
FIBER LASER

MODEL: YLR-500-CT
PL0804899

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Preface

Please take time to read and understand this User's Guide and familiarize yourself with the operating and maintenance instructions that we have compiled for you before you use the product. We recommend that the operator read Chapter 2, Safety Information, prior to operating the product.

This User's Guide should stay with the product to provide you and all future users and owners of the product with important operating, safety and other information.

US Export Control Compliance

IPG's policy and business code is to comply strictly with the U.S. export control laws.

Export and re-export of lasers manufactured by IPG are subject to the US Export Administration Regulations administered by the Department of Commerce, Bureau of Industry and Security.

The applicable restrictions vary depending on the specific product involved, intended application, the product destination and the intended user. In some cases, an individual validated export license is required from the U.S. Department of Commerce prior to resale or re-export of certain products. Please contact IPG, if you are uncertain about the obligations imposed by US law.

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1. Introduction

IPG YLR product line has been developed to meet industrial market demands on efficient reliable maintenance-free high power lasers. YLR products are diode – pumped ytterbium fiber lasers with output power scaled from 100 W up to 20000 W at wavelength region of 1070 – 1100 nm. Depending on power level these lasers may be air - or water-cooled. Typical wall plug efficiency of YLR laser exceeds 25%.

The IPG fiber laser has been designed and tested with safety in mind. By following this User's Guide and applying sound laser safety practices, it can be a safe and reliable device.

Because of its special characteristics, laser light poses safety hazards different than light from other sources. All laser users and persons near the laser must be aware of the hazards involved in operating a laser.

In order to ensure the safe operation and optimal performance of the product, please follow these warnings and cautions in addition to the other information contained elsewhere in this document. These safety precautions must be observed during all phases of operation, maintenance and repair of this instrument.



Operators are urged to adhere to these recommendations and to apply sound laser safety practices at all times.

2. Safety Information

Safety Conventions

IPG Photonics use various words and symbols in this User's Guide that are designed to call your attention to hazards or important information. These include:

WARNING:

Refers to a potential *personal* hazard. ( *Electrical*) ( *Laser radiation*) It requires a procedure that, if not correctly followed, may result in bodily harm to you and/or others. Do not proceed beyond the WARNING sign until you completely understand and meet the required conditions.

CAUTION:

Refers to a potential *product* hazard. It requires a procedure that, if not correctly followed, may result in damage or destruction to the product or components. Do not proceed beyond the CAUTION sign until you completely understand and meet the required conditions.

IMPORTANT

Refers to any information regarding the operation of the product. Please do not overlook this information.

Laser Classification IV > 500 W at 1070 nm

This device is classified as a high power **Class IV** laser instrument under 21 CFR 1040.10. This product emits invisible laser radiation at or around a wavelength of **1070 nm**, and the total light energy radiated from the optical output is greater than **500 W** per optical output port. This level of light may cause damage to the eye and skin. Despite the radiation being invisible, the beam may cause irreversible damage to the cornea. Laser safety eyewear is not provided with this instrument, but must be worn at all times while the laser is operational.

WARNING: 

Use appropriate laser safety eyewear when operating this device. The selection of appropriate laser safety eyewear requires the end user to accurately identify the range of wavelengths emitted from this product. If the device is a tunable laser or Raman product, it emits light over a range of wavelengths and the end user should confirm the laser safety eyewear used protects against light emitted by the device over its entire range of wavelengths.

WARNING: 

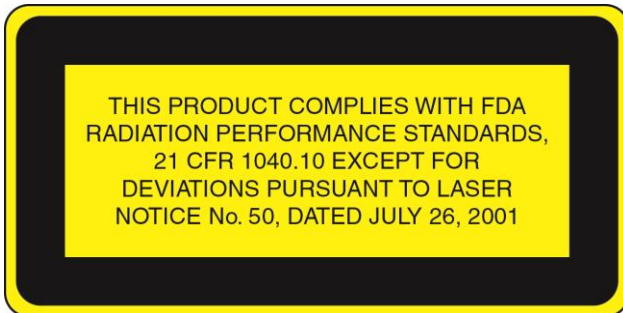
Use of controls or adjustments or performance of procedures other than those set forth in this User's Guide may result in hazardous radiation exposure.

CAUTION: 

Do not install or terminate fibers or collimators when laser is active.

Device Safety Label Locations

The figures below show the required laser safety labels and the locations of these labels on the product.



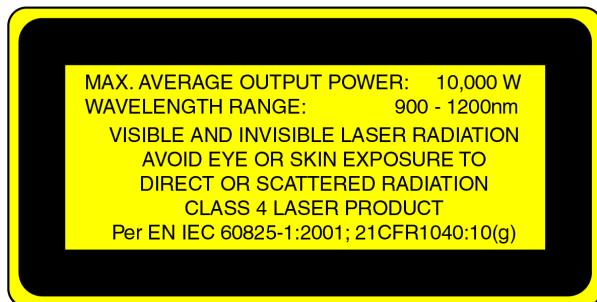
Certification Label
Location

Front, rear, side
or top panel of the device
enclosure.



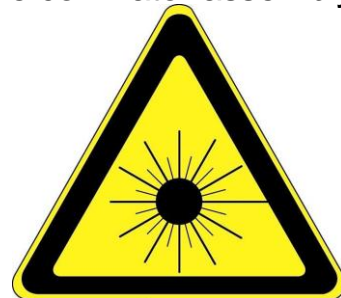
Aperture Label
Location

Front, rear, side or top panel
of the device enclosure and
on the collimator assembly.



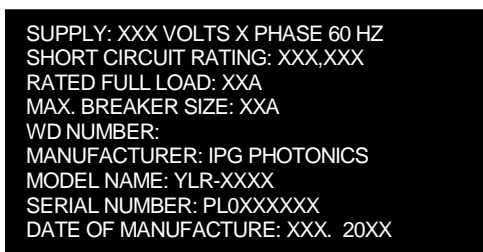
Warning Label
Location

Front, rear, side or top panel
of the device enclosure.



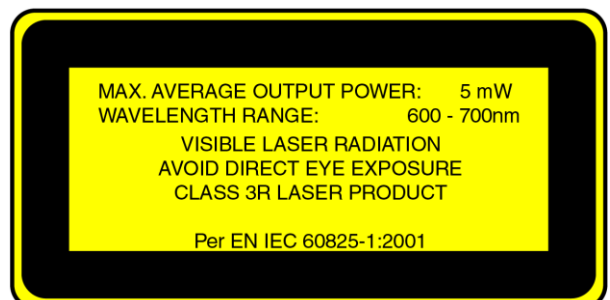
Hazard Symbol
Location

Front, rear, side or top panel
of the device enclosure and
on the collimator assembly.



Identification Plate
Location

Front, rear, side or top panel
of the device enclosure.



Warning Label
Location

Front, rear, side or top panel
of the device enclosure.

General Safety Instructions

WARNING:



Exercise caution to avoid/minimize specular reflections because reflections at the laser's wavelength are invisible.

There are often numerous secondary beams present at various angles near the laser. These beams are specular reflections of the main beam from various surfaces. Although these secondary beams may be less powerful than the total power emitted from the laser, the intensity may be great enough to cause damage to the eyes and skin as well as materials surrounding the laser.

The laser light is strong enough to burn skin, clothing and paint. Further, laser light can ignite volatile substances such as alcohol, gasoline, ether and other solvents. The laser can cut and weld metal. Exposure to solvents or other flammable materials and gases must be avoided and considered when installing and using this device.

Light-sensitive elements in equipment, such as video cameras, photomultipliers and photodiodes may also be damaged from exposure to the laser light.

We also recommend that you follow these procedures to operate the IPG laser safely:

Never look directly into the laser output port when the power is on.

Set up the laser and all optical components used with the laser away from eye level.

Provide enclosures for laser beam.

Use the laser in a room with access controlled by door interlocks. Post warning signs. Limit access to the area to individuals who are trained in laser safety while operating the laser.

Avoid using the laser in a darkened environment.

Do not enable the laser without a coupling fiber or equivalent attached to the optical output connector.

Always switch the laser off when working with the output such as mounting the fiber or collimator into a fixture, etc. If necessary, align the output at low output power and then increase the output power gradually.

Do not install or terminate fibers or collimators when laser is active.

If this instrument is used in a manner not specified in this document, the protection provided by the instrument may be impaired and the warranty will be voided.

CAUTION:



If the output of the device is delivered through a lens with an anti-reflection coating make sure that the lens is of good quality and clean. Please refer to the instructions described in “Cleaning the Quartz Block” of this document.

Any dust on the end of the collimator assembly can burn the lens and damage the laser. Check the quality of the spot emitted from the laser output at low power levels using an infrared viewer and then gradually increase the output power.

CAUTION:



Hot or molten pieces of metal may be present when using this laser. Exercise caution if debris is being generated in your application.

Electrical Safety

WARNING:



The input voltage to the laser is potentially lethal. All electrical cables and connections should be treated as if it were a harmful level. All parts of the electrical cable, connector or device housing should be considered dangerous.

Make sure this instrument is properly grounded through the protective conductor of the AC power cable. Any interruption of the protective grounding conductor from the protective earth terminal can result in personal injury.

Always use your device in conjunction with properly grounded power source.

For continued protection against fire hazard, replace the line fuses (if applicable) with only the same types and ratings. The use of other fuses or material is prohibited.

Before supplying the power to the instrument, make sure that the correct voltage of the AC power source is used. Failure to use the correct voltage could cause damage to the instrument.

Before switching the power on make sure that line voltage corresponds to the specified level.

There are no operator serviceable parts inside. Refer all servicing to qualified IPG personnel. To prevent electrical shock, do not remove covers. Any tampering with the product will void the warranty.

Environmental Safety

WARNING:



NEVER look directly into a live fiber or collimator and make sure that you wear appropriate laser safety eyewear at all times while operating the product.

Proper enclosures should be used to secure a laser safe work area. This includes but is not limited to laser safety signs, interlocks, appropriate warning devices and training/safety procedures. Also, it is important to install the output assembly away from eye level.

The interaction between the laser and the material being processed can also generate high intensity UV and visible radiation. Ensure that laser enclosures are in place to prevent eye damage from visible radiation.

CAUTION:



Injury to the laser is possible, unless caution is employed in operating the device.

IPG provides the following recommendations to promote the long life of the IPG laser:

- Do not expose the device to a high moisture environment.
- The device may have fans for active cooling. Make sure there is sufficient airflow to cool the device, any objects or debris that cover the ventilation holes must be removed at all times.
- Operation at higher temperatures will accelerate aging, increase threshold current and lower slope efficiency. If the device is overheated, do not use it and call IPG for assistance.
- Ensure that the work surface is properly vented. The gases, sparks and debris that can be generated from interaction between the laser and the work surface can pose additional safety hazards.

For additional information regarding Laser Safety please refer to the list below, which contains some available information:

Laser Institute of America (LIA)

13501 Ingenuity Drive, Suite 128
Orlando, Florida 32826
Phone: 407.380.1553, Fax: 407.380.5588
Toll Free: 1.800.34.LASER
Email: lia@laserinstitute.org

American National Standards Institute

ANSI Z136.1 – 2000, American National Standard for the Safe Use of Lasers
(Available through LIA)

International Electro-technical Commission

IEC 60825-1, Edition 1.2, 2001-08
Safety of laser products –
Part 1:
Equipment classification, requirements and user's guide.
(Available through LIA)

Center for Devices and Radiological Health

21 CFR 1040.10 – Performance Standards for Light-Emitting Products
<http://www.fda.gov/cdrh/rad-health.html>

US Department of Labor – OSHA

Publication 8-1.7 – Guidelines for Laser Safety and Hazard Assessment.
<http://www.osha.gov/>

Laser Safety Equipment

Laurin Publishing
Laser safety equipment and Buyer's Guides
<http://www.photonics.com/Directory/>

IPG Photonics recommends that the user of this product investigate any local, state or federal requirements as well as facility or building requirements that may apply to installing or using a laser or laser system.

3. Description of your device

Certification

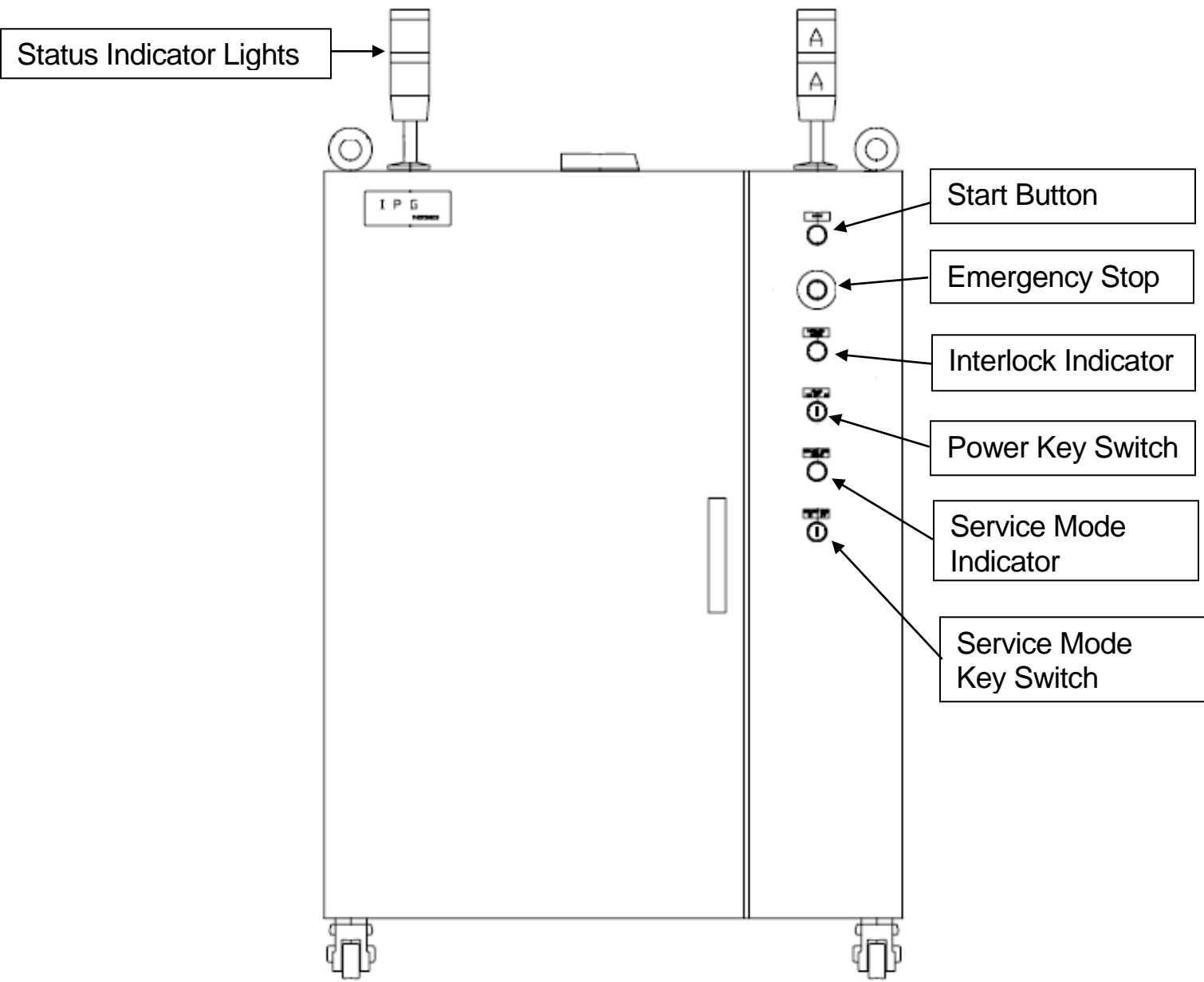
IPG certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping. Upon receiving your device check the packaging and parts for any possible damage that may have occurred in transit. If damage is apparent please contact IPG immediately.

