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Operator's Manual for

Green Diode-Pumped Solid-State OEM Laser Systems

This manual covers the following laser systems:

85 GCJ 005	**85 GCJ 010**
85 GCJ 015	**85 GCJ 020**

Manufactured by

MELLES GRIOT

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Notice: This manual contains specifications, descriptions, and drawings for diode-pumped solid-state lasers manufactured by Melles Griot.

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1 Introduction



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



Wenn andere als die hier angebenen Kontrollfunktionen oder Einstellungen oder die Ausführung von Abläufen erfolgen, kann zu einer Aussetzung von gefährlicher Strahlung führen.

The 85 GCJ-series of laser systems represent a full solution for laser beam delivery. The modules provide a variety of output power options along with high-performance current and temperature control. This manual describes system operation and summarizes the handling procedures recommended to ensure reliable operation and highest performance.

1.1 System Description

Figure 1 is a block diagram of the 85 GCJ-series laser system; comprising a laser head and laser controller. The 85 GCJ-series system consists of a diode-pumped intra-cavity-doubled solid-state laser, an integrated automatic power control (APC) assembly, collimation optics and a laser controller. The controller contains the laser diode driver and user interface electronics.

The 85 GCJ system is powered by user supplied 5 Vdc input. All control connections are made though the external interface connector on the laser controller.

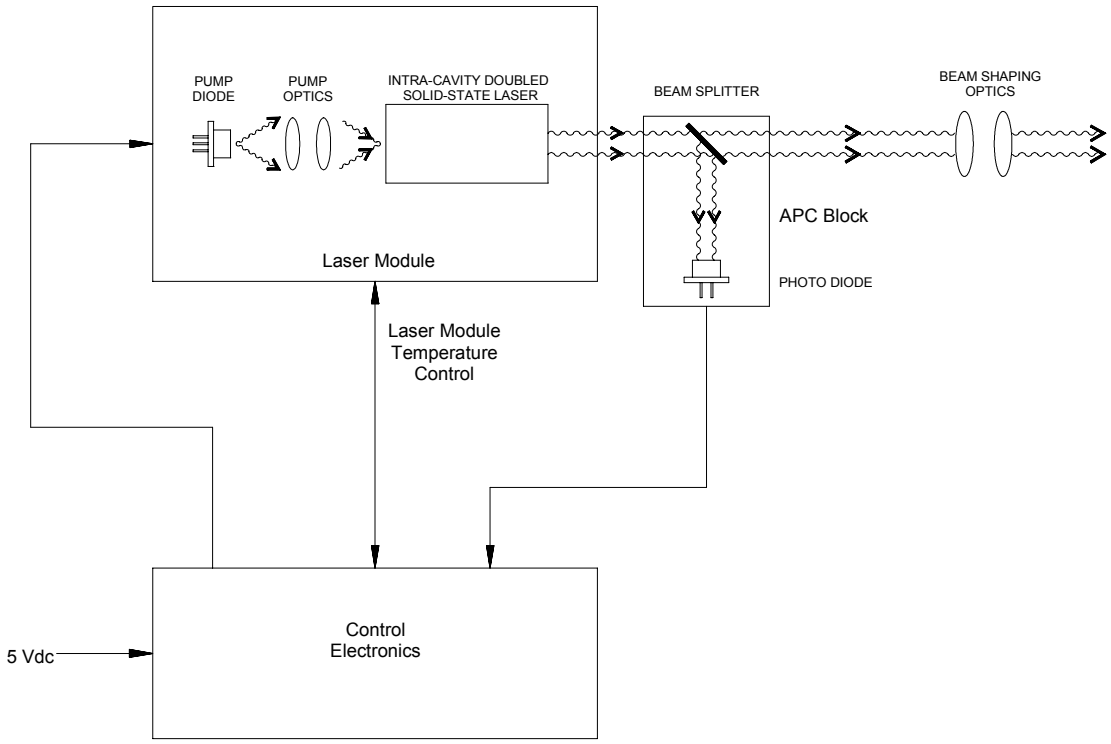


Figure 1: System Block Diagram

If your beam shaping requirements cannot be accommodated by standard optical components or your specific system requirements require a different configuration, please contact Melles Griot for a customized design solution.

