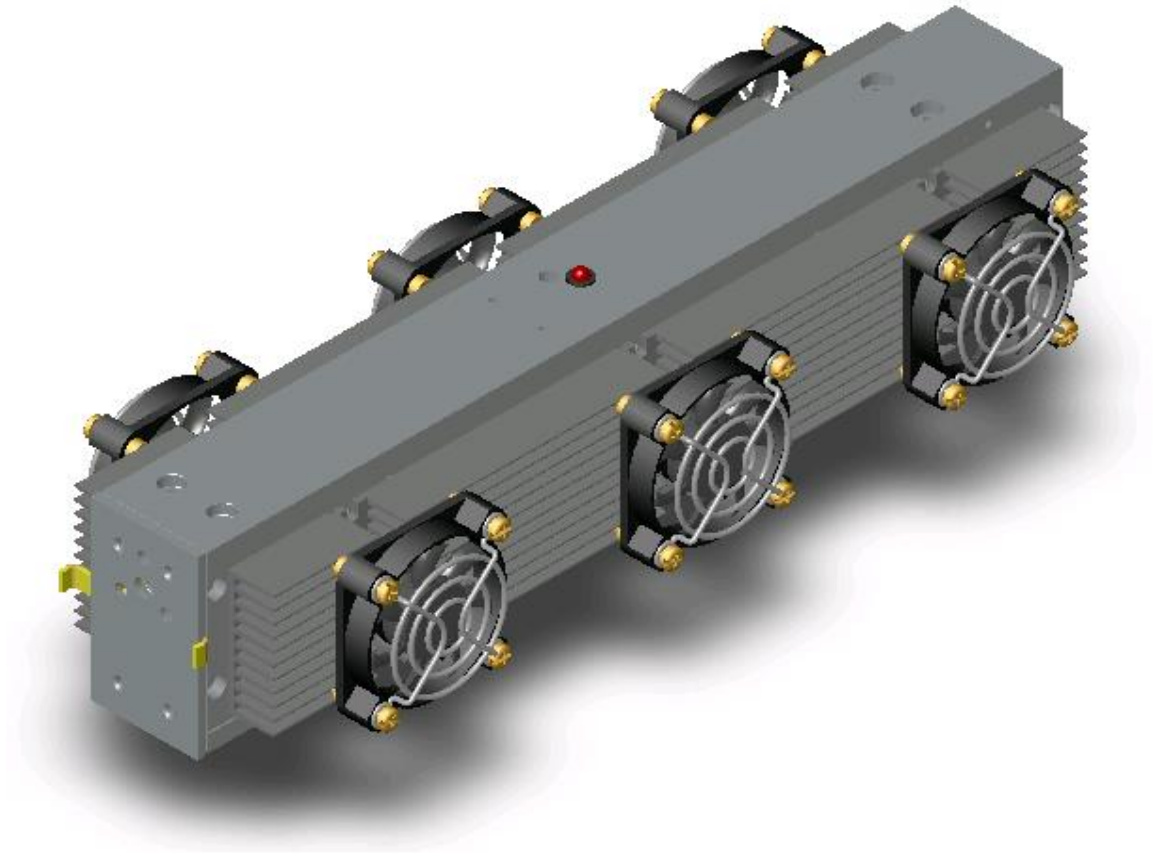
ACCESS LASER

where innovation never stops

L4 Series Operator Manual



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

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Company Statement

Thank you for purchasing an Access Laser product. We remain dedicated to your needs long after your initial purchase. In order to help us meet your needs, please contact us if you have any questions, comments or concerns about your laser, at sales@accesslaser.com or call us at 425-582-8674. Our staff will make every effort to assure that your laser is operating at its peak performance. We look forward to working with you through the life of your project.

Contact Information

Access Laser Company is a multi-national company with its headquarters in Everett, Washington.

Mailing Address	Access Laser Company 917 134th St SW Suite A1 Everett, WA 98204
Phone Number	425.582.8674
Fax Number	425.582.8679
Email	sales@accesslaser.com

Access Laser Company specializes in innovative solutions to meet your application needs. Our Sales Team and Customer Service Team can provide you with the most up-to-date product information. If you need assistance with an order or service, contact Access Laser Company at 425.582.8674, ext.1 or email your questions.

Sales/Technical Questions	sales@accesslaser.com
Service Department	service@accesslaser.com

Warranty

All of Access Laser Companyôs lasers come with a one-year standard warranty, which certifies that your laser is found to be free of any defects in material or workmanship. This warranty applies regardless of your laser application. It does not cover any issues that may arise due to operator negligence, environmental factors, accident, alterations, or improper maintenance.

Access Laser Company requests that you inspect your shipment within 14 days 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 within 14 days, 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: _____

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 changes or improvements to product design without notice, and without expectation of equivalent changes in products previously manufactured or shipped.

The L4 Series

The L4 Series lasers are low power CO_2 lasers, with an operating power of 1 Watt in Continuous Wave mode. The L4 is the base model. The series also includes the L4S, providing more power and wavelength stability, and the L4G, providing grating tuning between 9.3 µm and 10.7 µm. Operations of the L4, L4S and L4G are covered in this Operator Manual.

Accessories are available in the L4 series. Operation instructions for these accessories are included in the Appendices of the Operator Manual, or in a separate manual, included with your shipment. Appearance of laser models with accessories may differ from the base models. Most notably the RF power input is mounted on top of the laser in polarized lasers and lasers with line tracking (see picture of L4SL for an example).

Because Access Laser Company provides innovative solutions to meet your needs, many specialty features are also possible with the L4 series. Many of these specialty features may alter the appearance of your laser from what is pictured in the Operator Manual, but they do not alter the basic specifications or operation instructions for your laser. If you have any questions about the specifications or operation of your laser, please feel free to contact us at 425-582-8674, ext 1.

Laser Shipment Contents

The following items are included with each standard laser shipment:

- L4 Series Laser
- DC power supply
- RF Supply
- TNC to TNC Coax Cable (1)
- L4 Series Laser Product Manual
- Laser Test Documents
  - Final Test Document
  - Pulse Power Document
  - Power Plot

If you have questions about the contents of your shipment, please contact us.

Safety Information

Safety Symbols and Terms

Commonly used safety symbols and terms are used throughout this manual and on our products. Please familiarize yourself with the definitions and use of the terms and symbols.

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Indicates a hazardous situation in which, if not avoided, could result in minor or moderate injury.

CAUTION: Indicates an unsafe practice that can result in property damage.

Note: Additional information provided for optimal product performance.

Safety Information

FDA and Federal Regulations

Access Laser Company has designed our lasers to comply with CDRH requirements set forth by United StatesôRadiation Control Health Act of 1968. Therefore the L4 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. It is the responsibility of the end user to assure compliance with any and all regulations related to final use or when used outside the United States.

Never Open the Laser

To prevent direct exposure from the laser beam and injury to the user, do not try to open the laser. Opening the laser may result in burns or eye damage or misalignment of the laser or other damage to the laser. The end user will never need to open the laser for maintenance or any other reason. All laser parts are serviceable only by authorized Access Laser personnel. Disassembling the laser voids any warranty. Use of controls, adjustments or performance procedures other than those specified herein may result in hazardous exposure.

