

# Laser Controller for Passively Q-Switched Diode Pumped Solid State MicroChip Lasers

(CDRH, OEM and OEM Short packages)

## User's manual

### Notice

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Thank you!

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

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#### **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

|  |           |
|--|-----------|
| <b>CONTENTS .....</b>  | <b>3</b>  |
| <b>PART I: INFORMATION PERTAINING TO ALL MICROCHIP LASER CONTROLLER MODELS .....</b> | <b>5</b>  |
| <b>1-PREFACE.....</b>  | <b>5</b>  |
| 1.1 Safety Symbols .....   | 5         |
| 1.2 Warning and Caution Symbols .....  | 6         |
| 1.3 Electrical Safety Precautions .....  | 6         |
| 1.4 Safety Recommendations for using the Laser controller.....                       | 8         |
| 1.5 Additional Laser Safety Informational Sources.....                               | 9         |
| <b>2. GENERAL INFORMATION .....</b>  | <b>10</b> |
| 2.1 Introduction .....   | 10        |
| 2.2 Identification Labels & indicators.....  | 11        |
| 2.3 Unpacking and Inspection .....   | 12        |
| 2.4 Repackaging for Shipment.....  | 12        |
| 2.5 Equipment Supplied .....   | 12        |
| 2.6 Warranty and Worldwide services.....   | 13        |
| <b>3. INSTALLATION .....</b>   | <b>14</b> |
| 3.1 Mounting.....  | 14        |
| 3.1.1 Laser Controller heat sinking.....   | 14        |
| 3.1.2 Desktop AC Voltage laser controller (CDRH ONLY).....                           | 14        |
| 3.1.3 Board/Module DC Voltage laser controller.....                                  | 14        |
| 3.2 Grounding features .....   | 15        |
| 3.2.1 Desktop AC Voltage laser controller (MLC-03A-DR1 and MLC-03A-DP1) .....        | 15        |
| 3.2.2 Module DC Voltage laser controller (MLC-03A-MR1 and MLC-03A-MP1).....          | 15        |
| 3.2.3 Board DC Voltage laser controller (MLC-03A-BR1 and MLC-03A-BP1) .....          | 16        |
| 3.3 Wiring .....   | 18        |
| 3.4 Connecting Power .....   | 19        |
| 3.4.1 Desktop AC Voltage laser controller (CDRH Only).....                           | 19        |
| 3.4.2 Board/Module DC Voltage laser controller.....                                  | 19        |
| <b>4. OPERATION.....</b>   | <b>20</b> |
| 4.1 Non-CDRH compliant MicroChip Laser controller (Board/Module).....                | 20        |
| 4.1.1 Elements of the MLC-03A-BR1 (Board, SNx/MNx lasers) controller panels.....     | 20        |
| 4.1.2 Elements of the MLC-03A-BP1 (Board, STx lasers) controller panels .....        | 21        |
| 4.1.3 Elements of the MLC-03A-MR1 (Module, SNx/MNx lasers) controller panels .....   | 22        |
| 4.1.4 Elements of the MLC-03A-MP1 (Module, STx lasers) controller panels.....        | 22        |
| 4.2 CDRH certified MicroChip Laser controller (Desktop).....                         | 22        |
| 4.2.1 Elements of the MLC-03A-DR1 (Desktop, SNx/MNx lasers) controller panels .....  | 23        |
| 4.2.2 Elements of the MLC-03A-DP1 (Desktop, STx lasers) controller panels .....      | 23        |
| 4.3 Connecting SMB synchronization chain on -xP1 controllers (-BP1, -MP1, -DP1)..... | 24        |
| 4.4 Instrument operating, LED or button status.....                                  | 25        |
| 4.5 Switching on the laser controller.....   | 25        |
| 4.5.1 Interlock .....  | 26        |
| 4.5.2 Loss of electrical power (CRDH ONLY).....                                      | 26        |
| 4.5.3 Pulse and timing chronograms.....  | 26        |
| 4.6 Operational Info on Front display.....   | 27        |
| 4.7 Operational Information on Serial Interface.....                                 | 27        |

|   |           |
|---|-----------|
| 4.8 Live control functionalities .....  | 31        |
| 4.8.1 Connection information for Board and Module packages.....                               | 31        |
| 4.8.2 Connection information for Desktop package.....   | 33        |
| 4.8.3 Function description diagrams.....  | 35        |
| 4.9 Turning off the laser controller (OEM and CDRH) .....                                     | 36        |
| <b>5. INTERFACE COMMAND DESCRIPTION .....</b>   | <b>37</b> |
| 5.1 Frame definition .....  | 37        |
| 5.2 Description .....   | 37        |
| 5.3 Command definition.....   | 37        |
| 5.4 Command list.....   | 37        |
| 5.5 Error and info registers .....  | 39        |
| <b>6. SERVICING, CLEANING .....</b>   | <b>41</b> |
| <b>7. TROUBLE SHOOTING .....</b>  | <b>42</b> |
| 7.1 No LED light: .....   | 42        |
| 7.2 Failure during initialization (start-up and auto-diagnostic): .....                       | 42        |
| 7.3 Error during laser emission or after auto diagnostics (yellow LED quick flashing):.....   | 43        |
| 7.4 Error during operation (yellow LED slow flashing).....                                    | 44        |
| 7.5 No temperature regulation .....   | 44        |
| 7.6 Bad DC voltage (red LED blinking). ....   | 44        |
| <b>8. SPECIFICATIONS .....</b>  | <b>44</b> |
| <b>PART II. INFORMATION PERTAINING TO YOUR MICROCHIP LASER HEAD AND LASER CONTROLLER.....</b> | <b>45</b> |
| <b>APPENDIX #1: DISSIPATIVE SPACERS' DESCRIPTION .....</b>                                    | <b>46</b> |

## PART I: Information pertaining to all MicroChip Laser Controller models

### 1-Preface

#### 1.1 Safety Symbols

The following symbols and messages (Table 1) can be marked on the unit or used in this manual. Observe all safety instructions that are associated with a symbol.

| Symbol | Description  |
|--------|--|
|        | Indicates hazardous voltages   |
|        | See the user's manual for instructions on handling and operating the unit safely.              |
|        | Frame or chassis terminal for electrical grounding within the unit.                            |
|        | Indicates AC voltage when following the voltage value  |
|        | Protective conductor terminal for electrical grounding to the earth.                           |
|        | ESD – Indicates risk of electrostatic discharge. Use proper isolation to protect devices.      |
|        | Contains electronics - EU Waste Electrical and Electronic Equipment Directive (WEEE Directive) |
|        | Compliant with CE norm   |

Table 1: Safety Symbols

## 1.2 Warning and Caution Symbols

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### Warning

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**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.**

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### Caution

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**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 Electrical Safety Precautions

MicroChip Lasers system are offered either as OEM products for incorporation into other equipment or as CDRH certified systems. Always check for part number stickers on the product that your laser head and laser controller are compatible and comply to those requirements. Please refer to the Specification Document Attached in Part II. With OEM products, the customer is responsible for CDRH certification of all systems sold with these products.

---

### Caution

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The protective housing of this laser controller product should always be left in place during normal laser operation. More generally the protecting cover of the system laser head and laser controller SHOULD NOT be removed. Removal of the protective housing is prohibited and should not be performed under any circumstances. NO SERVICEABLE PART INSIDE.

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 (**FOR DESKTOP VERSION ONLY**).

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## Warning

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Although the MicroChip Laser systems conform to CE electrical requirements (unless otherwise specified in the Specification Control Document attached in Part II) 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 laser controller's covers in place. Do not remove cover under any circumstances of the laser and/or the laser controller.
2. For the sake of safety, NEVER depend upon 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
4. The IEC connector may be used to disconnect the laser controller from the mains. It MUST remain accessible by the user at any time (**FOR DESKTOP VERSION ONLY**).
5. 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 renders the equipment dangerous (**FOR DESKTOP VERSION ONLY**).

Responsible Authority is defined as an individual or a group of people responsible for the good use or preventive maintenance or servicing of the equipment and whose task is to assure that all person having to use or operate the system is properly trained.

The user's responsible authority of the MicroChip Laser system should be aware that by operating the product without due regards to the here mentioned precautions, or in a manner that is not compliant with procedures recommended here in this document or with any of the laser controller/laser specification, the protection provided by the equipment may be impaired and cause unsafe operating conditions.

## 1.4 Safety Recommendations for using the Laser controller

### Warning



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

1. Safety Key Switch: When laser system is un-operated or unattended but still accessible to untrained people, it is recommended to remove key from key switch or unplugged or disconnect power cord (**FOR DESKTOP VERSION ONLY**).
2. Limit access to the laser system to those familiar with the equipment. Keep the laser out of the hands of inexperienced or untrained personnel.
3. Emission Lamp (Emission LED): This is a safety feature. It MUST BE clearly visible by operator or anyone situated within confined laser system environment when laser is operated or not. (**FOR DESKTOP VERSION ONLY**)
4. Interlock: This is a safety feature. It MUST be used to prevent laser emission in the presence of unaware people entering in a defined or confined laser system security perimeter including room, inside cover, etc.
5. NEVER LEAVE THE LASER system ON, OPEN, AND UNATTENDED!

