



YLP-2/500/50

Ytterbium Pulsed Fiber Laser

User's Guide

Please take time to read and understand this User's Guide and familiarize yourself with the information that we have compiled for you before you use 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.

Notices

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The IPG Laser Model YLP-2/500/50 is a Class IV laser product.

This laser emits more than 100 Watts of average power and more than 4 kW of invisible laser radiation in the optical band near 1064 nm.

Avoid eye or skin exposure to direct or scattered radiation emitted from the optical output.

Do not open the device. There are no user serviceable parts, equipment or assemblies associated with this product. All service and maintenance will be performed only at the factory.



Safety Information

Safety Conventions

We use various words and symbols that are designed to call your attention to hazards or important information. These include:

WARNING

Refers to a potential *personal* hazard. 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.



This symbol indicates laser radiation. We place this symbol on products which have a laser output.

General Safety Instructions

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.

WARNING: 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.

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

WARNING: 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.

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

WARNING: If this instrument is used in a manner not specified in this document, the protection provided by the instrument may be impaired. This product must be used only in normal conditions.

WARNING: This instrument is used water for cooling. Without water cooling this laser will be damaged. Please provide water flow not less than 1 liter/per minute.

WARNING: The laser is sensitive to the power reflected back to the laser. Please do not exposure to the reflected surfaces.

Laser Classification

This device is classified as a high power Class IV laser instrument under IEC 60825 and 21 CFR 1040.10. This product emits wavelength light at or around 1065 nm at total power of light radiated out of the optical output greater than 100 W. 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: Do not install output head when laser is active.

WARNING: NEVER look directly into output head and make sure that you wear appropriate laser safety glasses at all times while operating the product.

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

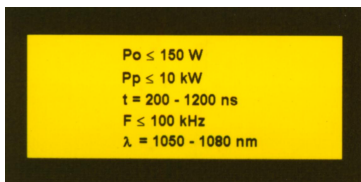
Safety Labels and Labeling Locations:

The figures below show the FDA, and other labels and their placement on the product.



Aperture Label

Location: Collimator assembly or output cable exit port.



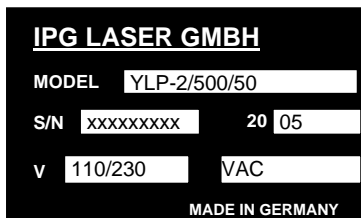
Certification Label

Location: Top Cover or Front Panel of the Unit



Warning Logotype

Location: Top Cover or Front Panel of the Unit



Identification Label

Location: Rear panel of the Unit

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1. Description

The YLP-2/500/50 Series pulsed Ytterbium Fiber Laser was developed for industrial applications. This laser is compact and efficient allowing that to replace bulky and less efficient non-fiber lasers.

The YLP-2/500/50 Series is a high power, efficient laser producing 100 watts of average optical power and 2 mJ pulse energy at a wavelength of 1064 nm.

Main Features:

- High quality fiber output
- High power
- Reliable, long lifetime
- Compact, rugged package
- Efficient
- External Computer interfaces

Applications:

- Industrial Applications
- Scientific Research

2. Accessories

Part	Quantity	Note
YLP-2/500/50	1	Ytterbium fiber laser
Power key	2	For switching control power supply
Interlock connector	1	Interlock mating connector with short circuit inside
Power supply cable	1	Plug according to IEC/EN 60320-1/C19
User's Guide	1	This Document
Optical Isolator	1	Connect to the collimator before use

3. Specification

This section lists typical specifications of the product. Specifications describe warranted performance over 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. Specification for particular unit may differ from the mentioned below if some modifications were requested by a customer.

