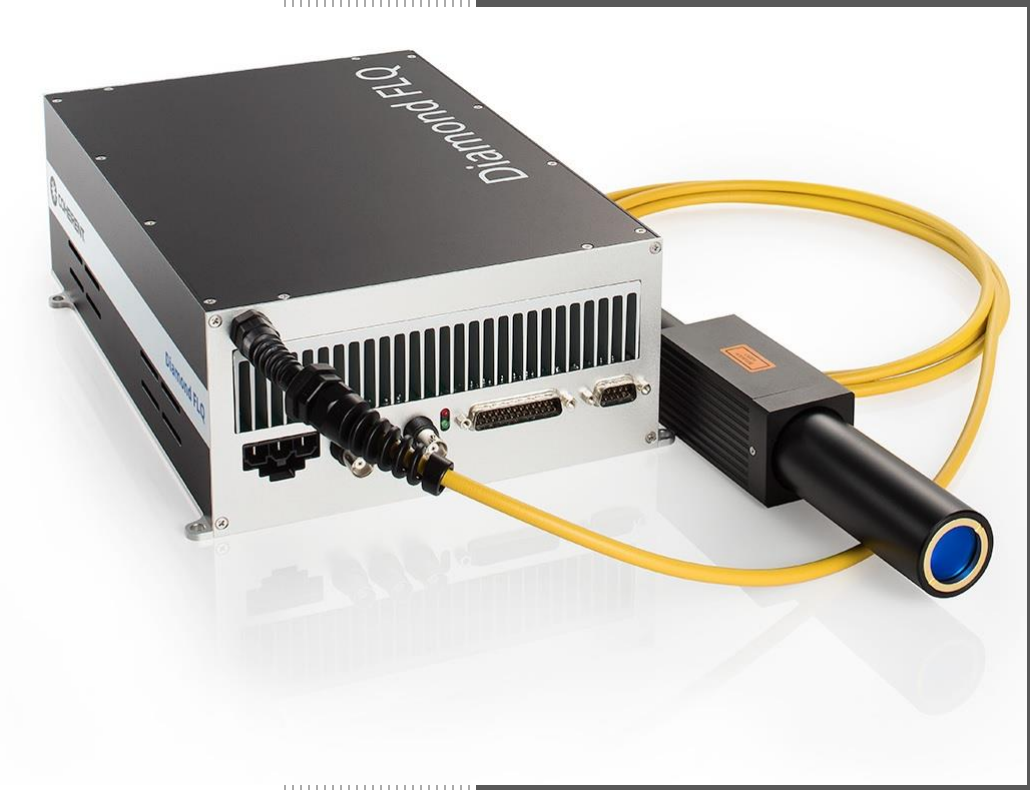
Diamond FLQ

10W, 20W, 30W, 50W& 100W Fiber Marking Lasers



Operator's Manual

Product Numbers:

FLQ-1064- XXXX-YZ

COHERENT | NUFERN

G026DOC Rev. U– November 2017

1. Preface

Thank you for purchasing the Diamond FLQ™ fiber laser. The Diamond FLQ laser is a pulsed fiber marking laser nominally delivering 1 mJ pulse energy with a fast turn-on time and high peak power over a wide range of repetition rates, which maximizes production throughput and marking capability. With its near single-mode beam quality, the Diamond FLQ laser can produce ultra-fine, crisp marks every time. Wide adjustability and stable operation, coupled with on-board optical monitoring, ensuring robust operation, even in the most adverse operating environments. Your Diamond FLQ laser comes complete with industry standard interfaces for easy integration; the system is pumped by single-emitter diode lasers, which offer long lifetime and maintenance free operation.

This manual is intended for experienced Original Equipment Manufacturer (OEM) customers familiar with integration and control of electronic sub-systems. If you have questions or comments about any section of this manual, please call Coherent | Nufern's Help Line (8 AM to 5 PM EST) or email us:

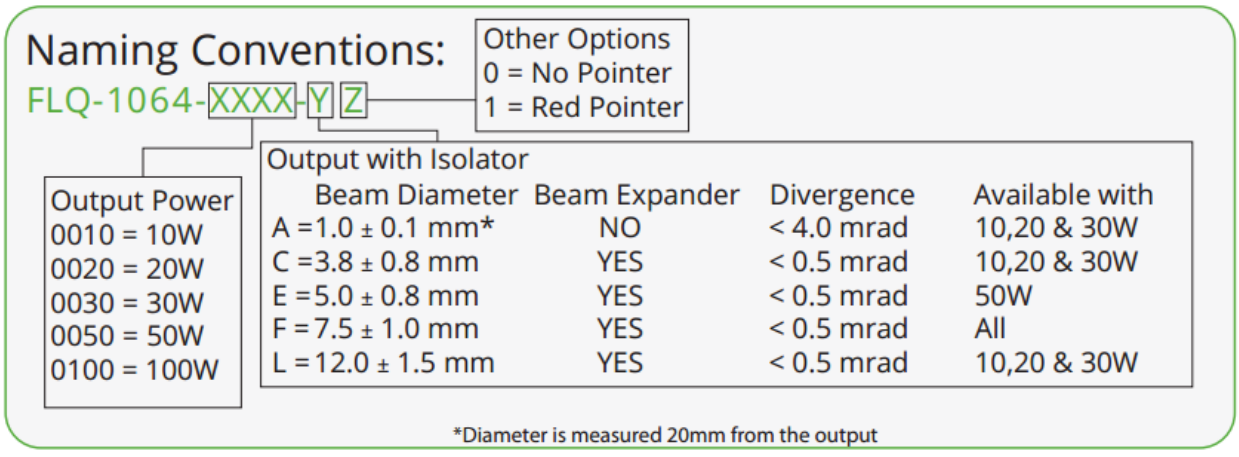
Within U.S. Call Toll-free:
(888) 684-3577

From outside the U.S. Call:
1-860-408-5000

Email: eby_info@coherent.com

1.1 Product Naming Convention

This manual covers the various configurations of the Diamond FLQ laser.



1.2 Symbols used in this manual

DANGER

Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

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

CAUTION

Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.

NOTICE

Possibly dangerous situation, goods might be damaged.

INPORTANT

Helpful information.

1.3 Acronyms used in this manual

The following acronyms are used in this manual:

MO:	Master Oscillator
FA:	Fiber Amplifier
PRR:	Pulse Repetition Rate
OEM:	Original Equipment Manufacturer
GND:	Electrical Ground
TTL:	Transistor-to-Transistor Logic 5V Signal Level Standard
SDS:	Safety Data Sheet

Table of Contents

2. Safety & Compliance

The Diamond FLQ fiber laser from Coherent|Nufern emits invisible laser radiation. Avoid eye or skin exposure to direct or scattered radiation. The Diamond FLQ fiber laser is a pulsed laser with a nominal output wavelength of 1.064 µm up to 110 W average power, 12 kW peak power, 20–200kHz PRR and 80-500 nsec pulse duration.

2.1 Warnings

Invisible & Visible Laser Radiation.
Avoid Eye or Skin Exposure to Direct or Scattered Radiation.

DANGER

Your Diamond FLQ Fiber Laser emits invisible infrared pulsed Class 4 laser radiation (nominally up to 110 W at 1064 nm). This device should not be operated unless all appropriate safety precautions are taken. Precautions must be observed whenever DC power is supplied to the laser and must be sufficient for the full range of optical parameters described below. Improper use of this device can cause personal injury, permanent eye damage, blindness, and possibly death. The laser beam is collimated so the hazards apply at long as well as short distances from the aperture. Under no circumstances should your Diamond FLQ laser be pointed at any person, animal, or flammable or explosive materials. Laser radiation, whether direct emissions or scattered and/or reflected light, can be harmful. This light will also generate a significant amount of heat, and care should be taken not to start a fire.

- **0.9–1.2 µm (1.064 µm nominal) Output Wavelength. < 150 W Average Power Max.**
- **< 40 kW Peak Power Max., 50–500 nsec Pulse Duration**
- **0.6–0.7 µm (0.658 µm nominal) Output Wavelength. 1 mW Average Power Max.**

Follow all Laser Safety Procedures

WARNING

The Diamond FLQ laser should not be supplied with external DC power unless all laser safety precautions are followed. These safety precautions include and are not limited to the following:

- Wearing appropriate safety glasses by all personnel in the vicinity of the laser who could be exposed to direct or indirect radiation within the full range of optical parameters described above.
- Installing appropriate warning signs and using safety curtains or enclosures.
- Implementing safety interlocks to avoid accidental exposure laser radiation.
- Taking appropriate precautions when using the Diamond FLQ with other optical instruments as they may increase eye hazard.
- Containing the beam to eliminate or minimize the possibility of exposure to the beam.
- Use of the Diamond FLQ laser other than as specified herein may result in hazardous radiation exposure.

Avoid exposure to potentially hazardous materials.

WARNING

Laser processing of materials can produce contamination such as vapors, fumes, and particles that can be potentially hazardous (noxious, poisonous, toxic, explosive, and corrosive). Always review the SDS information for any materials being processed. Make sure to provide adequate ventilation, flame or explosion control and filtration before venting any by-products.

CAUTION

Diamond FLQ laser is ESD sensitive

The electronics board in the Diamond FLQ laser has components sensitive to electrostatic discharge (ESD). Please exercise standard ESD mitigation practices while handling the laser and making electrical and interface connections to the laser.

NOTICE

Diamond FLQ laser is NOT user serviceable

Do not remove any of the panels or attempt to service this unit. There are electrical and optical hazards present inside the chassis. Unit should be serviced by trained Coherent|Nufern personnel only. Opening of this case will also void the warranty.

IMPORTANT

American National Standards Institute (ANSI) Z136.1 has created a document titled “Safe Use of Lasers” for reference. This document should be used as a standard for implementing your own laser safety program. Key points to consider include establishing a Laser Safety Officer (LSO) for your organization, and operating the laser in an area of limited access with proper warning signs and interlocks. Under no circumstances should this device be serviced by anyone other than the trained personnel at Coherent|Nufern.

2.2 Safety Resources

For additional information the following safety resources are also provided:

American National Standards Institute (ANSI)
Safety Standards for Laser Users
New York, NY
Phone: (212) 642-4900
www.ansi.org

Center for Devices & Radiological Health (CDRH)
Center for Devices and Radiological Health
U.S. Food and Drug Administration
10903 New Hampshire Avenue
WO66-4521
Silver Spring, MD 20993
www.fda.gov/cdrh/

Laser Institute of America
Safety Standards for Laser Users
13501 Ingenuity Drive, Suite 128
Orlando, FL 32826
Phone: (800) 345-2737 or (407) 380-1553
Fax: (407) 380-5588
www.laserinstitute.org

Occupational Safety & Health Administration (OSHA)
U.S. Department of Labor
Occupational Safety & Health Administration
200 Constitution Avenue
Washington, D.C. 20210
www.osha.gov

2.3 Certifications and Compliance

IMPORTANT

This product is specifically designed to be an OEM laser device for incorporation or integration into other equipment. As such, it DOES NOT MEET the full requirements for a complete laser system as defined by 21 CFR 1040.10 and 1040.11 under the Radiation Control for Health and Safety Act of 1968 and EN 60825-1. It is the responsibility of the purchaser to meet all of the regulatory requirements for the complete laser system defined in IEC60825-1 (latest revision).

