Diode Pumped Solid State PowerChip NanoLasers

User's manual

PowerChip IR 1064nm

PowerChip Visible 532nm

PowerChip UV 355nm

PowerChip UV 266nm

Thank you!
And congratulations for selecting a version of the Laser Controller, MLC series, for Q-Switched Diode Pumped Solid State MicroChip Lasers

How to use this Manual

If you have just taken delivery of the laser system, please read the Preface, General Information and Installation sections. If you are installing the equipment, read the Installation section. See Operation when you are ready to operate the equipment.

Contents

I. Information pertaining to all PowerChip NanoLaser Models

1- Forewords

1.1 Safety Symbols

The following symbols are used in JDS Uniphase manuals. Some of the symbols may not be used in this manual; however, they are presented here to ensure your familiarity.

Instruction manual symbol. The product will be marked with this symbol when it is necessary for you to refer to the manual in order to protect against damage.

Indicates hazardous voltages.

Indicates protective earth (ground) terminal. This symbol is used to indicate the reference ground connection to a chassis.

Indicates AC voltage when following the voltage value

1.2 Warning and Caution Symbols

Warning

When you see a warning, it denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in *injury or death.* Do not proceed beyond a warning until the indicated conditions are fully understood and met.

Caution

When you see a caution, it denotes a hazard. It calls attention to an operating procedure practice, or the like, which, if not correctly performed or adhered to, could result in damage to or *destruction of part or the entire product.* Do not proceed beyond a caution until the indicated conditions are fully understood and met.

1.3 Laser Safety Precautions

Teem Photonics solid-state lasers are offered as OEM products for incorporation into other equipment. OEM customers are responsible for CDRH certification of all systems sold with these products. Teem Photonics also offers CDRH compliant laser systems.

Caution

The protective housing of this laser product should always be in place during normal laser operation. Removal of the housing exposes the user to dangerous visible and invisible laser radiation and destroys the integrity of the sealed cavity. Only trained service personnel should perform removal of the protective housing.

Warning

During installation and operation of this product, the use of protective eyewear or other precautionary procedures depends on the conditions of use and the amount of visual function required for the installation or operation procedure. Consult user standards such as ANSI, ACGIH, or OSHA for guidance.

Optical Safety

The laser is a source of intense light having characteristics that are very different from the light emitted from conventional light sources. The user must be aware of these characteristics of laser light and the proper safety precautions before attempting to operate the laser. The energy level of the laser beam is high enough to cause serious injury to the eye with probable loss of vision if the beam were to pass directly into the eye. The laser beam is uncollimated and coherent, though the energies in the beam remains high and dangerous even at great distances from the laser.
Each PowerChip is labeled with according to the IEC 60825-1 standard for laser safety and to the FDA per CFR 1040.10 norm. It is the responsibility to tailor the protection goggles according to the Class of the laser used.

Electrical Safety

The electrical safety hazards of solid-state laser systems should not be ignored, as they are as great as other electrical systems operating from AC power lines. The voltages involved and the current available have the potential to cause fatal electric shock. Although the PowerChip NanoLaser conforms to OSHA and CE electrical requirements and additional safety features have been included in their design, the following safety precautions should be noted and observed under the control of the responsible authority:

1. Your laser is intended for operation only with the laser head and power supply covers in place. Do not remove cover of the laser or the power supply.

2. For the sake of safety, NEVER depend on any electrical safety device or interlock but carefully make other determinations that all power is off and components are de-energized before working on the electrical connections of the laser system.

3. Do not allow anyone to perform electrical maintenance on the laser, except those personnel who are familiar with Teem Photonics lasers and who are trained to service them.

4. The mains cord must be plugged in a socket comprising the earth connection. Disconnection of the earth is forbidden as it may impair the electrical protection and make the equipment dangerous.

Users of the PowerChip NanoLaser should be aware that operating the product without due regard to these precautions, or in a manner that is not in compliance with procedures recommended here, may cause an unsafe condition.

Safety Recommendations for Using the Laser

Warning

When operating the laser system, it is recommended that you observe the following safety precautions:

1. Always have the power supply cover and the laser head cover in place when the laser is connected to line power.

2. Limit access to the laser to that familiar with the equipment. Keep the laser out of the hands of inexperienced or untrained personnel.

3. When the laser is on and the output beam is not being terminated in an experiment or optics system, the beam should be blocked.

4. NEVER LOOK DIRECTLY INTO THE MAIN LASER BEAM, NEVER SIGHT DOWN A BEAM INTO ITS SOURCE,

5. Do not allow reflective objects to be placed in the laser beam. Laser light scattered from a reflective surface can be as damaging as the original beam. Even objects such as rings, watchbands, and metal pens or pencils can be hazardous,

6. Attenuate laser power to a low level to minimize intensity of accidental stray reflections or refractions when aligning a chain of optical components in the laser beam.

7. Set up experiments so that the laser beam is NOT at eye level.

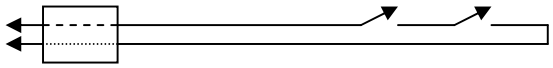
8. Post warning signs and limit access to the laser area when the laser is in operation.

9. Even when wearing laser safety glasses, there are two hazards that exist while operating solid-state lasers:
   a. The glasses make the beam itself invisible, therefore increasing the danger of skin burns.
   b. Laser glasses may not afford enough protection if a very powerful beam is viewed directly.

1 0. NEVER LEAVE THE LASER **ON, OPEN, AND UNATTENDED**!

11. On CDRH/CE compliant systems, remove the key when the laser is off and store it in a safe place to avoid use of the laser by untrained or unauthorized personnel.

12. For the CDRH/CE compliant systems, the remote interlock connector can be wired to door switches to shut the laser down if someone enters the room while the laser is operating. We recommend 2 switches in series to provide redundancy against potential switch failure.



Remote Interlock Connector

Switches are closed when the door is closed.

1.4 Safety Labels and Indicators (fig 1 to 3)

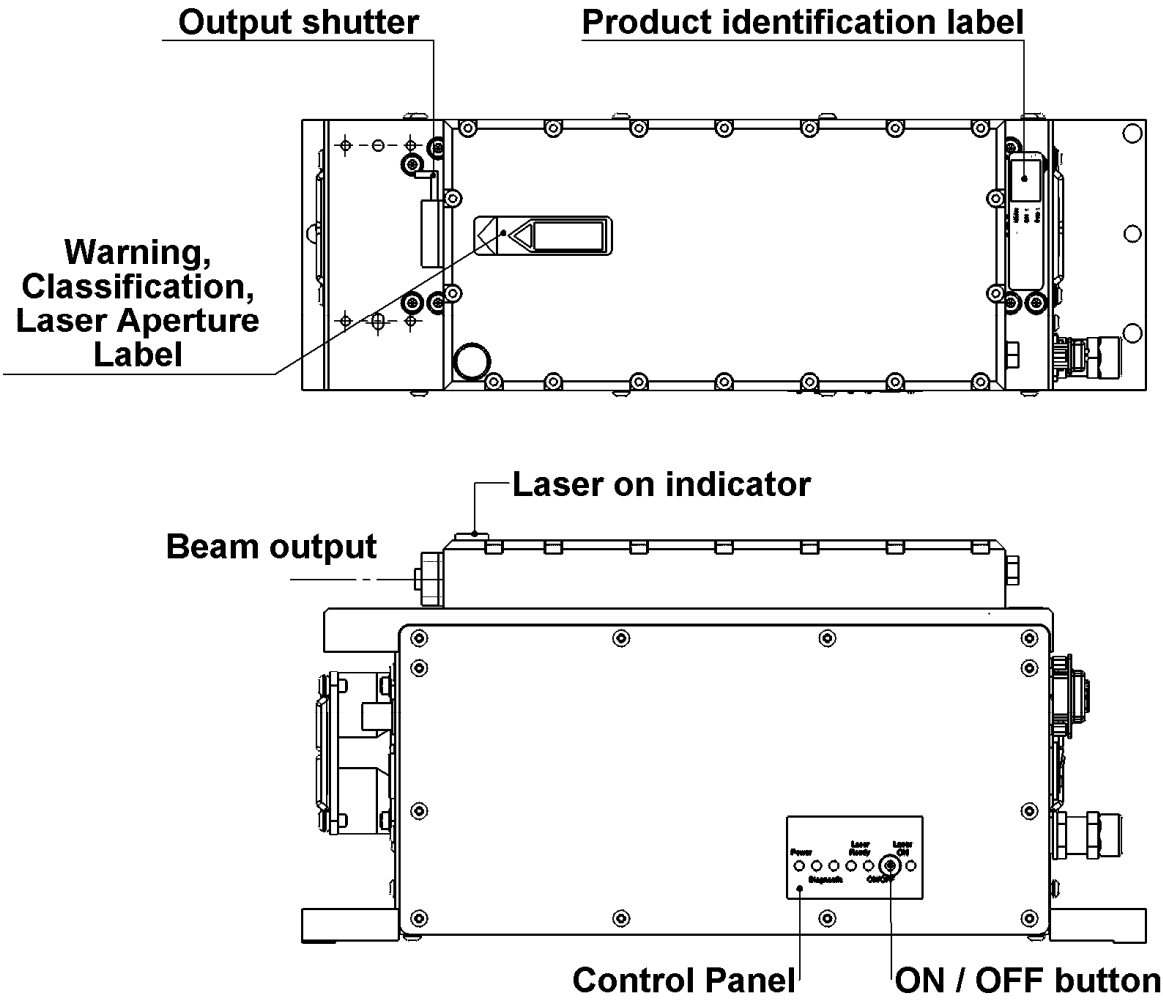


Figure 1: CDRH Version of Power Chip Laser Source

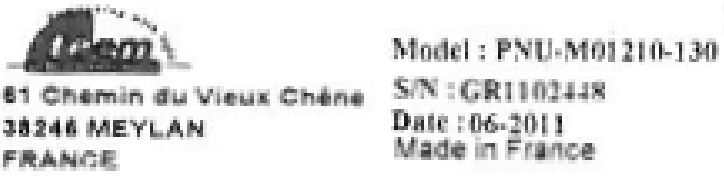


Figure 2: Product Identification Labels

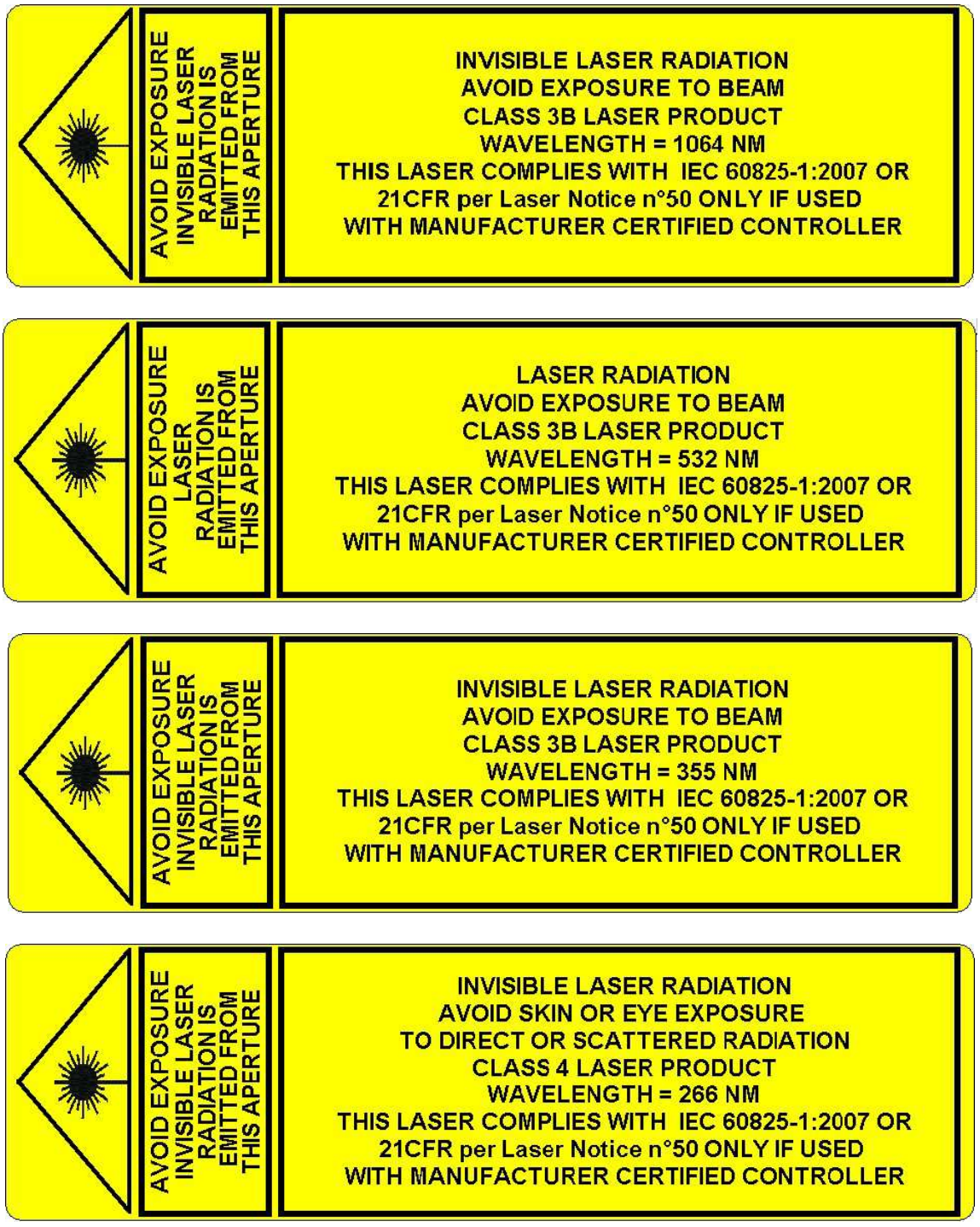


Figure 3: Warning Labels (21 CFR 1040.10 & IEC 60825-1:2007)

2- General Information

This chapter contains general information covering the PowerChip NanoLaser System and includes the following:

- Part numbering
- Unpacking and inspection
- Repackaging for shipment
- Description
- Equipment supplied
- Support strategy

2.1 Part numbering

The PowerChip NanoLasers can emit at 1064 nm, 532 nm, 355nm and 266nm. The laser source and power supply are contained in the same package with model numbers corresponding to the following description (figure 4):

