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CUSTOMIZED FIBER-COUPLED IR LASER SOURCE

MODEL QTFS-1060-LD/LD-05IR

Instruction Manual

- **Please read the entire manual prior to use**
- **Please keep this manual with LD-05IR**

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CLASS IIIB laser product

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QPHOTONICS, L.L.C.

LASER DIODES: LARGER SELECTION FOR FAST DELIVERY

1. Safety Information and Instructions

This manual contains operating and maintenance instructions for the LD-05IR medium power Infra-red single-mode fiber coupled laser source. Please review this manual carefully before operating.

1.1 Safety Information

The following safety instructions must be observed whenever LD-05IR infrared spectra laser source is operated, serviced or repaired. Failure to comply with any of these instructions or with any precaution or warning contained in the User's Manual is in direct violation of the standards of design, manufacture and intended use of the instrument. The QPhotonics, LLC. assumes no liability for the customer's failure to comply with these safety requirements.

1.2 Safety Messages

The following messages may appear in the User's Manual. Please observe all safety instructions that are associated with this message.

WARNING	**The procedure can result in serious injury or loss of life if not carried out in proper compliance with all safety instructions. Ensure that all conditions necessary for safe handling and operation are met before proceeding**
CAUTION	**The procedure can result in serious damage to or destruction of the instrument if not carried out in compliance with all instructions for proper use. Ensure that all conditions necessary for safe handling and operation are met before proceeding**
	**Refer to the User's Manual for instructions on handling and operating the instrument safely.**

Please contact QPhotonics, LLC. (www.qphotonics.com) with any questions related to any subjects described within this manual.

In no case will QPhotonics, LLC. be liable to the buyer, or to any third parties, for any consequential or indirect damage, which is caused by product failure, malfunction, or any other problem.

1.3 WARNINGS and CAUTIONS

WARNING
In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.
Laser source must be unpacked at ESD protected work station
Use only the cords provided with LD-04 modules and original wall plug power supply. Using inappropriate cords or extending the cords may cause them to heat up abnormally and may cause fire.
Do not look into a fiber or optical connectors of LD-05IR laser module during operation. Wearing appropriate protection goggles is required. Do not expose skin to laser radiation. This is Class IIIB laser product.
Never touch the output fiber connector when LD-05IR is powered on. Doing so may cause device damage and represents serious hazard for your health.
Do not operate equipment, which may generate high frequency surge energy near LD-05IR laser source or power supply.
Do not disassemble the instrument. The LD-05IR modules contains no user serviceable parts.
Turn the laser safety key switch “OFF” and power control knob to “Minimum” position before connecting instrument MAINS. Not doing so will cause device damage.
Avoid soaking the LD-05IR modules with water or any other liquids and operating instrument in high humidity environment. Doing so may cause fire, electrical shock or malfunction.
Do not use inappropriate MAINS voltage (currently it is only 110 V, 60 Hz). Doing so may cause fire, electrical shock or malfunction.
Do not insert or drop any metal or any flammable material into any modules of LD-05IR through any aperture. Doing so may cause fire, electrical shock or malfunction.
Do not remove any screws and panels of LD-05IR modules. Some parts generate high voltage. Removing screws and panels may cause electrical shock.
If abnormal sounds or extra high temperatures are observed, turn off the power, disconnect the power cords and contact QPhotonics, LLC. Continuing to operate under these conditions may cause fire or electrical shock.

Do not use a damaged power cord where the inner cable is exposed or severed. Doing so may cause fire or electrical shock.
If water or any other liquid is spilled into any modules of LD-05IR, turn off the laser power switch, disconnect power cords and contact QPhotonics, LLC. Continuing to operate under these conditions may cause fire or electrical shock.
If smoke or strange smells are observed turn off the power switch, disconnect power cords and contact QPhotonics, LLC. Continuing to operate under these conditions may cause fire or electrical shock.
If any modules of LD-05IR are dropped and damaged, turn off the power switch, disconnect power cords and contact QPhotonics, LLC. Continuing to operate under these conditions may cause fire or electrical shock