## 1.5 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)

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

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

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

**Association Française de Normalisation  
(AFNOR)**  
11, avenue Francis de Pressensé  
F-93571 Saint-Denis La Plaine Cedex  
[www.afnor.fr](http://www.afnor.fr)

**Deutsches Institut für Normung e.V.  
(DIN)**  
Postfach D-10772 Berlin  
[www.din.de](http://www.din.de)

**British Standards Institution (BSI)**  
389 Chiswick High Road  
GB-London W4 4AL  
[www.bsi.com](http://www.bsi.com)

## 2. General information

This chapter contains general information covering MicroChip Lasers Controller and includes the following:

- Safety label
- CE Certificate
- Unpacking and inspection
- Repackaging for shipment
- Equipment supplied
- Warranty and Worldwide Service

### 2.1 Introduction

The instrument of the MLC series are compact control units for driving up to 3 Amps Power Laser Diodes integrated in Microchip Lasers laser head.

Besides the controlling of the laser diodes, the MLC features also two built in thermoelectric coolers (TECs = Peltier elements) regulation control.

Thanks to its high efficiency MLC series operates without needs from additional cumbersome heat sinks nor fans. It is only set to cooling via airflow.

The MLC controllers can be declined under a PC board for OEM integration, a Module corresponding to a tightly packaged board conform to CE mark for easy integration and a Desktop version for laboratory and evaluation test prior to OEM integration and fully compliant to CE and CDRH regulation, see table below.

|         | Input Power | CE | CDRH |
|---------|-------------|----|------|
| Desktop | 100-240VAC  | ✓  | ✓    |
| Module  | 12V DC      | ✓  |      |
| Board   | 12V DC      |    |      |

**Table 2: MLC Models**

The MLC series features consist of one external input supply line, one external RS232 standard serial link connector, one interlock jack connector and one analog “utility” connector.

MLC units functionalities are controlled by a microprocessor based central unit. All parameters are factory set and no user intervention is required to set the device to operate other than action on a start/stop button.

Additionally a set of parameters can be accessed and set via an RS232 interface to a PC.

MLC series also integrate a firmware feature that can retrieve operating time, Serial number and various other SPC data collection.

Each MLC Laser Controller is interchangeable with all MicroChip laser heads including the same level of options. Data are stored into the Laser Head Board referred to as personality board. Additional technical information on the laser controller as well as the wiring details can be found in the Specification Control Document attached in the Part II.

The MLC series is CLASS 4 compatible and fully compliant laser controller. Please REMEMBER that ONLY a complete system (laser head + laser controller) will be compliant to CDRH or OEM regulation. Check part numbers and match laser and controller specifications for exact regulation compliancy.

## 2.2 Identification Labels & indicators

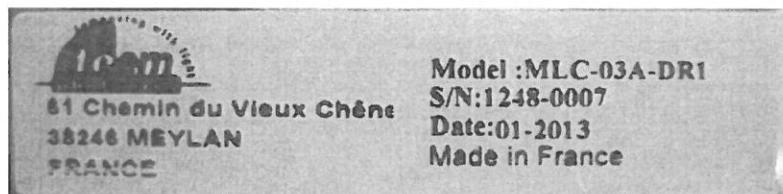
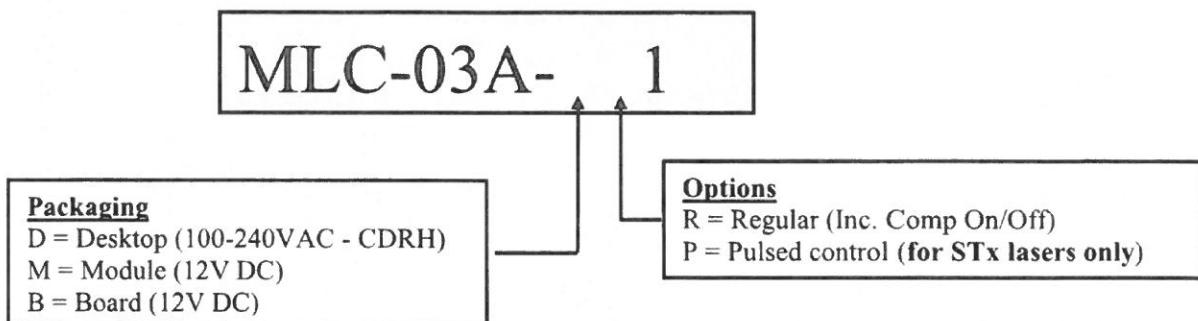
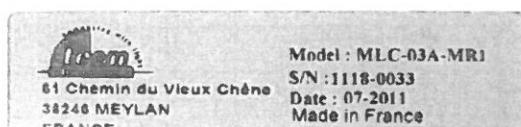


Figure 1a: CDRH Product Identification Label

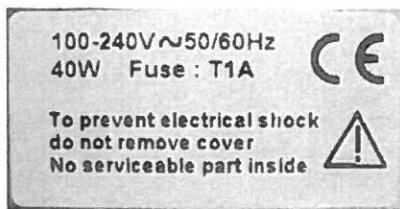


Module package

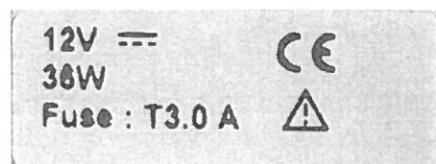
46000222\_003  
1219-0025

Board package

Figure 2b: OEM Product Identification Label



CDRH package



Module and Board package

Figure 2: Labels Settings

### 2.3 Unpacking and Inspection

Before unpacking the MicroChip Laser controller, inspect the shipping carton for evidence of damage. If the shipping box 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 recommended that you retain the original shipping box and packing material in case any Microchip Laser controller item has to be returned to Teem Photonics. Most shipping damage occurs when the item is not shipped in the original shipping container.

### 2.4 Repackaging for Shipment

If it is ever necessary to repack any MicroChip Laser controller 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.

### 2.5 Equipment Supplied

Each MicroChip Laser Regular Controller consists of the following:

|   | <b>Desktop</b> | <b>Module</b> | <b>Board</b> |
|---|----------------|---------------|--------------|
| 1x US compliant Power Cable (2,5m grounded main cable)          | ✓              |               |              |
| 1x EEC Power Cable (2,5m grounded main cable)                   | ✓              |               |              |
| 1x Key ring with 2 keys for Safety Key Switch                   | ✓              |               |              |
| 1x Connector 2 contacts type Molex ref. 39-01-2020 (receptacle) |                | ✓             | ✓            |
| 2x 39-00-0039 (crimp sockets)                                   |                | ✓             | ✓            |
| 1x Controller MLC-03A-xR1 <u>or</u> MLC-03A-xP1                 | ✓              | ✓             | ✓            |
| 1x Interlock (3.5mm Jack Connector)                             | ✓              | ✓             | ✓            |
| 1x User's Manual (this document)                                | ✓              | ✓             | ✓            |

For MLC-03A-xP1 controllers only, the following parts are added:

|                 | <b>Desktop</b> | <b>Module</b> | <b>Board</b> |
|-----------------|----------------|---------------|--------------|
| 1x 50 Ohms load | ✓              | ✓             | ✓            |
| 1x SMB cable    | ✓              | ✓             | ✓            |

**NB:**

Details of your configuration and connector reference may be found in Specification Control Documents attached in Part II of this document and will include a list of the extra equipment supplied/to be self procured relative to each operation mode.

## 2.6 Warranty and Worldwide services

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

**Teem Photonics**  
**61 Chemin du vieux Chêne**  
**F-38246**  
**FRANCE**

**Available Monday through Friday, 8:00 AM-5:00 PM Pacific Time (GMT-8)**

**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.**

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|        |  |
|--------|--|
| Phone  | Phone: +1 925-307-7063   |
| Fax    | Fax : +1 925-886-8171  |
| E-mail | <a href="mailto:sales@teemphotonics.com">sales@teemphotonics.com</a> |

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**European Sales Offices – Europe, Middle-East, Asia**

Teem Photonics 61, chemin du Vieux Chêne F-38246 Meylan FRANCE

|        |  |
|--------|--|
| Phone  | (+33 0) 47 604 0506  |
| Fax    | (+33 0) 47 604 0302  |
| E-mail | <a href="mailto:sales-eo@teemphotonics.com">sales-eo@teemphotonics.com</a> |

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

### 3. Installation

The installation may vary from laser types and option. The intent of this paragraph is to present the main guidelines for installation. It is recommended for each specific laser to carefully read through § 4 and to go for details in the Specification Control Document (SCD, see Part II). The reader should find details on wiring and other electrical linkage both on the laser heads and the laser controller.

#### 3.1 Mounting

When mounting the MicroChip Laser Controller, consider the following information:  
**The laser system controller has to be operated in a non-condensing environment.**

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#### **Caution**

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Select an environment that does not exceed the specifications, for temperature, humidity, etc., as listed in the Specifications section.

