



***Operator's Manual
FACH-450-10W-FC105 Fiber-
coupled Blue Diode Laser***



Preface

This manual describes the safety, installation, operation, and service of the fiber-coupled blue diode laser module, particularly for the model **FACH-450-10W-FC105**.

The fiber-coupled blue diode laser module directly emits laser radiation that can permanently damage eyes and skin, ignite fires, and vaporize substances. The Laser safety section contains information and guidance about these hazards. To minimize the risk of injury or expensive repairs, carefully follow these instructions.

The Service and repair section is intended to help guide you to handle the source of problems. Do not attempt repairs while the unit is under warranty; instead, report all problems to **FLC** for warranty repair.

Do not open the factory packaging before carefully reading this complete operation and maintenance manual. If you have any questions on the product which have not been discussed sufficiently within the manual, contact the manufacturer for complete instructions. Failure to heed this warning may result in the destruction or serious damage to the device, and will void the product warranty.

Laser safety

Please read this section carefully before installing or operating your fiber-coupled blue diode laser module.

According to the U.S. FDA Center for Device and Radiological Health (CDRH) and international IEC60825-1-2007, **FLC** fiber-coupled blue diode laser module creates a Class IV high power laser, whose beam is a safety hazard.

Avoid eye or skin exposure to direct or scattered laser radiation. Avoid direct viewing of the beam or its specular reflection. When energized, a large amount of high power visible laser radiation is emitted from the laser module.



Warning label

We recommend the use of protective eyewear at all times. The protection goggles should have an optical density (OD) 4 or higher at wavelength of 440-460nm. Please check with ANSI, ACGIH, or OSHA standards for guidance.

Precautions for safe operation of Class IV Lasers

- Never look directly into the laser beam or at specular reflection, even with protective goggles on.
- Always wear laser safety goggles that is appropriate for the output power at the wavelengths of operation (440-460 nm).
- Set aside a controlled-access area for laser operation; limit access to those trained in the principles of laser safety.

- Post readily readable warning signs in prominent locations near the laser operation area.
- Restrict access to laser areas to those who have been instructed in the necessary safety precautions.
- Enclose beam paths wherever possible.
- Set up experiments so the laser beam is below eye level.
- Work in an area that is well lit to avoid dilation of pupils.
- Set up a target for the beam.
- Set up shields to prevent reflected beams from escaping the laser operation area.
- Insure that all electrical connections are made in a safe manner.
- Where possible, position equipment so that electrical connections are shielded from accidental touch.
- No smoking, eating, or drinking should be allowed in laser areas.
- Never leave an operating laser unattended.

Introduction

The fiber-coupled blue diode laser module is designed as a direct diode laser, coupled into a 105 μ m core diameter fiber with high brightness output. The laser has center wavelength of 450nm. This laser could be suitable for various industrial, medical and scientific applications, including laser marking, materials processing, micro soldering, laser display/projector, 3D printing, soft tissue ablation, and Ti:sapphire laser pumping.

Description

The model **FACH-450-10W-FC105** fiber-coupled blue diode laser module consists of 9 single emitter blue diodes lasers made by Osram. All single emitter diodes are electrically connected in serial. After beam shaping and spatial multiplexing, all 9 beams are combined and coupled into a silica fiber with core diameter of 105 μ m and number aperture (NA) of 0.22.

Our unique optical and mechanical design allows the module very compact. The mechanical dimensions are 215mm (8.46") L x 66mm (2.16") W x 29.5 mm (1.16") H.