CAUTION
Do not place LD-05IR on an unstable or inclined surface. There is a possibility that instrument modules will fall and cause injury.
Disconnect all cords when moving LD-05IR Failure to do so may damage the cords, which may cause fire or electrical shock. Follow standard static safety precautions, when moving device.
Do not place the electrical or optical cords around any heating instrument. Doing so may damage the cords, which may cause fire or electrical shock.
Do not connect or disconnect electrical cords with wet hands. Doing so may cause fire or electrical shock.
Do not pull electrical cords to disconnect. Doing so may damage the cords, which may cause fire or electrical shock. Hold the plug portion and disconnect the cords.
Do not put heavy items on the cords. Doing so may damage the cords, which may cause fire or electrical shock.
Do not modify the cords and do not over-bend, over-twist, or over-stretch the cords. Doing so may damage the cords, which may cause fire or electrical shock.
Ensure that the cords are disconnected when storing LD-05IR. Ensure that optical connector on laser module is closed with cap when not in use or when storing.
Do not bend optical patch-cord. Doing so might damage patch-cord fiber or results in reduction of optical power.

Do not bend optical patch-cord. Doing so might damage patch-cord fiber or results in reduction of optical power.
Store LD-05IR in a cool dry place
Use **only APC** optical adapter/connector to extend the length of LD-04 patch-cord fiber. *Perform optical connections only when device is powered off.* Try to avoid unnecessary disconnections, if possible. Keep optical connectors protected with provided caps when the laser module is not in use.

POWER REQUIREMENTS

The LD-05IR can operate from any single-phase AC power source that supplies between100 and 120 V at a frequency of 50-60 Hz. Please check instrument power supply voltage rating before connecting to the power source.

1.4 CORDS.

The power supply module of LD-05IR uses a three-wire power cords.
Connection between the laser module and external interlocking circuits is performed using the wire cord #2, having RCA connector. Use RCA connectorized 2 wire cords to connect device to external “ON/OFF” remote control signal source.

1.5 TOXIC HAZARDS

Under normal conditions of use, storage and handling the LD-05IR modules presents no toxic hazards. However, under the following conditions, certain precautions are necessary.

1.5.1 INCINERATION

Some of the electronics components and parts of enclosures are containing resins and other chemicals that can produce toxic fumes during incineration.

1.5.2 ACIDIC OR CAUSTIC COMPOUNDS

Some of the electronics components included in the assembly, particularly electrolytic capacitors, contain acidic or caustic compounds. In the event that damaged component come in contact with the skin, wash the affected area immediately with cold water. In the event of eye contamination, irrigate thoroughly with recognized eyewash and seek immediate medical assistance.

1.5.2 PHYSICAL DAMAGE

Some of components used in assembly may contain very small quantities of toxic materials. There is remote possibility that physically damaged electronic components may present a toxic hazard. As a general precaution, avoid unnecessary contact with

damaged electronic components and arrange for disposal in accordance with local regulations.

2. General Information

LD-05IR is a medium power customized fiber-coupled laser source, operating at typical wavelength of 1055-1075 nm, designed for different laboratory applications demanding medium-power laser. Light from LD-05IR is delivered using a single mode fiber output with FC/APC connector and can be perfectly collimated or focused at different distances using optional compact fiber lens collimator (Model-014, Model 011 and Model 015)

Laser source has internal temperature control and current drive circuits, power controller and passive air- cooling system. Optional accessories allow coupling laser light to optical fibers, having different optical core diameter, laser light polarization control. Internal monolithic laser resonator provides good short- and long-term wavelength *stability*, low sensitivity to *vibrations* and good laser power stability, significantly improving signal-to-noise ratio of optical sensing and optical test/measurement systems.

