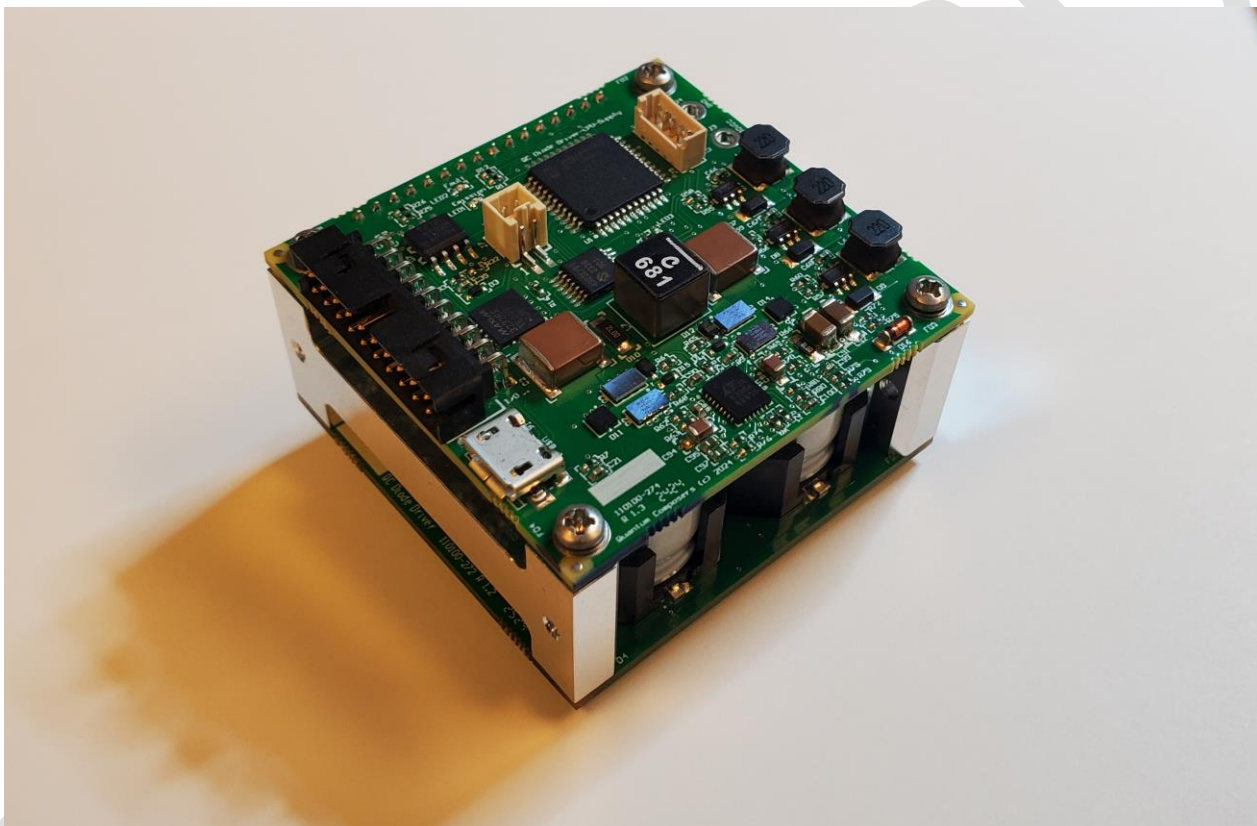




Diode Driver Manual



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1. INTRODUCTION

This manual contains the information necessary to operate and maintain the Quantum Composers Diode Driver. It provides information for setup and installation, operation, service, preventive maintenance, and troubleshooting (fault isolation). Generally, each topic has its own section and no section assumes knowledge of information from other sections.

Technical Support

For questions or comments about operating the Diode Driver the Quantum Composers technical staff can be reached via one of the following methods:

- Phone - (406) 582-0227
- Fax - (406) 582-0237
- Internet - www.quantumcomposers.com

Warranty

The Diode Driver has a one-year limited warranty from the date of delivery. This warranty covers defects in materials and workmanship. Quantum Composers will repair or replace any defective unit. Contact the Quantum Composers Service Dept. for information on obtaining warranty service.

Package Contents

The box you receive should contain the following:

- Diode Driver
- User's Manual and Control Software on USB drive
- Optional cables

Contact Quantum Composers (406) 582-0227 if any parts are missing.

2. SYSTEM OVERVIEW

DIODE DRIVER BLOCK DIAGRAM

Figure 1 shows a typical system block diagram, which consists of the Diode Driver, a personal computer, and power source and laser diode.