Cooling water

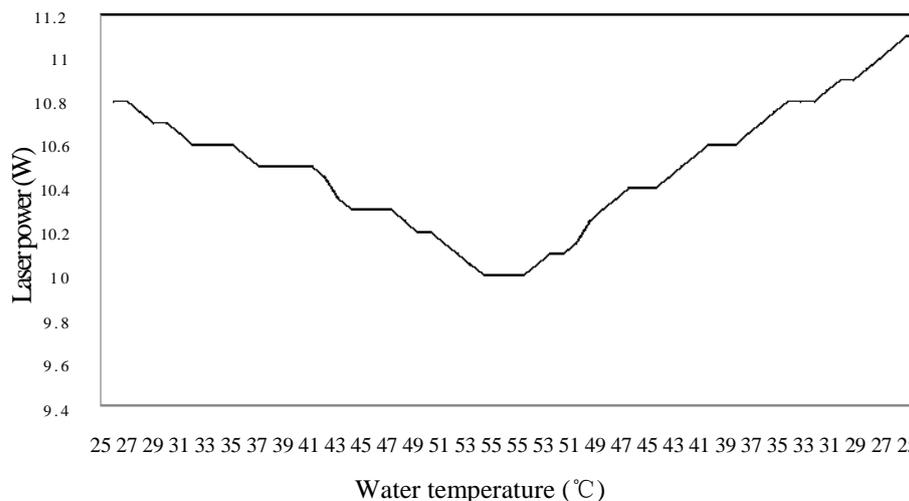
Module **FACH-450-10W-FC105** requires water cooling to operate properly. We recommend to use clean water, like distilled water to cool the module. There are two quick connectors on the module for water tubes. Water flow direction is not polarized. Either connector can be used as an inlet or outlet. The water tube must have an outer diameter (OD) of 6mm. For better operation, we recommend to have a water filter connected into the cooling system.

The module is designed to operate with cooling water temperature below 30°C and flow rate of 3 - 5L/min. Heat dissipation for a single module may less than 60W at 1.3Amps operating current. Please make sure your heat management / chiller can dissipate at least 60W for each module.

Temperature characteristics

As all other diode lasers, the fiber-coupled blue diode laser center wavelength and output power are temperature depended. For every 10 degrees of centigrade temperature increase (or decrease), the center wavelength has red shift (or blue shift) about 0.6nm. For optimum operation, we recommend the cooling water temperature is between 5°C -25°C. Higher water temperature may cause output power decrease. The figure bellow shows the laser output power drops close to 8% when cooling water temperature increases from 25°C to 55°C, then recovers to normal level when cooling water temperature goes back to 25°C.

Output power temperature characteristics



Laser output power varies as cooling water temperature changing at 1.3A operating current

Specifications

Technical Specifications		
Optical Specifications		
CW Output Power	10	W
Center Wavelength	450	nm
Center Wavelength Tolerance	±10	nm
Spectral Width (FWHM)	<15	nm
Beam Divergence	0.22	NA
Beam Diameter (µm)	105	µm
Electrical Characteristics (typical)		
Power Conversion Efficiency	>18	%
Threshold Current	0.2-0.3	A
Operating Current @ 10W	1.2-1.5	A
Operating Voltage @ 10W	43-45	V
Recommended Hookup Wire	18 or heavier	AWG
	0.8 or heavier	mm ²
Thermal Specifications		
Water temperature	+20 to +25	°C
Environmental Temperature	+15 to +30	°C
Storage Temperature	+5 to +60	°C
Mechanical Specifications		
Dimensions (LxWxH)	215 x 66 x 29.5	mm
	8.46 x 2.60 x 1.16	inch
Weight	650	gram
Fiber core diameter	105 or larger	µm
Fiber numeric aperture	0.22 or lager	NA
Fiber connector	SMA-905	

Each module has been tested before shipping. A test data sheet of P-I-V is attached with each module. All test are performed at water temperature and environmental temperature of 25°C.

Installation and operation

The following is the step-by-step procedure detailing the installation and operation of the fiber-coupled blue diode laser module.

Do and do not

The **FLC** fiber-coupled blue diode laser module was carefully packed for shipment. If the carton appears to have been damaged in transit, please contact the shipper's agent and **FLC** when you unpack.

Caution

The module is susceptible to damage due to electro-static discharge (ESD). Always use proper ESD control devices when handling the module.

