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# YLPM-16-TP Ytterbium Fiber Laser

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## User's Guide

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## **CAUTION !!!**

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**The IPG Group Model YLPM-16-TP  
is a Class IV laser product.**

**Laser emits more than 16 W of the  
invisible laser radiation in the optical  
band near 1060 nm.**

**Avoid direct viewing of the beam  
emitted from the headpiece.**

**Do not open the device. Inside there is  
invisible hazardous laser radiation  
emitted by pump laser diodes at 975  
nm.**

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## 1. Summary

The YLPM-16-TP Pulsed Ytterbium Fiber Laser you have just received is the one of most advanced products of IPG Group. It is a revolutionary, new, high-performance OEM device which was developed for integration into high-speed, chemical-free, large-film Laser Printing Systems.

The main advantage of YLPM-16-TP, if to compare with the traditional line of diode-pumped solid-state lasers like Nd: YAG lasers and others, is the use of **Master Oscillator & High Power Fiber Amplifier (MOPFA)** configuration. It became possible thanks to the very high gain of fiber amplifiers (up to 50-60 dB). Solid-state lasers are able to proceed the single-pass gain less than 10 dB only, so they could not be configured on the base of MOPA technology. As result, to reach the operation regime, which our YLPM-16-TP device demonstrates at first, solid-state laser designers should to combine the mode-locked laser with the external amplitude modulator at the laser output. This device will be huge, very complicate, expensive, and absolutely unpracticed machine which, by our estimations, have to consummate more than 1 kW of electrical power.

The YLPM-16-TP is tens times more effective, low power consumption and very practical device which can be used even in field conditions. It has a rugged, stand-alone, compact, ready-to-use, turn-key design, so it can be directly inserted into user's apparatus. The laser is pumped by highly reliable 1W multimode diodes mounted on their own heat sink cooled by fans. The device should be driven by an external DC power supply.

The important device function is possibility of digital modulation of the output power by external digital pseudo-random signal up to 50 MHz. The built-in processor controls the operation regime of laser, including: output optical power, diode current, case temperature, alarm, interlock etc. It is also possible to use the regime of external laser control via the interface port RS-232C by the external PC.

**The YLPM Laser is an ideal high power source for laser printing industry.**

## 2. Accessories

Please check the included accessories according to Table 1.

Tab. 1

Items	Quantity	Note
Cable N 1	1	For connecting YLPM-16-TP to Power Supply
Cable N 2	1	For connecting YLPM-16-TP to Computer
Interlock connector	1	For shorting the interlock input
Instruction manual	1	

## 3. Power supply

Power supply voltage is 24 V DC ( >10A ). Red plugs of the power cables are positive("+"), black plugs are negative("-"), green wire is ground. This wire have to be grounded to decrease the influence of the electromagnetic interference's on the optical output power stability.

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#### **4. Environment and precautions**

- Always use your laser device in conjunction with properly grounded power source.
- Do not expose to high moisture environment.
- NOTE: This device has output head which is connected to the YLPM-16-TP by fiber cable. The place of connection is not protected against shocks and force influence. So please, be careful dealing with output head.
- YLPM-16-TP Laser has three fans in the rear panel for active cooling. Make sure that there is sufficient airflow to cool the device.
- Do not disconnect RF cable under device operation.
- Always wait at least 3 sec after turned off the power supply, before the start of operation again.

## 5. Specifications

### OPTICAL CHARACTERISTICS

Mode of operation	CW, encoding
Output beam mode	TEM <sub>00</sub>
Output beam quality, M <sup>2</sup>	<1.1
Polarization	Random
Central emission wavelength, nm	1064 ± 10
Emission bandwidth ( FWHM ), nm	< 3
Nominal average output power, W	16 ± 0.8
Output power tunability, W	0.5 to 16
*power level increment, bit	12
*type of commands	digital
Noise: 20 Hz to 20 MHz, % RMS	2
Power repeatability, pulse to pulse, %	± 5
Long-term average output power instability (over 10 hours), %	± 5

### OPTICAL HEAD

Beam quality at TEM <sub>00</sub> , M <sup>2</sup>	<1.1
Beam diameter at 1/e <sup>2</sup> , mm	4.8 ± 0.5
Maximum distance of the beam waist from the output head, mm	200
Centration of beam in optical head, mm.	0.5
Angular deviation of beam axis from center axis of housing, mrad	50
Output fiber length, m	4
Optical head includes isolator	Yes
Back reflection, %	<10
Output head dimensions, mm	192 x 46 x 46

