User Manual

D2-200 DBR Laser Module

Revision 04

VESCENT

14988 W. 6th Ave., Suite 700
Golden, CO 80401
vescent.com

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1 Introduction

This manual contains information for operating the Vescent D2-200 DBR Laser Module. The D2-200 is a distributed Bragg reflector (DBR) diode laser that produces a near gaussian free-space output beam with a very low M^2 and exhibits mode hop-free tuning over more than 25 GHz.

This section has information for safely operating the D2-200. Please carefully read this section before using the D2-200. Section 2 introduces the user to the instrument and defines all hardware connections. Section 3 helps users immediately get started using the D2-200 in their application by showing an example of typical setup and operation. Section 4 contains further detail about the operation of the D2-200. Troubleshooting help can be found in Section 5. For further information, including product specifications, additional resource links, and warranty information, see the appendices.

1.1 Symbol Definitions

The following symbols may be encountered in this manual or on the device.

Symbol	Description
	Caution: Follow instructions to avoid injury or damage to equipment
	Caution: Risk of electric shock
	Caution: Laser beam
	WEEE: Separate collection for waste electric and electronic equipment is required
	Circle Indicator: Indicates relevant item in image
	Pointer Indicator: Points to relevant item in image

1.2 Safety





1. This instrument is intended for use by qualified personnel who recognize shock hazards and laser hazards and are familiar with the safety precautions required to avoid possible injury. Read the instruction manual thoroughly before use to become familiar with the instrument's operations and capabilities.



2. Never look directly into the laser aperture! Do not stare into the beam!



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



4. The Current Input port has a direct, unprotected connection to the DBR chip. Care must be taken to avoid ESD damage. The Current Input port should always be securely connected to a grounded laser controller or covered by a 50 Ω SMA terminator to avoid damage to the diode.



5. Never connect or disconnect the D2-200 Laser Module to/from an energized laser controller. Always power down the laser controller completely before making connections to the D2-200.



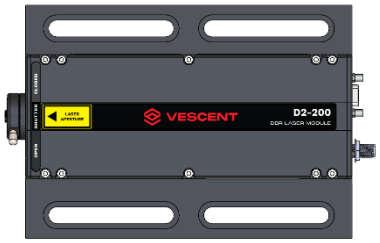
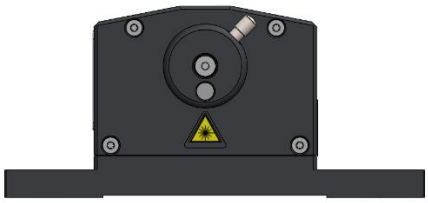
6. The D2-200 is not intended for fail-safe operation in hazardous environments or life-threatening situations. The user assumes full responsibility for correct and safe usage of the D2-200 in accordance with any applicable laws, codes, regulations, and standards pertaining to their specific application. Vescent is not liable for any consequential damage due to misapplication or failure of the D2-200.



7. There are no field-serviceable parts inside the instrument. Maintenance performed by persons not authorized by Vescent will void the warranty.

1.3 Affixed Labels

The following labels are affixed to the D2-200 housing.

<table>
<tr><th>Label</th><th>Location</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">Note: The Maximum Output and Emitted Wavelength will depend on the submodel of D2-200.</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">Points to the laser aperture on the front of the D2-200. Laser light emits in the direction of the arrow.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Warns the user about the laser emission hazard at the front of the D2-200.</td></tr>
</table>

2 Hardware

This section discusses the hardware features and connections of the D2-200 and the other items that are shipped with the unit.

2.1 Package Contents

The D2-200 is shipped in a package designed to provide excellent protection from shock and vibration experienced during shipping. The shipping box should be saved for future transportation or storage needs.