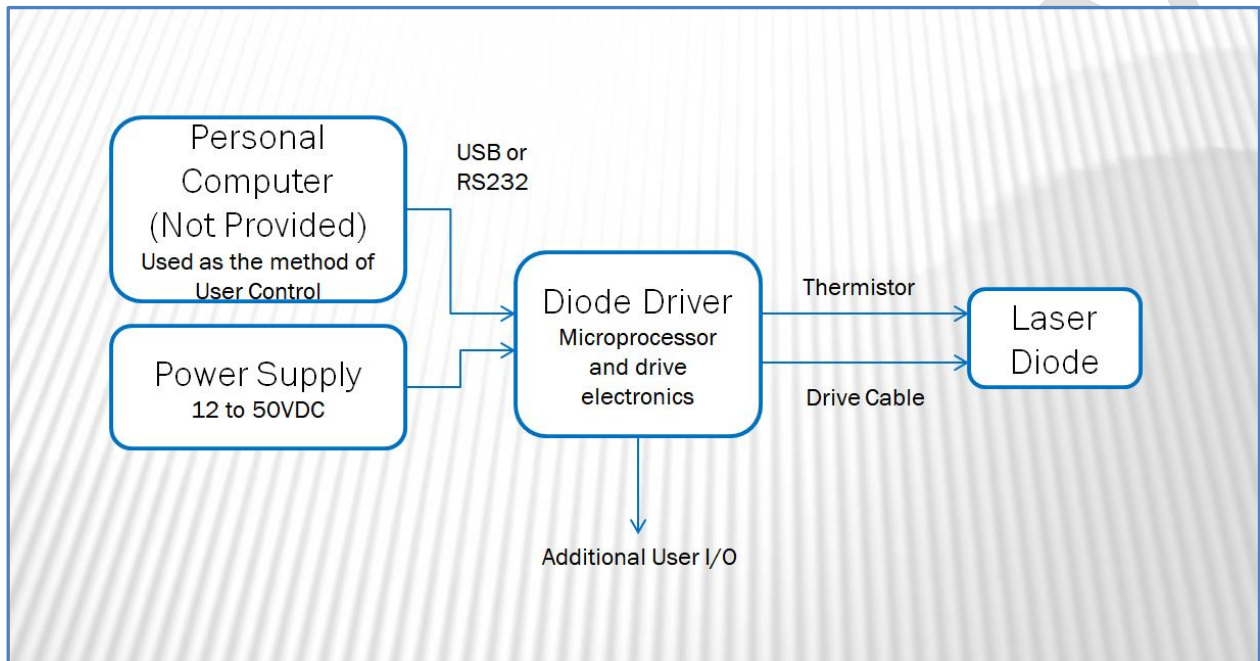


Figure 1: System Block Diagram

DIODE DRIVER DESCRIPTION

The Diode Driver is a small, compact module that includes control electronics for driving and controlling laser diodes. The Diode Driver is powered by an external DC voltage from 12-50V. The Diode Driver can generate current pulses up to 130A and 300us and at frequencies up to 50Hz. The Diode Driver allows for diode voltages up to 40VDC so that various types of laser diodes can be used. The Diode Driver is microprocessor based to allow for easy setup and integration. The Diode Driver can be interfaced with by using either RS232 or USB and an included software application.

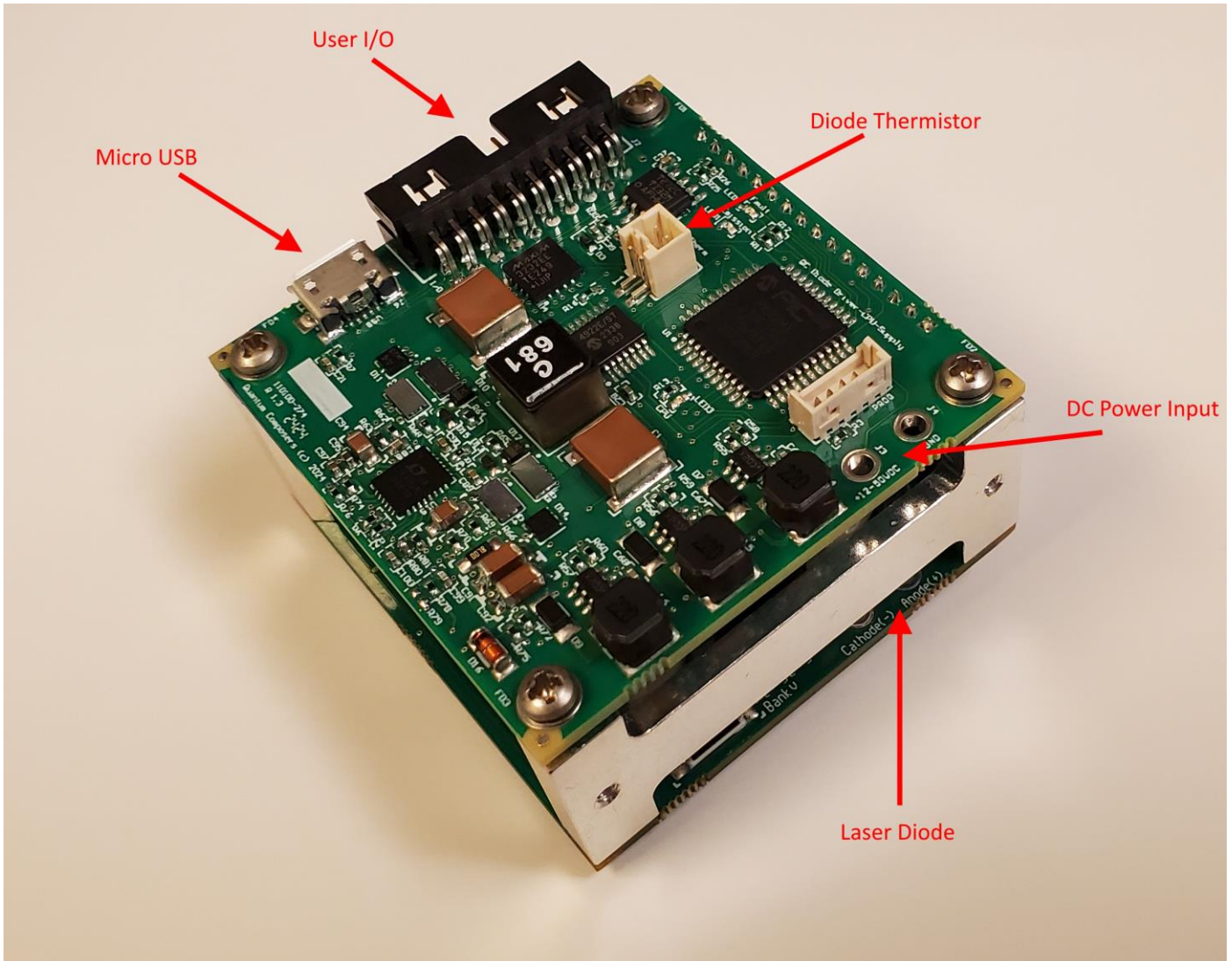


Figure 2: Diode Driver Connections

Pre

3. DIODE DRIVER SETUP

SYSTEM SETUP

- Set up remote interlock, as needed.
- Connect the Diode Driver to a computer by using USB or the optional RS232.
- The Diode Driver must be mounted to an appropriate heat sinking surface (See Interface Drawing - Figure 7) when operating the driver at the max ratings.
 - Note: The Diode Driver will operate without a heat sink, but its duty cycle and pulse rate should be reduced. Contact manufacturer for further details.
- Connect the Diode Driver to the laser diode.
- Connect the Diode Drive to a DC power source.

CONNECTIONS

In order to start using the Diode Driver, there are some basic connections that need to be done. At the very minimum, these are:

- **DC Power Input.** The DC power input connection is shown below. The connection will be directly soldered to the circuit board as shown. It is recommended that a minimum of 24AWG wire be used.