Eye Protection Required

The L4 series lasers are Class IV lasers. Class IV Lasers have power outputs 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.

Use Appropriate Beam Blocks

The L4 series lasers produce laser radiation around 10.6µm. This wavelength is invisible and requires special equipment to detect or view. Some materials may cause the laser beam to reflect and scatter, causing injury or damage. Take precautions to block the beam from unintentional reflection. Avoid using materials such as copper, aluminum, or gold as beam blocks which are highly reflective and may cause the beam to scatter. Organic materials may be flammable when exposed to the laser beam. Never use organic materials such as plastic or wood as a beam block. Use a beam block designed for the wavelength and power of your laser, or use a laser power meter.

CAUTION Water Cooled Lasers

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.

Safety Information

Safety Label Location

Safety labels identify some potential risks while operating the laser. Please familiarize yourself with the labels.

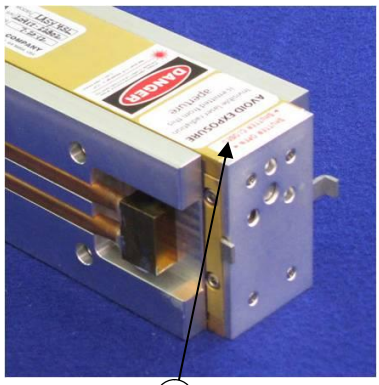
Safety Label Definitions

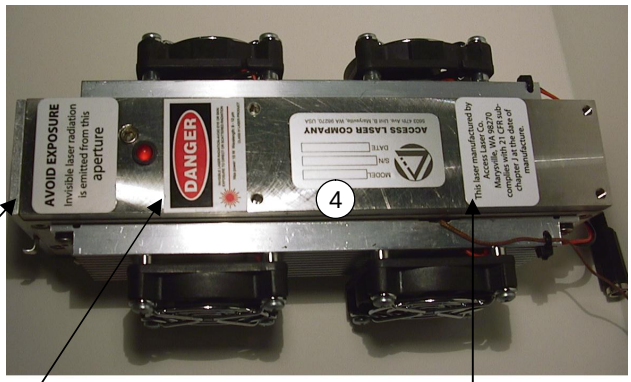
1. Shutter Open/Closed label ï Indicates whether the manual shutter is in the ñOpenò or ñClosedòposition.

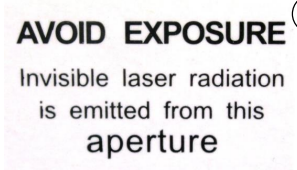
   

   Close the manual laser shutter to interrupt the beam. Operate the shutter using the lever closest to your body. Never pass your hand in front of the laser beam to close the shutter.

2. Aperture label ï Indicates location of laser beam exit (aperture)
3. Laser Danger label ï Indicates laser class and associated warnings
4. Product Identification label ï Indicates Model, Series and date of manufacture
5. CDRH Compliance label ï Indicates whether the laser was manufactured in compliance with United States Code of Federal Regulations







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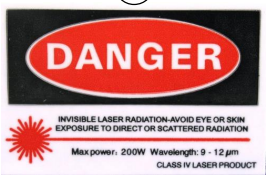
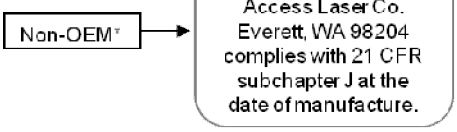
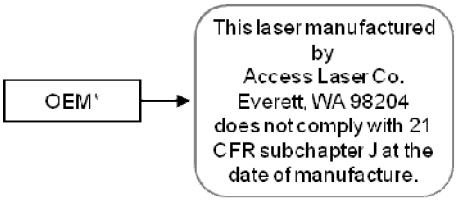






* All non-OEM lasers comply with 21 CFR subchapter J at the time of manufacture. If your laser is a custom order (OEM), it is your responsibility to assure compliance with CFR in your final application.

Laser Operation Instructions

Operating the Laser

1. Close the laser shutter (if present).
2. Connect the laser system components, as shown in the Connection Diagrams.
    a. Air Cooled Lasers (where cooling is provided by the end user)
        i. If no cooling is built in to your laser, you are responsible for providing sufficient cooling to maintain the laser specifications.
        ii. Connect your air cooling system to the laser.
        iii. Connect the RF cable to the laser and the RF driver.
        iv. Plug the 12VDC supply into an AC power line and into the RF Driver.
    b. Built-in Fan Cooled Lasers
        i. Connect the RF cable to the laser and the RF driver.
        ii. Plug the 12VDC supply into an AC power line and into the RF Driver.
        iii. If your laser has a TC2a temperature controller, connect this to the laser and follow the instructions found in Appendix A.
    c. Built-in Water Cooled Lasers
        i. Connect the tubing to the PISCO fitting as described in the Water Cooling Connection Instructions.
        ii. Connect the tubing to the laser and the chiller, as shown in the Connection Diagrams. Be sure that the tubing input and output are the same on both sides of the laser.
        iii. Connect the RF cable to the laser and the RF driver.
        iv. Plug the 12VDC supply into AC power line and into the RF Driver.
        v. Connect the temperature sensor cable from the laser to the chiller.
3. Direct the laser toward an appropriate target, such as a power meter or a beam-blocking device. (See Safety Information regarding appropriate beam blocking devices.)

4. Follow the Instructions for your RF driver (photos in Specification Section).

Non-OEM RF Driver Operator Instructions

a. Select the desired laser modulation setting using the modulation control. Modulation control can be Continuous Wave (CW), Gated Continuous Wave or Pulse Width Modulation (PWM).

   i. **CW**: The laser operates in Continuous Wave at 27.12 MHz when there is no input to the BNC connector.

   ii. **Gated CW** The laser operates in Gated Continuous Wave by applying a TTL signal through the TTL Gate Connector (BNC), where Hi = On, Low = Off

   iii. **PWM**: The laser operates with pulse width modulation at 16KHz with the built-in PWM generator. The PWM control knob is adjustable.

b. To operate laser in CW mode, adjust the PWM knob to the maximum.

c. To operate laser in PWM mode, adjust PWM knob to proper position to choose desired duty cycle.

d. Turn Key Switch to ON position. Status LED will flash red for 5seconds.

e. Push RF Power Toggle to turn on the RF driver. The status LED and the PWM indicator LED will turn green. A green LED indicates the RF driver is ON.

f. After a 5 second delay, the red LED on the laser will light up, indicating power to the laser.

g. The RF Driver runs with no gate signal applied.

h. If an external gate signal is applied, the signal needs to be 0 ï 100 KHz and 5V maximum.

i. If an alternate DC power supply is used, the required DC voltage range is 12.0 +/- 0.4V, and 5A minimum.

Note: If the DC Power to the RF driver is interrupted, or the interlock is opened, the key switch must be cycled off and on to resume operation.