Accessories

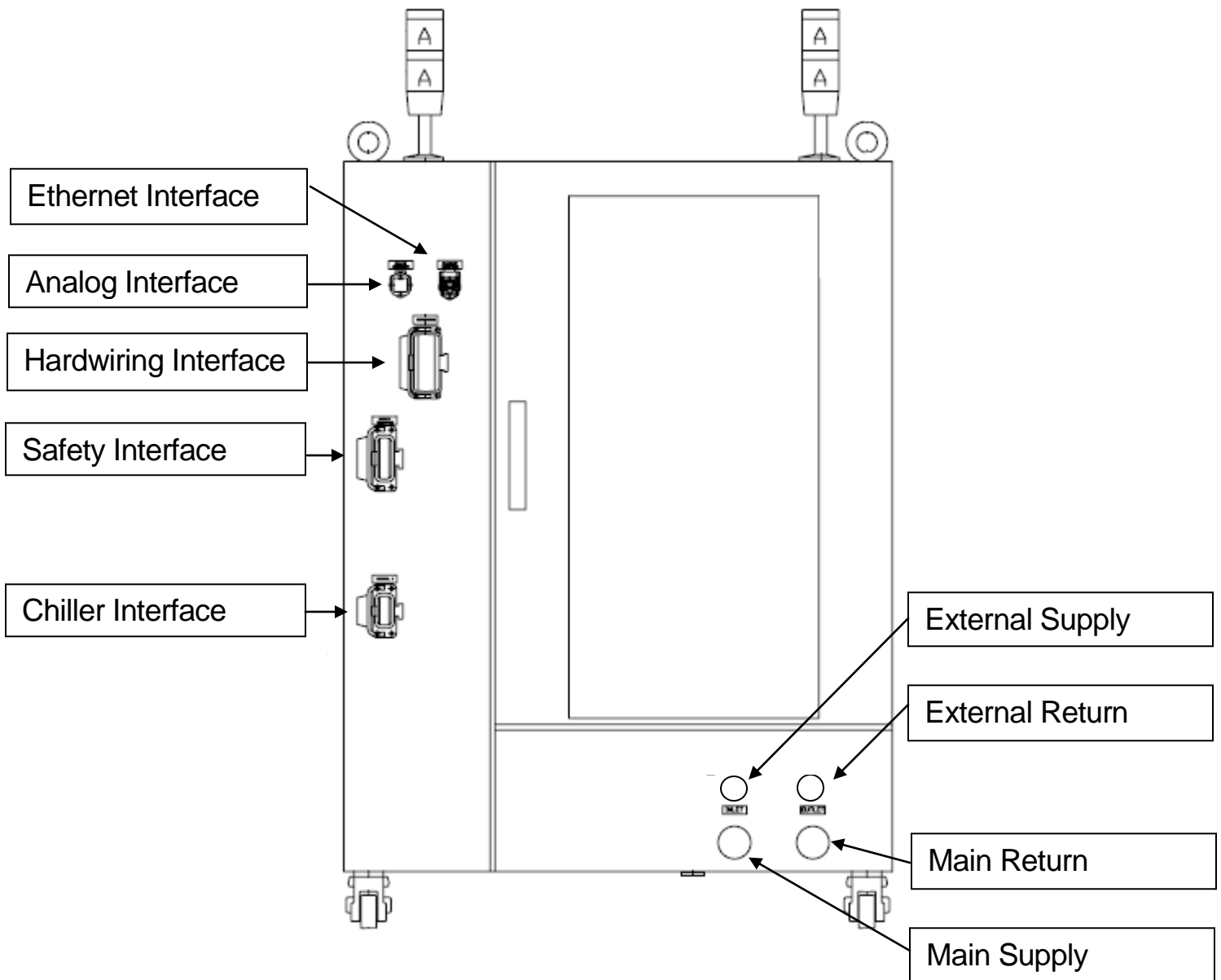
Part	Quantity
YLR-500-CT	1
Control key	2
Cabinet key	2
Laser User's Guide	1
100 micron Delivery Fiber (QBH) 10m	1
Software LaserNet on CD	1

Laser Layout

Front View



Rear View



Status Indicator Lights

These lights display flashing amber when the laser power supply is on. These lights display steady amber during laser emission, or when laser emission is possible.

Start Button (Main Supply)

This button controls the DC power to the laser. The emergency stop button must be released before this button is operational.

Emergency Stop Button

If this button is pressed, the safety circuit is opened and it is not possible to activate Main Supply. To release E-stop button rotate it clockwise.

Interlock Indicator

The light is lit when an interlock is open. Press to test.

Power Key Switch

This key switch provides power to the electronics in the laser. It is necessary to release the E-stop before this switch is operational. Keys are provided. Clockwise rotation puts the laser in Local Control Mode; counterclockwise rotation is for use in Remote Control Mode.

Service Mode Switch

This key switch allows IPGP service personnel to run the laser in service mode. Only trained operators should attempt to service the laser. Call IPGP with questions.

Service Mode Indicator

This light is lit when service mode is active. Press to test.

Optical Output

Optical fibers exit the laser from the top cover.

Ethernet Interface

This connector provides network connection to control the laser with a computer.

Hardwiring Interface

This connection provides digital interface with robots or hardwiring control of the laser. See System Installation for pin out.

Safety Interface

This is the safety interface for connection with external emergency circuitry, external key switch and start button. See System Installation section for pin out.

Chiller Interface

This is the interface for connection to an external chiller.

Analog Interface

Analog control connections are made here. See System Installation section for pin out.

Laser Coolant Outlet

Connection must be made to the Laser Coolant Inlet of the Chiller.

Laser Coolant Inlet

Connection must be made to the Laser Coolant Outlet of the Chiller.

Identification plate

Plate lists input power specifications and displays laser identification.

4. System Installation

Precautions

Refer to the specification for proper electrical power requirements.

Before switching the power on, make sure that the incoming AC voltage is equal to the level noted in the specification.

Before switching the power on, make sure that the cooling water tubes are properly connected to the inlet/outlet ports of the laser with the water supply. Refer to specification for flow rate.

Please take care and use a wrench to hold plumbing steady when connecting external plumbing to avoid damaging the internal plumbing.

Operate only in an environment with sufficient airflow capacity that allows for the specified heat load developed during operation (for air-cooled units).

If the laser will be in an environment of less than 0 degrees Celsius, drain all coolant out of laser completely or add sufficient antifreeze to prevent damage to the laser.

Electrical Power Connection

A NEMA L16-30P power connector attached to a four conductor 10 AWG electrical cable is supplied with the Laser. Refer to the specification for power requirements. To hardwire the laser, make connections to Main Power terminals inside the laser electrical panel.

Fuses

All fuses are accessible on the panel inside the front door. Always replace fuses with the correct fuse as outlined in the Fuse Chart below.

Fuse Chart

Reference	Function	Description	Bussman Part#
1FU, 2FU, 3FU	Main Power	Class CC, 20A	FNQ-R-20
4FU, 5FU, 6FU	Control Power	Class CC, 3A	FNQ-R-3
7FU, 8FU	A/C Power	Class CC, 6A	FNQ-R-6
9FU, 10FU	DC Logic Power	Class CC, 6A	FNQ-R-6

Water Connection

De-ionized water with < 50 micron filtration should be used to cool the laser and the optics. Use only stainless steel or plastic tubing with de-ionized water. Refer to the specification for appropriate flow rates. Keep long hoses of maximum size to reduce pressure drop and flow restriction.

If the relative humidity is high enough in the laser room (or plant), then the moisture in the air can condense on cool parts within the laser, such as water lines, optics, flow tubes, etc. This can potentially cause serious damage to internal components.

A psychrometric chart can be used to calculate the dew point (temperature at which moisture will precipitate or condense out of ambient air) given a dry bulb (regular thermometer) temperature and relative humidity reading.

If the dew point is below 68°F (20°C), then there is little risk of condensation within the laser. Proceed with normal operation of your laser.

If the dew point is above 68°F (20°C), then there is considerable risk for condensation within the lasers. Take one or more of the following actions:

- i. Check the de-humidifiers in the rooms and drain as necessary.
- ii. Check the A/C units for proper operation (are they actually cooling?) May need to replace or add extra A/C units. Note: A/C units can lose up to 10% of their cooling efficiency each year.
- iii. Ensure the doors are sealed properly to keep the humid air out.
- iv. Clean the heat exchange vents on the outside of the A/C units.
- v. Increase coolant temperature above dew point. **IPG Photonics authorization is required if cooling water temperature needs to be adjusted above 30°C.**

Chiller Interface Connector Pin Out

Harting Han 15 D Female

Pin	Description	Notes
A1	Signal Common	
A2	Chiller Ready	24VDC Input
A3	Spare	NC
A4	Chiller Fault	24VDC Input
A5	24VDC	NC
B1	AIN_1	Water Temp 0-10VDC Input
B2	AIN_2	Tap Water Temp 0-10VDC Input
B3	AIN_3	Water Conductivity 0-10VDC Input
B4	Spare	NC
B5	Signal Common	
C1	Reserved	
C2	Reserved	
C3	Spare	NC
C4	Reserved	
C5	Reserved	

Safety Interface Connector Pin Out

Harting Han 25 D Female

Pin	Assignment	Description
A1	Modulation Enable	+24 VDC for external emission enable. Not active in Remote Mode.
A2	Modulation Enable Return	
A3	Emission ON Monitor	Potential free output. A3 and A5 closed when emission enabled.
A5	Emission ON Monitor	
A8	Remote Laser Power Key Switch	Contact Closure 24VDC, must be used when main key switch is in remote position.
A9	Remote Laser Power Key Switch	Contact Closure 24VDC, must be used when main key switch is in remote position.
B3	E-Stop Out Channel 1	Two channel potential free output. If E-Stop push-button pressed, channels 1 and 2 opened.
B4	E-Stop Out Channel 2	
B5	E-Stop Out Channel 2	
B6	E-Stop Out Channel 1	
B7	SC Status/Power Supply Active	Potential free output. Contacts closed when main power supply activated.
B8	SC Status/Power Supply Active	
C1	Interlock Channel 1	Two channel external E-Stop input. Only potential free contacts can be connected between pins C1-C4; C2-C3.
C2	Interlock Channel 2	
C3	Interlock Channel 2	
C4	Interlock Channel 1	
C5	SC Reset	Momentary connection between pins resets safety circuit and starts main power supply when main key switch is in remote position.
C6	SC Reset	
C7-9	Reserved	Reserved

Analog Interface Connector Pin Out

Harting Han 7 D Female

Pin	Description	Notes
1	Analog Control Input	Analog Input 0-10VDC=0-100%
2	Signal Common	
3	Analog Power Monitor	Analog Output 0-10V = 0-3kW
4	Power Monitor Return	
5-7	Reserved	Reserved