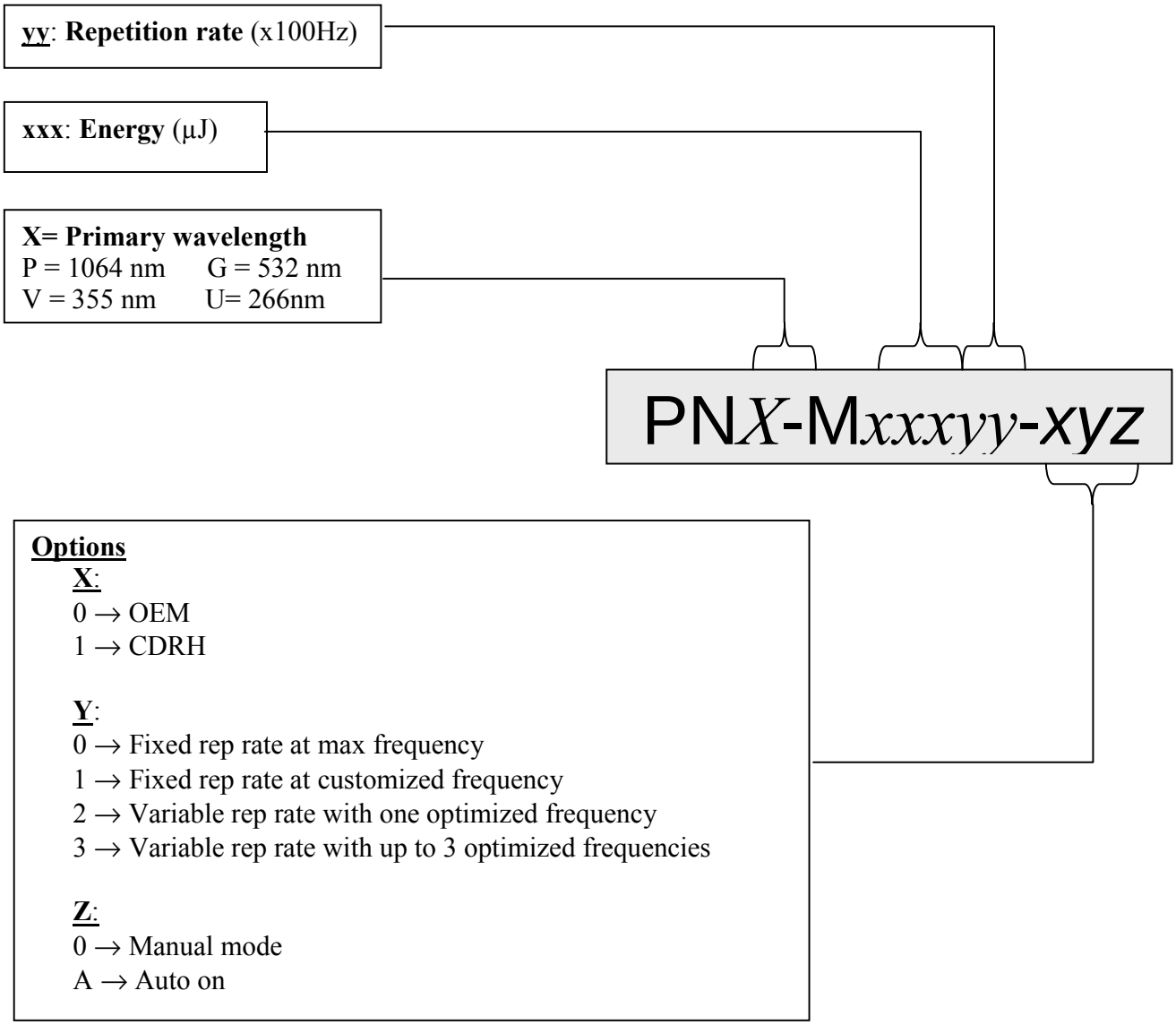


Figure 4a: Commercial Product Reference / Part Number for Laser Head

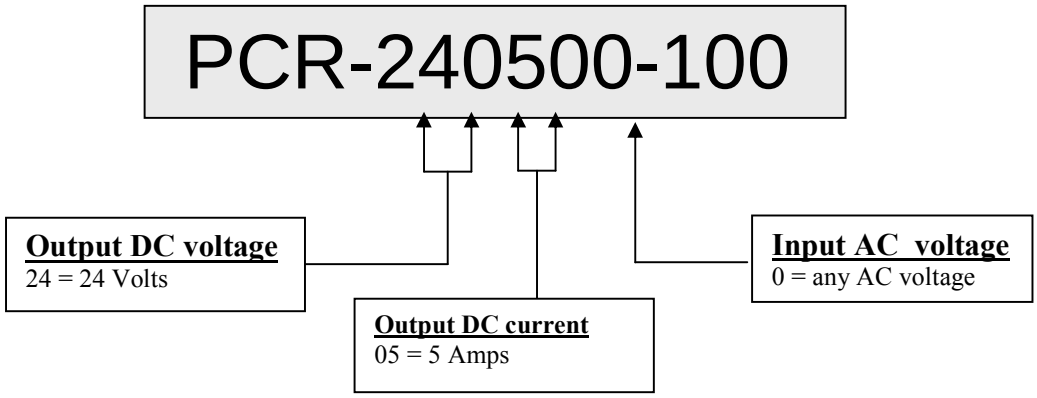


Figure 4b: Commercial Product Reference / Part Number for controllers

2.1 Unpacking and Inspection

Before unpacking the PowerChip NanoLaser System, inspect the shipping carton for evidence of damage. If the carton appears to be damaged, file a claim immediately with the freight carrier. After unpacking, inspect each item carefully for evidence of damage. If any item appears to be damaged, file a claim immediately with the freight carrier. It is contractually COMPULSORY that you retain the original shipping carton and packing material in case any PowerChip NanoLaser System item has to be returned to Teem Photonics Most shipping damages occur when the item is not shipped in the original shipping container

2.2 Repackaging for Shipment

If it is ever necessary to repackage any PowerChip NanoLaser System item for reshipment, use the original carton and packing material, if available. If the original carton and material are not available, use a similar carton and pack the item(s) in suitable packing material, or contact Teem Photonics for a container. Falling to return the laser without its original packaging MAY lead to WARRANTY VOID. Moreover on each return to factory, a replication of the problem seen at the customer's site is performed during expertise, which expertise may be rendered impossible due to bad traveling conditions.

2.3 Preliminary description

A PowerChip NanoLaser source consists of a laser head and controller in the same housing. CDRH compliant laser system includes a laser source and an AC/DC converter. Unless indicated otherwise, the operation instructions apply to all PowerChip NanoLasers.

The PowerChip NanoLaser source provides the following features and benefits:

- Passive Q-switching reduces number of components, improving reliability.
- Monolithic Microlaser design eliminates costly optics and alignments.
- Compact design promotes ease and flexibility in system integration.
- Rectangular design provides for straightforward mounting and heat sinking.
- Registration holes or 3 feet.

- Sealed laser head prevents contamination.
- Thermoelectric coolers insure precise temperature control for the components.
- Microprocessor based electronics.
- Serial Interface for remote control through a Sub-D 9 pins connector.
- Innovative current and temperature control circuits reduces number of components, improving reliability.
- Build-in electrostatic discharge protection improves reliability.
- EMC requirements.
- Air cooled built-in heat sink allows stand alone operation.
- Built-in thermal protection against any over temperature range operation.
- Image of optical pulse through a BNC connector.
- Control panel with on/off button.

2.4 Equipment Supplied

OEM systems

The OEM PowerChip NanoLaser Systems (PNX-Mxxxyy-xyz models or customer specific models) lasers are intended to be integrated into OEM systems. The OEM PowerChip NanoLaser System consists of the following:

- Model "PNX-Mxxxyy-xyz" Laser source.
- A male DSub 9 pins connector for electrical interlock inhibition installed on the head.
- 50 ohms termination for BNC connector
- A certificate of compliance
- User's Manual (this manual) with the laser specification (SCD).

CDRH compliant systems

The CDRH/CE compliant PowerChip NanoLaser System consists of the following:

- Model "PNX-Mxxxyy-xyz" Laser source.
- A male DSub 9 pins connector installed on the head.
- 50 ohms termination for BNC connector
- Remote Access Interlock connector
- Model PCR-240500-100 AC/DC converter with key and remote access interlock socket
- 1 set of power chord + fuse compliant with 220-230V
- 1 set of power chord + fuse compliant with 110-115V
- A certificate of compliance
- User's Manual (this manual) with the laser specification (SCD).

2.5 Warranty

Teem photonics warrants the PowerChip NanoLaser to be free from defects in material and workmanship for twelve months from the date of shipment or 5,000 hours pump diode supplied, whichever occurs first, except for otherwise specified.
Warranty may be subjected to specific terms and agreement. Please refer to your specification document.

If any item of the laser fails during the warranty period specified above, return the item freight prepaid to Teem Photonics or the nearest authorized assistance center. Teem Photonics only accepts returns for which an approved Return Material Authorization (RMA#) has been issued by Teem Photonics. This number must be obtained prior to shipping any material back to Teem Photonics. The owner's name and

address, the model number and full serial number of the unit, the RMA number, and an itemized statement of claimed defects **MUST BE INCLUDED** with the returned material.

Teem Photonics will, at discretion, repair or replace the defective item and return it freight prepaid to your facility. Note that any attempt by the user to repair any PowerChip NanoLaser System during the above warranty period will void the warranty.
Note that during expertise system may need opening up and thus may not be sent back to customer is equivalent state as it was prior to shipment back to factory.
After the expiration of the warranty period specified above, Teem Photonics will, provided the defective item is returned to Teem Photonics, repair the item on a time and materials cost basis. The item will be shipped back to you at your own expense.

2.6 Worldwide Teem Photonics Assistance

For sales and service information, contact Teem Photonics or your local representative

Teem Photonics
61 Chemin du vieux Chêne
F-38246
FRANCE

Please contact Customer Service to get a quote, place an order, or check on the status of an order. A team of dedicated customer service professionals is on hand to answer your questions and provide the service and support you need.

North & South America 9:00 AM - 6:00 PM AT, Monday through Friday

Phone	Phone: +1 925-307-7063
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Phone	(+33 0) 47 604 0506
Fax	(+33 0) 47 604 0302
E-mail	sales-eo@teemphotonics.com

Please visit our web site at http://www.teemphotonics.com/ for our worldwide representatives

3- Modes of operation

3.1 Diode Pumped, Passively Q-switched, High Energy Microchip Laser

Diode pumped solid state lasers usually produce high peak power pulses by using active modulation of a high gain medium, such as Nd:YVO_4 laser, resulting in complex and expensive systems. Passively Q-switched microchip laser technology, manufactured by Teem Photonics since 1996, dramatically reduces the size and cost of such lasers. The PowerChip NanoLaser uses a new generation of microchip exhibiting a ten-fold increase in energy per pulse compared to the existing NanoLaser product line. The PowerChip NanoLaser is an all solid state laser which produces in excess of 100 kW peak power in the infrared and more than 20 kW in the UV with unparalleled compactness, simplicity and ease of use.

The higher energy of the PowerChip NanoLaser is obtained with a new, larger microchip cavity consisting of a layer of Cr^{4+} doped YAG saturable absorber embedded monolithically in a YAG crystal, with doped and un-doped regions, and mirrors deposited at both ends (*Figure 5, left*). When pumped with a high power diode bar, this cavity emits short pulses with high peak power, without the costly and complicated use of electronics necessary to drive traditional Q-switched lasers. The diode bar pump beam is shaped to optimize the pumping density (*Figure 5, right)*. The longer cavity supports a larger laser mode oscillation, resulting in a more efficient use of the pump, producing high-energy pulses. The output of the laser cavity is a train of sub-nanosecond pulses with 100 kWatts of peak power at a repetition rate up to 1 kHz in the infrared.

Since the conversion efficiency to generate green and UV wavelengths increases with the incoming IR beam power, green and UV output can be efficiently generated from a passively Q-switched laser with high peak power. This efficiency allows us to place the non-linear crystals outside the cavity, in a single pass configuration, giving the PowerChip NanoLaser stability and good beam quality with a simple, efficient and compact design.

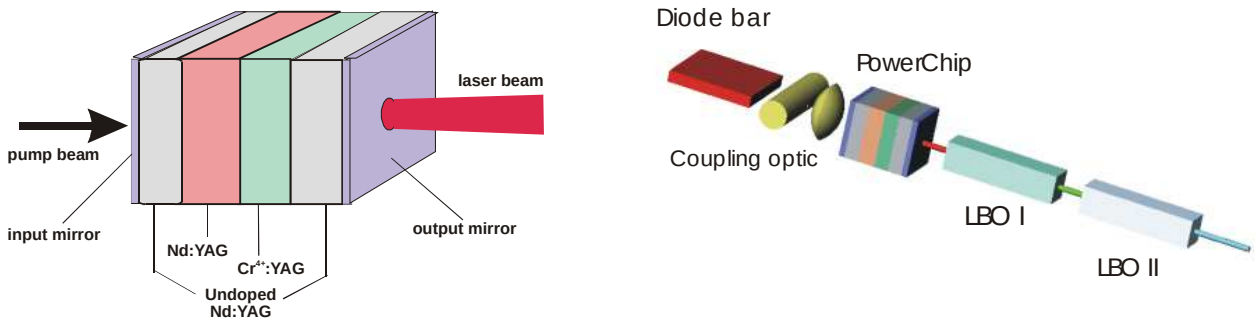


Figure 5: PowerChip NanoLaser Optical Layout

3.2 Compact Industrial Laser

The PowerChip NanoLaser is designed as a product aimed at working in different and changing environments. A rugged mechanical design and a sealed laser head protect the optical components from dust, fumes, condensation and vibrations. These features bring an inherent stability to the laser, eliminating the need for complex and costly electronic feedback loops. A new microprocessor-based power supply controls the entire laser operating parameters, the temperature of the components, the diagnosis and electronic protection circuits, and can be easily interfaced to a computer. The driver electronics are included in the laser head and only need a 24V DC supply.
Thermal management of the electronics and of the heat generated by the pump diode and the two TE Coolers accomplished by a built-in air-cooled heat sink allowing the laser to work as a stand-alone unit. Whether used in an OEM system or in a scientific environment, the PowerChip NanoLaser is an easy to use, hands-off laser.

3.3 Principle of Operation

The standard PowerChip NanoLaser operates at a fixed, factory set, repetition rate of 1 kHz. On demand, it can be preset for different, customer selected, frequencies in the range 0-1000 Hz. Whatever the frequency, the mode of operation is identical.