Optical characteristics

No	Characteristic	Conditions	Symbol	Min.	Typ.	Max.	Unit
1	Mode of Operation			pulsed			
2	Polarization state			random			
3	Average output power	PRR=20kHz PRR=50 kHz	Pavg		40 100		W
4	Pulse repetition rate		PRR	20		50	kHz
5	Central Emission Wavelength		λ	1055	1065	1075	nm
6	Emission Bandwidth				2	5	nm
7	Pulse duration	may vary depending on PRR		400	550	1000	ns
8	Pulse energy				2		mJ
9	Adjustment mode power	average power				200	mW

Optical output / Output Isolator

No	Characteristic	Conditions	Min.	Typ.	Max.	Unit
10	Output beam diameter	level 1/e ²		7		mm
11	Output beam quality	M ²			5	
12	Output fiber length			5*		m
13	Operating time under strong back reflection	refl.> 10%			30	sec
14	Output isolator weight				3.0	kg
15	Isolator dimensions	ØxL		67x320		mm
16	Isolator operating temperature range		+10		+35	°C

* Length may be changed on request

Guide laser (optional)

No	Characteristic	Conditions	Min.	Typ.	Max.	Unit
17	Operating wavelength			660		nm
18	Output power			0.05	1	mW

Control interface

RS-232C interface to control the laser and monitor parameters

Laser Modulation signal

No	Characteristic	Symbol	Min.	Typ.	Max.	Unit
19	Signal format		0V=LOW, 5V=HIGH			
20	HIGH LOW disconnected (floating)		emission (Laser ON) no power (Laser OFF) no power (Laser OFF)			

Electrical characteristics

No	Characteristic	Conditions	Min.	Typ.	Max.	Unit
21	Power supply voltage		100		240	VAC
22	Power consumption				600	W
23	Computer interface		RS-232C, 9 pin Dsub connector			

General Characteristics

No	Characteristic	Symbol	Min.	Typ.	Max.	Unit
24	Environment		non-condensed including laser internal parts			
25	Operating temperature range (environment)		+10		+50	°C
26	Operating temperature range (internal water cooled modules)		+15		+35	°C
27	Storage Temperature		-20		+70	°C
28	Cooling water temperature		+15		+30	°C
			above dew point			
29	Humidity		10		95	%
			below dew point			
30	Device dimensions (WxHxD)		482x265x561			mm
31	Hosing type		19" rack mountable 6U height			
32	Cooling method		regular water			
33	Water flow		1	2		liter/min
34	Maximum pressure in water cooling system				2	bars

Front panel operating controls

No	Name	Description
35	Power Key Lock	Switch ON and OFF power to the laser
36	Main switch	Press ones to supply power to the laser
37	Emergency button	Stop laser operation

Rear panel functions

No	Name	Description
38	Emergency interlock	Stop laser operation
39	RS-232C	Connection to PC for the laser control
40	Power inlet	AC power voltage connector
41	Laser Modulation	Laser ON/OFF input (modulation)
42	Water input	Connector for cooling water input
43	Water output	Connector for cooling water output
44	Output optical cable	Cable with output fiber

4. Environment and Precautions

CAUTION: During operation there is no need to remove any protective coverings. No operator serviceable parts inside. Refer servicing to qualified personnel.

CAUTION: Do not expose the device to a high moisture environment.

CAUTION: Before turning the power to the device on, make sure the laser optical output is properly aligned and terminated.

CAUTION: The output of the YLP-2/500/50 is delivered through a more than 100 watts power. Make sure that the end face of collimator is of good quality and clean. Any dust on the output burn 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: Always switch the laser off when working with the collimator such as mounting the collimator into a fixture, viewing the end face with optical instruments, etc. If necessary, align the collimator at low output power and then increase the output power gradually.

Important: The manufacturer will not be responsible for damage sustained to the device as result of dirty end faces.

WARNING: This instrument is used water for cooling. Without water cooling this laser will be damaged. Please provide water flow not less, than 1 l/per minute.

CAUTION: For collimated outputs, maintaining a clean output lens is essential. Always close (re-cap) the collimator after use. Do not touch the output lens and do not clean with any solvents.