Hardwiring Interface Connector Pin Out

Harting Han 64 D Female

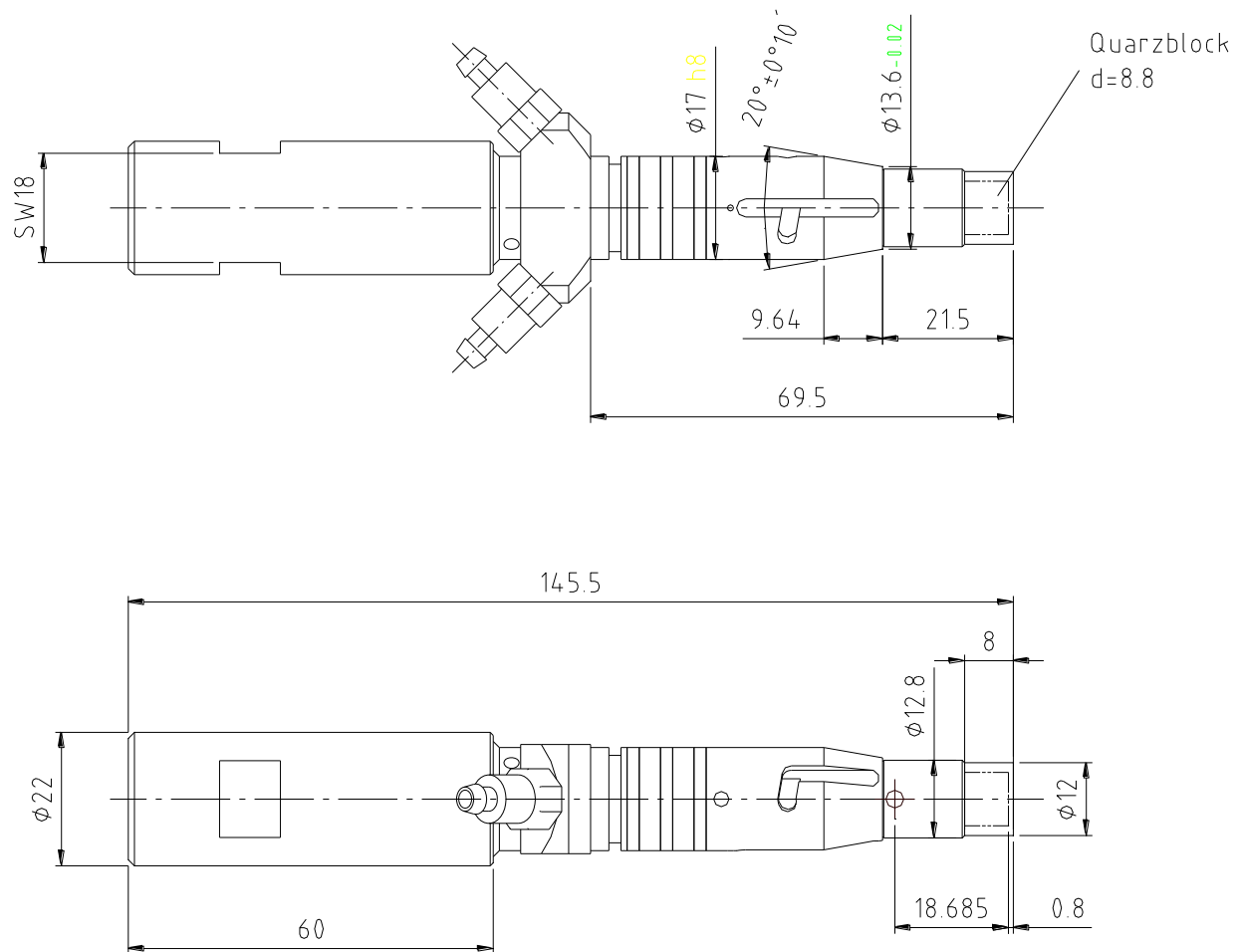
High Signal = 24VDC

Pin	Assignment	Description
A1	Laser Request	High active. With this signal one of several external controllers (robots) can request laser power. This function is only valid if several I/O cards are installed. If only one robot is connected to the laser, this bit always must be set high during the control process. Without this bit all other input bits are ignored. As a confirmation that laser is connected to the particular controller (robot) B7 will be set high.
A2	Program Start	High active. By changing state of this pin the Laser programs can be started and stopped. A program gets started if input is active and stopped if the input is cleared or the program ends. Program starts only once. Program number is defined by bits A8-A14. If the program number is 0000000 and bit A6 (analog control) is high, then laser power is controlled by Analog input. If the program number is 0000000, A6 (analog control) is low and A3 (PC control) is high, laser power value can be set by Ethernet program. B1 (laser ready) must be High before start of the program. After start of the program confirmation "Program active" (B9) will be set High. B9 will be cleared after the end of the program and B10 (End of the program) will be set high. B10 will be cleared after A2 (Program start) is cleared (handshake; - not valid if program number is 0000000).
A3	Enable PC Control	High active. Laser can be controlled from PC if this bit set high.
A4	Reset	High active. This input is used to reset all messages of the laser system and output bits: "Laser Error", "Program is interrupted" and "Warning". Input should be active at least for 1ms.
A5	Guide Laser Control	High active. Guide laser On/Off.
A6	Analog Control Enable	High active. Analog control input can be activated by this bit if program number is 0000000.
A7	Program Stop	High active. The active program can immediately be stopped by this bit. If this happens before the end of the program, B11 (interrupt) and B13 (warning) will be set high, B9 (program active) will be cleared, B10 (program end) will not be set and you will have to activate A4 (Reset) for at least 1ms.
A8-A14	Program Number	Sets program number. Any program number change is ignored until next low to high transition of A2 (Program start).
A15	Synchronization Input	This input can be used in the Laser Program (wait for low or for high).
A16	Common	Common for all inputs.
B1	Laser Ready	Output. If this bit is high laser program can be started by bit A2 (program start).
B2	Emission Status	Emission On/Off Monitor
B3	PC Control Status	PC Control enable/disable monitor
B4	Laser Error	Abnormal situation detected if this bit set high.
B5	Guide Laser Status	Indicates status of aiming laser.
B6	Analog Control Status	Indicates if analog control is chosen.
B7	Laser Assigned	See A1.
B8	Power Supply Status	Indicates the status of main power supply.
B9	Program Active	Laser is executing the laser program.
B10	Program End	If set high the laser program finished. See A2 (program start).
B11	Program Interrupted	Set high if program interrupted. A4 (reset) resets this pin.
B12	Synchronization Output	Can be used with the laser program.
B13	Warning Output	
B14	Spare Output	

B15	+24VDC Supply Voltage	Customer provides +24V to drive outputs. 27VDC Max.
B16	24VDC Supply Return	Return from +24 VDC Supply
C1	Reserved	
C2	Spare Input	
C3	Beam Switch Channel Select LSB	Binary input for beam switch channel Selection
C4	Beam Switch Channel Select	Binary input for beam switch channel Selection
C5	Beam Switch Channel Select	Binary input for beam switch channel Selection
C6	Beam Switch Channel Select MSB	Binary input for beam switch channel Selection
C7-C8	Spare Input	
D1-D4	Spare Output	
D5	Chiller Warning	Active if a chiller is present.
D6	Chiller Error	Active if a chiller is present.
D7	Spare Output	
D8	Chiller Ready	Active if a chiller is present.

Optical Connector Installation

A conical guide positions the fiber connector into the interfacing unit. The connector is locked in position by a bayonet that also ensures correct orientation. The safety interlock system connects only when the bayonet is closed, via the two contact rings of the connector.



Optical Connector Cleaning

IMPORTANT: It is imperative that a fiber connector is checked for dust, dirt, or damage **every time** it is connected to an optical head or beam coupler/beam switch.

The use of a dirty or damaged fiber connector can result in serious laser damage. IPG is not responsible for any damage due to contaminated connectors.

For cleaning a fiber connector, you need the following materials:

- Powder free rubber gloves
- Optical cleaning swabs
- Isopropanol (water free)
- Acetone (water free)
- Compressed air (oil free, water free)
- Microscope (IPG model or equivalent)
- Light Source



Lens Tissue and Cleaning Swabs

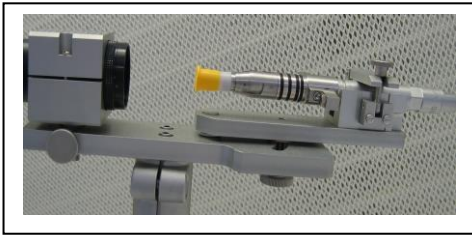


IPG Microscope

Steps for cleaning a High Power IPG/Optoskand connector

It is imperative that you wear powder free rubber gloves during this cleaning procedure!

1. Switch off the laser's main power.
2. Leave protective cap on and clean the fiber connector with isopropanol, wipe it with a clean optical wipe and dry with compressed air.
3. Place fiber connector in the holder of the microscope.



4. Remove yellow cap and sleeve from connector.

IMPORTANT! Always place cap open-face down to prevent internal deposit of dust and dirt.



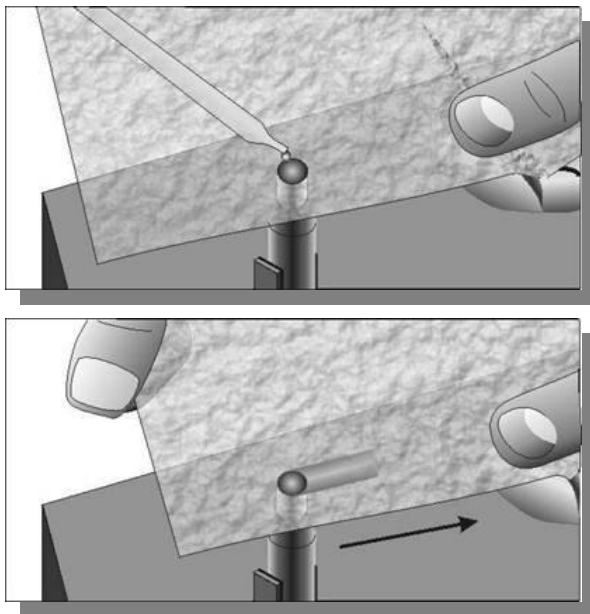
5. Focus the microscope onto the connector surface.
6. Use a light source to illuminate the face of the connector so that the light is reflected off the surface of the endface. This is achieved if you see a bright golden shine from the IPG (yellow) connector endface or a blue reflection from the Optoskand connector endface.

IMPORTANT! Always look at the surface at a slight angle to improve visibility.

7. Inspect the surface carefully. If contamination is visible on the quartz block, cleaning is necessary. Contamination will lead to dark spots/burns on the surface.
8. Try to blow away the dust with compressed air from the side.

IMPORTANT! Never blow air directly at the surface because you could imbed contaminants into the surface. Always blow across the surface!

9. Put a drop of isopropanol onto a lens cleaning paper and wipe the wet spot laterally across the surface until it is dry.



CAUTION! Do not let the areas where your fingers touched the tissue come into contact with the lens.

10. Re-inspect lens.
11. Repeat step 9 with acetone if lens is still contaminated.
12. If necessary, you should put a drop of acetone onto a cleaning swab and wipe away contamination in a circular motion, do not scratch lens.

CAUTION! Do not touch the tip of the cleaning swab with your fingers and use each swab only once to prevent contamination.

13. You should repeat these cleaning steps until all contamination is removed.
This cleaning procedure can be stopped at any time if a good result has already been achieved.

CAUTION: It is hereby stated that damage to the fiber connector can occur due to mishandling, the use of incorrect cleaning procedures, or chemicals for cleaning. This is not covered by the warranty.

14. Install the cleaned connector into the bayonet fixing of an appropriate terminating device or the beam switch/coupler and lock the bayonet.
15. If the fiber is not going to be connected immediately with a suitable optical component, recap it with the protection cap.

Do not forget to clean the cap and sleeve before installing onto connector.

Initial Power up Sequence

- Make all electrical connections with the laser and external devices prior to applying power to the laser.
- Insert the key into the main power switch on the front panel of the Laser.

WARNING:



NEVER look directly into a live fiber or collimator and make sure that you wear appropriate laser safety eyewear at all times while operating the product. Make sure all power is removed from the laser when handling the delivery cable.

- Remove protective cap from the optical connector and the input of the optical coupling unit/collimator.
- Inspect the optical connector end face to check for dust and debris. Please refer to “Optical Connector Cleaning” in this manual for instructions.
- Properly align the “red” markings (dots) of the optical connector and the coupling/collimating unit and insert the optical connector into the coupling/collimating unit.
- Rotate the bayonet on the coupling unit to lock the optical connector into position.
- Repeat above procedure for connecting coupling unit with optical cable and collimator assembly if supplied.

WARNING:



If this is the first time that you are running this laser, it is imperative that you verify the alignment of the Fiber to Fiber Coupler or Beam Switch before you run any process with this laser. (If Applicable)

- Using the “Guide Laser”, properly align the collimator and delivery optics.
- Make sure the water chillers are turned on for both the main laser assembly and the optical connectors/coupling unit.
- Make sure the emergency stop button is released and turn the key switch clockwise.

- Make sure the interlocks in the “Safety Interface” are satisfied. The “Interlock Active” light on the front panel will be off if the interlocks are satisfied.
- Press the start button. Two “Power Supply Active” warning lights on the top of the main laser assembly will turn on. (if applicable)
- Set required laser power (no less than 10%).
- Enable the emission from computer or hardwiring interface. Two “Emission ON” warning lights on the top of the main laser assembly will turn on.

Back Reflection Prevention

CAUTION:



Back reflection into the laser cavity can degrade the laser performance or cause laser failure. The laser is designed to accommodate normal back reflections produced from the use of your laser output, whether it is outfitted with a connector, optical coupling unit or/and collimator.

Your laser is equipped with back-reflection prevention circuitry, which shuts the laser off in the case of excessive back-reflected light into the laser cavity. An error light will activate and a “high back-reflection” message will appear on the LaserNet Alarm page, if this occurs.

For collimated outputs, maintaining a clean output lens is essential. Always cover (re-cap) the collimator after use. Do not touch the output, only use isopropanol to clean lens. Cleaning with lens tissue is allowable as required.

Optical damage may result from failure to comply with the above instructions. Such damage is not covered by the warranty.

5. LaserNet Program Description

Installation

LaserNet program is used for controlling IPG high power fiber lasers. Up to 100 lasers can be controlled by the program by using fast Ethernet. If only one laser should be controlled the connection can be made with a crossed Ethernet cable.

Computer Requirements:

Minimum	Recommended
Pentium III 1 GHz	Pentium IV 2GHz
256 MB RAM	512 MB RAM
Display resolution 1024x768 (XGA) 256 colors	True Color
20 MB free space on HDD	
100 MB fast Ethernet	
CD ROM	
Windows 2000	Windows XP
Optional Modem	

Local Area Network (LAN) settings:

Choose TCP/IP Properties and set the following values.

IP address: 192.168.100.2

Subnet mask: 255.255.255.0

Default Gateway: 192.168.100.1

Note: Windows Vista™ is not supported at this time.

Laser Net program installation.

1. Place LaserNet CD in CD-Rom of computer.
2. Double Click setup.exe

This will automatically install LaserNet and place a shortcut on the desktop.

Start LaserNet program

Open Settings and choose IP configuration:

Choose laser name, set IP address to 192.168.100.1 and set state to enable.

(This will be the default factory setting.)