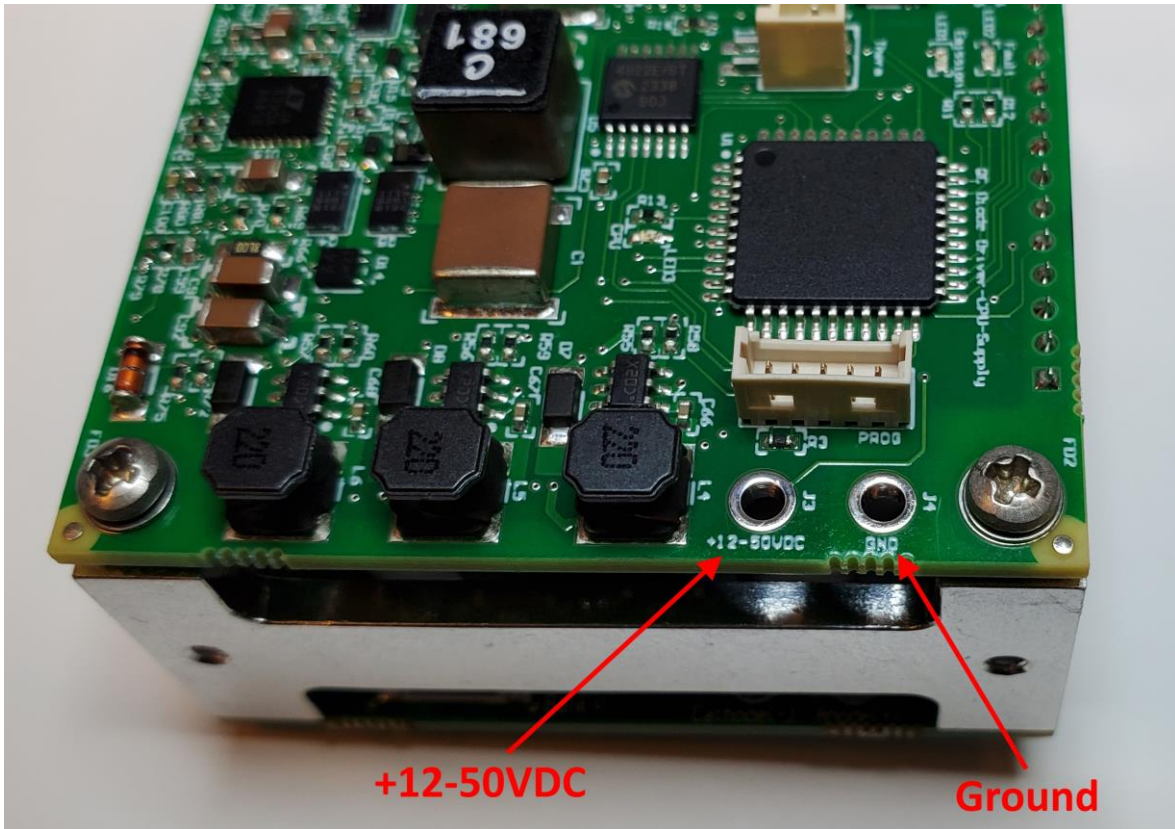


Figure 3 DC Power Input

- **Laser Diode Connection.** The laser diode connection is shown below. The laser diode connection should be soldered directly to the board. It is recommended that a minimum of 22AWG wire be used and the connections be made as short as possible.

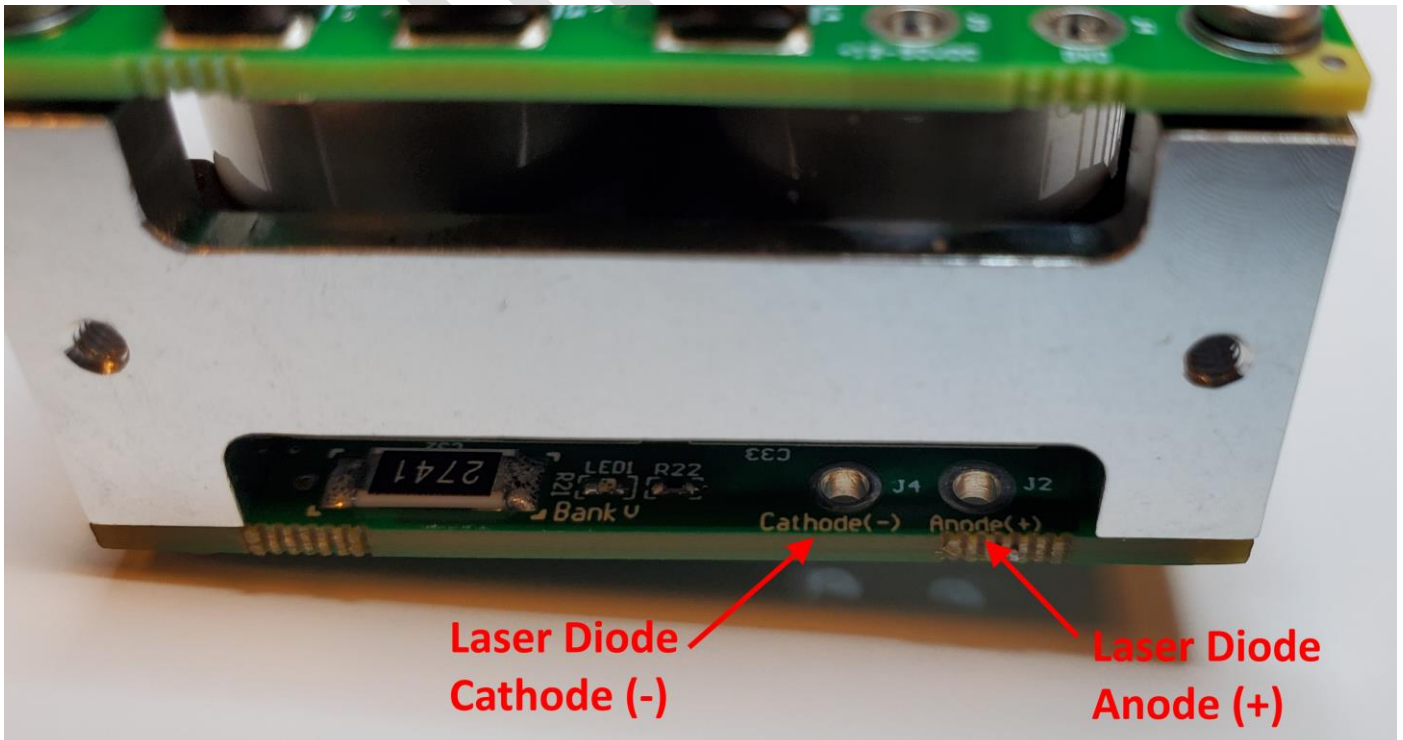


Figure 4 Laser Diode Connection

- **Communication.** Communication is required to operate the unit. Communication can be either USB or RS232. The USB can be accessed by either the onboard microUSB connection or by the user I/O connection. RS232 can be accessed by the user I/O connection.
- **Diode Temperature Thermistor.** The thermistor input is recommended to monitor the laser diode temperature to make sure that it does not exceed the manufactures specification.