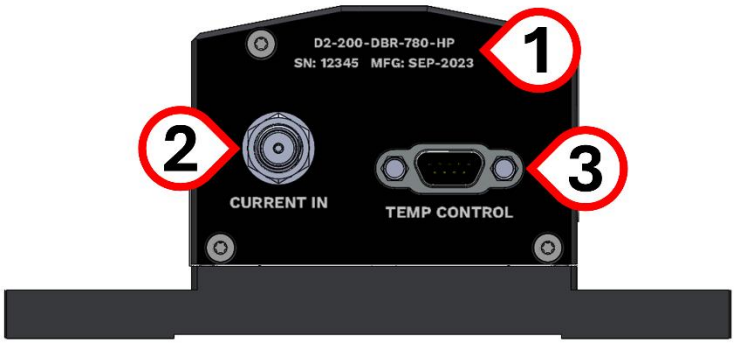
Carefully remove and inspect the following items that are contained in the shipping box:

- D2-200 DBR Laser Module
- 50 Ω SMA Terminator to protect diode (affixed to Current Input port)
- SMA male to SMA male Cable, 6-ft
- One of the following cables:
    - Micro-D to Hirose Cable, 6-ft (for connection to D2-105)
    - Micro-D to DB9 Cable, 6-ft (for connection to SLICE-DLC)
- One of the following sets of mounting hardware:
    - Four ¼-20 socket head cap screws and four washers
    - Four M6-1.0 socket head cap screws and four washers
- Final Test Documentation

2.2 Controls and Connections

This section introduces all the hardware controls and connection ports on the D2-200.

2.2.1 *Rear View*



1. Unit Information

Includes the model designation, serial number (SN), and manufacturing date (MFG). The model designation includes information about the laser wavelength and power. See the table below for complete details:

D2-200-DBR-λ λ λ(-HP)(/M)	
λ λ λ	Laser wavelength in nanometers, e.g. 780
-HP	If included, indicates high power variant
/M	If included, indicates the baseplate spacing is metric

2. Current Input Port (SMA)

Bias current is provided to the diode laser through the Current Input port. The central conductor of the SMA connects to the laser anode and the outer conductor connects to the laser cathode. The cathode of the diode is electrically connected to the case of the D2-200.

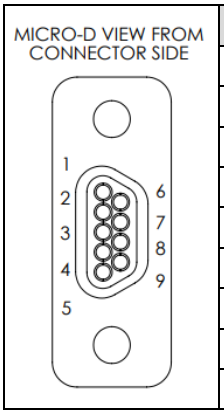
The Current Input port has a direct, unprotected connection to the anode of the DBR chip. Care must be taken to avoid ESD damage. The Current Input port should always be securely connected to a grounded laser controller or covered by a 50 Ω SMA terminator to avoid damage to the diode.

Never connect or disconnect the D2-200 to an energized laser controller. Doing so can cause irreparable damage to the diode laser. Always power down the laser controller completely before making connections to this laser.

3. Temperature Control Port (Micro-D)

The D2-200 has two temperature control stages: the housing stage (1) and the diode stage (2). Each stage has a thermo-electric cooler (TEC) that controls the temperature and an NTC thermistor (Rth) that monitors the temperature. A laser controller (e.g. D2-105 or SLICE-DLC) is required to stabilize the temperature of the D2-200.

The connections to the TECs and thermistors are made via a Mirco-DB9 connector on the rear of the D2-200. The pin assignments are as follows:



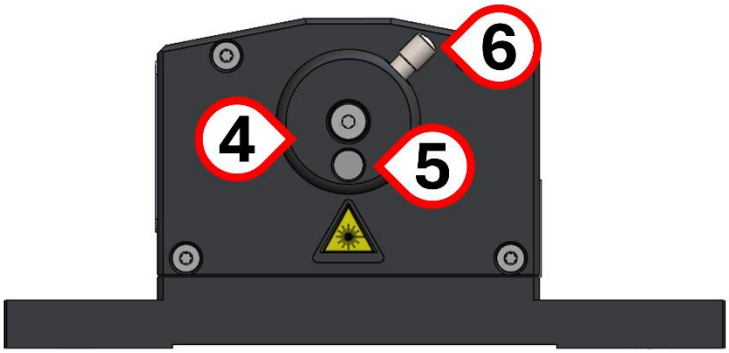
Pin	Signal
1	TEC1-
2	TEC1+
3	N/C
4	TEC2-
5	TEC2+
6	Rth1-RTN
7	Rth1
8	Rth2-RTN
9	Rth2+

Connecting the Temperature Control port to a Vescent laser controller requires one of the following cables:

Laser Controller	Cable
D2-105	Micro-DB9 to Hirose
SLICE-LC or SLICE-DLC	Micro-DB9 to DB9

Vescent provides one of these cables with your D2-200. Please discuss your cable needs with a Vescent representative when making a purchase.