Principle

The diode laser current is activated by the leading edge of an internal fixed frequency oscillator and the first optical pulse is produced by passive Q-switching approximately 50 to 400 µs after this edge. This delay corresponds to the cavity built up time. When the photo detector, included in the laser head, detects the optical pulse coming out of the chip, it sends a signal to the electronic driver which turns the diode current down. Under these conditions, one and only one optical pulse is permitted each time the oscillator leading edge is produced (*Figure 6*).

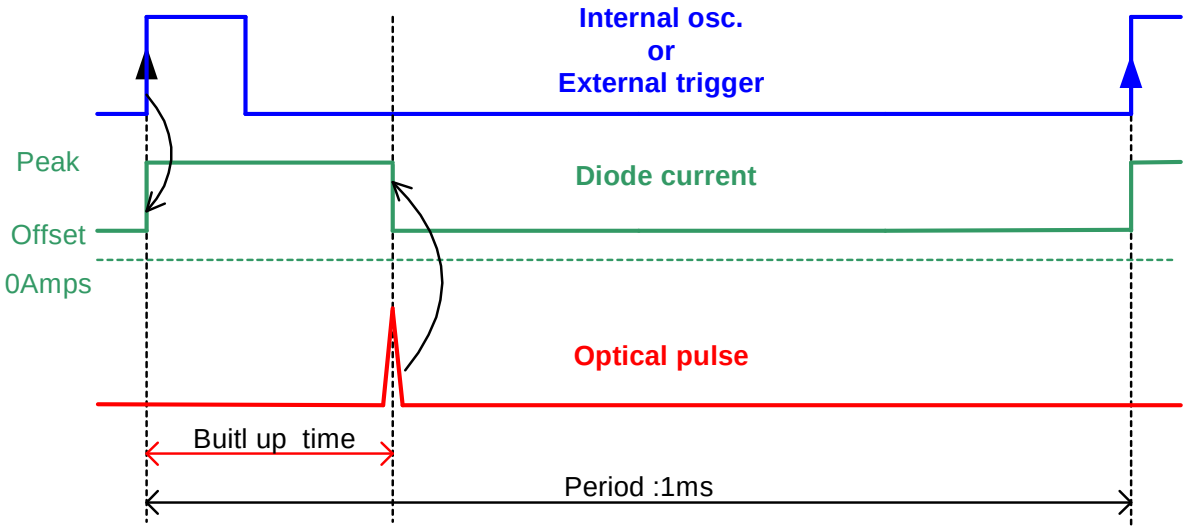


Figure 6: Timing diagram

Modes of operation

This PowerChip NanoLaser system can be used in different modes of operation. The mode of operation is factory set and can be:

- An Internal Mode
- A Manual External Mode
- An Auto External Mode

Whatever the mode of operation, the energy per pulse and the wavelength are always factory set.
Whatever the mode of operation, the user can get the optical pulse image from the detector inside the laser through the BNC connector on the front side of the laser (see the description Section for details).

Note that in any operation mode, **a 50 Ohms termination is mandatory on the BNC connector** located on the front side of the laser (this connector is used to give an image of the optical pulse to the user, see figure 13 pg 24, 'Detector response through the BNC connector'). Either you keep the 50 Ohms load on the connector or connect the BNC connector to a 50 Ohms input impedance oscilloscope.

Internal Mode

This mode is the basic mode of operation for this laser. All the parameters are factory set. As the SubD female connector is ONLY used for Computer on/off laser control. When Computer on/off control is not required, a SubD male connector with shorted interlock pins must be installed (figure 15 pg 27 'Dsub 9 pins connector as shipped'). The repetition rate of the optical pulses is set to 1 kHz in the standard model, but could be factory set to other value upon request at time of ordering. When the laser is plugged on the 24V DC power supply (PCR-240500-100 AC/DC converter in the CDRH version or customer provided for OEM) and switched on, the initialization process of the parameters starts automatically until a LED indicates that the laser is ready to emit. Then, the operator can push the 'on/off' button located on the control panel to start the emission (the led 'laser On' lights-up). The energy per pulse and the repetition rate of the pulses are not adjustable.
The user can monitor the laser with a computer using a specific cable. The connection to the computer is detailed in the description section of this manual and its operation in the operation section.

Manual External Mode

In this mode of operation, the customer signal generator gives the repetition rate of the optical pulses. The laser has to be triggered by a computer or a pulse generator through the 'external trigger' pin on the DSub connector. When the laser is in the 'Laser ON' mode (after pressing the 'laser On' button on the control panel), the pulses will be emitted when the user signal generator will send the trigger signals.

For each trigger electrical pulse, one optical pulse is emitted with a delay of 50 µs to 400 µs corresponding to the built-up time of the cavity.

The standard laser is factory optimized for one frequency specified by the user. Performance of the laser at other frequencies may be different. In specific cases otherwise stated within the specification document attached to this manual, the laser may be optimized differently. Refer to Section II.

Auto External Mode (OEM systems only)

This mode of operation is the same that the Manual External Mode described before except that the user does not have to push the 'on/off' button to bring the 'laser on' status. When the user switches on the 24V DC, the laser goes automatically to the 'laser on' mode and is waiting for the trigger signal. As soon as the signal is sent, the laser emits.

Note **:** The laser is always optimized at preset frequencies by the factory. When used in external trigger mode, the performances of the laser are stable over a limited frequency range around that preset value. Performances may vary slightly outside this range.

NB: In addition to the various operation modes described here above, the laser output can be remotely controlled using a set of functionalities described in 4.5 Computer Interface (p25)

4 - Description

4.1 Schematic diagrams of the Laser Heads and Power Supply (CDRH only)

The OEM laser system is shown on the *Figures 7 and 8* following (all the dimensions in millimeters).
The CDRH laser source is shown on the *Figures 9 and 10* (all the dimensions in millimeters).
The Laser Controller or AC/DC Converter for CDRH configuration is shown on figure 11

4.1.a OEM Product & CDRH Product

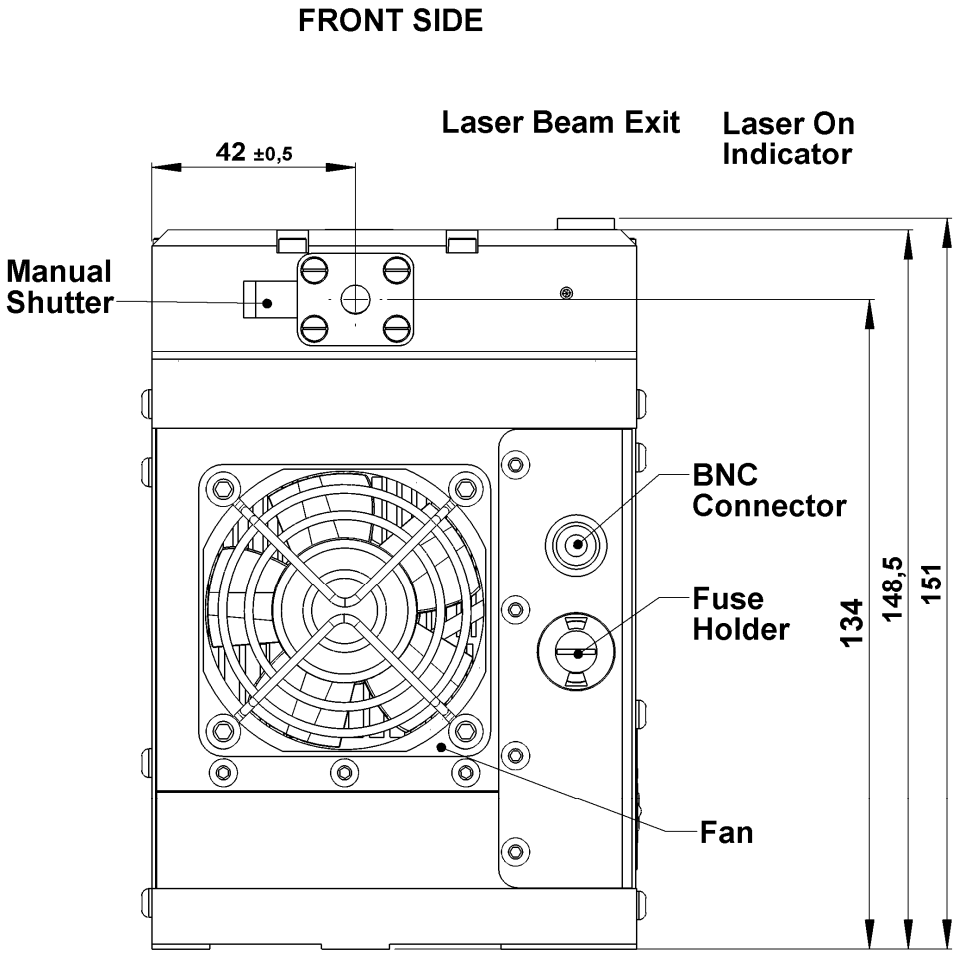


Figure 7.a: OEM Laser system drawing (front view)

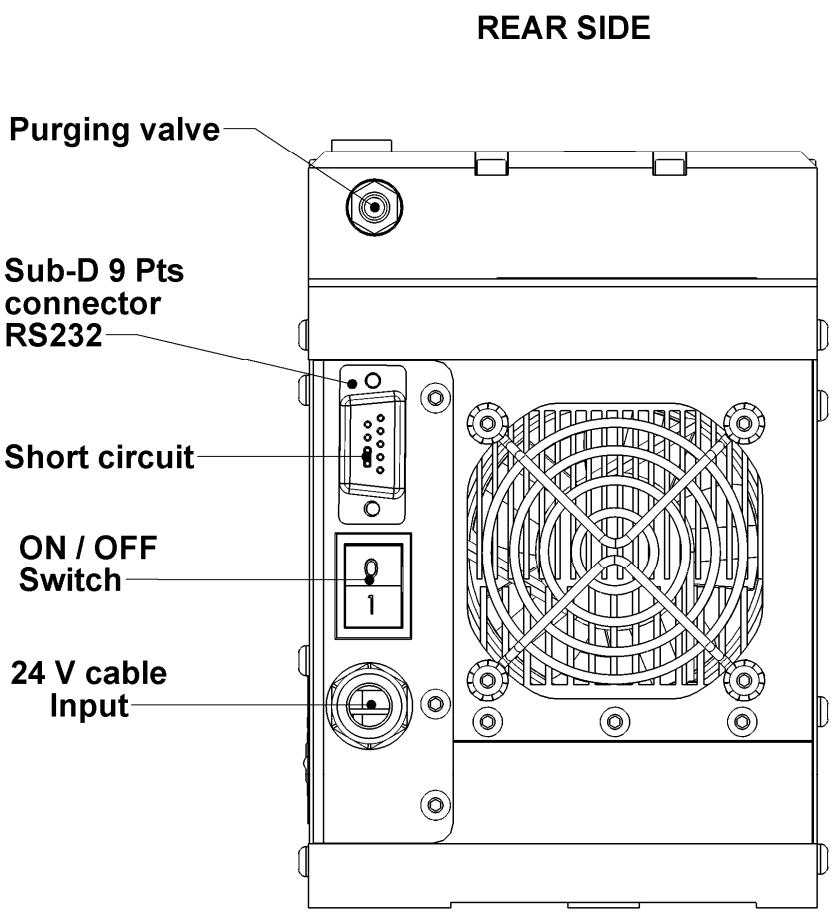


Figure 7.b: OEM Laser system drawing (back view)

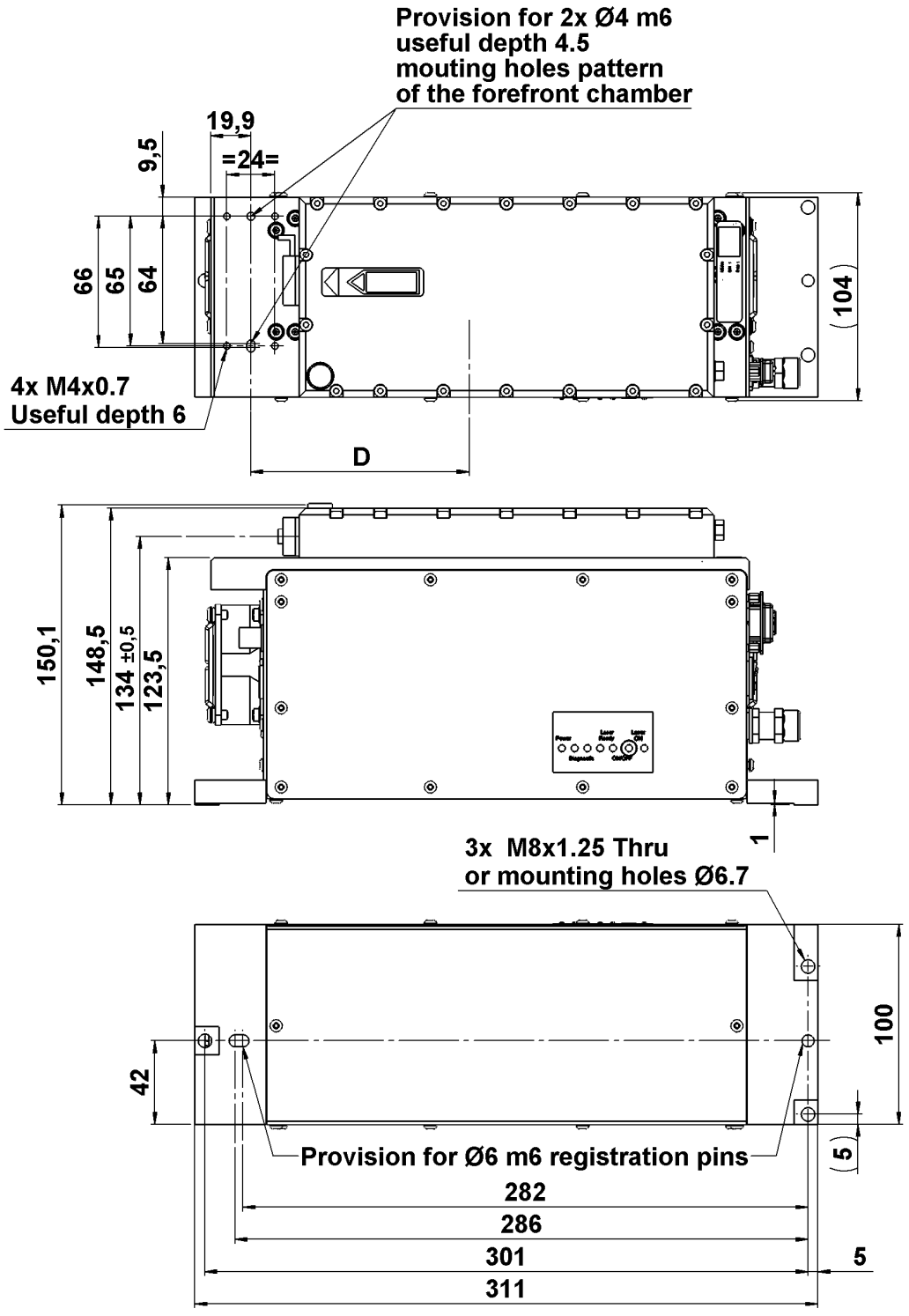


Figure 8: OEM Laser system drawing (Bottom, Side, Top view)

NB : the active cooling air flow inside the laser is shown by the red arrow in figure 8.