Coherent|Nufern certifies that this device was tested and found to meet the published specifications prior to shipping. Upon the receipt of this package, please inspect contents for any possible damage that may have occurred in shipping. Please report any shipping damage immediately to the factory at 1-888-684-3577
(8 AM to 5 PM EST) or email us at eby_info@coherent.com.

2.3.1 RoHs

Coherent|Nufern certifies that it has assessed the Diamond FLQ laser in relation to the requirements of the RoHS Directive[1], and that it conforms in full to the requirements thereof, that the product does not contain any of the following restricted substances in excess of the indicated Maximum Concentration Values.

Figure 1 RoHS Compliance Table

Restricted Substance	Max. Concentration Value
Lead	0.1%
Mercury	0.1%
Hexavalent Chromium	0.1%
Polybrominated Biphenyls, PBBs	0.1%
Polybrominated Diphenylethers, PBDEs	0.1%
Cadmium	0.01%

[1] *"RoHS Directive" means Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast).*

2.3.2 REACH

Coherent|Nufern also certifies that it has assessed the Diamond FLQ laser in relation to the requirements of the REACH.

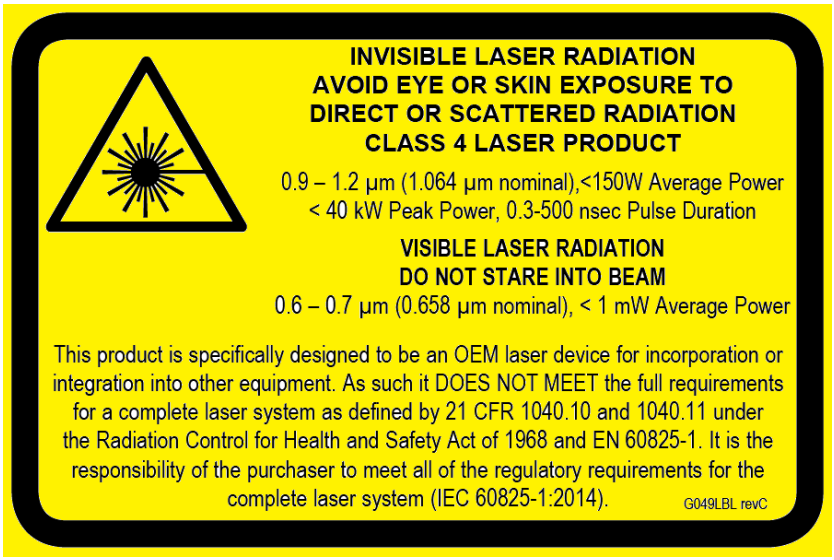
Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) is a European Union regulation dated 18 December 2006.

REACH addresses the production and use of chemical substances, and their potential impacts on both human health and the environment.

For additional information on chemicals, please contact Coherent|Nufern.

2.4 Safety Label

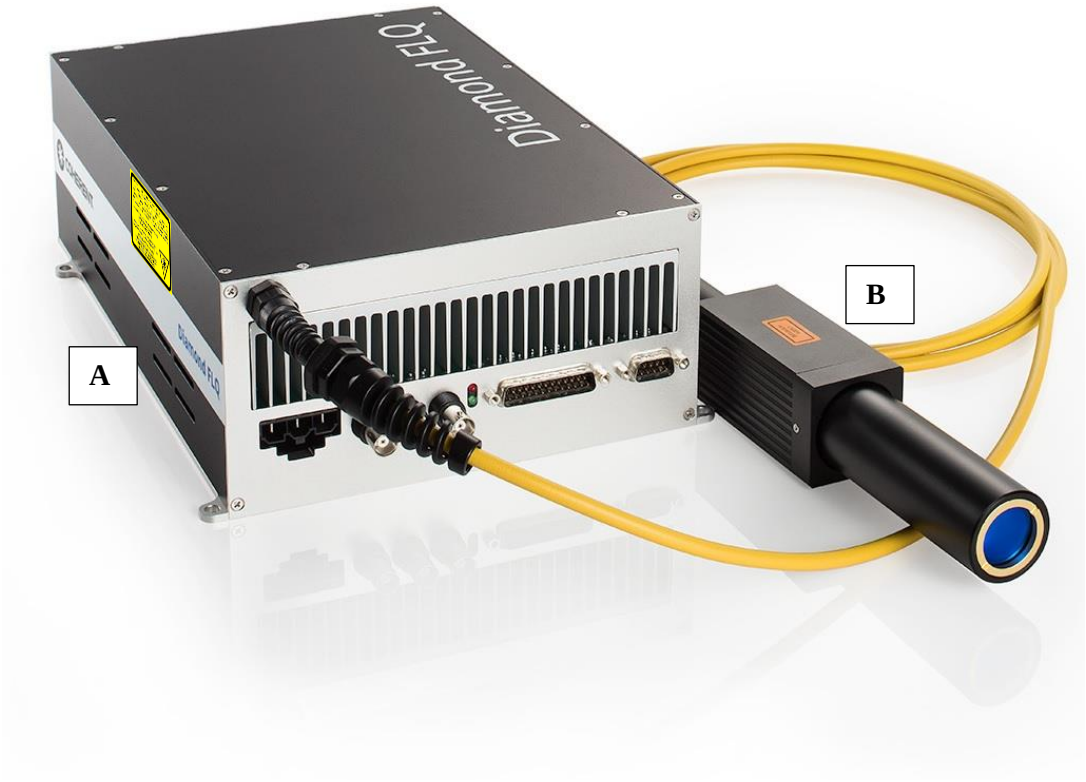
A.



2.5 Laser Aperture label

B.

Figure 2 Location of Safety & Laser Aperture Labels



3. GETTING STARTED

The Diamond FLQ™ fiber laser from Coherent|Nufern is a pulsed marker delivering 1 mJ pulse energy with a fast turn-on time and higher peak power over a wide range of repetition rates, which maximizes production throughput and marking capability. With its single-mode beam quality, the Diamond FLQ laser can produce ultra-fine, crisp marks every time. Wide adjustability and stable operation, coupled with on-board optical monitoring, ensures robust operation, even in the most adverse operating environments. The system is pumped by single-emitter diode lasers, which offer long lifetime and maintenance-free operation. A DB25 interface is provided to match the industry standard for simple drop-in replacement. The laser can also be operated with an RS-232 interface.

3.1 Unpacking the Laser

3.1.1 Package Contents

Please check the shipping container to make sure you have identified each of the following items. Please report any omissions immediately to Coherent|Nufern.

- Diamond FLQ Laser
- Input power cable (based on model)
  - E012CBL – ferrule end terminals, 10-30W
  - E013CBL – spade end terminals, 10-30W
  - E029CBL - ferrule end terminals, 50W
  - E030CBL - spade end terminals, 50W
  - E036CBL – spade end terminals, 100W
- Final Test Report

3.1.2 Operator's Manual

The Diamond FLQ product manual is available on Coherent|Nufern's website; www.Nufern.com under *Products → Fiber Lasers.*
If it is not accessible or you want a hard copy, please contact Coherent|Nufern.

3.1.3 Initial Inspection

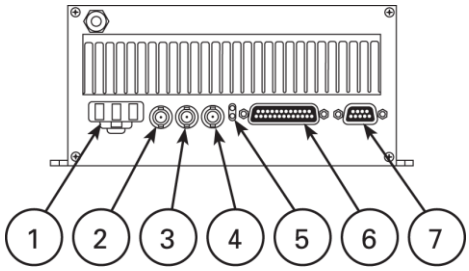
Upon delivery of your Diamond FLQ Laser, please inspect all packaging for evidence of mishandling or damage. If you find any evidence of mishandling, please photograph these findings and save the damaged shipping materials. Carriers do not accept claims for damage during transit without the original shipping material. All shipping damage is the responsibility of the shipping company. Please report this information to the shipping company and Coherent|Nufern.

Inspect the laser for any physical damage. Check the fiber delivery cable for any kinks, tight bend radii (minimum static bend radius for the cable is 30mm) or other damage. Check the output device (refer to Figures 11 and 13) for any damage. Inspect the laser housing for dents or damage to connectors. If more than cosmetic damage is observed, please contact the Coherent|Nufern Help Line at 1-888-684-3577 (8 AM to 5 PM EST) or email us at eby_info@coherent.com.

3.2 Diamond FLQ Laser Details

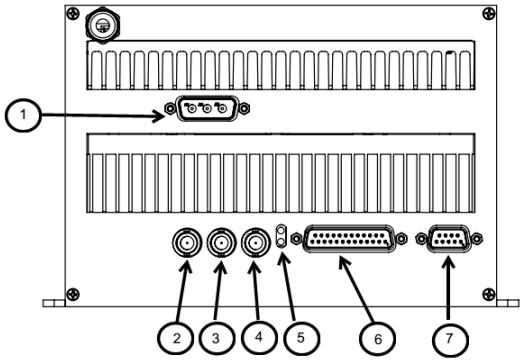
This section provides detailed information about the front panel connections, the placement of cooling fans on the rear panel view, the electrical connections, the DB25 and R232 interfaces and the pin descriptions and functions.

Figure 3 Front Panel Connections



1. 24 V In
2. PRR Out
3. Gate
4. PRR In
5. Status LED
6. 25 Pin Interface Connector
7. RS-232

Front Panel on 10, 20, 30 and 50W Models



1. 24 V In
2. PRR Out
3. Gate
4. PRR In
5. Status LED
6. 25 Pin Interface Connector
7. RS-232

Front Panel on 100W Model

3.2.1 Front Panel View

1. 24 Volt DC Input: As supplied, see section 3.1. Please refer to the label on the cable for the circuit connections.

2. PRR Output: This connector provides an output signal indicating when RF power is supplied to the Q-switch in the Master Oscillator (MO). This signal will mimic the pulse repetition rate (PRR) of the MO. This can be used as a diagnostic tool and can also be used to synchronize other electronics in a laser processing system.

3. Gate Signal: The gate signal is logically OR'ed with the Pin 19 signal on the DB25 interface.

4. PRR Input: The optional PRR input signal is provided for customers to use a BNC cable to provide the PRR signal to the laser. This input is logically OR'ed with Pin 20 of the DB25 connector.