OEM RF Driver Operator Instruction

a. The RF Driver is on as soon as the driver is powered. The laser will also be powered at this time.

b. The RF Driver runs with no gate signal applied.

c. If an external gate signal is applied, the signal needs to be 0 ï 400 KHz and 5V maximum.

d. If an alternate DC power supply is used, the required DC voltage range is 12.0 +/- 0.4V, and 5A minimum.

5. The red LED on top of the laser indicates the laser is powered on.

6. Open the laser shutter (if present).

Operate the shutter using the lever closest to your body. Never pass your hand in front of the laser beam to close the shutter.

Laser Operation Instructions

Water Cooling Connection Instructions

If your laser is water-cooled, your laser comes with a kit containing the parts required to connect your laser to your chiller (chiller not provided).

Note: For optimal performance with your water cooling system, keep the laser balanced, cool the laser equally, and keep the laser stable.

The quick connect tubing fittings are made by PISCO (www.pisco.com). These fittings are easy to use.

Assemble the PISCO fittings

1. Cut the end of the tubing clean and flat.
2. Assure that the outer surface of the tubing is free of defects for the first ½ò(13mm)
3. Assure that the tubing is round (not distorted).
4. Verify that the tubing is the correct diameter for the fitting.
5. Insert the tubing into the fitting and push it on as far as possible. It should go in approximately 0.7ò(18mm)
6. Pull gently on the tubing to verify that the small Stainless Steel teeth in the fitting are grabbing the tubing securely.
7. The fitting is ready to be used.

To Remove the PISCO fittings

1. Push the tubing gently into the fitting.
2. Push the ring into the fitting. This will release the small Stainless Steel teeth from the tubing.
3. While holding the ring close to the fitting, gently pull the tubing out of the fitting.
4. The fitting can be removed and replaced on the tubing many times, until the end of the tubing becomes scratched. If the end of the tubing is scratched, it should be cut back to expose smooth surface.

CAUTION

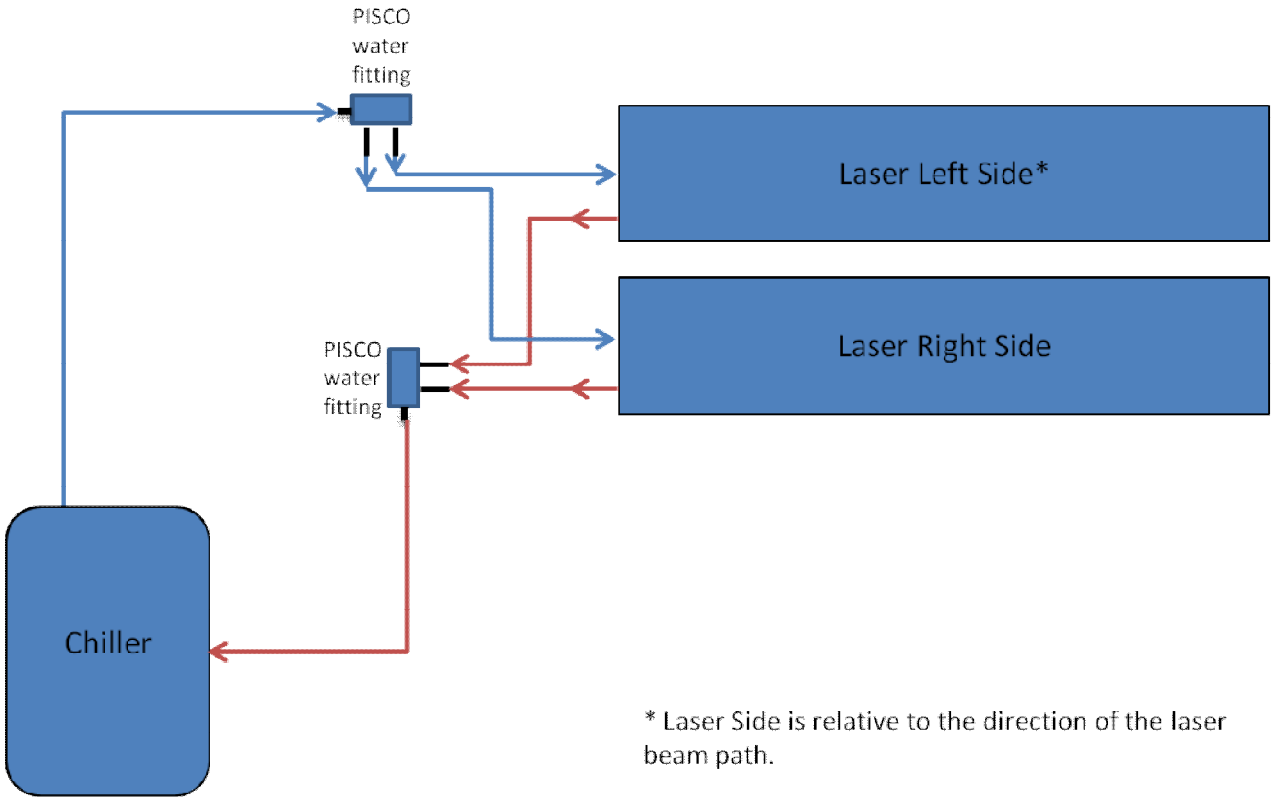
Always turn on/off the water chiller and the laser power at the same time.

CAUTION

If the coolant is running while the laser power is off, condensation can occur. This will damage the laser electronics.