4.1.b CDRH AC/DC Converter – Laser controller

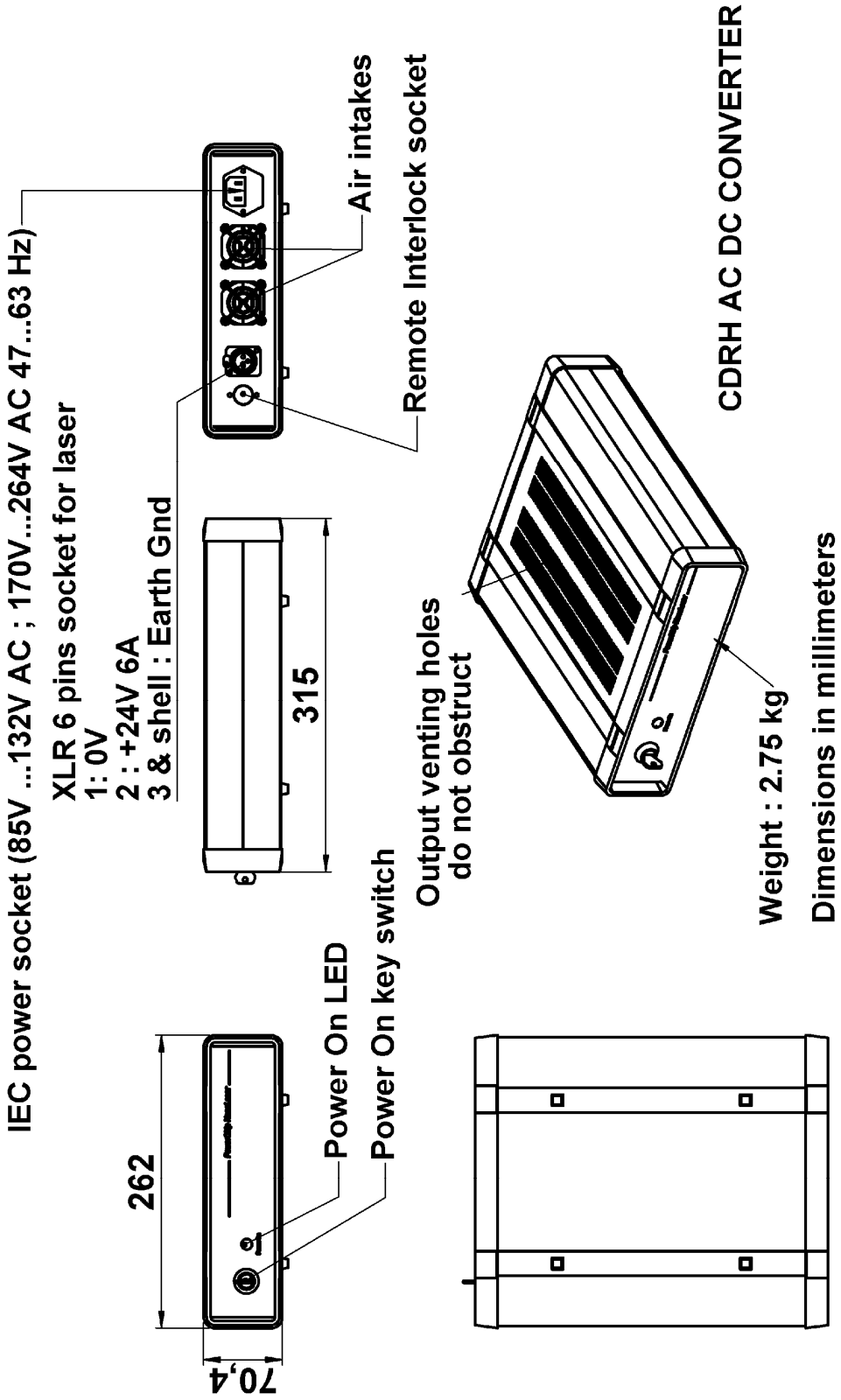


Figure 9: CDRH Laser controller drawing

4.2 LEDS panel

A panel with several LED indicators is located on the side of the laser. They indicate the operational status of the laser. Please refer to the LED indicator section in the chapter on Operation.

The 'Control panel' is detailed on *Figure 12*. There are six **light emitting diodes** (led)

- the 'Power' led: indicates that the laser system is powered by 24v (in particular, the on-off switch is ON).
- the 'Diagnostic' leds: indicate the status of the laser operation and first level diagnosis of errors (for details, see Servicing, cleaning and trouble shooting Section).
- the 'Laser ready' led: indicates the initialization is finished and the laser is ready to produce optical pulses.
- The 'Laser ON' led: indicates the laser beam is turned on (as the 'Laser On' indicator on the front side of the laser).

Plus a **push button**

- The 'Laser On/Off button': used to turn on or turn off the output beam.

NB: When laser is in a Sleeping state or Idle state, the 'Laser ON' LED is OFF but all other LEDS are lit.

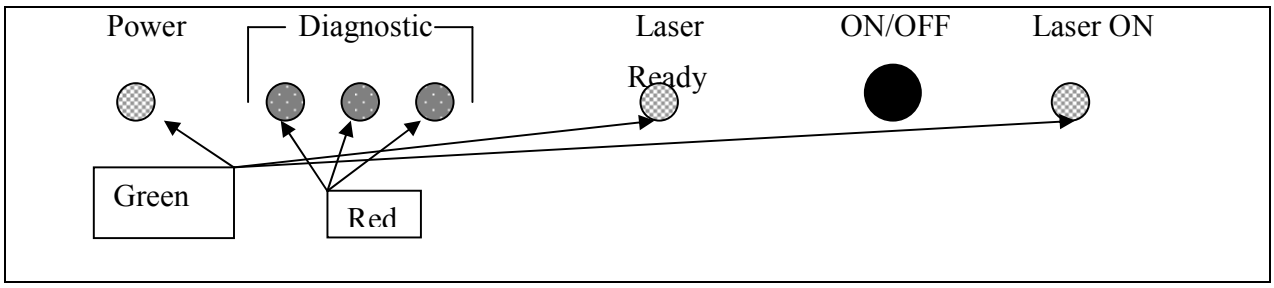


Figure 10: Control/Front panel

4.3 Image of optical pulses

The image of the optical pulse can be read in parallel through a BNC connector on the front of the laser under the condition that the readout configuration is 50 Ohms terminated. If this output is not used, plug the 50 Ohms charge delivered with the laser on the BNC connector figure 14.

The detector rise time is approximately 3.5 nsec. (*Figure 11)*.

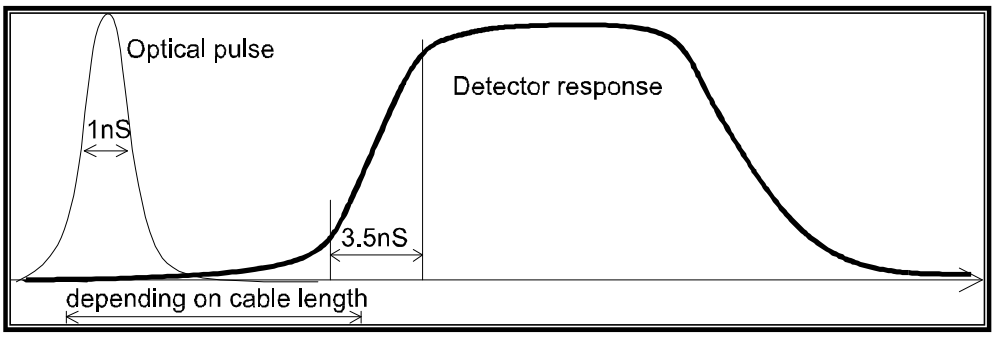


Figure 11: Detector response through the BNC connector

The detailed BNC connector is described on *Figure 12*.

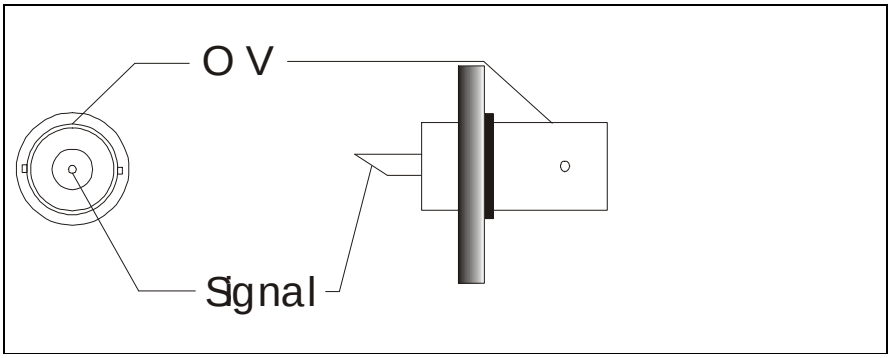


Figure 12: BNC connector socket

4.4 Computer interface

The laser can be interfaced to a computer via the serial interface. The corresponding protocol is not described in this manual.

The laser can also be controlled through TTL logic inputs that can be used as an ON/OFF control or as the external trigger.

The detailed pins allocation from the Sub-D connector is described on *Figure 13*.

Caution

For realization of computer interface cables, refer to: "*connecting the computer interface in a safe way*" hereafter.

4.4.a Inputs/Outputs description

The signals required on the DSub 9 pins connector to control the laser system are as follow (the pins 7, 8 and 9 are linked to 0V):

- **Computer On/Off** (can be used in all operating modes, i.e. Internal Mode, Manual External Mode or Auto External Mode)
  TTL compatible input:
  Signal on pin 3: V≤0.4V: the laser is inhibited

  4<V<5V DC: the laser produces optical pulses at a factory set repetition rate (Internal mode) or depending of the Trigger signal (External mode and Auto external mode).

  Pin 7 to 0V

- **Trigger signal** (Manual External Mode or Auto External Mode **ONLY**)
  TTL compatible input
  Signal on pin 4: V≤0.4V: the laser is inhibited

  Pulse with high level 4<V<5V and width >50µs: the laser produces one optical pulse for each rising edge of the trigger pulse. The repetition rate depends on the frequency of the Trigger signal.

  Pin 8 to 0V

- **Interlock signal** (can be used in all operating modes)
  TTL or relay compatible input :
  Signal on pin 6: V≤0.4V: for laser operation
  Not connected to inhibit the laser operation

  Pin 9 to 0V

- **Laser ON/OFF signal** (Internal Mode, External Mode or Auto External Mode)
  TTL or relay compatible input, behaves like the push button :

  Signal on pin 5:
  From V>2.4V : V≤0.4V for >75ms = switch to different state (On ↔Off)

  Pin 9 to 0V

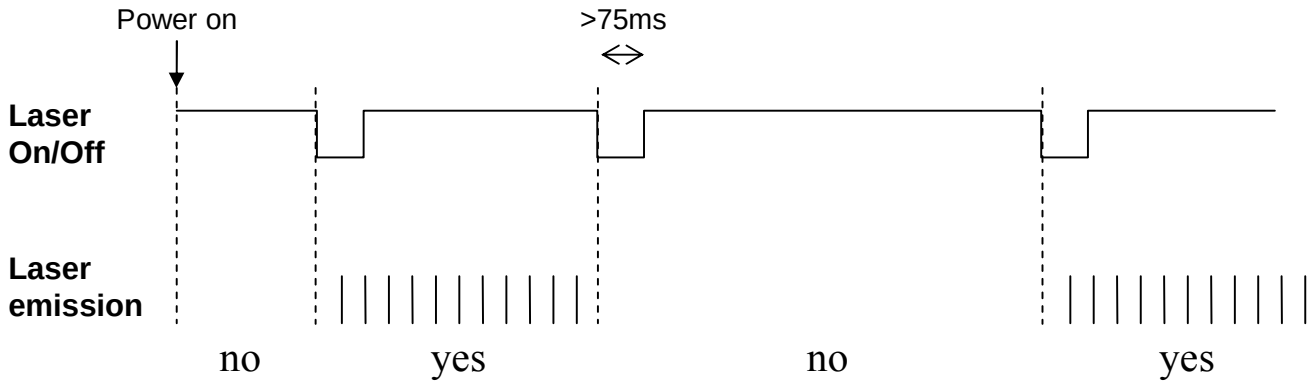


Figure 13: Chronogram for Laser On-Off function

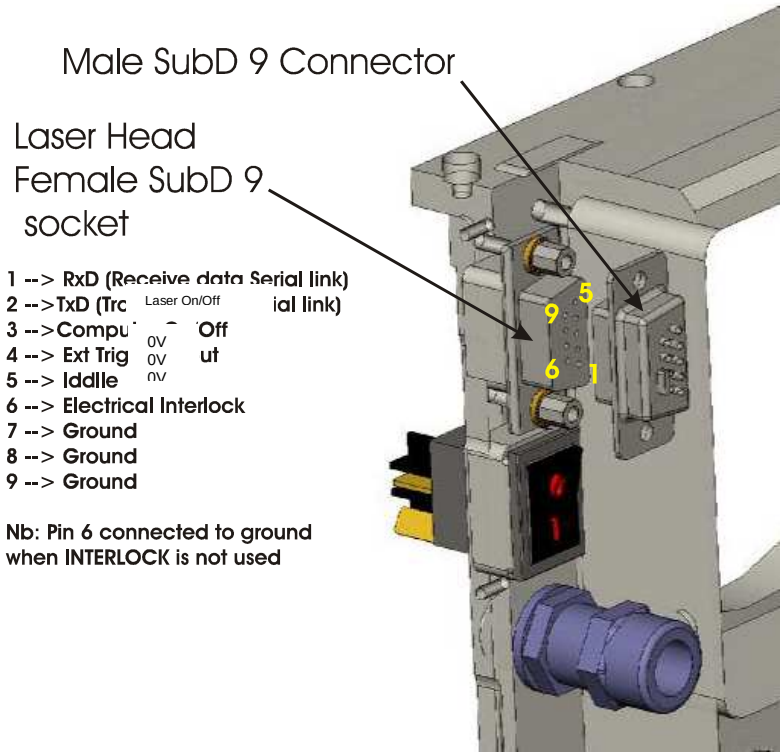


Figure 14: DSub 9 pins connector as shipped

Pin n°	Name	Comments
1	RxD RS232 Reception	V_{ILmin} threshold = 0.8V V_{IHmax} = 2.4V
2	TxD Transmission	V_{out} mini = ±5V on 3kΩ to Ground Z_{out} max = 400Ω
3	Computer On/Off	Input with 10kΩ pull-up to +5V V<0.4V: the laser is inhibited V>2.4V: the laser fires in the defined mode conditions
4	Ext Trigger	Input with 10kΩ pull-up to +5V Operates in External modes only V<0.4V: the laser is inhibited in stand by ready to fire V>2.4V and width>50µs: the laser produces one pulse for each rising edge
5	Laser On/Off	Input with 10kΩ pull-up to +5V From V>2.4V : V≤0.4V for >75ms = switch to different state (On ↔Off)
6	Electrical Interlock	Input with 10kΩ pull-up to +5V V<0.4V: the laser is ready for operation V>2.5V: the laser is inhibited and set to eye safe condition. If pin is unconnected to ground, the laser is inhibited and reset to start conditions (push button to recover from interlock)
7	Ground	

8	Ground	
9	Ground	

4.4.b Connecting the computer interface in a safe way

The D Sub connector includes different functions: serial link, computer On/Off, Trigger ext, Interlock and Laser On/Off.