5. Status LEDs (Red/Green): The two LED indicators provide status of the laser. Figure 4 summarizes the information conveyed by these two LEDs.

6. DB25 Interface Connector: The 25-pin connector can be used to control and monitor the Diamond FLQ laser. Detailed PIN information is discussed in Sections 3.2.3 and 3.4.1.

7. RS-232 Communications: The 9-pin connector can be used to control and monitor the laser in RS232 mode. Detailed information on how to operate the laser in RS232 mode is discussed in Section 9.

Figure 4 LED Status Indication

LED Status	Laser Status	Action Required
Green LED On Red LED Off	DB25 interface detected, status OK	None
Green LED Blinking Red LED Off	RS-232 interface, status OK	None
Green LED On or Blinking Red LED On	Error detected	Check the laser status using the alarm pins on the DB25 interface or the "GERR" RS-232 command. After correcting the source of the error, clear the error by sending the "RESERR" RS-232 command or by cycling the 24VDC power supply. If the error persists, call Coherent|Nufern at 1-888-684-3577.
Green LED On or Blinking Red LED Blinking	Internal error detected	Cycle the 24 VDC power supply. If error persists, call Coherent|Nufern at 1-888-684-3577.

3.2.2 Rear Panel

NOTICE

Do not obstruct air flow

Do not obstruct air flow. All fans must remain unobstructed in order to properly cool the Diamond FLQ laser. Failure to provide adequate cooling can shorten lifetime and/or impair performance of the laser. **For 10W, 20W, 30W and 50W lasers ensure that >100 cfm (0.047m^3/s) of air flow is provided. For 100W lasers ensure that > 150 cfm (0.071m^3/s) of air flow is provided.**

3.2.3 25-Pin Interface Communications

The 25-pin connector can be used to control and monitor the Diamond FLQ laser with TTL signals at the individual pins. Note that the RS-232 interface can be used in conjunction with the DB25 interface. Figure 5 outlines the functions of these connector pins.

Figure 5 DB25 Digital Interface (All Pins TTL Compatible, see note 1)

Pin(s)	Description	Specification
1- 8	Bit 0 to Bit 7 of Power Setting (Input), respectively	TTL input 0: Minimum power, 255: Maximum power
9	Latches power on low to high transition (Input)	TTL input, The minimum period between two latch signals is 1 msec.; 1 µsec. hold time required.
10-15	Ground	
16	Alarm 0 Output	TTL output, Refer to Figure 7
17	Auxiliary 5V Input (Optional)	5 ± 0.2 V; 700 mA typical current consumption, 1400 mA max.
18	Master Oscillator Enable 1 = On, 0 = Off (Input)	TTL input. This pin has to be set to TTL high 200 µs prior to Pin 19 being set to TTL high.
19	Amplifier Enable 1 = On, 0 =Off (Input)	TTL input. Rising edge triggered. Amplifier may not be enabled when visible pointer is enabled. See Pin 22 description.
20	Pulse Repetition Rate (Input)	TTL input, (20 kHz to 100 kHz) ± 2%, Minimum 20 kHz, for FLQ-1064-0010-YZ TTL input, (20 kHz to 100 kHz) ± 2%, Minimum 20 kHz, for FLQ-1064-0020-YZ TTL input, (30 kHz to 100 kHz) ± 2%, Minimum 30 kHz, for FLQ-1064-0030-YZ TTL input, (50 kHz to 200 kHz) ± 2%, Minimum 50 kHz, for FLQ-1064-0050-YZ TTL input, (100 kHz to 200 kHz) ± 2%, Minimum 100 kHz, for FLQ-1064-0100-YZ
21	Alarm 1 Output	TTL output, Refer to Figure 7
22	Visible Pointer Enable 1= On, 0= Off (Input)	TTL input Visible pointer may not be enabled when amplifier is enabled. See Pin 19 description.
23	Enable 1= Normal Operation 0= Laser Disable (Input)	TTL Input
24	Ground	
25	Not connected	

Note 1. V_{INL} is 1.35V typ.
V_{INH} is 3.85V typ.
V_{OL} is 0.4V typ.
V_{OH} is 4.6V typ.

3.2.3.1 Input Signals - Pin Description

Pins 1 to 8: Power Setting
Figure 6 shows the correspondence between the 8-bit value latched on pins 1–8 of the DB25 connector and the resulting optical power.

Figure 6 Nominal Power Set Point Mapping for FLQ-1064-XXXX-YZ

8 Bit Value	10W	20W	30W	50W	100W
0 – 6	Approximately 0.2W (MO Only)				
7 – 12	1.0	2.0	3.0	5.0	2.4
13 – 19	1.0	2.0	3.0	5.0	4.9
20 – 25	1.0	2.0	3.0	5.0	7.3
26 – 31	1.0	2.0	3.0	5.0	9.8
32 – 38	1.3	2.5	3.8	6.3	12.2
39 – 44	1.5	3.0	4.5	7.5	14.6
45 – 51	1.8	3.5	5.3	8.8	17.1
52 – 57	2.0	4.0	6.0	10.0	19.5
58 – 63	2.3	4.5	6.8	11.3	22.0
64 – 70	2.5	5.0	7.5	12.5	24.4
71 – 76	2.8	5.5	8.3	13.8	26.8
77 – 82	3.0	6.0	9.0	15.0	29.3
83 – 89	3.3	6.5	9.8	16.3	31.7
90 – 95	3.5	7.0	10.5	17.5	34.1
96 – 102	3.8	7.5	11.3	18.8	36.6
103 – 108	4.0	8.0	12.0	20.0	39.0
109 – 114	4.3	8.5	12.8	21.3	41.5
115 – 121	4.5	9.0	13.5	22.5	43.9
122 – 127	4.8	9.5	14.3	23.8	46.3
128 – 133	5.0	10.0	15.0	25.0	48.8
128 – 133	5.0	10.0	15.0	25.0	51.2
134 – 140	5.3	10.5	15.8	26.3	53.7
141 – 146	5.5	11.0	16.5	27.5	56.1
147 – 153	5.8	11.5	17.3	28.8	58.5
154 – 159	6.0	12.0	18.0	30.0	61.0
160 – 165	6.3	12.5	18.8	31.3	63.4
166 – 172	6.5	13.0	19.5	32.5	65.9
173 – 178	6.8	13.5	20.3	33.8	68.3
179 – 184	7.0	14.0	21.0	35.0	70.7
185 – 191	7.3	14.5	21.8	36.3	73.2
192 – 197	7.5	15.0	22.5	37.5	75.6
198 – 204	7.8	15.5	23.3	38.8	78.0
205 – 210	8.0	16.0	24.0	40.0	80.5
211 – 216	8.3	16.5	24.8	41.3	82.9
217 – 223	8.5	17.0	25.5	42.5	85.4
224 – 229	8.8	17.5	26.3	43.8	87.8
230 – 235	9.0	18.0	27.0	45.0	90.2
236 – 242	9.3	18.5	27.8	46.3	92.7
243 – 248	9.5	19.0	28.5	47.5	95.1
249 – 254	9.8	19.5	29.3	48.8	97.6
255	10.0	20.0	30.0	50.0	100.0

Pin 9: Latch
Once the laser power bits (Pin 1-8) have been sent, it is necessary to latch the signal for the laser power to be updated accordingly. A TTL low to high signal transition on Pin 9 is required to update the set power.

Pin 17: Auxiliary 5 V Input
If the optional auxiliary 5V input is provided to Diamond FLQ, the microcontroller and the optional visible pointer can be operated even when the 24 V input is turned off.

Pin 18: MO On/Off
The Diamond FLQ pulsed laser manages the MO turn on and off internally. This pin must be set at TTL high 200 µs prior to Pin 19 being set to TTL high. **This is required to ensure proper turn-on of the laser. It is recommended to keep this pin set at the TTL high state for optimal performance.**

Pin 19: FA On/Off
A rising edge of the signal on pin 19 will turn on the laser, while a low signal will turn off the laser.

Pin 20: PRR Input
An input signal at the desired pulse repetition rate (PRR) is sent through this pin. The rising edge of signal triggers the laser. The TTL signal should have a duty cycle between 20% and 80%. For optimal performance, we recommend that the PRR be set to the desired frequency before setting the FA(Pin 19) signal.

Pin 22: Visible Pointer Enable
A TTL high signal will turn on the visible pointer. The visible pointer may not be enabled when amplifier is enabled. See Pin 19 description for controlling the amplifier.

Pin 23: Enable Input
If this pin is set to TTL high, the laser operates normally. If this pin is set to TTL low, the laser is disabled.

3.2.3.2 Output Signals - Pin Description

Pins 10-15 and 24: Ground for DB25
Pins 10–15 and 24 are connected to the ground for the DB25 control signals. Note that this ground is electrically isolated from the 24V ground.

Pins 16 and 21: Status Monitors
Pins 16 and 21 together provide information regarding the status of the laser. Figure 7 summarizes the possible combinations and the corresponding definitions.

Pin 25: Not Connected

Figure 7 Status Monitors

Condition	Alarm 0 State (Pin 16)	Alarm 1 State (Pin 21)
Laser Not Ready (Over Temperature, E-Stop, 24V Supply Off)	LOW	LOW
Normal Operation	LOW	HIGH
MO/Back Reflection Error (Transient or Persistent)	HIGH	HIGH
Reserved	HIGH	LOW

- Transient MO error refers to temporary loss of MO power.
- Persistent MO error refers to a sustained loss of the MO power.
- For transient MO or back-reflection errors, the alarm pins will be asserted to indicate an error condition for a minimum of 500 ms to allow time for the external control system to detect and respond to the error. Note: The laser output will recover from transient MO and high back-reflection error conditions as soon as possible, often times within 250 µs of the error occurring.

3.3 Laser Installation

3.3.1 Mounting the Laser

Mount the Diamond FLQ laser as desired using the 4 bolt holes to firmly attach the unit to a surface. Do not block the airflow to the cooling fans on the rear panel. Coherent|Nufern recommends a minimum clearance of 25mm (1.00”) at end of laser for the fans provide the desired flow to cool the diodes and other components in the laser to ensure longevity of the laser. Provide adequate room in front of the front panel to access the various connections. The 10-W, 20-W and the 30-W lasers can be mounted vertically or horizontally. The 50-W and 100-W laser can only be mounted horizontally (feet down), due to its mass. Contact Coherent|Nufern if vertical mounting is required for your 50-W or 100-W laser application.

