

LDI-6/7

Operating Manual

This manual contains important information necessary for the safe and efficient operation of the LDI light source system. Please read the manual in its entirety and heed all safety warnings before operating the light source.

Follow all safety precautions!

DANGER – LASER RADIATION
AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

The 89 North[®] LDI (15000-000-000-XX) light source system is designed and tested in accordance with IEC 61010-1, CAN/CSA C22.2 Number 61010-1, CENELEC EN 61326-1:2006, and FCC Part 15 Subpart B, Class B.

Prior to use, carefully unpack and inspect all components for any signs of damage which may have occurred during shipping. If shipping damage is suspected, notify 89 North or your authorized 89 North distributor immediately.

89 North customer service or your authorized 89 North distributor should be informed immediately in the event of any damage or malfunction in the equipment.

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1 Document Symbols

Special instructions are emphasized as follows:

NOTE:

This term contains important information regarding set-up and operation to facilitate ease of use and obtain effective results







This term contains critical information regarding safe handling and use of this system. Device malfunction or property damage could result if these instructions are not followed.

WARNING:

This term contains critical information by identifying conditions or practices that may result in injury or loss of life if these instructions are not followed.

2 Equipment Symbol Definition

	<p>Caution - Risk of electric shock</p> <p><i>This symbol indicates there are hazardous electrical parts inside the equipment.</i></p>
	<p>Caution - Risk of danger</p> <p><i>This symbol indicates that safe handling and usage instructions must be followed to avoid injury and/or damage.</i></p>
	<p>DANGER – LASER RADIATION</p> <p>AVOID EYE OR SKIN EXPOSURE TO DIRECT OF SCATTERED RADIATION</p> <p>CLASS 4 LASER PRODUCT</p> <p>IEC 60825-1:2014-05</p> <p>Maximum Output: 2W</p> <p>Emitted Wavelengths: 398nm-643nm</p>
	<p>AVOID EXPOSURE – LASER RADIATION IS EMITTED FROM THIS APERTURE</p> <p><i>This symbol indicates that Class 4 laser radiation emits from the aperture to which this label is closely affixed.</i></p>
	<p>CAUTION – CLASS 4 VISIBLE AND INVISIBLE LASER RADIATION WHEN OPEN AND INTERLOCKS DEFEATED. AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.</p> <p><i>This label indicates that removal of the panel to which this label is affixed will permit laser radiation in excess of Class 3B when interlocks are failed or defeated.</i></p>
	<p>DANGER – OPTIONALLY INTERLOCKED PROTECTIVE HOUSING PANEL</p> <p>Visible and/or invisible laser radiation when open and interlock failed or defeated. Avoid eye or skin exposure to direct or scattered radiation.</p> <p><i>This label indicates that removal of the panel to which this label is affixed will permit laser radiation in excess of Class 3B when interlocks are failed or defeated.</i></p>

See section 6 for locations of each label.

3 Specifications

Physical Specifications	
Dimensions	Length: 33cm (12.9 inches) Width: 15 cm (5.8 inches) Height: 24 cm (9.5 inches)
Weight	~9 lbs
Operating Conditions	
Required Clearance	15 cm (6 inches) around front and rear of unit
Operating Temperature	10-32°C / 50-90°F
Operating Humidity	<80% relative humidity, non-condensing
Power Supply	
AC Input Power Requirements	100-240V AC, 50/60 Hz, 3.0 amps (maximum)
DC Input Power Requirements	24 VDC, 10.41A
Fuses	None
Optical	
Spectral Range	398nm –643nm
Internal fiber, RGGBBV	400 µm, .39 NA
Internal fiber, 555	400 µm, .22 NA
External Output Fiber (supplied or recommended)	400 µm, .39 NA
Control Options	
TTL	>2.3 V High
Analog	0-5V
USB-DSP	Virtual COM port – SDK available upon request

4 Introduction and Intended Use

The LDI is a multi-wavelength laser-diode light source intended for use in fluorescence imaging applications. The LDI is a standalone unit, designed to operate on a desk or bench and connect to a microscopy instrument or other imaging equipment via optical fibers.

The LDI-6 has six discrete wavelength channels (RGGBBV) while the LDI-7 has seven (RGGBBV + 555nm). The LDI-6 has one output aperture for all channels and the LDI-7 has two output apertures: one for RGGBBV channels and another for the 555nm channel. 89 North supplies an optional 400 µm bifurcated fiber to combine the two LDI outputs into one fiber.

Because of its intense brightness, the LDI includes several safety interlocks that, when tripped, will block the laser emission produced by the system. **Do not override these interlocks.** Doing so may result in injury to the user and/or the unit and will immediately void the warranty.

5 Safety

The LDI incorporates Class 4 lasers which produce heat as well as visible and UV light. Proper care must be taken in setup and operation to prevent injury.

The laser emission output apertures are SMA-905 fiber connections which are located on a connector panel in the 'fiber access area' of the LDI. The fiber access area is accessible by raising the interlocked fiber access cover (see section 6).

Locations of apertures where laser radiation exceeding Class 1 AEL specifications is emitted are shown in Figure 1:

1. SMA connector corresponding to the multicolor NovaLum RGGBV laser
2. SMA connector corresponding to the 555 (Green Necsel) laser

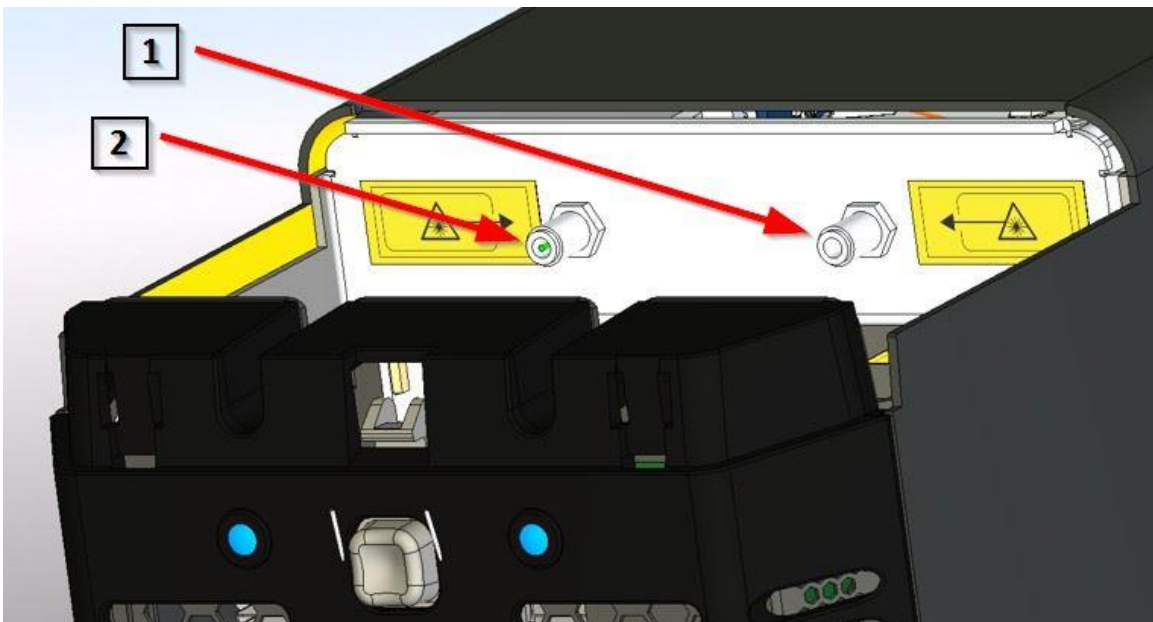


Figure 1: SMA connectors with arrow 1 pointing to the RGGBV connector and arrow 2 pointing to the 555 connector.

