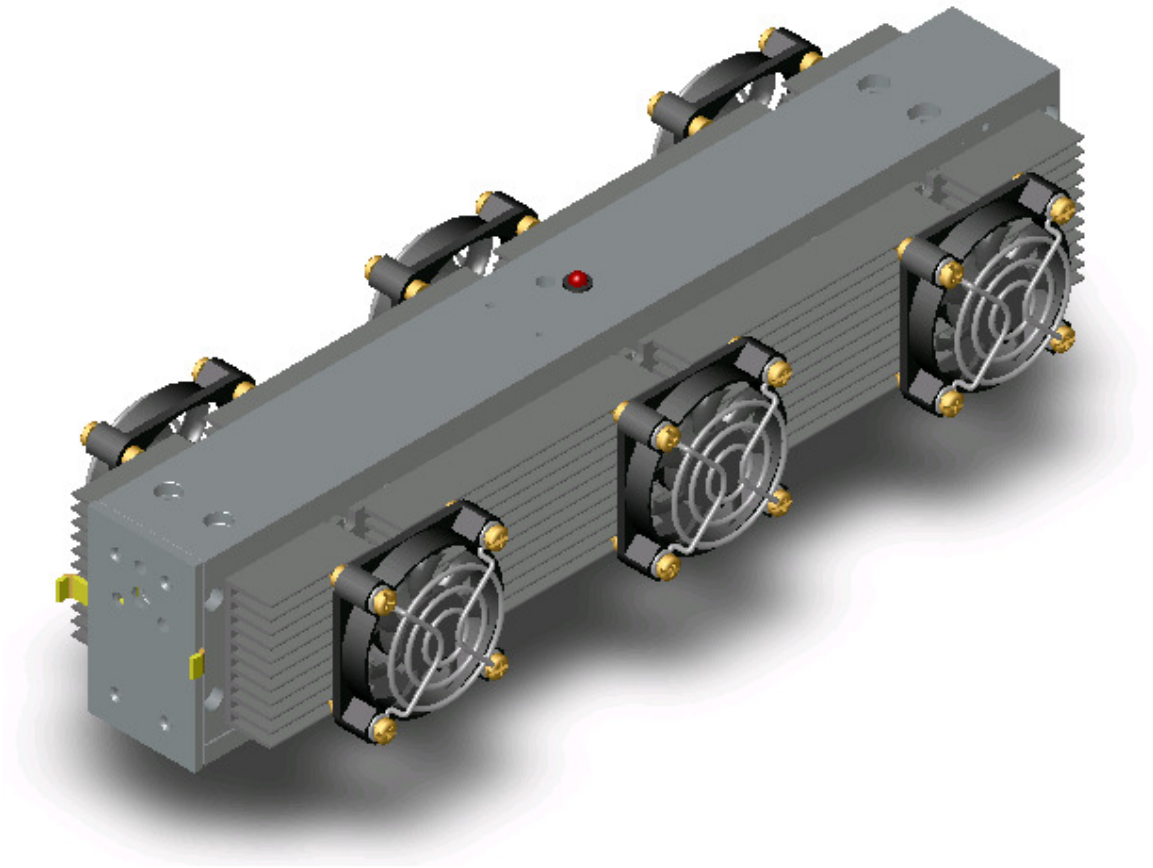
ACCESS LASER

where innovation never stops

L5 Series Operator Manual



L5 899-05001-000
L5P 899-05005-000
L5D 899-05002-000

Access Laser Company
917 134th St SW Ste A1
Everett, WA 98204
425.582.8674
www.accesslaser.com

REVISION G

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Company Statement

Access Laser Company would like to thank you for your purchase of our L5 series laser. We shall remain dedicated to your development and customer service needs. If you have any questions, concerns, or comments about your purchase please feel free to contact us at sales@accesslaser.com or call us at 425-582-8674. As our customer we always value your input to help us with future product development.

Contact Information

Sales/Technical Questions	sales@accesslaser.com
Service Department	service@accesslaser.com
Mailing Address	917 134th St SW Ste A1 Everett, WA 98204
Phone Number	425.582.8674 x1
Fax Number	425.582.8679

Warranty

All of Access Laser Company's lasers come with a one-year standard warranty, which certifies that the L5 series lasers are found to be free of any defects in material or workmanship. This warranty applies regardless of laser usage. It does not cover any issues that may arise due to negligence, environmental factors, accident, alterations, or improper maintenance.

Access Laser Company requests that you inspect your shipment within 48 hours of arrival. If there appears to be any damage or defect you must notify Access Laser Company, in writing, at service@accesslaser.com. If Access Laser Company is not notified, we will assume that the shipment arrived in satisfactory condition.

Please complete the information below upon final inspection of your order.

Date Received: _____

Laser Model: _____

Laser Serial Number: _____

RF Driver Serial Number: _____

Received By: _____

Only Access Laser Company and its Authorized Distributors maintain the sole authority to make any claims or statements regarding warranty on Access Laser Company products. Access Laser Company reserves the right to make any changes or improvements to product design without notice, and without expectation of equivalent changes in products previously manufactured or shipped.