3.3.2 Mounting the Termination Housing

The termination housing has a built-in isolator and beam expander (not all models). The housing should be mounted in a manner such that there is minimal stress on the fiber delivery cable. The fiber delivery cable should be laid out to avoid excessive twisting and tight bend radii (less than 30mm radius). The termination head should be mounted such that the laser output is directed in a manner that ensures no danger to personnel or property in the vicinity of the laser.

3.3.3 Electrical Connections

Refer to Section 3.2.1. Connect the power cable per the labels attached to the cable. Next connect the 25-pin D-Sub. If using the RS-232 interface, also connect the 9-pin D-Sub. (Please refer to Section 9.4.) If you will gate the FA via the Gate BNC, then connect this signal. If you intend to use the PRR Out to synchronize other equipment or instruments, then connect to this signal. Power supply requirements are given in Figure 8.

Figure 8 Power Supply Requirements

Parameter	Specification
Input Voltage	23-25 Volt DC
Noise and Ripple	1% Peak-to-Peak
Recommended Current Capacity	6 A for FLQ-1064-0010-YZ 8 A for FLQ-1064-0020-YZ 10 A for FLQ-1064-0030-YZ 15 A for FLQ-1064-0050-YZ 20 A for FLQ-1064-0100-YZ
Max. Off Voltage*	1.5 VDC

* Highest voltage allowable on the +24VDC input when the power supply is intended to be off.

3.4 Starting Up the Laser

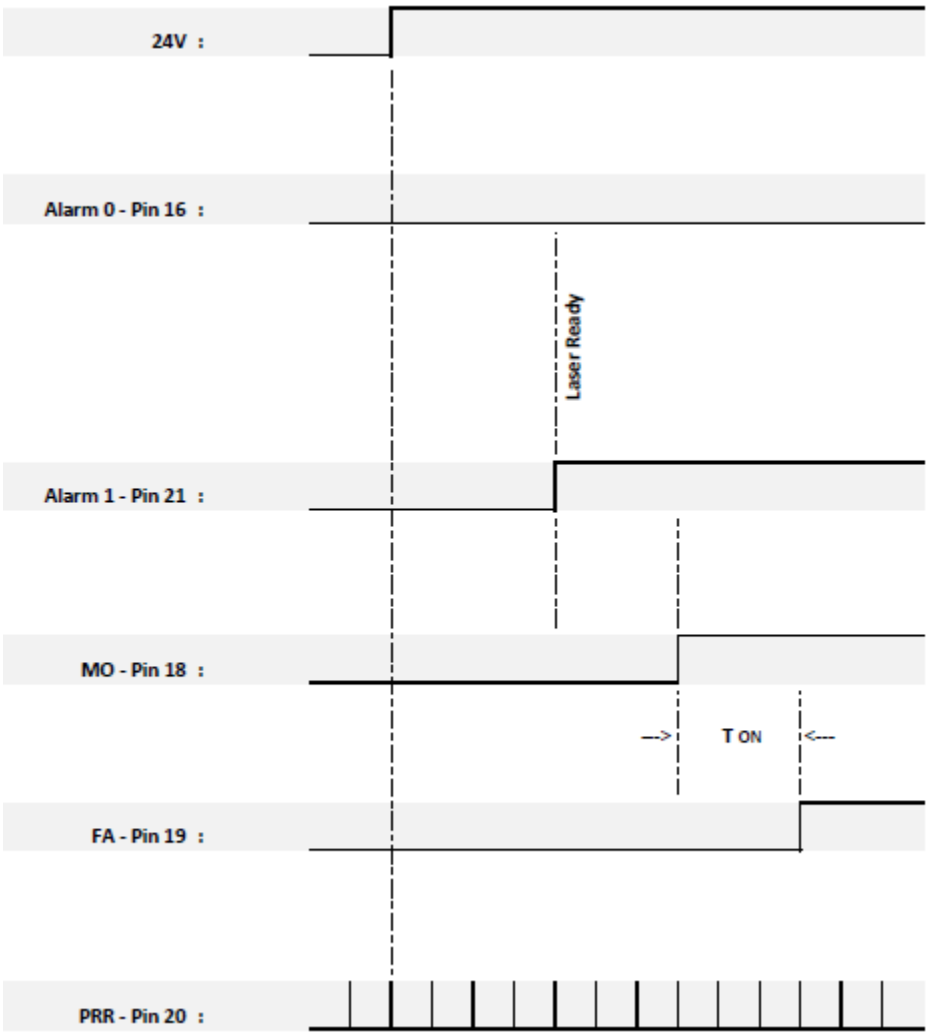
3.4.1 Laser Start-Up Using DB25 Parallel Interface

Once the laser module and termination assembly are properly mounted and the correct electrical connections are made, the laser is almost ready to run. In order to get the Diamond FLQ to produce output, the following steps need to be completed.

1. Apply the appropriate voltages to the power cable, as described in Figure 8.
2. Apply a TTL low signal to all signal inputs, pin #s 1–8, 9, 18–19, 22.
3. Apply a TTL high to Pin 23.
4. Apply the Pulse Repetition Rate (PRR) Signal to Pin 20. This should be a TTL signal with the duty cycle between 20% and 80%.
   FLQ-1064-0010-YZ: the PRR has to be between 20 kHz and 100 kHz.
   FLQ-1064-0020-YZ: the PRR has to be between 20 kHz and 100 kHz.
   FLQ-1064-0030-YZ: the PRR has to be between 30 kHz and 100 kHz.
   FLQ-1064-0050-YZ: the PRR has to be between 50 kHz and 200 kHz.
   FLQ-1064-0100-YZ: the PRR has to be between 100kHz and 200 kHz.
5. Set the desired power of the laser using pins 1–8. The default is 0 W (Only MO is on).
6. Latch the power setting by toggling pin #9.
7. Apply a TTL high to Pin 18 to enable the MO. Wait at least 200 µs before setting Pin 19 high.
8. Apply a TTL high to Pin 19 to turn on the amplifier.
9. Turn the amplifier on or off by applying a TTL high or low to Pin 19.

Figure 9 Min/Max Timing Settings

	Min (µs)	Max (µs)
T_{CLOCK}	10W: 10.0 µs 20W: 10.0 µs 30W: 10.0 µs 50W: 5.0 µs 100W: 5.0 µs	10W: 50.0 µs 20W: 50.0 µs 30W: 33.3 µs 50W: 20.0 µs 100W: 10 µs
T_{ON}	200	∞



3.4.2 Turn on the Visible Pointer

1. Only valid for units equipped with the visible pointer option.
2. Apply 24V to the unit or apply the optional auxiliary 5 V to Pin 17.
3. Apply a TTL high or low to Pin 22 to turn on or off the visible pointer.

3.4.3 Laser Start-Up Using RS-232 Interface

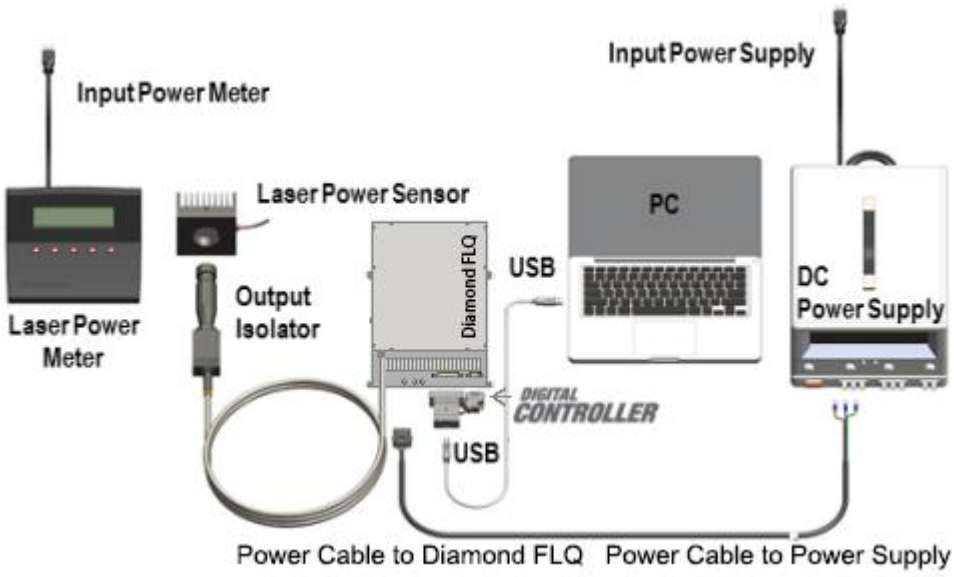
Please refer to Section 9.

3.4.4 Laser Troubleshooting Using Digital Control Software

The Digital Control Software is an optional diagnostic tool for the Coherent|Nufern Diamond FLQ Fiber Marking Laser products. The Digital Control Software provides an all-in-one interface to operate the laser from a Windows PC. This tool can be used for any Diamond FLQ Fiber Amplifier manufactured after August 1, 2012. The Digital Control Adapter, **P/N E001IFC which can be purchased from Coherent|Nufern,** consists of an inline signal adapter to be plugged into both the 25 Pin Interface Connector and the RS-232 Connector located on the back panel of the Diamond FLQ Fiber Marking Laser. This adapter is connected to a computer via a USB port. The Digital Control Software commands the Diamond FLQ laser through the USB connection, providing the user with real time laser controls and feedback from the laser's health and status monitors.

For more information or to order the Diamond FLQ DC Adapter, please visit Coherent|Nufern's website. Also, you can request a copy of the Diamond FLQ DC Adapter Quick Start Guide, G322DOC.

Figure 10 Digital Control Software Interface Connection



4. MAINTENANCE

The Diamond FLQ fiber laser has no field serviceable parts. You may need to make sure the ventilation ports do not become obstructed and limit air flow, but otherwise there is no required maintenance for this unit. If you are having problems with the operation of your unit, please contact customer service to obtain a Return Material Authorization (RMA) number before sending your unit back to the factory.

5. TROUBLESHOOTING / CUSTOMER SERVICE

This manual addresses the most common issues related to the setup, operation, and general safety considerations for the Diamond FLQ laser. If you have questions that are not resolved by reading this manual, or if your laser does not perform as specified, you may call the Diamond FLQ help line (8 AM to 5 PM EST) or email us at eby_info@coherent.com for assistance.

5.1 Diamond FLQ Help Line

Within U.S. Call Toll-free:
(888) 684-3577

From outside the U.S. Call:
1-860-408-5000

Coherent|Nufern customer service may, at their discretion, attempt to resolve your issue over the phone, or may request that you return your laser for repair or replacement. Please note that all product returns require a Returned Merchandise Authorization (RMA) number from Coherent|Nufern. Customer Service will advise you of the precise procedure and packing instructions for merchandise returns when needed.