2 System Inspection

2.1 Introduction

This chapter includes information about:

- Unpacking the system
- Inspecting the system for damage and completeness

2.2 Unpacking the System

Retain the shipping box and packaging materials. These materials have been designed to protect the laser system during shipment and storage. These materials should always be used for storage or to ship the system to Melles Griot for service.

Immediately upon receipt of your Melles Griot laser system, inspect the packaging for obvious signs of damage. The laser's packaging is quite substantial and will protect the equipment from normal shipping stresses. If, however, the packing cartons are significantly damaged and you suspect damage has occurred to any of the components, file a claim with the shipper and have a representative from the shipper present when the unit is unpacked.

When unpacking, look for dents, scratches and other obvious signs of damage to any of the components. If any damage is evident, immediately file a claim with the shipper and contact your Melles Griot sales representative immediately. If any damage it suspected, *do not operate the system*.

2.3 Component Identification

The following components, along with any purchased options, will be included in your shipment:

2.3.1 Laser Head

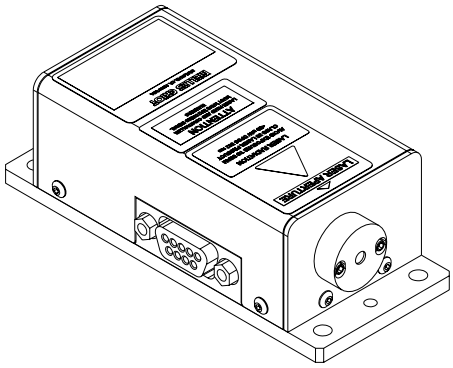


Figure 2: Laser Head

2.3.2 Controller

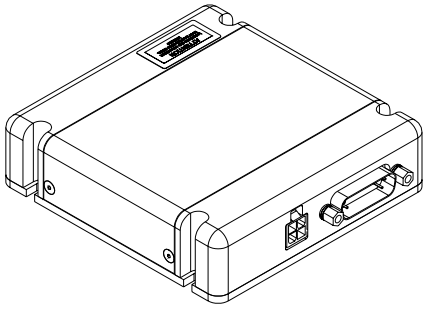


Figure 3: Laser Controller

2.3.3 Control Cable

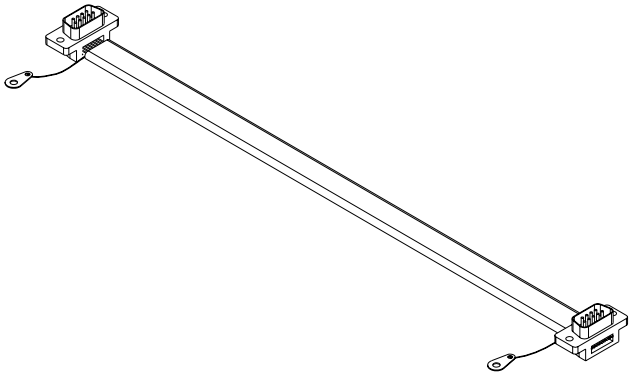


Figure 4: Control Cable

2.3.4 Shorting Connectors

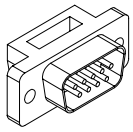


Figure 5: Laser Diode Shorting Connector

Note

The male shorting connector must be connected directly to the laser head if the control cable is removed. The female shorting connector must be connected to the control cable if the control cable is removed from the laser controller. Failure to attach the shorting connectors may result in ESD damage to the laser diode, which is not covered under warranty.

2.3.5 Ferrite

In order to meet the regulatory requirements of EN 61326 (1997 w/A1: 98 & A2: 01) Class A, it is necessary to install a ferrite on the dc input to the laser controller. The dc input lines must be wrapped three times through the core of the ferrite.

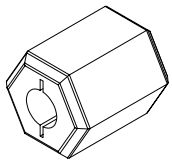


Figure 6: Ferrite for dc Input

3 Safety, Installation and Handling Precautions

3.1 Laser Safety

The light emitted by the laser module can cause severe damage to the human eye. Never look directly down the beam, into the laser aperture (even if the laser is off) or at any specular reflection of the beam. Keep laser light well away from eye level and use absorptive beam dumps to block stray beams. Appropriate laser goggles provide an additional level of safety and may be ordered from Melles Griot. The 85 GCJ modules can be switched off remotely so that safety interlock systems can be implemented.