##### *3.1.1 Laser Controller heat sinking*

All laser controllers are built to be self-sustaining and should not require additional heat dissipation when operating under environmental conditions described in the specifications.

##### **Important!!**

**The above information is only valid for the controller alone. User is advised to read Laser head related paragraph to get the proper requirements.**

Microchip lasers controllers can be fixed on location by the sets of holes present on its base plate or inside the 4 rubber feet. Mounting holes and registration holes are provided as described on mechanical drawing included in the attached Specification Control Document (Part. II at the end of this manual).

For Desktop unit (CDRH) please remove all 4x rubber feet to reach the threaded holes.

For Module and Board please use screw holes or spacers at specified locations.

##### *3.1.2 Desktop AC Voltage laser controller (CDRH ONLY)*

Four M4 mounting holes can be used to attach the MicroChip Lasers AC voltage controller onto a support.

##### *3.1.3 Board/Module DC Voltage laser controller*

**Controller Module:** Four 3.2mm mounting holes can be used to attach the MicroChip Lasers DC voltage Module controller onto a support.

**Board controller:** 3 locations are provided to mount the board onto its support. 2 of the location situated on the central part of the board are used for heat evacuation and should be mounted with

the help of dissipative spacers whose characteristics are defined in Appendix 1 at the end of this manual. The 3<sup>rd</sup> location, close to the RS232 connector can be used as a third fixing point to avoid vibrations. Characteristics of this spacer are also described in Appendix #1

---

## Caution

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**CAUTION**

The MicroChip Laser controller is cooled by natural air convection. To ensure a correct operation, the Desktop laser controller must be sited on its 4 rubber feet, the underneath air vents must be free and free air convection flow must be set.

Laser controller board also requires a minimum of ventilation. Never attach the board directly on a support without using dissipative spacers described in appendix 1.

### 3.2 Grounding features

The following features should be implemented to ensure a proper laser system grounding for EMI reduction. All the shields (controller shield or box, cable shield and laser housing) must be connected to the system ground.

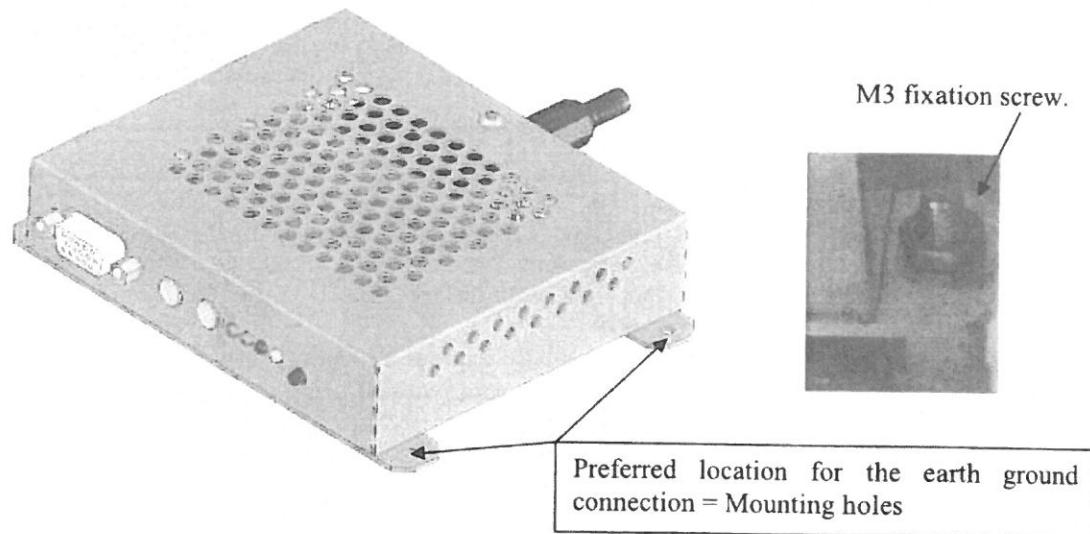
#### *3.2.1 Desktop AC Voltage laser controller (MLC-03A-DR1 and MLC-03A-DP1)*

Grounding to earth is automatically achieved through the AC inlet cable when using a Desktop controller.

#### *3.2.2 Module DC Voltage laser controller (MLC-03A-MR1 and MLC-03A-MP1)*

Grounding has to be provided separately when using a Module controller MLC-03A-MR0 by the mean of a solid wire (AWG16) that connects to the fixation pads located close to the DC supply input connector. If the equipment frame is properly grounded, then this can be achieved by the M3 fixation screws to the equipment frame.

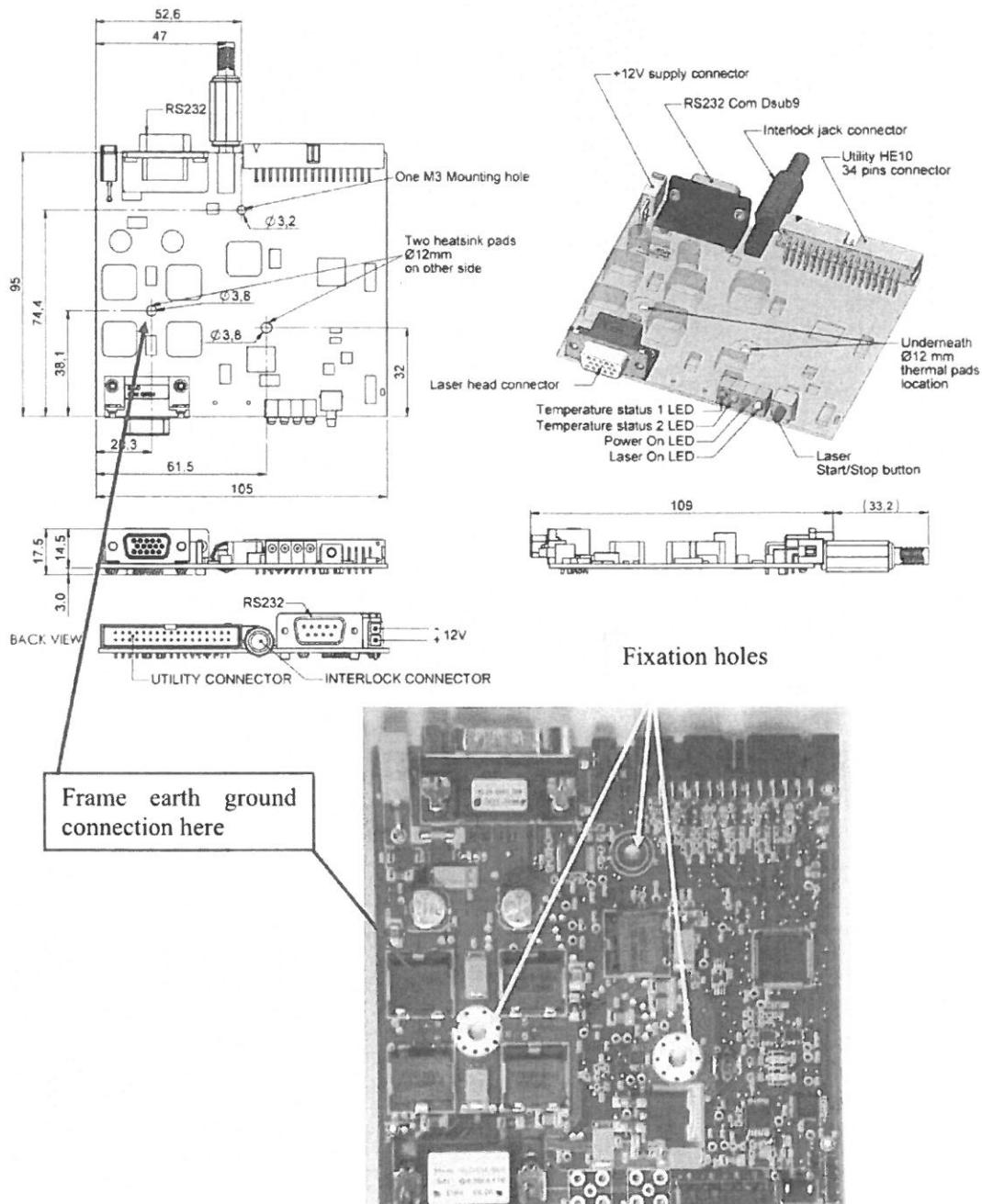
Nota: The module base is made of aluminum with a chromate anodization to ensure a good electrical connection.