6. NOTICES

Information contained in this manual is deemed to be reliable and accurate. No responsibility is assumed for its use, nor for any infringement on the rights of others. Coherent|Nufern reserves the right to change the design and specifications of the product described and the related information provided in this manual at any time without notice.

7. SPECIFICATIONS (Typical, see Nufern.com for current data)

Optical Specifications	**FLQ-1064-0010-YZ**	**FLQ-1064-0020-YZ**	**FLQ-1064-0030-YZ**	**FLQ-1064-0050-YZ**	**FLQ-1064-0100-YZ**
Output Power	10.5 ±1.0W	20.5 ± 1.5 W	30.5 ± 2.0 W	51.0 ± 3.0 W	100.0 ± 5.0 W
Output Power Adjustment	10 – 100%	10 – 100%	10 – 100%	10 – 100%	10 – 100%
Leakage Power in Off State	< 8.0 mW	< 8.0 mW	< 8.0 mW	< 15 mW	< 60 mW
Power Stability[1]	-2.5% Min, +2.5% Max	-2.5% Min, +2.5% Max	-2.5% Min, +2.5% Max	-2.5% Min, +2.5% Max	-2.5% Min, +2.5% Max
Beam Quality (Nominal)	M^2 < 1.5 (nominal)	M^2 < 1.5 (nominal)	M^2 < 1.5 (nominal)	M^2 < 1.5 (nominal)	M^2 < 1.5 (nominal)
Beam Divergence No Beam Expender	< 4.0 mrad	< 4.0 mrad	< 4.0 mrad	< 5.5 mrad	< 5.5 mrad
Beam Divergence With Beam Expender	< 0.5 mrad	< 0.5 mrad	< 0.5 mrad	< 0.5 mrad	< 0.5 mrad
Output Beam Diameter No Beam Expender[2]	NA	NA	0.65 ± 0.1 nm	NA	NA
	1.0 ± 0.1 nm	1.0 ± 0.1 nm	1.0 ± 0.1 nm	NA	NA
Output Beam Diameter With Beam Expender	3.8 ± 0.8 mm	3.8 ± 0.8 mm	3.8 ± 0.8 mm	NA	NA
	NA	NA	NA	5.0 ± 0.8 mm	NA
	7.5 ± 1.0 mm	7.5 ± 1.0 mm	7.5 ± 1.0 mm	7.5 ± 1.0 mm	7.5 ± 1.0 mm
	12.0 ± 1.5 mm	12.0 ± 1.5 mm	12.0 ± 1.5 mm	NA	NA
Visible Pointer	No Pointer	No Pointer	No Pointer	No Pointer	No Pointer
	Red Pointer	Red Pointer	Red Pointer	Red Pointer	Red Pointer
Output Type	Fiber to free space isolator	Fiber to free space isolator	Fiber to free space isolator	Fiber to free space isolator	Fiber to free space isolator
Mode of Operation	Pulsed	Pulsed	Pulsed	Pulsed	Pulsed
Polarization	Random	Random	Random	Random	Random
Peak Power[3]	5.0 kW (nominal)	10.0 kW (nominal)	10.0 kW (nominal)	8.5 kW (nominal)	8.5 kW (nominal)
Pulse Energy[3]	0.5 mJ (nominal)	1.0 mJ (nominal)	1.0 mJ (nominal)	1.0 mJ (nominal)	1.0 mJ (nominal)
Pulse Width[4]	100 ± 20 ns	100 ± 20 ns	100 ± 20 ns	120 ± 20 ns	120 ± 20 ns
Pulse Repetition Rate (PRR)	20 – 100 kHz	20 – 100 kHz	30 – 100 kHz	50 – 200 kHz	100 – 200 kHz
Turn-on Time[5]	< 250 µs	< 250 µs	< 250 µs	< 250 µs	< 250 µs
Turn-off Time[6]	< 2 µs	< 2 µs	< 2 µs	< 2 µs	< 2 µs
Central Wavelength	1064.0 ± 2.0 nm	1064.0 ± 2.0 nm	1064.0 ± 2.0 nm	1064.0 ± 2.0 nm	1064.0 ± 2.0 nm
Emission Linewidth[4]	< 5.0 nm	< 5.0 nm	< 5.0 nm	< 5.0 nm	< 5.0 nm
Mechanical Specifications					
Delivery Fiber Length	3.0 ± 0.2 m	3.0 ± 0.2 m	3.0 ± 0.2 m	3.0 ± 0.2 m	3.0 ± 0.2 m
Output Cable Minimum Bend Radius	30 mm	30 mm	30 mm	30 mm	30 mm
Dimensions	215 x 95 x 284 mm	215 x 95 x 284 mm	215 x 95 x 284 mm	215 x 95 x 284 mm	215 x 136 x 284 mm
Weight	5.7 kg (nominal)	5.7 kg (nominal)	5.7 kg (nominal)	10.0 kg (nominal)	12.0 kg (nominal)
Electrical Specifications					
DC Supply Voltage	23 – 25 VDC	23 – 25 VDC	23 – 25 VDC	23 – 25 VDC	23 – 25 VDC
Current Consumption at 24 VDC	≤ 6.0 A	≤ 8.0 A	≤ 10.0 A	≤ 15.0 A	≤ 20.0 A
Digital Interface[7]	RS-232 & DB25	RS-232 & DB25	RS-232 & DB25	RS-232 & DB25	RS-232 & DB25
Max Off Voltage[8]	1.5V DC	1.5V DC	1.5V DC	1.5V DC	1.5V DC
Environmental Specifications					
Operating Ambient Temperature[9]	0 to 42 ^{0}C	0 to 42 ^{0}C	0 to 42 ^{0}C	0 to 42 ^{0}C	0 to 42 ^{0}C
Storage Temperature	-10 to 60 ^{0}C	-10 to 60 ^{0}C	-10 to 60 ^{0}C	-10 to 60 ^{0}C	-10 to 60 ^{0}C
Operating Humidity	0 to 85% RH non-condensing	0 to 85% RH non-condensing	0 to 85% RH non-condensing	0 to 85% RH non-condensing	0 to 85% RH non-condensing
Warm-up Time	60 sec	60 sec	60 sec	60 sec	60 sec
Cooling[10]	Air cooled	Air cooled	Air cooled	Air cooled	Air cooled

[1] Power fluctuation at full rated power for 5 hrs.; ±(Max-Min)/(Max+Min).

[2] Beam diameter ($1/e^2$), for options with no beam expander, beam diameter is measured at distance of 20mm from output aperture.

[3] At the lowest PRR and full rated power.

[4] FWHM at the lowest PRR and full rated power.

[5] Rise time from 0 to 90% of max power at 80 kHz.

[6] Fall time from 100% to 10% of max power at 80 kHz.

[7] DB25 connector uses industry standard pin assignments

[8] Highest voltage allowable on the +24VDC input when the power supply is intended to be off.

[9] 36-42 °C with less than 50% duty cycle.

[10] Ensure 100 cfm (0.047m^3/s) of air flow provided for 10-W, 20W, 30-W & 50-W units. Ensure that 150 cfm (0.071 m^3/s) of air flow is provided for 100-W units

8. MECHANICAL DRAWINGS

8.1 FLQ-1064-0010-YZ, FLQ-1064-0020-YZ and FLQ-1064-0030-YZ

Figure 11 Laser Housing of FLQ-1064-0010-YZ, FLQ-1064-0020-YZ, and FLQ-1064- 0030-YZ

Dimensions in mm

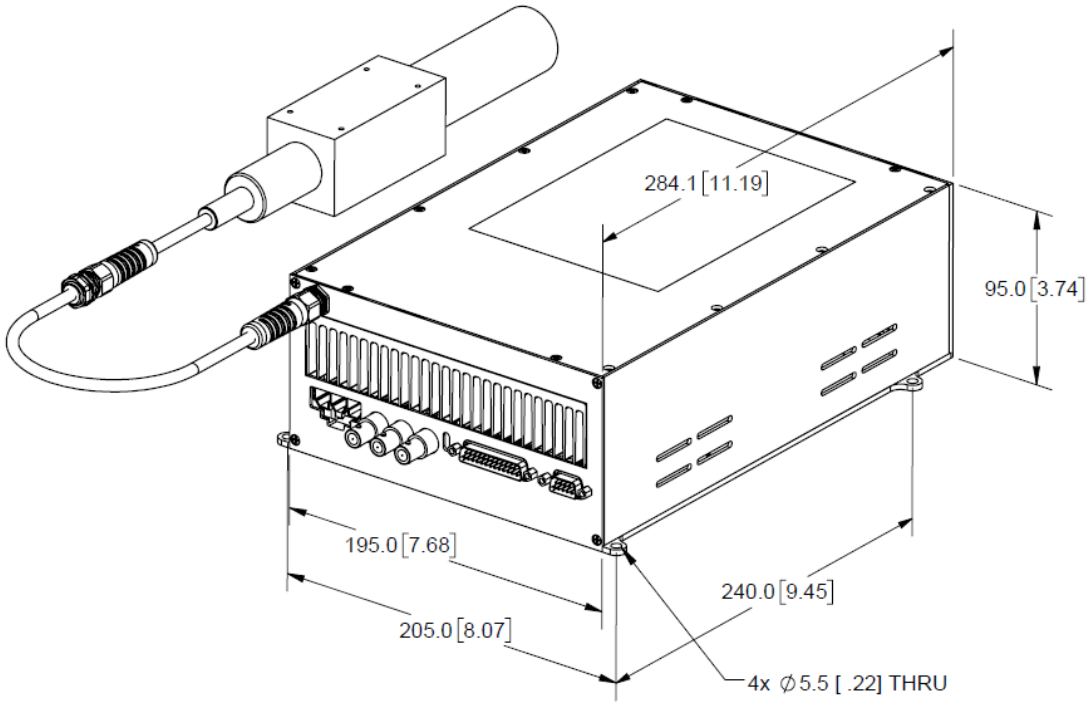
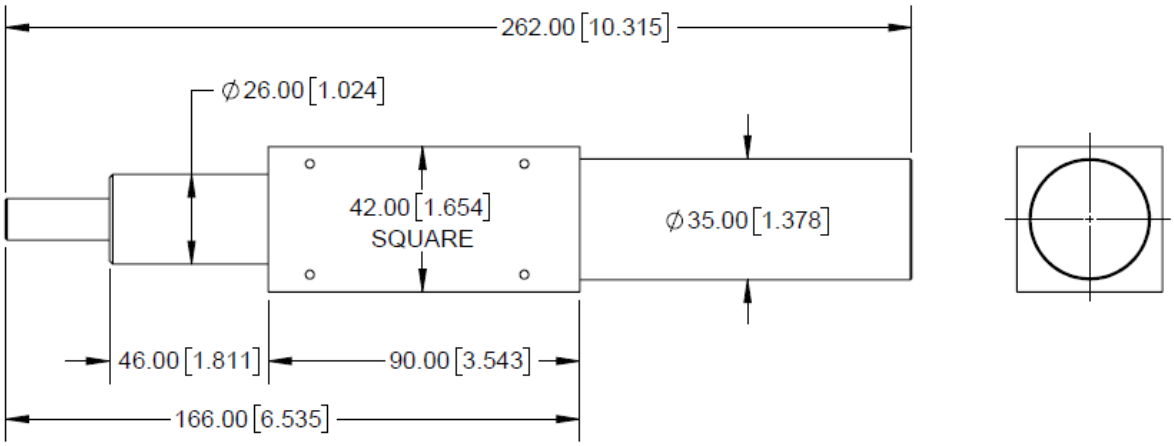