Water Cooling Connection Diagrams

Water Cooling

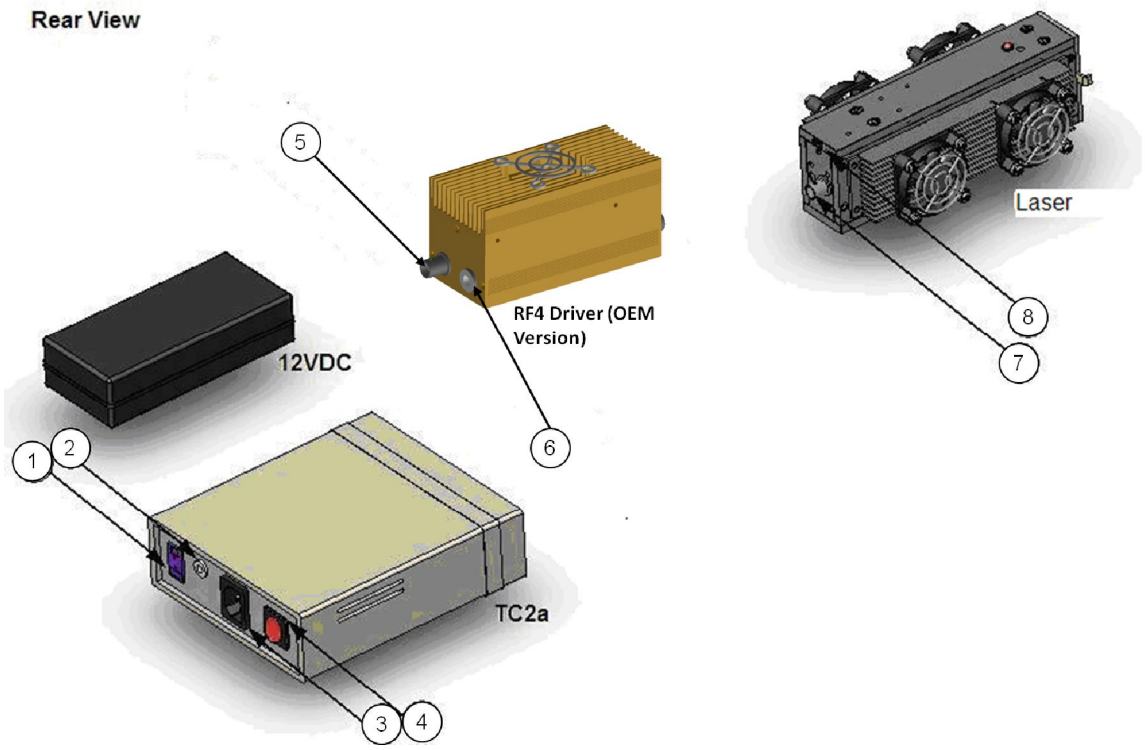


* Laser Side is relative to the direction of the laser beam path.

Laser Operation Instructions

Laser System Connection Diagrams

Rear View (L4 & L4S)

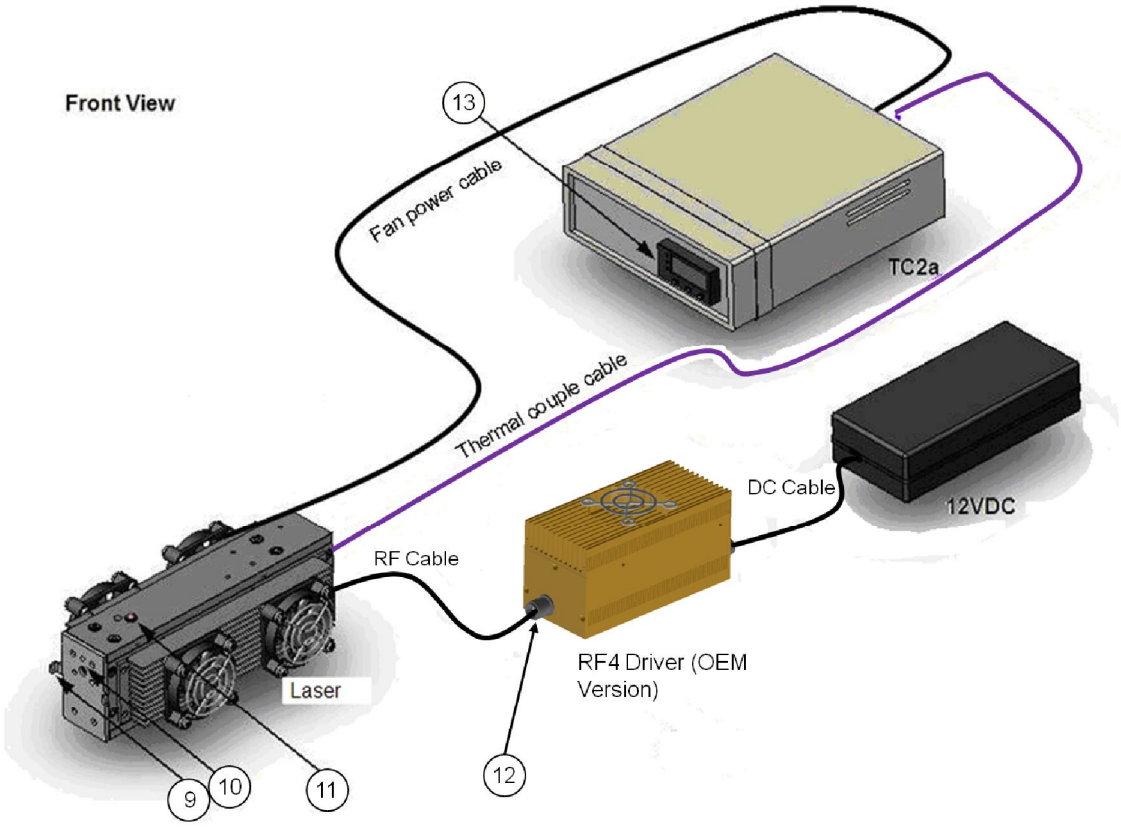


1. Type E Thermocouple Input
2. Controlled fan power out
3. AC power in (110-240V) for TC2
4. TC2 power switch
5. RF driver control signal input, BNC
6. DC power input for RF driver, 12V
7. RF input to laser, TNC
8. Interlock to laser, Mini-USB

Note: Heat sinks, fans, and TC2a temperature controller are default for L3S and L4S. They are not included with standard L2, L3, or L4.

Laser System Connection Diagrams

Front View (L4 & L4S)



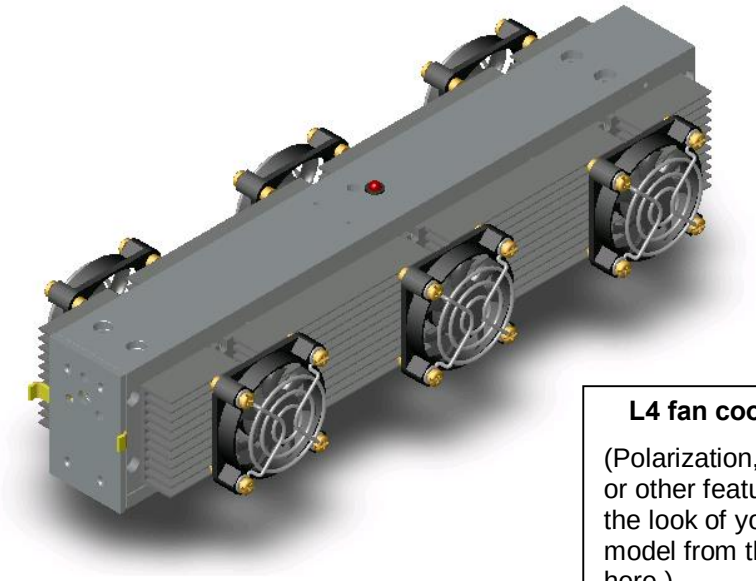
9. Manual Shutter
10. Laser Beam Exit
11. Laser Power-on indicating LED
12. RF Output (Some L4 Series lasers have top-mounted RF Output connections)
13. Temperature Display

Laser Specifications

L4 Specifications

Low Power CO_2 Laser

The L4 laser is the standard model in the L4 Series. The linear polarization of the standard model does not have a specific orientation. Horizontal linear polarization is available as the L4L. Other options include: fan cooling, water cooling, and isotope gas fills.



L4 fan cooled pictured

(Polarization, water cooling or other features may alter the look of your specific model from that shown here.)