Laser Shipment Contents

The following items are enclosed with each laser shipment:

- L5 Series Laser
- RF Supply
- BNC to TNC Coax Cable (1)
- D-sub 15 Dongle
- L5 Series Laser Product Manual
- Laser Test Documents
    - Final Test Document
    - Pulse Power Document
    - Power Plot

Safety Information

FDA and Federal Regulations

Access Laser Company has designed our lasers to comply with CDRH requirements set forth by the Radiation Control Health Act of 1968. Therefore the L5 series lasers meet all standards for laser products under 21CFR 10.40.10 and 21CFR 1040.11. These standards have been set forth to protect the end user from harmful radiation.

ΔCAUTION

The L5 series lasers are Class IV lasers. Lasers in Class IV have output powers of greater than 500 mW. This laser can cause mild to severe burns if skin or eyes are exposed to the beam or scattered radiation. Protective eyewear should be worn at all times.

ΔCAUTION

The L5 series lasers produce laser radiation around 10.6µm. This wavelength is invisible and requires special equipment to detect or view. Always take special precautions to block the beam from unintentional reflection. Never use organic materials such as plastic or wood as a beam block. Avoid using materials such as copper, aluminum, or gold, which are highly reflective and may cause the beam to unintentionally scatter.

ΔCAUTION

Use of controls, adjustments or performance procedures other than those specified herein may result in hazardous exposure. To prevent direct exposure to the laser beam do not try to open the enclosure.

ΔCAUTION

For water cooled lasers, do not leave the chiller running while the laser is powered off. This may cause condensation in the electrical circuits and optical components, which will lead to damage.

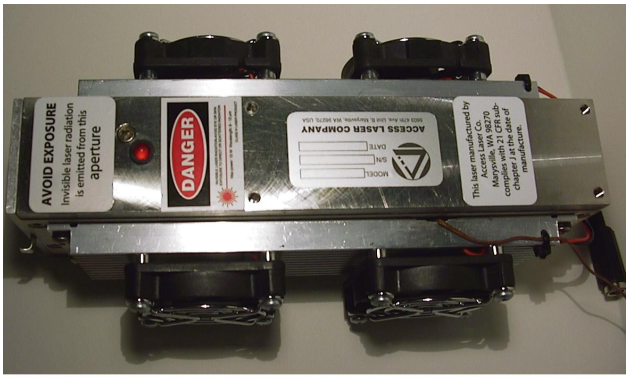
Warning

For Super Pulse lasers (-P model), running the laser above a 25% duty cycle or 800µs pulse length may damage the RF driver. The internal protection program will interrupt the user signal beyond these parameters, making the output inconsistent.

Safety Information: Safety Label Location

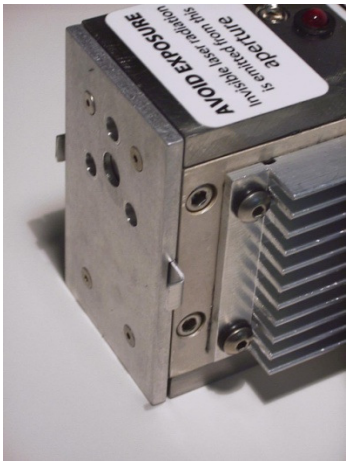
Top (from left to right):

1. Aperture label
2. Laser warning label
3. OEM label
4. Identification label



Front:

1. Laser shutter



L5: Specifications

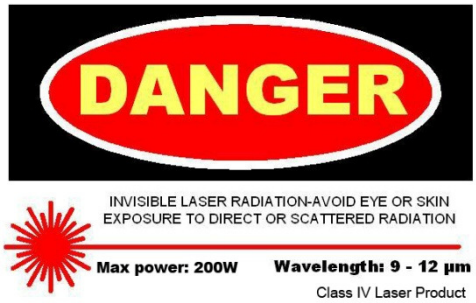
Model	L5	L5P	L5D
Wavelength (µm)	around 10.6	around 10.6	L5D has features of both L5 and L5P when the appropriate DC power supply is used.
CW Power (W)	5	4 (average)	
Peak Power (W)	5	20	
Power Stabilty	±10%	±10%	
Mode Quality (M^2)	< 1.1	< 1.1	
Beam Waist Diameter	2.4 mm	2.4 mm	
Waist Location	Output Coupler	Output Coupler	
Full Div. Angle	5.5 mrad	5.5 mrad	
Rise Time (µs)	200	100	
Fall Time (µs)	200	100	
Supply Voltage (DC)	28V 240W	48V 240W	
Electronic PWM Parameters	Any frequency up to 100 kHz, duty cycle 0-100%	Any frequency up to 100 kHz, duty cycle 0-25%, pulse length to 0.8 ms	
Cooling Requirement	Air Cooled	Air Cooled	
Working Temperature	5-40° C	5-40°	
Dimensions (LxWxH, inch)	12x1.5x3	12x1.5x3	

Factory Warranty: One year for parts and labor due to manufacturing quality, regardless of usage.