3. Specifications and Components

a. Standard Specifications

Description	Min	Typical	Max	Unit
Operating wavelength	1055	1065	1075	nm
Output power		5	*	mW
Output connector		FC/APC		
Power consumption	35	45	55	VA
Electrical	100	110	120	V
Dimensions		280 x195x 40		mm
Operating temperature	0	23	35	^{o}C
Storage temperature	0	25	65	^{o}C
Humidity (non-condensing)			85	%R.H
Number of outputs		1		

Spectral width (FWHM)	0.3	3.5	12.0	nm

3.2 Components

Part	Part Number	Quantity
LD-05IR laser module	LD-05-01/ QFLD-1060-10S	1
User's Manual	QTFS-1060-LD	1
Optional components		
Power cord	LD-05_PC 1	1
Cable 2 (connection to interlock)	LD-05-C2	1
Cable 3 (connection to external remote circuits)	LD-04-C3	1
Optical fiber collimator	Model -014	1
Polarization controller	FPC-01	1
FC/APC connectorized extension patch-cord	LD-05-O-01	1
FC/APC adapter	LD-05-O-02	1
FC/APC-to-FC/PC cross-connection patch cord	LD-05-03	1
"Bulet" bare fiber adaptor	BULET	1
Ultra-splice bare fiber connector	US	5
Ball-type lensed fiber	BLx	6

* Higher output power model can be developed on request.

Recommended consumables

It is recommended to keep the following items with the LD-05IR:

- Protective eye glasses
- IPA and lint-free tissue
- APC connector's cleaner

Fiber inspection microscope

4. External description

4.1 Laser source module LD-05

Front view. Side view Back view

- **Laser source module** is shipped to end-users assembled as shown in the Figure above. The assembly consists of the LD-05IR module with high-quality FC/APC connectorized fiber pigtail. Front and back panels of the laser source module are made from dielectric material, partially coated with conductive foil. Electrical connection between the laser source module and the Main's is performed using standard 3 pin mains cable through connector mounted on the back of the laser source. Security key and laser operation mode selection switch are used to enable laser source. When security key turned clock-wise (white dot), laser is enabled. Laser source output power is controlled using single (or 10) turn knob, positioned at the front panel of the module. Two lamps on the front panel are indicating normal operation of the TEC and semiconductor laser. Operation of the laser in local or remote control mode (optional) is selected using two positions switch at the front panel.

FRONT PANEL:

Laser source module (LD-05IR) controls are:

(1) Indicate operation of the laser TEC (green LED "TEC")

(2) Laser enable/disable safety key (OFF/white dot)

(3) Switch laser power OFF/MAXIMUM/control (3 posit switch "REG/OFF/MAX")

(4) Select laser control Local-Remote (opt.) ("LOC/REM")

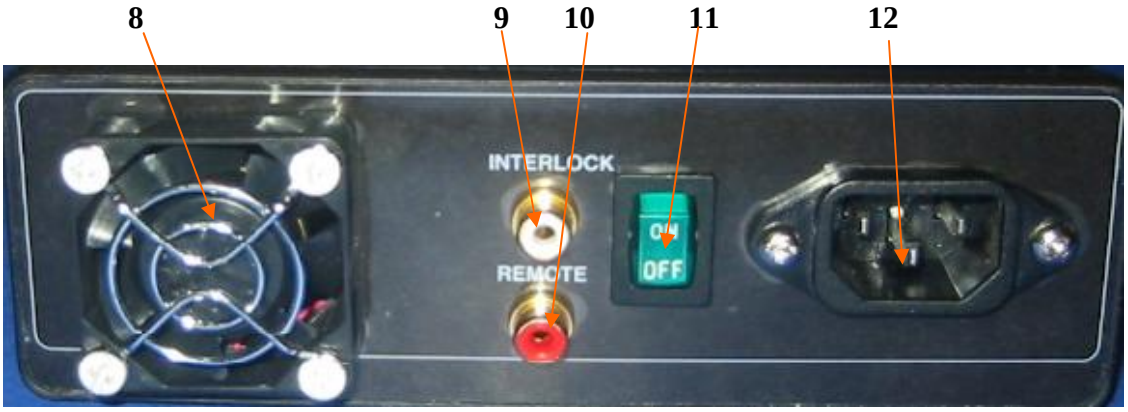
(5) Indicate that laser is "ON" (green LED "LASER ON")

(6) Regulates laser output power (knob "POWER")

