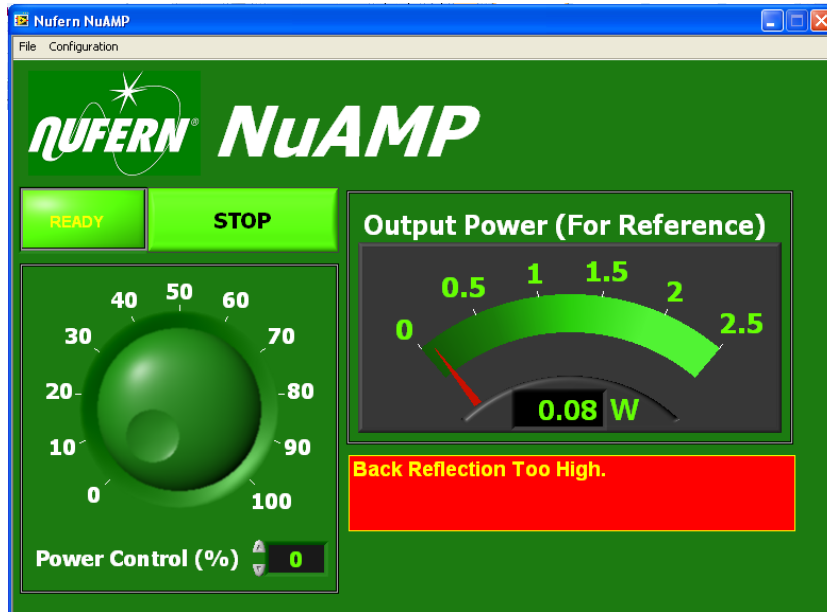


Figure 10: Fault Condition Display

3. MAINTENANCE

The NuAMP fiber laser amplifier has no field serviceable parts. It is required to have the amplifier properly cooled, but otherwise there is no required maintenance for this unit. If you are having problems with the operation of your unit, please contact customer service to obtain a Return Merchandise Authorization (RMA) number before sending your unit back to the factory.

4. TROUBLESHOOTING / CUSTOMER SERVICE

This manual addresses the most common issues related to the setup, operation, and general safety considerations for the NuAMP laser. If you have questions that are not resolved by reading this manual, or if your laser does not perform as specified, you may call the Nufern help line for assistance:

4.1 NuAMP Help Line

Within the U.S. Call Toll-free:
(888) NU-HELPS
(888) 684-3577

Outside the U.S. Call:
1-860-408-5000

Nufern customer service may, at their discretion, attempt to resolve your issue over the phone, or may request that you return your laser for repair or replacement. *Please note that all product returns require a Returned Merchandise Authorization (RMA) number from Nufern.* Customer Service will advise you of the precise procedure and packing instructions for merchandise returns when needed.

5. NOTICES

Information contained in this manual is deemed to be reliable and accurate. No responsibility is assumed for its use, or for any infringement on the rights of others. Nufern reserves the right to change the design and specifications of the product described and the related information provided in this manual at any time without notice.