Water Cooling

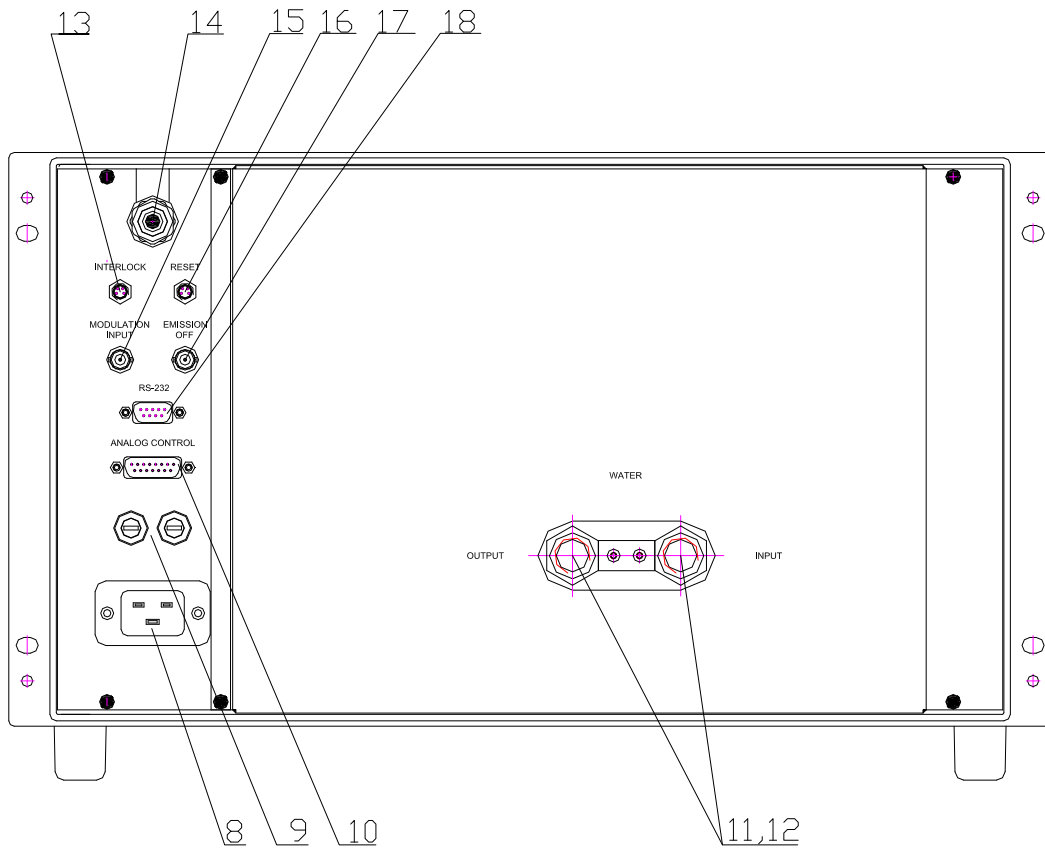
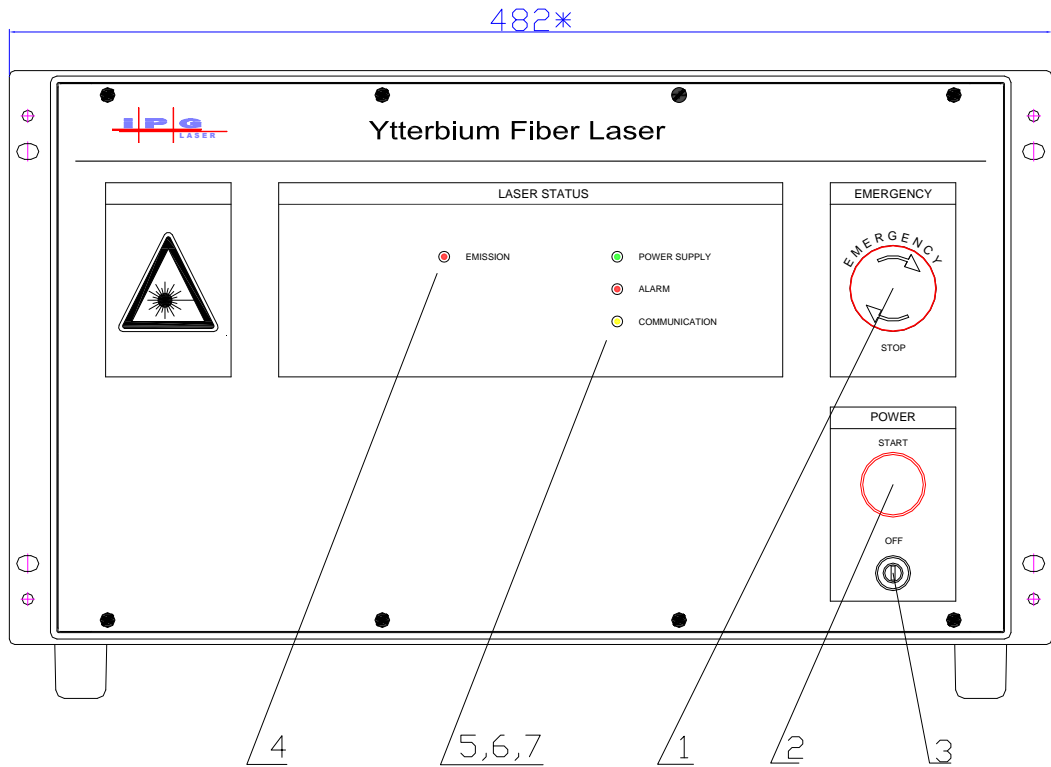
There is a risk of condensation damage when laser is placed in a high temperature and humidity environment, while cooling water temperature is colder than the dew point of the surrounding air. The cooling water temperature must always be above the dew point temperature.