Options Available

- Fan or Water cooling
- Real time power sampling
- Stabilization with Line Tracker
- External high speed modulator (up to 200 kHz)
- Linear polarization (horizontal)

*Includes RF driver
*Specifications subject to change
*Please contact us if you have custom requirements



RF Driver: Specifications

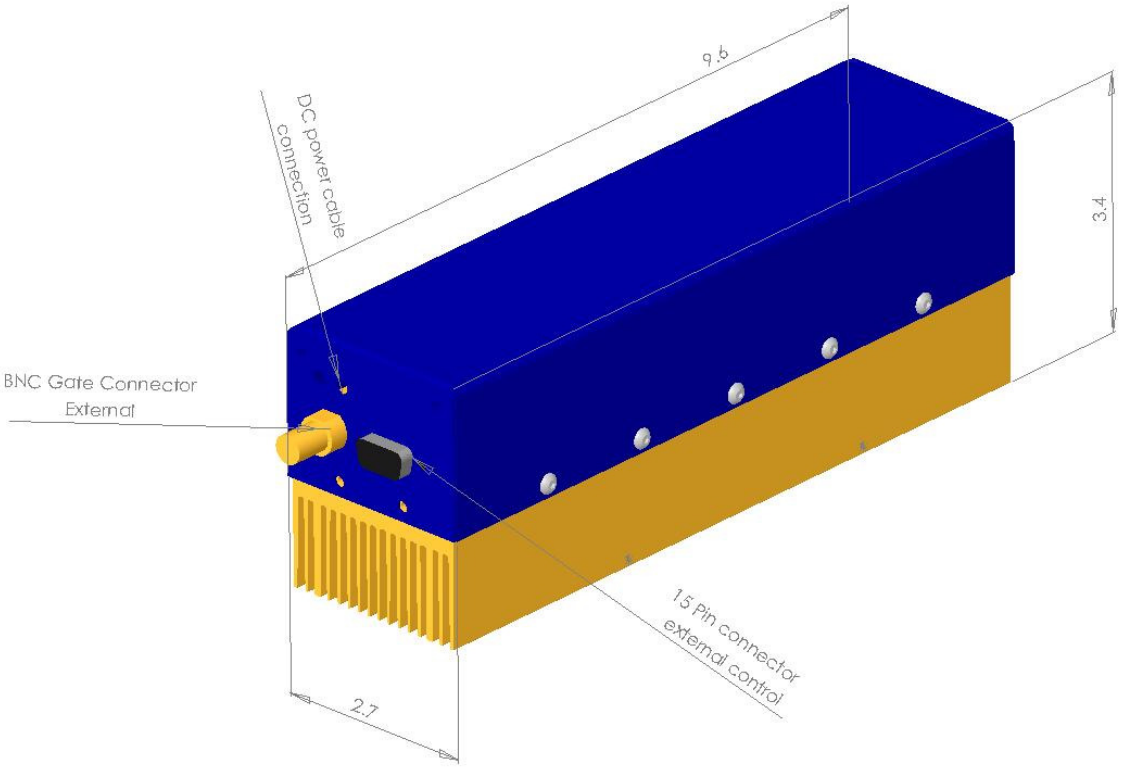
Model	RF10b	RF10b-P	RF10b-D
Features	Standard	Super Pulse	Smart Driver that can be either Standard or Super Pulse
	External TTl Control Input up to 100kHz		
	Built-in Plasma Ignition Signal at 2.5kHz		
Frequency	40.68 MHz		
Supply Voltage	28V DC	48V DC	28V or 48V DC
Supply Current	7 Amps	4 Amps	7 or 4 Amps
Output Power	120W up to CW	300W up to 30% or 400µs	120W up to CW, 300W up to 30% or 400µs
Dimensions (inches)	9.6 x 3.4 x 2.7		

Caution:

1. Never connect the DC to the RF driver with the wrong polarity, or the RF driver will be damaged.
2. Never operate the RF driver without its output properly connected to the laser.
3. Do not block the air flow to and from the heat sink, or the RF driver will be damaged.
4. If the fans fail the RF driver will stop immediately.
5. Do not gate the RF driver at frequencies above 10 kHz.