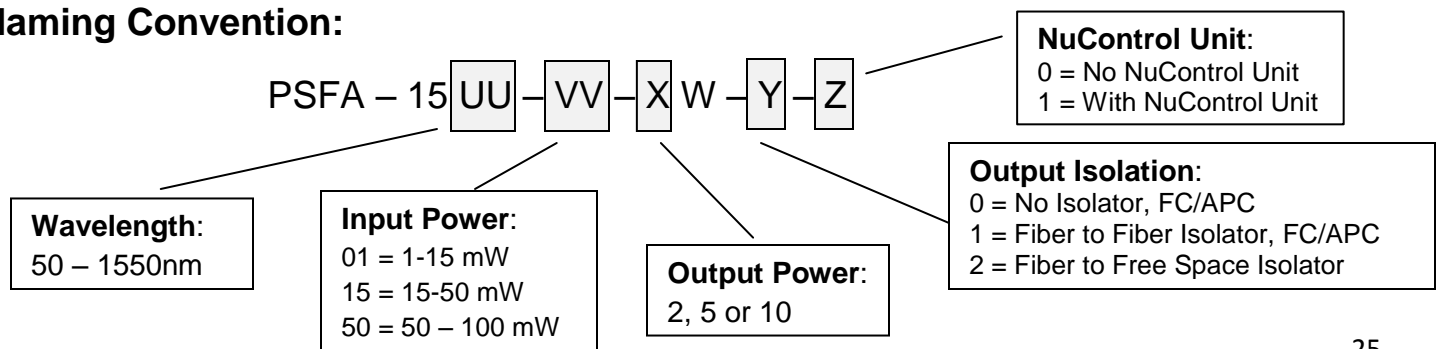
Nufern owns or licenses the following U.S. pending or issued patents, one or more which may cover this product: 6,779,364; 6,832,026; 6,904,214; 7,003,206; 7,050,686; 7,110,647; 7,116,887; 7,167,621; 7,317,857; 7,371,019; 7,400,812; 7,483,610; 2005/0041697; 2006/0198590; 2008/0095199 and more specifically the following licensed from: Furukawa Electric Co. of North America: 5,949,941; IMRA America Inc.: 5,818,630; USA, as represented by the Secretary of the Navy: 6,496,301; United Technologies Corp.: 5,666,372. Product modification, combination with other products or specific uses can necessitate additional customer licensing. See the terms and conditions specific to your purchase. Generally, see also www.nufern.com/legal/.

APPENDIX A: LASER SPECIFICATIONS

Optical Specifications ¹	PSFA-15UU-VV-2W-Y-Z	PSFA-15UU-VV-5W-Y-Z	PSFA-15UU-VV-10W-Y-Z
Output Power	2 W	5 W	10 W
Operating Wavelength ²	1540 – 1560 nm	1540 – 1560 nm	1540 – 1560 nm
Input Isolation	> 30 dB	> 30 dB	> 30 dB
Mode of Operation	CW	CW	CW
Output Power Tunability (nominal)	10-100%	10-100%	10-100%
Polarization	Linear	Linear	Linear
PER at Rated Power ³	> 10 dB	> 10 dB	> 10 dB
Input Signal Linewidth (nominal)	10 kHz	10 kHz	10 kHz
Peak-to-Peak Power Stability ⁴	< 3%	< 3%	< 3%
Beam Quality	SM, TEM ₀₀	SM, TEM ₀₀	SM, TEM ₀₀
Mechanical Specifications			
Input Fiber and Connector	FC/APC bulkhead	FC/APC bulkhead	FC/APC bulkhead
Package Size ⁵	275 x 250 x 36.5 mm	275 x 250 x 36.5 mm	275 x 250 x 36.5 mm
Output Cable	Armored Flex Cable	Armored Flex Cable	Armored Flex Cable
Electrical Specifications			
Operating Voltage	24VDC ± 5%	24VDC ± 5%	24VDC ± 5%
Operating Current	< 3 A	< 4 A	< 6 A
Thermal Specifications			
Operating Case - Temperature, °C	23 ± 3 °C	23 ± 3 °C	23 ± 3 °C
Options			
Input Power	1-10, 15-50, 50-200 mW	1-10, 15-50, 50-200 mW	1-10, 15-50, 50-200 mW
Output Isolation	No isolator, Fiber-to-Fiber Isolator, or Fiber-to-Free Space Isolator	No isolator, Fiber-to-Fiber Isolator, or Fiber-to-Free Space Isolator	No isolator, Fiber-to-Fiber Isolator, or Fiber-to-Free Space Isolator
Interface	DB25 w/o NuControl USB w/ NuControl	DB25 w/o NuControl USB w/ NuControl	DB25 w/o NuControl USB w/ NuControl