The LDI incorporates safety interlocks which prevent laser emission when optical fibers are not installed in the unit.

NOTE:

The LDI will not produce laser emission from an aperture unless an external output fiber is installed.

The LDI incorporates a remote safety interlock which prevents laser emission when the connected remote interlock is open.

The LDI incorporates a safety interlock which prevents the unit from being powered with the protective cover removed.

Additionally, the LDI incorporates a safety interlock which prevents laser emission when the fiber access cover is removed.



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



If the equipment is used in a manner not specified within this manual the protection provided by the equipment may be impaired.



The fiber access cover should be removed for fiber installation or removal only. Removal of the fiber access cover will result in lasers turning off.

WARNING: Do not remove any covers except the fiber access cover. Removal of covers other than the fiber access cover could expose the user to electrical hazards and moving parts and will void the product warranty.



Do not operate the unit near any flammable materials including flammable gases or liquids.

WARNING: The light engine produces ultraviolet radiation. Never look directly at the output from the optical fiber or at scattered laser light from any reflective surface.

WARNING: Never operate the light engine with the optical fiber disconnected from the fluorescence instrument as visible and invisible laser radiation can be harmful to the unprotected eye and skin.

WARNING: Use the laser in an enclosed room with restricted access.

WARNING: The light engine produces significant amounts of heat. Ensure sufficient clearance around the front and rear of the unit for proper cooling.

WARNING: Never attempt to override safety interlocks or operate unit with interlocks overridden.

6 System Overview

The LDI-6 has six laser lines while the LDI-7 has seven laser lines. Values of the maximum output power of available laser lines in either pulsed or continuous operation are given in Table 1:

Table 1: Maximum output power values for each laser line.

Configuration	Center Wavelength (nm)	Max. Output Power (mW)
LDI-6, LDI-7	405	300
LDI-6, LDI-7	445	1000
LDI-6, LDI-7	470	1000
LDI-6, LDI-7	520	500
LDI-6, LDI-7	528	500
LDI-7	555	1000
LDI-6, LDI-7	640	500

Laser emission is delivered from the LDI through optical fibers which are connected to SMA optical connectors on the top of the LDI in the fiber access area. For the LDI-6 and -7, one SMA output (right side of unit when viewed from the front) corresponds to a multi-color laser diode module which contains the six laser lines 405nm, 445nm, 470nm, 520nm, 528nm, 640nm. This output is labelled “RGGBBV” where the fiber exits the LDI. On the LDI-7, a second SMA output (left side of unit when viewed from front) corresponds to the 555nm laser line. This fiber output is labelled “555”.

Output beam divergence is dependent on the external output fiber installed.

The 555nm laser line can be pulsed up to 120Hz, 50% duty cycle at 100% intensity before performance degradation is evident (4 msec pulse). The RGGBBV lines can be pulsed up to 8000 Hz, 50% duty cycle at 100% intensity before performance degradation is evident (0.625 msec pulse). ‘Performance degradation’ could be laser line failing to achieve full set intensity or irregularity of pulse shapes, depending on the laser line and exact operating parameters. Laser diode lines cannot be overdriven for pulsed operation, i.e. the maximum output powers above hold for continuous wave and pulsed operation.

LDI Overview Figures

LDI:



Figure 2: LDI Model

Front Panel Controls and Indicators:

Laser Ready Indicators

Fiber Access Cover
Release Button

Master Key Switch

Status Indicator &
Soft Power Switch



Rear Panel Connections:



USB Connector:
Host Computer Interface

DB-25 System Connector:
Analog/TTL Interfaces

Remote Interlock

Power Input

Figure 4: Front Panel

Figure 3: Rear Panel

Laser Safety Label Locations:

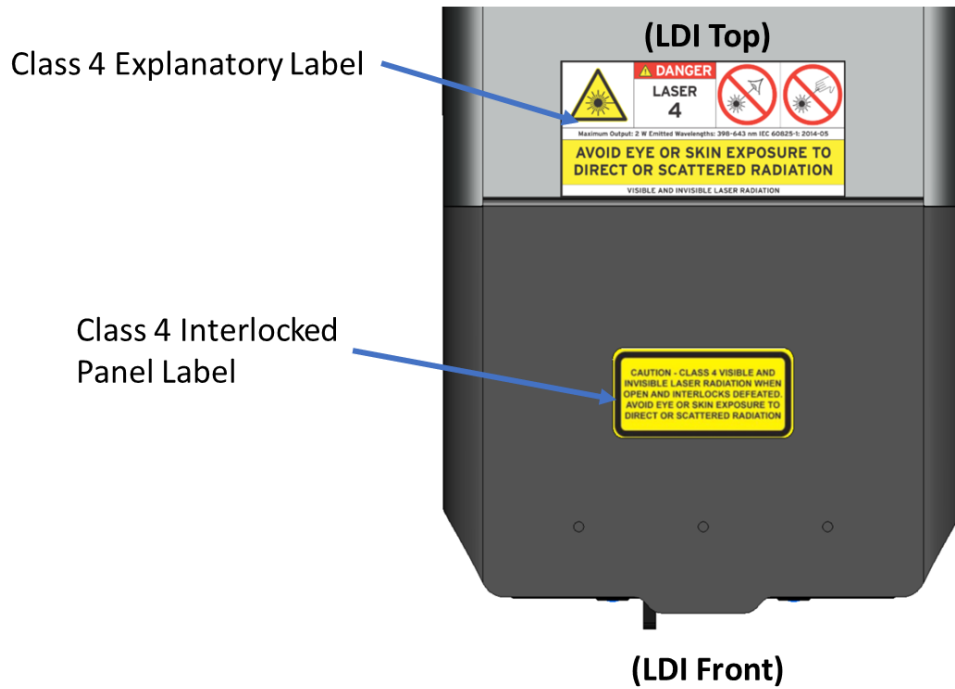


Figure 5: Laser Safety Labels, Interlocked Fiber Access Cover, Class 4 Laser

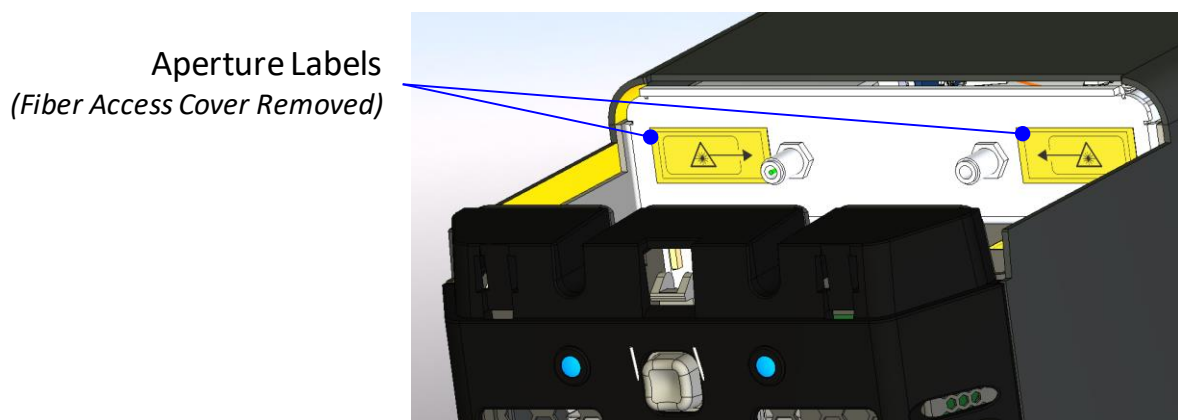


Figure 6: Laser Safety Labels, Apertures



Class 4 Optionally
Interlocked Panel Label

Figure 7: Laser Safety Label, Interlocked Cover

7 I/O Connections

Serial I/O connection is made through the USB connector on the rear panel. Analog voltage and TTL signal connections for intensity and shutter control are made via the DB25 connector on the rear panel:

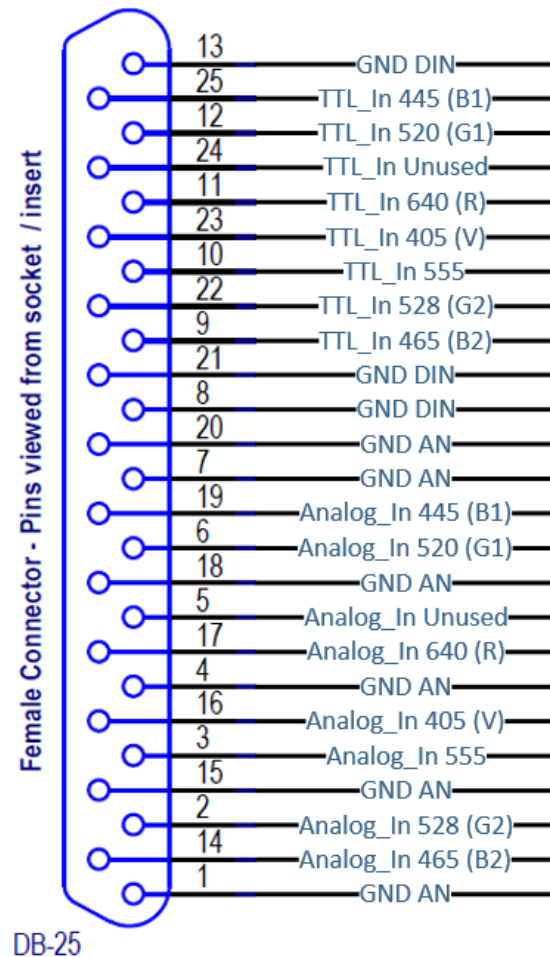


Figure 8: DB25 Connector Pinout

8 Breakout Box (Optional)

The optional 'Breakout Box' provides an external analog intensity control and TTL shutter control connections for each of the channels in the LDI and routes them to the appropriate pins of the LDI interface connector.

The Breakout Box connects to the LDI unit with the supplied DB25 male to male cable. BNC connections are provided to connect to the customer supplied equipment (BNC cables not included).



Figure 9: Breakout Box and Cable

9 Initial Setup

System Components

The LDI-6/7 illumination system is comprised of:

- Laser light engine
- External power supply: AC-DC adapter
- Electrical power cord
- USB cable
- External output fibers (89 North supplied or customer supplied)
- LDI.exe graphical user interface

Carefully unpack all components.

Picking a Location

Place the LDI-6/7 on a flat, level surface, with its feet on the surface in the orientation shown in Figure 2. Set the external power supply on a flat surface that allows for adequate ventilation on all sides. Maintain 6" (15 cm) of clearance on the front and rear of the LDI. Note that the clearance between The LDI and other pieces of heat producing equipment should be increased to ensure that the heat from one unit does not contaminate the required cooling air stream for the other.

NOTE: Maintain **at least 6" of clearance** around the front and rear of the LDI for adequate ventilation.

NOTE: For proper temperature regulation, the LDI must be placed on a flat surface on its feet.

Installing Output Fibers and Master Key

Remove the fiber access cover by pressing the fiber access cover release button and lifting the fiber access cover (Figure 10). Remove the bag containing the master key, USB flash drive, remote interlock mating connector, and SMA-SMA adapter (if ordered).



Figure 10. Top: LDI with the fiber access cover. Bottom: LDI without the fiber access cover.

Install the output fiber(s):

LDI-6: Remove the SMA cap from the SMA connector installed in fiber access area. Connect the output fiber to the SMA connector. Route the fiber through the associated slot in the LDI front panel (Figure 11).

LDI-7: Remove the SMA caps from the SMA connectors installed in fiber access area. Connect output fibers to the SMA connectors. Route the fibers or bifurcated fiber legs through the associated slots in the LDI front panel (Figure 11). Note: If an output channel is not intended to be used, i.e. the output fiber for this channel will not be installed, the SMA cap for that channel should remain in place.

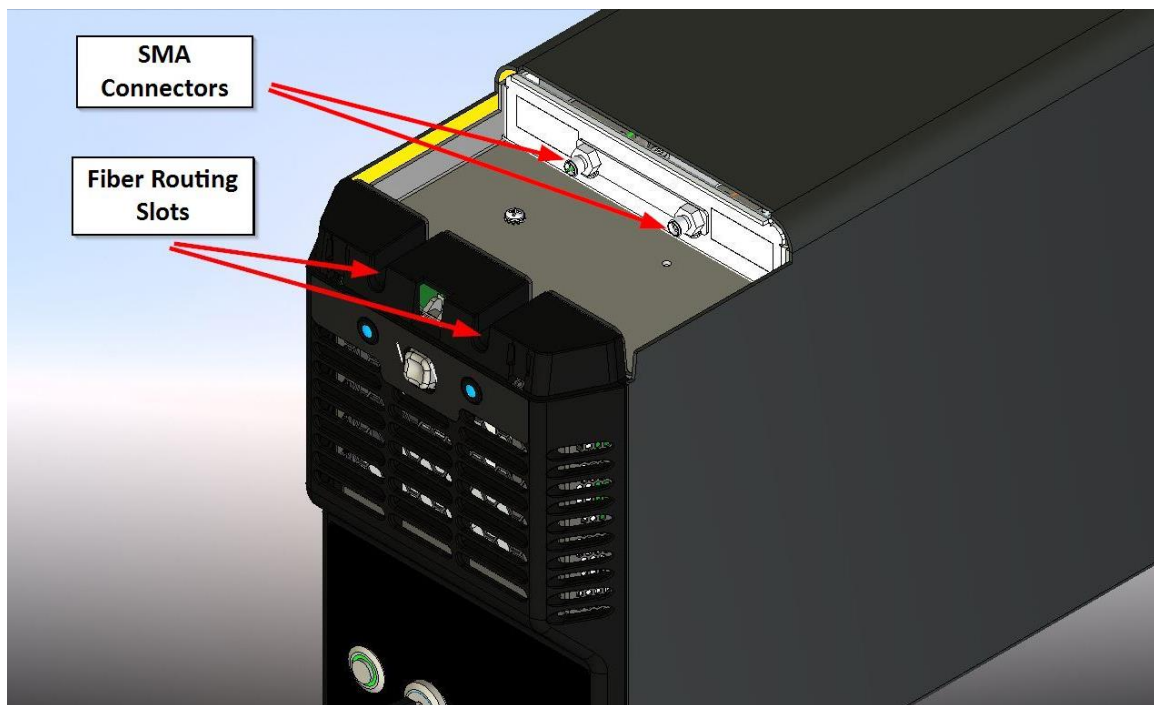


Figure 11. Fiber routing slots in the front panel of the LDI.

Replace the fiber access cover by inserting the lip of the fiber access cover into the fiber access cover slot, as shown in Figure 12.