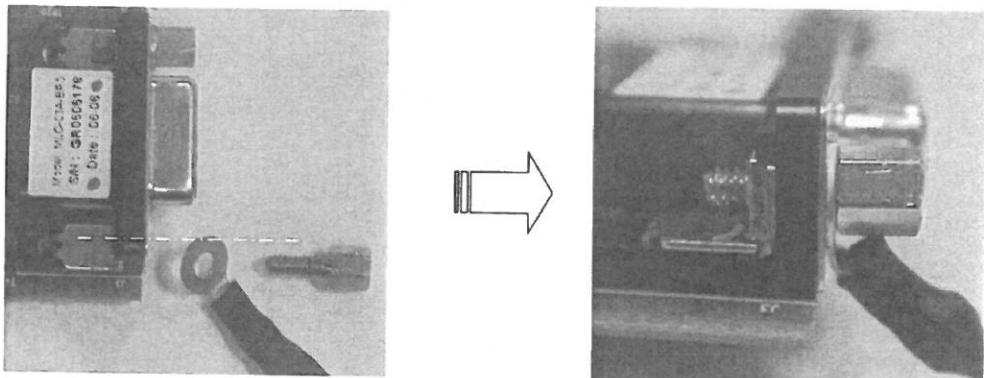


### 3.2.3 Board DC Voltage laser controller (MLC-03A-BR1 and MLC-03A-BP1)

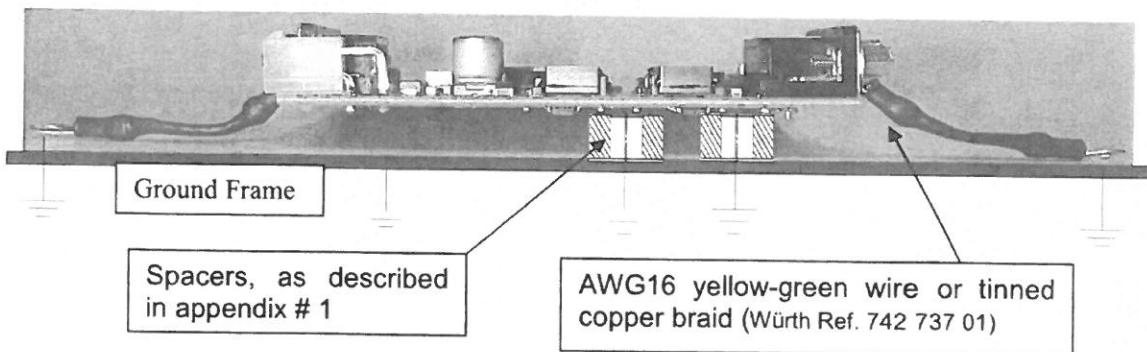
In this configuration, the earth ground connection must be ensured by the fixation to a well grounded frame. To perform this operation, the controller board should be fixed to the ground frame using two metallic dissipative spacers (as described in appendix # 1). The controller board includes a 9-pin Sub-D connector and a 15-pins D-Sub connector. The shell of these two connectors should also be connected to the grounded frame. This can be made using an AWG16 yellow-green wire or a tinned copper braid.

Note: the shielding of the controller board may be ensured by the equipment integration.





**9-pins and 15-pins D-Sub connectors : details of the earth connexion.**



### 3.3 Wiring

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#### **Caution**

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**ESD**



The Laser Head 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. Take extreme caution to prevent ESD, whenever the laser head is disconnected from the Laser Controller. Use wrist straps, grounded work surfaces, and rigorous anti-static techniques and procedures when handling the system in this situation

The MicroChip Laser System is shipped with the laser head and controller not connected. A 15-pins connector to be connected to the controller terminates the laser head cable

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**Caution**

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**NEVER CONNECT OR DISCONNECT THE LASER HEAD FROM THE CONTROLLER WHEN THE CONTROLLER IS ON. It could permanently damage the diode.**

### 3.4 Connecting Power

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**Caution**

---



Always have the laser head and laser controller connected together before applying power.

#### *3.4.1 Desktop AC Voltage laser controller (CDRH Only)*

The AC voltage controller includes an AC/DC converter and can be connected to the line voltage via a three-prong plug (2 for the phases and 1 for the ground). Never change the plug for one with no ground.

---

**Caution**

---

**CAUTION**

The AC voltage controller is auto ranging from 100 to 240V

#### *3.4.2 Board/Module DC Voltage laser controller*

The DC voltage controller includes a single 12V line voltage via a 2 contacts connector.

## 4. Operation

During operation of the Microchip Laser, the diode current, the diode temperature and the thermoelectric cooler current are measured and regulated.

All the parameters for the operation of the Microchip Laser are factory set for optimum performance and are not adjustable. The operation of the Microchip Laser is therefore limited to the connection of the controller to the line voltage, once the laser head is connected to the controller. Before you connect the controller to the line voltage, make sure that you are in compliance with the safety rules listed in the safety section.

**FOR SAFETY REASONS, THERE IS A FIVE SECONDS TIME DELAY BEFORE THE ON LIGHT AND THE LASER BEAM COMES ON, DO NOT WATCH DIRECTLY INTO THE BEAM.**

### 4.1 Non-CDRH compliant MicroChip Laser controller (Board/Module)

**Recall:** This laser controller is intended for use in OEM applications only.

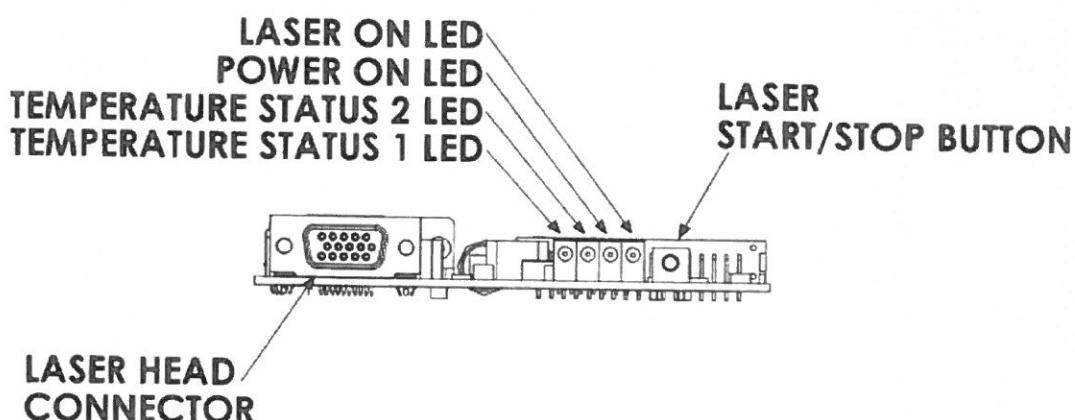
To start operating the laser controller (board or module), provide a 12V signal through the supplied Molex 2 contacts connector. When ready to operate, press the "Laser start" button.

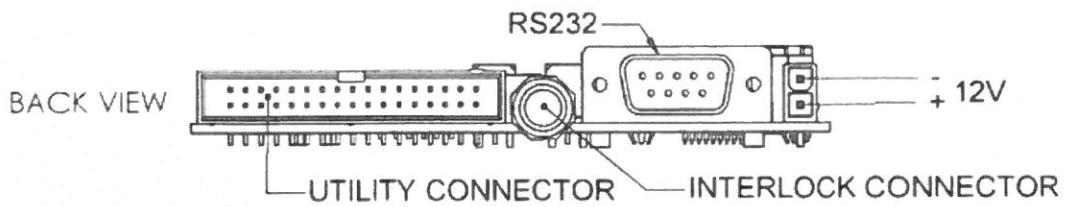
Alternatively, laser can be turned on by supplying respectively suitable signal [suitable command] on the RS232 [utility connector] (see details on section 5 later in this manual).

When the controller "laser on" light starts to shine, the laser is in operation. From this point onward please refer to the laser head operation manual for detail on laser operation.

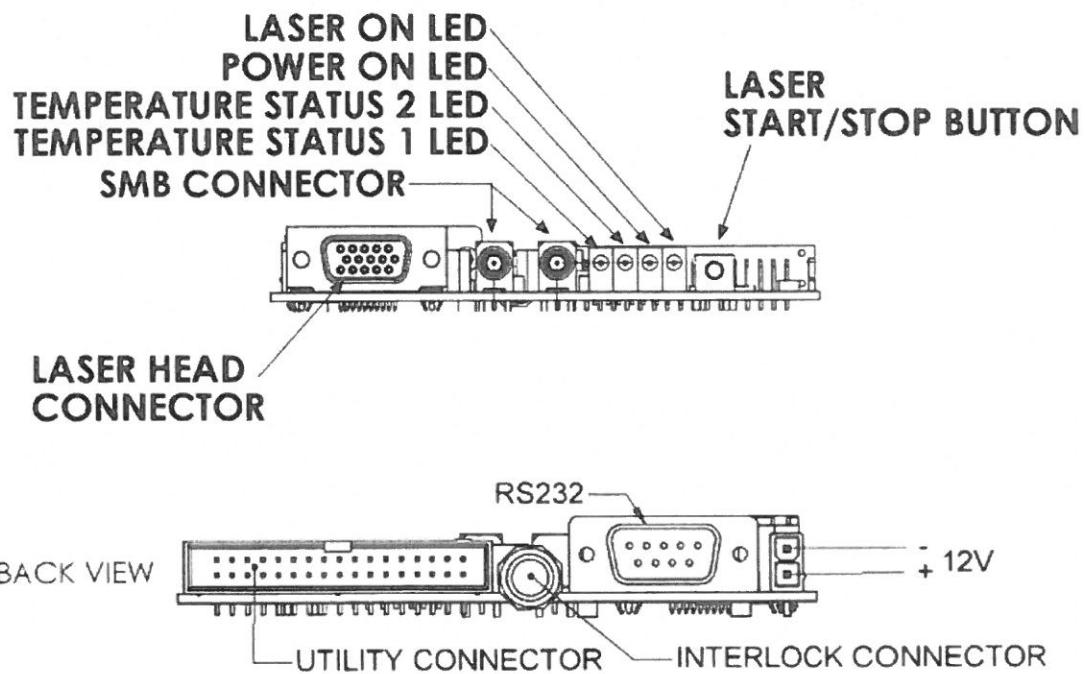
**Note:** if operated via computer on/off, logic input must be at high level when first starting the laser controller. Failing to do so, laser will not start.