Dew point temperatures table (minimum temperature of the cooling water)

Air, Temp °C	Relative Humidity, %															
	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
16				0	2	4	5	7	8	9	10	11	12	13	14	15
18			1	3	4	6	8	9	11	12	13	14	15	16	17	18
21		1	3	5	7	9	11	12	13	14	16	17	18	18	19	21
24		3	6	8	9	11	13	14	16	17	18	19	20	21	22	23
27	2	5	8	10	12	14	16	17	18	19	21	22	23	24	25	26
29	4	7	10	12	14	16	18	19	21	22	23	24	26	27	28	28
32	7	10	12	15	17	19	21	22	23	25	26	27	28	29	31	31
35	9	12	15	17	19	21	23	24	26	27	29	30	31	32	33	34
38	11	14	17	20	22	24	26	27	29	30	31	33	34	35	36	37

Failure to comply with the cautions and instructions in this document may lead to damaging the fiber laser and will void the warranty.

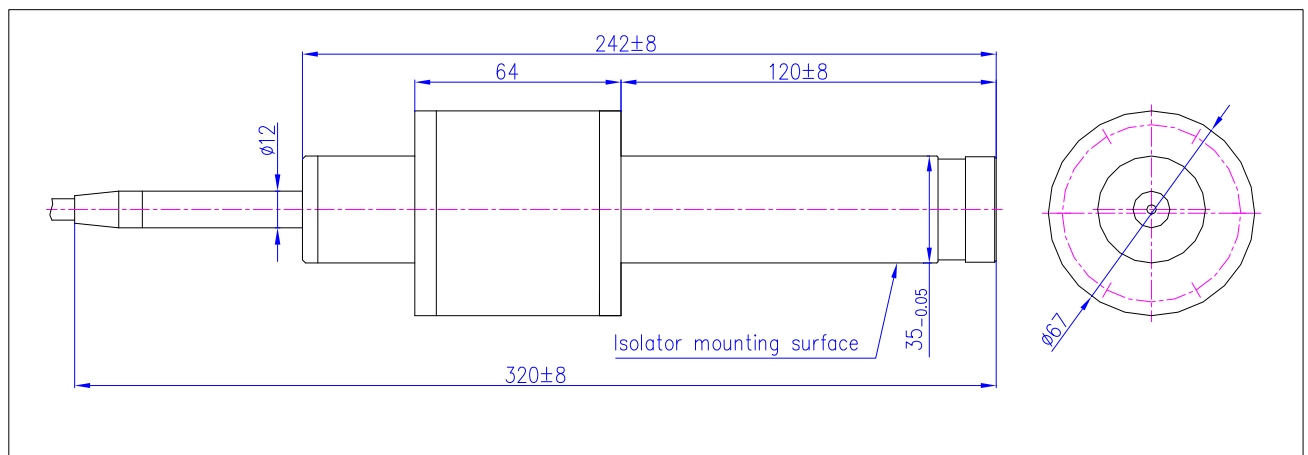
5. Front and Rear Panel Description



The operating controls and indicators of the Laser front and rear panels are listed in table below.

1	EMERGENCY button	Button switches OFF the laser in the case of emergency
2	MAIN SWITCH button	Press to turn ON power supply voltage of the laser.
3	POWER key	Key to turn ON and OFF the power
4	EMISSION led	Indicates that laser emission ON
5	POWER SUPPLY led	Indicates that power is supplied to the laser
6	ALARM led	Indicates that laser internal alarm occurs
7	COMMUNICATION led	Indicates communication through RS-232
8	AC OUTLET	100/230 VAC, 50/60 Hz
9	Fuses holders	Replaceable fuses 10A x250V
10	Analog control	Not used
11, 12	WATER IN/OUT	Minimum water flow 1 l/min
13	EMERGENCY INTERLOCK	When shorted, laser operation is enabled. (short pins 1 to 4 and 2 to 3 simultaneously) When opened, laser power supply voltage is switched OFF (open pins 1 to 4 and 2 to 3 simultaneously)
14	OPTICAL OUTPUT	Optical fiber cable with output mounting
15	MODULATION INPUT	5 VDC external modulation input 0V – LD current is switched OFF +5V – pump LD current is switched ON disconnected - LD current is switched OFF
16	Reset	External main power switch ON circuit
17	Emission OFF	Not used
18	RS-232 connector	RS-232 interface (PC levels)

Optical isolator external layout



6. Operation