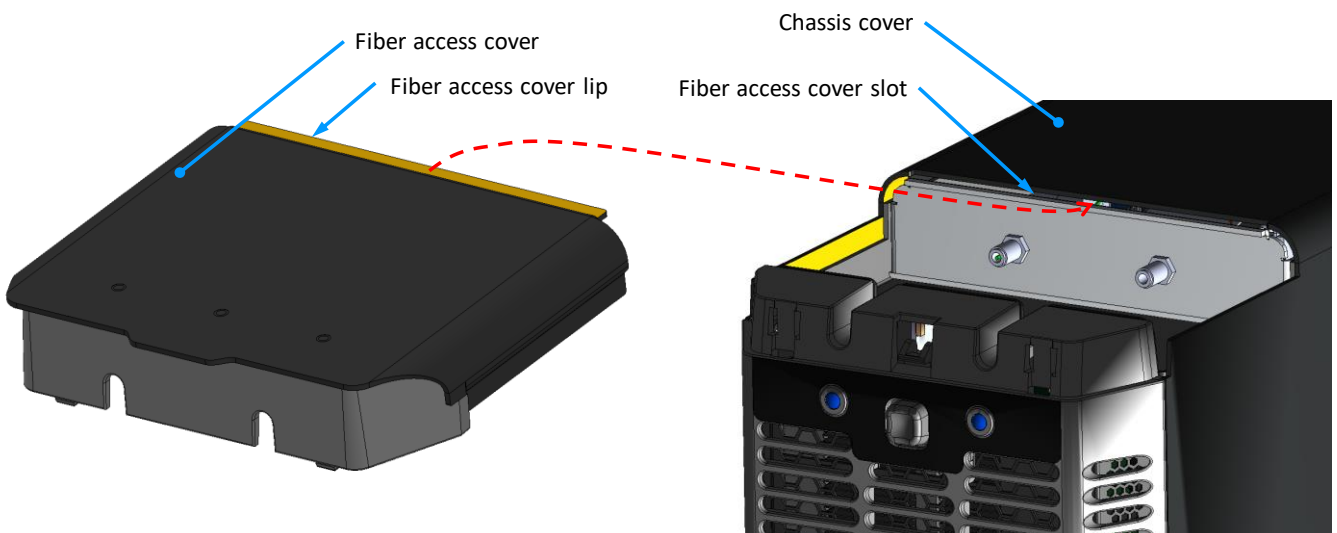


Figure 12: Fiber Access Cover Replacement

Close the fiber access cover by pressing down on the cover until it latches. If the fiber access cover is not properly installed and closed, the LDI will not emit light.

Connect the distal end of the installed output fiber(s) to customer-supplied equipment.

Connecting the AC-DC Power Supply and AC Power Cord

Insert the external power supply cord receptacle into the DC jack on the rear of the LDI (Figure 13). Insert the AC power cord plug receptacle end into the AC plug on the external power supply. Plug the AC power cord into a standard AC outlet. See the technical specifications in this manual for power requirements.



Only the power cord supplied with the unit should be used. The use of an inadequately rated power cord may impair safe operation of the equipment.



Figure 13. Power connection on the LDI rear panel.

Setting Up Control Interfaces

Run "LDI Setup.exe" supplied on the USB flash drive to install the LDI graphical user interface ("LDI.exe") and device drivers on the host PC. Follow the prompts to complete the installation. Note: The device drivers will install after the LDI.exe application install completes.

If external signals will be used for controlling intensities and/or shutters, connect the control cable to the DB25 system connector on the LDI rear panel (Figure 14).

Connect the USB port to the host PC with the cable provided (Figure 14).

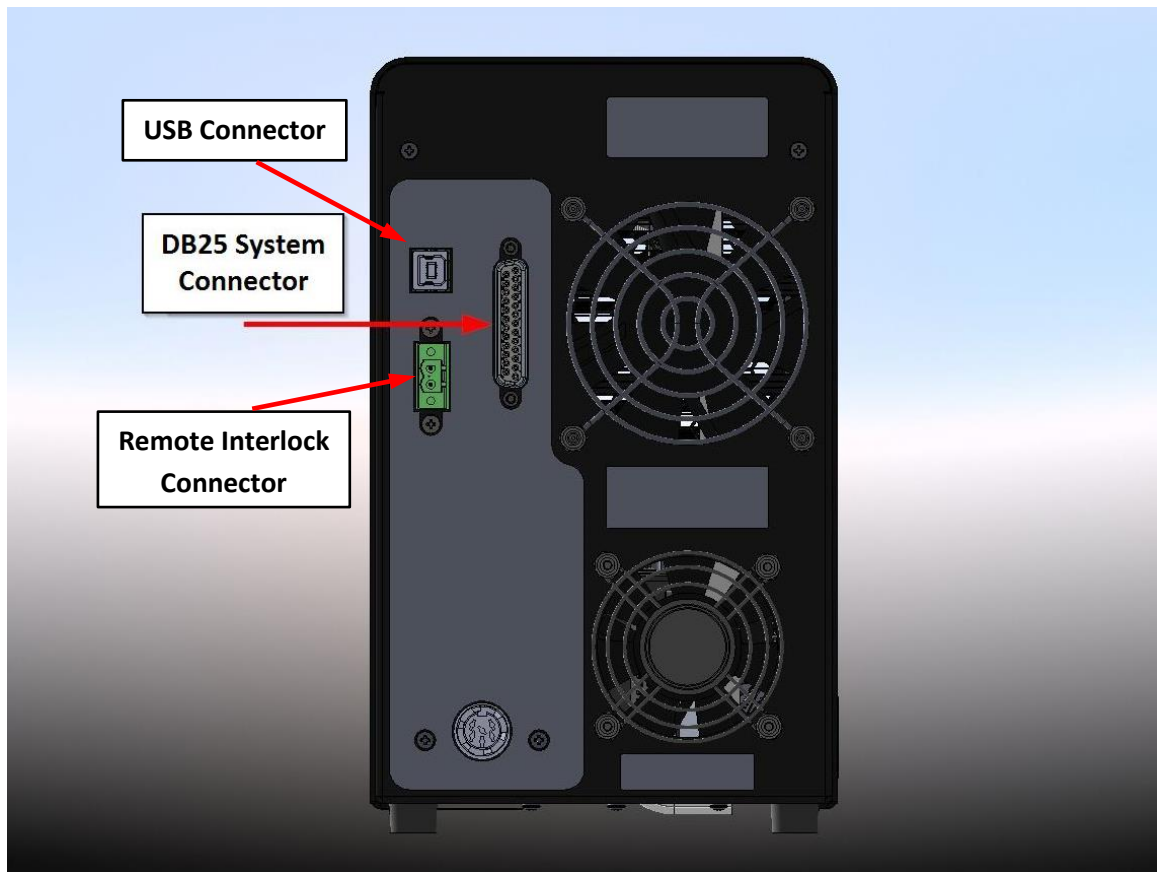


Figure 14. DB25 connection on the LDI rear panel.

Installing Master Key and Remote Interlock

Install the master key in the LDI front panel. Leave the master key in the OFF position until the LDI is ready for use.

Terminate the leads of the customer-supplied equipment interlock to the remote interlock mating connector provided. Connect the resulting remote interlock cable to the remote interlock connector on the LDI (Figure 14).



The remote interlock insures that laser emission is not accessible when the terminals of the interlock are open-circuited. Operating the LDI without the remote interlock properly connected to the customer-supplied equipment may impair safe operation of the equipment.

Turn the master key to the ON position. The LDI is now ready to be operated.

Additionally, cycling the master key ON-OFF-ON again will often clear a fault. See Troubleshooting for further information.

10 Operation

WARNING: Caution - use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

WARNING: Even with protective eyewear, **never look directly into the fiber** or allow for skin to be exposed to the beam, as invisible laser radiation can be harmful to the eyes and skin.

Following initial setup, the LDI is ready to operate. The LDI can be controlled using the graphical user interface provided (LDI.exe), through serial commands sent to the LDI via USB, or through external analog and TTL signals to control intensity and shutter positions, respectively. To control the LDI via serial commands, refer to the LDI End-User Command Specification. The LDI GUI must be used to set control modes and perform firmware updates.

With the LDI connected via USB to the host PC, launch the LDI GUI (LDI.exe) on the host computer. Prior to powering the LDI on, the GUI should appear as seen in Figure 15.



Figure 15. The GUI prior to powering on the LDI.