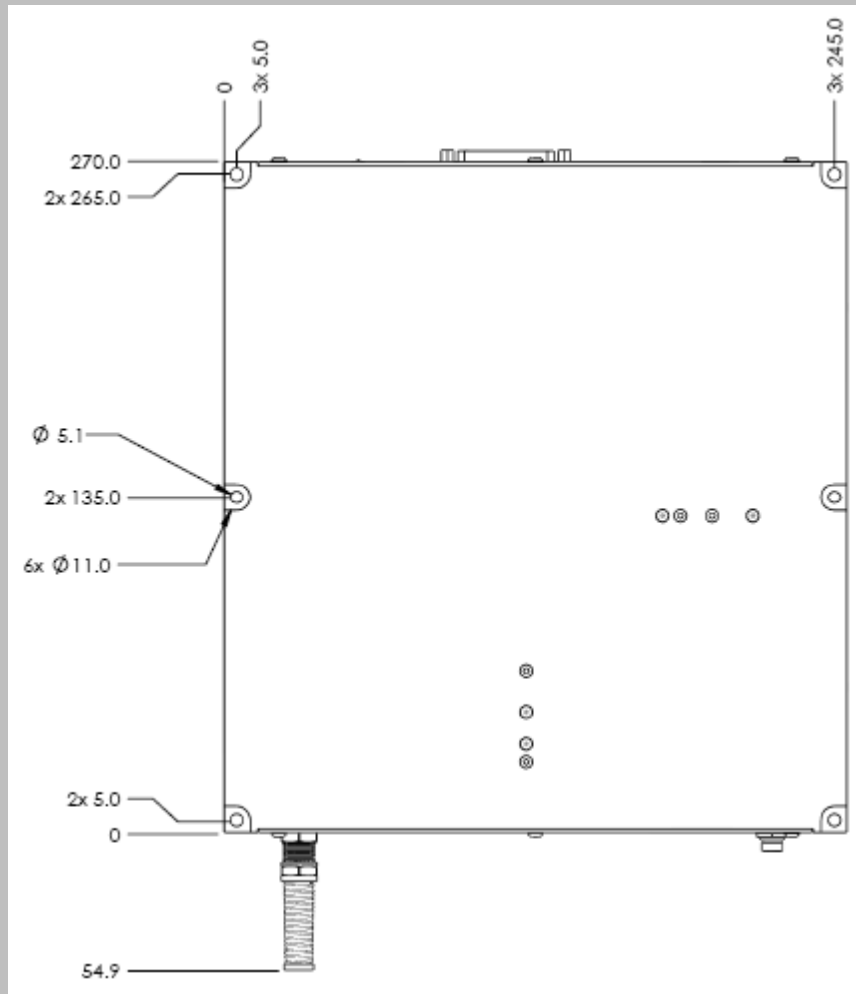
¹All specifications are at room temperature and proper heat sinking is required. ²Other wavelengths in the 1040-1090 nm range available upon request. ³PER >13dB for units without output isolator. ⁴Stability is measured over a 2hr period and calculated as (Max-Min)/Avg after the 15-minutes warm-up time. ⁵Custom OEM packaging available upon request.

Naming Convention:



APPENDIX B: MECHANICAL DRAWINGS

Amplifier Unit Top View



Amplifier Unit Front View

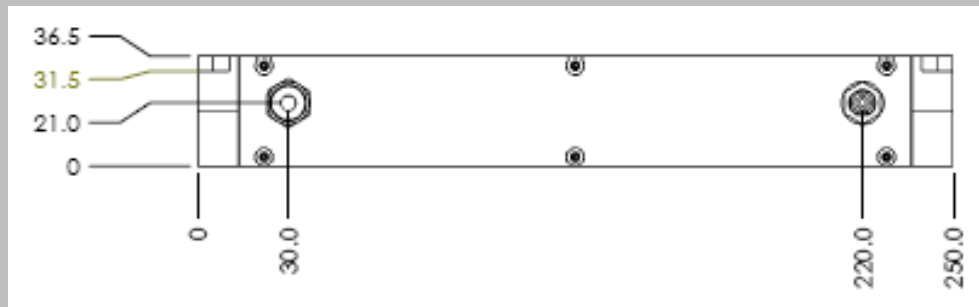
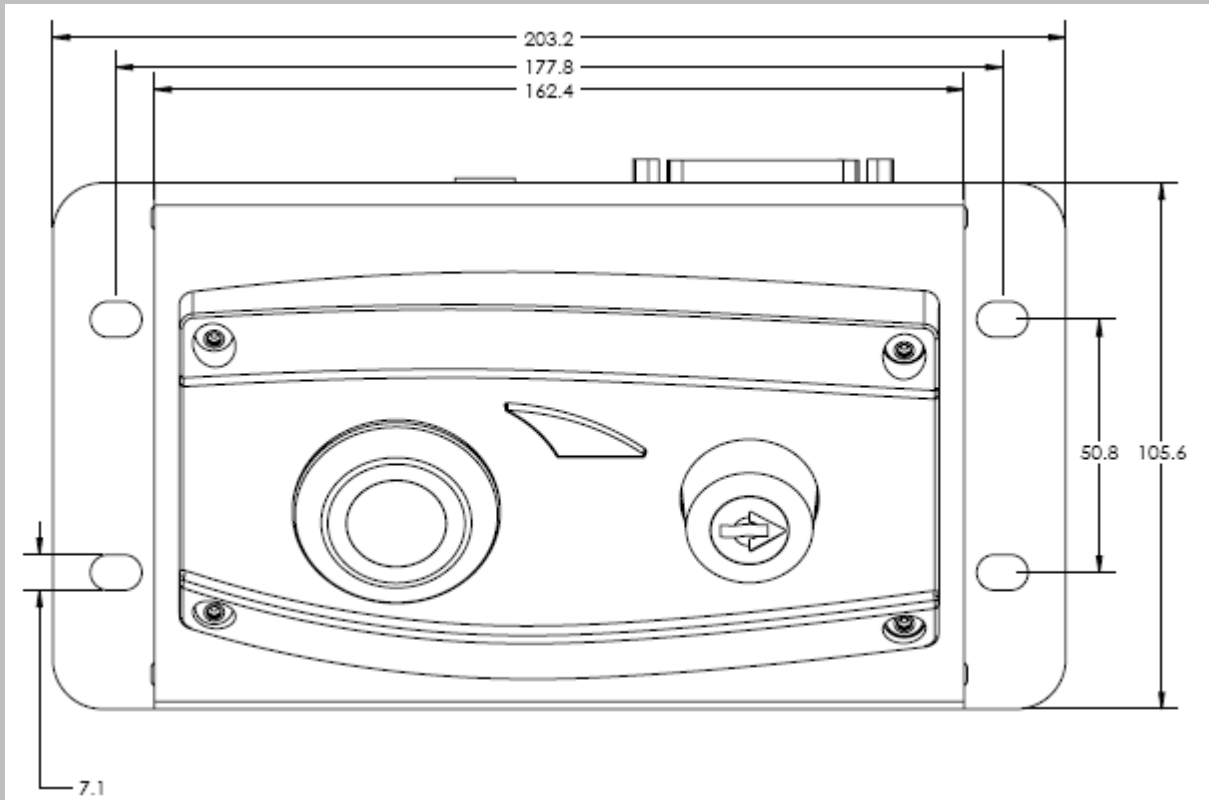