For ESD and EMI immunity, it is highly recommended to follow the subsequent instructions:

- Use twisted pairs cable shielded pair to pair (multipairs individually shielded cable can be used).
- Never mix two signals in the same pair, always pair signal and its corresponding 0V.
- Use on each cable a ferrite tube with approximately 150 Ohms at 25 MHz . Recommended model: Würth electronik ref: 7427007.

Caution

1. When preparing your cable according to your selected mode of operation, make sure of the proper pins allocations. **Whenever the interlock is not used, pins 6 and 7 must be shorted for the laser to operate.**

2. You can either use the male DSub installed on the laser head or a new one. If you select to use the one installed on the laser, remove it from the laser head prior to solder your wires onto it.

3. **DO NOT USE STANDARD SUB-D 9 SERIAL CABLES SHIPPED WITH COMPUTERS, THE PIN ALLOCATIONS ARE DIFFERENT AND WIRE-TO-WIRE CAPACITANCE COUPLING MAY CREATE PERTURBATIONS ON UNUSED INPUTS.**

5- Installation

5.1 Mounting

When mounting the ***PowerChip*** NanoLaser System, consider the following information:
The location should be as clear as possible from dust. Select an environment that does not exceed the specifications, for temperature, humidity, etc., as listed in the Specifications section. The ***PowerChip*** NanoLaser should be mounted on its feet or base plate. Mounting holes and registration holes are provided on the base plate as described on the drawings.

Heat Sinking

Built-in, air cooled, active heat-sinking is provided for proper operation of the laser. The built-in fan ensures proper airflow to maintain the laser in the proper temperature range. The air flow direction is pictured in figure 8. The cooling is designed for environment with temperature in the range 15°C-35°C or 20°C-35°C (see attached specs for model type), if your environment exceeds this range additional temperature control must be provided.

Important

The surroundings of the laser must be clear of any object that would disturb the cooling airflow, even partially. Never keep the laser system powered with obstructed airflow.

Caution ESD!

The PowerChip NanoLaser incorporates a diode laser as the pump source. **Diode lasers are extremely sensitive to electrostatic discharge (ESD). ESD is the primary cause of premature diode laser failure.** Extreme precaution to prevent ESD are taken at the factory when handling the laser, never attempt to disconnect cables inside the laser.

5.2 Connecting Power

The CDRH laser source PNX-Mxxxyy-1yz works with Model PCR-240500-100 AC/DC converter in the CDRH version. The OEM laser source PNX-Mxxx-0yz (or customer specific reference) works from a 24V DC voltage that each individual OEM user must supply.

Before connecting to the 24V DC voltage insures that the Power ON/OFF switch on the back of the laser is OFF.

For the CDRH version, just plug the Laser head XLR connector into the AC/DC converter XLR socket. In the OEM version, the voltage should be applied via the black cable exiting the laser through the back panel in the following way:

Green or Yellow/Green wire	: Laser housing to be connected to earth ground
White wire	: 0V/Ground
Black wire	: +24V

For proper EMI and ESD operation, it is mandatory to connect 0V to Earth ground.
The maximum average current consumption is below 3A. It means the maximum input power consumed is 75W. Due to switch-on inrush current, the use of a 24V/6A source is recommended.

Caution Voltage !

The input voltage must be kept in the range 22-26V DC. The polarity of the voltage must be correct. **Failure to apply the proper DC voltage may results in permanent damage**.

Connecting a cable with Dsub connector

For any mode of operation other than the "internal" and "auto internal" mode, a cable terminated by a subD connector is necessary. It is used to connect the laser to the Interlock signal generator, the trigger signal generator and/or the computer "ON/OFF" signal generator.

The signals needed for each of these functions and the pins allocation is detailed in the description section. Please refer to it to connect the laser to your external signal generator according to the mode of operation that the laser has been ordered for.

Laser Grounding

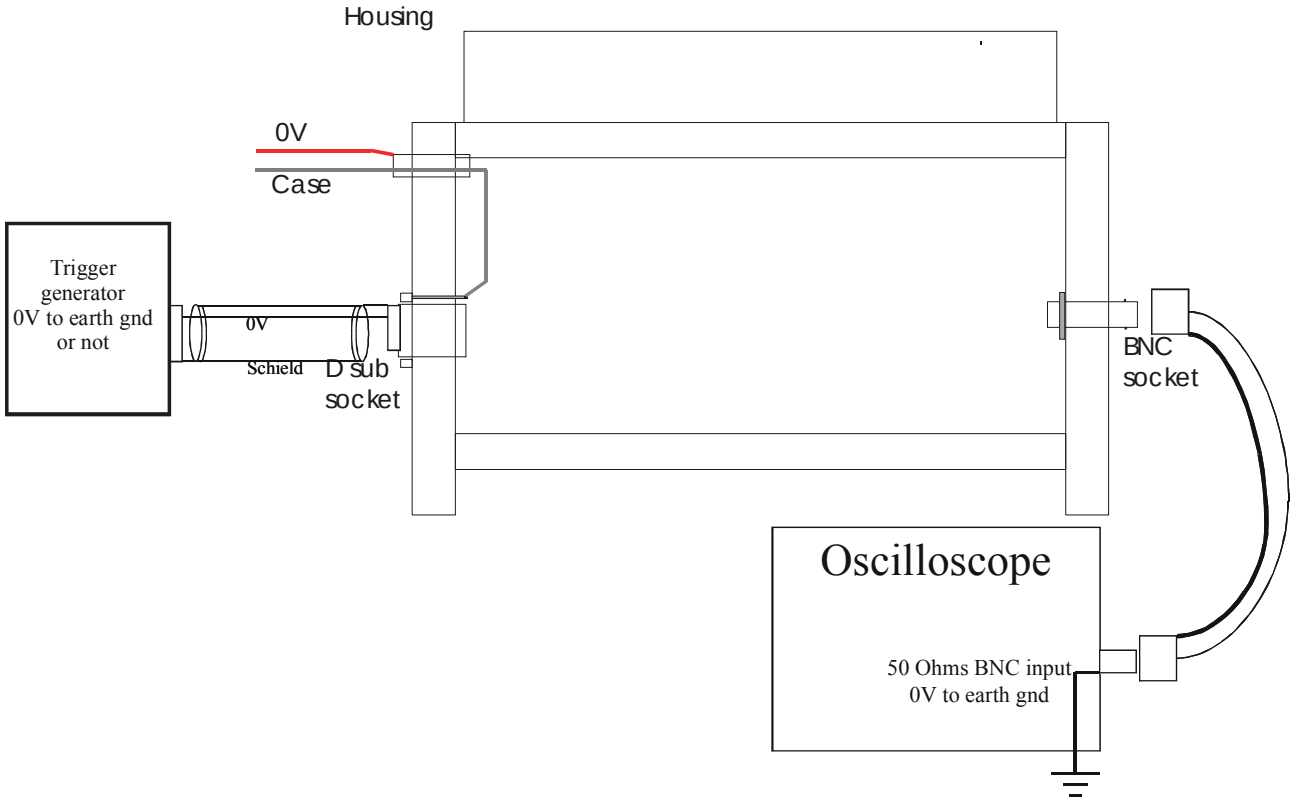


Figure 15: Schematic of recommended laser grounding

- Connecting the laser through BNC or DSub connector is likely to connect signal return path to earth ground. In order to keep the laser free from EMI or ESD influence, it is mandatory to provide a low impedance path from case to earth ground.
- As the BNC outer shell (signal return path) is connected to housing, it is mandatory to connect case to 0V in a Star-Ground scheme (possibly at the 0V power supply output – see figure 14).

6- Operation

During operation of the PowerChip NanoLaser System, the current to the diode, the temperature of the diode and the current to the thermoelectric coolers are measured and regulated.
All temperature and current parameters for the operation of the PowerChip NanoLaser are factory set for optimum performance and are not adjustable by the end user.

At this step of installation/operation, the 24V DC input voltage is supplied to the laser.

First, the user has to know in which mode the laser operates. This mode is factory set and referenced to the Model Number as follow (OEM or CDRH model numbers - X letter here replaces P for 1064: nm, G for 532 nm, V for 355 nm depending on the wavelength of the laser used- Please refer to model numbering description at the beginning of chapter 2 for additional information):

- PNX-Mxxxyy-x0z: Internal fixed rep rate at max frequency
- PNX-Mxxxyy-x1z: Internal fixed rep rate at customized frequency
- PNX-Mxxxyy-x2z: External fixed rep rate at customized frequency
- PNX-Mxxxyy-x3z: External multi rep rate at up to 3 customized frequencies

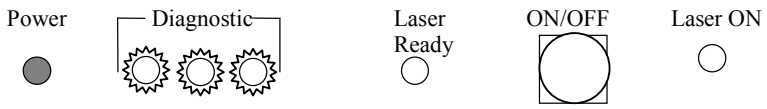
For each of these Modes of operation, it is possible to use or not use the electrical interlock or the computer ON/OFF
When activated, manually or electronically, the interlock immediately shuts down the power electronic that drives the pump diode, the laser stops operating.
The computer On/Off sends enabling signals to operate the laser, when the signal is OFF, all the electronics in the laser continues to operate but laser cannot fire.
The CDRH AC/DC converter remote interlock circuit interruption immediately shuts down the primary DC power from the laser that is immediately stopped and reset. When interlock circuit is restored, it is necessary to restart the laser operation either manually or remotely (same as a new power on).

Be sure that the BNC connector is equipped with the supplied 50 Ohms termination (or is connected to a 50 Ohms input of an oscilloscope).

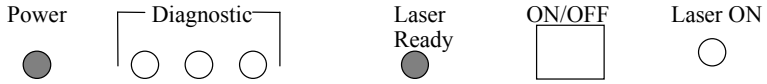
Before operating the laser, open the beam shutter located at the laser output, verify which mode of operation you ordered, select if you chose to use the interlock and /or computer on/off and read the appropriate section.

6.1 Internal mode operation (-x0z,-x1z) – fig 15

1. The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the electrical Interlock. Verify that this connector is installed on the laser, if not plug it in.
2. To start the laser operation, switch on the primary 24V voltage source (by either keying on the PCR-240500-100 AC/DC converter on the CDRH version, PCR power on led comes on OR bring your own 24V signal for OEM version), turn the Power ON/OFF switch on the backside of the laser head to the ON position. At that time the green “Power” LED on the Control panel lights up, indicating that the electronics is powered.

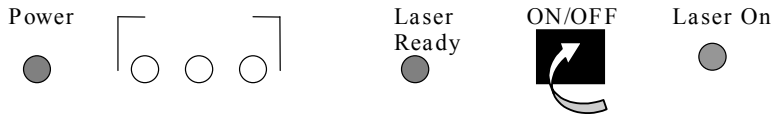


3. During the start up phase, the initialization of the electronics takes place and the TE coolers start to operate to bring the optical components to their operating temperature. During that phase, the left red "Diagnostic" LED will shine for a brief period, less than 3 seconds. Then the middle red followed by the right "diagnostic" LED will in turn shine for 3 sec. When the operating temperature of the crystals is reached and the initialization is completed, the green "Laser Ready" LED lights up.



At this stage, the right "Diagnostic" red LED may or may not shine. If it shines, it just indicates that the proper operating temperature has been reached without the fans being switched on.

4. To obtain laser emission, verify that the beam shutter is open, push on the black round "laser ON/OFF" button on the Control panel. The "laser ON" LED lights up. **There is a few seconds time delay between the "laser on" light and the actual laser beam emission, DO NOT WATCH DIRECTLY INTO THE BEAM.**



Wait 10 min to reach a stable operation.

5. To stop the laser emission, push again on the "Laser ON/OFF" button on the Control panel. The LED "Laser ON" goes off while the laser system electronics continues to operate.

6. Close the beam shutter. To turn off the laser system, switch off the "Power ON/OFF" switch on the backside of the laser. All the LED's go out., Key off the PCR.

Interlock Connection

The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the electrical Interlock. Remove this connector and plug your cable with the 9-pin DSub connector in. Verify that the proper leads have been connected to your interlock enabling system (see installation section).

Electrical Interlock signal will affect the laser operation as follow:

Signal on pin 6:	V<0.4V for laser operation
	Not connected to inhibit the laser operation
Pin 7 is 0V	

To start the laser operation, follow step 1 to 4 from §6.1.

Computer On/Off

The PowerChip NanoLaser is delivered with a male 9 pin DSub connector with pins 7 and 6 shorted to inhibit the Interlock. Remove this connector and plug your cable with the 9-pin DSub connector in. Verify that the correct leads have been connected to the computer driver (see installation section p.27).