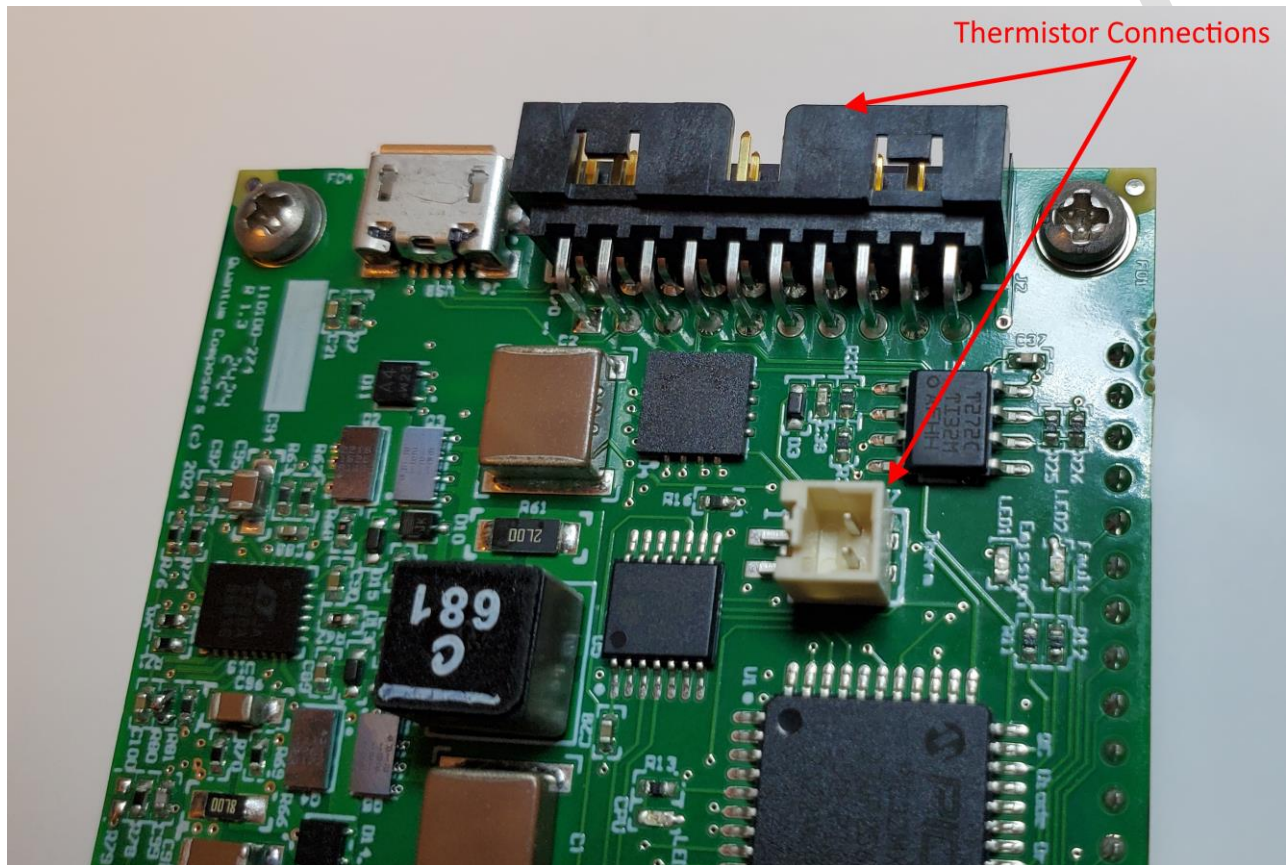


Figure 5 Thermistor Connections

COMMUNICATION - USB OR RS232

The Diode Driver provides a standard USB connection for remote communications. When the Diode Driver is connected to a remote computer via the USB connection, the computer will recognize the unit as a “QC-LASER”. No drivers should be needed as most Windows versions after Windows XP will automatically install the driver. The Diode Driver can then be communicated with by either the included Diode Driver application, or by using any generic communication terminal program. The unit is baud rate independent when using USB, so any speed can be selected. Typically a rate of 115,200bps can be used. When using RS232 the unit will use a baud rate of 57600 and an even parity.

4. DIODE DRIVER APPLICATION

DIODE DRIVER APPLICATION OVERVIEW

The Diode Driver can easily be interfaced by means of the included Diode Driver application. This application is based on the same application as the Quantum Composers Jewel series lasers. On standard models, a USB cable and a port with USB 1.1 capabilities or greater (2.0 or greater recommended) are required to communicate with the unit.

GETTING STARTED

- Attach a USB cable from the port of the computer to the port on the control box.
- Plug in the DC power supply to the driver.
- Start the Diode Driver software.
- The Diode Driver application will be displayed as shown in Figure 6.
 - This application has been designed as a graphical user interface for ease of use. It includes a Command Terminal section that can be used to manually send and receive commands to and from the laser system.
 - The software allows you to control the basic functions of the driver. The user can pick Pulse Mode, Pulse Rate (Rep Rate) and Burst Count for example.
 - The software provides system status indicators for the current state of the driver as well as any major interlocks and faults.
Note – Depending on the type of fault, the driver may be disabled or stopped. In either case, the user must resolve the fault condition before re-enabling or firing the driver.
 - The System Information section displays the Diode Driver serial number as well as firmware versions.
- Select and enter control parameters on the Diode Driver software panel.
- Enable and Fire.
 - Note: See below for detailed information on driver operation.

