Operation and Service Manual

NL100
Nitrogen Laser

Stanford Research Systems

Revision 1.6 (12/07/04)

Certification

Stanford Research Systems certifies that this product is in compliance with U.S. Code of Federal Regulations Title 21, Part 1040.10 and that it met its published specifications when shipped.

Warranty

This product is warranted against defects and materials for a period of one (1) year after shipment. The laser cartridge is warranted for a period of two (2) years or 20,000,000 laser shots, whichever comes first.

Service

For warranty service or repair, this product must be returned to a Stanford Research Systems authorized service facility. Contact Stanford Research Systems or an authorized representative before returning this product for repair.

Information in this document is subject to change without notice.

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Printed in U.S.A.

Safety and Preparation For Use

CAREFULLY READ THE SAFETY INFORMATION IN THIS SECTION BEFORE USING THE NL100 NITROGEN LASER. LASER SAFETY PAYS!

The NL100 Nitrogen Laser is a Class IIIb that emits invisible ultraviolet (UV) radiation at 337.1 nm with sufficient intensity to be considered an acute hazard to human eyes and skin. Therefore, all persons operating the NL100 laser and all persons in the vicinity of the NL100 laser when it is in operation must be aware of the hazards of UV laser beams.

Basic Safe Laser Practices

- **NEVER** look directly into the laser beam.
- Only qualified personnel should operate the laser system.
- Always wear laser safety glasses or eyewear that protects against UV laser light whenever the red LED emission indicator is lit. See below for a partial vendor list of laser safety eyewear.
- Do not expose skin to the laser beam because burns may result. Chronic exposure of skin to UV light may increase the risk of skin cancer.
- Do not expose eyes or skin to specular reflections generated by the laser beam and an optical surface.
- Securely mount the NL100 laser system and all optical elements in the beam path. Trace all specular reflections of the laser beam and block eye or skin access to these specular reflections.
- NEVER operate the laser with the protective housing off. The laser power supply generates high voltages and currents that have the potential to produce a lethal electrical shock.

Stanford Research Systems recommends that users obtain the American National Standards (ANSI) Z136.1 (2000) Safe Use of Lasers, (available from the Laser Institute of America on the Internet at www.laserinstitute.org) or the IEC 60825-1 Safety of Laser Products – Part 1: Equipment Classification, Requirements, and Users Guide prior to operating the NL100 nitrogen laser system.

Safety Features and Warning Labels

The NL100 laser system has been designed with the required safety features for compliance with 21 CFR 1040.10, which regulates laser products manufactured in the U.S.A.

1. Protective housing
2. Beam shutter
3. Remote interlock connector
4. Emission indicator
5. Key switch
6. Three-second delay (not shown)

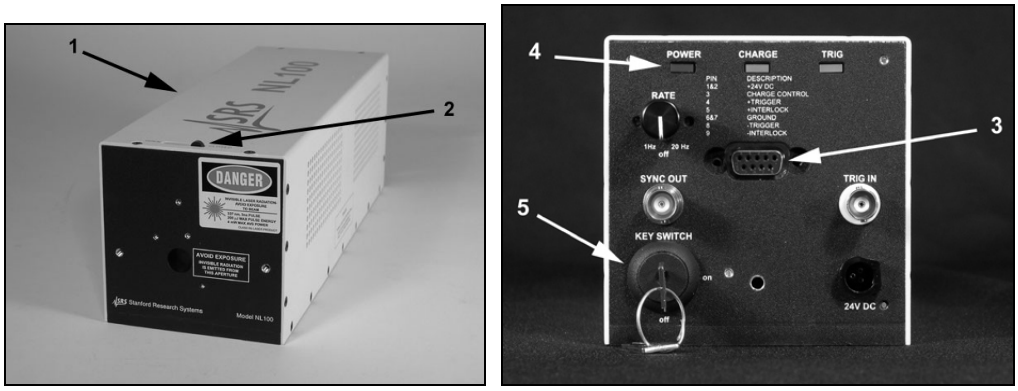

Figure 1. Front and back views of the NL100.

Warning Labels

The NL100 laser system has been designed with the required warning labels for compliance with 21 CFR 1040.10, which regulates laser products manufactured in the U.S.A.