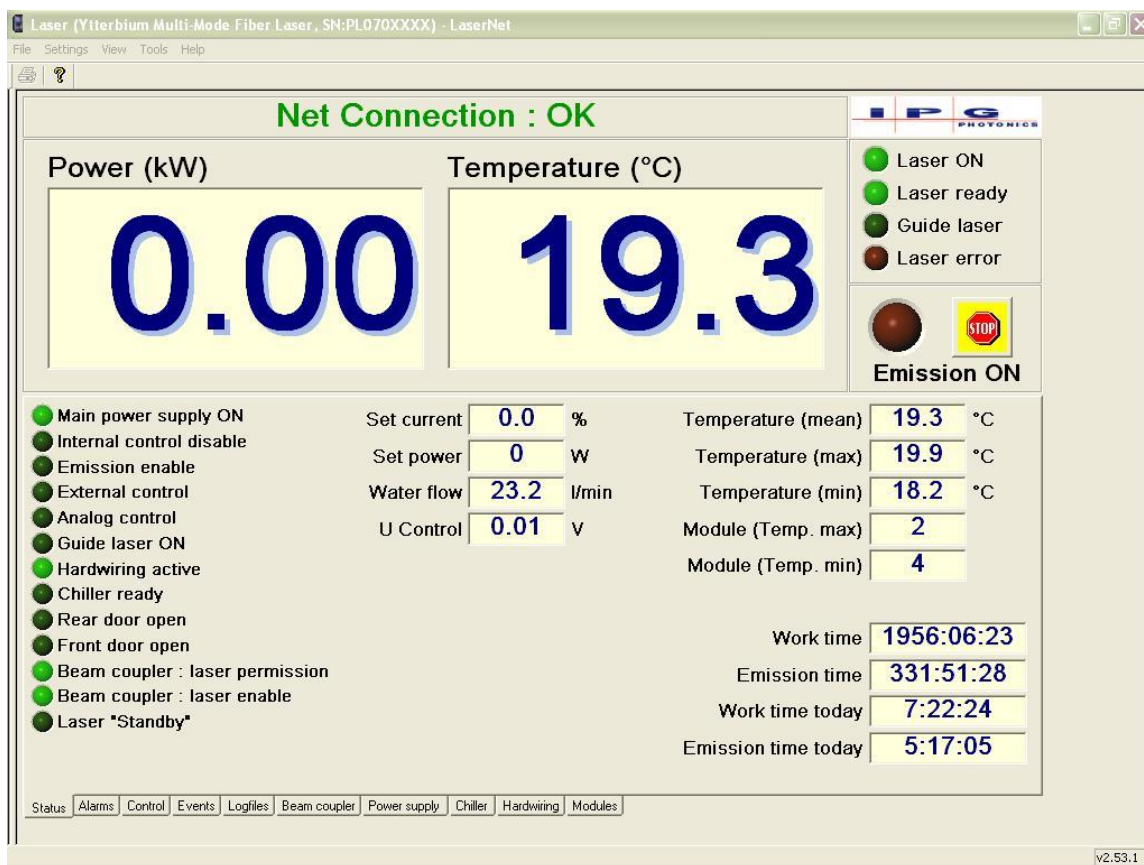
Under Settings there is an option called Control.

This is used to enable/disable control of the laser, emission possibilities and reset rights.

LaserNet program contains following windows:

1. "Status" – main program window. The main laser parameters are listed in this program.
2. "Alarms". All lasers alarms are represented on this page. If alarm signal from the laser is presented – it is not possible to switch laser emission.
3. "Control". From this page you can switch ON/OFF main laser power supply, switch ON/OFF emission, reset error message, set rise and fall time, switch ON/OFF guide laser and activate external or analog control mode.
4. "Events". All events (main status and alarms) have happened in the laser are listed on this page.
5. "Logfiles". This page is used for logfiles reading from the laser. This is service page.
6. "Beam coupler". Beam coupler status is reported on this page.
7. "Power supply". Information about main laser power supply (status, current, voltage and temperature) is represented on this page.
8. "Chiller". On this page you can read main chiller parameters.
9. "Hardwiring" The status of all Hardwiring pins is described on this page.
10. "Options". Single Optical Module operation could be chosen on this page.

Status Page



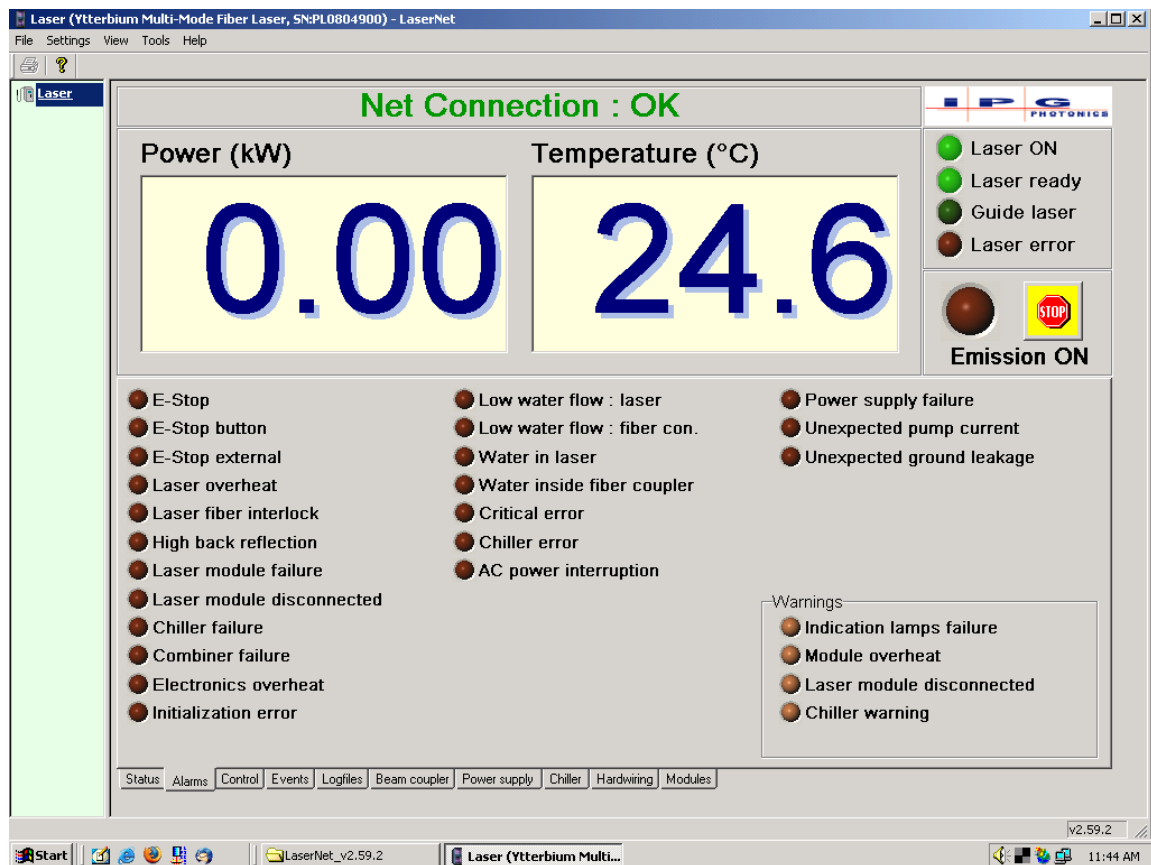
Signal	Function
Main power supply ON	<p>Active when main power supply is ON.</p> <p>It is not possible to switch emission ON without this signal. If this signal no present –“Laser ready” signal also stays low.</p> <p>It is not possible to get this signal active if:</p> <ol style="list-style-type: none"> 1. Safety circuit is open: internal or external "E-Stop" loops opened, the laser cabinet doors opened (signals "Rear door open" and "Front door open"). 2. Leakage from the water cooling system detected (signal "Water in Laser") 3. Output fiber is not installed into optical head (signal "Optical Interlock")
Internal control disable	<p>This will be activated if the Key Switch on the front side of the laser is set to "Remote/Robot" position. Now LaserNet can only be used for monitoring.</p> <p>When the Pin A3 in the Hardwiring is set high while robot is controlling the laser internal control will again be enabled.</p>
Emission enable	<p>If this signal is presented it is possible to switch on laser emission. This signal is equivalent to "Laser ready" signal.</p> <p>This signal disappears if:</p> <ol style="list-style-type: none"> 1. Safety circuit is open (signal "E-Stop") 2. Output fiber is not installed into optical head (signal "Optical Interlock") 3. Defect in laser combiner detected (signal "Coupler photodiode1" or

	<p>“Coupler photodiode2” on the Alarms Page)</p> <p>4. One of the laser cabinet doors is opened (signals “Rear door open” and “Front door open</p> <p>5. No command for laser emission is presented.</p> <p>6. “High back reflection” signal from one of the laser modules is presented.</p>
External control	By pressing “External control” button on the Control Page External modulation mode is activated. In this mode level of laser power is set from computer (see Control Page). Laser emission is switched ON/OFF by supplying signal on pins A1 and A2 of safety interface connector. Pressing of “Emission” button is needed to switch emission on anyway.
Analog control	By pressing “Analog Control” button on the Control Page Analog control mode is activated. In this mode level of output power is set via analog control input 0-10 VDC. To switch laser emission on it is necessary to supply external modulation signal and press “Emission” button.
Guide laser ON	Indicate guide laser status.
Hardwiring active	Indicates if the connection inside the laser between laser micro-controller and internal hardwiring micro-controller is established
Chiller ready	Indicate chiller status. If this signal is not presented, it is necessary to check all connections between laser and chiller and water temperature. Absence of this signal will remove “Laser ready” signal.
Rear door open	Rear door is open. Laser emission and power supply will be switched off and the signal “Laser ready” will be removed
Front door open	Front door is open. Laser emission and power supply will be switched off and the signal “Laser ready” will be removed
Beam coupler: laser permission	Laser permission is only active if the water flows for the fiber connectors are in the specified range. If this signal disappears laser emission will be switched off and “Laser ready” will be set to low
Beam coupler: laser enable	This signal is high if inside the coupler everything is alright. If this signal disappears laser emission will be switched off and “Laser ready” will be set to low
Laser Standby	This signal is active when laser is in remote or local mode and all safety interlocks are satisfied.

Laser parameters:

Parameter	Description
Set current	Pump current settings (in current stabilization mode)
Set power	Absolute power settings (in power stabilization mode)
Water flow	Water flow through the laser
Temperature (mean)	The mean temperature of all laser modules
Temperature (max)	Temperature of the hottest module
Temperature (min)	Temperature of the coldest module
Module (Temp. max)	Number of the module with maximal temperature.
Module (Temp. min)	Number of the module with minimal temperature.
Work time	Total work time
Emission time	Total emission time
Work time today	Total work time today
Emission time today	Total emission time today

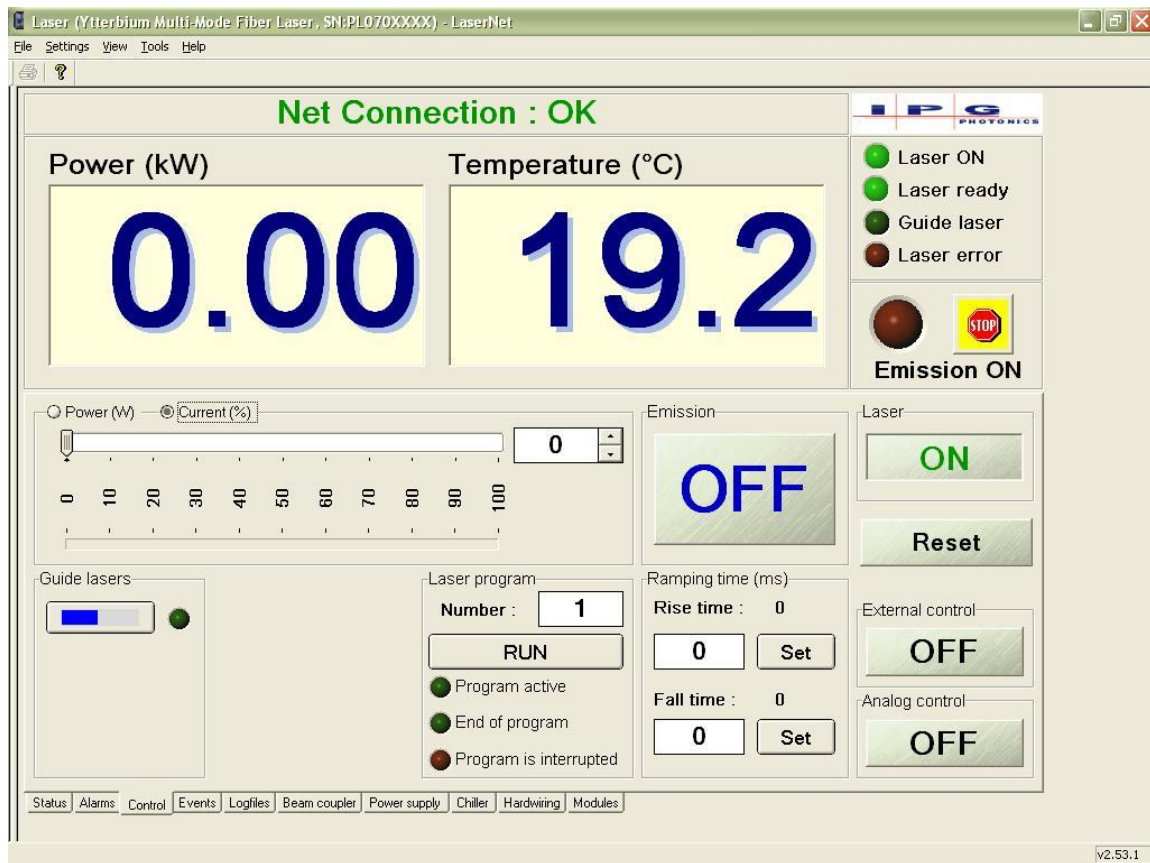
Alarms Page



Signal	Description
E-Stop	Safety circuit is open. If this signal disappears laser emission and power supply will be switched off and “Laser ready” will be set to low, but “Laser error” will not be set high
E-Stop Button	Active if the E-Stop button at laser is pressed. While the E-Stop signal is high the power supply can’t be turned on.
E-Stop External	Active if the External safety circuit becomes interrupted
Laser overheating	Temperature of one or several laser modules is higher 35°C. In this case emission of overheated module will be switched off and switched on again when module temperature will be lower 32°C. The reserve module will not be switched on.
Laser fiber interlock	Fiber interlock circuit disconnected. This signal create “Laser error” signal, remove “laser ready” signal and switched off emission and main power supply. Use “Reset” button to remove this message when fiber is plugged into optical head.
High back reflection	High back reflection detected. This signal switch off laser emission, remove “Laser ready”, activate “Laser error” signal and switch off main power supply. Use “Reset” button or Reset signal (A4) to remove this signal.
Laser module failure	An error in one of the laser modules is detected. In this case defect module will be switched off and reserve module will be activated. Total laser power in this case does not change. This signal has no influence to the “Laser ready” and “Laser error” signals. When this signal

	appears, laser emission will be off.
Laser module disconnected	Communication error between laser module processor and main laser processor. Check laser module connection cable. If communication is OK green LED on the module will blink.
Chiller Failure	This signal is generated by the chiller. This signal switches the laser emission to "off" deactivates "Laser Ready" signal and sets "Laser Error:" high.
Combiner Failure	Signal is present if "Critical Error" status signal is active. This signal switches laser emission off, deactivates "Laser Ready" signal and sets "Laser Error" status signal high.
Electronics Overheat	This signal will be active if the temperature of the electronics exceeds set value. This signal will not disable Laser emission or "Laser Ready" signal.
Initialization Error	An error occurred during LaserNet startup. Please contact IPG representative.
Low water flow: laser	Low water flow through the laser. Check the chiller and water connection line. This message will create "Laser error" signal and remove "Laser ready" signal.
Low water flow: fiber connector	Low water flow at the feeding fiber connector. Check for leakage from the water line for external optics. This message will create "Laser error" signal and remove "Laser ready" signal.
Water in laser	Leakage from the laser water distribution system. This signal will switch off main power supply, remove "Laser ready" signal and create "Laser error" signal.
Water Inside Fiber Coupler	Leakage from the Fiber Coupler water distribution system. This signal will switch off main power supply, remove "Laser ready" signal and create "Laser error" signal.
Power supply failure	Indicates no output voltage from the main power supply caused by internal Power supply failure. This signal switch off emission, remove "Laser ready" signal and set "Laser error" signal.
Critical Error	This alarm is present with "Combiner Failure" signal. Please contact IPG representative.
Chiller Error	Signal is active if tap or DI water exceeds set threshold values or water conductivity is too high. Also active if chiller malfunction occurs.
Indication Lamp Failure	One of the indicator lamps damaged or bad connected. This is only information signal; it has no influence on "Laser ready" and "Laser error" message.
Reserve Module is On	One of the active modules has become disable and reserve module is now active. Please contact IPG Representative
Unexpected pump current	One of the laser modules reported about pump current in situation when there was NO appropriate command to turn it ON. This signal switches off emission, and main power supply, and sets "Laser error" signal and removes "Laser ready" signal.
Unexpected ground leakage	Main power supply of the Laser (which provides DC power for the laser modules) has floating output. Negative terminal of the power supply output is not grounded. The message "Unexpected ground leakage" appears when the control system senses some current leakage from negative terminal of the power supply to the ground (Protective Earth). This signal switches off emission, and main power supply, sets "Laser error" signal and removes "Laser ready" signal.