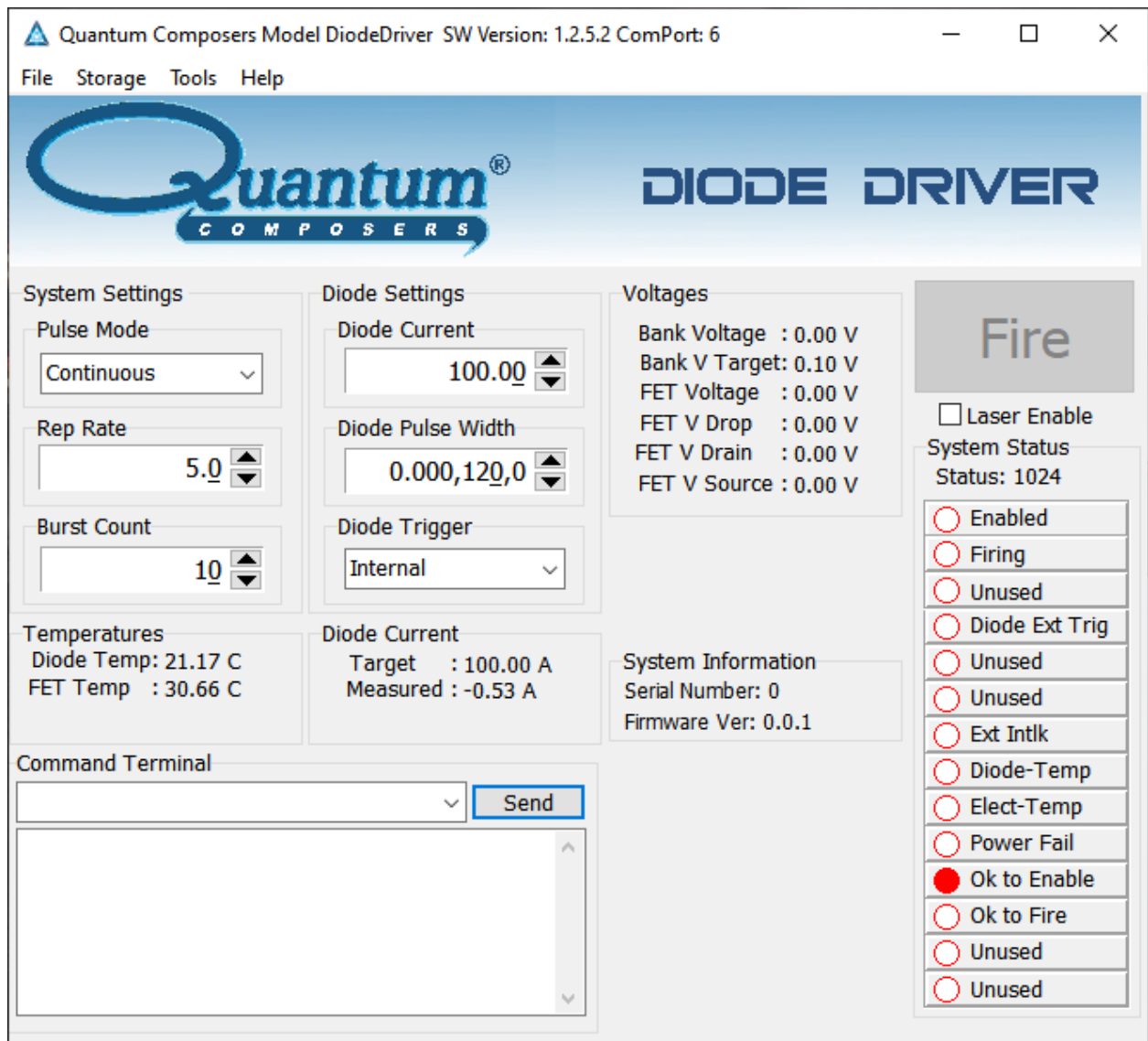


Figure 6: Diode Driver Software Application Main Window

LASER OPERATION CONTROLS

The user is responsible for ensuring a suitable beam path and appropriate beam dumps are in place before firing any connected laser diode.

1. Pulse Mode – Options are continuous, single shot or burst.
 - a. Continuous mode – The driver will fire continuously from the time the Fire button is pressed until the Stop button is pressed. The pulses per second are controlled with the Rep Rate parameter under System Settings.
 - b. Single Shot – The driver will output 1 single current pulse when the Fire button is pressed.

- c. Burst mode - The driver will output the number of pulses specified by the Burst Count parameter under System Settings. The driver will stop pulsing at the end of the burst.
2. Diode Trigger - The driver can be internally or externally triggered. Default is internal trigger. When in external trigger mode, the driver will fire once for every trigger input. Pulse modes or burst counts do not apply when in external trigger mode. When in external trigger mode, the fire command must be issued to arm the driver to accept external trigger signals.
3. Driver Enable – This enables the driver and readies it for firing.
4. Fire button – Selecting the fire button will start driver output. NOTE: the driver must be enabled before the Fire button becomes active.

STATUS

The status of the driver can be determined by monitoring the following items:

1. System Status – The system status reports various conditions of the driver. These status “bits” can be used to determine if there is a fault or what enable or firing state the driver is in.
2. Temperatures – Critical temperatures of the driver and attached diode are reported here. If any of these temperatures reach pre-set limits, a fault will occur.
3. Measured Diode Current – This reports the actual measured pulse current of the laser diode. This current should report within ~5% of the set diode current value.
4. Voltages – This reports various voltages in the system for diagnostic purposes only.

5. COMMUNICATIONS

The Diode Driver has a standard USB port for communications. An optional RS-232 port is available on the user I/O connector. All system parameters can be set and retrieved over either computer interface using a simple command language. The command sequence is controlled by a software handshake. A response of “ok” or “?n” in case of an error is returned after every command. To ensure reliable communications, it is important to wait until a response from the previous command is received before sending the next command.

USB INTERFACE OVERVIEW

The USB port is located on the back of the Diode Driver control box and uses a USB-B type connector with the following pinout (as viewed from the back of the unit):

Pin Number	Name	Description
1	+5 VDC	Vbus
2	D-	Data -
3	D+	Data +
4	Ground	Power Return

RS-232 INTERFACE OVERVIEW

The serial port is located on the user I/O connector.