Depress the power switch on the front panel to turn the LDI on. The unit will start in Warm-Up mode, as indicated by the yellow indication on the front panel status ring LED. The LDI is ready for operation when Warm-Up is completed, which is indicated by the front panel status LED turning green. Front panel indication is also indicated in the upper right corner of the GUI; mode status and fault indication is indicated in status bar in the bottom left corner of the GUI (Figure 16).

NOTE:

This equipment has been successfully tested for EMI/RFI radiation and susceptibility; however, if not installed and used in accordance with these instructions, interference with other devices in the near vicinity may occur. If this equipment does cause harmful interference to other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving device.
- Increase the separation between the equipment.
- Connect the equipment into an outlet on a circuit different from that to which the other device(s) are connected.
- Consult the manufacturer or field service technician for help.

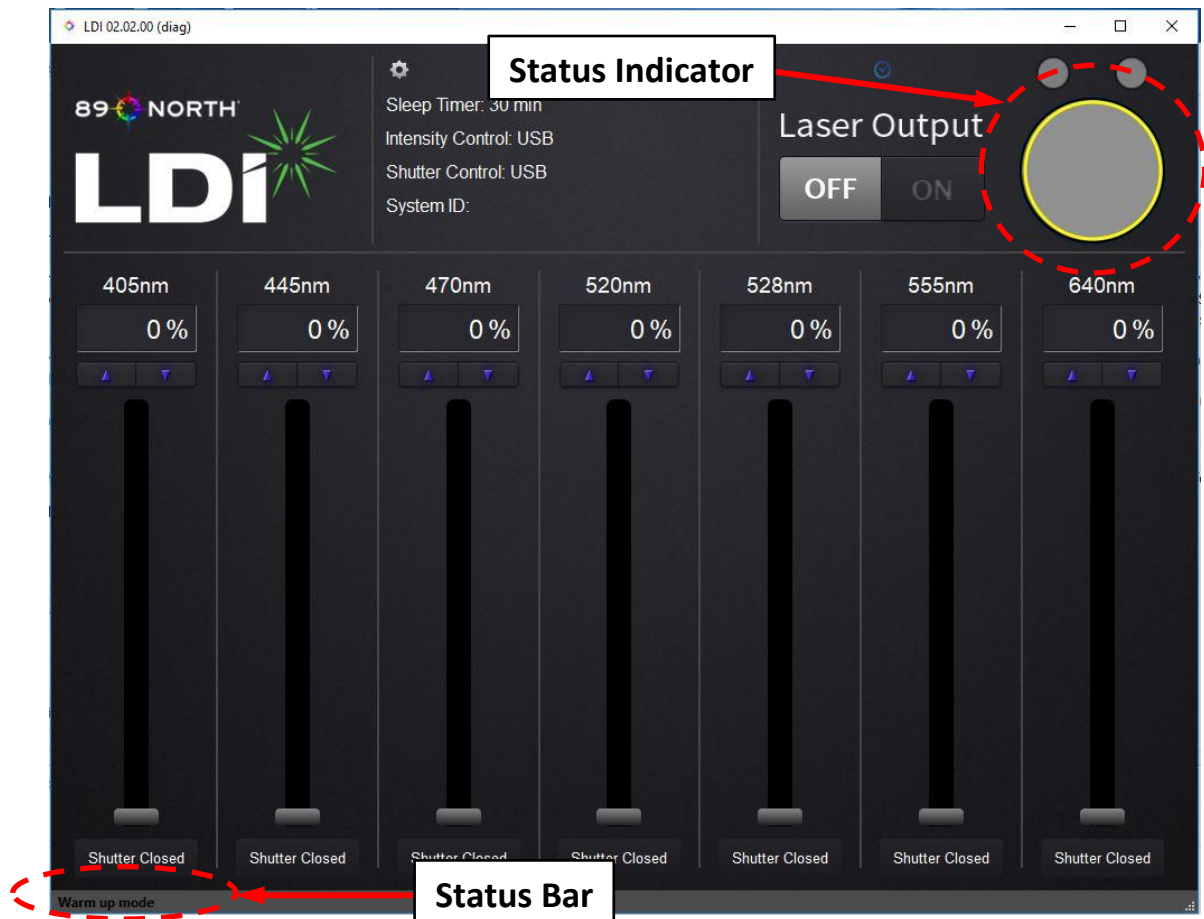


Figure 16. Here, the ring in the upper right corner of the GUI is yellow, indicating that the LDI is in Warm-up mode. The operating mode is indicated in the status bar in the lower left corner.

Setting the Control Mode

After the unit completes Warm-up, configure the desired shutter and intensity control modes from 'Control Modes' tab in the 'System Info & Settings' window. The 'System Info & Settings' window is accessed by gear icon in the LDI GUI (Figure 17).

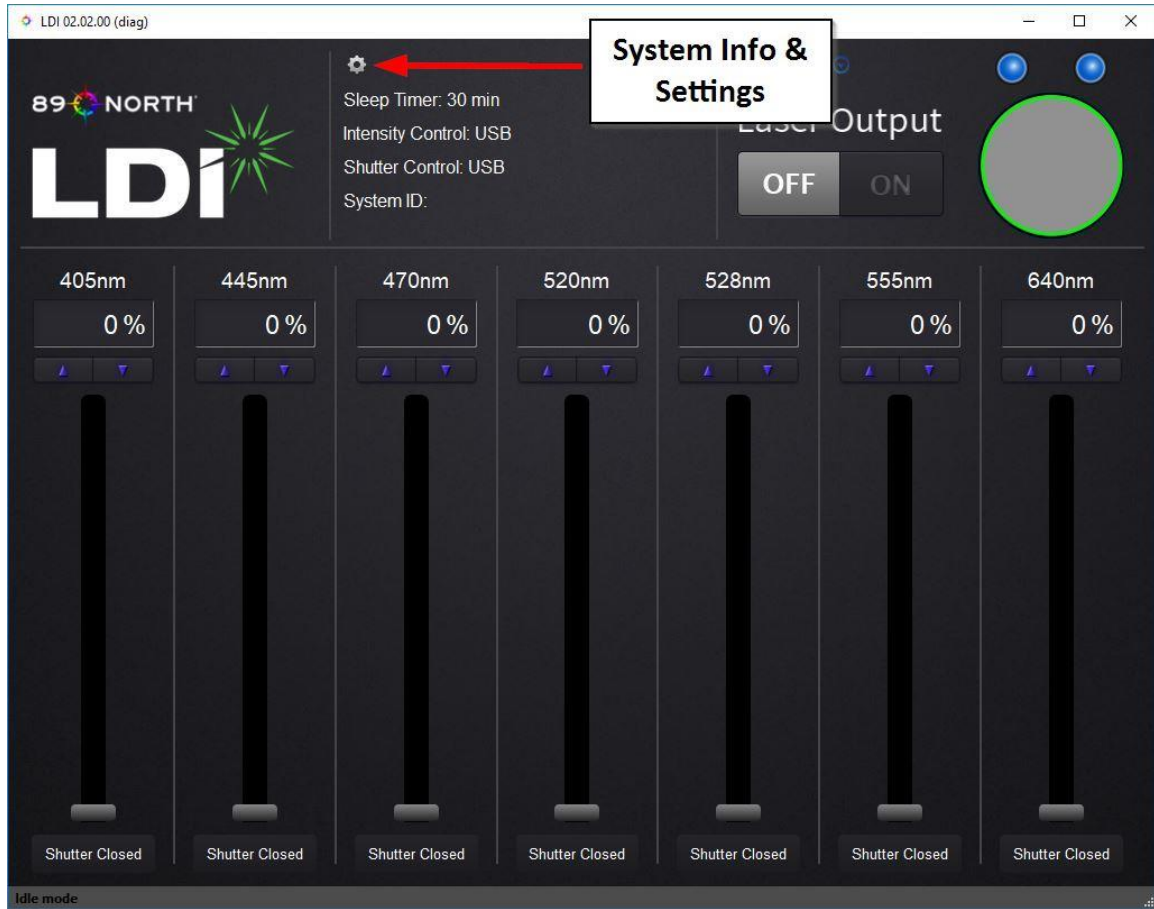


Figure 17. System Info & Settings can be accessed by pressing the gear icon. Also note that the ring indicator is now green, indicating that the LDI is no longer in Warm-up mode.