The output beam of this laser contains a small amount of infrared light at 808 nm and 1064 nm. Power levels for these wavelengths are specified to be <0.5% of the 532 nm output power.

3.2 Pump Diode Protection

This product employs an infrared diode laser as a pump source for the intra-cavity doubled solid-state laser. While commercial diode lasers are capable of operating continuously for many thousands of hours, they are more sensitive to electrical transients than almost any other electronic component. Reverse bias voltages as small as a few volts and over-currents of only a few milliamps lasting less than a microsecond can be sufficient to damage a diode laser. While the 85 GCJ-series is designed with safe laser diode operation in mind, it is impossible to guard against all electrical transients. The following guidelines should help to prevent damage.

3.2.1 ESD Prevention

Standard ESD prevention measures, including conductive garments, wrist straps, conductive mats, grounded soldering irons, humidifiers and air ionizers, should be instituted in environments where diode laser assemblies are used.

3.2.2 Electrical Connections

Use only high-quality contacts and connectors to ensure reliable electrical connections.

3.2.3 Module Input Power

For proper operation, 5 Vdc must be supplied to the laser controller. Make certain that the dc power supply is well-regulated, transient-free and does

not pick up transients from nearby electronic equipment such as fluorescent lights, computers, electric motors, etc. A surge suppressor is recommended. Use of a stable dc power supply also enhances the performance of the current/temperature controller. Make certain all connecting cables are of sufficient wire gauge to minimize voltage drops.

3.2.4 Electrical Environment

Use careful mounting techniques to ensure reliable electrical connections and minimize entry of electrical transients. The case of the module forms a Faraday cage and must be connected to an appropriate external earth ground to minimize the effects of external electrical disturbances.

3.3 Mounting

Both thermal and mechanical issues must be considered when mounting the laser head and controller.



Failure to properly heat sink and mount the laser head and controller will degrade performance or cause catastrophic product damage.

3.3.1 Heat Sinking

A mounting surface with sufficient heat sinking capability is required for optimal laser lifetime and performance. Refer to Table 1 for data required for proper thermal management.

If an alternate mounting geometry is required, please contact the factory for design assistance

3.3.2 Mounting Stresses

The precise optical alignment of the laser module can be disturbed by excessive stress applied in mounting. Employ low-stress clamping and mounting techniques

Mount both the laser head and controller securely to a flat heat sink. Do not use thermal grease or compound between the laser and the heatsink or the controller and the heatsink. Melles Griot recommends the use of Q-Pad II from the Bergquist Company (`http://www.bergquist.com/`) for a clean, non-contaminating thermal interface material.

Make certain that all laser safety and electrostatic discharge (ESD) precautions are in place to avoid damage to the laser diode.

Table 1: Component Mounting Requirements

	Laser Head	Controller
Operating Temperature, Minimum (ºC)	10	10
Operating Temperature, Maxiumum (ºC)	40	40
Heat Dissippation (W)	5	5
Roughness, Mounting Surface (microinch rms)	63	63
Flatness, Mounting Surface (inches)	.003	.010

3.4 System Installation

To install the 85 GCJ-series laser system, use the following procedure:

- Mount the laser controller into the equipment using an appropriate heatsink (see Table 1).



The serial number on the laser head must exactly match the serial number on the controller for proper system operation.

- Attach the control cable to the laser controller and route the cable to the area in which the laser head will be mounted. The ground lug on the cable must be inserted under the head of the mounting screw for proper shielding
- Attach the laser head to an appropriate heatsink (see Table 1).
- Remove the shorting connector from the laser head. At this point, extreme care must be observed to prevent damage to the laser diode within the laser head. Do not touch the 9 pin connector on the laser head.
- Attach the control cable to the laser head. The ground lug on the cable must be inserted under the head of the mounting screw for proper shielding.
- Attach the 5 Vdc source to the controller, wrapping the input three times through the included ferrite.
- Attach the interface cable to the 15-pin interface connector on the controller
- Store all shorting connectors for future laser head protection.

3.5 Optimum Performance

Achieving the highest level of performance from the 85 GCJ-series laser requires careful design consideration for installation. In addition to the measures above, the following steps can lead to improved stability and noise performance.

3.5.1 Stabilize environmental temperature

Although capable of operation over a fairly wide temperature range, a more stable ambient environmental temperature will ultimately lead to even greater current and temperature stability, and consequently to enhanced output power stability.