Figure 12 Output Device of FLQ-1064-0010-YZ, FLQ-1064-0020-YZ, and FLQ-1064-0030-YZ (except –CZ models)

Dimensions in mm



8.2 FLQ-1064-0050-YZ

Figure 13 Laser Housing of FLQ-1064-0050-YZ

Dimensions in mm

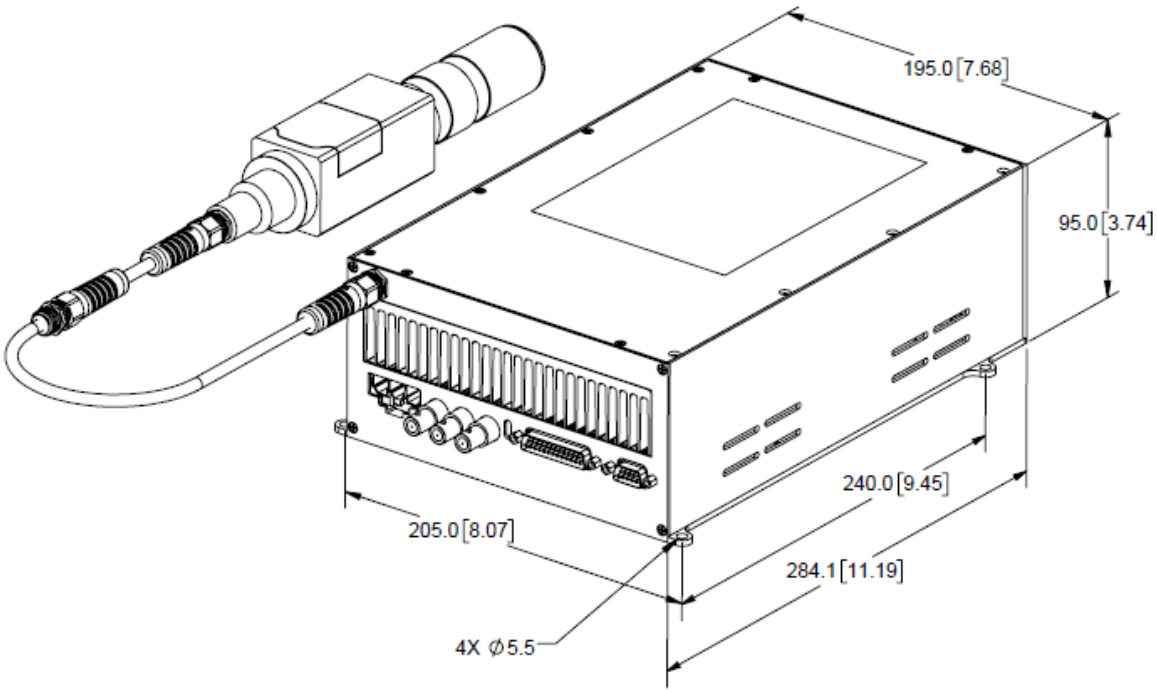
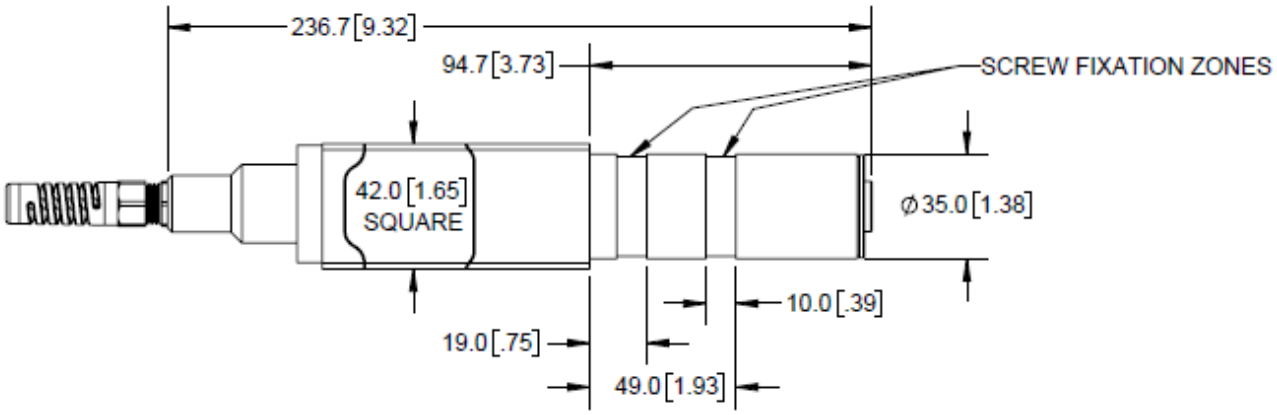


Figure 14 Output Device of FLQ-1064-0050-YZ

Dimensions in mm



8.3 FLQ-1064-0100-YZ

Figure 15 Laser Housing of FLQ-1064-0100-YZ

Dimensions in mm

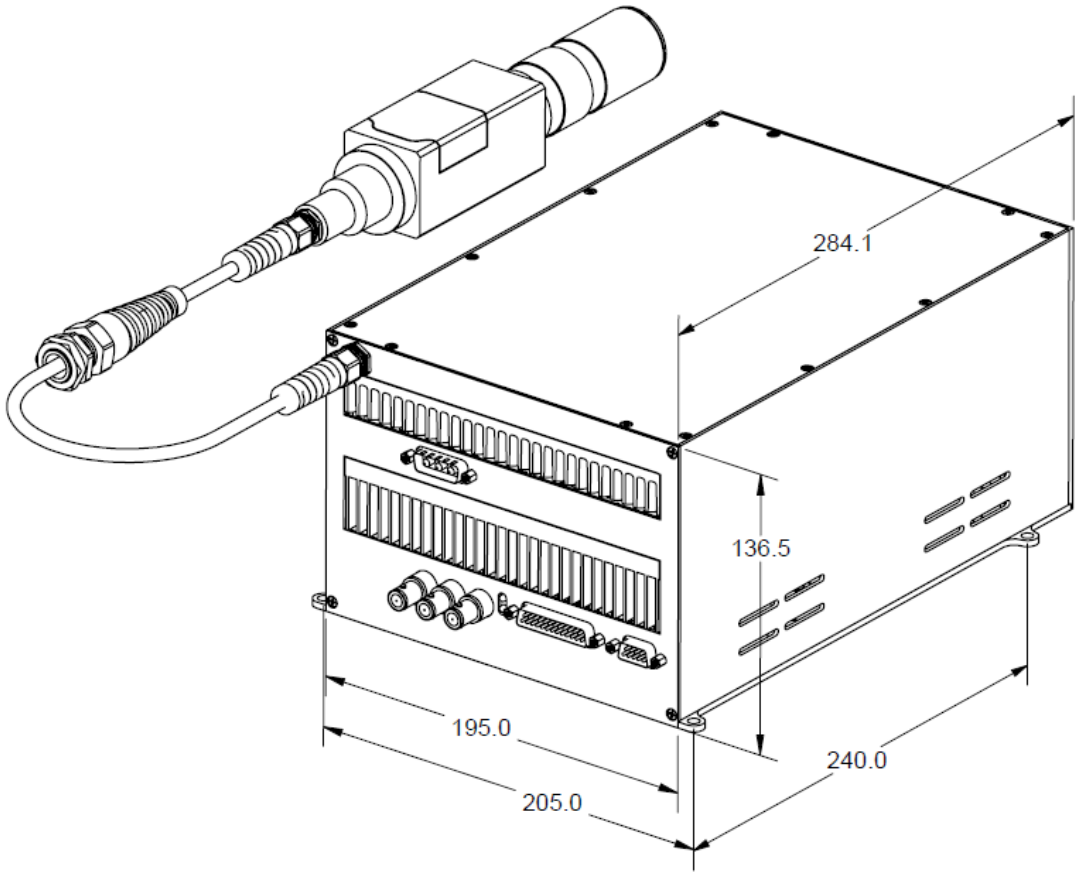
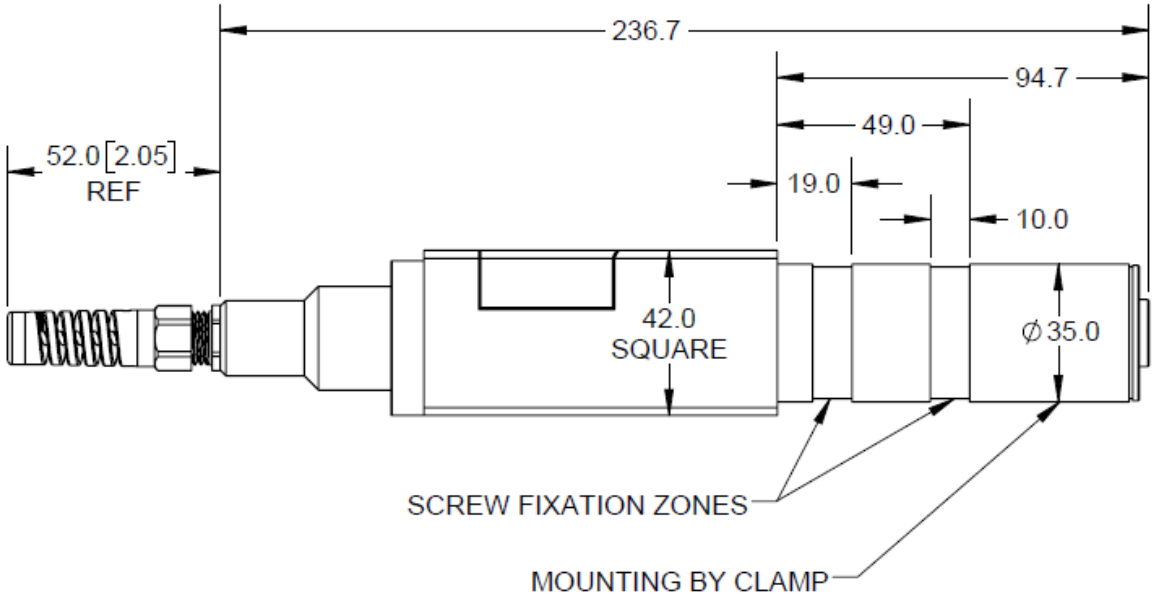


Figure 16 Output Device of FLQ-1064-0100-YZ

Dimensions in mm



9. OPERATING THE LASER WITH RS-232 INTERFACE

9.1 RS-232 Interface

The RS-232 interface will use the following set of parameters:

Figure 17 Parameters for-RS 232 Interface

Parameter	Value
Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None
Flow Control	None

Notes:

- All commands must be terminated with a carriage return (0x0D, 13) – line feed (0x0A, 10) pair.
- All responses will be terminated with a CR/LF.
- The examples here show the commands in uppercase, but the commands are not case sensitive.
- A space character (0x20, 32) must be placed between a command and the command's parameters.
- The laser will send no unsolicited responses, except for boot messages that may appear within 5 seconds of power on.
- Laser defaults to DB25 mode. RS-232 mode can be selected by sending the "S_232" command, described below.