Electro-static discharge (ESD) that would up to several thousand volts during operation and use, damage the diode laser easily. Thus, the module should be protected from ESD when any operator and equipment using it.

Caution

Do not open sealed package until package has normalized to room temperature. Condensation can seriously damage the diode lasers in the blue laser module and may void warranty.

Unpacking your Module

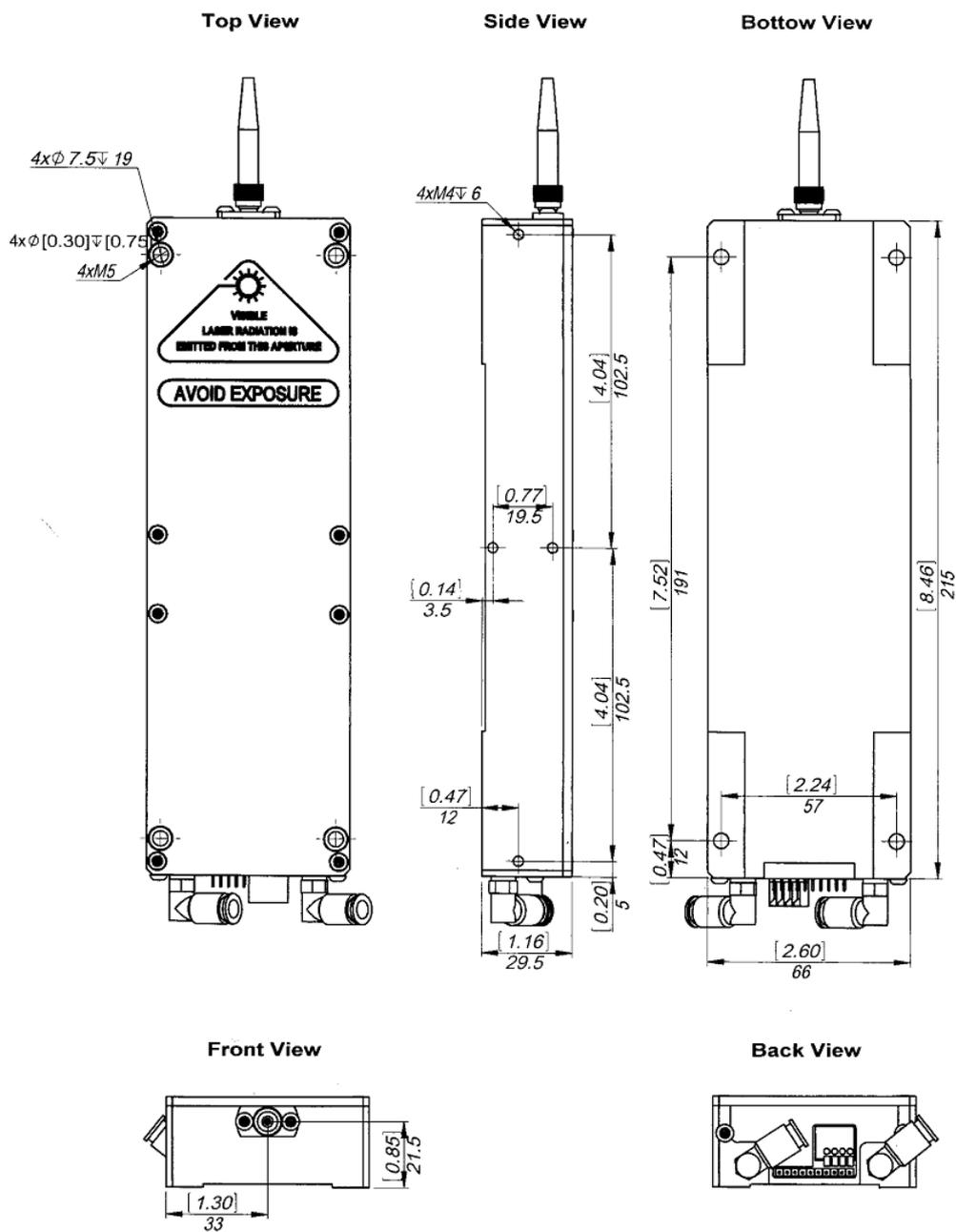
Before you unpack the package, the fiber-coupled blue diode laser module should be kept at least for 4 hours in the room where that will be opened to achieve thermal equilibrium, until the inner temperature equal to the environment. Recommend operational environment: condensation 10%~70%, temperature 15 - 30°C.