A. Warning logotype
B. Aperture warning
C. Protective housing warning
D. Certification/Identification label (On bottom plate)

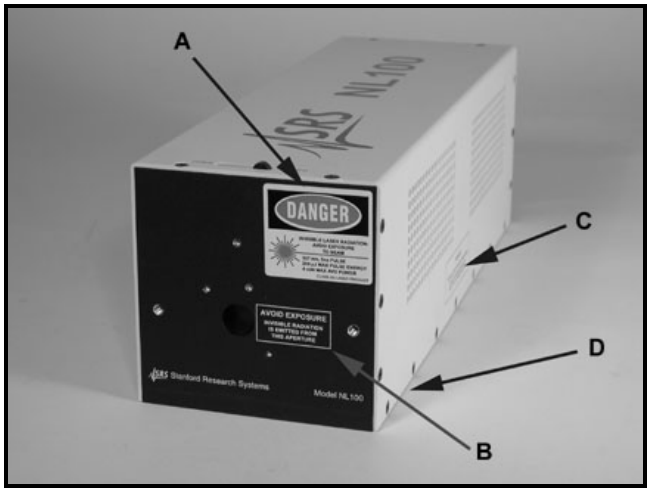

Figure 2. Location of warning labels on the NL100.

The warning labels that are attached to the NL100 or are painted onto the case are reproduced below. These warning labels are a requirement for compliance with 21 CFR 1040.10.

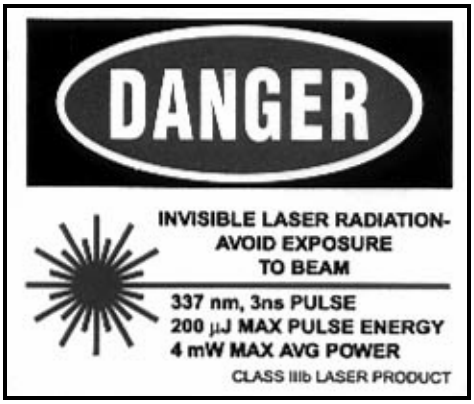

Figure 3. Danger warning label, located on the front panel.

Figure 4. Aperture label, located on the front panel, near output aperture.

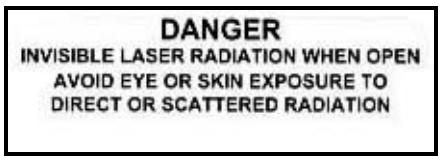

Figure 5. Protective housing label, located on both sides of the protective cover.

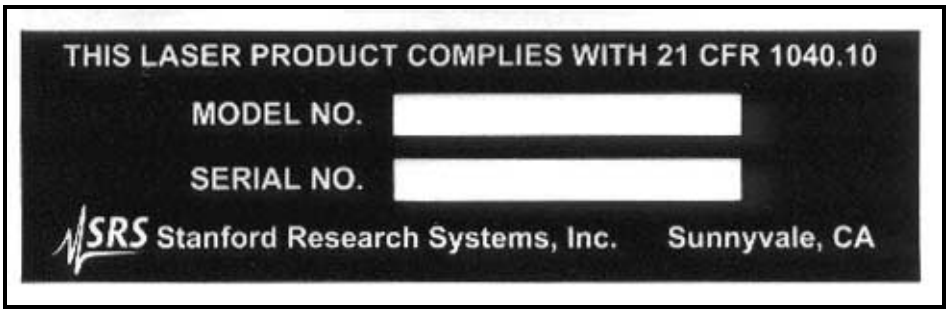

Figure 6. Identification and certification label, located on bottom plate.

Vendors of Laser Safety Eyewear

Below is a partial list of vendors of laser safety eyewear. SRS does not endorse these vendors or their products over other available safety eyewear vendors and products, and provides this vendor list only for reference.

Kentek Corporation
1 Elm Street
Pittsfield, NH 03263
800-432-2323
www.kentek-laser.com

Rockwell Laser Industries
7754 Camargo Rd.
Cincinnati, OH 45243
www.rli.com

Lase-R Shield
7011 Prospect Place NE
Albuquerque, NM 87110
1-800-288-1164
www.lase-rshield.com

GPT Glendale, Inc.
5300 Region Court
Lakeland, Florida 33815
800-500-4739
www.glendale-laser.com

Trinity Technologies
4110 Central Avenue NE
Minneapolis, Minnesota 55421
Phone: 763-788-8278
www.lasersafety.com

NL100 Nitrogen Laser Specifications

Optical

Laser wavelength	337.1 nm
Optical bandwidth	0.1 nm
Pulse repetition rate	1-20 Hz, internal trigger; 0-20 Hz external trigger
Pulse width	<3.5 ns (FWHM)
Pulse energy	175 μJ
Peak power	50 kW
Average power	3.5 mW
Beam size	3 x 7 mm
Beam divergence	5 x 8 mrad
Shot-to-shot energy stability	< 3% standard deviation

Electrical

Trigger mode	internal or external
Power requirements	+24 VDC, 3 A peak, 1.5 A average @ 20 Hz

Mechanical

Dimensions	11”L x 3.75”W x 3.75”H, 27.9 x 9.5 x 9.5 cm
Weight	7.5 lbs, 3.4 kg

Contents

Unpacking

WARNING!
Read the safety information and these operating instructions carefully before operating this laser system.