The serial port parameters should be set as follows:

Baud Rate	57600
Data Bits	8
Parity	Even
Stop Bits	1

Device Command Format

All commands use ASCII characters and are composed of the following fields:

<Prefix><Address>< Delimiter ><Command String>[Parameters]<Terminator>

Field	Description
Prefix	Single semicolon character ";", must precede all commands. All devices will reset their command input buffer when the prefix is received.
Address	2 ASCII characters. Each device has a unique address which is programmed into its firmware. See the table below for a list of addresses.
Delimiter	Single colon character ":", must follow device address.

Command String Parameters	Commands are specific to each device -- see the following sections for the commands that each device supports. (optional field) Some commands may not require a parameter. For Query commands immediately follow the command string with the question mark character "?". For non-query commands immediately follow the command string with a single space character " " followed by the parameter. Multiple commands are separated by commas.
Terminator	ASCII carriage return character (ODh). The receiving device does not process any commands until the terminator is received.

Device Addresses

Address	Device
LA	Laser

COMMAND TYPES

There are two types of commands -- those that set a value or initiate an action (control commands), and those that request information (query commands). Each device must respond in the proper manner to each type of command.

Control Commands

A device must always parse a control command and return a response immediately.

- If the command is a recognized command and the parameter is valid, then the device returns an "ok<CR><LF>".
- If the command is not recognized, then the device responds with a "?1<CR><LF>".
- If the command is recognized, but the parameter value is missing or invalid, then the device responds with a "?4" or "?5".
- If a control command is received while the device is in the midst of executing a previous command, and the commands are mutually exclusive (cannot be executed in parallel), then the previous command is aborted and the new one executed. It is up to the host controller (the PC) to poll the device and make sure the previous command has finished, if that is needed.

Query Commands

Query commands return a value to the PC as soon as the command is parsed and executed. The value returned will depend on the command. The response is always terminated with a "<CR><LF>". If a query command is not recognized by the device, then a "?1" is returned.

Error Codes

?1	Command not recognized.
?2	Missing command keyword. If command requires keyword.
?3	Invalid command keyword. If command requires keyword.
?4	Missing parameter.
?5	Invalid parameter.
?6	Query only, command needs a question mark.
?7	Invalid query, command does not have a query function.

?8 Command unavailable in current system state.

Diode Driver Command Examples

Below are a few example commands and queries. A <CR><LF> indicates the carriage return and linefeed values appended:

Set pulse mode to burst:

Command to send: ;LA:PM 2<CR><LF>

Response: ok<CR><LF>

Set burst count to 123:

Command to send: ;LA:BC 123<CR><LF>

Response: ok<CR><LF>

Set Rep Rate

Command to send: ;LA:RR 5<cr> sets rep rate to 5 Hz

Response: ok<CR><LF>

Enable driver:

Command to send: ;LA:EN 1<CR><LF>

Response: ok<CR><LF>

Fire driver:

Command to send: ;LA:FL 1<CR><LF>

Response: ok<CR><LF>

Query system status:

Command to send: ;LA:SS?<CR><LF>

Response: 3075<CR><LF>

(3075 decimal, when converted to bytes, means: Laser enabled, Laser firing, ok to enable and ok to fire)

Communications Timeout Safety Feature

The driver has a safety feature that will stop firing the driver if the any communication is not initiated in a 3 second period. This prevents the driver from firing unattended if the user application has locked up or a commutation cable has become disconnected. Any command or query can be sent to prevent the timeout from happening.

Laser Operation Commands

BC # BC?	Burst Count. Sets the number of shots to be fired when firing mode is set to burst. Parameters are from 1-65535. Default is 10. A query will return the currently set burst count.
BV?	Bank Voltage. Returns the current diode driver bank voltage.
DC?	Diode Current. Queries the diode current setting.
DT # DT?	Diode Trigger Mode. Set the driver to operate in either internal or external diode trigger mode. When set to external mode, a trigger

	signal present on the external trigger connection will trigger the firing of the laser diode. 0 = internal, 1 = external, default = internal. A query returns the current trigger state.														
EC # EC?	Echo. Parameters: 0=echo characters off (Default: 0), 1=echo characters on. EC? returns echo state.														
EN # EN?	Enable. This will enable or disable the driver. The driver must first be enabled before firing. 0 = Disabled, 1 = Enabled. (Default: 0). A query returns the current enable state.														
FL # FL?	Fire Laser. Starts the laser diode pulsing. 0 = Stop Firing Laser, place laser in idle state. 1 = Fire laser. A query returns the current firing state.														
FT? FT:MAX?	FET temperature in degrees C.														
FV?	FET Voltage in Volts.														
ID?	System ID – QC, model #, serial # (5 digits),FW version#-GA version (##-##-##) (ex. QC,Diode Driver,00101,1.0-0.0.0.8). Query only.														
IM?	Diode current measurement, in Amps.														
LS?	Latched Status. Returns the latched system status. Cleared upon read. See SS? query for details.														
PE ## PE? PE:MIN? PE:MAX?	Sets pulse period in seconds. A query returns the current period value. A MIN and MAX query will return the limits for the setting.														
PM # PM?	Mode. Sets the diode firing mode, 0 = continuous, 1 = single shot, 2 = burst. (Default: 0). A query returns the currently set mode.														
RC # RC?	Recall settings from user bin 1-4. 0 = recall factory defaults.														
RR ## RR? RR:MIN? RR:MAX?	Repetition Rate. This sets the rate at which the diode will fire at. Values are from 1-50 Hz. (Default: 1 Hz). A query will return the current rate. A MIN and MAX query will return the limits for the setting.														
RS	Reset. Resets the system.														
SS?	System Status – Query Only. Returns the current system state. Value is a 16 bit decimal value with each bit position corresponding to a system state (See Table below, bits 0-15).														
15		14		13		12		11		10		9		8	
Spare		Spare		Spare		Spare		Ready to Fire		Ready to Enable		Power Failure		Electrical Over Temp	
7		6		5		4		3		2		1		0	
Resonator Over Temp		External Interlock		Reserved		Reserved		Diode External Trigger		Reserved		Driver Active		Driver Enabled	
SV # SV?	Save settings to user bin 1-4.														