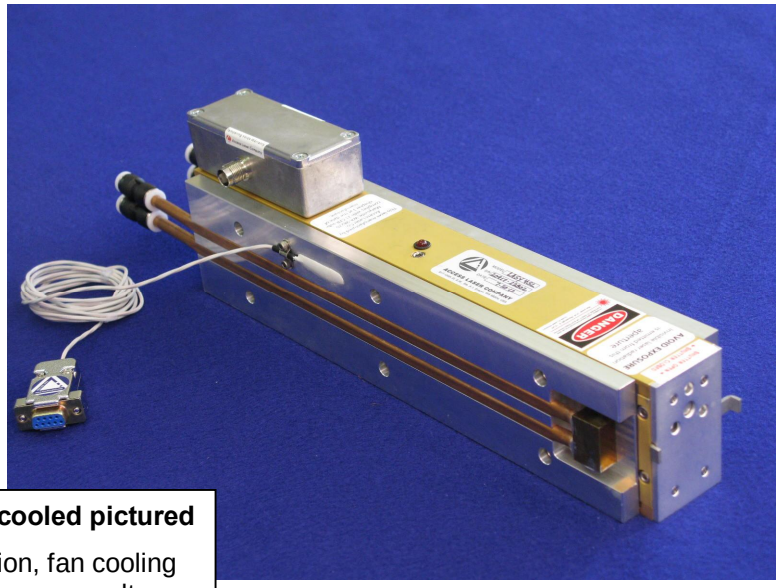
Description	Spec*
Model	L4
Wavelength (µm)	10.3-10.8
CW Power (W)	1
Peak Power (W)	1
Power Stability	±15%
Mode Quality (M^2)	< 1.1
Beam Waist Diameter	2.4 mm
Full Div. Angle	5.5 mrad
Supply Voltage (DC)	12V 20W
Cooling Requirement	Air Cooled
Working Temperature	5-40° C
Dimensions (LxWxH, inch)	12.5x1.5x2.5

*Specifications subject to change without notice.

Laser Specifications

L4S Specifications

The L4S provides more power and wavelength stability than the L4. The standard model is closed-loop fan cooled; with water cooling as an available option. The linear polarization of the standard model does not have a specific orientation. Horizontal linear polarization is available as the L4SL. Additional features may include real time power monitoring and line tracker for increased stabilization of ±1%.



L4SL water cooled pictured

(No polarization, fan cooling or other features may alter the look of your specific model from that shown here.)

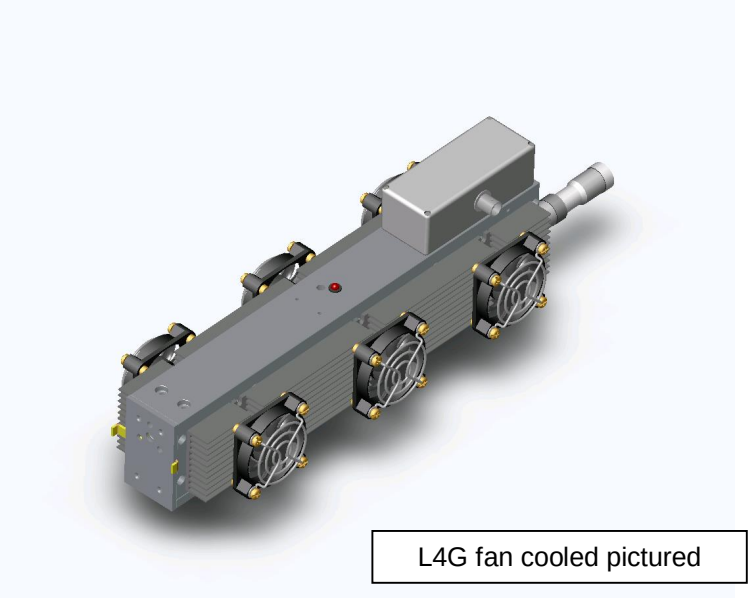
Description	Spec
Model	L4S
Wavelength (µm)	10.3-10.8
CW Power (W)	1
Peak Power (W)	1
Power Stability	±2%
Mode Quality (M^2)	< 1.1
Beam Waist Diameter	2.4 mm
Full Div. Angle	5.5 mrad
Supply Voltage (DC)	12V 20W
Cooling Requirement	Fan Cooled Closed Loop
Working Temperature	5-40° C
Dimensions (LxWxH, inch)	12.5x4.5x2.5

*Specifications subject to change without notice.

Laser Specifications

L4G Specifications

The L4G laser provides grating tuning between 9.3 µm and 10.7 µm. The standard model is fan cooled; closed-loop fan cooling or water cooling are available. An external high speed modulator (up to 200 kHz) or 11.2µm with 13CO2 isotope versions are available. Additional features may include line tracker for increased stabilization of ±1%.