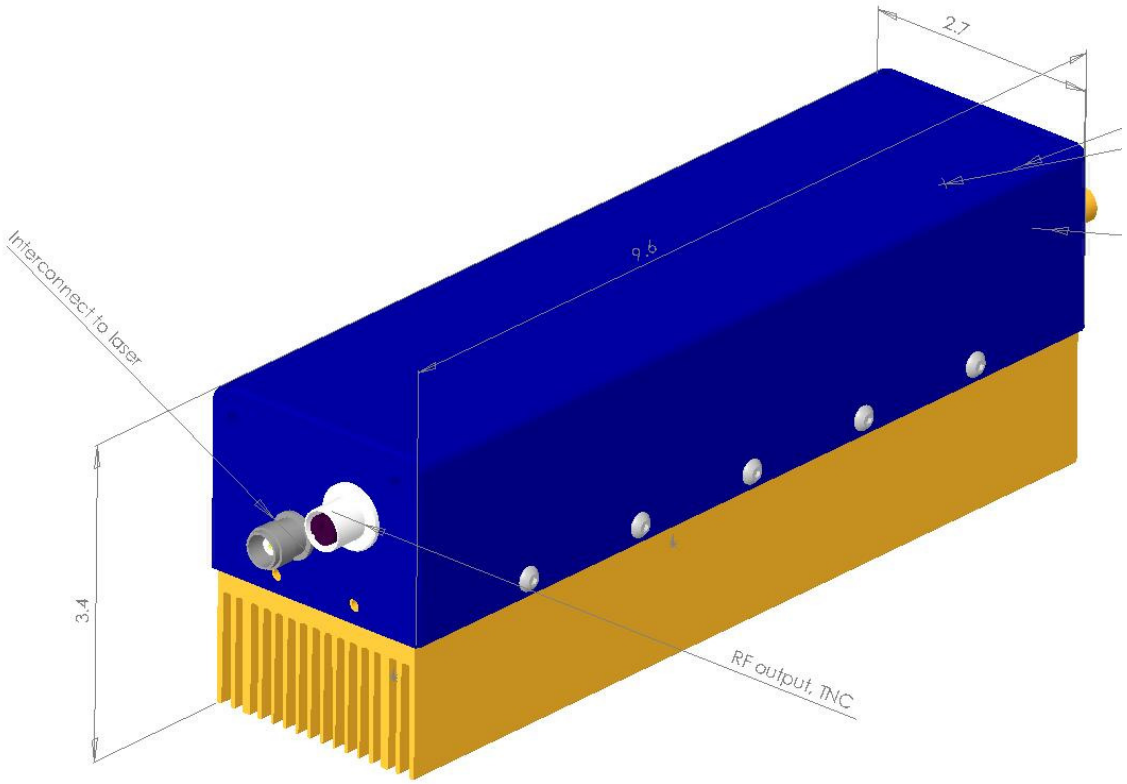
RF Driver: Dimensions

View from Input End

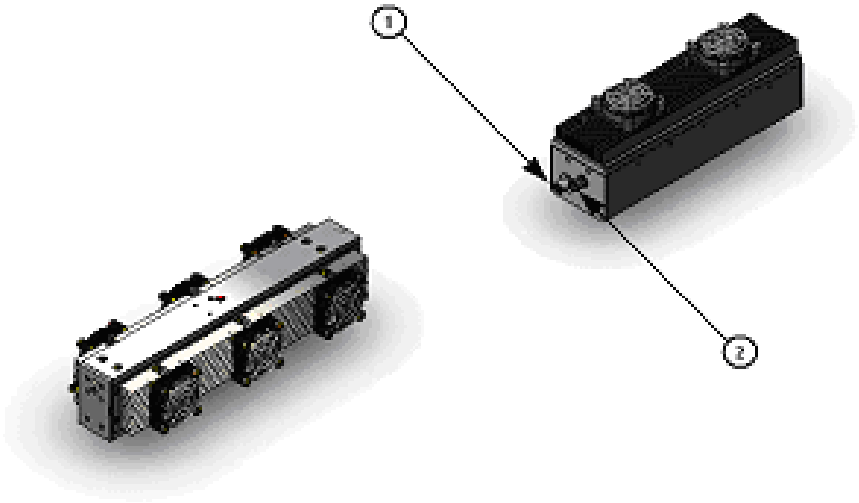


RF Driver: Dimensions

View from Output End

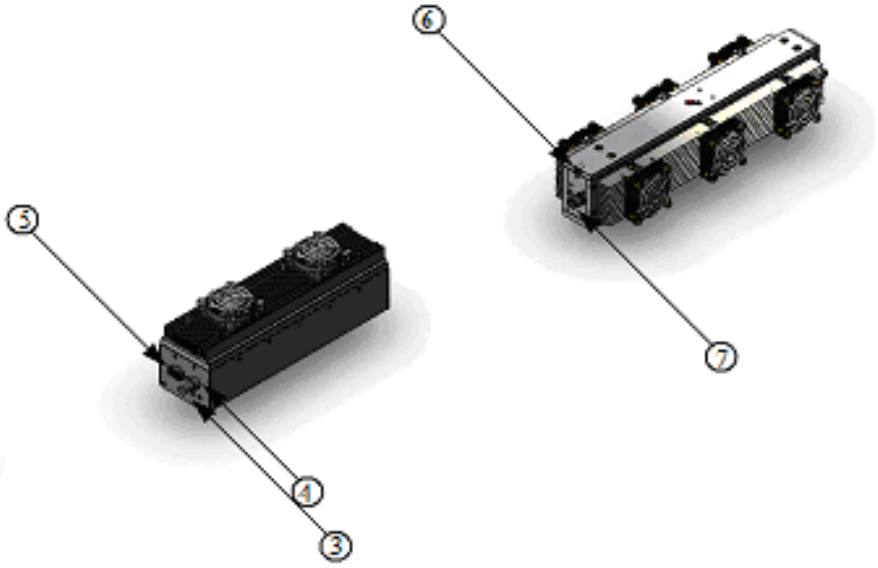


Connection Diagrams: Front View



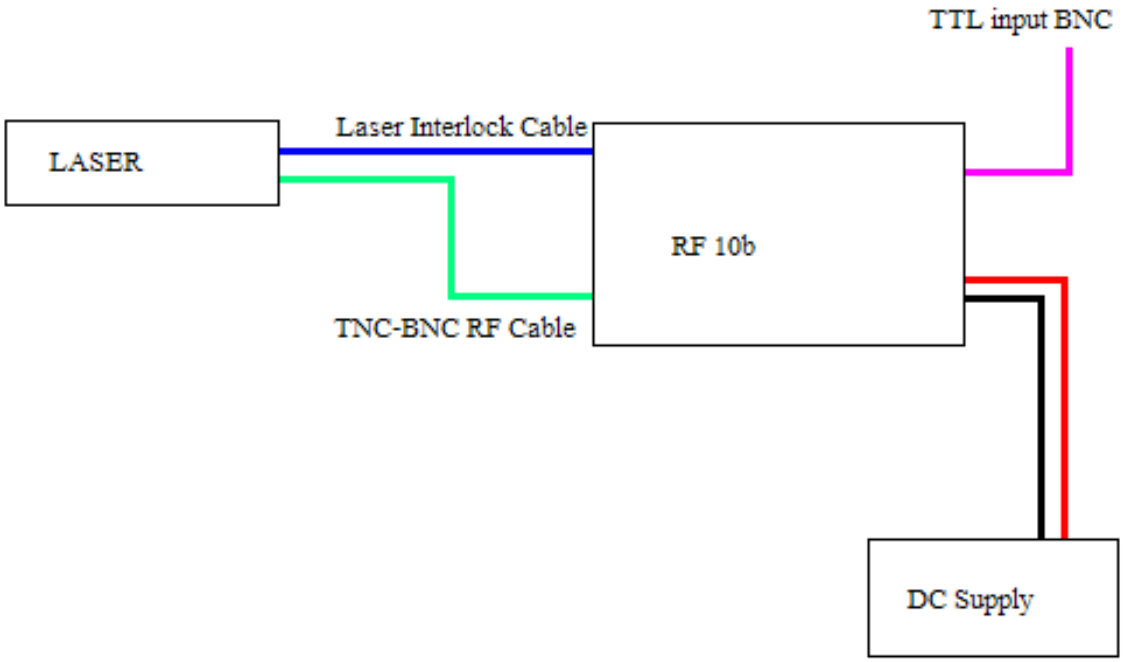
1. 6 PIN Mini-DUN Laser Interlock
2. TNC RF Output