TR? TR:MAX?	Thermistor Reading. Thermistor temperature in degrees C. A MAX query will return the limit for the setting.
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Preliminary

6. MAINTENANCE

SERVICE PROCEDURES

No User-Serviceable Parts Inside

If service is required, contact the vendor for more information.

Preliminary

7. TROUBLE-SHOOTING

The Diode Driver control electronics are designed to control the diode and warn the user of problems that may occur. The microprocessor-based system monitors the diode system and automatically shuts down if a fault occurs. Software limits have been factory selected to protect the laser system against electrical and optical damage.

NO DRIVER OUTPUT

1. Check Fault and Interlock Conditions. Query status information using commands listed in the command set. Refer to status to determine if a fault or interlock conditions exists.
2. Check Cables. With the main power OFF and unplugged, check all electrical connections between the laser diode and the driver electronics. Make sure all connections are secured. If any of the cables are not installed properly, the system will not function.

Contact the Quantum Composers for any repair actions necessary beyond those described in this manual. Attempts to adjust, repair or replace any portion of the laser system may cause additional problems and void the warranty.

8. SPECIFICATIONS

Current Amplitude	0-130A
DC Input Voltage	12-50VDC
Pulse Width	0-300us
Pulse Rise Time	<10us
Pulse Rate	1-50Hz
Compliance Voltage	3-36VDC (Adjustable)
External Trigger	5VDC
External Sync	5VDC
Thermistor Input	10K NTC
Communication	USB or RS232
External Interlock	Contact Closure
External Heater Control	Optional
Photo Diode Input	Optional
Power Consumption (Average)	Enabled/Standby: 1.3W 1Hz, 100A, 200us: 2W 5Hz, 100A, 200us: 5W 10Hz, 100A, 200us: 8W
Dimensions	2" x 2" x 1.3"
Operating Temperature Range	-25C to +50C

9. CONNECTIONS

User I/O Connector

Molex #87833-2020. Mating Connector: Molex #0511102051

Pin #	Name	Description
1	VBus	USB VBus connection
2	USB D(-)	USB Data +
3	USB D(+)	USB Data -
4	GND	Ground
5	RS232 Tx	RS232 transmit out
6	GND	Ground
7	RS232 RX	RS232 receive in
8	GND	Ground
9	Diode Thermistor	10K NTC thermistor input
10	GND	Ground
11	Photodiode Cathode	Photodiode cathode input
12	GND	Ground
13	External Trigger	External trigger input
14	GND	Ground
15	Heater Thermistor (+)	10K NTC thermistor input
16	Heater Drive	Heater resistor drive output
17	Sync Output	Sync output
18	GND	Ground
19	External Interlock	External interlock. Short to ground to satisfy
20	GND	Ground

USB

The USB interface can be accessed via the onboard USB micro connection or by using the USB connections available on the user I/O connector. When using the onboard USB micro connection a USB cable that has a Standard-A plug to USB Micro plug should be used.

External Trigger

The diode driver can be externally triggered when critical timing synchronization between other devices is required. The external trigger input is available on the user I/O connector.

External Trigger Specifications			
	Minimum	Typical	Maximum
Voltage Input Range	0-1V (Low level)	5V	2.5-5.5V (High level)

Pulse Width	5us	10us	100us
Insertion Delay		100us	
Jitter		2us p-p	

Sync Output

The sync output connector provides a signal that represents the diode pulse. The external sync signal is available on the user I/O connector.

Sync Out Specifications	
Voltage Output Range	5V (+/-100mV)
Insertion Delay	2us
Jitter	60us p-p

Thermistor Input

Molex #0874370243. Mating connector: Molex #0874390200

The thermistor input monitors the laser diode temperature. A 10K NTC thermistor should be used. The thermistor input is available on the connector J7 or on the user I/O connector.