(7) Output fiber pigtail ("OUTPUT")

- Switch power on/off (back panel) ("2 position switch")

BACK PANEL



(8) Air cooling fan (intake)

(9) Connection to INTERLOCK circuits ("INTERLOCK")

(10) Remote control signal input ("REMOTE")

(11) Switching "On/Off" module power supply ("ON/OFF" switch)

(12) Connect module power supply to 110 V (using cable 1)

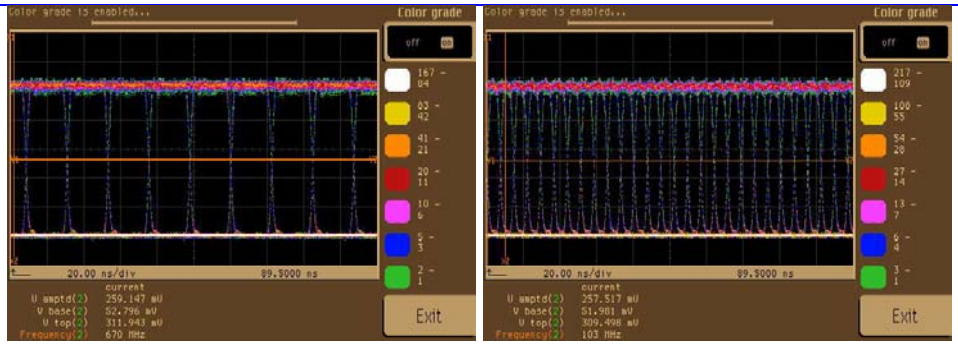
4.2 Optional modules/components

REMOTE laser power "ON/OFF" control. LD-05IR can be equipped with laser power remote "ON/OFF" control input. Remote control input has ~159 Ohm impedance and can be triggered using 4-5 V positive polarity voltage signal (I<45 mA). When remote control signal voltage is zero, laser power is disabled. Remote control can operate at repetition rate of up to ~1 kHz and can be used when laser source is producing optical power <150 mW.

RF modulation input: LD-05IR can be fitted with 50 Ohm impedance matched RF modulation circuits, providing analog modulation of the laser output power in the frequency range of ~ 20kHz-50 MHz. Different signal sources, having 50 Ohm matched impedance can be used to drive the RF laser modulation port. Modulation depth is proportional to the voltage of the RF source. Linearity of the modulation is a function of the average power emitted by the laser source. Typically linear modulation with 3-6 dB depth can be achieved when laser is working at half of output power.

Also, signal from digital patter generators can be used to drive RF port of the laser source. The waveforms of the output light for laser source modulated using pattern generator is shown below:

Bit rate : 22.29 Mb/s **68.5 Mb/s**

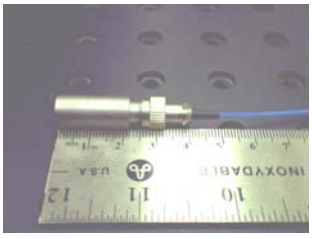


FC/APC connectorized patch-cord used for extension of the laser module pigtail length, for optical connections between the laser source module and other optional modules

FC/APC adapter used for connection between FC/APC connectorized optical cables.

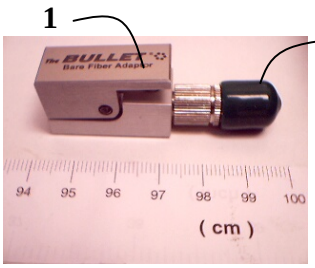
Polarization controller controls polarization of light propagating through FC/APC connectorized patch-cord. Must be loaded with optional fiber patch-cord (LD-05-01). Please place two turns of the fiber in the outer diameter of first and third paddle and three turns of the fiber in the middle paddle.

Optical fiber collimator (model 014)



Has stainless still body and provides high quality collimation or focusing of light emitted from the end of FC/APC **connectorized** patch-cord/pigtail. Collimator can be directly connected to FC/APC or FC/PC connector at the end of the patch cord.