The 'Control Mode' tab lists options for the control modes of laser intensity and shutter control (Figure 18). Intensity control mode options are 'Host USB' or 'External Analog'; shutter control mode options are 'Host USB' or 'External Digital'.

If 'External Digital' shutter control mode is selected, configure the TTL shutter positions in the 'TTL Configuration' tab of the 'System Info & Settings' window (Figure 19). Options are active (shutter open) high or active (shutter open) low.

When control modes have been set, select OK to close the 'System Info & Settings' window. Control mode settings will be retained between LDI power cycles.

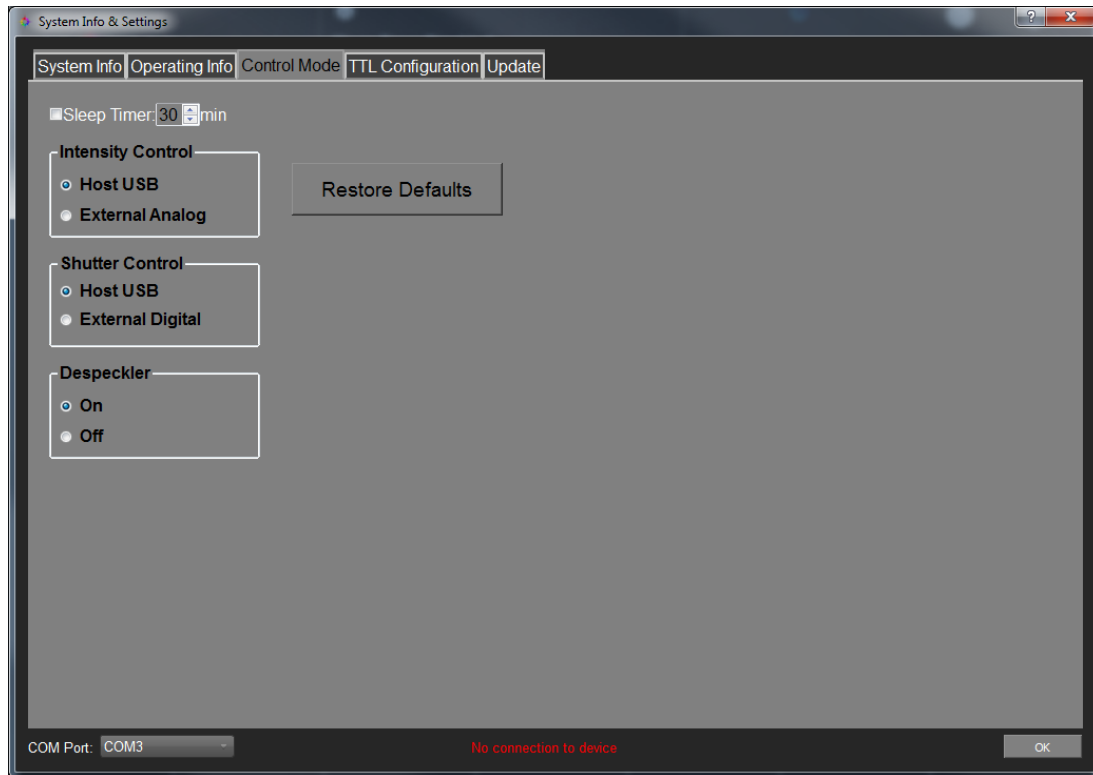


Figure 18. The 'Control Mode' tab in the GUI.

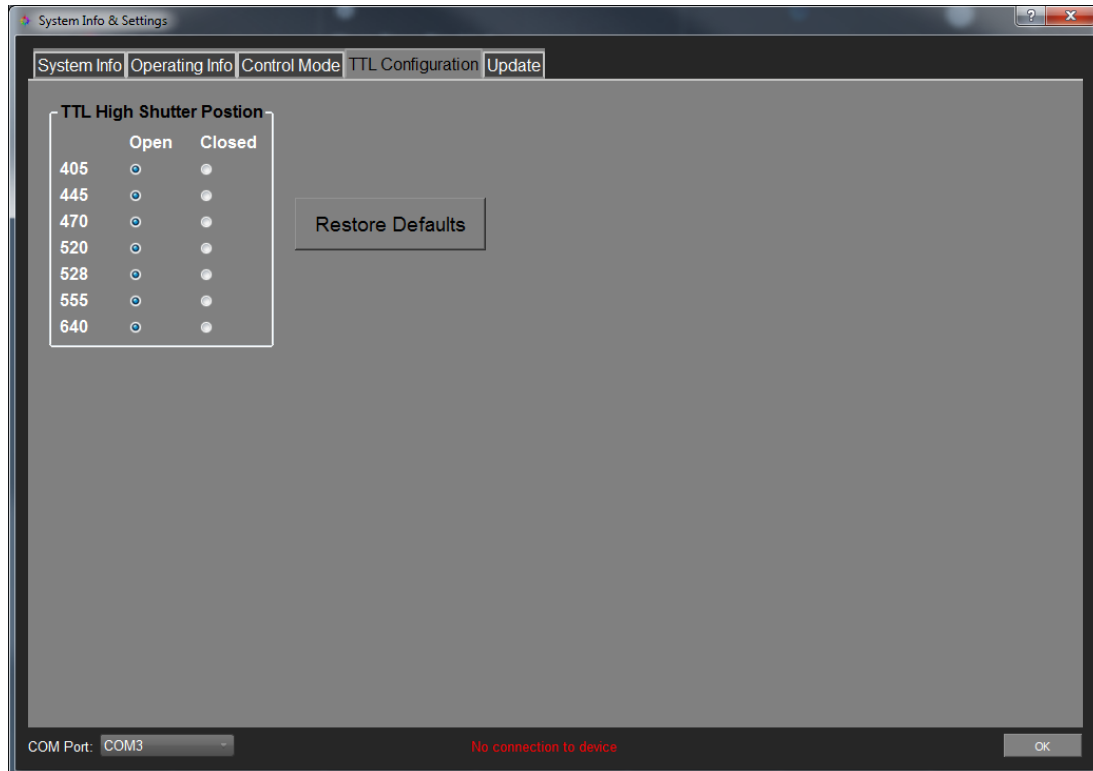


Figure 19. The 'TTL Configuration' tab in the GUI.

If 'Host USB' mode is selected for intensity control, set channel intensities to the desired levels (0-100%) via the slider, arrows (incrementing by 1%), or text controls in the GUI (Figure 20). Additionally, clicking in the intensity bar space for a given channel will increment the intensity setting by 10%.

If 'External Analog' control mode is selected for intensity control, verify the applied voltage levels (0-5V) correspond to the desired intensity settings as reported in the GUI.