#### 4.1.1 Elements of the MLC-03A-BR1 (Board, SNx/MNx lasers) controller panels

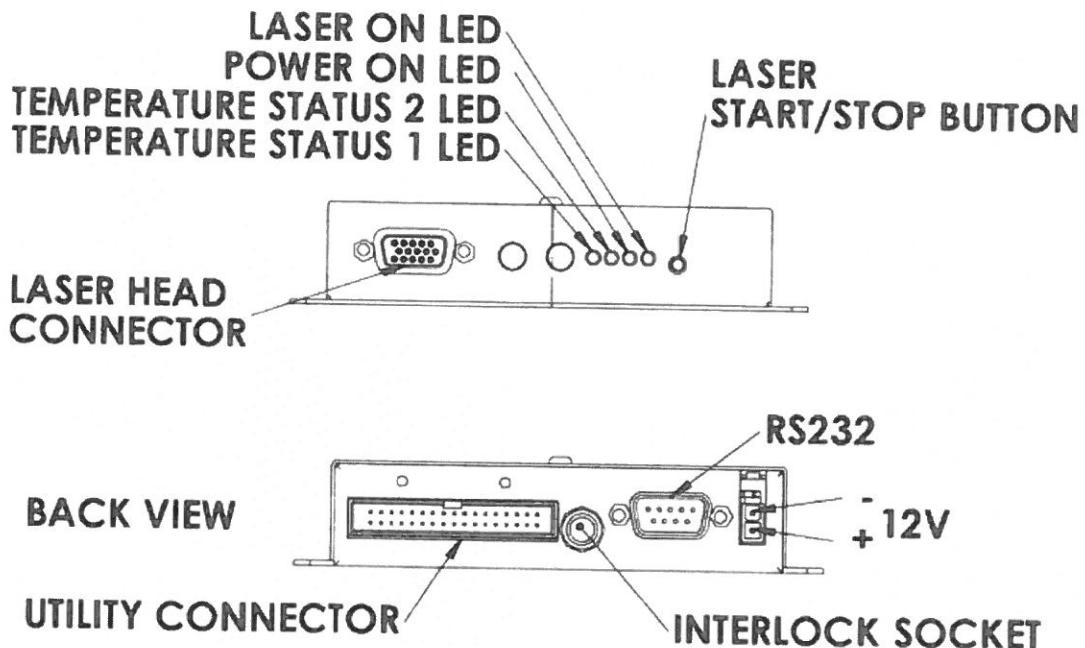




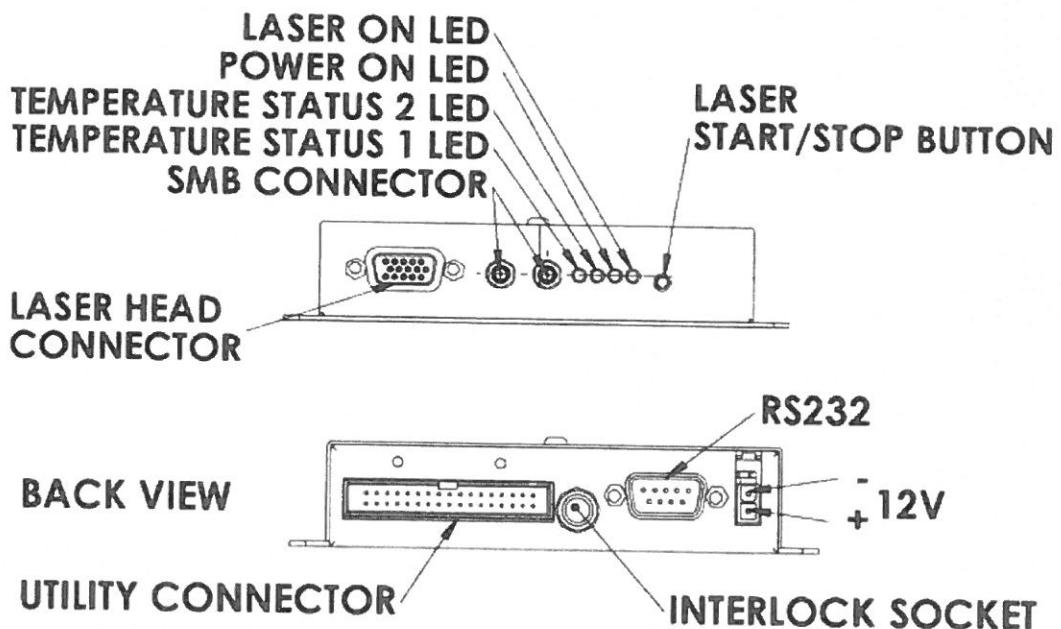
*4.1.2 Elements of the MLC-03A-BP1 (Board, STx lasers) controller panels*



*4.1.3 Elements of the MLC-03A-MR1 (Module, SNx/MNx lasers) controller panels*



*4.1.4 Elements of the MLC-03A-MP1 (Module, STx lasers) controller panels*



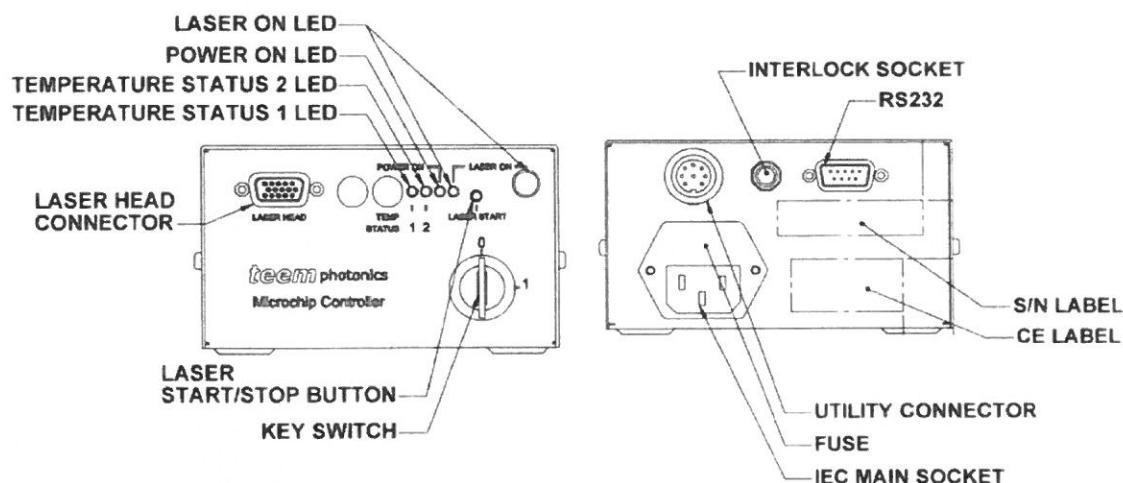
**4.2 CDRH certified MicroChip Laser controller (Desktop)**

To start operating the CDRH laser controller, turn the key switch on. When ready to operate, press the “Laser start” button. Alternatively, laser can be turned on by supplying suitable signal on the RS232 or the utility connector (see further details on section 5 later in this manual).

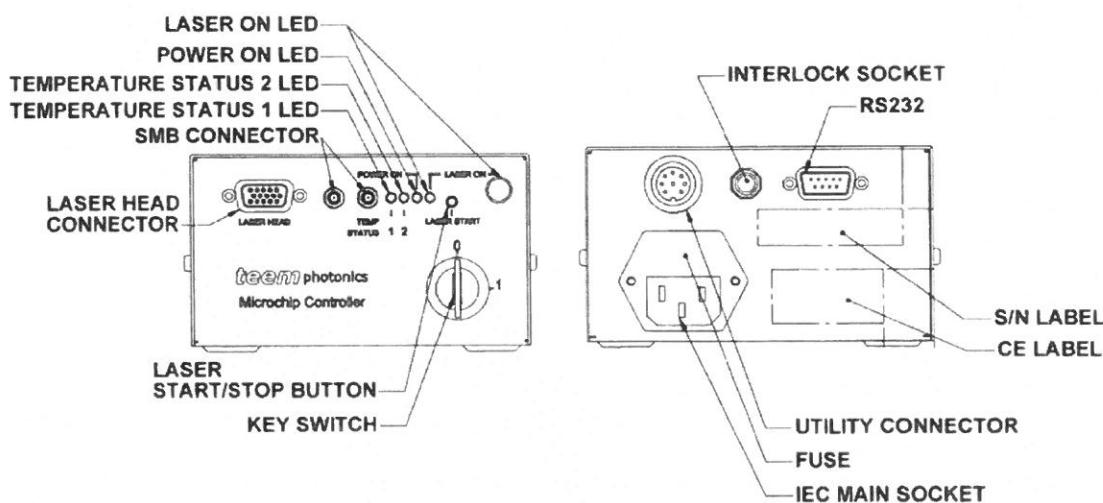
*Note: if operated via computer on/off, logic input must be at high level when first starting the laser controller. Failing to do so, laser will not start.*

When the controller “laser on” light starts to shine, the laser is in operation. From this point onward please refer to the laser head operation manual for detail on laser operation.