NOTE: 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 Laser immediately.

ACTIVATING AND DEACTIVATING.

Before supplying the power, make sure that:

the Power AC Line is 100/230 VAC.

cooling water temperature is above the dew point.

1. Connect water for cooling, refer to the dew table for minimum water temperature.
2. Make sure, that the water flow is not less, than 1 liter per minute.
3. Terminate the output optical head.
4. Put on protection glasses.
5. Connect the power cord to the AC Line.
6. Insert the key and switch ON the front panel of the Laser.
7. Press the start button on the front panel. **POWER SUPPLY** led should emit.

The device is ready for operation.

8. The laser emission switches ON after receiving "LaserON" command via RS-232C interface. After accepting "LaserON" command the **EMISSION** led starts emit.
9. Now the laser output power is controlled via **EXTERNAL MODULATION** input.
In case of: **0V** the laser power is zero
+5V the laser pump diodes current is set to programmed value.
10. You can switch ON/OFF the Guide laser by sending corresponding command to the laser independently of the main output power state.
11. To deactivate the laser, send the command "LaserOFF".
12. Each RS-232 commands causes **COOMUNICATION** led to blink.

NOTE: Each time before turning OFF the electrical power LASER OFF command must be sent.

POWER MONITORING.

The monitoring of the optical power must be used only as indication of the output laser power. The accuracy of the output power indication is about $\pm 30\%$.

- In order to measure correct value of the output power use direct measuring of the optical power by the proper power meter.
- Every time after pump laser current changing it is necessary to wait at least 2 min for diode's temperature stabilization. Otherwise slow variation of the output power can take place.

EMERGENCY STATUS.

The **ALARM** led starts to emit if an internal failure occurs in the laser. The reason of the failure may be decoded from "STATUS" bytes of the laser, use command "Read Status" to get it.