Inspect the unit as you unpack it, looking for dents, scratches, or other evidence of damage. If you discover any damage, immediately file a claim against the carrier and notify the **FLC**.

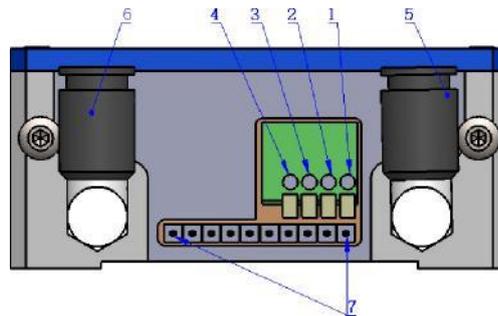
Keep the shipping container. If you file a damage claim, you may need it to demonstrate that the damage occurred as a result of shipping. If you need to return the unit for service, the specially designed carton assures adequate protection. A final test report should accompany each unit shipped.

Installation and connections

1. Use four screws to mount the module to the place you want.
The following figure is the mechanical drawings, showing positions of the screws. Unit is in millimeter [inch].



2. Make sure the AC power switch located on your diode laser controller is in the OFF position.
3. Connect two water tubes (6mm OD) to inlet and outlet, respectively to your chiller or a water flow heat dissipater. We recommend a water filter attached between the chiller and the laser.
4. Your chiller should be operated at proper temperature and flow rate. Minimum water flow is 3 liters per minute and optimum water temperature will be between 20-25 °C.
5. Water connectors and electrical pins are located on the back panel, as shown below. Please refer each connector / pin definition to connect your cooling water and electrical power supply.



No.	Definition
1	Laser diode (+)
2	Laser diode (-)
3	PT1000 (A)
4	PT1000 (B)
5	Flow In/Out
6	Flow In/Out
7	Test port pins (not used for normal operation)

6. Connect your diode laser driver or DC power supply to the module Pin 1 (positive) and Pin 2 (negative), accordingly. To support necessary electrical current for normal operation, we recommended the hookup copper wire cross-section area should have at least 0.8mm² or 18 AWG.
7. To protect the laser module, we recommend connect your temperature readout (for PT1000) to the Pin 3 and Pin 4.

Warning

The operation voltage will be approximately to 50VDC. If it exceeds 50VDC, operator should be careful to avoid electric shock.

Don't connect the positive to the negative pin. We DO NOT have a reverse bias protection inside the diode laser module.

Pin 7 has 10 individual pins for factory testing/ debugging purpose. Do not use Pin 7 during your normal operation.

8. Connect your SMA905 connector tightly to the module.

Warning

Not tight enough SMA connection may cause SMA connector to be damaged by the blue diode laser. We strongly recommend ceramic ferrule for the fiber SMA905 connector to the module.

9. Connect the other end of your SMA905 fiber to your workstation or laser power meter.

Turn on the laser

1. Turn on your chiller. Please make sure your chiller temperature and water flow rate are appropriate.
2. We recommend an interlock connected to your chiller. Before applying electrical power to the module, shut off chiller to verify if the interlock works.

Warning

Chiller must be turned on before applying electrical power to the module.

Turn on your diode laser controller / DC power supply.

Please make sure the applied DC voltage and current are appropriate according the module specifications.