#### 4.2.1 Elements of the MLC-03A-DR1 (Desktop, SNx/MNx lasers) controller panels



#### 4.2.2 Elements of the MLC-03A-DP1 (Desktop, STx lasers) controller panels



#### 4.3 Connecting SMB synchronization chain on -xP1 controllers (-BP1, -MP1, -DP1)

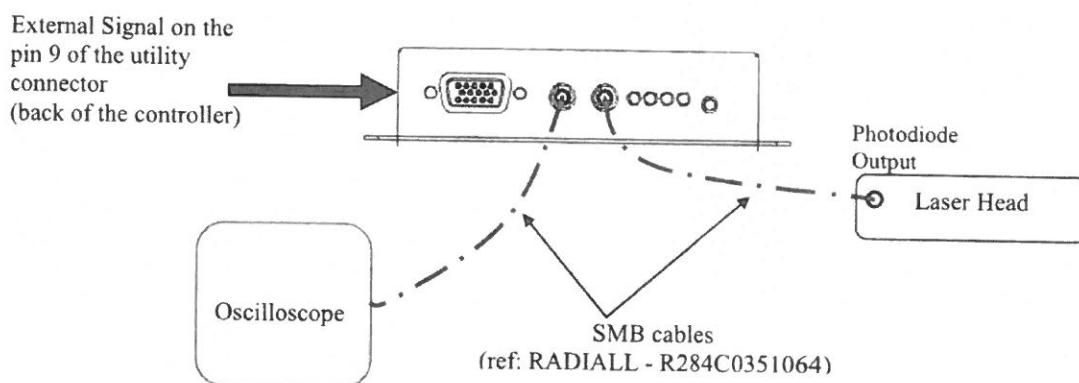
For triggered lasers (STx lasers) to operate, it is necessary to convey the synchronization signal between the laser head and the controller. This is why an extra cable connexion is required between the laser and the controller.

**Important!!**

If you fail to connect correctly the SMB synchronization chain, the laser will start but it won't lase.

There are two SMB connectors on the front panel of your -xP1 controller dedicated to triggered lasers (see sketch below for MLC-03A-MP1):

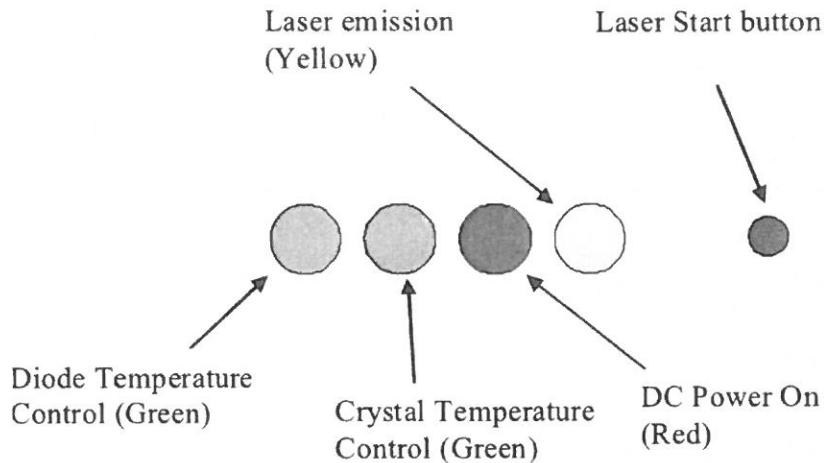
- The right SMB connector must be connected to the laser head (the SMB plug is located at the back of the laser head) with the use of one 50Ohms coaxial SMB cable (included).
- the left SMB connector needs to be matched to 50Ohms for the laser to operate properly.
  - if you want to use the laser without any external equipment, you need to plug a 50 Ohms load (included) on the other SMB connector.
  - If you want to monitor the synchronization signal with an oscilloscope for instance, your oscilloscope input needs to be set to a 50Ohms input impedance.



**Important!!**

Depending on your STx triggered laser type, it may be necessary to send a trigger signal on the utility connector for the laser to effectively start emitting. See the "Operation" chapter of the corresponding Microchip Laser User Manual for further details.

#### 4.4 Instrument operating, LED or button status



##### **Important!!**

For the lasers designed with one single TEC cooler (MNx, SNP-08E, SNG-03E, SNV-05P, SNU-02P), the crystal temperature control LED is always off.

#### 4.5 Switching on the laser controller

When powered up :

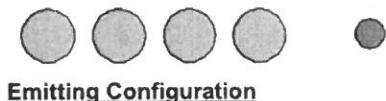
- 1 - LED sequence starts verifying the operating conditions of the system. This LED sequence lasts approximately for 3 seconds. During that time a series of tests is applied to the controller.
- 2 - Once over, the laser controller settles to the operating temperature regulation. After few seconds (less than 1min), the controller reaches the steady state characterized by a final LED status represented below.

##### **LEGEND :**



- 3 - Turning the laser on is achieved by pressing the start/stop button or alternatively, by supplying respectively suitable command [suitable signal] on the RS232 [utility connector] (see further details on section 5 later in this manual).

After a 5sec delay the laser emits and the LED front panel displays. During this 5 sec, laser reaches another steady state.



##### **Emitting Configuration**

**NB:** For Auto-start operating mode, repeat sequence described above but skipping step 3.

**Important!!**

For the lasers designed with one single TEC cooler (MNx, SNP-08E, SNG-03E, SNV-05P, SNU-02P), the crystal temperature control LED is always off.

**4.5.1 Interlock**

Interlock connector can be activated either by pulling out the shorted connector (delivered with the controller) or through a contact open activated switch (switch to be supplied by the user with the following characteristics: minimum 0.5 Amp, 10 Ohm contact, voltage below 10 Volt). The laser switches off immediately.

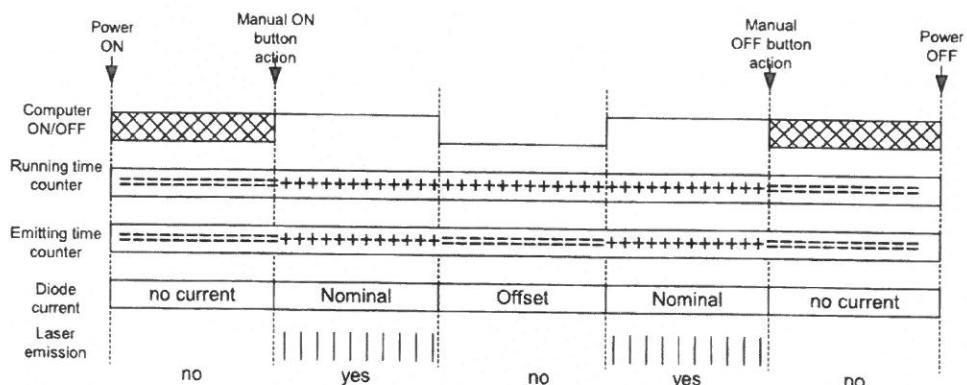
Once the interlock is reset, the laser emission will not restart. Press the laser on/off button on front **OR** send a command through serial link **OR** send analogical signal on "utility" connector, wait for a minimum five seconds time delay. The laser emission will restart.

**4.5.2 Loss of electrical power (CRDH ONLY)**

In the case of a loss of electrical power for more than 5 seconds, it is necessary to press the laser start button **OR** send a command through serial link **OR** send analogical signal on "utility" connector to initiate the laser emission after a delay greater than 5 seconds.