Possible reasons of the **ALARM** status are:

- internal failure observed during the laser self-checking
- high level of "BACK REFLECTION", the power reflected back to the laser is higher than acceptable. Investigate the reason of back reflection and remove it.
- overheat of the module. The module automatically stops emission if the laser temperature is more than maximum acceptable one. The maximum temperature may be read from the laser by "Read maximum temperature" command. Please check if environmental conditions are within specification and is there sufficient water flow to cool the laser.

To reset alarms the electrical power should be switched OFF for at least 5 seconds and than switched ON again, use "power key" and "main switch" button.

NOTE:

The laser is sensitive to the back reflected signal. The strong back reflection may destroy laser and/or output fiber termination assembly.

7. RS-232 communication Interface

1. Initialization of RS-232:

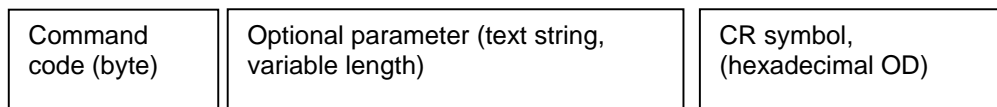
speed: 57600 bit per second

parity / flow control: none

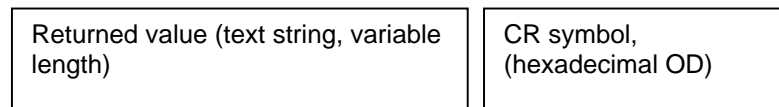
start / stop bits: 8 data bits, 1 stop bit

three wires (RxD, TxD, GND) are used in the cable (null-modem)

2. Firmware command structure:



3. Laser reply structure:



4. The command code is individual for each command and is shown in the table.

5. Command parameter is a text string. If the parameter is a numerical value it should be converted into ASCII string.

6. The reply value is also a text string. If the requested value is numerical, the opposite conversion from text string to the numerical value required.

7. All commands should be terminated by "Carriage Return" symbol, hexadecimal value "0D". The RS-232C buffer of the laser receives bytes until the CR symbol occurs. All bytes before this symbol are interpreted as a command. The bytes after CR and until next CR will be interpreted as a next command.

8. For all "write" commands device answers "Y" if the command was successfully executed and "N" if the command was not executed.

9. For all strings sent to the laser, which were not recognized as valid commands the laser answers "E".

10. Device state after switching on electrical power:

pulse repetition frequency	50kHz
LaserON/OFF	in "LaserOFF" state
pump diodes current	0%
guide laser On/OFF	in "Guide laser OFF" state (if installed)

Firmware commands

N	Name	Type	Code, hex	Description
1	Vendor/ Device	read	90	Device answers by the device, CR-terminated ASCII-string. The string is written to the device during manufacturing process.
2	Serial Number	read	91	Device returns its serial number. Example: assuming that device serial number is "1234567" bytes to send from computer to the device: 91 0D bytes replied by the device: 31 32 33 34 35 36 37 0D
3	Get Firmware ID	read	A0	Device returns firmware version
4	Read module status	read	8D	Device answers by the CR-terminated ASCII-string. To obtain status information, conversion to unsigned integer (16 bit) should be made. Description of bits in status bytes: Bit 16 (MSB) = reserved Bit 12–Bit 15 = reserved Bit 11 = 1 – Back reflection alarm active = 0 – Normal operation Bit 10 = 1 – Temperature alarm active = 0 – Normal operation Bit 9 = Reserved Bit 8 = 1 – Alarm master oscillator active = 0 – Normal operation Bit 7 = Reserved Bit 6 = 1 – Guide laser ON = 0 – Guide laser OFF Bit 3-5 = Reserved Bit 2 = 1 – External modulation input ON state = 0 – External modulation input OFF state Bit 1 = Reserved Bit 0 (LSB) = 1 – Emission enable (LaserON state) = 0 – Emission disable (LaserOFF state)
5	LaserON	write	89	Command to switch enable laser emission and switch the laser into "LaserON state". After receiving this command the laser is capable to emit power. "Emission" LED starts indicate active state. The output optical power depends on pump diodes currents and external "Modulation" input state. Example: bytes to send from computer to the device: 89 0D
6	LaserOFF	write	8A	Command to disable emission and switch the laser into "laser OFF state". The laser stops to emit regardless of preset pump current and "Modulation" input state. "Emission" LED is OFF. Example: bytes to send from computer to the device: 8A 0D
7	Set pump diodes current	write	80	Command sets pump level, which determines the optical power. Parameter: percentage of current relative to maximum value, acceptable range 0...100 %. Example 1: set current to 35% bytes to send from computer to the device: 80 33 35 0D Example 2: set current to 100% bytes to send from computer to the device: 80 31 30 30 0D Example 2: set current to 0% (no pump current) bytes to send from computer to the device: 80 30 0D
8	Read pump diodes current	read	82	Device return measured pump diodes current in percent relative to maximum value. Note: that the value depends on "Modulation" input state.