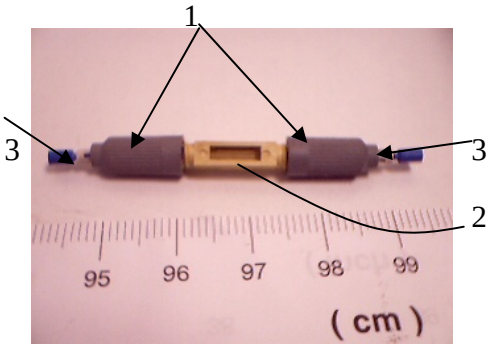
“BULET” bare fiber adapter



This adapter can accommodate single or multi-mode striped and cleaved fibers, having diameter of 125 um exactly.

It provides simple and fast way to put bare cleaved fiber in connection with FC/PC (black color sleeve) connectorized patch-cord, using standard FC-FC adapter. To load stripped and cleaved fiber into adapter, push at point 1 and insert fiber through the hole at the left side of adapter until fiber will be seen from the connection side 2. Level the fiber end inline with the ferrule end. Release clump 1.

“Ultra-splice”: bare cleaved fiber mechanical connector.



Ultra-splice is a high precision mechanical connector of two stripped and cleaved fibers, having diameter of 125 um exactly. It has index-matching gel filled capillary tube, having inner diameter of 126 um. To load the fibers, remove blue protectors. (3) and unscrew fiber clamps (1). Insert first fiber into the capillary to reach approximately center of the capillary (2) and fix the clamp 2 in place. Insert second fiber and put fibers in a contact. Fix the fiber into connector by returning second fiber clamp (1) into original position.

5. Working with laser source

5.1 Initial Inspection and electrical cords connections

1. Please inspect the shipping container for any indications of excessive shock to the contents.

2. Package must be unpacked at ESD protected workstation.

3. Inspect the contents of shipping container to ensure that shipment is complete

4. Visually inspect delivered parts of LD-05IR and all accompanying components and cables for structural damage.

Please inform QPhotonics, LLC. immediately and, if necessary, the carrier, of any damage to LD-05IR components, defective or missing parts, or if the LD-05IR does not pass initial visual inspection.

WARNING	**To avoid electrical shock, do not initialize or operate LD-05IR if there is any sign of damage to any of the components.**

5.2 Assembly of the LD-05IR and laser source operation:

- **Make sure that the "Power" switch (11) at the back panel is in the "Off" position. Power control knob (6) readings is "0" and security key (2) is in "OFF" position.**

- After unpacking, place laser source on the flat surface and make sure that ventilation holes are not obstructed.

- Release fiber pigtail from the holders. Clean, if necessary FC/APC connector, using fiber cleaner.

- Connect Fiber collimator to FC/APC connector of fiber pigtail. Avoid bending and twisting of the fiber pigtail. *Optional fiber collimator is adjusted to certain position, as described in the Testing Report when shipped from QPhotonics.*

- *Connect interlock output of the laser source to your lab door safety switch. Laser source will be enabled without any delay every time when interlock circuit is closed (electrodes of RCA connector are shorted). Please consult with your local safety officer regarding interlock installation/connections. Please give a call to QPhotonics if you have any doubts regarding interlock operation/connections.*

- Connect the laser source module (LD-05IR) to the wall socket using provided cable 1. Put laser mode selection switch (3) in "OFF" position.

- Switch-on the laser using "Power" switch at the back panel of the laser source, located next to power cable connector. Green lamp "TEC" (1) will indicate that laser drivers are operational.

- Put switch (4) in "LOC" position

WARNING	**Laser source emit sufficient optical power. Always use protective goggles when laser source is on.**

- Insert safety key and turn it clock-wise. Put switch (6) in “REG” position.
- Laser is in operation. Green lamp (5) will indicate that laser is emitting power.
- Set required laser output power using power regulation knob (6). Refer to the laser module testing report for laser output power vs. knob readings calibration curve.