### ENCODING

Modulation:	
external control, MHz	DC-50
format	TTL compatible
connector	BNC
termination, ohm	50
when connector is open, laser power is:	OFF
when TTL is high, laser power is:	ON
Duty cycle	Random

Intensity extinction ratio (on-off)	25 : 1
Shape of pulse	Square
Over/under shoot tolerance, ns	10
Rise time of optical pulse, ns	4

### **INTERFACE**

Format	RS232
Connector	9 pole D type
RS232 Communication based on ACK/NACK procedure	Yes
Monitoring:	
Laser diode current	Yes
Laser power	Yes
Laser case temperature	Yes
Laser interlock open/closed	Yes
Laser back reflection	Yes
Laser overheating	Yes
Laser firmware revision number	Yes
Power line connector	3 pole AMP UMNL
Safety interlock:	
high power enabled	Shorted
low power, max 0.3 mW enabled	Disconnected
connector	2 pole AMP UMNL

### **INTERNAL PROTECTION**

High case temperature	Yes
High back reflection	Yes
High laser diode current	Yes
Setting laser current before warm-up time	Yes

### **ELECTRICAL CHARACTERISTICS**

Supplied Voltage, V DC	23 – 25
Operating Current ( at 24 V, 20 °C ), A	<10
Power consumption( at 40°C), W	<240
Power line connector	3 pole AMP UMNL

### **PUMP LASER DIODES**

Nominal wavelength, nm	970
Laser diode type	Multimode
MTTF ( 20 °C ), hours	> 100 000

**GENERAL CHARACTERISTICS**

Operating Temperature Range, °C	+15 to +35
Non-operating temperature, °C	-5 to +50
Warm-up Time, min : to start of operation to full stabilization	2 10
Maximum temperature gradient °C/hour	4
Humidity, %	20-80 RH, non-condensing, max 17 g water/kg air
Maximum humidity gradient % RH/hour	20
Dimensions, WxHxL, mm.	215 x 286 x95
Weight, kg	7

**TEST BEFORE DELIVERY**

Continues operation test: output power time of the test measurements of the power deviation of the power	Maximum 50 hours every 5 min ± 5 %
One hour operation test: output power time of the test measurements of the power deviation of the power	Maximum 1 hour every 5 sec ± 2 %
Pulse shape test: modulation frequency  rise and fall time maximum deviation of the pulse amplitude minimum on/off ratio	DC, 1 kHz, 50 kHz, 100 kHz, 1 MHz, 10 MHz, 25 MHz, 50 MHz 4 ns 5 % 25 : 1

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## 6. External layout

The control of operation and connection of the laser are illustrated in table 2 and shown in Figures 1 - 3.

Table 2.

1.	VENTILATION grid	
2.	POWER SUPPLY connector	24 VDC
3.	COMPUTER OR REMOTE CONTROL connector	RS-232C
4.	RF connector	Controls the output power: "1" - laser emits light, "0" (or disconnected) – optical power is suppressed, TTL-CMOS input
5.	OUTPUT fiber	Output fiber 5/125 $\mu\text{m}$ , single mode
6.	OPTICAL part of YLPM-16-TP	
7.	ELECTRICAL part of YLPM-16-TP	
8.	VENTILATION holes	
9.	GROUND connector	
10.	SAFETY INTERLOCK connector	When shorted, emission is enabled. Otherwise, the emission is inhibited.

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## **7. Preparations for use**

### **Certification**

IPG Laser GmbH certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.

*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 GmbH immediately.*

### **Operation**

1. Connect Laser and PC.
2. Connect to power supply.
3. Turn the DC "POWER" switch to the "ON" position.
4. Run the demo program (YLPM1M.exe for COM1, YLPM2M.exe for COM2).
5. Put the modulation signal to BNC connector.
6. Wait about 2 min while laser warms up.
7. Set laser output power 30 – 100 %.
8. Laser is ready to use.

### **YLPM1M.exe; YLPM2M.exe**

After running the program, computer displays two parameters of the laser: CASE temperature, output power (note 1).

F2 – Set laser output power.

F4 – Get firmware version.

F9 – Restart the program.

F10 – Quit the program.

If the interlock circuit is disconnected, LD current shuts down automatically, and "INTERLOCK ACTIVE !!!" appears on display.

If the CASE temperature exceeds 60°C, LD current shuts down automatically, and "OVERHEAT !!!" appears on display.

If back reflection exceeds 10 %, LD current shuts down automatically, and "DECREASE BACK REFLECTION!!!" appears on display. In this case, the signal "high back reflection" will disappear after sending to the laser any new value of laser output power ( 30 – 100%).