3.5.2 Minimize mechanical vibrations

Mechanical vibrations can disrupt the operation of systems requiring careful optical alignment.

3.5.3 Minimize back reflections (optical feedback)

At levels far below those required to cause permanent damage, reflections back to the laser can result in unstable behavior. Observed responses to low levels of optical feedback include: power fluctuations at time scales from nanoseconds to hours; increased mode hopping; multimode oscillation; hysteresis during current and temperature scans; wavelength shifts; enhanced relaxation oscillations; and frequency noise. Any application involving retro-reflections must be handled with great care.

3.5.4 Avoid etalon effects

In some applications, a substantial amount of the output power of the laser module may inadvertently be reflected back to the laser. This optical feedback should be avoided if possible, since increased power density in the lasing cavity can cause mode-stability and optical noise problems.

Interference between the main beam and stray reflections can cause vastly increased system noise as optical surfaces shift and vibrate on the scale of a wavelength. Employ wedged, anti-reflection coated, or tilted (wedged) surfaces where feasible.

The 85 GCJ-series has been designed to give the most stable, reliable and versatile performance attainable in a compact and cost-effective package. If you have questions concerning the best use of the laser system in your instrument, or comments about the product in general, please contact Melles Griot.

4 System Operation

This section describes basic laser control using the external interface connector on the laser controller. A full description of all connectors and connector pin-outs is found in Chapter 5.

Because the 85 GCJ-series of laser modules are OEM component lasers, the system integrator is responsible for ensuring that end-user equipment meets all applicable regulatory requirements for the regions in which the product is to be used.

Laser output is initiated by the following sequence of events:

1) Apply 5 volt dc power input

2) Close the laser safety interlock

3) Enable system

4) Initiate laser

4.1 Power Input

Provide +5 volt, 2 amp dc power to pins 2 and 4 and ground pins 1 and 3 on connector J7 on laser controller. The mating connector housing is Molex part number 39-01-2040 and the pins are part number 39-00-0039. The dc input line must be wrapped three times through the included ferrite.

4.2 Laser Safety Interlock

Close the laser safety interlock by pulling pin 1 high on controller connector J1 (CMOS high = enabled, low = disabled). If desired, pin 11 on controller connector J1 can be used to provide a +5V dc source.

4.3 System Enable

Enable system by pulling pin 3 high on controller connector J1 (CMOS high = system enable, low = system disable). Note: Pulling pin 3 high powers up the thermo electric coolers (TEC) allowing the laser module to reach its set point temperature. After pin 3 has been pulled high it will take approximately 30 seconds before the laser can be turned on. If desired, pin 11 on controller connector J1 can be used to provide a +5V dc source.

Note that if pin 3, on controller connector J1, is pulled low, both the TEC and the laser diode will turn off.

4.4 Turning the Laser On

Note that completion of this step will result in laser emission. All appropriate safety measures must be in place before continuing.

Turn on the pump laser diode by pulling pin 2 high on controller connector J1 (CMOS high = laser diode on, low = laser diode off). If desired, pin 11 on controller connector J1 can be used to provide a +5V dc source. Laser emission will begin immediately.

4.5 Turning the Laser Off

Turn the pump laser diode off by pulling pin 2 CMOS low on controller connector J1.

4.6 Error Outputs

If an over or under temperature condition arises for either the laser diode or the laser baseplate, the laser will shut-down immediately. An error signal (CMOS high) will be present on controller connector J1 to specify the error.

1) Laser diode temperature error: pin 7 on controller connector J1.
2) Laser baseplate temperature error: pin 12 on controller connector J1.

4.7 Resetting Errors

1) Disable the laser pulling pin 3 on controller connector J1 CMOS low.
2) Re-enable the laser pulling pin 3 on controller connector J1 CMOS high.