Checklist

- Open the box and inspect all components of the NL100 laser system.
- Report any damage to Stanford Research Systems immediately.
- Compare the contents of the shipping box against your original order and the checklist below. Report any discrepancies immediately.

Standard Equipment and Supplies

- NL100 laser system unit
- One Hypertronics #D01PB 306 MST plug
- Two keys for the key switch
- Two DB-9 connectors, one labeled “CCON” and the other labeled “CCOFF”

Optional Equipment

- Optical synchronous detection circuitry, installed in factory
- Synch. out BNC connector, back panel

Additional Necessary Equipment

- 24 VDC, 50 W, 3 A peak power supply

Operating Instructions

WARNING!
Read the safety information and these operating instructions carefully before operating this laser system.

Operating Controls

The operating controls for the laser system, with the exception of the beam shutter, are located on the back panel, as shown in Figure 7.

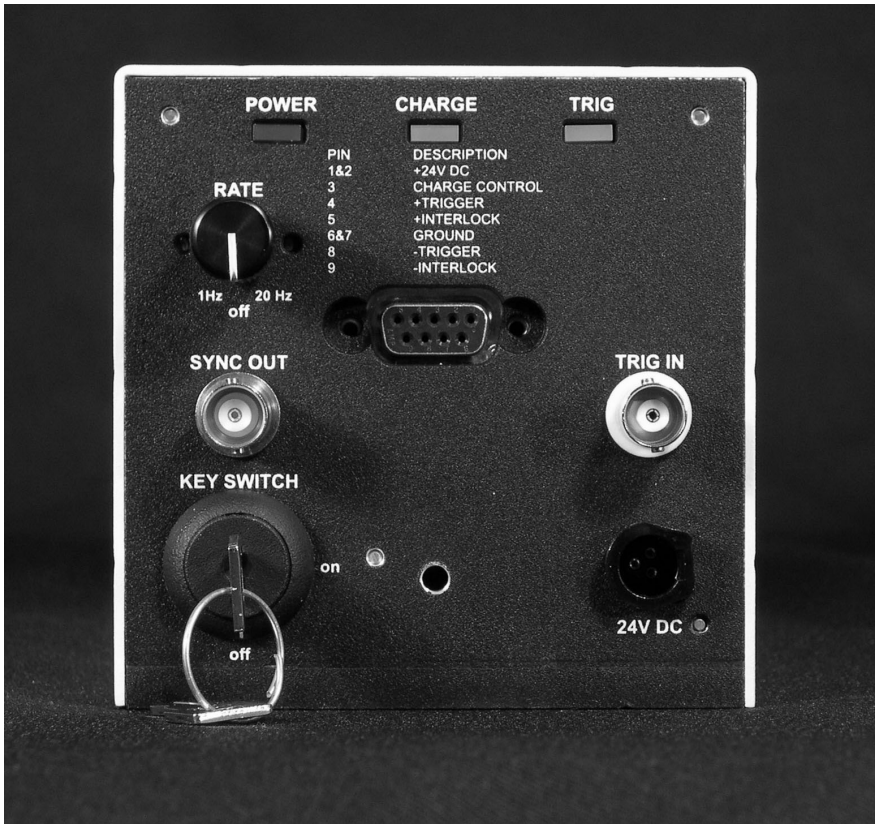

Figure 7. Back panel and operating controls of the NL100.

Key Switch

Turning the key switch to the ON position connects the 24V DC input power to the laser system, the POWER LED illuminates, and the laser system begins a 3-second delay timer. Following the 3-second delay, the laser is armed and ready to fire, either from an

internal trigger (see RATE below) or from an external trigger. The key cannot be removed from the key switch when the switch is in the ON position.

Power Input

The NL100 requires 24V DC, 3A peak, 1.5 A average input power. Power may be applied through a Hypertronics #D01PB 306 MST plug connected to the Hypertronics receptacle located on the bottom right of the back panel. A Hypertronics connector is supplied with your laser. Alternatively, power can be supplied through the DB-9 connector (see DB-9 CONNECTOR below).

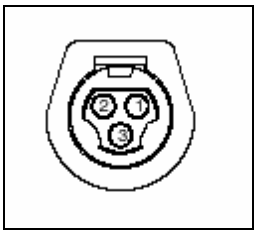

Figure 8. Hypertronics power receptacle, as viewed from the back panel of the NL100. Supply +24V DC on Pin 1. Pin 2 is the supply return and pin 3 is the case ground.