9.2 RS-232 Command List

The following RS-232 commands will be available to the customer. Additional commands exist in the laser, but are not available to the customer.

Figure 18 Customer Accessible RS-232 Command List

Command	Brief Description
PRR	Sets or gets the pulse repetition rate.
NUQON	Turns the laser output on.
NUQOFF	Turns the laser output off.
POW	Gets or sets the output level of the laser.
GSTA	Gets the overall status of the laser as either a bit mapped integer or as a verbose listing.
GERR	Gets the error flags for the laser as either a bit mapped integer or a more verbose listing.
SRED	Sets the state of the red laser pointer.
RESERR	Resets error indicators in the laser.
RFS	Reads several status values at once.
S_232	Selects RS-232 mode. Note that DB25 mode is the default.
HELP	Returns a list of available commands.

9.3 Detailed Command Description

Command:	PRR	
Description:	Sets or gets the PRR frequency.	
Parameters:	The parameter is optional. If no parameter is sent with the command the existing PRR frequency will be reported. If a parameter is supplied with the command, it will set a new PRR frequency in the laser.	
Response:	Regardless of whether a parameter is supplied, the response will be “OK” followed by the command echoed back as an identifier, and finally the PRR frequency that is set. If a parameter is sent with the command, the frequency reported will be the newly set frequency. If a parameter sent with the command is outside the acceptable range, the response will be “ERROR- Parameter out of range”.	
Examples:	Sent:	“PRR”
	Response:	“OK PRR 56 KHZ”
	Effect:	This indicates that the PRR frequency is 56 kHz. The laser state is not changed.

	Sent:	"PRR 73"
	Response:	"OK PRR 73 KHZ"
	Effect:	The PRR frequency is set to 73 kHz.
	Sent:	"PRR 23000"
	Response:	"ERROR – Parameter out of range"
	Effect:	The PRR frequency is unchanged because the parameter was outside the valid range.
Notes:	The command is not available in DB25 mode.	
Command:	**NUQON**	
Description:	Turns the laser output on.	
Parameters:	None	
Response:	If the laser is in a mode where its output can be turned on, the response will be "OK" followed by the echoed back command as an identifier. If the laser cannot turn its output on, the response will be "ERROR" with a message indicating why the laser cannot turn on. The following error responses are possible: "ERROR – ERRORS PRESENT" "ERROR – RED LASER IS ON" "ERROR – WRONG MODE"	
Examples:	Sent:	"NUQON"
	Response:	"OK NUQON"
	Effect:	The laser's output will turn on and go to the previously set level.
	Sent:	"NUQON"
	Response:	"ERROR – ERRORS PRESENT"
	Effect:	The laser's output is not turned on because there are errors present.
Notes:	The command is not available in DB25 mode. The main laser output cannot be turned on when the red guide laser is on. A list of specific errors that may be present can be read using the GERR command.	
Command:	**NUQOFF**	
Description:	Turns the laser output off.	
Parameters:	None	

Response:	The response will be "OK" followed by the command echoed back as an identifier.	
Examples:	Sent:	"NUQOFF"
	Response:	"OK NUQOFF"
	Effect:	The laser output is turned off.
Notes:	The command is not available in DB25 mode.	
Command:	**POW**	
Description:	Sets or gets the output level setpoint of the laser.	
Parameters:	The parameter is optional. If no parameter is sent with the command the existing output power setpoint will be reported. If a parameter is supplied with the command, it will set a new output power setpoint in the laser. The parameter will be the laser's output level as a percentage, from 0 to 100.	
Response:	Regardless of whether a parameter is supplied, the response will be "OK" followed by the command echoed back as an identifier, and finally the output power setpoint that is set. If a parameter is sent with the command, the setpoint reported will be the newly set one. If a parameter sent with the command is outside the acceptable range, the response will be "ERROR- Parameter out of range".	
Examples:	Sent:	"POW"
	Response:	"OK POW: 63.0"
	Effect:	This indicates that the output power setpoint is 63%. The state of the laser is not changed.
	Sent:	"POW 86"
	Response:	"OK POW: 86.0"
	Effect:	The output power setpoint is changed to 86%.
	Sent:	"POW 2350"
	Response:	"ERROR – Parameter out of range"
	Effect:	The output power setpoint is unchanged because the 2350 is outside of the acceptable range of 0 to 100.
Notes:	The command is not available in DB25 mode.	
Command:	**GSTA**	
Description:	Reads the overall status of the laser.	

<table>
<tr><td>Parameters:</td><td colspan="3">The parameter is optional. If a parameter is added to the command, the response will be a verbose description of the status. Otherwise the response will be a more compact bit mapped 16 bit integer.</td></tr>
<tr><td rowspan="8">Response:</td><td colspan="3">The response will depend on the parameter. If no parameter is passed, the response will be “OK”, followed by the command echoed back as an identifier, and finally the laser status as a bit encoded integer. The mapping of the bits is explained below.
If a parameter is sent with the command, the response will be “OK” followed by the command echoed back as an identifier, which will be followed by a CR/LF terminator. Following that will be a series of messages describing the status of the laser. Each line of messages will be terminated with a CR/LF. Finally, a line with just ‘GSTA DONE” will indicate the end of the response.
Bit mappings:</td></tr>
<tr><td>Bit</td><td>Definition</td><td>Verbose Message</td></tr>
<tr><td>0</td><td>0 = Laser Output Off
1 = Laser Output On</td><td>“LASER OUTPUT ON”</td></tr>
<tr><td>1</td><td>0 = DB25 Mode Not Active
1 = DB25 Mode Active</td><td>“DB25 MODE”</td></tr>
<tr><td>2</td><td>0 = RS-232 Mode Not Active
1 = RS-232 Mode Active</td><td>“RS-232 MODE”</td></tr>
<tr><td>3</td><td>Not Used/ Reserved</td><td>None</td></tr>
<tr><td>4</td><td>0 = Red Laser Off
1 = Red Laser On</td><td>“RED LASER ON”</td></tr>
<tr><td>5 - 15</td><td>Not Used / Reserved</td><td>None</td></tr>
<tr><td rowspan="8">Examples:</td><td>Sent:</td><td colspan="2">“GSTA 1”</td></tr>
<tr><td>Response:</td><td colspan="2">“OK GSTA”
“Output On”
“RS-S32 Mode”
“GSTA DONE”</td></tr>
<tr><td>Effect:</td><td colspan="2">This indicates that the laser output is on, the control mode is RS-232, and the PRR is from the internal source.</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td>Sent:</td><td colspan="2">“GSTA”</td></tr>
<tr><td>Response:</td><td colspan="2">“OK GSTA 5”</td></tr>
<tr><td>Effect:</td><td colspan="2">This indicates that bits 0 and 2 are set ($5 = 2^0 + 2^2$), so the laser output is on, the control mode is set to RS-232, and the PRR is from the internal source.</td></tr>
<tr><td></td><td colspan="2"></td></tr>
</table>

<table>
<tr><td>Notes:</td><td colspan="3">None</td></tr>
<tr><td>Command:</td><td colspan="3">GERR</td></tr>
<tr><td>Description:</td><td colspan="3">Reads the error flags in the laser.</td></tr>
<tr><td>Parameters:</td><td colspan="3">The parameter is optional. If a parameter is added to the command, the response will be a verbose description of the status. Otherwise the response will be a more compact bit mapped 6 bit integer.</td></tr>
<tr><td>Response:</td><td colspan="3">The response will depend on the parameter. If no parameter is passed, the response will be “OK”, followed by the command echoed back as an identifier, and finally the error flags as a bit encoded integer. The mapping of the bits is explained below.
If a parameter is sent with the command, the response will be “OK” followed by the command echoed back as an identifier, which will be followed by a CR/LF terminator. Following that will be a series of messages describing any errors that have been detected in the laser. Each line of messages will be terminated with a CR/LF. Finally, a line with just ‘GERR DONE” will indicate the end of the response. If there are no errors present, the message “No Errors” will be listed.
Bit mappings:
<table>
<tr><th>Bit</th><th>Definition</th><th>Verbose Message</th></tr>
<tr><td>0</td><td>0 = No MO Error
1 = Persistent MO Error Detected</td><td>“MO Error”</td></tr>
<tr><td>1</td><td>Not Used/Reserved</td><td>None</td></tr>
<tr><td>2</td><td>0 = No overtemp error present
1 = Overtemp error present.</td><td>“OVERTEMP”</td></tr>
<tr><td>3</td><td>0 = 24V Supply On
1 = 24V Supply Off</td><td>“POWER SUPPLY OFF”</td></tr>
<tr><td>4</td><td>0 = Interlock Not Active (Pin HIGH)
1 = Interlock Active (Pin LOW)</td><td>“EMO ACTIVE”</td></tr>
<tr><td>5</td><td>Not used/Reserved</td><td>None</td></tr>
<tr><td>6</td><td>0 = No power supply error detected.
1 = Power supply error detected</td><td>“24V Error”</td></tr>
<tr><td>7 - 15</td><td>Not Used / Reserved</td><td>None</td></tr>
</table></td></tr>
<tr><td rowspan="3">Examples:</td><td>Sent:</td><td colspan="2">“GERR 1”</td></tr>
<tr><td>Response:</td><td colspan="2">“OK GERR”
“OVERTEMP”
“GERR DONE”</td></tr>
<tr><td>Effect:</td><td colspan="2">This indicates that an overtemperature condition has been detected.</td></tr>
</table>