5 Connector Pinouts

5.1 Laser Interconnect Connector (Laser Head/Controller)

Table 2: Connector J3, Laser Interconnect

Pin	Description
1	Ground, Chassis
2	TEC, +
3	TEC, –
4	Laser Diode [Cathode]
5	Laser Diode [Anode]
6	Thermistor, + [Laser Diode]
7	Thermistor, – [Laser Diode, Baseplate] Photodiode [Cathode]
8	Photodiode [Anode]
9	Thermistor , + [Baseplate]

5.2 External Interface Connector (Controller)

Table 3: Connector J1, External Interface

Pin	Description
1	Safety Interlock
2	Laser On/Off
3	Module TEC On/Off
4	Monitor, Laser
5	Reserved for Future Use
6	Reserved for Future Use
7	Temperature Error, Laser
8	Reserved for Future Use
9	Ground, Signal
10	Reserved for Future Use
11	dc Output, +5 V, 200 mA
12	Temperature Error, baseplate
13	Reserved for Future Use
14	Monitor, Power
15	Reserved for Future Use

5.3 dc Input Connector (Controller)

Table 4: Connector J7, dc Input

Pin	Description
1	Ground
2	dc Input,+5 V
3	Ground
4	dc Input,+5 V

6 Specifications

6.1 Available Models

Table 5: Available Models

Model Number	85 GCJ 005	85 GCJ 010	85 GCJ 015	85 GCJ 020
Wavelength	532.0 ± 1.0 nm	532.0 ± 1.0 nm	532 ± 1.0 nm	532 ± 1.0 nm
Output Power	> 5 mW	> 10 mW	> 15 mW	> 20 mW

6.2 Electrical, Mechanical and Environmental Specifications

Table 6: Mechanical and Environmental Specifications

Warm-up Time	< 5 min to specified output power
	<15 min to specified pointing stability
Power Consumption	< 10 W
Mounting Hardware	6-32 or M3 screws and flat washers
Input Connectors	Refer to Chapter 75
Input Power	5 ± 0.2 Vdc at 2.0 A max
Operating Temperature	10 to 40 ºC (baseplate temperature)
Storage Temperature	-10 to +50 ºC
Relative Humidity	0 to 95% noncondensing
Shock and Vibration	Shock: maximum 25 g for 5 msec Vibration: 20 g sinusoid along three orthogonal axes
Laser and Controller Dimensions	(See outline and mounting drawings)
Weight, Controller	0.41 kg (0.89 lb)
Weight, Laser Head	0.21 kg (0.46 lb)

6.3 Optical Specifications

Table 7: Optical Specifications

Wavelength	532 nm ± 1.0 nm
Wavelength Purity	> 98% at 532 nm
Transverse Mode	TEM_{OO}
Beam Quality (M^2)	< 1.2
Polarization, Orientation	Perpendicular to baseplate ± 5.0°
Polarization Extinction Ratio	> 100:1
Bore sight with respect to baseplate (both planes):	< 5 mrad
Beam Pointing stability (22 ˚C ± 1˚C):	< 0.02 mrad
Beam Pointing Temperature Dependence	<6 µrad/ ºC
Power stability (22 ˚C ± 2 ˚C over 8 hours):	± 2%
Amplitude Noise (20 Hz to 2 MHz):	< 3% peak–to-peak < 0.5% rms
Beam Diameter ($1/e^2$ at waist):	0.32 mm ± 10%
Beam Divergence (full angle $1/e^2$)	< 2.5 mrad
Beam Waist Asymmetry:	< 1.1:1
Centration (with respect to nominal):	< 1.0 mm

6.4 Regulatory Compliance

6.4.1 Low Voltage Directive: 73/23/EEC (LVD)

(Does not apply).

6.4.2 Electromagnetic Compatibility Directive 89/336/EEC (EMC)

EN61326 (1997 w/A1: 98 & A2: 01) Class A: "Electrical equipment for measurement, control and laboratory use".



Product is compliant only if the included ferrite is installed on the dc input to the laser controller.

6.4.3 Electromagnetic Conformance (FCC)

FCC Part 18 Subpart C Sections 18.305 and 18.307.

6.4.4 Safety of Laser Products (IEC)

85 GCJ-series laser systems do not comply with EN 60825-1. This is an OEM product and is not intended for use as a standalone system.

6.4.5 Performance Standards for Light-Emitting Products (FDA/CDRH)

85 GCJ-series laser systems do not comply with 21 CFR 1040.10. This is an OEM product and is not intended for use as a standalone system.

6.5 Laser Emissions

The following are general emission data on the 85 GCJ-series green DPSS lasers.