Sync Out (Optional)

This BNC connector outputs a +5V pulse into 50 Ohms synchronously with the laser emission from the front aperture. Figure 9 shows a single shot from the sync out BNC captured with an oscilloscope.

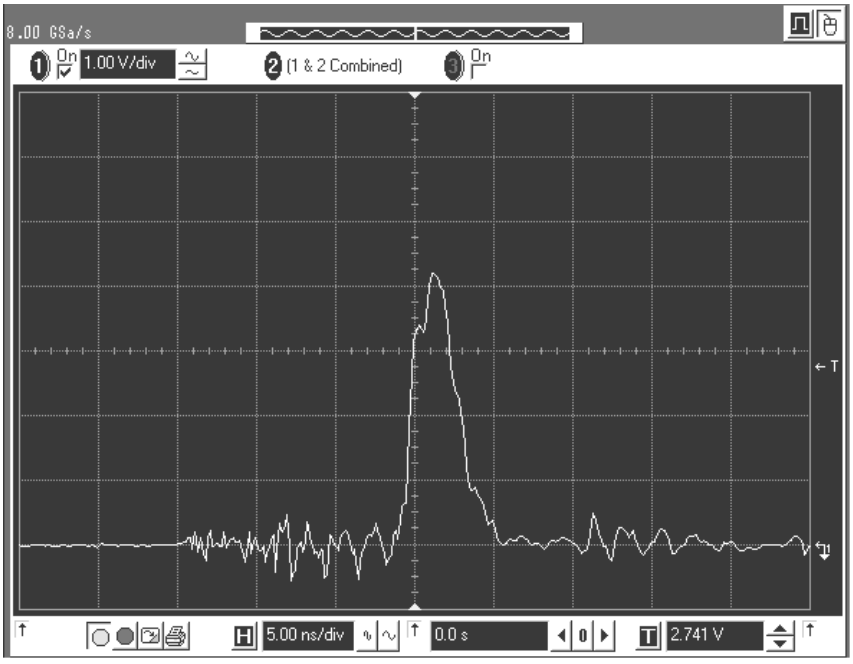

Figure 9. Single shot oscilloscope trace of the sync out of the NL100.

Trigger In

When the RATE switch is in the OFF position (see RATE below), the NL100 is triggered by a TTL pulse at this BNC connector. The laser will fire the laser on the rising edge of the TTL pulse. The width required of the TTL pulse depends on whether the laser is being operated in COMMAND CHARGE or AUTO CHARGE mode. (See DB-9 CONNECTOR below for information on how to configure the laser in either COMMAND CHARGE or AUTO CHARGE modes).

In AUTO CHARGE mode, the falling edge of the trigger pulse has no effect on the operation of the NL100 laser system, as shown in Figure 10. The trigger pulse width should be > 1 μs. The high voltage charging circuitry becomes active immediately after the laser has fired.

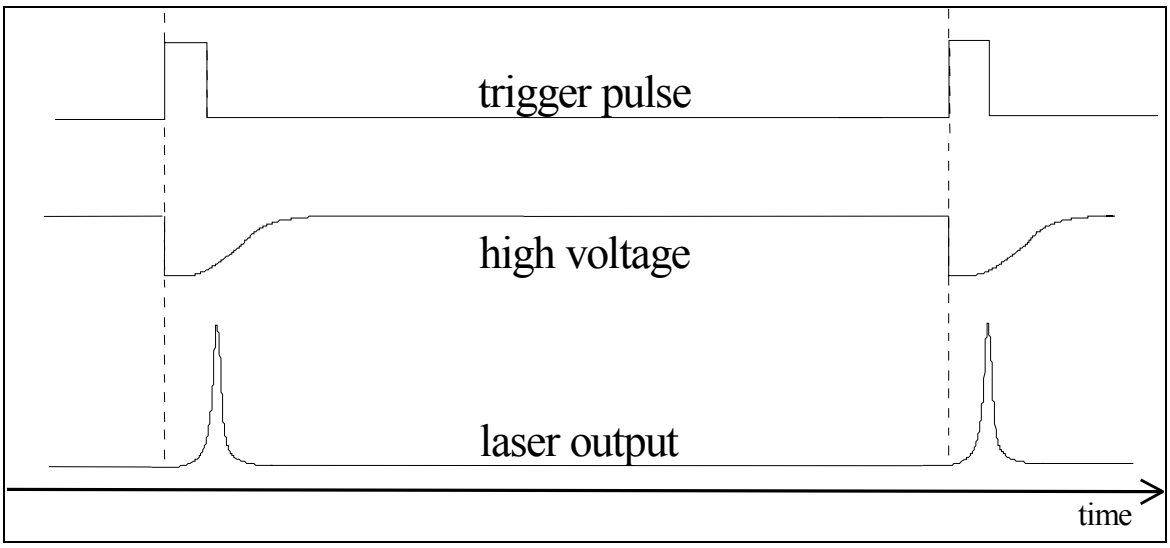

Figure 10. Timing diagram of AUTO CHARGE mode. Note that time is not shown to scale and the diagram does not reflect triggering delays, etc.