Control Page



“Power/Current” slider. Using this slider you can set required laser power or current (it depends if power stabilization or current stabilization mode is set). Under the slider there is process indicator. It shows what power/current is set. In a small window power/current are represented in numerical form. Current setting is possible in the range of 10...100%.

“Guide lasers”. Press this button to switch on the guide laser (red aiming beam) installed inside fiber laser. Press it again to switch it off.

“Emission” button. When OFF (blue color) mean emission is disabled. When ON (red color) mean emission is enabled. Always set this button in ON position if you want to get emission from the laser. This is only working when you are in Local Mode or have the internal control enabled from Hardwiring.

“Laser”. This button shows the status of the Main Power Supply and similar to Start button on the front panel of the laser, however it is not possible to activate power supply from LaserNet for safety purposes, only turn it off.

“Reset”. Using this button you can remove error (alarm) messages with locking function if the reason for its occurrence is already eliminated.

“External control”. By pushing this button you activate External modulation mode. To get laser emission in this mode you have to:

1. Set required laser power (in percents or in watts)

2. Press "Emission" button
3. Supply external signal to A1 (+) and A2 (ground) pins of Safety interface connector.
4. Switch emission off by removing one of these points.

"Analog control". By pushing this button you activate Analog control mode and automatically the external control mode. To get laser emission in this mode you have to:

1. Set required laser power via analog control input: 0 V DC corresponds to 0 W output power, 10 V DC corresponds to maximum laser power (>1000 W).
2. Press "Emission button"
3. Supply external signal to A1 (+) and A2 (ground) pins of Safety interface connector.(XP2)
4. Switch emission off by removing one of these points.

"Ramping time". Using this option you can set variable rise and fall time for laser emission. Time range for this option is 0...5000ms.

"Laser program". With these buttons you can run the LaserProgram (See also description below).

Choose a program that was written before in the program editor

Run will start a chosen program if the laser in ON and READY.

WARNING: The program does not wait for the Emission ON button to be pressed

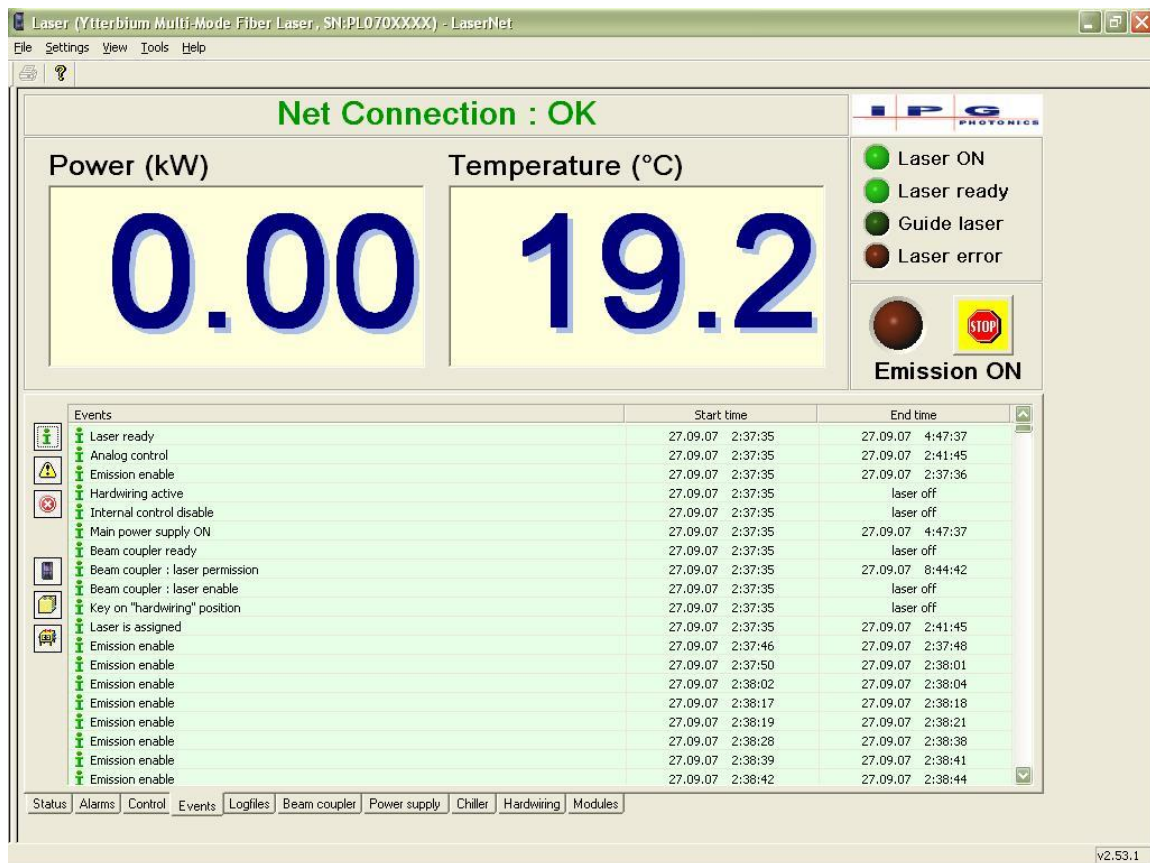
While program is active the label on the RUN button will change to STOP. Press it to stop the program immediately.

Program active indicator will be illuminated until the program is working.

When the program was completely executed End of program will be illuminated.

If something disturbed the program and stopped execution Program is interrupted will be active. Check in the events the reason of interruption and press Reset to remove the high signal on Program is interrupted.

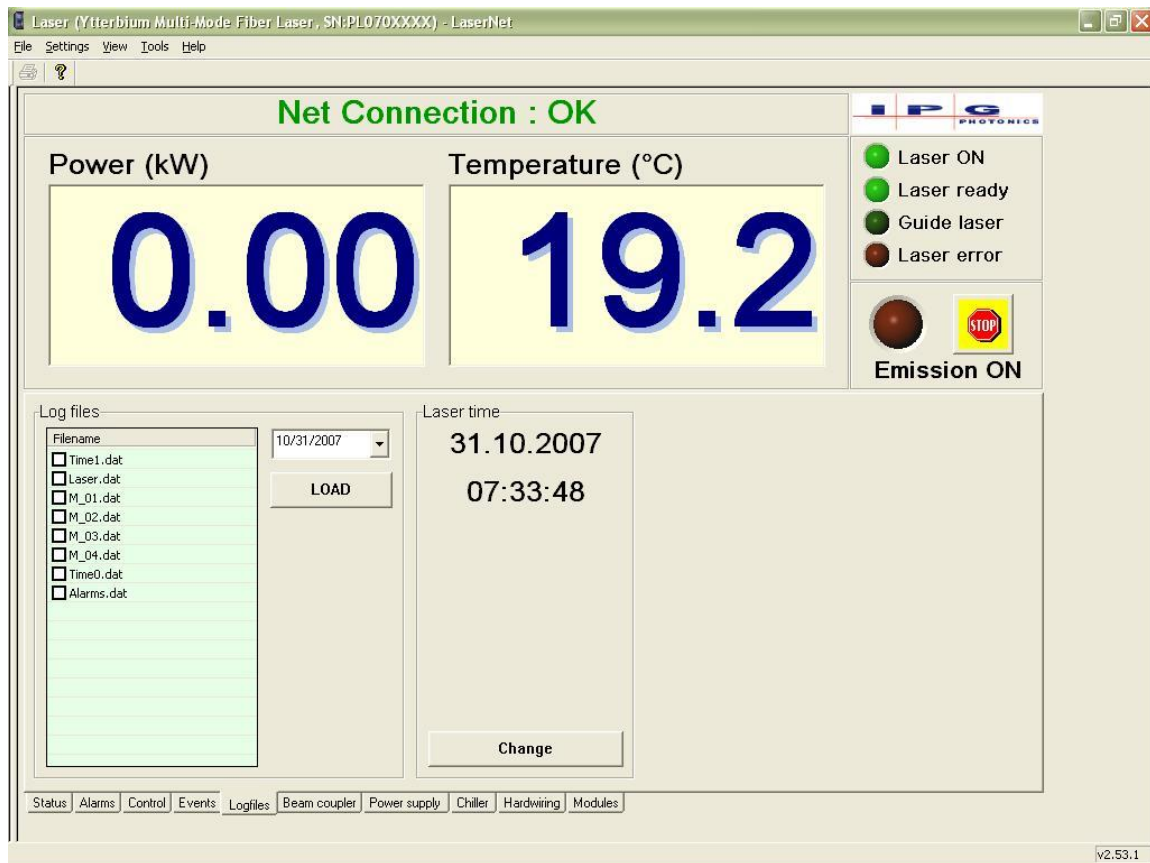
Events Page



On this page all interesting events are listed. For every event appearance time is fixed. To remove old events press right mouse button and choose "Delete all events".

HINT: Please delete all the events weekly. This will reduce the time that is needed to open this window. The data will still be saved inside laser on the internal HDD.

Logfiles Page

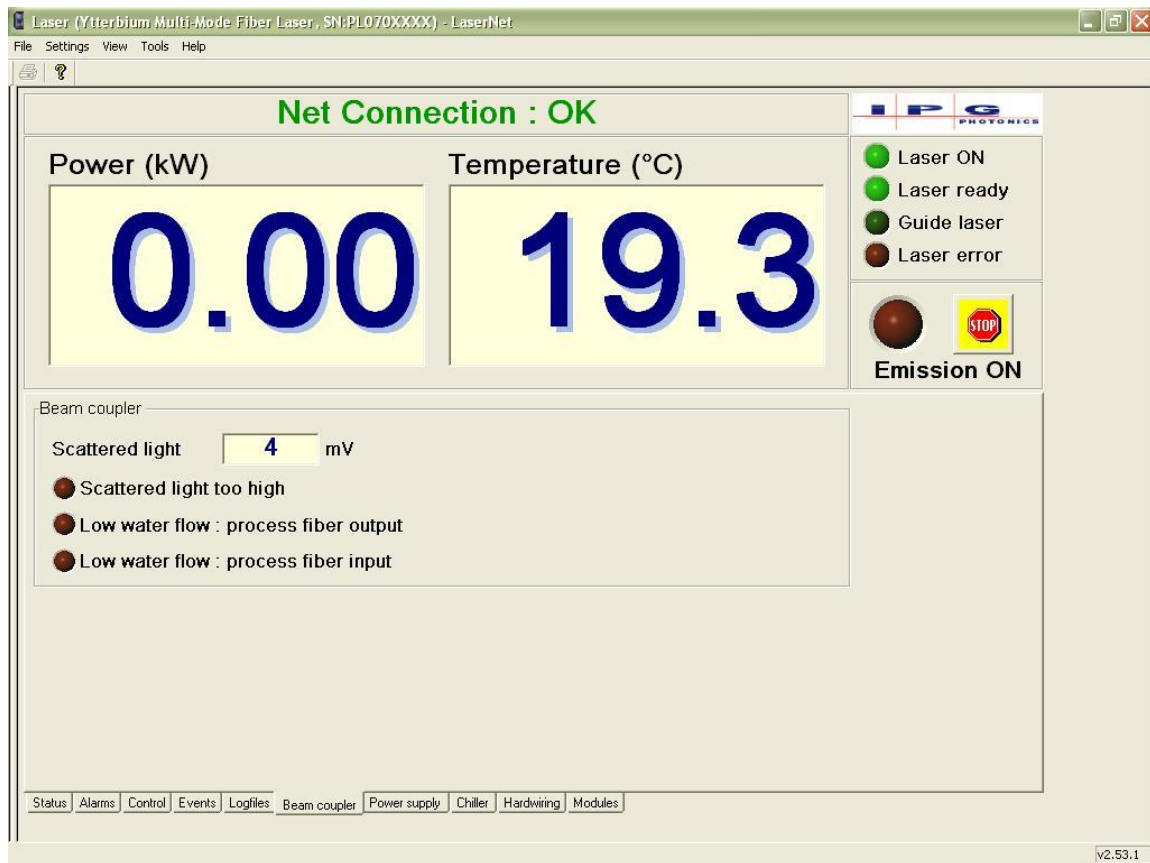


This page is used for the service. Using this page it is possible to get complete information about laser system performance.

You can change the laser time by pressing the change button and write the local time and date. This has to be done so that the correct working and emission time can be calculated.