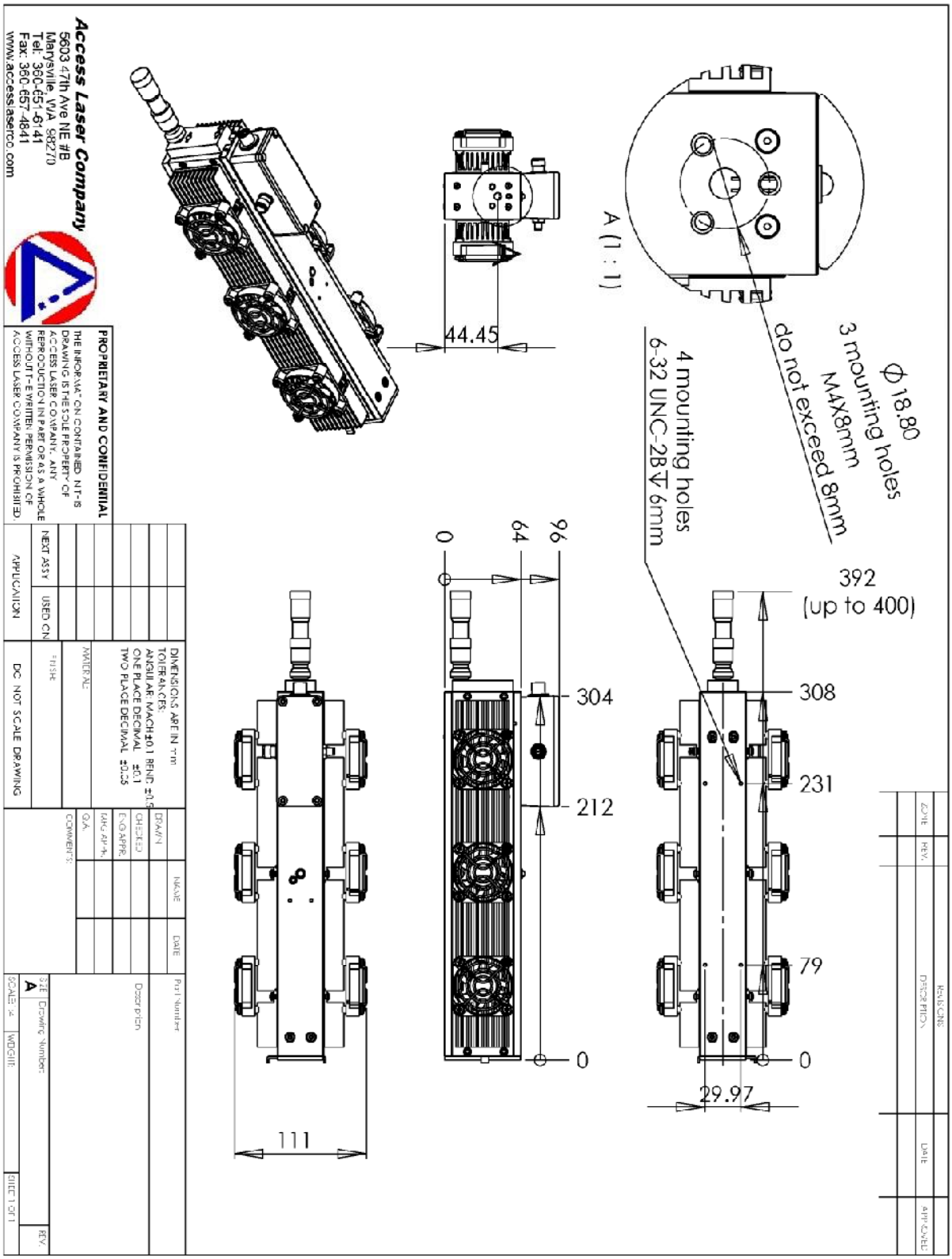


L4G fan cooled pictured

Description	Spec
Model	L4G
Wavelength (µm)	9.2 - 10.7
No. of Lines	30
CW Power (W)	200 mW
Peak Power (W)	200 mW
Power Stability	±10%
Mode Quality (M^2)	< 1.2
Beam Waist Diameter	2.4 mm
Full Div. Angle	5.5 mrad
Polarization	Vertical
Supply Voltage (DC)	12V 20W
Cooling Requirement	Fan Cooled
Working Temperature	5-40° C
Dimensions (LxWxH, inch)	12.5x3x2.5

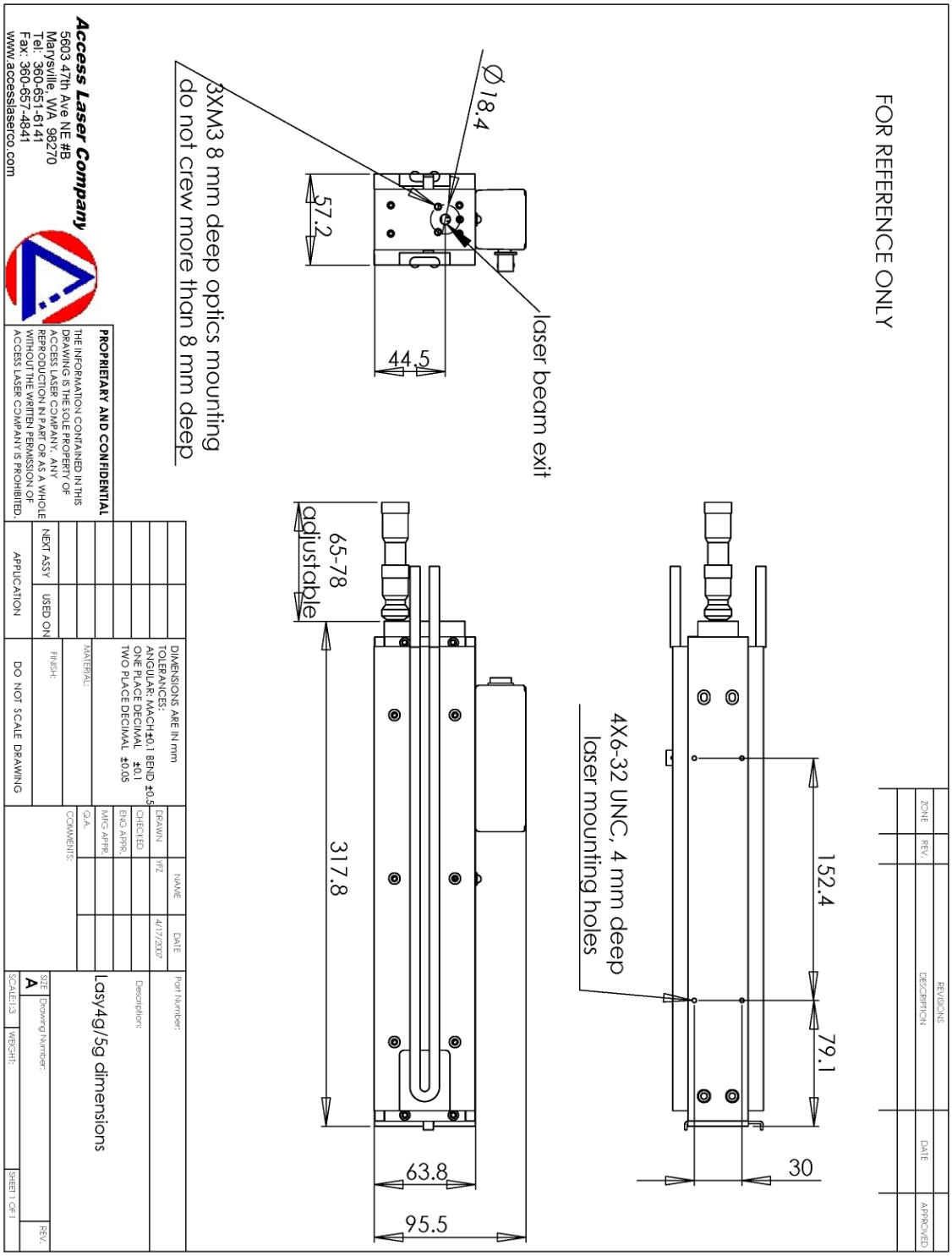
Laser Specifications

L4G Mounting Dimensions (Air Cooled)



Laser Specifications

L4G Mounting Dimensions (Water Cooled)



Laser Specifications

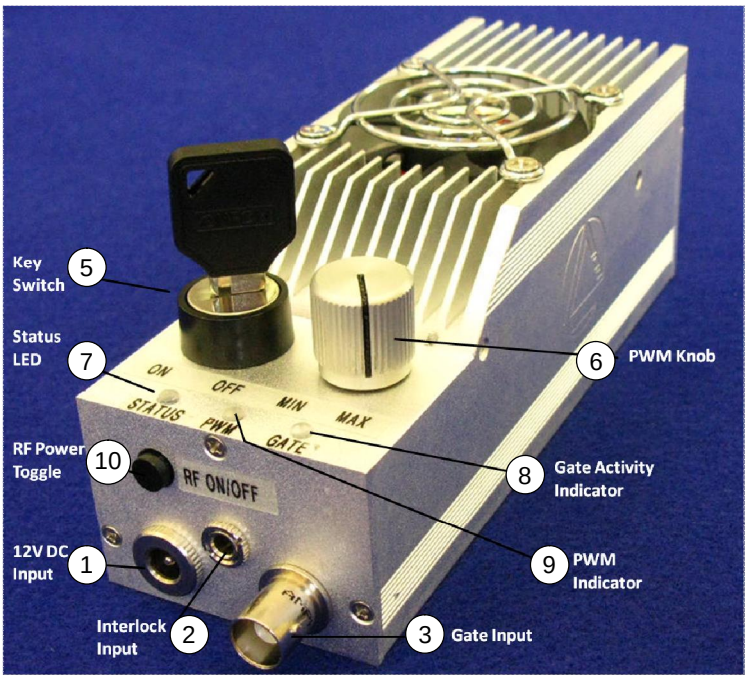
RF4 Driver Specifications

Model:	RF4
Supply Voltage:	12+/-0.4VDC
Output Power:	20W
Frequency:	27.12 MHz
Internal PWM:	16 kHz
Operating temperature:	0 to 60C
Maximum input current:	4A (typical 2.7A)
Typical power dissipation:	9.3W