10. MECHANICAL INTERFACE DRAWINGS

Preliminary

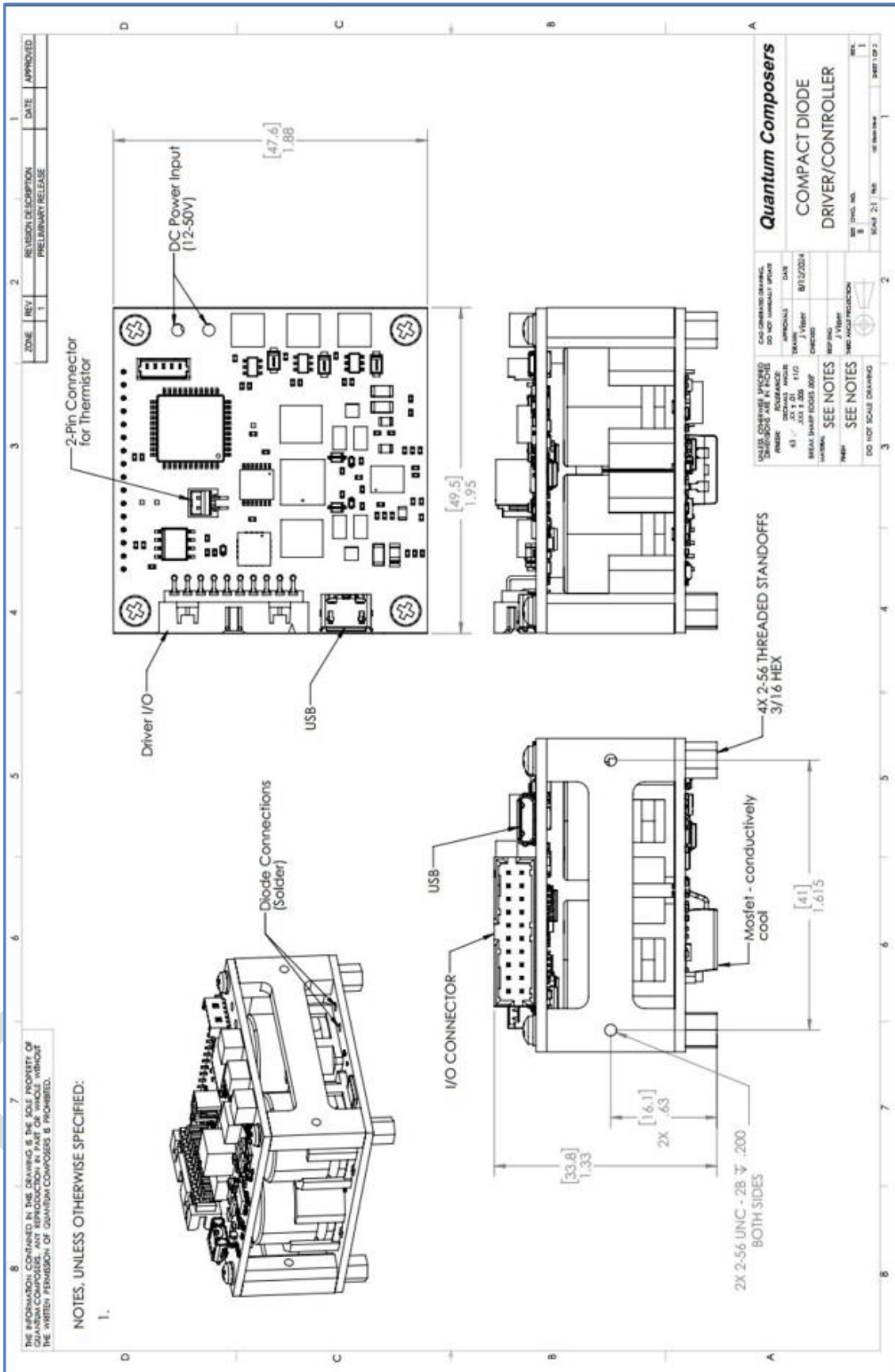


Figure 7 Interface Drawing

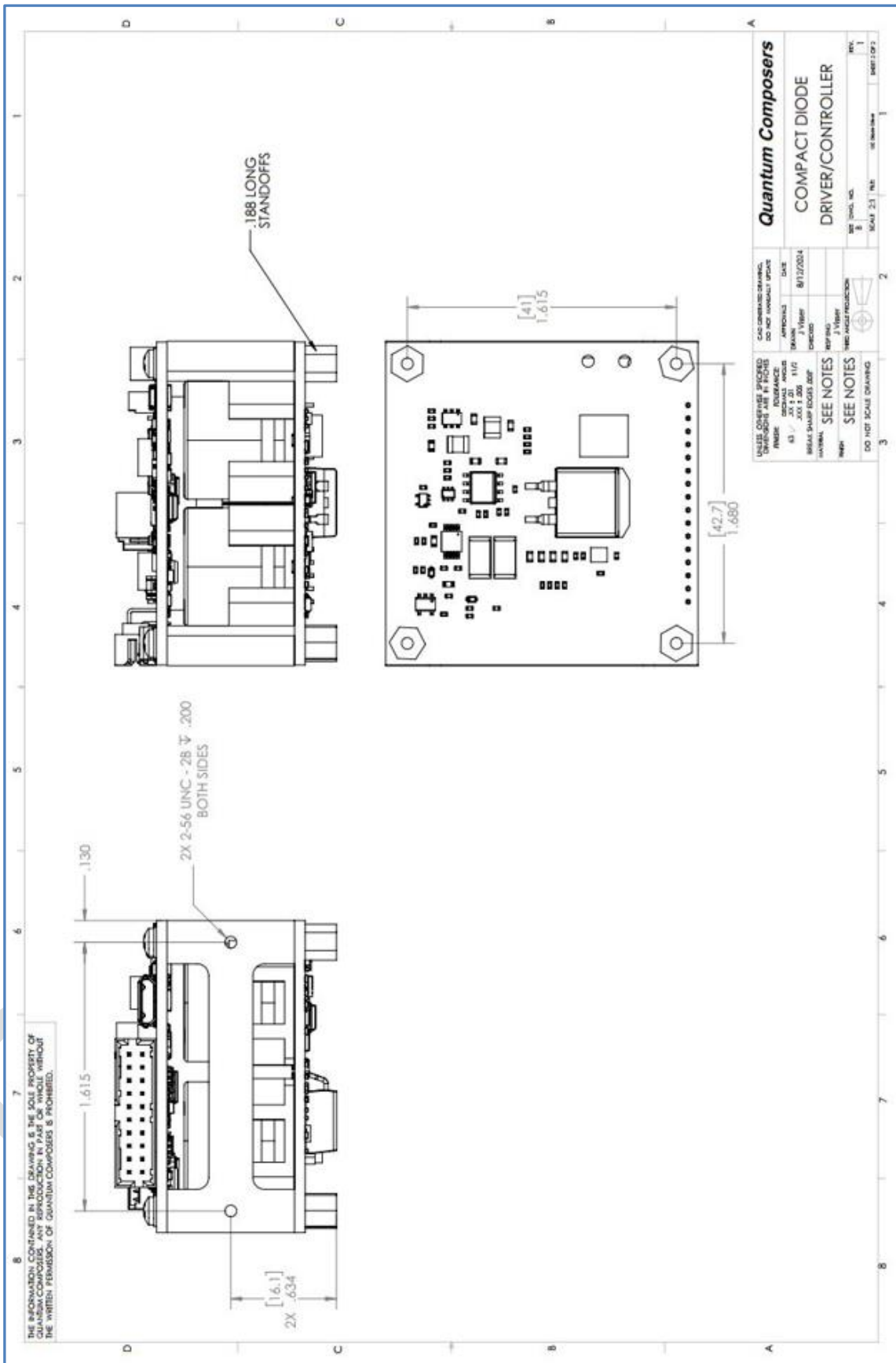


Figure 8 Interface Drawing

11. CUSTOMER SERVICE

WARRANTY

The manufacturer warrants the lasers it produces to be free from defects in materials and workmanship for one year following the date of shipment. Laser optics are warranted for 90 days following the date of shipment provided that operating instructions are properly followed. This warranty is limited to the original purchaser of the laser and is not transferable.

During the one year warranty period, we will repair or replace, at our option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to Quantum Composers. All replaced parts and products become the property of the manufacturer.

This warranty does NOT extend to any lasers which have been damaged as a result of accident, misuse, abuse (such as use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions provided by the manufacturer, or other contingencies beyond our control), or as a result of service or modification by anyone other than the manufacturer.

FEEDBACK

We welcome your feedback regarding the use and performance of our laser system. Product improvements and refinements come about from these contacts; continually improve our product reliability, performance and customer satisfaction.