**Warning**

The laser emission may start few seconds after applying the diode power supply (even if thermoelectric power supplies are not applied).  
**DO NOT WATCH DIRECTLY INTO THE BEAM.**

**4.5.3 Pulse and timing chronograms****Legend :**

===== no counter increment

+++++ counter increment

||||| pulse emission

*Note: Computer on/off is a fast on/off way to commute the laser from off state to emitting state. It is a logic input with an internal 10kOhms pull up to +5Volts. Logic input must be at high level when first starting the laser controller. Failing to do so, laser will not start.*

#### 4.6 Operational Info on Front display

The controller front panel presents the operational information as 4 LEDS: from the left to the right, two green ones, one red and one yellow.

| CONTROLLER LED FUNCTIONS  |  |   |
|---------------------------|--|---|
| RED                       | POWER ON   | <b>ON:</b> Illuminated whenever DC voltage is supplied to controller<br><b>QUICK FLASHING:</b> over voltage >14V<br><b>SLOW FLASHING:</b> under voltage <10V<br><b>OFF:</b> no power  |
| YELLOW                    | LASER ON   | <b>ON:</b> laser is turned on<br><b>QUICK FLASHING:</b> laser is off caused by fault or caused by interlock switch<br><b>SLOW FLASHING:</b> laser is off, laser is not ready<br><b>OFF:</b> turned off  |
| GREEN                     | TEMP STATUS (x2)   | <b>ON:</b> Illuminated whenever diode temperature is at set-up point within 1°C: appropriate conditions for start of laser cavity pumping.<br><b>QUICK FLASHING:</b> above set point T°C by 0,5°C<br><b>SLOW FLASHING:</b> below set point T°C by 0,5°C<br><b>OFF:</b> turned off |
| CONTROLLER SWITCH CONTROL |  |   |
| Start Stop button         | <b>When pressed, starts or stops the laser emission (CDRH CLASS 4 requirement)</b> |   |

Additional information can be obtained when connecting a terminal or a PC in HyperTerminal mode to the serial link (See further details in section 5 of this manual).

#### 4.7 Operational Information on Serial Interface

The serial interface is a standard RS232 asynchronous communication port and can be used either for passive information (activity status) or actively to command the laser controller.

Active command

See chapter §5.

Activity status reading

##### Connecting the serial interface

The connector is D-SUB 9 (male).

Pin out

| PIN Number | Designation |
|------------|-------------|
| 2          | RxD         |
| 3          | TxD         |
| 5          | GND         |
| All other  | n.c.        |

Cable

Use a standard null modem cable (D-SUB 9 (female) to D-SUB 9 female, pin 2 and 3 crossed in the cable) for connecting the laser to the PC.

Only pin 2,3 and 5 need to be connected.

Serial communication configuration

Flow control: None

Byte transmission:

Transmission speed: 19200 Bits/s

Data length: 8 bits

Start bit: 1

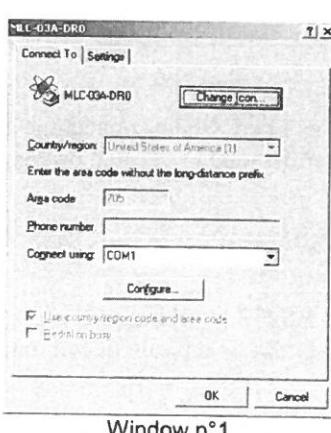
Stop bit: 1

Parity: none

Operation

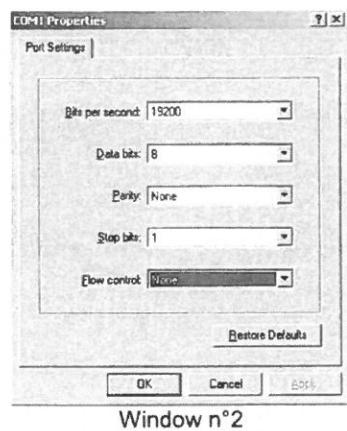
Connect the cable to a terminal or hyperterminal. Launch an hyperterminal session from the dashboard of your computer. After choosing an icon and setting the session's name, select "File" from menu bar and "Properties" from the roll up menu.

Configure the properties of the hyperterminal as follows on Window n°1:



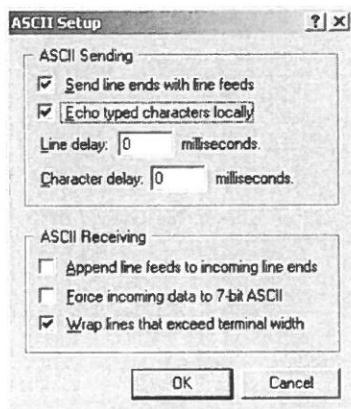
Window n°1

Click on the "Configure" tab and set the parameters as described here above (see window 2) :



Window n°2

Click "OK". From window n°1 click on the "Settings" tab and verify that all boxes are ticked as displayed on window n°3 below.



Window n°3

"OK" twice on both opened windows to activate the hyperterminal.

[Auto diagnostic Information at power On \(displayed on computer screen under hyperterminal link\)](#)

00:03:29 connecté

Détec. auto

19200 8-N-1

DÉFI

Page Number

CARTOGRAFIA

100

**Error Message examples**

In case of error, error number information concerning the error is displayed on the terminal or HyperTerminal screen.

Example: For a DC voltage too low user will read the following information

```
TEST END: Test PASS>ERROR: E2
```

By referring to section 5.5, textual information on the error can be retrieved

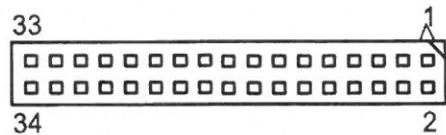
#### 4.8 Live control functionalities

Various type of inputs and outputs are accessible from the utility connector located at the back of the controller.

The pinning and time evolution information of these functionalities are described in the following paragraphs.

##### *4.8.1 Connection information for Board and Module packages*

The Utility Connector is an HE10 34 pins connector.(male socket front view, see below)



Functionalities include live controls (Comp ON/OFF, MOD-EXT, STB-EXT, FREQ-ANA), safety signals management (interlock, Laser Ready, EM lamp, +12V EM lamp) or operation mode management (TEC ENABLE, INT/EXT).

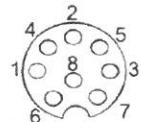
| Pin No. | Mnemonic  | Function  | In (I), Out (O) |
|---------|-----------|---|-----------------|
| 1       | RX2       | Do Not Use (module to module communication)   | I               |
| 2       | TX2       | Do Not Use (module to module communication)   | O               |
| 3       | INT       | Do Not Use (module to module communication)   | I               |
| 4       | GND       | Do Not Use (module to module communication)   | -               |
| 5       | Interlock | Interlock connection (same as through jack) logic input with an internal 10kOhms pull-up to +5V.<br>Vil = 0.4V Vih = 3.5V.<br>A contact to GND with less than 500 Ohm will keep the laser activated. A high level (or impedance > 10kOhm) will stop the laser emission.<br>The laser emission cannot be restored without a laser start-stop (button or STB-EXT) | I               |
| 6       | GND       | Interlock GND (same as through jack)  | -               |

|    |                    |  |   |
|----|--------------------|--|---|
| 7  | <b>Comp ON/OFF</b> | Laser On/Off (can be faster than STB-EXT but depends on ON/OFF sequence: refer to factory for further information)<br>Logic input with an internal 10kOhms pull-up to +5V.<br>$V_{il} = 0.4V$ , $V_{ih} = 3.5V$ .<br>At low level, the laser diode current is set to the offset value (factory set-up, no laser emission),<br>at high level, the laser diode current settles to the nominal value (factory set-up, the laser emits within its specifications).<br><b>Note:</b> Logic input must be at high level when first starting the laser controller. Failing to do so, laser will not start.<br>If this signal is driven by a power supply, this one must be switched on after the laser controller. | I |
| 8  | <b>GND</b>         |  | - |
| 9  | <b>MOD-EXT</b>     | <b>FOR MLC-03A-MP1 ONLY<br/>NOT ACTIVATED ON MLC-03A-MR1</b><br>Pulse control input. Logic input with 10kOhms pull-up to +5V.<br>$V_{il} = 0.4V$ , $V_{ih} = 3.5V$ , edge sensitive.<br>This signal initiates the laser pulse generation of the pulse control option on its rising transition (start of the TW cycle). <b>Start the laser before sending the trigger signal.</b>   | I |
| 10 | <b>GND</b>         |  | - |
| 11 | <b>STB-EXT</b>     | Laser start-stop (similar to start button action). Logic input with an internal 10kOhms pull-up to +5V.<br>$V_{il} = 0.4V$ $V_{ih} = 3.5V$ , it is edge sensitive.<br>This signal activates the laser On or Off on the rising transitions. On rising transition the laser comes either On after a 5 Seconds time lag, or Off with a short time delay.<br><b>Note:</b><br>If this signal is driven by a power supply, this one must be switched on after the laser controller.  | I |
| 12 | <b>GND</b>         |  | - |
| 13 | <b>TEC ENABLE</b>  | TEC On/Off<br>Logic input with an internal 10kOhms pull-up to +5V.<br>$V_{il} = 0.4V$ , $V_{ih} = 3.5V$ ,<br>When the laser is On, TEC is enabled and the command is not active.<br>When laser is Off , a high level enables the TEC cooler driver and a low level disable the TEC cooler driver.<br>When disabled, laser cannot be turned On.   | I |
| 14 | <b>GND</b>         |  | - |
| 15 | <b>Laser Ready</b> | Laser ready functionality  | O |
| 16 | <b>GND</b>         |  | - |
| 17 | <b>TBD</b>         | Do not connect   | - |
| 18 | <b>GND</b>         |  | - |
| 19 | <b>PULSE</b>       | Do not connect (TBD)   | - |
| 20 | <b>GND</b>         |  | - |