In COMMAND CHARGE mode, high voltage charging circuitry becomes active only when a TTL low appears on the trigger input, as depicted in Figure 11. To allow for complete high voltage charging In this case, the dwell time of the trigger pulse must be >45 ms. In other words, the trigger must be TTL low for >45 ms in COMMAND CHARGE mode.

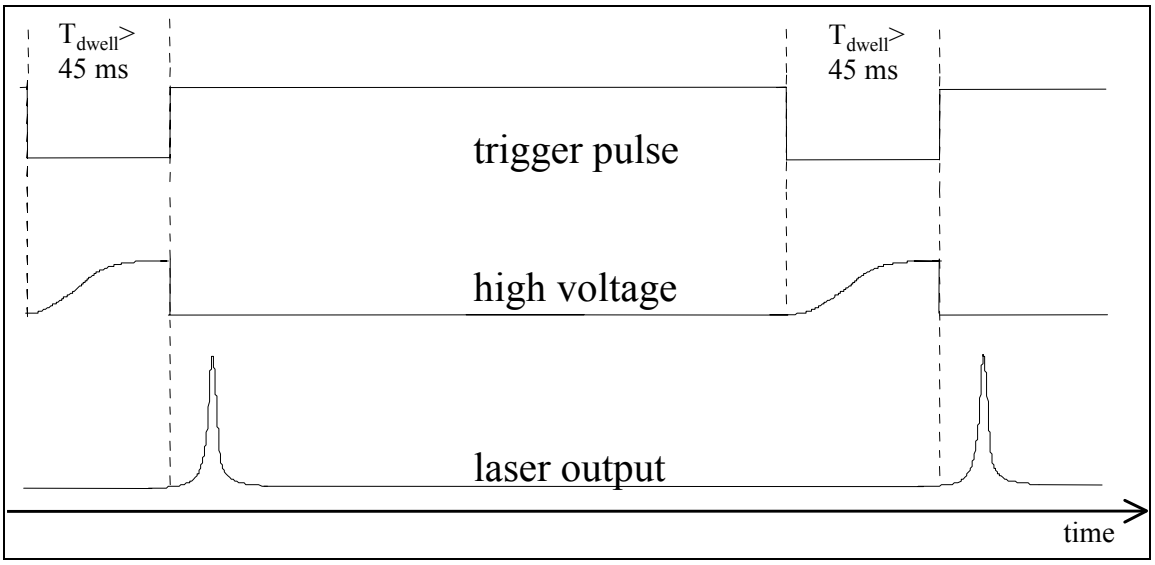

Figure 11. Timing diagram of COMMAND CHARGE mode. Note that time is not shown to scale and the diagram does not reflect triggering delays, etc.

Where possible, we recommend using the NL100 in the COMMAND CHARGE mode. This mode limits the amount of time high voltage resides on the laser components and therefore improves laser performance and lifetime.

As shown in Figure 12, the trigger pulse is optoisolated from the rest of the laser electronics. This allows triggering of the laser without permitting electrical noise from the laser discharge from impacting the user's electronics.

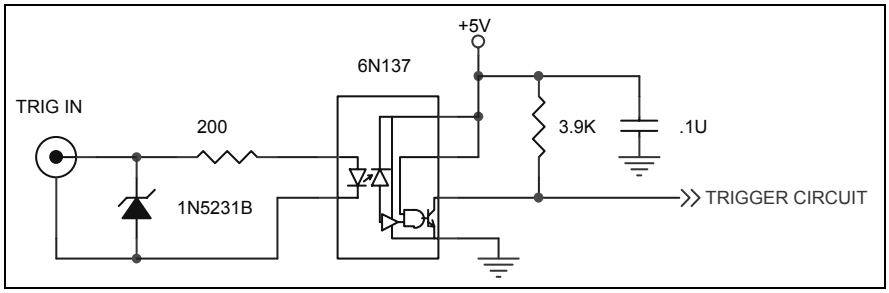

Figure 12. Schematic diagram of optoisolated trigger input.