Warning

The output laser beam has a safety hazard. Avoid direct viewing of the beam or its specular reflection.

Turn off the laser

1. Decrease operating current to 0.0Amp.
2. Switch the main AC power switch of your diode laser controller / DC power supply to the OFF position.
3. Allow chiller to run for a couple of minutes.
4. Turn off your chiller.

DC power requirements

The approximate diode bias voltage for the FACH.459.19W-FC105 fiber-coupled blue diode laser module is between 43.5VDC to 46VDC at 1.5Amp. The final test sheet shipped with the module has its individual P-I-V data. FLC recommends users not exceed the current of 1.5Amp, since overdriving the module may significantly reduce diode lifetime.

Protection

We recommend to use close-loop diode laser controller / DC power supply with over-current and over voltage protection, with which electrical power may immediately shut down when over-current or over-voltage alarms.

We recommend to connect the module's PT1000 temperature sensor to a temperature readout interlock, then further connect to

your diode laser controller / DC power supply. Please set the alarm temperature to 55 °C. Electrical power may immediately shut down when cooling water temperature is above 55 °C.

Temperature sensor

Each module has a temperature sensor inside. The sensor is a PT1000 (Class B). You can connect the Pin 3 (PT1000A), Pin 4 (PT1000B) to your temperature readout. The temperature can be read by means of the resistance of the thermocouple, as shown below. For example, the PT1000 resistance is 1213.21 Ω at 55 °C.

°C	0	1	2	3	4	5	6	7	8	9
0	1000.00	1003.91	1007.81	1011.72	1015.62	1019.53	1023.43	1027.33	1031.23	1035.13
10	1039.03	1042.92	1046.82	1050.71	1054.60	1058.49	1062.38	1066.27	1070.16	1074.05
20	1077.94	1081.82	1085.70	1089.59	1093.47	1097.35	1101.23	1105.10	1108.98	1112.86
30	1116.73	1120.60	1124.47	1128.35	1132.21	1136.08	1139.95	1143.82	1147.68	1151.55
40	1155.41	1159.27	1163.13	1166.99	1170.85	1174.70	1178.56	1182.41	1186.27	1190.12
50	1193.97	1197.82	1201.67	1205.52	1209.36	1213.21	1217.05	1220.90	1224.74	1228.58
60	1232.42	1236.26	1240.09	1243.93	1247.77	1251.60	1255.43	1259.26	1263.09	1266.92
70	1270.75	1274.58	1278.40	1282.23	1286.05	1289.87	1293.70	1297.52	1301.33	1305.15
80	1308.97	1312.78	1316.60	1320.41	1324.22	1328.03	1331.84	1335.65	1339.46	1343.26
90	1347.07	1350.87	1354.68	1358.48	1362.28	1366.08	1369.87	1373.67	1377.47	1381.26
100	1385.06	1388.85	1392.64	1396.43	1400.22	1404.00	1407.79	1411.58	1415.36	1419.14

Unit: Ω, Precision: Class B, $\Delta t = \pm (0.30 + 0.005 * t)$

Storage

Proper storage of the fiber-coupled blue diode laser module involves three steps:

1. Empty all water from module by blowing compressed dry air through it for at least two minutes.
2. Electrically shorten Pin 1 and Pin 2.
3. Store module in a clean, dry atmosphere in a temperature range of 5°C up to 60°C and relative humidity less than 30%. If necessary, place module in a sealed bag with some form of desiccant.

Service and repair

The fiber-coupled blue diode laser module has been designed to provide trouble-free operation with minimal maintenance. We offer standard 12 months limited warranty to this module. If you have any problems when using this product, please contact us will offer all necessary service, repair or replace.

Return for repair

Empty all water from module by blowing compressed dry air through it for at least two minutes, prior to packaging for shipment. Place a shorting connector across the electrical connectors Pin 1 and Pin 2. Please put the laser module into a sealed bag. Please use the original packing box or similar box to ship.