Computer On/Off signal will affect the laser operation as follow:

Signal on pin 3:	V<0.4V : the laser is inhibited
	2.4<V<5V DC: the laser produces optical pulses at the factory set repetition rate.
Pin 7 is 0V	

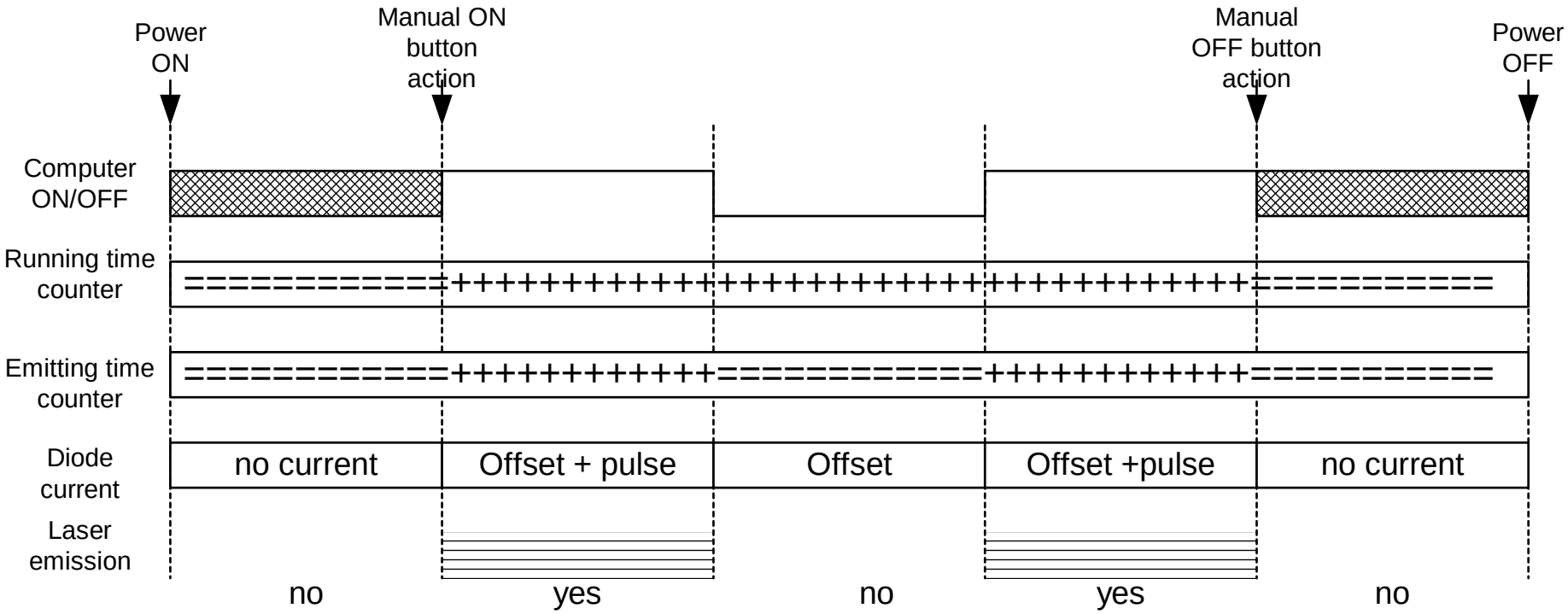
a) Operation is obtained following step 1 to 4 from §6.1.
To obtain laser emission, verify that the beam shutter is open, verify that the proper signal is sent to the computer "on/off" pins,. Wait 10 min to reach a stable laser emitting operation. Laser emission will start few seconds after the computer sends the "On" signal; setting on the "Laser ON" led.

b) To stop the laser emission, pull down signal from the computer ON/OFF pins. The laser stops firing while the laser system electronics continues to operate.

c) To turn off the laser system, switch off the "Power ON/OFF" switch on the backside of the laser. All the LED's go out. Close the beam shutter, key off the PCR.

Internal mode with Interlock and Computer On/Off

The Interlock and Computer "on/off" can be used simultaneously. In that case pins 3 and 6 are connected to their respective signal generator as described above. The operation is similar to the one describe above. When activated, the Interlock will take priority over the computer "on/off"



+ : This means that the counter is incremented
= : This means that the counter is not incremented

Figure 16: Chronogram for Internal Mode operation

6.2 Manual External Mode Operation (-x2z, -x3z) – fig16

1. The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the Interlock. Remove this connector and plug your cable with the 9-pin DSub connector in. Verify that the correct leads have been connected to your trigger signal generator (see installation section).

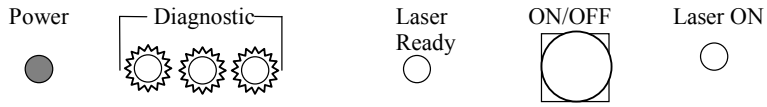
The Trigger signal required is as follow:

Signal on pin 4: V<0.4V: the laser is inhibited

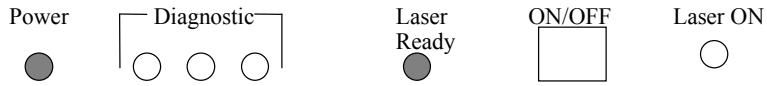
Electronic Pulse with 4<V<5V DC and width>50µs: the laser produces one optical pulse for each trigger pulse. The repetition rate depends of the frequency of the Trigger signal.

Pin 8 is 0V

2. To start the laser operation, switch on the primary 24V voltage source (by either keying on the PCR-240500-100 AC/DC converter on the CDRH version, PCR power on led comes on OR bring your own 24V signal for OEM version), turn the Power ON/OFF switch on the backside of the laser head to the ON position. At that time the green "Power" LED on the Control panel lights up, indicating that the electronics is powered.

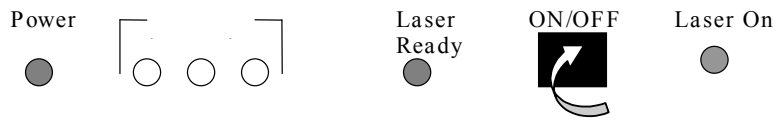


3. During the start up phase, the initialization of the electronics takes place and the TE coolers start to operate to bring the optical components to their operating temperature. During that phase, the left red "Diagnostic" LED will shine for a brief period, less than 3 seconds. Then the middle red followed by the right "diagnostic" LED will in turn shine for 3 sec. When the operating temperature of the crystals is reached and the initialization is completed, the green "Laser Ready" LED lights up.



At this stage, the right "Diagnostic" red LED may or may not shine. If it shines, it just indicates that the proper operating temperature has been reached without the fans being switched on.

4. To obtain laser emission, verify that the beam shutter is opened, push on the black round "Laser ON/OFF" button on the Control panel. The "laser ON" LED lights up. **There is a few seconds time delay between the "laser on" light and the actual laser beam emission, DO NOT WATCH DIRECTLY INTO THE BEAM.** Now the laser is firing at the frequency of your external trigger generator.



Wait 10 min to reach a stable operation.

5. To stop the laser emission, push again on the "Laser ON/OFF" button on the Control panel. The LED "Laser ON" goes off while the laser system electronics continues to operate.

Close the beam shutter. To turn off the laser system, switch off the "Power ON/OFF" switch on the backside of the laser. All the LED's go out, Key off the PCR.

Manual External Mode Operation with Interlock

1. The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the Interlock. Remove this connector and plug your cable with the 9 pin DSub connector in. Verify that the correct leads have been connected to your trigger signal generator (see installation section).

The Trigger signal required is as follow:

Signal on pin 4: V<0.4V (at least <0.8v DC): the laser is inhibited

Electronic Pulse with 2.4<V<5V DC and width>50µs: the laser produces one optical pulse for each trigger pulse. The repetition rate depends of the frequency of the Trigger signal.

Pin 8 is 0V

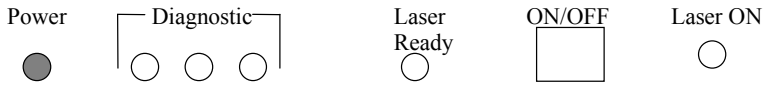
Interlock signal will affect the laser operation as follow:

Signal on pin 6: V<0.4V: for laser operation

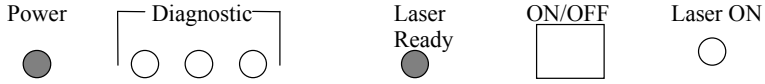
Not connected to inhibit the laser operation

Pin 7 is 0V

2. To start the laser operation, switch on the primary 24V voltage source, switch the ON/OFF switch on the backside of the laser head to the ON position. At that time the green "Power" LED on the Control panel lights up, indicating that the electronics is powered.



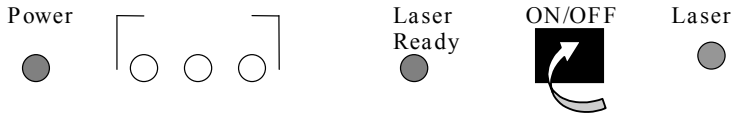
3. During the start up phase, the initialization of the electronics takes place and the TE coolers start to operate to bring the optical components to their operating temperature. During that phase, the left red "Diagnostic" LED will shine for a brief period, less than 3 seconds. When the operating temperature of the crystals is reached and the initialization is completed, the green "Laser Ready" LED lights up.



4. At this stage, the right "Diagnostic" red LED may or may not shine. If it shines, it just indicates that the proper operating temperature has been reached without the fans being switched on.

To obtain laser emission, verify that the beam shutter is open, verify that the proper signal is sent to the Interlock pins, verify that the proper signal is sent to the trigger pins, push on the black round

"ON/OFF" button on the Control panel The "Laser ON" led lights up. Wait 10 min to reach a stable laser emitting operation. Laser emission will start when the trigger signal generator sends the "On" signal.



5. To stop the laser emission, push again on the "ON/OFF" button on the Control panel. The LED "Laser ON" goes out while the laser system electronics continues to operate.

6. To turn off the laser system, switch off the "ON/OFF" switch on the backside of the laser. All the LED's go out. Close the beam shutter, key off the PCR.

External mode operation with Computer On/Off

1. The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the Interlock. Remove this connector and plug your cable with the 9-pin DSub connector in. Verify that the correct leads have been connected to your trigger signal generator (see installation section).

The Trigger signal required is as follow:

Signal on pin 4: V<0.4V: the laser is inhibited

Electronic Pulse with 2.4<V<5V DC and width>50µs: the laser produces one optical pulse for each trigger pulse. The repetition rate depends of the frequency of the Trigger signal.

Pin 8 is 0V

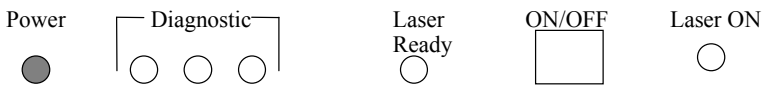
Computer On/Off signal will affect the laser operation as follow:

Signal on pin 3: V<0.4v : the laser is inhibited

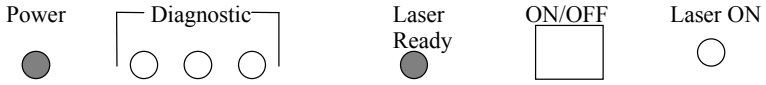
2.4<V<5v DC: the laser produces optical pulses at a repetition rate set by the Trigger signal

Pin 7 is 0V

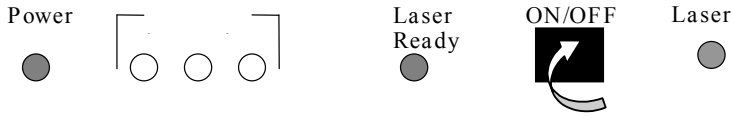
2. To start the laser operation, switch on the primary 24V voltage source (by keying on the PCR-240500-100 AC/DC converter on the CDRH version, PCR power on led comes on), switch the ON/OFF switch on the backside of the laser head to the ON position. At that time the green "Power" LED on the Control panel should light up, indicating that the electronics is powered.



3. During the start up phase, the initialization of the electronics takes place and the TE coolers start to operate to bring the optical components to their operating temperature. During that phase, the left red "Diagnostic" LED will shine for a brief period, less than 3 seconds. When the operating temperature of the crystals is reached and the initialization is completed, the green "Laser Ready" LED lights up.



4. At this stage, the right "Diagnostic" red LED may or may not shine. If it shines, it just indicates that the proper operating temperature has been reached without the fans being switched on.
   To obtain laser emission, verify that the beam shutter is open, verify that the proper signal is sent to the "Computer On/Off", verify that the proper signal is sent to the trigger pins, push on the black round "ON/OFF" button on the Control panel. The "Laser ON" led lights up. Wait 10 min to reach a stable laser emitting operation. Laser emission will start when the trigger signal generator sends the "On" signal.



5. To stop the laser emission, push again on the "ON/OFF" button on the Control panel. The LED "Laser ON" goes out while the laser system electronics continues to operate.

6. To turn off the laser system, switch off the "ON/OFF" switch on the backside of the laser. All the LED's go out. Close the beam shutter, key off the PCR.