2.2.2 Front View



Laser light is emitted from the laser through an aperture located on the front panel of the D2-200. Never view the laser from the above position.

4. Shutter

The D2-200 has a rotating manual shutter that features a laser aperture and control lever, each of which are described below.

5. Laser Aperture

The D2-200 has one laser aperture located on the front of the unit.



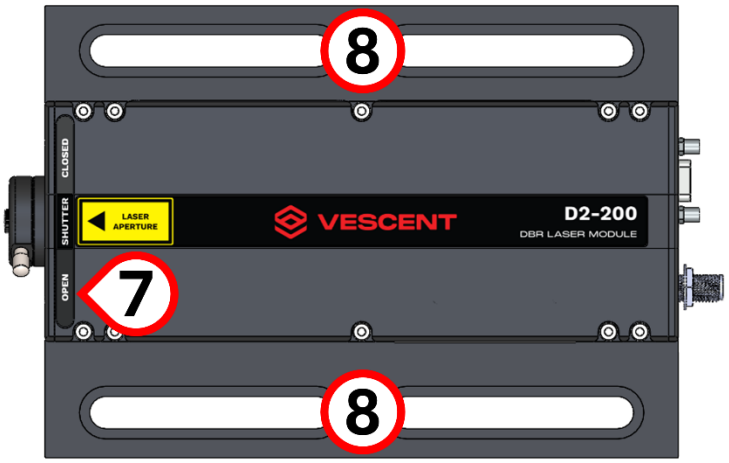
Laser radiation is emitted from this aperture. Never look directly into the laser aperture!

When the orientation of the aperture matches the image above, the shutter is open and laser light can be emitted from the aperture. When this aperture is rotated 90 degrees from this position, the shutter is closed and prevents the laser and collateral radiation from reaching the user.

6. Shutter Lever

To rotate the shutter, use the Shutter Lever. The state of the shutter can be determined by looking at the orientation of the Shutter Lever relative to the Shutter State Indicator (see below).

2.2.3 Top View



7. Shutter State Indicator

This indicator shows the user the current state of the shutter. When the shutter lever is aligned with OPEN, the shutter is open, and laser light can be emitted from the aperture. When the shutter lever is aligned with CLOSED, the shutter is closed, preventing laser emission and collateral radiation from reaching the user.

8. Baseplate Slots

The D2-200 comes with either an imperial or metric baseplate for mounting the unit to a matching optical breadboard. To mount the D2-200 to a breadboard, use the included cap screws and washers in the baseplate slots and securely fasten.

Securely fasten the D2-200 to a stable platform before using the laser.

3 Getting Started

This section explains typical use of the D2-200 DBR Laser Module for new users. A brief theory of operation is followed by an example of a typical setup and operation.

3.1 Theory of Operation

DBR laser diodes are fabricated with the feedback grating patterned directly adjacent to the gain region of the diode. The cavity of the D2-200 is short with no moving tuning element, making it highly immune to vibrations and acoustic perturbations.

The D2-200 has internal beam-shaping optics that significantly reduce the inherent astigmatism of the diode laser and produces a near gaussian output beam with a very low M^2. Additionally, optical isolation at the output prevents optical feedback into the diode.

The wavelength output of the D2-200 can be coarsely tuned by changing the temperature of the diode. The D2-200 employs two stages of temperature control. The first stage maintains the temperature of the housing (T1) and the second stage stabilizes the temperature of the laser diode (T2). Both stages utilize a TEC to control the temperature and a thermistor to monitor the temperature.

Current control allows for fine tuning and modulation. This tuning is very fast and is amenable to high-bandwidth servo control for easy locking to atomic or molecular transitions, optical cavities, or offset locking to a reference laser. For optimal performance the D2-200 should be connected to a stable current source (e.g. Vescent D2-105 or SLICE-DLC).

3.2 Typical Setup

The setup instructions in this manual refer to the Vescent D2-105 Laser Controller. If you are using another laser controller (e.g. Vescent SLICE-DLC), refer to that device manual for setup instructions.

To connect the D2-200 to a Vescent D2-105 Laser Controller, refer to the following instructions:

- Prepare a D2-005 Power Supply and D2-105 Laser Controller.
    - Note: The D2-005 can radiate observable line noise (50 or 60 Hz) on nearby instruments. Place the D2-005 at least 18 inches away from other instruments or on a separate shelf to remove this noise.
- Ensure the D2-005 Power switches (front and rear) are in the OFF position.