The logfiles are stored on the internal HDD in binary form. They can not be read with the LaserNet program. If service reasons occur please send the logfiles of the actual day to IPG. To do this first choose the date when failure happened and second the needed files in the filename table. Then press the load button. The files will be saved onto the HDD of the controlling computer in the LaserNet folder.

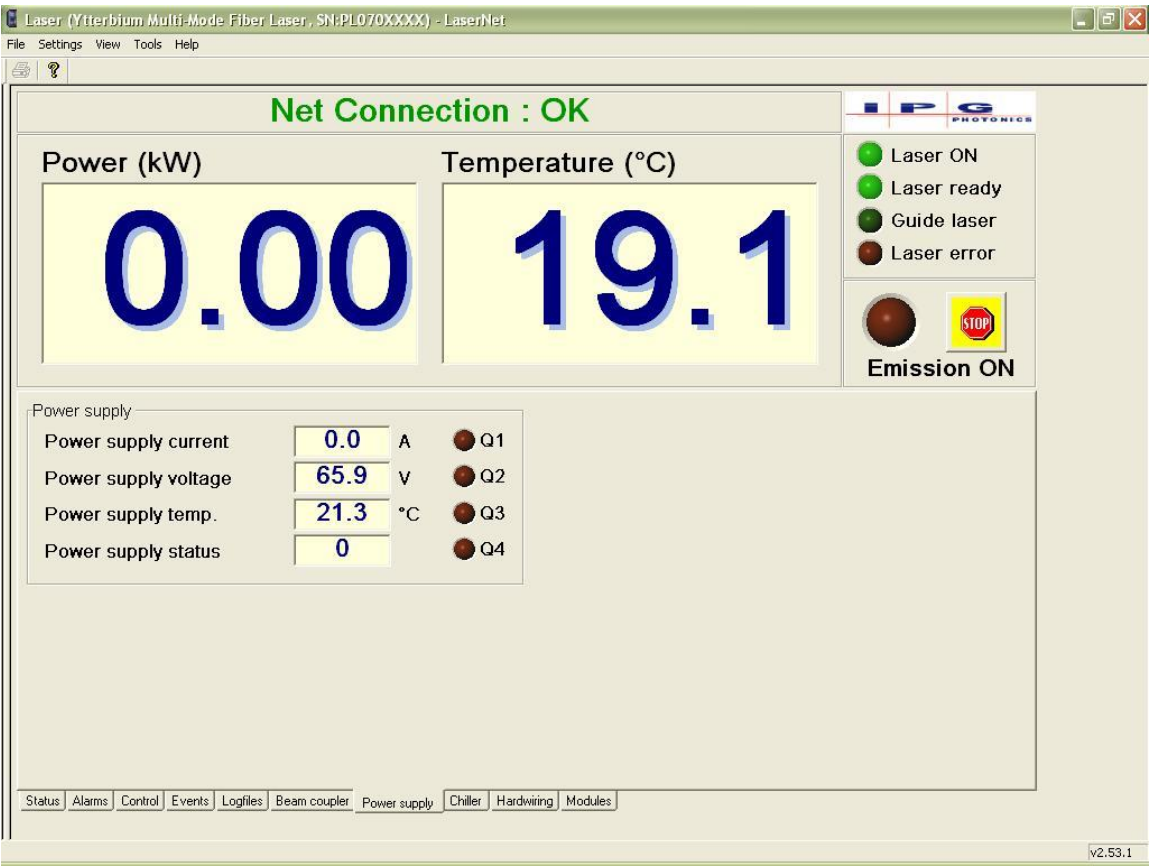
Beam Coupler Page



This page contains information about the statuses of the beam coupler.

Signal	Description
Scattered light	Measured level of scattered light in the beam coupler.
Scattered light too high	Alarm: the level of scattered light inside the beam coupler is too high. (Photodiode signal higher then 3.5 V DC)
Low water flow : Output fiber connector	Water flow through the delivery fiber connector at the beam coupler is too low.
Low water flow: Process fiber connector	Water flow through the final output connector is too low.

Power Supply Page

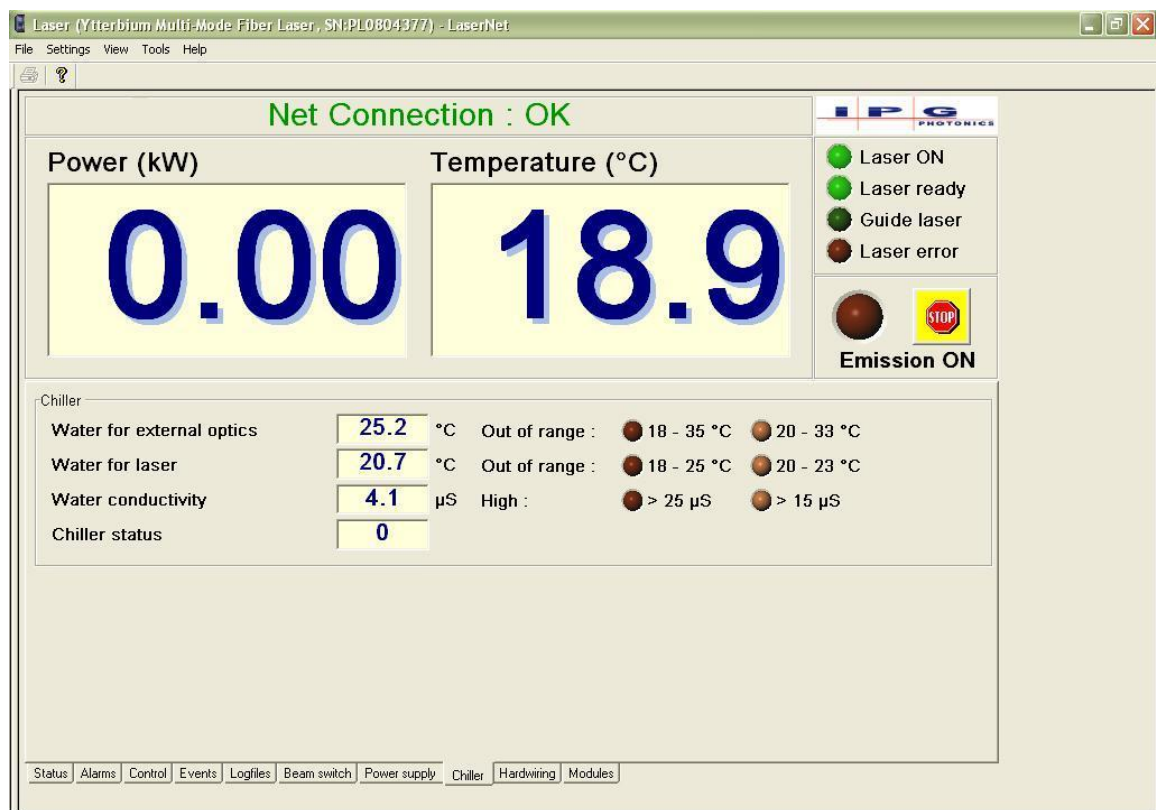


On this page you can see main power supply parameters.

Q1-Q4 parameters meaning are listed in the table:

Q1	Q2	Q3	Q4	Status	Comments
0	0	0	0	Normal Operation	All these alarms are associated with external parameters/environment (Water flow, input voltage, etc.)
0	0	0	1	Overheating	
0	0	1	0	Output Overvoltage	
0	0	1	1	Output Overcurrent/Short circuit	
0	1	0	0	Input Undervoltage/Phase loss	
0	1	0	1	Interlock Disconnected	
0	1	1	0	Reserved	
0	1	1	1	Reserved	
1	0	0	0	Internal Error (Code_X)	All these alarms are associated with internal failures. Power supply should be replaced with another one
1	0	0	1	Internal Error (Code_Y)	
1	1	1	1	Internal Error (code_Z)	

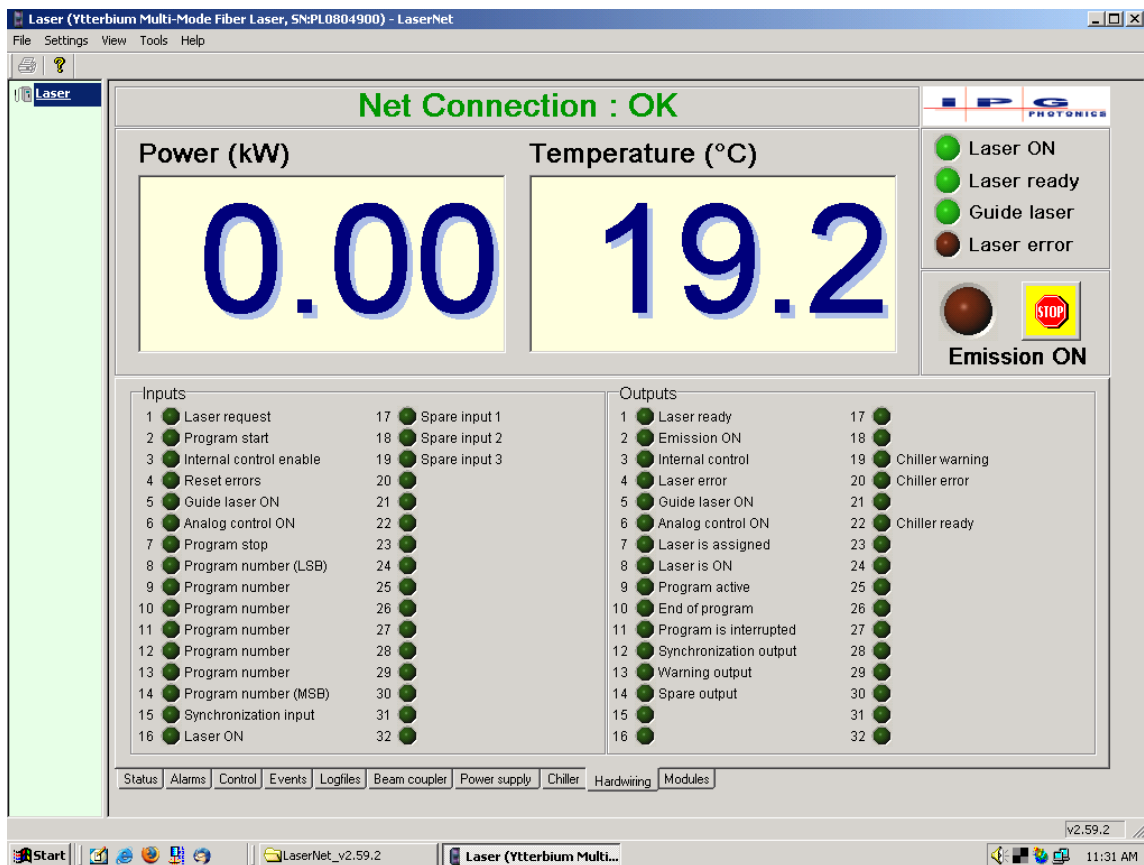
Chiller Page (if applicable)



On this page you can see current water temperature for laser cooling and for external optics and the chiller status. If these values are not in the specified range as it is displayed in brackets “Laser ready” status will be removed until values are in a valid range.

(Information on this page may vary depending on a chiller version).

Hardwiring Page



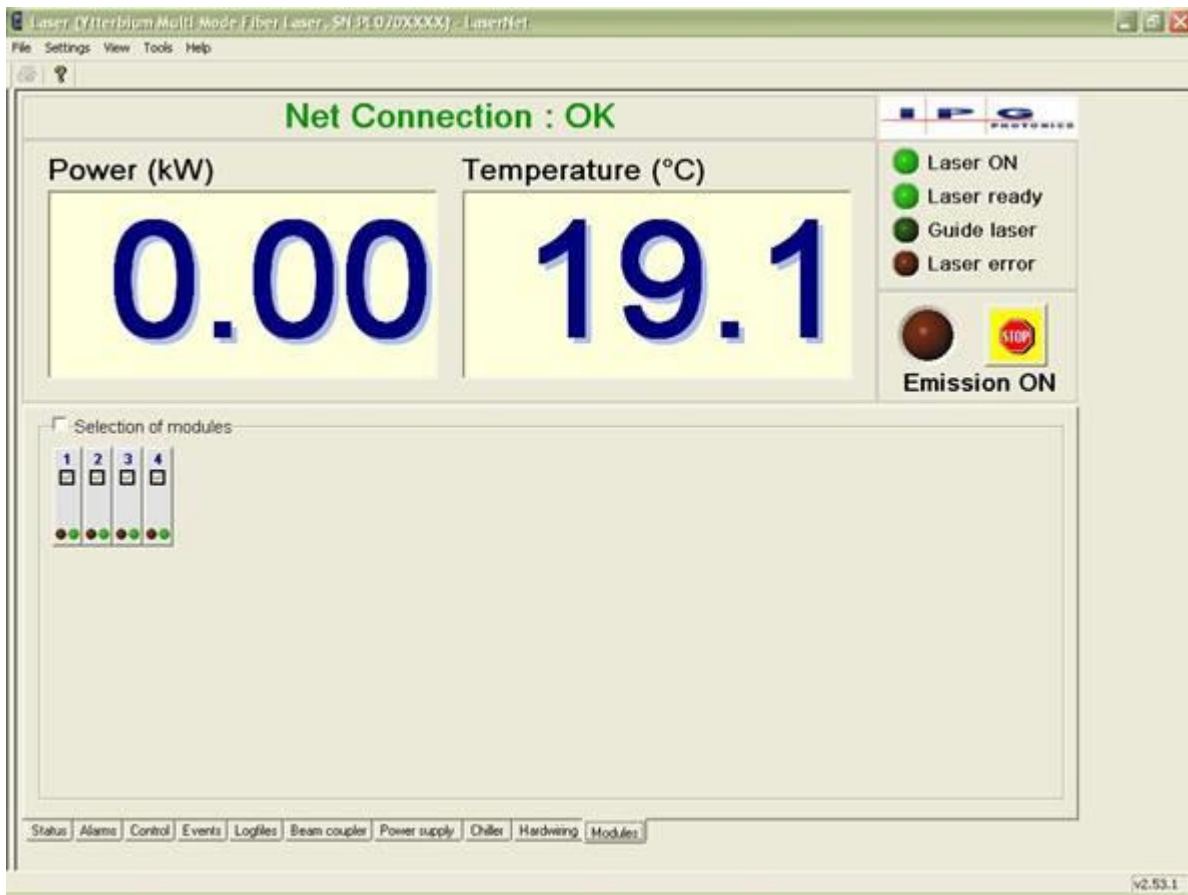
In this window the status of all hardwiring bits is shown.
At high signal the bit will be ignited in green.