FIGURE 11

NuControl Top View



NuControl Front View

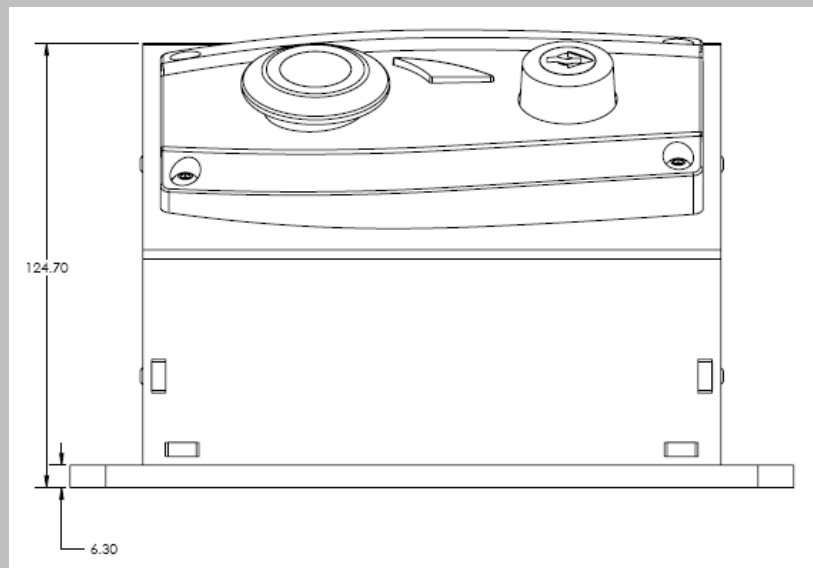


FIGURE 12

APPENDIX C: WARRANTY

Nufern warrants the NuAMP Fiber Laser to be free from defects in workmanship and materials, hereinafter called "Nonconformity," for a period of twelve (12) months from the date of shipment or such other date set forth in the contract.

This warranty does not apply to systems which Nufern determines, upon inspection, have failed, become defective or unworkable due to abuse, mishandling, misuse, alteration (unless approved in writing by Nufern), negligence, improper installation, use which is not in accordance with the information and precautions described in the NuAMP Operator's Manual, or other causes beyond Nufern's control.

Operating at above the maximum rated output power specified in Appendix A will void the warranty.

This warranty does not apply to (i) any products or components not manufactured by Nufern or (ii) any aspect of the products based on buyer's specification, unless Seller has reviewed and approved such specification in writing.

EXCEPT FOR THE FOREGOING WARRANTY, NUFERN SPECIFICALLY DISCLAIMS AND EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Buyer shall notify Nufern of any Nonconformity during the warranty period, obtain a return authorization for the nonconforming products, and return the nonconforming products, freight prepaid, to Nufern's designated facility along with a written statement describing the Nonconformity. Nufern's sole and exclusive obligation under this warranty is to use reasonable commercial efforts, at Nufern's option, to repair, replace or refund the purchase price for any products which are returned to Nufern as set forth above and which are, after examination by Nufern, determined in Nufern's reasonable discretion to be nonconforming. Products which are repaired or replaced within the warranty period are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced products or components. However, the warranty period does not include the time period between when Nufern receives the nonconforming products and when Nufern returns the repaired or replacement products to Buyer. Buyer agrees that the foregoing provisions constitute the sole and exclusive remedies available to Buyer for breach of warranty by Nufern with respect to the products.

IN NO EVENT WILL NUFERN BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS OR BENEFITS, EVEN IF NUFERN HAS BEEN INFORMED OF THE POSSIBILITY THEREOF IN ADVANCE. IN NO CASE WILL NUFERN'S AGGREGATE LIABILITY TO BUYER BE GREATER THAN THE PURCHASE PRICE PAID BY BUYER TO NUFERN FOR THE PRODUCTS WHICH ARE THE SUBJECT OF BUYER'S CLAIM.

The products are not authorized by Nufern for Buyer's use in any device or application where the failure, malfunction or inaccuracy of the product carries a risk of death or serious bodily injury, such as, but not limited to medical equipment, nuclear facilities, aircraft operations, air traffic control, life support or other applications representing a similar degree of hazard. Any such use is prohibited without prior written agreement of Nufern under terms intended to allocate the risks of selling the product for such uses. Buyer will indemnify, defend and hold Nufern harmless from all claims, losses, damages and expenses, including attorney's fees arising from any prohibited use or application of the products.

None of the warranties or other obligations of Nufern made in this Appendix C shall apply where Nufern provides a NuAMP Fiber Laser for evaluation purposes and any terms of an evaluation agreement executed by the evaluator shall prevail over any applicable and conflicting terms of this Appendix C.