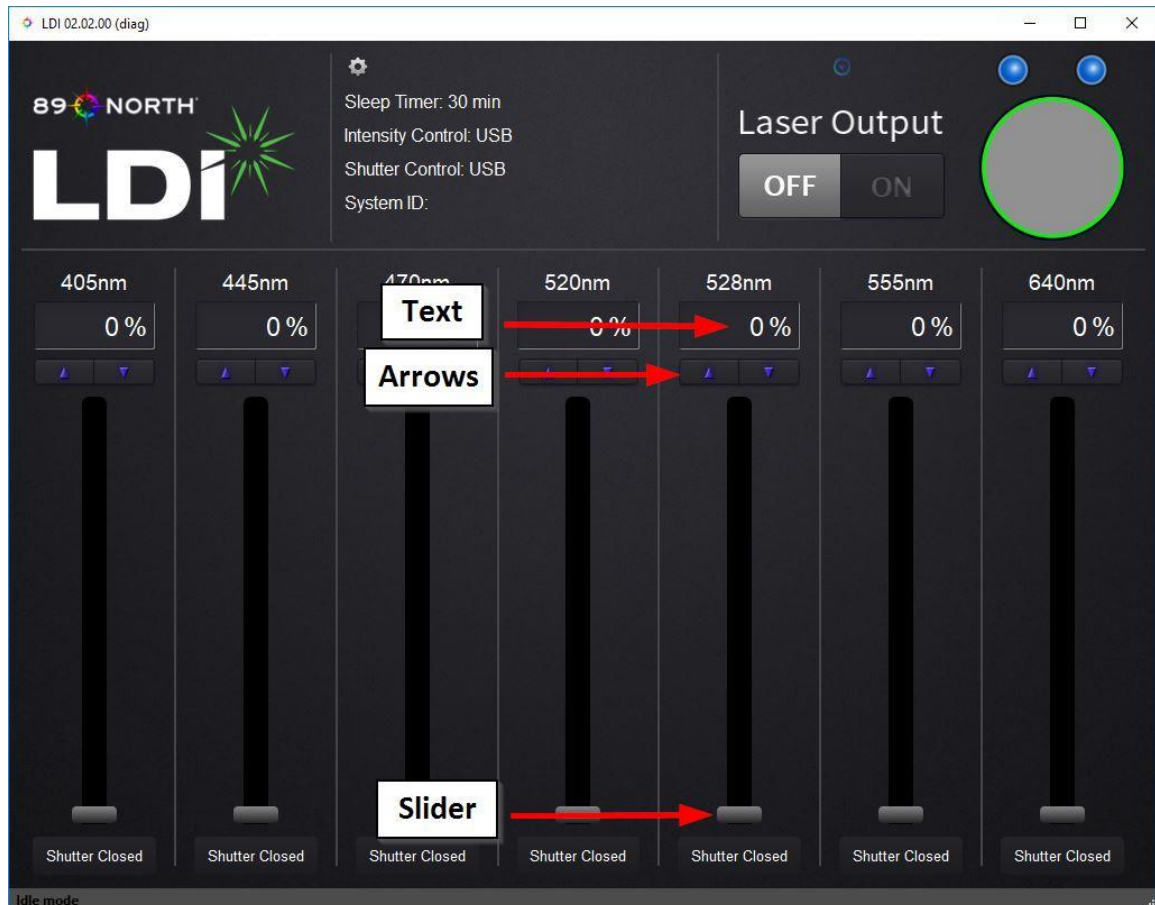


Figure 20. Controls of the LDI can be changed on the home screen of the GUI using the slider, arrows, text boxes, or by clicking in the intensity bar space.

If 'Host USB' mode is selected for shutter control, open the shutters of the desired channels by clicking the shutter buttons of the corresponding channels. The buttons will toggle between “Shutter Open” and “Shutter Closed” when clicked.

Turning Lasers On (Run Mode)

The LDI supports the concurrent operation of up to 4 laser lines. In ‘Host USB’ control mode, the system limits the number of concurrently open shutters to 4. In ‘External Digital’ shutter mode, the number of concurrently open shutters is not constrained by the LDI firmware. Attempting to operate more than 4 channels simultaneously could lead to performance degradation or over-temperature conditions. Operation of more than 4 laser line channels simultaneously is not recommended.



Attempting to operate more than 4 channels simultaneously could lead to performance degradation and/or over-temperature conditions. Operation of more than 4 laser lines simultaneously is not a supported operating mode.

Light will not emit from the system until Run mode is selected. If 'External Digital' mode is selected for shutter control, verify that the shutters indicated as Open correspond to the desired channels.

Click the ON button in the upper right corner of the GUI to put the system in Run mode. When the system is in Run mode, laser light will emit from channels with Open shutters and intensities greater than 0%.

NOTE:

The LDI will not produce light until commanded into the Run mode. The System Indicator icon in the upper right corner of the GUI will display the IEC laser radiation warning symbol when the system is in Run mode.

If 'Host USB' mode is selected for shutter control, to turn a channel off, click the corresponding shutter button to turn it to "Shutter Closed". If 'External Digital' mode is selected for shutter control, to turn a channel off, set the corresponding TTL input voltage to the Shutter Closed TTL level.

To turn all channels off, click the OFF button in the upper right corner of the GUI to put the system in Idle mode.

At any point, depressing and releasing the soft power button on the LDI front panel will remove power from all lasers. Alternatively, selecting 'System Reset' from the 'System Info' tab of the 'System Info & Settings' window will also remove power from all lasers and restart the system, as if the soft power button was toggled (Figure 21).

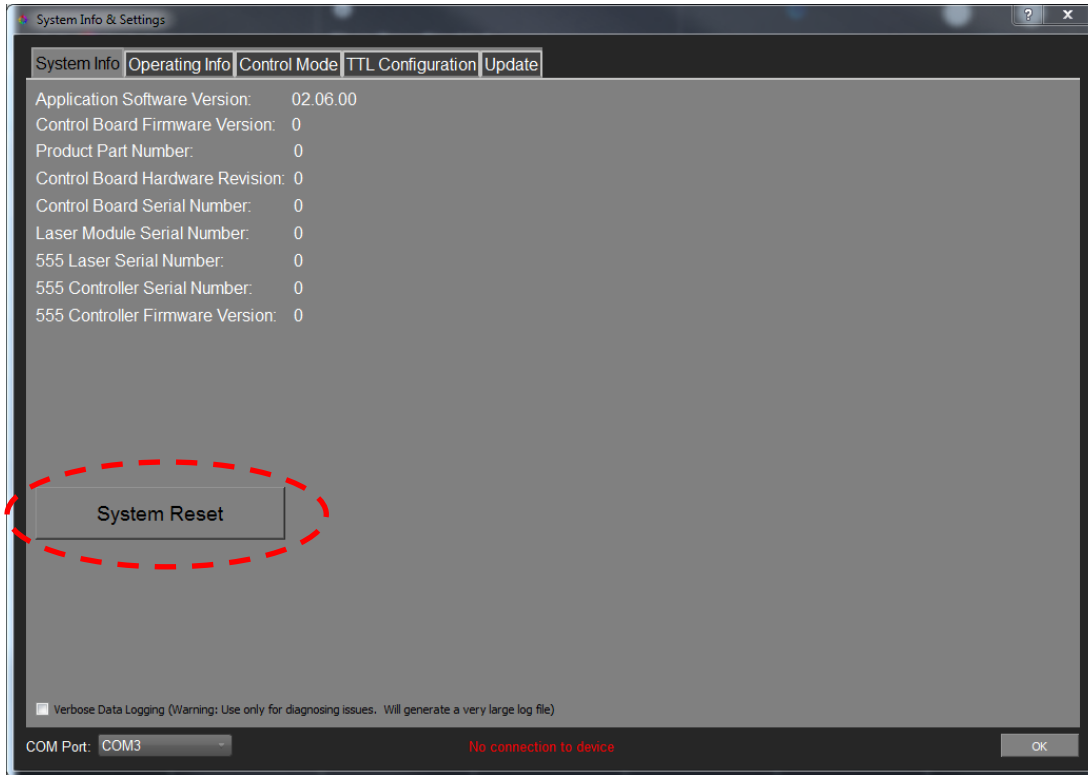


Figure 21: System Reset Button

System Status Indicators

A multi-color System Status indicator ring LED is located on the front panel soft power switch. The System Status Indicator LED has 3 possible states in normal operation:

- Yellow, solid: Indicates the system is in Warm-Up mode
- Green, solid: Indicates the system is in Idle or Run mode, ready to be operated and produce laser emission
- Red, solid: Indicates the system is has a fault

Other indications are utilized for factory service modes. If the Status Indicator LED displays a color or blink rate other than described above, contact 89 North. See “Troubleshooting”.