N	Name	Type	Code hex	Description
9	Read back pump diodes current	read	81	Reads back current preset by "Set pump diodes current" command. For safety reason this command is recommended to be used every time before "LaserON" command to check preset value of pump current. Return value is current in percents relative to maximum value. Example: assuming that preset current is 12%. bytes to send from computer to the device: 81 0D bytes replied by the device: 31 32 0D
10	Read output power	read	83	Read measured average value of output power value is in W. Note 1. Power depends on "Modulation" input state. Note 2. Power depends on pulse repetition rate, since pulse energy is limited by 2 mJ. The accuracy of monitor is better than $\pm 30\%$.
11	Read device temperature	read	86	Device reports measured temperature of the laser, value in $^{\circ}\text{C}$. If the temperature goes over the operating limits, the pump current will be automatically switched off.
12	Read maximum temperature	read	87	Read maximum acceptable device operating temperature in $^{\circ}\text{C}$. The value of temperature is preset at the factory.
13	Read minimum temperature	read	88	Read minimum acceptable device operating temperature in $^{\circ}\text{C}$. The value of temperature is preset at the factory.
14	Set repetition rate	write	84	Set pulse repetition rate for the device. Parameter: pulse frequency in kHz, acceptable range 20...50 kHz Example 1: set PRR to 20 kHz bytes to send from computer to the device: 84 32 30 0D Example 2: set PRR to 49 kHz bytes to send from computer to the device: 84 34 39 0D Note: changing of PRR is available only if the laser is in "LaserOFF" state.
15	Read repetition rate	read	85	Returns current pulse repetition rate, value in kHz.
16	Read minimum repetition rate	read	94	Read minimum acceptable pulse repetition rate. The value is preset at the factory.
17	Read maximum repetition rate	read	95	Read maximum acceptable pulse repetition rate. The value is preset at the factory.
18	Guide laser ON	write	C4	Switches ON guide laser
19	Guide laser OFF	write	E4	Switches OFF guide laser
20	Read back reflection counter	read	E0	Read back reflection counter. This counter increases with each back reflection events occurred in the laser.
21	Reset alarms	write	CE	Reset alarms. The alarms may be reset at least in 10 seconds after its activation.

8. Warranty

General Warranty

All products are warranted by IPG against defects in materials and workmanship for the period of time as set forth on the applicable purchase order or in the specifications starting with the date of shipment. IPG also warrants that this product will meet applicable specifications under normal use.

IPG shall, at its option, repair or replace any product that proves, in the reasonable opinion of IPG, to be defective in materials or workmanship during the warranty period. All products repaired or replaced under warranty are only warranted for the remaining un-expired period of time in the original warranty for the particular defective product. IPG reserves the right to issue a credit note for any defective products that have proved defective through normal usage.

Warranty Limitations

This warranty excludes products, parts (including fiber connectors) or equipment which have been tampered with, opened, disassembled, opened, or modified by persons other than IPG personnel, misused, neglected, or damaged by accident, used in applications which exceeds their specifications or ratings, used outside of environmental specifications for the product, used with buyer software or interfacing, improperly installed, maintained or otherwise abused or used other than in accordance with the information and precautions contained in this User's Manual. It is the customer's responsibility to understand and follow operating instructions in this User's Guide and specifications prior to operation—failure to do so may result in voiding this warranty. Accessories and fiber connectors are not covered by this warranty.