Table 8: Laser Emission Data

Laser medium	Nd:YVO_4
Emission duration	Continuous
Full beam diameter	0.32 mm ± 10% at waist
Full beam divergence	< 2.5 mrad
Operating wavelengths	532 nm, 1064 nm, and 808 nm
Maximum output power	50 mW @ 532 nm, 0.25 mW @ 1064 nm, 0.25 mW @ 808 nm

6.6 Fusing

No fuses are present in either the laser head or laser controller.

6.7 Safety Labeling

Melles Griot applies laser aperture, laser hazard and laser emissions labels as a convenience to our customers. However, full compliance with all applicable regulatory labeling requirements is ultimately the responsibility of the purchaser of this laser system as these devices are solely intended for incorporation into customer equipment and instrumentation.

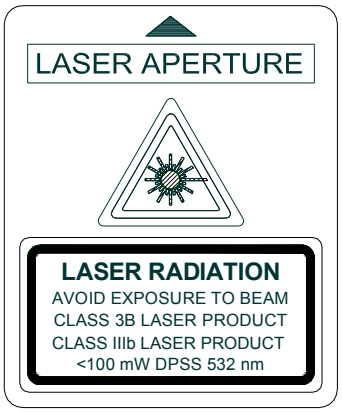


Figure 7: Laser Label

6.8 Laser Head Mechanical Drawing

Dimensions are in inches (mm).

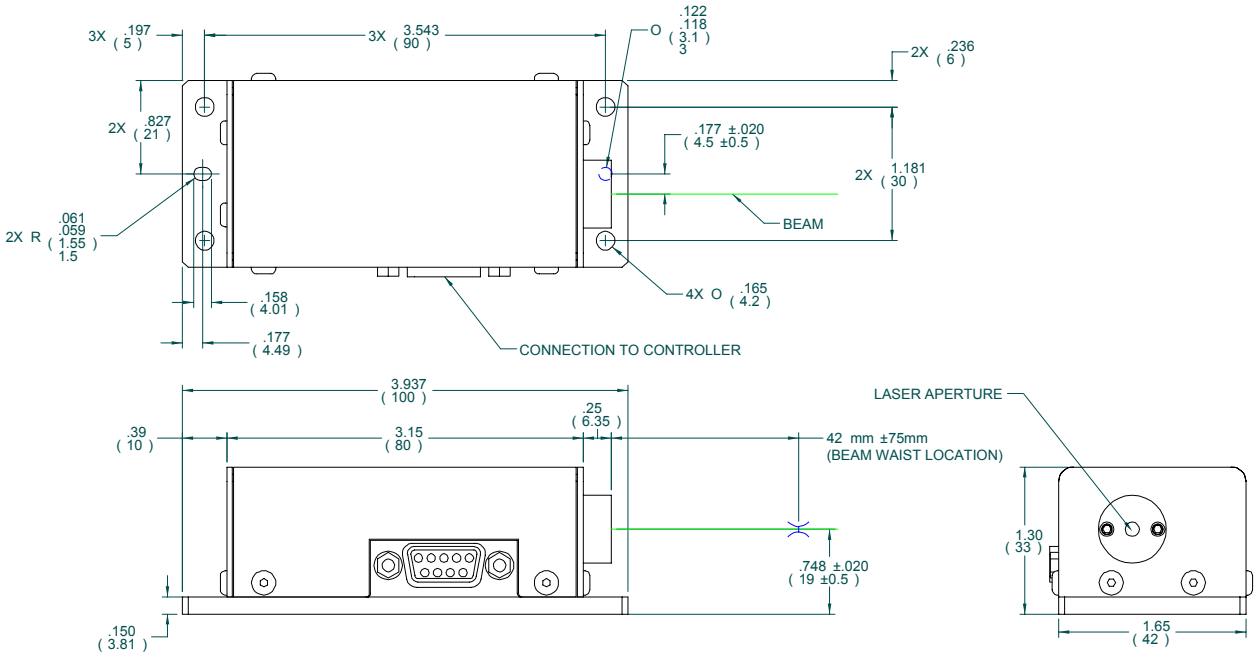


Figure 8: Laser and Mechanical Drawing

6.9 Controller Mechanical Drawing

Dimensions are in inches (mm).