Laser Specifications

RF4 Driver Description

Non-OEM Units



Front view (Non-OEM)

Rear View

1. 12V DC input: DC supply jack (center positive).
2. Interlock Input (when using interlock plug)

   Closed loop = on;
   Open loop = system fault - triggers system shut down. To reset, cycle the Key Switch.
3. Gate input:

   Defaults active high; gate off RF driver with TTL low input. (400kHz max).
4. RF output:

   RF Driver power output connector.
5. Key Switch: Enables/Disables RF driver.

Non-OEM Units

6. PWM Control Knob:

   RF pulse width modulation (PWM) adjustment from 0 (min) to 100% (max) duty cycle. (100% = CW mode).

7. Status LED:

   Solid red ï input DC voltage is applied;
   Flashing red/green ï five second delay after key is turned to ON position (color depends on RF switch on/off status);
   Solid green ï power is enabled and unit is in standby mode;
   Flashing orange ï fault has been detected.

8. Gate activity Indicator:

   Solid red ï gate is externally driven low (0-5V TTL).

9. PWM Indicator LED:

   Solid green ï RF power is on (unless PWM knob is at minimum position).

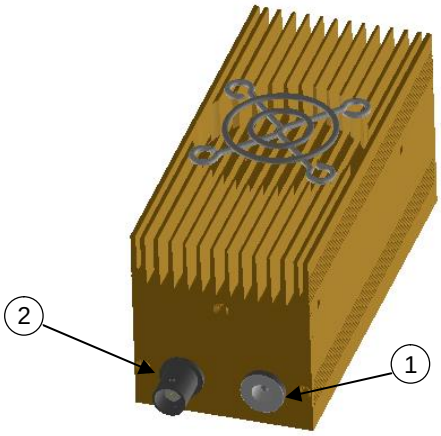
10. RF Power Toggle:

    Toggles RF output on/off. (Adjust PWM knob first, then toggle RF power).

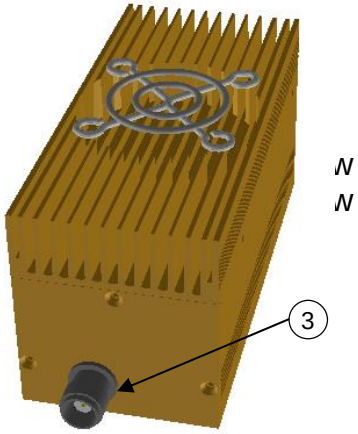
Laser Specifications

RF4 Driver Description

OEM Units



Front view (OEM)



Rear View

1. 12V DC input:
   DC supply jack (center positive).
2. Gate input
   Defaults active high; gate off RF driver with TTL low input. (400kHz max).
3. RF output
   RF Driver power output connector.

Appendix A: Available Accessories

TC2a Temperature Controller (Standard on the L4S)

TC2a Specifications

Supply Voltage: 110V AC to 240V AC

Features: Improved stability in laser power and wavelength by providing closed loop temperature control of the laser. A laser can expand and contract with changing temperatures, reducing the laserôs stability in power and wavelength. A laser becomes more stable when the laser resonator is kept at a constant temperature.

The TC2a temperature controller is integral in the ï S version lasers, providing a stability of ±2%.

Closed loop cooling provides a constant feedback loop to assure consistent temperature of the laser. The feedback loop monitors the laser temperature and cycles the cooling fans to achieve the desired constant temperature. The TC2a works together with our advanced resonator structure and temperature sensor to achieve high stability, both in power and wavelength. This minimizes thermal expansion and contraction of the optical resonator due to ambient temperature fluctuations.

A temperature sensor is built into the laser and measures the temperature of the laser resonator, feeding the information back to the TC2a. The TC2a then controls the temperature by turning the cooling fans on and off to stabilize the length of the laser, thereby achieving stability of both laser power and laser wavelength. Properly adjusting the temperature settings allows for wavelength tuning, within a specified range.

More information about the TC2a controls can be found in the Micro-controller X Instruction Manual, provided in your laser shipment.

Appendix A: Available Accessories

TC2a Temperature Controller (Standard on the L4S)

Operation Instructions for TC2a when used with RF4 Driver

To find the temperature range for the TC2a:

- Run the laser at full power (no modulation) with the fans constantly on. The laser temperature should rise approximately 6° F above room temperature.
- Run the laser at full power with the fans off. The laser temperature should rise approximately 25° F above room temperature.
- This gives the maximum range above ambient temperature that the controller should be set to (25°Fï 6°F=19°F).
    - For example, with an ambient room temperature of 68°F, the temperature settings can be between 74°F (68°+6°) and 87°F (68°+19°).
- Different wavelengths may be tuned in and stabilized by setting the temperature controller within the maximum range. A calibration table specific to your laser was created at the time of your laserôs manufacture. Because lab conditions vary, the calibration table provides you with an approximation. A final calibration table should be created in your own lab environment. This calibration table is included as part of the final Test Documents included in your laserôs shipment.
- From a cold start, thermal equilibrium and stability are achieved after approximately 30 to 45 minutes.

Notes

- The temperature rise will differ at duty cycles of less than 100%. The set point on the TC2a where the laser is most stable at the desired wavelength will therefore be different.
- If the power is not within the desired stability the laser may switch from one wavelength to another. Try adjusting the set point by ±0.1° F to ±0.4° F. This will ñcenterò the laser resonator for a particular wavelength.
- The controller has an auto-tune feature for its PID control. A cycle time of approximately 7 seconds is expected, with a proportional band set around 1° F.

Appendix A: Available Accessories

TC2a Temperature Controller (Standard on the L4S)

Temperature Controller Default Settings

P = 1	P-N2 = 8
I = 125	P-SL = 32
D = 28.8	P-SU = 150
CTRL = PID	P-DP = 1
TC = 7	P-N1 = 3

CAUTION

This controller is intended for Continuous Wave (CW) laser operation. If you modulate the laser to achieve different power levels, the laser resonator will have different thermal characteristics and the TC2a may not perform as designed.

CAUTION

Air from fans may interfere with laser power monitoring.