- Ensure the D2-105 Temp Lock switch is in the STANDBY position and the Laser switch is in the OFF/RESET position.
- Place the D2-200 on an optical table and within reach of the D2-105.
- Secure the D2-200 to the optical table with the provided screws.



- While taking care to avoid ESD damage, remove the 50 Ω SMA terminator from the Current In port on the D2-200 and connect the instruments according to the following table.

D2-005 ports	Cable	D2-105 ports	Cable	D2-200 ports
Power I/O	DB9 to DB9	Power I/O		
		Laser Current Output	SMA to SMA	Current In
		Laser Temp Output	Micro-DB9 to Hirose	Temp Control

- Use a power cable to connect the D2-005 to mains power.
- Place a 50 Ω BNC terminator on the D2-105 Remote Interlock port.

3.3 Typical Operation

To start D2-200 laser emission, follow these instructions.

3.3.1 Powering the Laser Controller

- Flip the D2-005 rear Power switch on.
- Flip the D2-005 front Power switch on.
    - The +5 V, +15 V, and -15 V LEDs on the D2-005 will light up.
    - The D2-105 will turn on and the Power light will light up.

3.3.2 Temperature Stabilization

If your D2-200 was purchased with a D2-105, then the D2-105 is set to the correct temperature settings for your laser. If your D2-105 was purchased separately, refer to Section 4 to configure the temperature settings.

- Flip the D2-105 Temp Lock switch to SERVO.

- The T1 and T2 Temp Status lights will turn green indicating the TECs have reached their final setpoint temperatures. This may take a few minutes.

3.3.3 *Setting the Current Limit*

- Turn the D2-105 Monitor selection knob until a red light appears under I_{lim}.
- In the supplied D2-200 test documentation, find the Maximum Current on the Laser Module table.



- Turn the D2-105 Current Limit Set knob to set I_{lim} at or below the Maximum Current. I_{lim} protects the diode from overcurrent by shunting excess current through a transistor to ground.

3.3.4 *Starting Laser Emission*



- Put on appropriate laser safety eyewear.
- Insert the Interlock key into the D2-105 Laser Enable lock and turn clockwise.
- Flip the D2-105 Laser switch on.
    - The D2-105 Laser On light will illuminate.
    - Note: there is an FDA-mandated 5 second delay before current starts flowing to the diode.
- Open the D2-200 Laser Shutter.
- Turn the D2-105 Monitor Selection knob until a red light appears under the Current Monitor, I.
- In the supplied D2-200 test documentation, find the Threshold Current on the Laser Module table.
- Turn the D2-105 Coarse Current knob until the Current Monitor value exceeds the Threshold Current.
    - Use an IR card or power meter to verify light is emitting from the laser.

4 Detailed Operations

This section provides additional detail about the operation of the D2-200.

4.1 Adjusting D2-105 diode temperature setting (T2)

If you are using a D2-200 with a D2-105 that was purchased separately, the diode temperature setting may not be set appropriately for spectroscopy. To adjust the diode laser setpoint temperature $T2_{SET}$, follow these instructions:

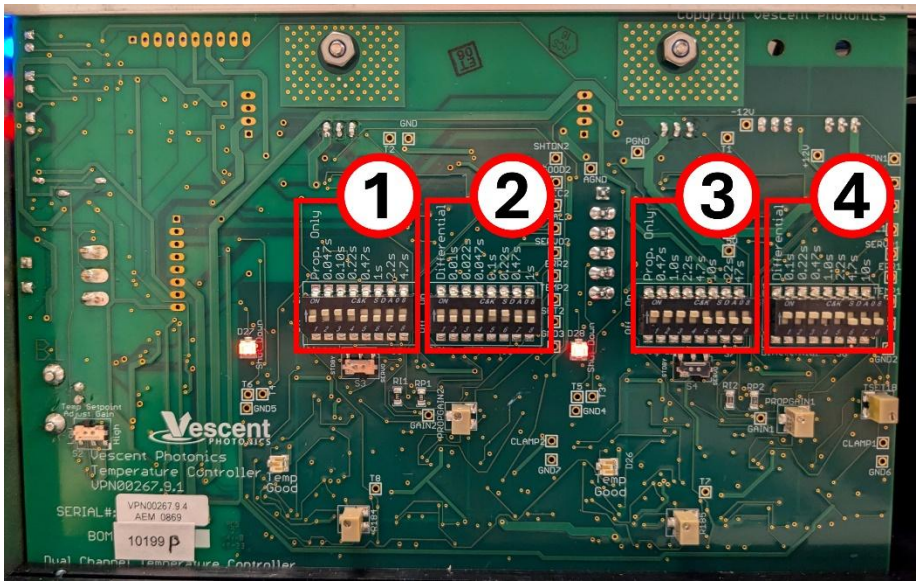
- Turn the D2-105 Monitor selection knob until a red light appears under $T2_{SET}$.
- In the supplied D2-200 test documentation, find the Laser Temp Setpoint under Spectroscopy Info.
- Use an Adjustment Tool to adjust the D2-105 T2 Set trimpot until the $T2_{SET}$ temperature is at the Laser Temp Setpoint.

The T1 setpoint should not need to be adjusted. If you wish to change the T1 setpoint, refer to the D2-105 manual.

4.2 Configuring D2-105 loop filter settings for a D2-200

If you are controlling the D2-200 with a D2-105 that has been configured for a different laser module (e.g. a D2-100), then the D2-105 loop filter settings will need to be updated. To configure the D2-105 for a D2-200, follow the instructions below.

- With the D2-105 off, open the right-side panel of the D2-105 by removing the 8 screws at the edge of the panel and sliding the panel off.
- Use the image below to locate the T2 DIP switches (1 & 2), T1 DIP switches (3 & 4).



- Use an Adjustment Tool to set the DIP switches according to the following tables.
  - T2 Proportional (1)

T2	Prop. On	0.047 s	0.1 s	0.22 s	0.47 s	1.0 s	2.2 s	4.7 s
On				X	X	X	X	X
Off	X	X	X					

  - T2 Differential (2)

T2	Prop. On	0.01 s	0.022 s	0.047 s	0.1 s	0.22 s	0.47 s	1.0 s
On					X	X	X	X
Off	X	X	X	X				

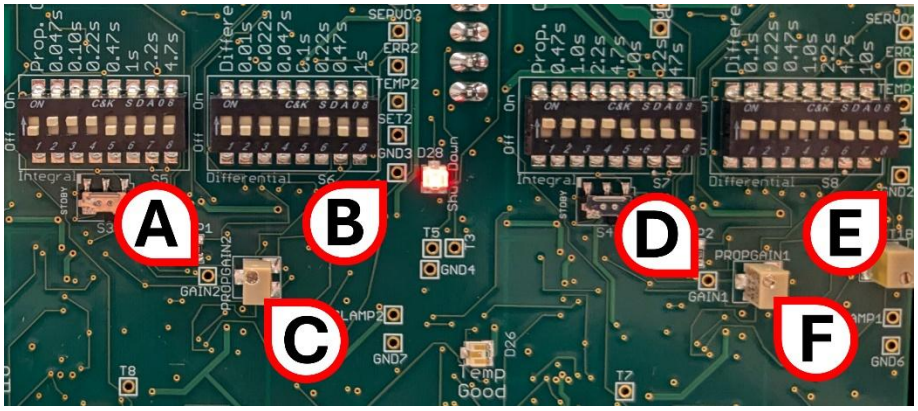
- T1 Proportional (3)

T1	Prop. On	0.047 s	0.1 s	0.22 s	0.47 s	1.0 s	2.2 s	4.7 s
On					X	X		
Off	X	X	X	X			X	X

- T1 Differential (4)

T1	Prop. On	0.01 s	0.022 s	0.047 s	0.1 s	0.22 s	0.47 s	1.0 s
On	X	X	X	X	X			
Off						X	X	X

- Use the image below to locate the GAIN2 test point (A), GND3 test point (B), and the PROPGAIN2 trimpot (C). Also locate the GAIN1 test point (D), GND2 test point (E), and the PROPGAIN1 trimpot (F).



- Use a multimeter to measure the resistance between test points GAIN2 and GND3. Use an Adjustment Tool to slowly tune the PROPGAIN2 trimpot until the resistance is 1000 ± 50 Ω.