Buyer must claim under the warranty in writing no later than 31 days after the claimed defect is discovered. This warranty does not extend to any third party, including without limitation Buyer's end-users or customers, and does not apply to any parts, equipment or other products not manufactured by IPG.

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Service and Repairs

CAUTION: No operator serviceable parts inside. Refer all servicing to qualified IPG personnel. All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to IPG Laser or its representative in your area. Items authorized for return by us must be returned in a suitable container.

Any damage noted upon receipt of the unit must be documented for appropriate claim against the carrier.

IMPORTANT: Never send any product back to IPG without a Return Merchandise Authorization (RMA). Please refer to the Sample RMA Clearance Form in this User's Manual for additional information. The customer will be charged for the cost of repairing the product if the product is not under warranty or if the repair is not covered under the warranty.

Changes

We reserve the right to make changes in design or constructions of any of our products at any time without incurring any obligation to make changes or install the same on units previously purchased.

9. RMA Clearance Form

RMA File No. (required)
(given by IPG): _____
Total Number of
Unit(s) Returned: _____
Serial No(s): 1. _____ 2. _____ 3. _____
Please ship the unit(s) to:

IPG Laser GmbH
Siemens Str. 7
B-57299 Burbach Germany
Attention: Quality Manager

This RMA file number will expire 31 days after **the faxed date from IPG Laser**. Thereafter, units received in under the expired RMA number will result in a longer turn around time. Please include one COPY of this form signed by the IPG Laser Quality Manger with the return of your unit(s).

INSTRUCTIONS FOR PRODUCT RETURNS

1. **IPG Laser will only accept returns for which an approved Return Material Authorization (RMA) has been issued by IPG Laser. You must first contact IPG Laser GmbH to discuss the return and request a RMA number.** You must return defective products freight prepaid and insured to IPG Laser at the address shown herein. All products which have returned to IPG Laser but which are found to meet all previously applicable specifications for such products or which indicate damage to the fiber connectors not resulting from defect manufacturing, shall be subject to IPG Laser' standard examination charge in effect at the time and these costs shall be charged to the Buyer. All products returned to IPG Laser which are not accompanied by an itemized statement of defects, shall be returned to the Buyer at the Buyer's expense and IPG Laser shall not carry out any evaluation of such products. IPG Laser warrants to Buyer that its services, labor and replacement parts, assemblies and modules will be free of defects in material and workmanship for ninety (90) days from the date of shipment or performance of services.
2. Warranty Returns - Domestic & *International Buyers should pay for one-way freight costs to IPG Laser. IPG Laser will reimburse Buyers for applicable reasonable third-party freight costs and IPG Laser will pay for freight return cost back to the Buyer.
3. Non-Warranty Returns - Domestic & *International Buyers are responsible for two-way freight costs. If shipment consists of returns that are both warranty and non-warranty, the shipment will be considered as non-warranty. Any UNAUTHORIZED shipments billed to IPG Laser without authorization will be re-invoiced to the Buyer. Confirming purchase orders are required for non-warranty returns.
4. *International Returns must include applicable DUTIES AND TAXES, and you must mark air bills with "RETURNED FOR REPAIR". In any event, where IPG Laser accepts a shipment, IPG Laser will invoice to the Buyer for any charges as stated above.
5. Returns for credit will not be accepted unless authorized in advance, in writing by IPG Laser, in accordance with IPG Laser' Terms and Condition, including the warranty provisions. In most cases, restocking fees will apply.
6. All returns must be packaged adequately to avoid damage during shipment.
7. Complete packing list with product model and serial number will insure prompt repair, if the other terms of this form are followed.
8. See the IPG Terms and Conditions for the applicable warranty for the products before you request the return of the products.