For detailed description check the hardwiring description in System Installation section of this manual.

HINT:

Inputs 1 – 15 correspond with pins A1 – A15 of Harting Han 64 D Connector.
Inputs 16 – 19 correspond with pins C1 – C4 of Harting Han 64 D Connector.
Outputs 1 – 14 correspond with B1 –B14 of Harting Han 64 D Connector.

Options



On this page it is possible to activate single optical module(s). Check the Single module mode and choose the module you want to activate. You can choose any module from M1 to M4

After the activation you can start the emission out of the activated module by using the control window. (Normal, external, analog, LaserProgram or hardwiring control is possible).

The only difference with the all module mode is that you cannot use the power slider on the control program. You have to use the current slider. This is due to an internal calibration of the power slider.

6. Operation

Laser can be operated in a combination of Local mode, Modulation Control, Analog Control, Laser Program **or** Remote Mode, Hardwiring Control, or Analog Control and Laser Program.

Hint: After switching on the laser controller, by turning the Key Switch to Local or Remote Mode, it can take up to two minutes to activate the controller. The internal computer needs this time to boot.

Local Mode

By turning the Key Switch clockwise you put the laser to Local/Test Mode. In this mode only external computer is needed to drive the laser. Computer has to be connected to the laser or network via Ethernet interface. Here is the sequence of actions:

1. Connect Laser to external computer directly or to local network. Put Key Switch to Local/Test position. Start LaserNet program. Laser parameters and statuses will be displayed in multi window screen.
2. The interlocks in the “Safety Interface” must be satisfied. Refer to “Safety Interface” pin-out description in this manual.
3. Press Start button on the front panel– main laser power supply will be activated. You should see Laser ON and Laser Ready status if everything setup properly.
4. Switch On red aiming beam by pressing guide button. Align beam position. You should see Guide laser status on Status Page.
5. Set required power or pump diodes current using slider on Control Page. You will see settings of output power (in Watt) or pump diodes current (in percents).
6. Press Emission ON/OFF button. Laser will emit power; you will see indicated laser power.
7. It is possible to change output power level during emission from 10 to 100%.
8. Switch OFF laser emission pressing Emission ON/OFF button.
9. It is possible to set different rise and fall time for switching ON and OFF laser emission. This option is available only in Manual mode.

Modulation Control

While laser is in Local Mode it is possible to externally enable/disable emission with frequencies up to 5 kHz. For operation in this mode additional external signal is required. 5-24 VDC signal required to switch ON laser emission.

1. Connect external 24V signal to the modulation input of the Harting Han 25 D Connector (safety interface). Refer to pin out in System Installation section.
2. Start LaserNet program. Open Control window.
3. Press External control ON/OFF button. Now External modulation mode is active.
4. Set required laser power (in percentage or in Watts).
5. Press Emission ON/OFF button. Warning lamps will start blinking, but no radiation emits until a high external modulation signal is applied.
6. Switch on external signal – emission will be on.
7. It is possible to change output power level during emission.
8. Switch off emission by removing external signal.

Analog Control

It is possible to control output power from the laser with an analog signal. 0 VDC corresponds to the 0 W output power, 10 VDC corresponds to maximum power. By activating this control, modulation input becomes active automatically.

1. Connect external 0-10 V analog signal to the Harting Han 7 D connector. Refer to the pin out assignment in the System Installation section.
2. Start LaserNet program. Open Control window.
3. Press Analog control ON/OFF button. Now Analog control mode is active. External modulation mode will be activated automatically.
4. Press Emission ON/OFF button.
5. Set required power level providing 0...10 V DC to analog input.
6. Apply high signal to modulation input – emission will be on.
7. It is possible to change output power level during emission by changing analog signal.

Remote Mode

By turning the Key Switch counter clockwise the laser is placed in Remote/Robot Mode. Without integration with external control system it is not possible to activate the power supply and turn emission on. Digital, so-called Hardwiring, interface must be used to control the laser. Refer to Safety Interface connector pin out for connections with external Key Switch, Start button, power supply and emission indicators, E-Stop circuitry. Connection with computer is still recommended for monitor functions.

Hardwiring Control

Refer to System Installation section for pin out of Harting Han 64 D connector used for digital inputs and outputs in Remote mode. When “Laser request signal” (pin A1) is supplied, a computer with the LaserNet program is used only for monitoring, it is blocked from direct control.

Timetables for the hardwiring interface

1. Laser request and Laser assigned signals



2. Guide laser ON and Guide laser is ON signals



3. Program start and Program active for Program number > 0.



4. Laser ON, Laser is ON and Laser ready signals



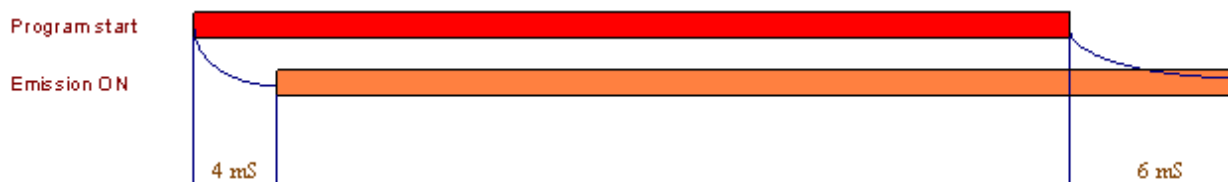
5. Analog control and Analog control is ON signals



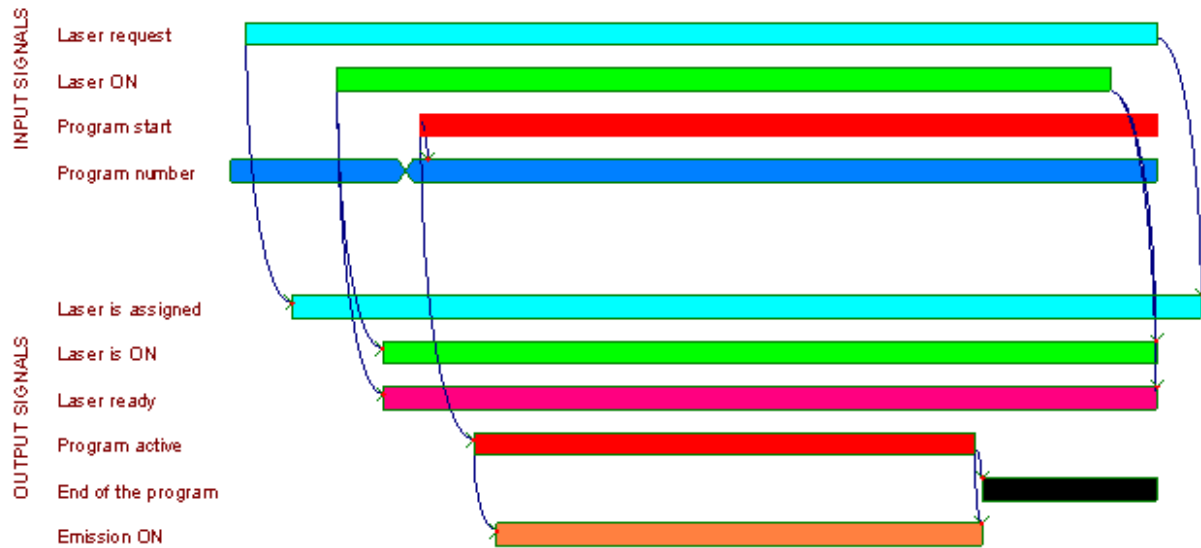
6. Internal control and Internal control is enabled



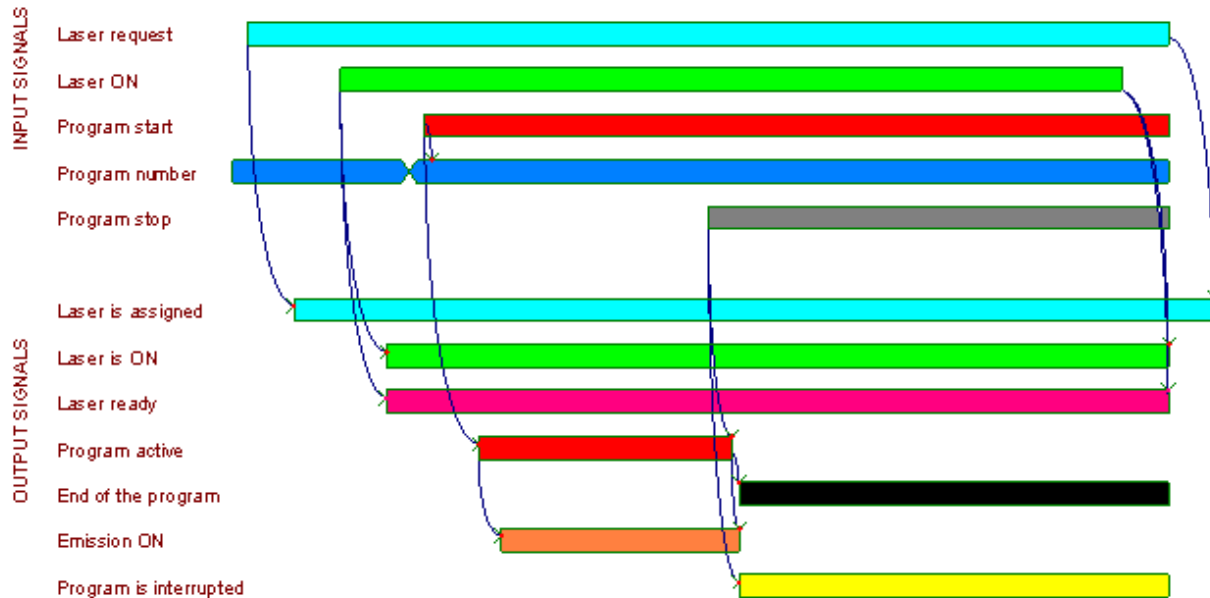
7. Program start and Emission ON for Program number = 0



8. The next timing diagram is applied to normal process flow, when laser program is started and terminated without errors or forced “Program stop” signal.



9. The next timing diagram is applied to situation, when forced “Program stop” signal is issued.



Using Laser Programs

Program editor:

Open editor by tools/program editor in the LaserNet program.

No. corresponds with the line number of the program (maximum 100) and is set automatically.

In the **CMD** column the commands of LP (Laser program) can be chosen.

For a new command click with left mouse button there and choose command. It is possible to insert a new command between existing lines by right clicking and pick insert line.

A line can be deleted by right clicking and picking delete line.

After a command is chosen the parameters for the command need to be specified in the other two columns.

Press the write button to save the file under a number. (1 – 50)

This is only possible if a connection between laser and program is established.

Press the read button if you want to recall a previously saved program from storage.

This is only possible if a connection between laser and program is established.

Structure of the laser program (LP):

Each LASER PROGRAM can be represented as three-column table. The codes of commands are specified in the first column, parameters of those commands are specified in the second and in the third columns.

Total number of lines in each LP is limited by 100 (it is defined by size of internal FLASH). The maximum number of LPs is limited by 50.

The command "Start LP number 0" is equivalent to Emission On command in Local Control Mode.

Description of commands of LASER PROGRAM:

1. *Stop*

This command switches off the emission, switches off analog control if it was switched on, stops execution of the LASER PROGRAM and sets a signal «*End of the program*» to high level.

2. *Set output power at a certain time*

(Linear interpolation between two points) - this command sets output power (W), specified as the second parameter of this command, after period of time (ms), specified as the first parameter. The initial value of power is taken from the previous command if applicable (see remark); or 0 if such a command has not been listed. If the initial power is equal to the new value, this command performs only a delay with specified time. This command switches off analog control if it was switched on.

3. *Set output power with ramping time*

This command is similar to the previous one, except for the first parameter: Ramping ratio (in W/ms) is specified instead of the time.

Remark: if the initial value of power is equal to the new one, command performs nothing.

Remark: commands 2 and 3 are the only commands to set power.

4. *Wait for event*

This command is waiting for events, which can be as follows:

- *Transition high/low on Synchronization Input,*
- *Transition low/high on Synchronization Input,*
- *Low level on Synchronization Input,*
- *High level on Synchronization Input,*
- *Timer (ms).*

Active synchronization input or timer is specified by the first parameter, type of event is specified by the second parameter.

5. *Go to another command line*

This command performs “GOTO” to another command (line of LP), specified in the first parameter if the counter specified in the second parameter is not zero. After the jump, if the counter is more than zero, program decreases counter by one. If the initial state of counter is zero – this command performs unconditional “GOTO”. In addition to the counter (instead) following events can be used: (GOTO IF)

- *Low level on Synchronization Input,*
- *High level on Synchronization Input.*

Jump will be performed, if specified condition is detected.

6. *Set signal on «Synchronization Output»*

This command sets low or a high level on Synchronization Output.

Number of «Synchronization Output» (only one in this version) is specified by the first parameter, level (high or low) - by the second one.

7. *Switch-over to external mode*

After performing this command the value of the output power is taken from the external interface. The external interface is specified by the first parameter of the command. Action of this command can be stopped by commands #1, #2, #3 (also #7, but with the different external interface specified).