	Sent:	"GERR"
	Response:	"OK GERR 4"
	Effect:	This indicates that error bit 2 is set ($4 = 2^2$), which indicates an overtemp condition.
Notes:	Any errors will turn off the laser output if it is on or prevent the output from being turned on.	
Command:	**SRED**	
Description:	Turns the red laser on or off.	
Parameters:	A parameter of 0 will turn the red laser off and a parameter of 1 will turn the red laser on. All other values will generate an error message.	
Response:	The response will be "OK" followed by the command echoed back as an identifier and finally a "0" or "1" to indicate whether the red laser was turned on or off. If the red laser was not able to be turned on because the main output was turned on, a response of "ERROR – LASER OUTPUT IS ON" will be returned.	
Examples:	Sent:	"SRED 1"
	Response:	"OK SRED 1"
	Effect:	The red guide laser is turned on.
	Sent:	"SRED 1"
	Response:	"ERROR – LASER OUTPUT IS ON"
	Effect:	The red laser is not turned on because the main laser output is on.
Notes:	The red laser cannot be turned on when the main laser output has been turned on. The state of the red laser can be determined with the "GSTA" command (bit 4).	
Command:	**RESERR**	
Description:	Resets any error flags that are active in the laser.	
Parameters:	None	
Response:	The response will be "OK" followed by the command echoed back.	
Examples:	Sent:	"RESERR"
	Response:	"OK RESERR"

	Effect:	Any active alarm flags are reset as long as the source of the error is no longer present.
Notes:	The error flags can be read using the GERR command.	
Command:	**RFS**	
Description:	Reads several status values from the laser at once.	
Parameters:	None	
Response:	The response will be "RFS:" followed by 7 status values, all separated by space characters. The 7 values will be:	
	Item #	Value
	1	Not used.
	2	FA Temperature, in degrees C.
	3	Not used.
	4	Laser status flags, with the same format as for the GSTA command.
	5	Laser error flags, with the same format as for the GERR command.
	6	The set PRR frequency, in kHz.
	7	The power setpoint, in percent.
Examples:	Sent:	"RFS"
	Response:	"RFS: 0 27 0 5 0 50 50"
	Effect:	This indicates the following: FA Temperature = 27 °C Laser Status Flags = 5 Laser Error Flags = 0 Set PRR = 50 kHz Set power level = 50 %
Notes:	See the description of the GSTA and GERR commands for the definitions of the individual bits in the status and alarm flags.	
Command:	**S_232**	
Description:	Selects RS-232 mode as the active control mode	
Parameters:	None.	
Response:		

	The response will be the command echoed back as a confirmation that the command was received. The control mode cannot be changed if the laser output is on.	
Examples:	Sent:	"S_232"
	Response:	"S_232"
	Effect:	The control Mode is set to RS-232 mode.
Notes:	None.	
Command:	**HELP**	
Description:	Provides information on RS-232 commands.	
Parameters:	None.	
Response:	The response will be a list of available commands. Each line of the list of commands will be terminated with a CR/LF pair.	
Examples:	Sent:	"HELP"
	Response:	"PRR" (Complete list of commands …) "SRED" "HELP DONE"
	Effect:	The state of the laser will not be affected.
Notes:	None.	

9.4 Examples

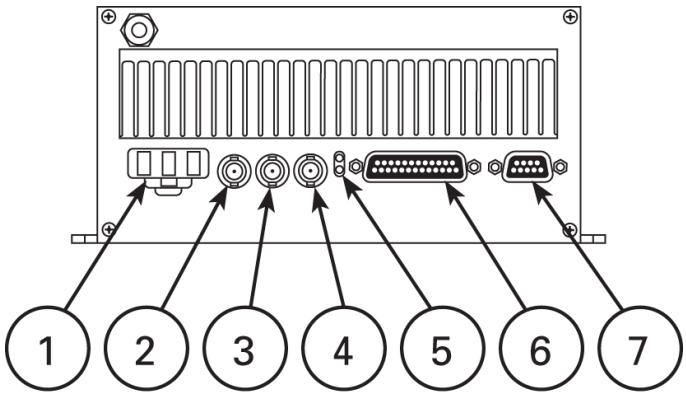
9.4.1 Example #1

Operate laser in RS-232 mode at 65 kHz and 75% power setting.

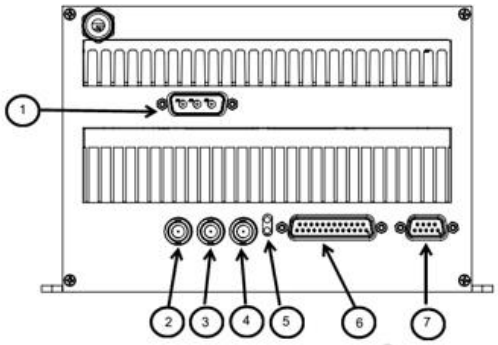
Electrical Connections:

- (Required) Apply 24V to the DC power input.
- (Required) Apply 5V to the Interlock pin on the DB25 (Pin 23).
- (Optional) Apply 5V to the auxiliary input pin on the DB25 (Pin 17).
- (Required) Connect the GATE signal. This connection can be made on the BNC (#3 on the diagram below), or the connection can be made by bridging Pin 18 to Pin 19 and connecting the GATE signal to both pins.
- (Required) Connect the laser's RS-232 interface to a host computer or other controller using a straight through DB9 cable.

Figure 19 Front Panel Connections for Operating the Laser with RS232 Interface



1. 24 V In
2. PRR Out
3. Gate
4. PRR In
5. Status LED
6. 25 Pin Interface Connector
7. RS-232



1. 24 V In
2. PRR Out
3. Gate
4. PRR In
5. Status LED
6. 25 Pin Interface Connector
7. RS-232

Front Panel on 100W Model

Sequence:

- Turn on the 24V supply.
- Send the command "GSTA" until a response appears.
- Send the command "S_232" to select RS-232 mode.
- Send the command "PRR 65". This will set the laser rep rate to 65 kHz.
- Send the command "POW 75". This will set the output to 75% of the maximum.
- Send the command "NUQON". This will enable the laser output. At this point, the laser is enabled and only the gate signal is preventing the amplifier from firing.
- Bring the gate signal HIGH to fire the amplifier.
- After the laser operation is complete, bring the gate signal LOW to turn off the amplifier.
- Send the command "NUQOFF" to disable the laser output.
- Operation complete.

9.4.2 Example # 2

Turn on the red guide laser to aim the laser output with only the auxiliary 5V input being present.

Electrical Connections:

- (Required) Make a connection of 5V to the auxiliary input pin on the DB25 (Pin 17), but leave the voltage off.
- (Required) Connect the laser's RS-232 interface to a host computer or other controller using a straight through DB9 cable.

Sequence:

- Turn on the voltage to the auxiliary 5V input.

- Send the command “GSTA” until a response appears.
- Send the command “S_232” to select RS-232 mode.
- Send the command “SRED 1”. This will turn on the red guide laser.
- Aim the laser output as needed.
- Send the command “SRED 0”. This will turn off the red guide laser.
- Operation complete.

9.4.3 Example # 3

Use the RS-232 interface to query the state of the 24V and interlock inputs.

Electrical Connections:

- (Required) Apply 5V to the auxiliary input pin on the DB25 (Pin 17).
- (Required) make the connection to the interlock pin on the DB25 (Pin 23). Leave the signal LOW for now.
- (Required) Make the connection to the laser’s 24V DC input. Leave the power supply off for now.
- (Required) Connect the laser’s RS-232 interface to a host computer or other controller using a straight through DB9 cable.

Sequence:

- Apply power to the auxiliary 5V input.
- Send the command “GSTA” until a response appears.
- Send the command “S_232” to select RS-232 mode.
- Send the command “GERR” and check the response. The response should indicate that the Interlock and 24V supplies are off (bits 3 and 4 of the response should be ones, for example 24 = 23 + 24, indicating that bits 3 and 4 are set).
- Apply a HIGH voltage to the Interlock pin.
- Send the command “GERR” and check the response. Bit 4, which indicates the Interlock status should be LOW, but bit 3, which indicates that the 24V supply is off, should still be HIGH. For example, an expected value would be 8 (8 = 23, which indicates that the 24V is off, but the Interlock pin is HIGH).
- Turn on the 24V supply.
- Send the command “GERR” and check the response. Bits 3 and 4 should both be LOW, which indicates that the Interlock pin is HIGH and the 24V supply is on.
- Operation complete.

10. WARRANTY

Nufern warrants the Diamond FLQ Fiber Laser to be free from defects in workmanship and materials, hereinafter called "Nonconformity," for a period of twenty-four (24) months from the date of shipment or such other date set forth in the contract.
This warranty does not apply to systems which Nufern determines, upon inspection, have failed, become defective or unworkable due to abuse, mishandling, misuse, alteration (unless approved in writing by Nufern), negligence, improper installation, use which is not in accordance with the information and precautions described in the Diamond FLQ Operator's Manual, or other causes beyond Nufern's control.

This warranty does not apply to (i) any products or components not manufactured by Nufern or (ii) any aspect of the products based on buyer's specification, unless Seller has reviewed and approved such specification in writing.

EXCEPT FOR THE FOREGOING WARRANTY, NUFERN 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 Nufern of any Nonconformity during the warranty period, obtain a Return Material Authorization (RMA) number for the nonconforming products, and return the nonconforming products, freight prepaid, to Nufern's designated facility along with a written statement describing the Nonconformity. Nufern's sole and exclusive obligation under this warranty is to use reasonable commercial efforts, at Nufern's option, to repair, replace or refund the purchase price for any products which are returned to Nufern as set forth above and which are, after examination by Nufern, determined in Nufern's reasonable discretion to be nonconforming. Products which are repaired or replaced within the warranty period are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced products or components. However, the warranty period does not include the time period between when Nufern receives the nonconforming products and when Nufern 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 Nufern with respect to the products.

IN NO EVENT WILL NUFERN BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS OR BENEFITS, EVEN IF NUFERN HAS BEEN INFORMED OF THE POSSIBILITY THEREOF IN ADVANCE. IN NO CASE WILL NUFERN'S AGGREGATE LIABILITY TO BUYER BE GREATER THAN THE PURCHASE PRICE PAID BY BUYER TO NUFERN FOR THE PRODUCTS WHICH ARE THE SUBJECT OF BUYER'S CLAIM.

The products are not authorized by Nufern for Buyer's use in any device or application where the failure, malfunction or inaccuracy of the product carries a risk of death or serious bodily injury, such as, but not limited to medical equipment, nuclear facilities, aircraft operations, air traffic control, life support or other applications representing a similar degree of hazard. Any such use is prohibited without prior written agreement of Nufern under terms intended to allocate the risks of selling the product for such uses. Buyer will indemnify, defend and hold Nufern harmless from all claims, losses, damages and expenses, including attorney's fees arising from any prohibited use or application of the products.

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