- Use a multimeter to measure the resistance between test points GAIN1 and GND2. Use an Adjustment Tool to slowly tune the PROPGAIN1 trimpot until the resistance is 3500 ± 50 Ω.

- Close the right-side panel of the D2-105 by setting the panel in place and fastening it with the screws.

5 Troubleshooting

The following table describes issues that may be encountered while using the D2-200 and recommended actions to solve the problems.

Problem	Recommended Actions
Current is supplied to the laser, but the unit is not emitting light.	1. Check that the aperture lever is in the OPEN position. 2. Check that the current supplied to the diode exceeds its threshold current.
The temperature of the temperature stages is not stabilizing.	Check the loop filter parameters on the temperature control unit. See Section 4.2.

A Specifications

A.1 Optics

Parameter	Min.	Typical	Max.	Units
Center Wavelength		Model dependent. See model designation on the next page.*		nm
Maximum Output power		See test documentation provided with the laser.*		mW
Laser Classification		3B		
Linewidth		500		kHz
Beam Diameter ($1/e^2$)		0.9		mm
Beam Divergence			1.3	mrad
Beam Polarization		Horizontal		
Polarization Extinction Ratio	18			dB
Optical Isolation, standard model	38	40		dB
Optical Isolation, HP model	60	63		dB

** See the product web page for complete product offerings.*

A.2 Tuning

Parameter	Min.	Typical	Max.	Units
Temperature		1.5		nm
Current, mode hop free range	25			GHz

A.3 Temperature

Parameter	Min.	Typical	Max.	Units
Diode Thermistor, Resistance @ 25C		10		kΩ
Diode Thermistor, Beta		3892		K
Housing Thermistor, Resistance @25 C		10		kΩ
Housing Thermistor, Beta		3380		K
Operating Temperature, diode TEC	15	30	45	°C
Operating Temperature, housing TEC	15	25	30	°C

A.4 Dimensions

Parameter	Value	Units
Beam Height	0.95	in
	24.1	mm
Package Dimensions (L x W x H)	5.87 x 3.75 x 1.71	in
	149 x 95.3 x 43.5	mm

A.5 Environmental

Parameter	Min.	Typical	Max.	Units
Operating Temperature	15		30	°C
Operating Humidity			60	%
Environmental Dew Point			15	°C

A.6 Model Designation

D2-200-DBR-λ λ λ(-HP)(/M)	
λ λ λ	Laser wavelength in nanometers, e.g. 780
-HP	If included, indicates high power variant
/M	If included, indicates the baseplate spacing is metric

B Additional Resources

QR Code	Details
	Vescent Home https://vescent.com/ Additional resources are available at vescent.com

C Service & Maintenance

The D2-200 is designed to be maintenance free. No user-serviceable parts are inside the unit. No further calibrations are necessary for the D2-200 to meet its accuracy specifications over the lifetime of the product. Opening the instrument case voids the warranty and exposes the user to hazardous voltages that are present inside the instrument case.

Cleaning instructions: Do *not* clean outside surfaces of any Vescent products with solvents such as acetone.

For service or repairs:

1. Contact Vescent customer service via telephone at (+1) 303-296-6766, online at www.vescent.com/contact, or via email at info@vescent.com. Customer service will determine if the equipment requires service, repair, calibration, or replacement. Factory office hours are 9:00 am-5:00 pm MST.

2. If the unit must be returned to Vescent, ask for a Return Merchandise Authorization (RMA) from customer service. **Never send any unit back to Vescent without a completed Return Merchandise Authorization (RMA).**

3. Reinstall the 50 Ω SMA terminator onto the Current Input port. **The warranty of any unit that returns to the factory without this terminator may be voided.**

4. Pack the unit in its original shipping material (if possible) with at least 1 inch of compressible packing material on all sides. Be sure to include an ownership tag and enter a description fully detailing the defect and the conditions under which it was observed on the RMA form.

5. Return the unit, postage prepaid, to Vescent. Do not forget to return a hard copy of the completed RMA form with the unit and write the RMA number on the shipping label. Vescent will refuse and return any package that does not bear an RMA.

6. After repair, the equipment will be returned with a repair report. If the equipment is out of warranty but operates within specifications, a test set-up fee will be charged to the customer. If the equipment is not under warranty, the customer will be invoiced for the cost appearing on the repair report.