*Note 1: The correct value of the output power can be measured only by external power meter.*

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## 8. RS232 Interface commands.

### Data transmission protocol layout

Interface must be set for the next parameters:  
9600 Baud, 8 bits data length, 1 stop bit, no even/parity check.

All data transmission between the host computer and the laser are initiated by the host. The laser never sends any data by own initiative.

A packet from sender looks like this:

SOH (ASCII 01h)
Number of bytes
Data/Command
Data (Optional)
-----"1"-----
Data (Optional)
Checksum
EOT (ASCII 04h)

If packet is send from the host computer, then third byte is always Command. If packet is send from the embedded controller, then this byte is always Data.

Number Of Bytes is number of bytes between SOH and EOT.

Data and Command bytes are always ASCII-digits or symbols.

Checksum is calculates as arithmetic cycled sum of the bytes between SOH and the last data byte, inclusively, but the MSB is always must be set to "1", to prevent possible erroneous situations (lost of software synchronization), when checksum is equal 01h or 04h (SOH and EOT respectively).

After packet receiving, command ACK(06h) returned to the sender, if calculated checksum is equal to the transmitted one.

If the checksums are differs, or receiver cannot get the EOT after approximately 50 msec after SOH, command NAK (15h) is returned back. In this case, embedded controller performs no action with the laser.

The embedded controller is ignore NAK and ACK from the host computer, so it is host software responsibility to take appropriate actions in the case of error data detection..

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## RS232 Commands description

### 1. Set output power value of the laser.

SOH (ASCII 01h)
Number of Bytes
30h
Data
-----"-----
Data
Carriage return (0Dh)
Checksum
EOT (ASCII 04h)

Where:

Data is power value in percents with 0.1% resolution. The decimal point must not be transmitted, so power 100% is sent as 1000, 95.5% as 955 and so on. For example, to set power value equal to 58.7%, the next bytes must be transmitted (HEX): **01 07 30 35 38 37 0D E8 04**

### 2. Read values from the laser.

To read the optical power value, the host must send bytes:

**01 03 32 B5 04.**

To read the laser case temperature, the host must send bytes:

**01 03 33 B6 04.**

Laser sends back the appropriate value as ASCII-string in accordance with the protocol.

Optical power measures in Watts with 0.1 W resolution.

Case temperature measures in Celsius degrees with 0.1 deg resolution.

### 3. Read STATUS byte from the laser.

Command: **01 03 34 B7 04.**

Controller sends back bytes: **01 03 Status Checksum 04.**

Meaning of bits in STATUS byte:

**Bit 7** (MSB) = 0 – normal operation, 1 – the laser is preparing for the internal calibration procedure.

**Bit 6** Calibration (if =1)

**Bit 5** Device fault ( if = 1)

**Bit 4** Reserved

**Bit 3** = 0 – normal operation, = 1 – warm up is in progress (approx. 2 min. after power on)

**Bit 2** = 0 – back reflection is low, = 1 – is high

**Bit 1** = 0 – interlock sensor is closed, = 1 – is break

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**Bit 0** (LSB) = 0 – normal temp. range, 1 – overheat.

If any of **Bits 3...0** is set to 1, then laser output power is OFF. To set the new value, appropriate command (30h) must be issued.

If **Bit7** = 1, then the laser is waiting for the moment, when the host turns off laser power for the internal calibration.

**The internal calibration takes approximately 5 seconds.**

If during ~10 minutes after the setting this bit the laser power will not be turned off, the laser begins calibration procedure during exposure, and while do it, the output signal will be corrupted.

**If internal calibration began during the laser was turned OFF and didn't finished before the laser turn ON the output power can became incorrect. To avoid any problems the host must wait until Bit7 will be cleared.**

4. Read version information from the laser.

Command: **01 03 35 B8 04.**

The laser sends back 40-bytes ASCII string in accordance with the protocol.

The demo program YLPM16M.BAS is included.

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## **9. Warranty**

All parts of this product are warranted by IPG Laser GmbH against defects in material or workmanship for a period of one year from the date of delivery.

In the event of a defect occurring during the warranty period, IPG Laser GmbH will repair or replace this product within a reasonable period of time after notification, free of charge, provided that: it is returned to IPG Laser GmbH; has not been misused; has not been damaged by an act of God, and that the user has followed the instructions in the operation manual. It is the customer's responsibility to understand operating instructions and specifications prior to operation.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and it is not transferable if it is resold.

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 GmbH or its representative in your area. Items authorized for return by us must be returned in suitable container. Any damage noted upon receipt of the unit must be documented for appropriate claim against the carrier.

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

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