Rate

When the RATE knob is in the OFF position (indicator pointing down), the laser system is in EXTERNAL TRIGGER mode, and will fire only when an appropriate pulse is applied either to the TRIG IN BNC or through the DB-9 connector.

When the RATE knob indicator is switched outside the OFF position, the laser system is in INTERNAL RATE mode and will generate laser pulses between 1-20 Hz, depending on the positioning of the RATE knob indicator.

NOTE: When the laser system is in INTERNAL RATE mode, it is also in AUTO CHARGE mode, regardless of the configuration of the DB-9 connector. When the laser is in INTERNAL RATE mode, trigger pulses applied at either the TRIG IN BNC or the EXT TRIG pin of the DB-9 connector have no effect on the operation of the laser.

DB-9 Connector

The female DB-9 connector provides a convenient way to interface to the NL100 laser's inputs and outputs. Below is a description of the function of each pin.

Pin 1 and Pin 2: +24V DC In

An alternate connection for providing electrical power to the NL100. Pins 1 and 2 are tied together.

Pin 3: + CHARGE CONTROL

The NL100 laser system provides a +5V (0.1 mA, max) level at Pin 3. If left high, the laser system will be in AUTO CHARGE mode. In AUTO CHARGE, the high voltage charging system will begin to recharge the storage capacitor and spark gap immediately after the laser fires. Use of the DB-9 connector labeled CCOFF provided with the NL100 will put the laser system in the AUTO CHARGE mode.

If Pin 3 is pulled low, the NL100 laser system will be in COMMAND CHARGE mode. With COMMAND CHARGE, the high voltage charging begins only when a TTL high level is received at one of the TRIGGER inputs (either the TRIG IN BNC or Pin 4 of the DB-9). Since high voltage charging requires 45 ms, the Trigger pulse width must be greater than 45 ms when COMMAND CHARGE is used. Use of the DB-9 connector labeled CCON provided with the NL100 will put the laser system in the COMMAND CHARGE mode.

Because COMMAND CHARGE reduces the amount of time key laser components are at high voltage, especially at lower repetition rates, we recommend use of this mode where possible.

Pin 4: +Trigger

Pin 4 provides an alternate connection for externally triggering the laser. Note that because the EXTERNAL TRIGGER is optoisolated, the reference for the trigger, Pin 8: -Trigger is isolated from GND. See TRIGGER IN above for additional information.

Pin 5: +Interlock

The laser system provides +24V (10 mA, max.) level that must be terminated into Pin 9: -Interlock or GND for the laser system to operate. The NL100 laser system is shipped with two male DB-9 connectors, labeled CCON and CCOF, where this connection is provided.

NOTE: The laser will not operate if one of the provided male DB-9 connectors is not in place and the Pin 5: +Interlock is not otherwise terminated!

This interlock is provided so that the user can control the laser system externally with a door switch, for example.

Pin 6 and Pin 7:GND
Ground and electrical power return.

Pin 8: -Trigger
Reference for opto-isolated external trigger pulse.

Pin 9: -Interlock
Return for Pin 1: +Interlock.

LED Indicators

Power LED
This red LED is illuminated whenever the NL100 laser system is powered. A three-second delay circuit prevents the laser from firing when electrical power is first applied to the laser system to allow time for the laser beam path to be cleared.

Charge LED
This amber LED is lit when the high voltage charging circuit is active. In AUTO CHARGE mode, the Charge LED is on whenever the laser is powered. In COMMAND CHARGE mode, the Charge LED flashes on while the trigger pulse is high.

Trig LED
The green Trig LED flashes when the NL100 laser system either receives a valid external trigger or generates a trigger internally.

Beam Shutter

The beam shutter is located at the front of the NL100 laser system, as shown in Figure 13 and Figure 14. Placing the beam shutter in the closed position mechanically blocks the beam aperture, preventing laser emission from exiting the laser housing.

Figure 13. Front of the NL100 laser system, showing the beam shutter in the closed position.

Figure 14. Front of the NL100 laser system, showing the beam shutter in the open position.

High Voltage Adjust

The energy output of the NL100 laser system is roughly proportional to the high voltage charge. The high voltage can be changed by adjusting the ten-turn potentiometer that can be accessed through the hole labeled HV ADJUST located in the left side of the protective housing. The high voltage of each unit is set during testing such that the unit meets specifications. As the pulse energy drops as the laser tube ages through use, increasing the high voltage will help offset the drop in pulse energy.

We do not recommend running the NL100 laser system with the high voltage adjusted to the maximum for long periods because this will shorten the life of laser cartridge. If your application does not require full pulse energy of the NL100, reducing the high voltage may significantly increase cartridge life.