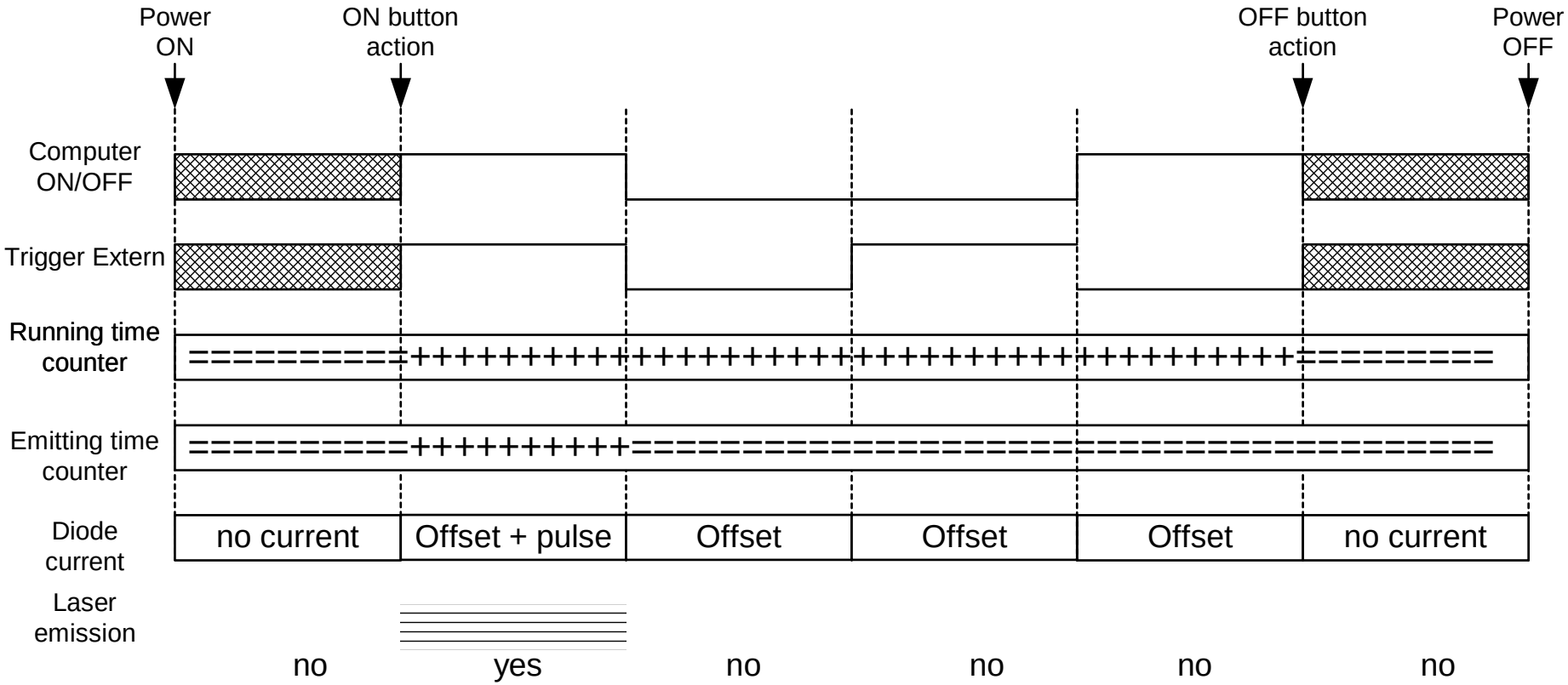


Figure 17: Chronogram for External Mode operation

6.3 Auto External Mode Operation (-x2A, -x3A; not available in CDRH version) – Fig 17

1. The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the Interlock. Remove this connector and plug your cable with the 9-pin DSub connector in. Verify that the correct leads have been connected to your trigger signal generator (see installation section p.30).

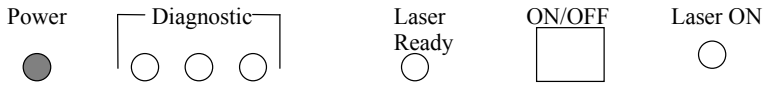
The Trigger signal required is as follow:

Signal on pin 4: V<0.4V: the laser is inhibited

Electronic Pulse with 2.4<V<5V DC and width>50µs: the laser produces one optical pulse for each trigger pulse. The repetition rate depends of the frequency of the Trigger signal.

Pin 8 is 0V

2. To start the laser operation, verify that the beam shutter is closed, verify that the proper signal is sent to the trigger pins, switch the ON/OFF switch on the back side of the laser head to the ON position. At that time the green "Power" LED on the Control panel lights up, indicating that the electronics is powered.



3. During the start up phase, the initialization of the electronics takes place and the TE coolers start to operate to bring the optical components to their operating temperature. During that phase, the left red "Diagnostic" LED will shine for a brief period, less than 3 seconds. When the operating temperature of the crystals is reached and the initialization is completed, the green "Laser Ready" and the "Laser ON" LEDs light up.

4. At this stage, the right "Diagnostic" red LED may or may not shine. If it shines, it just indicates that the proper operating temperature has been reached without the fans being switched on.
Laser emission will start when the trigger signal generator sends the "On" signal. Open the beam shutter. Wait 10 min to reach a stable laser emitting operation.

5. To stop the laser emission, push again on the "ON/OFF" button on the Control panel. The LED "Laser ON" goes out while the laser system electronics continues to operate.

6. To turn off the laser system, switch off the "ON/OFF" switch on the backside of the laser. All the LED's go out. Close the beam shutter.

Auto external mode operation with Interlock (not available in CDRH version)

1. The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the Interlock. Remove this connector and plug your cable with the 9-pin DSub connector in. Verify that the correct leads have been connected to your trigger signal generator (see installation section).

The Trigger signal required is as follow:

Signal on pin 4: V=0.4V : the laser is inhibited

Electronic Pulse with 2.4<V<5V DC and width>50µs: the laser produces one optical pulse for each trigger pulse. The repetition rate depends of the frequency of the Trigger signal.

Pin 8 is 0V

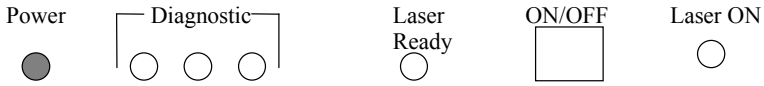
Interlock signal will affect the laser operation as follow:

Signal on pin 6: V=0V: for laser operation

Not connected to inhibit the laser operation

Pin 9 is 0V

2. To start the laser operation, verify that the beam shutter is closed, verify that the proper signal is sent to the Interlock pins, verify that the proper signal is sent to the trigger pins, switch the ON/OFF switch on the back side of the laser head to the ON position. At that time the green "Power" LED on the Control panel lights up, indicating that the electronics is powered.



3. During the start up phase, the initialization of the electronics takes place and the TE coolers start to operate to bring the optical components to their operating temperature. During that phase, the left red "Diagnostic" LED will shine for a brief period, less than 3 seconds. When the operating temperature of the crystals is reached and the initialization is completed, the green "Laser Ready" and The "Laser ON" LEDs light up.

4. At this stage, the right "Diagnostic" red LED may or may not shine. If it shines, it just indicates that the proper operating temperature has been reached without the fans being switched on.
   Laser emission will start when the trigger signal generator sends the "On" signal. Open the beam shutter. Wait 10 min to reach a stable laser emitting operation.
5. To stop the laser emission, push again on the "ON/OFF" button on the Control panel. The LED "Laser ON" goes out while the laser system electronics continues to operate.
6. To turn off the laser system, switch off the "ON/OFF" switch on the backside of the laser. All the LED's go out. Close the beam shutter.

Auto external mode operation with Computer On/Off (not available in CDRH version)

1. The PowerChip NanoLaser is delivered with a male 9-pin DSub connector with pins 7 and 6 shorted to inhibit the Interlock. Remove this connector and plug your cable with the 9-pin DSub connector in. Verify that the correct leads have been connected to your trigger signal generator (see installation section).

The Trigger signal required is as follow:

Signal on pin 4: V<0.4V : the laser is inhibited

Electronic Pulse with 2.4<V<5V DC and width>50µs: the laser produces one optical pulse for each trigger pulse. The repetition rate depends of the frequency of the Trigger signal.

Pin 8 is 0V

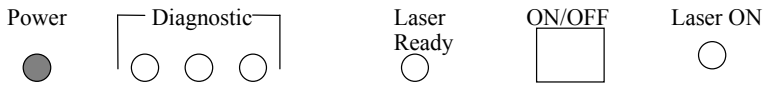
Computer On/Off signal will affect the laser operation as follow:

Signal on pin 3: V<0.4V: the laser is inhibited

2.4<V<5V DC: the laser produces optical pulses at a repetition rate set by the Trigger signal

Pin 7 is 0V

2. To start the laser operation, verify that the beam shutter is closed, verify that the proper signal is sent to the computer "on/off" pins, verify that the proper signal is sent to the trigger pins, switch the ON/OFF switch on the back side of the laser head to the ON position. At that time the green "Power" LED on the Control panel should light up, indicating that the electronics is powered.



3. During the start up phase, the initialization of the electronics takes place and the TE coolers start to operate to bring the optical components to their operating temperature. During that phase, the left red "Diagnostic" LED will shine for a brief period, less than 3 seconds. When the operating temperature of the crystals is reached and the initialization is completed, the green "Laser Ready" and the "Laser ON" LEDs light up.

4. At this stage, the right "Diagnostic" red LED may or may not shine. If it shines, it just indicates that the proper operating temperature has been reached without the fans being switched on.
   Laser emission will start when the trigger signal generator sends the "On" signal. Open the beam shutter. Wait 10 min to reach a stable laser emitting operation.
5. To stop the laser emission, push again on the "ON/OFF" button on the Control panel. The LED "Laser ON" goes out while the laser system electronics continues to operate.
6. To turn off the laser system, switch off the "ON/OFF" switch on the backside of the laser. All the LED's go out. Close the beam shutter.

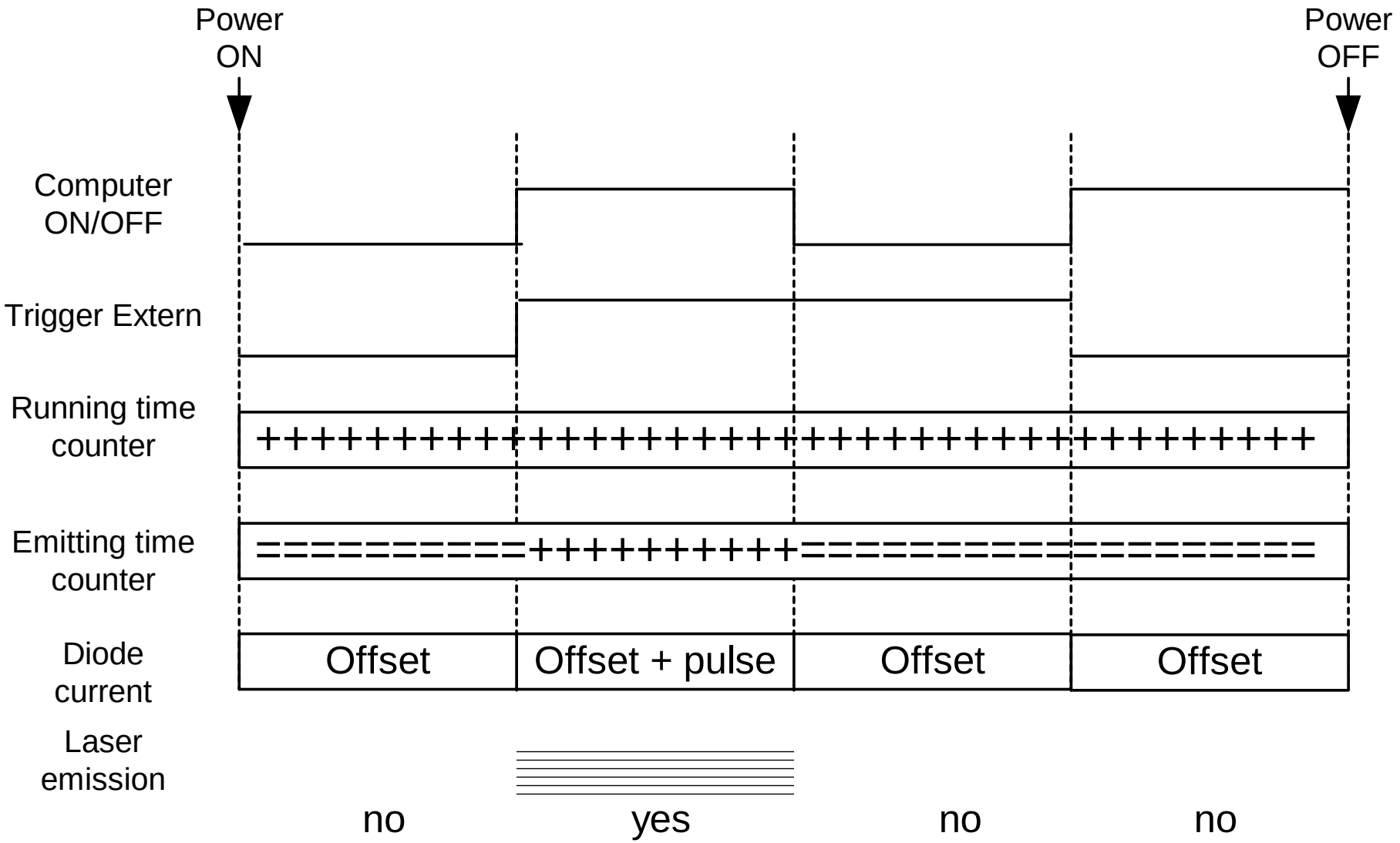


Figure 18: Chronogram for Auto External Mode operation

6.4 Example of Configuration: Auto External mode, with interlock and computer ON/OFF

1) To prepare your laser for operation :
Provide a 24V DC supply to the laser head. Connect the leads to the laser head.

Powerchip is delivered with a male 9 pin Dsub connector with pins 7 and 6 to inhibit the interlock.
Remove this connector and plug your cable with the 9 pin D-sub connector in.
Verify that the correct leads have been connected to your trigger signal generator.

Trigger signal required is as follow:

Signal on pin 4 : V<0,4V : the laser is inhibited
Electronic pulse with 2.4V<V<5V DC and width>50µs : the laser produces one optical pulse for each trigger pulse.

The repetition rate depends of the frequency of the trigger signal.
Pin 8 is 0V

Interlock signal will affect the laser operation as follow:

Signal on pin 6 : V=0V : for laser operation

Computer On/OFF signal will affect the laser operation as follow:

Signal on Pin 3 : V<0,4V (at least <1,5V DC) the laser is inhibited
2.4V<V<5V DC: the laser produces optical pulses at a repetition rate set by trigger signals.

2) To start the laser operation.

a) Interlock should be closed
b) Send a 24V DC signal to the laser head.

The electronics is now powered, and the initialization of the electronic takes place. The TE coolers start to operate to bring the optical components to their operating temperature.
When the operating temperature of crystals is reached and the initialization is completed, the laser is ready to laze.

c) Send the trigger signals.
d) Send the “On” signal.

After 10 minutes, the optical pulses are stable.

If you want to switch off the laser for 30 min, just send the off command.
To switch it On again, send the On command, and wait 10 min for stable pulses.

3) To switch off the system completely:

a) Send a off signal.
b) Stop your trigger signal
c) Switch off your 24 DC supply.

6.5 Common recommendations for all operating modes

Thermal protection

All PowerChip Lasers have a built-in protection circuit that shuts the diode laser off when the temperature of the diode exceeds the factory set limit. When this occurs the laser will stop operating. The laser will be ready to operate again when the normal temperature will be reached. To restart it, a reset has to be done; it is achieved by turning the laser off.

The thermal shut-off of the laser is a signal that the laser head is not properly cooled or that it is used in an environment whose temperature exceeds the specified range. Take the appropriate corrective actions to reduce the temperature of the PowerChip NanoLaser System base plate before restarting the laser.

Warning Laser!