Connection Diagrams: Rear View



3. DC Input
4. BNC TTL Gate Input
5. Connector for optional controller
6. Mini-USB Laser Interlock Input
7. BNC RF Power Input

Connection Diagrams: Wiring Diagram



For L5 connect a 28V 240W DC power supply for CW operation
For L5P connect a 48V 240W DC power supply for Super Pulse operation
For L5D connect the appropriate power supply for the desired operation

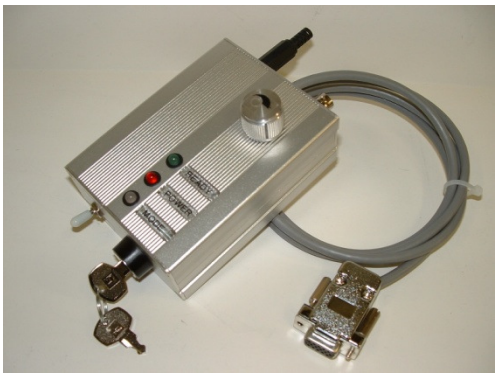
Laser Operation Instructions

1. Direct the laser toward a target, such as a power meter or a beam-blocking device.
2. Connect the components of the laser system with the cables provided as shown in the Laser Setup Diagram
3. Open the laser shutter (if present)
4. The laser is controlled by applying 5V DC (20 mA) to the TTL Gate on the RF Driver (0V=off, 5V=on). The RF driver can be modulated at frequencies from 0 Hz to 100 kHz, but optimal grating frequency is 1-15 kHz.
5. Verify the enabling plug on the D-sub 15 connector is installed on the RF driver.
6. Connect the appropriate DC Power Supply to the RF Driver
    a. L5: 28V DC for CW operation
    b. L5P: 48V DC for Super Pulse operation
    c. L5D: Correct power supply for desired mode
7. For Super Pulse operation, using the 48V DC power supply, the laser is designed to be run up to 25% duty cycle and pulse length up to 800µs.
8. WARNING: Running above 25% duty cycle or 800µs pulse length may damage the RF driver. The internal protection program will interrupt user signal beyond these parameters, making the output inconsistent.

Appendix A: LC3 Laser Controller (Optional)

SPECS & OPERATION

Model: LC3
Features: Safety Key Switch
Safety Interlock
Power Adjustment
External Gate



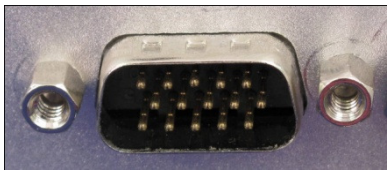
Operation Procedure

- Make certain the D-sub15 Connector on the RF Driver is available to accept the connector on the end of the controller.
- Make certain that the 3 position switch is in the middle, placing the laser in standby “STBY” mode.
- Install the LC3 D-sub15 Connector, the Red “POWER” LED should light.
- Turn the key switch from the “OFF” position to the “ON” position, the Green “READY” LED should light after ~5 seconds.
- If running the DC voltage at 28V switch into “0-100% mode, the Red “MODE” LED should light up. The knob will adjust from off to CW (0-100%) as it is turned Clockwise.
- The TTL Gate on the controller can be used to turn off the laser by applying ground. When the ground is removed or 5V is applied the laser will turn on at the duty cycle setting determined by the knob position. The gate can be modulated as necessary up to 100kHz.
- The interlock connector on the LC3 can be connected to a user provided safety switch or door switch, to have the laser turn off. It is a 1/8” stereo jack, the two wires must remain shorted together for the laser to operate. The connector is self-shorting, so if not using the interlock there is no need to plug anything into it.
- If any of the interlocks are triggered or the DC power is interrupted the Keyswitch will need to be cycled OFF and back ON to turn the laser back on.