5.3 To switch laser source off:

- Reduce laser power to minimal value by turning power regulation knob (6) anti clock-wise the minimum power position (anti clockwise, “0”).
- **Put switch (6) into position “Off”.**
- **Turn security key in “OFF” position**
- Wait 10-25 seconds. Allow laser diode to cool down
- Put power switch (11) in “OFF” position
- Remove power cord from the wall plug (“Mains”).

5.4 Troubles shooting

In case if laser source emit low power or don’t operate:

- Check if the LD-05IR power is turned on (switch 11). In case if the LED indicating “TEC” state at the LD-05IR front panel is not “ON”, check electrical connections between power supply and laser source module.
- Make sure that safety key (2) is inserted and pointing to “white dot”.
- Check is switch (6) is in “REG” position.
- Check integrity of interlock circuits.
- Clean the fiber connector.
- For all other problems contact your LD-05IR source representative or QPhotonics Inc directly.

WARNING	**To avoid electrical shock, do not open any LD-05IR module.**

6. Tips on how to keep laser source stability and output power high

In general, laser diodes (especially high power) are sensitive to light reflected back into the laser cavity from optical surfaces in the light path. Even the light back-reflected from the cleaved fiber end or FC/PC connector can damage the laser diode. Take care to minimize the opportunity for light to be coupled back into the laser diode via the optical fiber. Here are some tips on how it can be done:

1. Use only FC/APC connectors. Clean connectors before every connection.
2. Don't bend the optical fiber. Even large diameter bends might affect output power and laser source line-width significantly. Keep fiber pigtail straight and adjust its position in space to achieve maximum output power.
3. Never touch connectors.
4. Fix position of the fiber in your setup using "invisible tape", when maximum power achieved.
5. Use polarization controller to provide additional isolation. Level of optical reflection even from high quality Angled fiber connectors (FC/APC) is polarization dependant.
6. Make sure that light reflected from your setup is not entering aperture of the fiber collimator.
7. Make sure that the air-flow ventilation holes on the laser source module are not obstructed.

LD-05IR source is designed to sustain significant value of the back-reflected light.

7. Maintenance Instructions

7.1 Fiber pigtail/patch-cord check.

It is recommended to periodically test the quality of the fiber pigtail and patch cords, using back-reflection meter. The level of back-reflected signal should be in the range of –55…-60 dB.

Also a simple way to check the quality of connectors is to observe far optical field emitted from the pigtail/patch-cord connectors, using white screen/IR card/IR viewer. Field distribution must have smooth Gaussian profile. Distortion of the field profile and reduced optical power indicates contamination (or damage) of the optical connector.

7.2 Cleaning the fiber pigtail (FC/APC)

WARNING	**To avoid laser source damage, switch power OFF and disconnect the power supply module from the laser source module before performing FC/APC connectors cleaning. Contact QPhotonics Inc in case of problem.**

To clean the optical connectors, please use ONLY IPA and fiber connector cleaner. Do NOT use acetone or any other solvents. Please visit www.qphotonics.com for more details.

7.3 Storage

To maintain optimum operating reliability, do not store the LD-05IR modules in locations where the temperature falls below –30°C or rises above +60°C. Avoid storing the LD-05IR in environmental conditions that can result in internal condensation. Ensure that these temperature and humidity requirements are also met whenever the LD-05IR is shipped.

8. Warranty and Return shipments to the QPhotonics Inc.

WARRANTY

QPhotonics, LLC. warrants this instrument to be free from defects in material and workmanship for a period of 30 days from date of shipment/delivery. During the warranty period, QPhotonics will repair or replace the unit, at our option, without charge.

LIMITED WARRANTY

QPhotonics, LLC. warrants that the products it manufactures and sells will be free from defects and materials and workmanship for a period of thirty days from the date of shipment. If any such product proves defective during the applicable warranty period, QPhotonics, at its option, either will repair the defective product without charge for parts and labor or will provide a replacement in exchange for the defective product. In order to obtain service under this warranty, the customer must notify QPhotonics, LLC. of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. In all cases the customer will be

responsible for packaging and shipping the defective product back to the service center specified by QPhotonics, with shipping charges prepaid. QPhotonics shall pay for the return of the product to the customer.