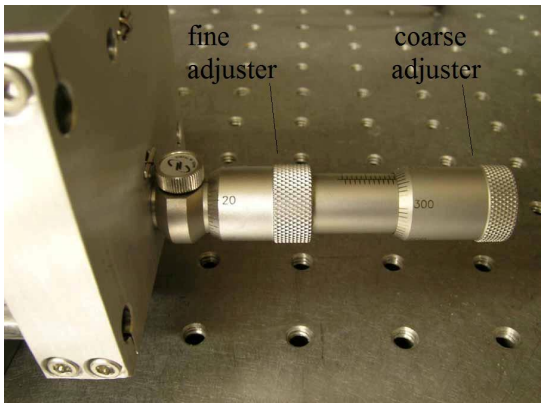
Appendix A: Available Accessories

Differential Micrometer (Standard on the L4G)

A differential micrometer is found on our grating lasers. The micrometer is used to adjust the wavelength, as well as maximize the output power and mode quality. Two knobs are available for tuning, a coarse adjuster (micrometer) and a fine adjuster (differential knob).

A reference table was created at the time of your laserôs manufacture. This reference table is included in your laserôs shipment as part of the Final Test Documents. The coarse adjuster (micrometer) is used to tune to the wavelengths listed in the reference table. We also recommend using a mode screen to verify the tuning. The micrometer has an adjustment range of 0-13mm, with markings at 0.5mm increments. The micrometer knob is scaled at 0.01mm per division.

The fine adjuster, or differential knob, has an adjustment of 0-0.2mm with markings at 0.025mm increments. The differential knob is scaled at 0.0005mm per division.



CAUTION

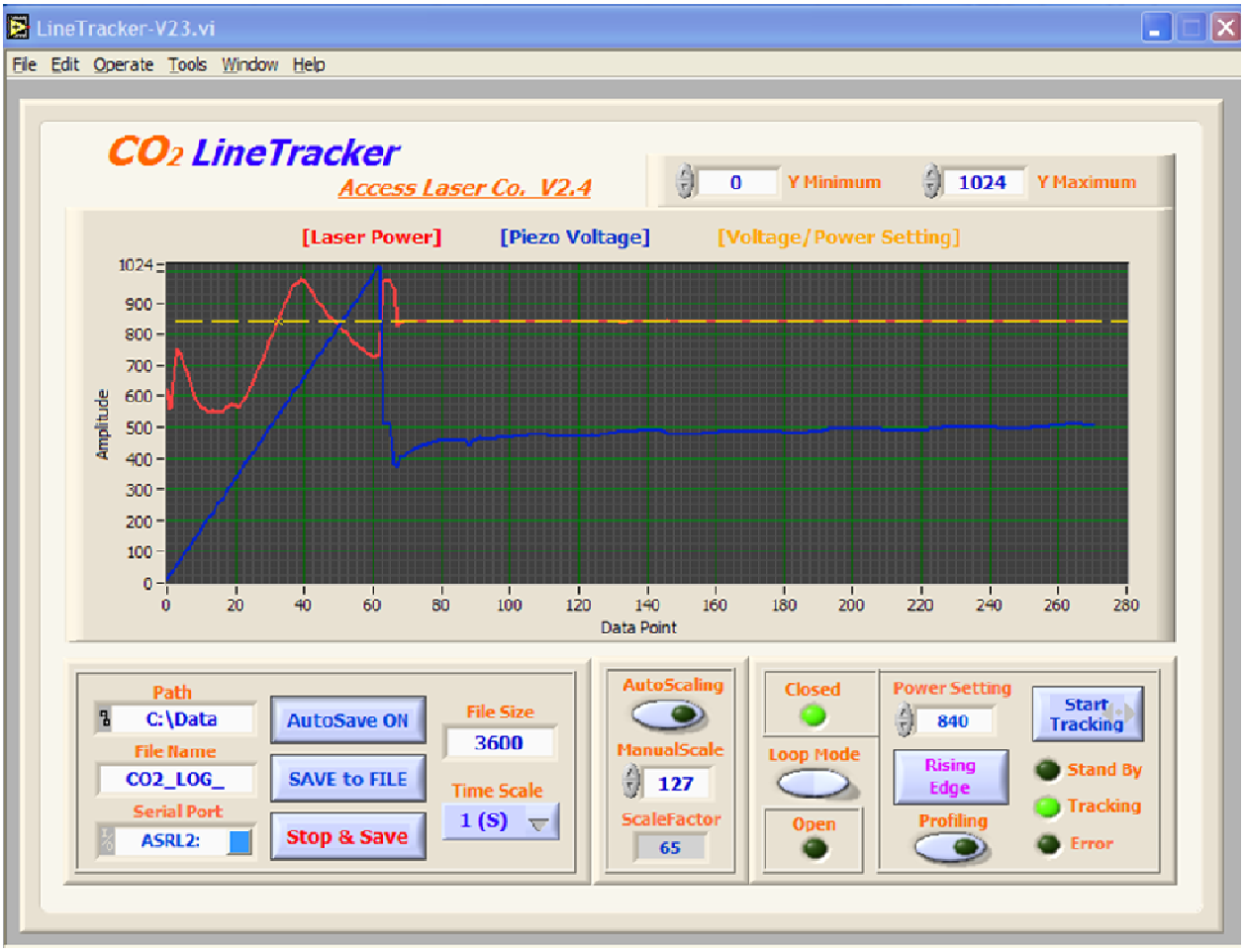
The fine adjuster should not be driven outside of its marked range or damage may occur. The coarse adjuster should not be driven outside the range marked in the reference table.

Appendix A: Available Accessories

Line Tracker (Available on L4S and L4G)

Closed-loop Spectrum / Power Stabilizer

A line tracker is available as an accessory for any ï S or ï G model laser. A line tracker maintains a fixed wavelength at a high degree of power and frequency stability in a CO_2 laser. The line tracker consists of a beam sampling assembly, a Piezo actuator 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 ï S (stabilized) or ï G (grating tuned) lasers can be equipped with Line Tracker to achieve more robust, longer term operation of ±1% power stability, even in outdoor applications where the ambient environment fluctuates.



Screen shot of the Line Tracker computer interface. This plot was obtained with a Merit laser.

Appendix B: Returns

If a failure should occur, please contact your Access Laser Company representative, or contact our Headquarters at 1-425-582-8674 or at service@accesslaser.com. A Company representative will determine whether your laser should be returned for repair or maintenance. If the laser needs to be returned, a Return Merchandise Authorization (RMA) will be issued. Any laser returned without an RMA will be at your sole expense.

An ALC representative will make a determination regarding shipping costs. Typically, tor failures within the first 45 days, ALC pays all shipping costs to and from ALC. For failures 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) to the client. Special considerations may apply. Be sure to verify shipping costs with your ALC representative.

When requesting an RMA please have the following information ready:

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

Fill out the RMA as completely as possible. Include a copy of the RMA in the laser package. Also fax a copy to us at 1-425-582-8679, Attention: Service. When faxing the RMA please include the tracking number for the return shipment.

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

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

Include the laser and ALL accessories when returning the laser. This allows ALC to test each component and determine the source of the issue.