Appendix B: RF Driver D-sub 15 Connector

RF Driver OEM

Custom Controls and Signals
at the D-sub 15 Connector



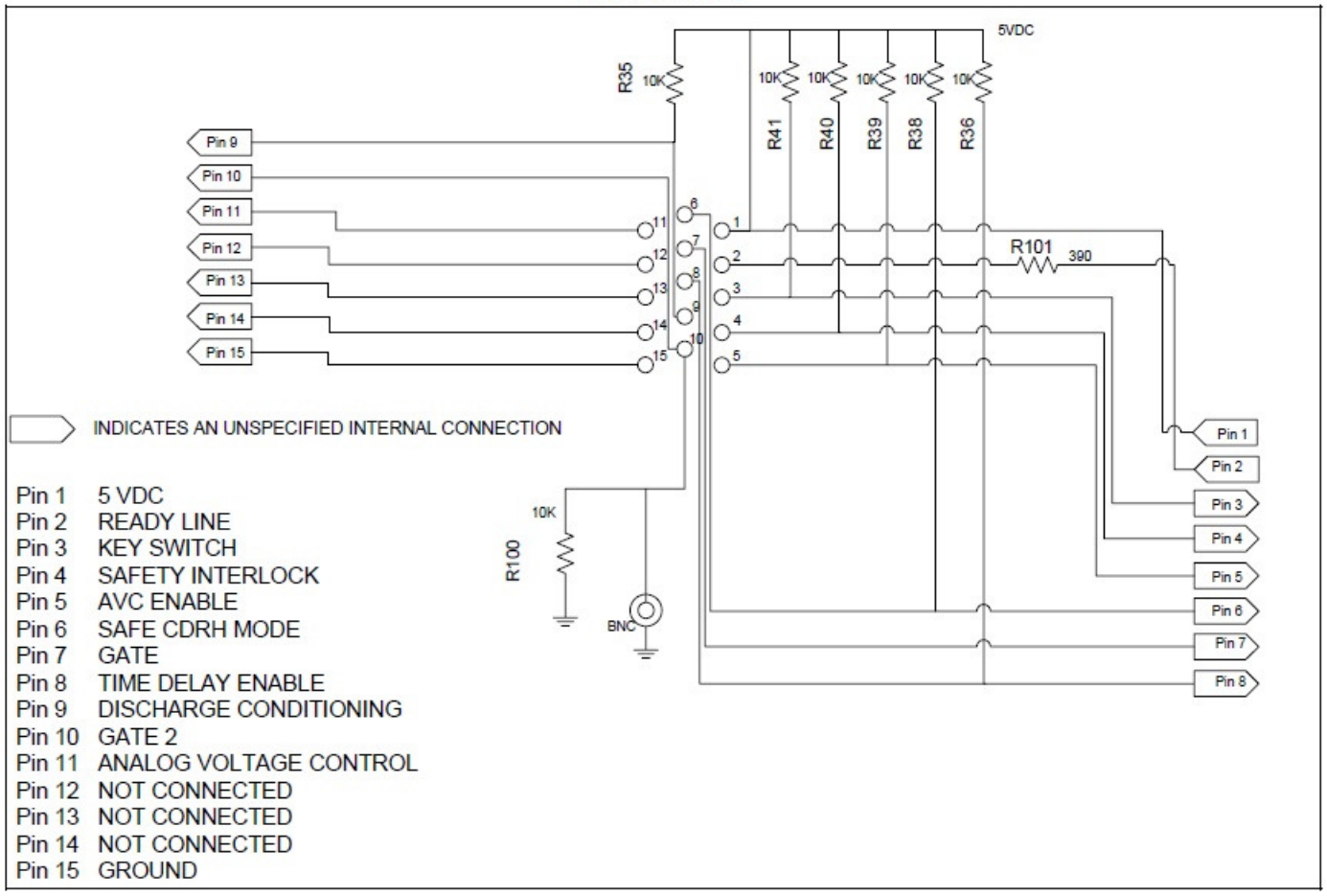
Slanted red text indicates OEM factory configuration with D-sub plug provided

Pin #	FUNCTION	MODE 0 Action/Result	MODE 1 Action/Result
1	5 VDC, 20 mA capacity, power ready. Connection to an external red LED.	Red LED off, no power.	*Red LED on, powered*
2	Connected to an external green LED to indicate laser ready status, up to 10 mA supplied.	Green LED off. Laser not ready, fault due to RF overtemp, interlock opened, or key switch fault.	*Green LED on. Laser is ready to fire.*
3	Safety Key Switch Connection. When this pin is enabled by PIN 6 and there is a power outage or opening interlock (PIN 4), this pin needs to be pulled high and then low again to restore laser operation.	Short to PIN 15. DC power supply is connected to laser	Open. DC power to laser is cut off.
4	Safety Interlock = top level laser enable. This pin also needs to be enabled by PIN 6.	Short to PIN 15. Laser enabled at the top level	Open. Laser not operational.
5	AVC (Pin 11) Enable.	Short to PIN 15. Enables AVC together with PIN 10.	*Open. Disables AVC.*
6	CDRH Safety Mode. Controls key switch on PIN 3 and Safety Interlock of PIN 4. Disabled for OEM.	Short to PIN 15. Enables key switch.	*Open. Disables key switch.*
7	Gate for Laser Enable.	Not connected or connected to 0V/Laser diasabled.	*Connected to 5V or to PIN 1/Laser enabled.*
8	Time delay control: 5 seconds between power on and lasing.	Short to PIN 15/No delay.	*Open/ Delay True.*
9	Discharge conditioning.	Short to PIN 15/ conditioning off (not recommended).	*Open/ conditioning on.*
10	Gate 2, connected to BNC input, signal is provided by the customer to turn the laser on/off electronically.	*Not connected or connected to 0V/Laser off*	Connected to 5V/Laser on
11	Input, AVC[1]	This is an analog function therefore there are more than two modes. [2]	
12-14	Do not use		
15	Ground	N/A	N/A

Appendix B: D-sub 15 Connector (cont.)