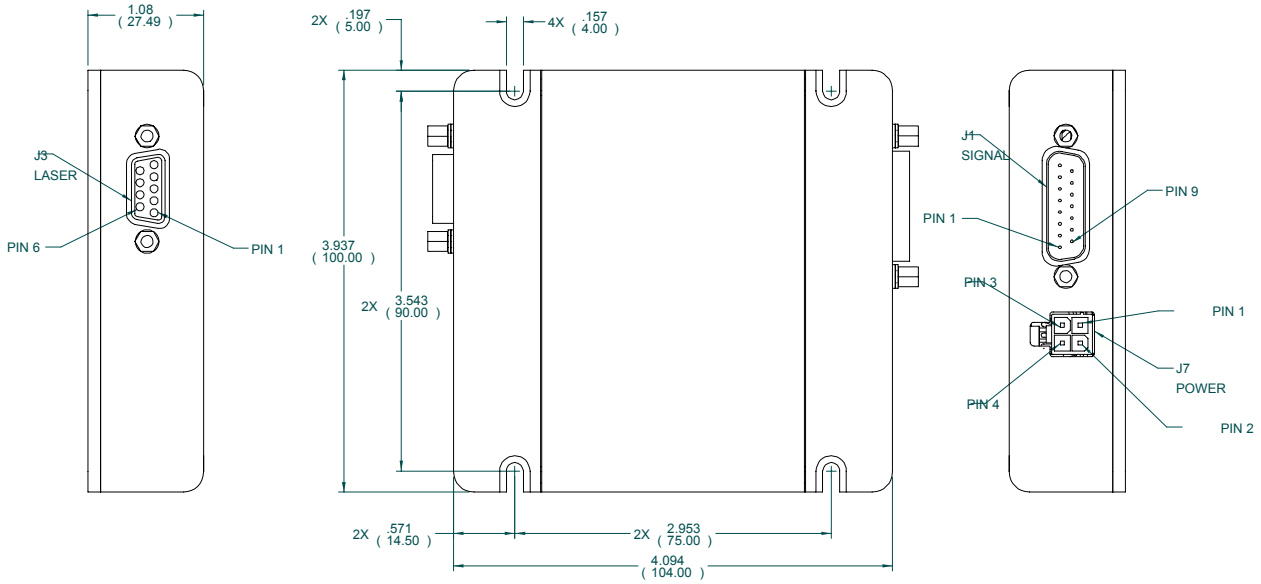


Figure 9: 85 CGJ Controller Mechanical Drawing

7 Warranty Statement

All Melles Griot lasers, unless otherwise specified, are covered by the comprehensive warranty described below. Special warranty terms for OEM manufacturers may be negotiated on a case-by-case basis.

7.1 Basic Warranty

Melles Griot warrants the 85 GCJ-series laser system to be free from defects in materials and workmanship, hereinafter called the "Nonconformity," for a period of twelve (12) months or 5000 hours from date of shipment. The performance specifications outlined in Appendix A, Table A-1 are guaranteed for 12 months after shipment date, whichever is sooner. These warranties do not apply to systems that Melles Griot determines, upon inspection, to have failed, or have become defective or unworkable due to abuse, mishandling, misuse (including but not limited to: optical feedback into laser cavity, improper mounting, exceeding recommended temperature range, contamination by particulates or chemicals), alteration of laser or power supply or opening of cover (unless approved in writing by Melles Griot), negligence, improper installation, use which is not in accordance with the information and precautions described in this operator's manual, or other causes beyond the control of Melles Griot.

This warranty does not apply to any products, systems or components not manufactured by Melles Griot.

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

Buyer shall notify Melles Griot of any nonconformity during the warranty period, obtain a return authorization for the nonconforming products, and return the nonconforming products, freight prepaid, to a facility designated by Melles Griot, along with a written statement describing the nonconformity. The sole and exclusive obligation assumed by Melles Griot under this warranty is to use reasonable commercial efforts to repair, replace, or refund the purchase price for any products that are returned to Melles Griot as set forth above and which are determined, at the reasonable discretion of Melles Griot, to be nonconforming product.

Products that are repaired or replaced within the warranty period are warranted only for the remaining unexpired portion of the original warranty period. However, the warranty period does not include the time

period between when Melles Griot receives the nonconforming products and when Melles Griot returns the repaired or replacement products to Buyer. Buyer agrees that the foregoing provisions constitute the sole and exclusive remedies available to Buyer for breach of warranty by Melles Griot with respect to the products.

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