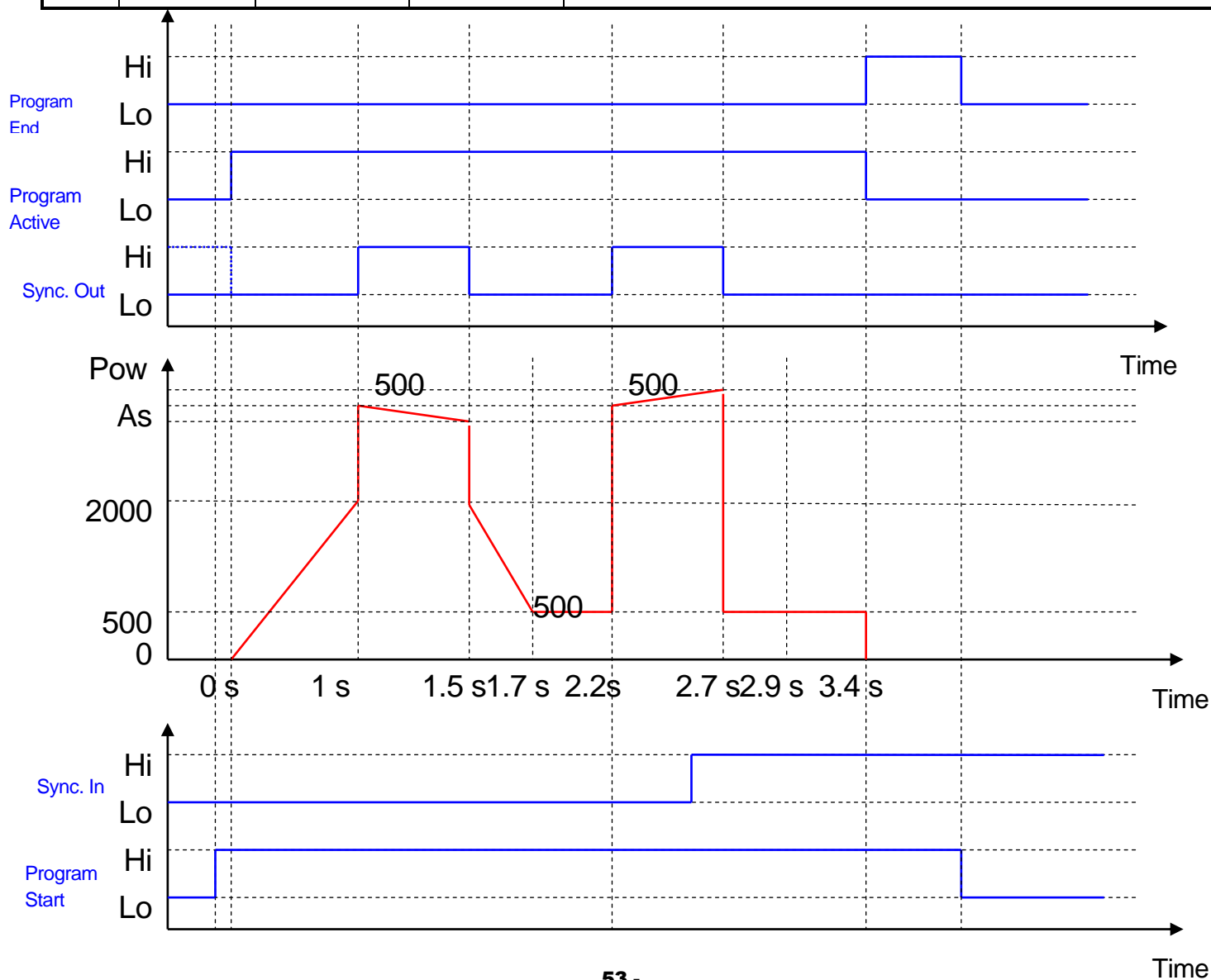
Remark: the current version of LASER PROGRAM supports only one type of external interface – External analog control.

Table of commands of Laser Program (LP)

Command		Parameter 1	Parameter 2	Remarks
#	Name			
1	STOP	-	-	No parameters
2	SPT	0 - 65535	0 – max power	Parameter 1 – time in ms Parameter 2 – power in W
3	SPR	0 - 65535	0 – max power	Parameter 1 – ramping ratio in W/ms Parameter 2 – power in W
4	WAIT	SI	LOW	Wait for low level on Sync.In.
		SI	HIGH	Wait for high level on Sync.In.
		SI	LH	Wait for transition from low to high level on Sync.In
		SI	HL	Wait for transition from high to low level on Sync.In
		Time	0 - 65535	Delay in ms
5	GOTO	Line 0 – 99	SI LOW	Go to the specified line of LP if low level is detected on Sync.In
		Line 0 – 99	SI HIGH	Go to the specified line of LP if high level is detected on Sync.In
		Line 0 – 99	0 - 32767	Go to specified line by counter
6	OUT	SO	LOW	Set Sync.In to low level
		SO	HIGH	Set Sync.In to high level
7	EXTPWR	ANALOG	-	Switch over to analog interface

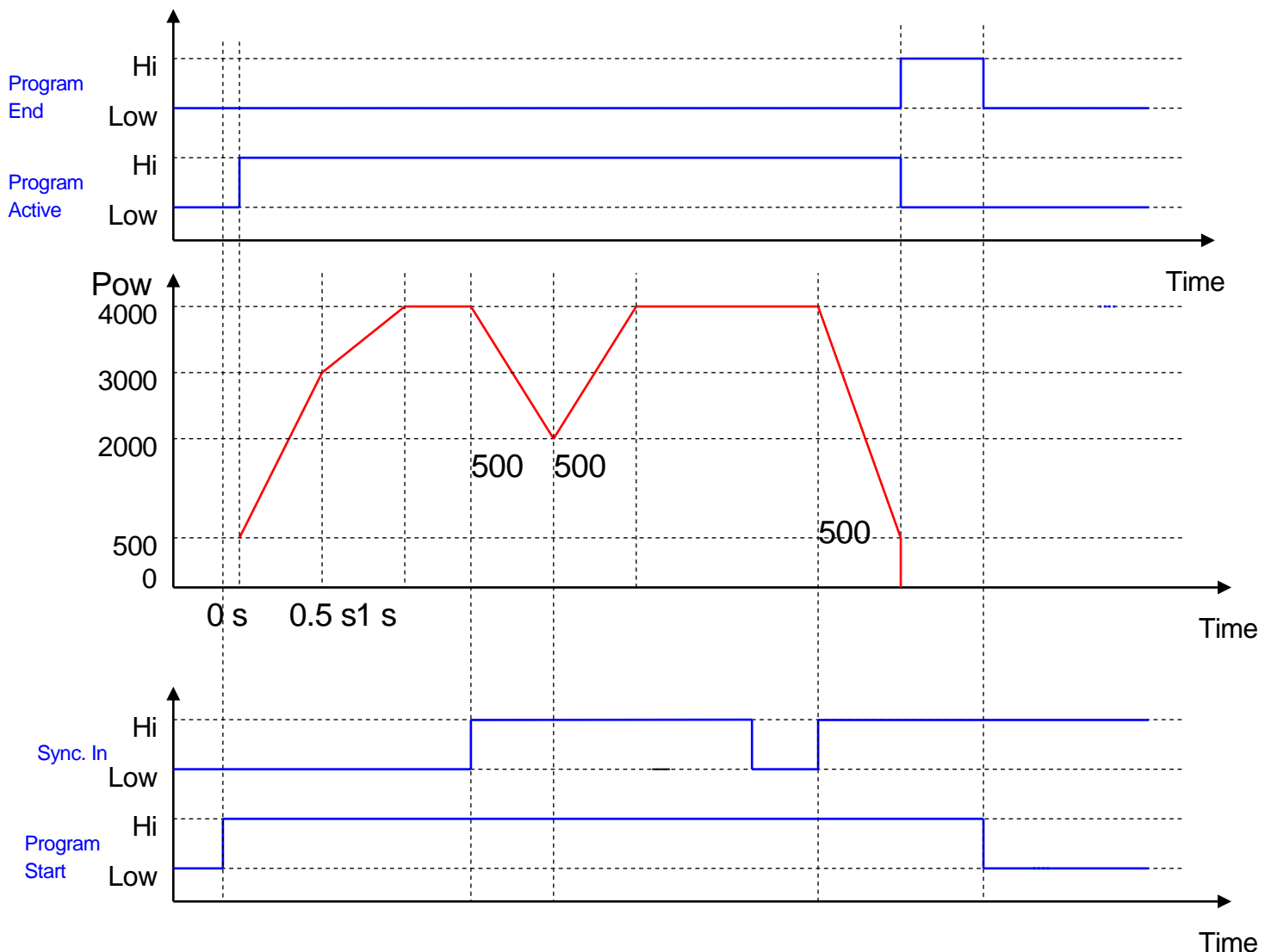
Example 1 of the LP (Sequence of pulses).

Line	Command	Parameter 1	Parameter 2	Remarks
1	OUT	SO	LOW	Sets the <i>Synchronization Output</i> to low level.
2	SPT	1000	2000	Reaches output power of 2 kW in 1 sec.
3	EXTPWR	ANALOG	-	Switches-over to analogue interface
4	OUT	SO	HI	Sets the <i>Synchronization Output</i> to high level.
5	WAIT	TIME	500	Wait 500 ms.
6	OUT	SO	LOW	Sets the <i>Synchronization Output</i> to low level.
7	SPT	200	500	Reaches output power of 500 W in 200 ms.
8	WAIT	TIME	500	Wait 500 ms.
9	GOTO	LINE3	SI LOW	Go to line 3 if Sync.In. has low level
10	STOP	-	-	End of the program



Example 2 of the LP.

Line	Command	Parameter 1	Parameter 2	Remarks
1	SPT	500	3000	Reaches output power of 3 kW in 0.5 sec.
2	SPT	500	4000	Reaches output power of 4 kW in 0.5 sec.
3	WAIT	SI	LH	Wait for transition from low to high level on <i>Synchronization Input</i>
4	SPT	500	2000	Reaches output power of 2 kW in 0.5 sec.
5	WAIT	SI	HI	Wait for high level on <i>Synchronization Input</i> .
6	SPT	500	4000	Reaches output power of 4 kW in 0.5 sec.
7	WAIT	SI	LH	Wait for transition from low to high level on <i>Synchronization Input</i>
8	SPT	500	500	Reaches output power of 0.5 kW in 0.5 sec.
9	STOP	-	-	End of the program



7. Specifications

This section lists specifications of the product. Specifications describe warranted performance under the temperature range 25°C +/- 5°C and relative humidity <80% (unless otherwise noted). All specifications apply after the instrument's temperature has been stabilized after 1 hour of continuous operation.

Optical Characteristics

Characteristics	Test conditions	Symbol	Min.	Typ.	Max	Unit
Operation Mode			CW, QCW			
Polarization			Random			
Nominal Output Power		P _{NOM}	500			W
Output Power Tuning Range			10		105	%
Emission Wavelength	P _{OUT} = 500 W		1070		1080	nm
Emission Linewidth	P _{OUT} = 500 W			3	6	nm
Switching ON/OFF Time	P _{OUT} = 500 W			80	100	μsec
Output Power Modulation Rate	P _{OUT} = 500 W				5.0	kHz
Output Power Instability	Over 8 hrs, T _{WATER} = Const			1.0	2.0	%
Beam Parameter Product	50 μm	BPP			2.5	mm*mrad
Beam Parameter Product	100 micron delivery fiber	BPP		--	5	mm*mrad
Aiming Laser Wavelength			640		680	nm
Aiming Laser Output Power			0.5		1	mW

Optical Output

Characteristic	Test Condition	Symbol	Min.	Typ.	Max.	Unit
Feeding Fiber Core			50			μm
Output Termination			IPG HLC-8 Connector (QBH compatible)			
Fiber Cable Length				5		m
Fiber Cable Bend Radius: unstressed stressed		R	100 200			mm

General Characteristics

Parameters	Test conditions	Min.	Typ.	Max	Unit
Operation Voltage (3 phases)		400-520V/3P+PE			VAC
Frequency		50/60			Hz
Power Consumption	$P_{OUT} = 500\text{ W}$		1.8	2	kW
Operating Ambient Temperature Range		+ 10		+ 50	°C
Humidity: without conditioner with built-in conditioner ¹	T < 25 °C T < 40 °C			90 95	%
Storage Temperature	WITHOUT WATER	- 40		+ 75	°C
Dimensions, H x W x D	NEMA-12 IP-55	1186 x 856 x 806			mm
Weight			180	200	kg
Plumbing		NPT Threaded Stainless Steel and/or Plastic Tubing			

Interfaces

Interface		Description
Front Panel	Controls	Emergency STOP Pushbutton START Pushbutton Power ON Keyswitch Service Mode Keyswitch
	Indicators	Power Supply Active Interlock Active Service Mode Active
Indicator Lights (Redundant Pair)		Emission ON – Amber Laser Power Supply ON – Flashing Amber
Remote Control		Ethernet - Harting RJ45 Data 3A Analog Control – Harting Han 7 D Safety Interface - Harting Han 25 D Hardwiring - Harting Han 64 D

Regulatory Compliance

Function	Description
Safety	EN 954-1 Category 3
Laser	CDRH 21 CFR 1040.10 Class IV EN 60825-1
Electrical (See IPG Specification P99-010408)	CE, UL, NFPA 79, NEC, EN 60204-1

Cooling Specification

Item	Parameter	Value	Unit
Water for laser cooling	Flow	20-30	l/min
	Pressure	2 - 4	bar
	Temperature	20 - 30	°C
DI water for the external optics cooling	Flow	5-10	l/min
	Pressure	2 maximum	bar
	Temperature	25 - 35	°C

8. Product Certification

Production Confirmation:

Date: 06/26/08

Model: YLR-500-CT

Sales Order: SO2766

Serial Number: PL0804899

Customer Selected:

Wavelength = 1070 - 1080

Input Termination: Not Applicable

Output Termination: IPG QBH connector

Options: See Specifications

Notes: See Specifications

Checked By: E. Redick

9. Warranty

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If you cannot resolve the issues through the use of this User's Guide or over the telephone with our technical support group, you may need to return the product to IPG.

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- ❑ Buyer must issue a purchase order for the value of the replaced parts/service items and IPG will issue credit or invoice when the parts/service are received. Speak to IPG Quality Manager for the amount authorized under the required purchase order.
- ❑ All requests for repair or replacement under this warranty must be made to IPG within 30 days after discovery of the defect (but not later than 7 days after warranty expiration).
- ❑ All products returned to IPG but which meet applicable specifications, not defectively manufactured or used not in accordance with this User's Guide, will result in the Buyer being charged IPG's standard examination charge.
- ❑ Complete packing list with product model and serial number will ensure prompt repair.
- ❑ Be sure to include with the returned product your 'ship to' address for the return of the serviced product.

Shipping Instructions:

Warranty Returns - Domestic & *International Buyers pay for one-way freight costs and insurance to IPG. IPG will pay for freight return cost and insurance back to the Buyer.

Non-Warranty Returns - Domestic & *International Buyers pay for two-way freight costs and insurance to IPG. If shipment consists of returns that are both warranty and non-warranty, the shipment will be considered as non-warranty.

Shipping address for returns to US:

IPG Photonics Corporation
50 Old Webster Road
Oxford, MA 01540
Attn: Product Returns
Tel: 508-373-1100

***International Returns must include applicable DUTIES AND TAXES, and you must mark air bills with "U.S. GOODS, RETURNED FOR REPAIR."**