ENGINEER'S NOTES (cont.)

Schematic



Pin 1 5 VDC
Pin 2 READY LINE
Pin 3 KEY SWITCH
Pin 4 SAFETY INTERLOCK
Pin 5 AVC ENABLE
Pin 6 SAFE CDRH MODE
Pin 7 GATE
Pin 8 TIME DELAY ENABLE
Pin 9 DISCHARGE CONDITIONING
Pin 10 GATE 2
Pin 11 ANALOG VOLTAGE CONTROL
Pin 12 NOT CONNECTED
Pin 13 NOT CONNECTED
Pin 14 NOT CONNECTED
Pin 15 GROUND

Appendix B: D-sub 15 Connector (cont.)

ENGINEER'S NOTES

PIN 1) 5V DC regulated supply output line. 20 mA source capacity. Intended to light remote "Power On" LED. (Important: no internal series current limiting resistor provided on this line.)

PIN 2) This output line is a "Laser Ready" indicator in both the Safe CDRH mode and the OEM mode. When LOW it indicates a fault has occurred and the laser is shut down: RF amplifier over heated, DIN cable not connected or RF cable not connected or damaged. The Amplifier will operate for approximately one minute on start-up before the processor checks for faults. This allows some troubleshooting before a Fault Shutdown. In the Safe CDRH mode two additional faults are indicated by PIN 2. The Key Switch fault status (see description of PIN 3) and the Interlock Fault Status (see description of PIN 4). This is an un-buffered output of 3.8V DC with internal 390 ohm current limiting resistor R101. If remoting this signal, we recommend buffering.

PIN 3) Key Switch is an active LOW input line. The Key Switch is a safety requirement for many laser systems. PIN 3 is internally pulled HIGH with a 10k resistor R41. The Key Switch is only functional in the Safe CDRH mode (PIN 6 LOW). To implement a Key Switch use the normally open contacts. (Key Switch "on" is PIN 3 pulled LOW). The Key Switch has to be turned on before the laser can operate. When there is a power outage the Key Switch has to be recycled to restore laser operation. The key should not be removable when the Key Switch is turned on.

PIN 4) Safety Interlock is an active HIGH input line. The Safety Interlock is a safety requirement for some laser systems. When PIN 4 is functional any logic HIGH transition on PIN 4 halts lasing. PIN 4 is internally pulled HIGH with a 10k resistor R40. The Safety Interlock is only functional in the Safe CDRH mode (PIN 6 LOW).

PIN 5) Analog Voltage Control (AVC) input enable line. The AVC input is a LOW enable. PIN 11 becomes active as a 0V DC to 5V DC analog PWM control line. See definition of PIN 11 for AVC mode of operation. When PIN 5 is pulled HIGH (internal 10kl pull up resistor R39), lasing is controlled exclusively by the logical result of Gate (PIN 7) AND Gate-2 (PIN 10).

PIN 6) Safe CDRH mode LOW enable input line. The Key Switch (PIN 3) and the Safety Interlock (PIN 4) becomes active. When PIN 6 is pulled HIGH (internal 10k pull up resistor R38) these two safety devices are disabled. Operation with PIN 6 disable (HIGH) is generally referred to as the "OEM mode".

Appendix B: D-sub 15 Connector (cont.)

ENGINEER'S NOTES (cont.)

PIN 7) Gate is an active HIGH lasing enable input. Gate is pulled LOW internally (processor controlled 10k pull down resistor). To initiate lasing, both the Gate (PIN 7) and Gate-2 (PIN 10) input lines must be pulled HIGH externally by user.

PIN 8) Delay Enable is an active HIGH input. When active, while operating in the OEM mode (PIN 6 HIGH), a 5 second delay is enforced every time the DC supply electrical power is cycled. PIN 8 must be enabled to operate in the Safe CDRH mode. When active, while operating in the safe CDRH mode, a 5 second lasing safety delay is enforced every time the Key Switch is cycled. The Delay Enable line is internally pulled HIGH by a 10k resistor R36. User must pull PIN 8 LOW to suppress the safety delay (not recommended).

PIN 9) Discharge Conditioning active HIGH enable input line. PIN 9 is internally pulled HIGH by a 10k resistor R35. User must pull PIN 9 LOW to suppress Discharge Conditioning (not recommended).

PIN 10) Gate-2 is an active HIGH lasing enable input. Gate-2 is pulled LOW by an internal 10k pull down resistor R100. To initiate lasing, both the Gate-2 (PIN 10) and Gate (PIN 7)input lines must be pulled HIGH externally by the user. Additionally, Gate-2 is wired directly to the external BNC connector.

PIN 11) AVC (Analog Voltage Control) input. See definition of PIN 5. A 0V DC to 5V DC analog voltage on PIN 11 results in a proportional 0% to 100% Pulse Width Modulated (PWM) laser output. The PWM frequency is 2.5 kHz. To enable the internal PWM drive signal in the AVC mode: PIN 5 must be held LOW by user, Gate-2 (PIN 10) must be pulled HIGH by user, Gate (PIN 7) can be left open (NC) or pulled HIGH by user and a non-zero voltage between 0V DC and 5V DC must be present on PIN 11 for lasing to occur. By the way of Example 1, 1V at this pin will cause the PWM to operate at a 20% duty cycle, 3V at 60%, etc. (Note: Gate (PIN 7) is pulled HIGH internally by the processor. PIN 7 is functional as a lasing sizable when pulled LOW by the user.)