1. Always have the power supply cover and the laser head cover in place when the laser is connected to line power.
2. Limit access to the laser to that familiar with the equipment. Keep the laser out of the hands of inexperienced or untrained personnel.
3. When the laser is on and the output beam is not being terminated in an experiment or optics system**,** the beam should be blocked.
4. NEVER LOOK DIRECTLY INTO THE MAIN LASER BEAM, NEVER SIGHT DOWN A BEAM INTO ITS SOURCE,
5. Do not allow reflective objects to be placed in the laser beam. Laser light scattered from a reflective surface can be as damaging as the original beam. Even objects such as rings, watchbands, and metal pens or pencils can be hazardous,
6. Attenuate laser power to a low level to minimize intensity of accidental stray reflections or refractions when aligning a chain of optical components in the laser beam.
7. Set up experiments so that the laser beam is NOT at eye level.
8. Post warning signs and limit access to the laser area when the laser is in operation.
9. Even when wearing laser safety glasses, there are two hazards that exist while operating solid-state lasers:
   a. The glasses make the beam itself invisible, therefore increasing the danger of skin burns.
   b. Laser glasses may not afford enough protection if a very powerful beam is viewed directly.
10. NEVER LEAVE THE LASER **ON, OPEN, AND UNATTENDED**!

Warning laser safety!

At all times during installations, operation, maintenance, or service of the laser, avoid all unnecessary exposure to laser light or collateral radiation in excess of the accessible emission limits listed in Performance Standards for Laser Products, 21CFR 1040.10 (d).

Additional Laser Safety Informational Sources

Sources for additional information and assistance on laser safety are:

Director (HFX-400)
Division of compliance ,
Bureau of Radiological Health
5600 Fishers Lane
Rockville, MD 20857
(Regulations and Requirements)

Laser Institute of America
400 Executive Park Drive
Cincinnati, OH 45241
(Safety Guides)

American National Standards Institute, Inc.
1430 Broadway
New York, NY 10018
(Safety Guides)

CEN Central Secretariat
36, rue de Stassart
B-1050 Brussels
Fax: + 32 2 550 08 19
E-mail: infodesk@cenorm.be

Union Technique de l'Electricité (UTE)
33, Av. Général Leclerc - BP 23
F - 92262 Fontenay-aux-Roses Cedex
http://www.ute-fr.com

Deutsche Elektrotechnische Kommission im DIN
und VDE (DKE)
Stresemannallee 15
D - 60 596 Frankfurt am Main
http://www.dke.de

7- Servicing, cleaning and troubleshooting

No specific servicing is required for this equipment.

Avoid dust, humidity and shocks, your equipment will be grateful.
Do not remove the plastic cap from the purge; this could accidentally remove the inert Argon gas from inside the laser head. The purpose of the inert, dry gas is to keep your laser reliable with time avoiding humidity or pollution effect. For cleaning, never use liquid or solvent, just wipe with a clean, soft dust clothe, never clean or touch the laser output window.
If the " Power" LED does not shine when the laser is switched on with the back panel "ON/OFF" switch, check:

- The availability of the DC voltage
- The connection of the power cord
- The fuse located on the front side of the laser

The LEDs of the Control panel give first level diagnostic of the laser status. The same LED may shine for different reasons depending on whether the laser emission is OFF or ON and operating.

The table below describes the troubleshooting, the adequate correction with either laser emission or without laser emission.

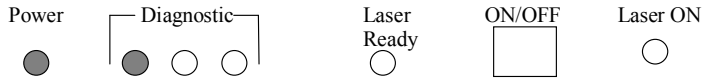
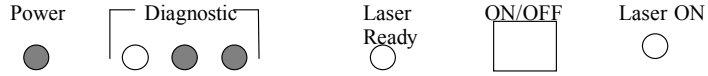
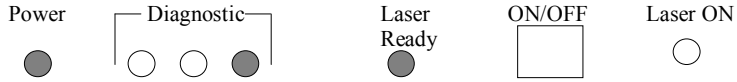
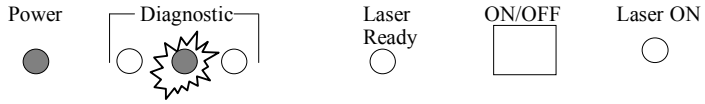
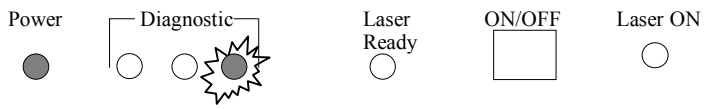
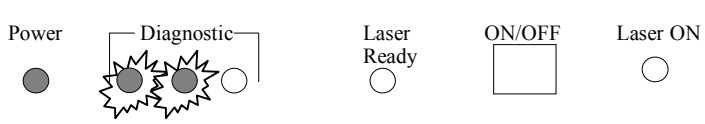
○	Indicates an off LED
●	Indicates a shining LED
	Indicates a blinking LED

In the case of a transient laser default, the laser will stop lasing. Once the laser recovers from its default status, the Laser Ready LED will be flashing showing that the laser has gone through a default error and one of the diagnostic LED will be permanently ON.

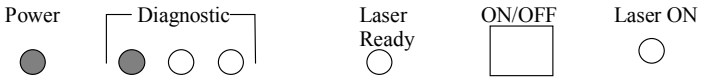
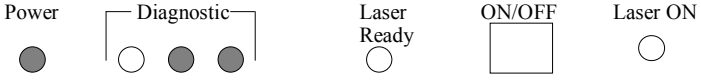
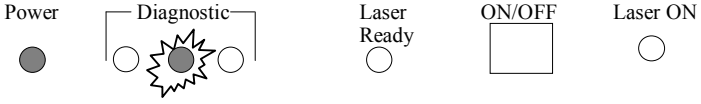
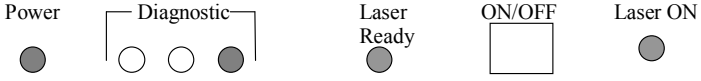
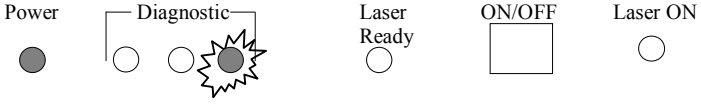
Since the laser has now recovered, it will be waiting from a manual action on the Laser On/Off button of the control panel to laze.

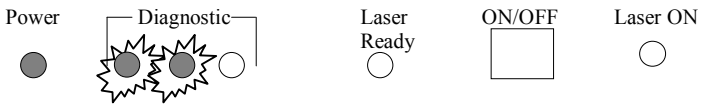
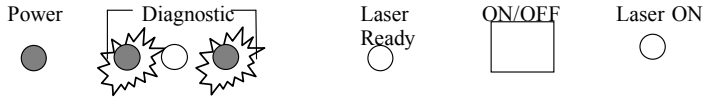
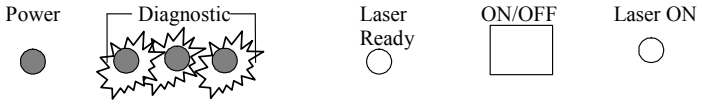
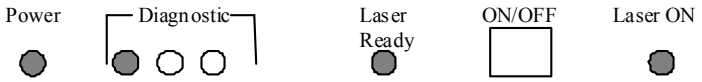
For other non transient error, please see following pages.

7.1 Without laser emission

Description / Correction	LEDs on the Control panel
Thermal protection switch Off the laser. **Correction:** Switch Off, check ambient temperature, switch On the laser when the temperature has decreased. **OR** The input DC voltage becomes too low. This LED will momentarily switch on during the initialization phase. **Correction:** Switch Off, check DC voltage and switch On the laser.	
Interlock activated. **Correction:** Switch Off disable the interlock, switch On the laser.	
Fans are not in use. The ambient temperature allows the laser to operate without fans. If fans become necessary and they switch on, the LED will switch off. **Correction:** None.	
Heat sink temperature is too high. **Correction:** Check the ambient temperature. Wait for Laser ready.	
Laser diode or crystals temperature is too high. **Correction:** Check the ambient temperature. Wait for Laser ready.	
Laser diode or crystal temperatures out of regulation range. **Correction:** Check the ambient temperature. Wait for Laser ready.	

7.2 With laser emission

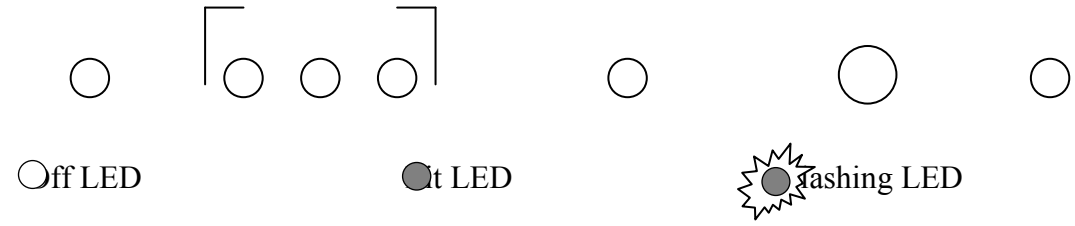
Description / Correction	LEDs on the Control panel
Thermal protection switch Off the laser. **Correction:** Switch Off, check ambient temperature, switch On the laser when the temperature has decreased. **OR** The input DC voltage becomes too low. This LED will momentarily switch on during the initialization phase. **Correction:** Switch Off, check DC voltage and switch On the laser. **OR** Laser diode curent anormal **Correction:** Check that BNC connector really has a 50 ohms termination	
Interlock activated. **Correction:** Switch Off disable the interlock, switch On the laser.	
Heat sink temperature is too high. **Correction:** Check the ambient temperature. Wait for Laser ready.	
Fans are not in use. The ambient temperature allows the laser to operate without fans. If fans become necessary and they switch on, the LED will switch off. **Correction:** None.	
Laser diode or crystals temperature is too high. **Correction:** Check the ambient temperature. Wait for Laser ready.	

Laser diode or crystal temperatures out of regulation range. **Correction:** Check the ambient temperature. Wait for Laser ready.	
Thermoelectric cooler over load. **Correction:** Check the ambient temperature. Wait for Laser ready.	
Root cause multiple. **Correction:** Contact our customer service	
Internal Data. **Correction:** None	

7.3 Sheet for Laser Problem Description

1 - Serial Number: S/N_____, Environment Temperature_____

2 - STATUS OF THE LED ON FRONT PANEL(Please fill in the status of the LEDs when problem is detected)



2 – DESCRIPTION of the problem

Power/Energy loss

Low power. Measured power is _____, Measured Output Beam Frequency_____

Check TEEM PHOTONICS Part number on laser.

3 – ARE YOU USING AN ADDITIONAL SET OF OPTICS BEHIND THE OUTPUT OF THE POWERCHIP (Yes/No)

Make sure beam path is free from any optics other than originally shipped

Still poor beam quality. **(Yes/No)**

Description_____

Rings around main spot

4 – STABILITY

Pulse to Pulse stability more than +/- 7.5 % around a central value. Value? Measurement set up? Apparatus used?

5 – INTERMITTENT PROBLEMS or FIRING

Laser does not fire when triggered:

a). Is an adequate trigger signal being supplied to the laser (i.e. >4V for 50 microseconds), **(Yes/No)**

b). Laser output detected (via spot on card) **(Yes/No)**

c). Adequate trigger signal is sent to the laser, shutter is in full open position but no laser output **(Yes/No)**

Document reference: **35 75 001 (created on April 2000 – rev 000)**
Revision: **15**
Date of the revision : **July 1st, 2014**

Revision	Date	Modification
01	17/07/00	
02	4/09/00	Chapter 'Servicing, cleaning…': changes in diagnostic LEDs of the Control Panel. (JMM)
03	27/02/01 8/03/01	Adding necessity of 50 Ohms termination (DBo) Addition in Servicing, cleaning and troubleshooting in case of "laser diode current abnormal" - Adding of 50 Ohms charge on BNC connector (JMM) § Mode of operation p11 § Image of the optical pulses p14 - 24v cable colors changed (Black-→ Brown, p17) (JMM) - Logical input spec changed (p15, 21, 22, 23, 25, 26, 27, 28) (JMM) Computer on/off and ext. trigger: 4<V<5v Ext. Trigger: pulse width> 50 µs - Last page with the PNV spec suppressed (p36)
04	8/20/01	Addition of information on the CDRH version of the system, added images of warning labels CDRH and OEM, added images of the CDRH version power supply and laser source, added safety information on the key switch and remote interlock.
05	3/04/2002	CDRH and OEM description (safety, labels, description, instructions) Installation (connecting instructions, voltage) Operation (Voltage, LEDs lighted), additions Cleaning addition New laser safety classification
06	3/28/2002	Label safety modifications (p8-9) Update of customer's contact points (p13)
07	04/25/2002	OEM/CDRH Laser source drawing correction (p.19-20)
08	24/10/02	Correction for all labels with CDRH and CE marking (p.8-9) Shutter orientation correction in drawings OEM/CDRH (p.7, 18-21)
09	29/10/02 never applied	New diagrams for CDRH and OEM with front chamber (p7, 18- 21) Removal of System References (p10)
10	16/03/04	Insertion New Logo **(TF)** Removal of PNU (266nm) mention from Manual **(TF)** Includes comments on safety (pg4) **(TF)** Safety label update according to new applicable norm (pg 8/9) **(TF)** Update General Info diagram (pg 10) **(TF)** Addition of comments on shipping box to be kept (pg11) **(TF)** Update of Worldwide assistance (pg13) **(TF)** Modification of Rear Connector diagram (pg 27)**(TF)** Introduction des chronogrammes explicatifs (pg 33, 39 & 43)(**TF**) Update of Troubleshooting (pg 48-50) **(TF)** Adds ups for customer failure description (pg 51) (**TF**) Correction for RR range, operating temperature, Voltage current on options Add ups on new operation mode including Auto Internal Mode **(TF)** Simplification of Operation guidelines **(TF)**
11	31/10/06	Update with new mechanical drawing (**LB)** Insertion of the new Teem Photonics banner (**LB**)

12	28/03/08	General update (**FLG**)
13	24/06/11	Updated with new designation
14	20/06/2014	Updated new mechanical design Added air flow direction in 5.1 Various minor changes
15	01/07/2014	Removed SCDs from the list of documents sent with the laser

II. Information pertaining to your PowerChip NanoLaser Model

PowerChip NanoLaser System Specifications

Adding to the present User Manual, your Microchip Laser was sent with the following documents that are pertaining to your product only :

- ✓ **The Certificate of Compliance (CoC)**: this is the final test report of your laser.
- ✓ **When applicable, Product Modification description** (only when a specific modification has been requested by a customer for 1 or few units)

Quick reference to Index

Quick reference to figures