7. Vescent is responsible for shipping the unit back to the customer if the unit is under warranty. **Shipping damage is not covered by this warranty,** and shipping insurance, which Vescent recommends, is at the customer's expense.

D Warranty

Vescent hereby warrants to Buyer, that during the applicable Warranty Period (as defined below) the Products will conform to Vescent's published specifications and will be free of defects in materials or workmanship when used, installed and maintained in accordance with Vescent's published specifications. Vescent's sole liability and Buyer's sole and exclusive remedy for breach of warranty shall be limited to, at Vescent's option, either repairing or replacing the defective components of the Product or crediting Buyer for the amount Buyer has paid to Vescent for the applicable Product. Vescent's liability shall apply only to Products which are returned to the factory or authorized repair point, with shipping charges prepaid by Buyer, and which are, after examination, determined to Vescent's satisfaction to be defective due to defects in materials or workmanship. Vescent will only accept returns authorized by a Vescent customer service representative and with a valid RMA number. This warranty does not apply to Products which are designated by Vescent as "Pre-Production Products", e.g. Alpha, Beta or Prototypes or are Products which have been repaired or modified without Vescent's written approval, or subjected to unusual physical, thermal, optical or electrical stress, improper installation or cleaning, misuse, abuse, accident or negligence in use, storage, transportation or handling. The "Warranty Period" during which this warranty applies varies with Product type as follows:

a. For standard Vescent lasers in which a counter is incorporated (i.e. lasers with counters for which Vescent has published a datasheet and which have not been obsoleted by the time of order placement): one (1) year after the date of original shipment or 3,000 hours of use, whichever occurs first;

b. For standard Vescent products other than lasers with counters, (i.e. products for which Vescent has published a datasheet and which have not been obsoleted by the time of order placement): one (1) year after the original shipment;

c. For any other Product including, without limitation, all product types as set forth in sections a. and b. of this clause 5 which are in any way customized, build-to-order, otherwise non-standard and/or are subject of a blanket purchase order: one (1) year after the date of original shipment unless otherwise agreed to in writing on a case by case basis. If, in relation to any Product Vescent offers as an additional purchase option, a warranty period over and above that which is set out in sections b. and c. of this clause 5 ("Extended Warranty") and Buyer exercises such option then the Warranty Period shall be the duration as specified on such Extended Warranty commencing on the date of original shipment. Any Extended Warranty option is only available at the time of and on the same order as the original Product purchase.

d. For any non-warranty Product that has been repaired, Vescent will extend the applicable Warranty Period by sixty (60) calendar days for the specific characteristic of the Product that is repaired by Vescent. Other characteristics of the non-warranty Product will remain uncovered by any warranty.

e. For Products that are discontinued, Vescent's liability shall terminate at the end of the applicable Warranty Period or one (1) year from the date of discontinuity, whichever occurs first.

f. Except for the warranty stated herein and to the extent permitted by applicable law Vescent specifically disclaims any and all warranties, express or implied, including, but not limited to, any warranties of merchantability, fitness for a particular purpose, or noninfringement.

EU Declaration of Conformity

In accordance with EN ISO/IEC 17050-1:2010

This declaration is issued under the sole responsibility of the manufacturer.

Manufacturers Name:	**Vescent Technologies, Inc.**
Manufacturers Address:	14998 W. 6th Ave., Suite 700 Golden, Colorado 80401 U.S.A.
Product:	**DBR Diode Laser Module**
Product Model Family:	**D2-200-DBR**

Product Model Numbers: D2-200-DBR-795, D2-200-DBR-767, D2-200-DBR-770, D2-200-DBR-780, D2-200-DBR-780-HP1, D2-200-DBR-795-HP1, D2-200-DBR-852, D2-200-DBR-852-HP1, D2-200-DBR-895-HP1

The object of the declaration described above is in conformity with the relevant Union harmonization Legislation:

Application of Council Directives:

RoHS 2	2011/65/EU, 2015/853/EU

Standards:

RoHS 2 Technical Documentation	BS EN IEC 63000:2018
Safety of Laser Products	IEC 60825-1:2014

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.

Location: Golden, Colorado
Date: 03/13/2025

Signature: _____
Full Name: Scott Rommel
Title: COO