This warranty shall not apply to any defect, failure or damage caused by improper use of, or failure to observe, proper operating procedures per the product specification or operator's manual, or improper or inadequate maintenance and care. QPhotonics shall not be obligated to furnish service under this warranty 1) to repair damage resulting from attempts by personnel other than QPhotonics's representatives to repair or service the product; 2) to repair damage resulting from improper use or connection to incompatible equipment; 3) to repair damage resulting from operation outside of the operating or environmental specifications of the product.

QPHOTONICS'S LIABILITY FOR THE MERCHANTABILITY AND USE OF THIS PRODUCT IS EXPRESSLY LIMITED TO ITS WARRANTY SET OUT ABOVE. THIS DISCLAIMER AND LIMITED WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL REPRESENTATIONS AND WARRANTIES EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR MERCHANTABILITY OR OF FITNESS FOR PARTICULAR PURPOSE, WHETHER ARISING FORM STATUTE, COMMON LAW, CUSTOM OR OTHERWISE. THE REMEDY SET FORTH IN THIS DISCLAIMER AND LIMITED WARRANTY SHALL BE THE EXCLUSIVE REMEDIES AVAILABLE TO ANY PERSON. QPHOTONICS, LLC. SHALL NOT BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF THIS PRODUCT, NOR ANY OTHER LOSSES OR INJURIES, WHETHER A CLAIM FOR SUCH DAMAGES, LOSSES OR INJURIES IS BASED UPON WARRANTY, CONTRACT, NEGLIGENCE, OR OTHERWISE. BY ACCEPTING DELIVERY OF THIS PRODUCT, THE PURCHASER EXPRESSLY WAIVES ALL OTHER SUCH POSSIBLE WARRANTIES, LIABILITIES AND REMEDIES. QPHOTONICS, LLC. AND PURCHASER EXPRESSLY AGREE THAT THE SALE HEREUNDER IS FOR RESEARCH USE ONLY AND NOT FOR CONSUMER USES AS DEFINED BY THE MAGNUSOM-MOSS WARRANTYACT OR SIMILAR STATE CONSUMER WARRANTY STATUTE.

Please contact QPhotonics to purchase extended warranty.

Please contact QPhotonics, LLC. to obtain return authorization prior to shipping any modules to QPhotonics, LLC. The owner's name, and address, the model number and serial number of device, return authorization number, and an itemized statement of defects must be included with the device returned for repair.

Pack the item in original transportation container and suitable protective box to prevent damage to the delicate instrument. Seal the shipping container securely and clearly mark FRAGILE on its surface.

Return shipments to the QPhotonics Inc.

If instrument is to be shipped to QPhotonics for repair or service, be sure to:

1. Obtain a Return Merchandise Authorization number (RMA) from QPhotonics Customer Service.

2. Attach a tag to the instrument identifying the owner and indicating the required service or repair. Include the instrument serial number from the rear panel of the

instrument. An itemized statement of defects must be included with the device returned for repair.

3. Attach the anti-static protective caps that were shipped with the instrument and place the instrument in a protective anti-static bag.

4. Place the instrument in the original packing container with at least 3 inches (7.5 cm) of compressible packaging material. Shipping damage is not covered by this warranty.

5. Secure the packing box with fiber reinforced strapping tape or metal bands.

6. Send the instrument, transportation and brokerage pre-paid, to QPhotonics, LLC. Clearly write the return authorization number on the outside of the box and on the shipping paperwork. QPhotonics recommends you insure the shipment.

If the original shipping container is not available, place your instrument in a container with at least 3 inches (7.5 cm) of compressible packaging material on all sides.

Repairs are made and the instrument returned transportation pre-paid. Repairs are warranted for the remainder of the original warranty or for 30 days, whichever is greater. The owner's name, and address, the model number and serial number of LD-04, return authorization number, and an itemized statement of defects must be included with the device returned for repair.

Claims for Shipping Damage

When you receive the instrument, inspect it immediately for any damage or shortages on the packing list. If the instrument is damaged, file a claim with the carrier. The factory will supply you with a quotation for estimated costs of repair.