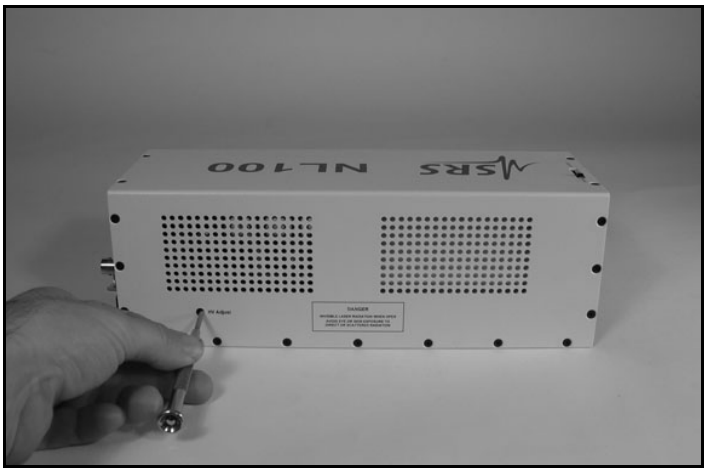

Figure 15. Changing the high voltage adjustment potentiometer.

Maintenance and Service

Maintenance

The NL100 laser system, with a sealed laser tube within a modular laser cartridge, is designed to be completely maintenance-free.

Service

The laser cartridge, which contains the laser tube and other high voltage components that are expected to degrade with use, can be replaced, thereby restoring the NLl00 laser system performance to that achieved when new.

We recommend that when the NL100 performance has degraded below the specifications listed in this manual, or 2 years have elapsed since the unit was purchased or last serviced, that the unit be returned to SRS for cartridge replacement, test and calibration. Please contact SRS at 408-744-9040 to obtain a return merchandise authorization (RMA) number.

For the technically sophisticated NL100 user who wishes to replace the laser cartridge by themselves, first obtain a replacement laser cartridge from SRS and then carefully follow the instructions and illustrations given below. We strongly recommend that only technically sophisticated users who are familiar with lasers and high voltage circuits perform this service operation. All other customers should return the unit to SRS for service. If you are in doubt, call SRS.

Laser Cartridge Replacement

Tools Required

- Replacement laser cartridge
- PH1 Phillips screwdriver
- Nut Driver, ¼”

Procedure

1. Turn the NL100 laser key switch off and disconnect all cables.
2. Remove the Phillips screws that secure the protective housing to the laser frame and remove the protective housing.

Figure 16. Remove the screws on the protective housing.

WARNING!
Never provide power to the NL100 laser or attempt to operate the NL100 laser with the protective cover removed! Doing so may expose the user to lethal voltages!

3. Disconnect the trigger and high voltage connectors on the laser cartridge, as shown below.

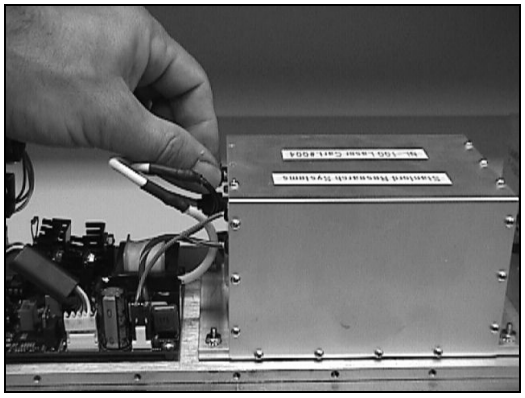

Figure 17. Disconnect high voltage connectors to the laser cartridge.

4. Disconnect the ground and monitor line connector, as shown.

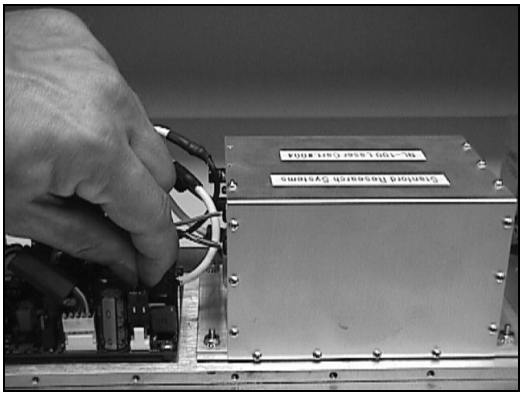

Figure 18. Disconnect the ground and monitor connector.