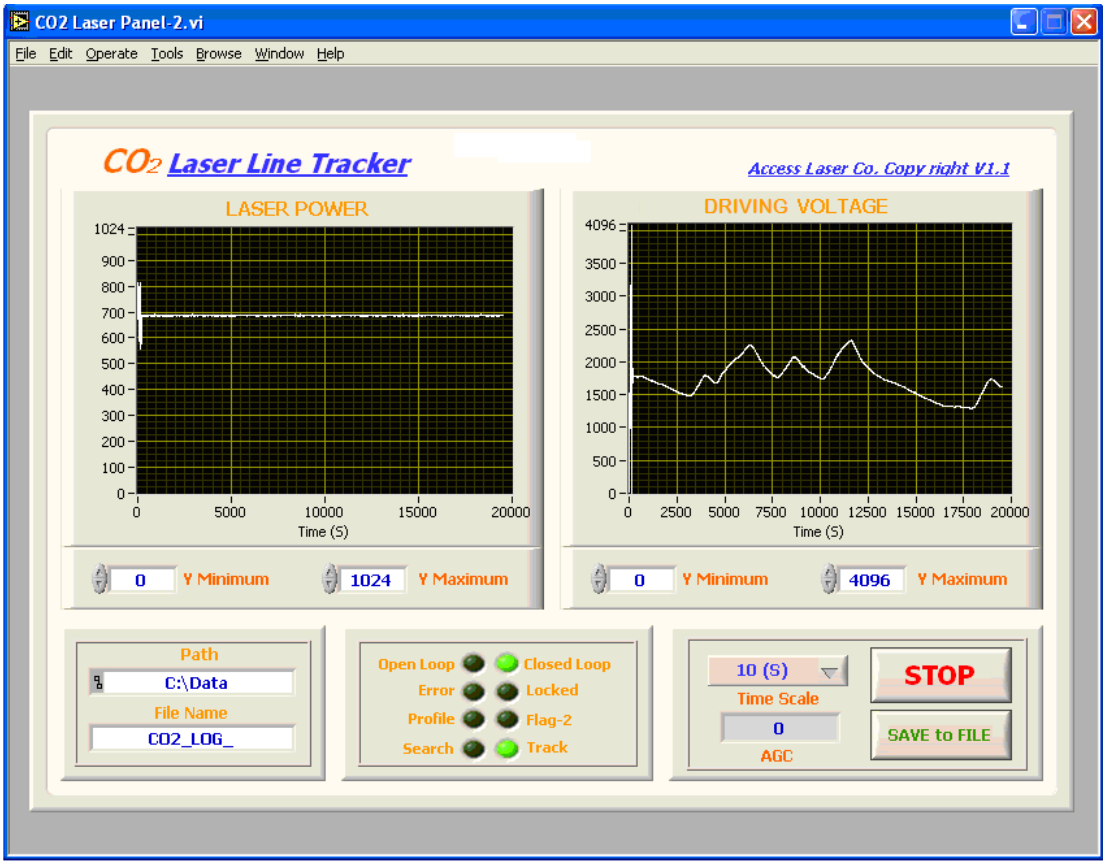
PIN 12-14) Disabled

PIN 15) Ground

Appendix C: Line Tracker

Line Tracker
Closed-loop Spectrum/Power Stabilizer

Line tracker is an accessory that keeps a CO_2 laser in a fixed wavelength at very high degree of power stability and frequency stability. It consists of a beam sampling assembly, Piezo actuator mounted on the laser and a controller. The Line Tracker can be connected to a computer through an RS-232 interface for information and data logging. Any of the Access Laser –S (stabilized) or –G (grating tuned) lasers can be equipped with Line Tracker to achieve more robust, longer term operation of ±1% power stability, even in out-door applications where the ambient environment fluctuates.



Above is a screen of its computer interface. The plot on the left is laser power over five hours of continues operation with a stability of better than ±1%. The plot on the right shows the closed-loop control signal. This plot is obtained with a L4S laser.

Appendix D: Returns

If at any time a failure should occur please contact Access Laser Company (ALC) at 425-582-8674, or via email at service@accesslaser.com. A Return Merchandise Authorization (RMA) will be issued.

The RMA must be filled out as completely as possible. A copy will need to be included in the laser package, as well as faxed to us at **425-582-8679, Attention: Service**. When faxing the RMA please also include the tracking number for the return shipment.

When requesting a RMA please have the following information ready:

- Date of purchase
- Laser model
- Serial number for both the laser and RF driver
- Date issue was first discovered
- Brief description of the issue

If a failure occurs within the first 45 days ALC will pay all shipping costs to and from ALC, in accordance with instructions provided by ALC customer service.

For any failures that occur after 45 days, but within the first year, the client shall be responsible for shipping costs to ALC. ALC will pay all shipping costs to return the item(s) back to the client.

For any returns, please ship the item(s) to:

Access Laser Company
Attn: Service Department
917 134th St SW
Ste A1
Everett, WA 98204

When preparing to return a laser to ALC, we request that all items be returned together, except for the product manual and laser test documents. This allows us to test each component so that we may accurately determine what components may be failing.

Appendix E: Laser Test Documents

This section contains all laser test documentation and power plots, unique to each laser.