Laser Ready Indicators

As shown in Figure 4, the front panel of the LDI includes two Laser Ready Indicators. These indicators illuminate blue when laser emission through the corresponding aperture can occur. Both Laser Ready Indicators will remain extinguished while the system is in Warm Up mode since laser emission is prevented in this mode. Once the system has completed warm up, the Laser Ready Indicator will illuminate blue for any aperture which is capable of producing laser emission and has a fiber installed.

WARNING: Laser Ready Indicators will illuminate blue whenever the corresponding aperture is capable of producing laser emission.

11 Maintenance

No scheduled user or factory maintenance is required for the LDI.



All maintenance and/or repair is to be performed by qualified personnel only.

Under no circumstances should any cover other than the fiber access cover be removed as electrical, mechanical, and radiation hazards exists.

Keep housing vents dust free.

If the unit should malfunction, please contact 89 North or you authorized 89 North distributor.

12 Troubleshooting

During normal operation, the Status Bar at the bottom of the LDI GUI screen will indicate which operation mode the LDI is in and the Status Indicator will be yellow or green; see Figure 16. The Status Indicator should reflect the status of the front panel LED. Should a problem or fault occur, the Status Indicator and front panel Status Indicator LED may change color, and/or the status bar may display an error message.

Clearing a Fault

Some faults will clear automatically when the fault condition is removed. Others require clearing manually. Faults can be cleared manually (if the fault has been removed) by clicking the GUI status indicator (See Figure 16) and/or cycling the master key on-off-on. **Attempt to remove the fault condition and clear the fault before cycling the power (unplug-plugin) in all cases.**

Below is a list of more common fault messages. Should the recommended actions not correct the problem, please contact 89 North Technical Support.

Fault or Error Message	Error Code	Source of Fault or Error	Corrective Action
Status Indicator LED is solid RED		The system is in fault.	Check the status bar for fault information. Note the status message displayed. Cycle the system power.
SYSTEM_FAULT_UNKNOWN		Unknown fault.	Please contact a technical representative if this error persists.

SYSTEM_FAULT_COVER_REMOVED		Interlock - Cover Removed.	Please contact a technical representative if this error persists.
SYSTEM_FAULT_INTERLOCK_USER_OPEN		Interlock - Remote Open.	Verify that the eyepiece interlock on the back of the LDI is properly installed and in the proper state.
SYSTEM_FAULT_INTERLOCK_FIBER1_OPEN		Interlock - Novalum Fiber Open.	Verify that the interlock switch in the RGGBBV fiber routing slot on the front of the LDI is completely depressed and the "Laser Ready" light is blue. See Figure 11.
SYSTEM_FAULT_INTERLOCK_FIBER2_OPEN		Interlock - 555 Fiber Open.	Verify that the interlock switch in the 555 fiber routing slot on the front of the LDI is completely depressed and the "Laser Ready" light is blue. See Figure 11.
SYSTEM_FAULT_OVER_CURRENT		Over current.	Please contact a technical representative if this error persists.
SYSTEM_FAULT_NECSEL_OVER_TEMP		Necsel Over Temp.	Close all shutters and let the system cool down. If the error persists, verify that the unit is operating within the specified ambient temperature range and nothing is blocking the air inlet or exhaust.
SYSTEM_FAULT_NECSEL_UNDER_TEMP		Necsel Under Temp.	Verify that the unit is operating within the specified ambient temperature range. Please contact a technical representative if this error persists.
SYSTEM_FAULT_NOVALUM_OVER_TEMP		Novalum Over Temp.	Close all shutters and let the system cool down. If the error persists, verify that the unit is operating within the specified ambient temperature range and nothing is blocking the air inlet or exhaust.
SYSTEM_FAULT_NOVALUM_UNDER_TEMP		Novalum Under Temp.	Verify that the unit is operating within the specified ambient temperature

			range. Please contact a technical representative if this error persists.
SYSTEM_FAULT_COM_ERROR		Communications Error.	Check USB cable connection to the host PC. Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
SYSTEM_FAULT_SYSTEM_ERROR		System Error.	Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
SYSTEM_FAULT_CHANNEL_ERROR		Channel Error.	Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
SYSTEM_FAULT_NOVALUM_HAL_ERROR		Novalum HAL Error.	Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
SYSTEM_FAULT_SYSCOM_HAL_ERROR		Interlock HAL Error.	Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
SYSTEM_FAULT_INTERLOCK_CVR_REED_OPEN		The Fiber Access Cover is open.	Verify that the fiber access cover is completely closed, and nothing is in-between the cover and the LDI. See Figure 12.
SYSTEM_FAULT_OVER_FREQUENCY		Over-Frequency.	Decrease the frequency at which the laser is being pulsed.
SYSTEM_FAULT_I2C_TIMEOUT		I2C Timeout.	Unplug the unit and wait 10 seconds before reapplying power to the system. If

			the error persists, please contact a technical representative.
T_COM_HAL_COM_ERR	-20035	HAL/low level communications failure.	Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
FIRMWARE_SYSTEM_IN_WARMUP	-20100	Attempted to go to RUN mode when system still in WARMUP	Wait for the system to exit WARM-UP mode and transition to RUN mode.
FIRMWARE_MAX_SHUTTERS_OPEN	-20103	Attempted to open a shutter when maximum number already open	Only 4 shutters can be open at one time. If this fault persists while less than four shutters are open, unplug the unit and wait 10 seconds before reapplying power to the system.
FIRMWARE_NECSEL_CONTROLLER_TEMP_SERVO	-20259	Necsel Controller temperature servo error	Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
FIRMWARE_NECSEL_CONTROLLER_LASER_UNDER_TEMP	-20262	Necsel Controller laser under temp error	Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
FIRMWARE_NECSEL_CONTROLLER_LASER_OVER_TEMP	-20263	Necsel Controller laser over temp error	Close all shutter and let the system cool down. If the error persists, verify that the unit is operating within the specified ambient temperature range and nothing is blocking the air inlet or exhaust.
FIRMWARE_NECSEL_CONTROLLER_CURRENT_AT_RAIL	-20265	Necsel Controller current at rail error	Please contact a technical representative if this error persists.
PC_APP_WRITE_COMMAND_ERR	-40006	LDI UI - communication error with LDI	Make sure the LDI is powered on. Check USB cable connection to the host PC and the LDI. Disconnect the LDI from the PC,

			wait 10 seconds and reconnect the LDI to the PC. Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.
PC_APP_WRITE_TIMEOUT_ERR	-40007	LDI UI - communication timeout with LDI Usually during a firmware update	If you were trying to update your unit's firmware, try updating the firmware again. If the error persists, place the unit in boot loader mode by holding down the soft power button until it starts blinking blue, then try updating the firmware again. If the error persists, please contact a technical representative.
PC_APP_WRITE_FLASH_ERR	-40008	LDI UI - error updating firmware	If you were trying to update your unit's firmware, Try updating the firmware again. If the error persists, place the unit in boot loader mode by holding down the soft power button until it starts blinking blue, then try updating the firmware again. If the error persists, please contact a technical representative.
PC_APP_INVALID_RESPONSE	-40009	LDI UI - received invalid response from LDI	Check USB cable connection to the host PC. Unplug the unit and wait 10 seconds before reapplying power to the system. If the error persists, please contact a technical representative.