5. Remove the four 4-40 nuts that secure the laser cartridge to the bottom plate.

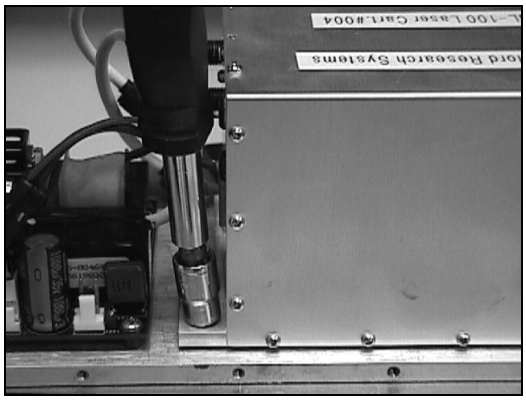

Figure 19. Remove laser cartridge mounting nuts.

6. Remove the laser cartridge.

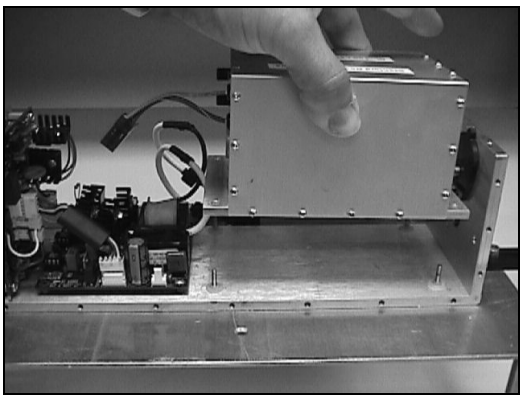

Figure 20. Remove laser cartridge.

7. Replace with new cartridge. Secure to bottom plate with four 4-40 nuts.

8. Connect ground and monitor line connector plug to the power supply board, as shown.

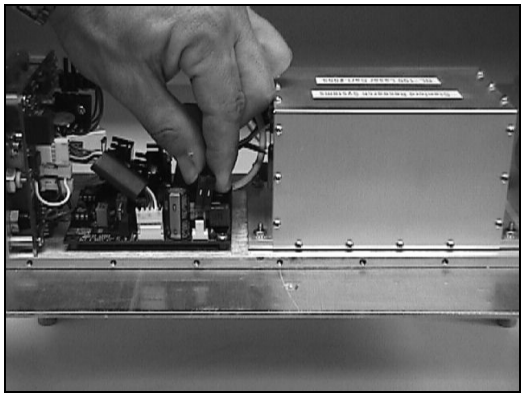

Figure 21. Reconnect ground and monitor line connector.

9. Identify the trigger and HV connector plugs. The trigger connector is the shorter of the two, and connects to the upper receptacle on the laser cartridge.

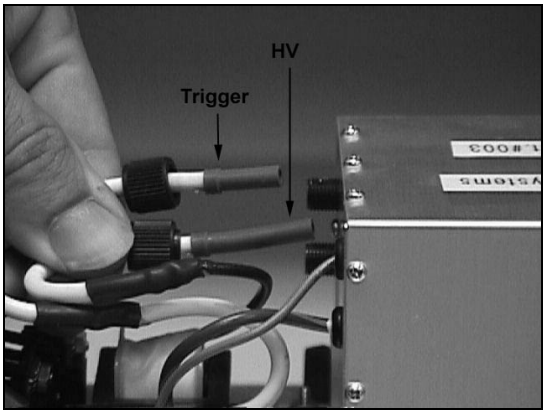

Figure 22. Identify the trigger and HV connectors.

10. Connect the trigger and HV plugs to the appropriate receptacle, as shown. Be sure to tighten the knurled nuts for each connector to the receptacle. Finger tight is sufficient.

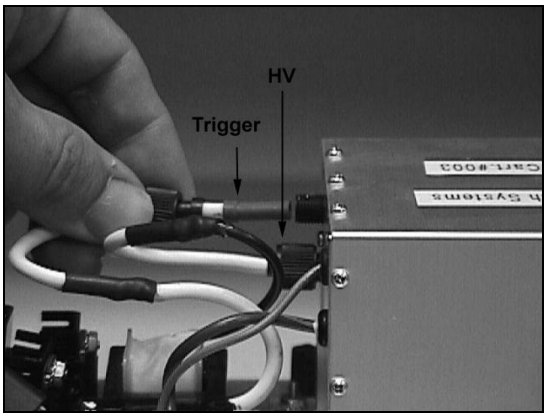

Figure 23. Connect the trigger and HV connector plugs to their respective receptacles.

WARNING!
Improper trigger and HV connections will result in the unit not operating, permanent damage to the unit, and expose the user to unsafe conditions. Contact SRS if you are unsure if you performed this step correctly.

11. Carefully reposition the protective cover and replace the 4-40 Phillips screws that secure the cover.

Figure 24. Secure protective cover with Phillips screws.

Mechanical Drawings