|           |                     |   |          |
|-----------|---------------------|---|----------|
| <b>21</b> | <b>EM Lamp</b>      | Emission lamp connection with fail safe. Open drain output with 30 Ohms impedance connecting to GND with lamp open short detection  | <b>O</b> |
| <b>22</b> | <b>+12V EM lamp</b> | Positive connexion of the emission lamp. 410 Ohms resistor to +12V to providing 22mA to a LED type lamp connected to 21   | <b>O</b> |
| <b>23</b> | <b>TBD</b>          | Fail safe test activated. Logic input with a 10kOhms pull-up. Vil = 0.8V Vih = 2.4V. A strap between 23 and 24 activates the fail safe mechanism that stops the laser emission if the lamp fails.                             | <b>I</b> |
| <b>24</b> | <b>GND</b>          |   | -        |
| <b>25</b> | <b>TBD</b>          | Do not connect  | -        |
| <b>26</b> | <b>GND</b>          |   | -        |
| <b>27</b> | <b>FREQ_ANA</b>     | Analog input 0-5V for Laser current control Zin >10k 1.5V/A. Do not drive with voltage below 0V or above 5V. Laser frequency  |          |
| <b>28</b> | <b>GND</b>          |   |          |
| <b>29</b> | <b>INT/EXT</b>      | Logic input with a 10kOhms pull-up. Vil = 0.8V Vih = 2.4V. Not connected or set to high level keep the internal laser current control, when set to low level, activates the FREQ-ANA input for laser current external control |          |
| <b>30</b> | <b>GND</b>          |   |          |
| <b>31</b> | <b>VNOM</b>         | Do not connect (TBD)  |          |
| <b>32</b> | <b>GND</b>          |   |          |
| <b>33</b> | <b>VSEED</b>        | Do not connect (TBD)  |          |
| <b>34</b> | <b>GND</b>          |   |          |

#### 4.8.2 Connection information for Desktop package

The Utility Connector is a Din 8 Female connector.( front view, see below)



Functionalities include live controls (Comp ON/OFF, MOD-EXT, STB-EXT, FREQ-ANA), safety signals management (interlock, Laser Ready, EM lamp, +12V EM lamp) or operation mode management (TEC ENABLE, INT/EXT).

**NB:** Male Connector not supplied. Customer will have to self procure a DIN utility connector.

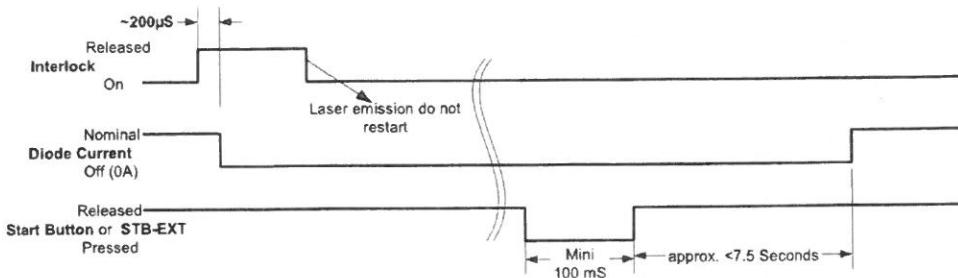
Reference: male DIN40040 8 pins plug connector type SV81

Suggested Manufacturer: Lumberg ref SV81

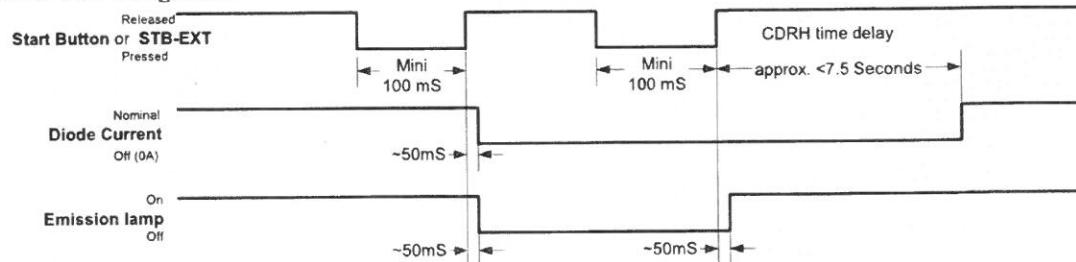
| Pin | Name        | Function   | In (I), Out (O) |
|-----|-------------|--|-----------------|
| 1   | Comp ON/OFF | <p>Laser On/Off (can be faster than STB-EXT but depends on ON/OFF sequence: refer to factory for further information)</p> <p>Logic input with an internal 10kOhms pull-up to +5V.</p> <p>Vil = 0.4V, Vih = 3.5V.</p> <p>At low level, the laser diode current is set to the offset value (factory set-up, no laser emission).</p> <p>At high level, the laser diode current settles to the nominal value ( factory set-up, the laser emits within its specifications).</p> <p><b>Note:</b> Logic input must be at high level when first starting the laser controller. Failing to do so, laser will not start.</p> | I               |
| 2   | MOD-EXT     | <p><b>FOR MLC-03A-DP1 ONLY</b><br/> <b>NOT ACTIVATED ON MLC-03A-DR1</b></p> <p>Pulse control input. Logic input with 10kOhms pull-up to +5V. Vil = 0.4V, Vih = 3.5V, edge sensitive.</p> <p>This signal initiates the laser pulse generation of the pulse control option on its rising transition (start of the TW cycle). <b>Start the laser before sending the trigger signal.</b></p>   | I               |
| 3   | STB-EXT     | <p>Laser start-stop (similar to start button action)</p> <p>Logic input with an internal 10kOhms pull-up to +5V.</p> <p>Vil = 0.4V, Vih = 3.5V, edge sensitive.</p> <p>This signal activates the laser On or Off on the rising transitions. On rising transition the laser comes either 'On' after a 5 Seconds time lag, or Off with a short time delay.</p>   | I               |
| 4   | GND         | GND MOD EXT  | -               |
| 5   | GND         | GND STB EXT  | -               |
| 6   | GND         | GND Comp On/Off  | -               |
| 7   | GND         | GND TEC ENABLE   | -               |
| 8   | TEC ENABLE  | <p>TEC On/Off</p> <p>Logic input with an internal 10kOhms pull-up to +5V.</p> <p>Vil = 0.4V, Vih = 3.5V,</p> <p>When the laser is On, TEC is enabled and the command is not active.</p> <p>When laser is Off , a high level enables the TEC cooler driver and a low level disable the TEC cooler driver. When disabled, laser cannot be turned On.</p>   | I               |

#### 4.8.3 Function description diagrams

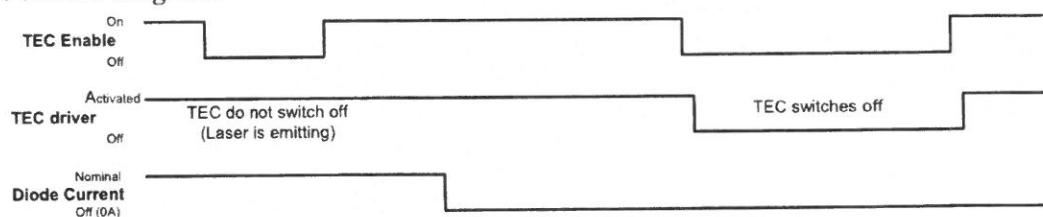
Interlock diagram:



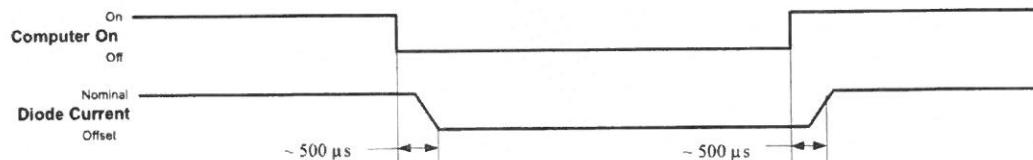
STB-EXT diagram:



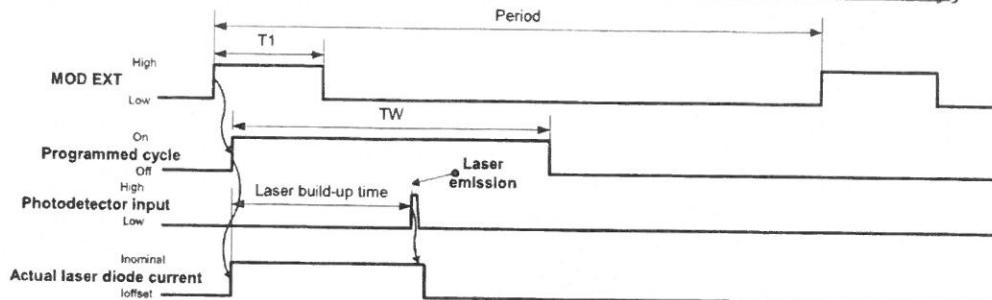
TEC enable diagram:



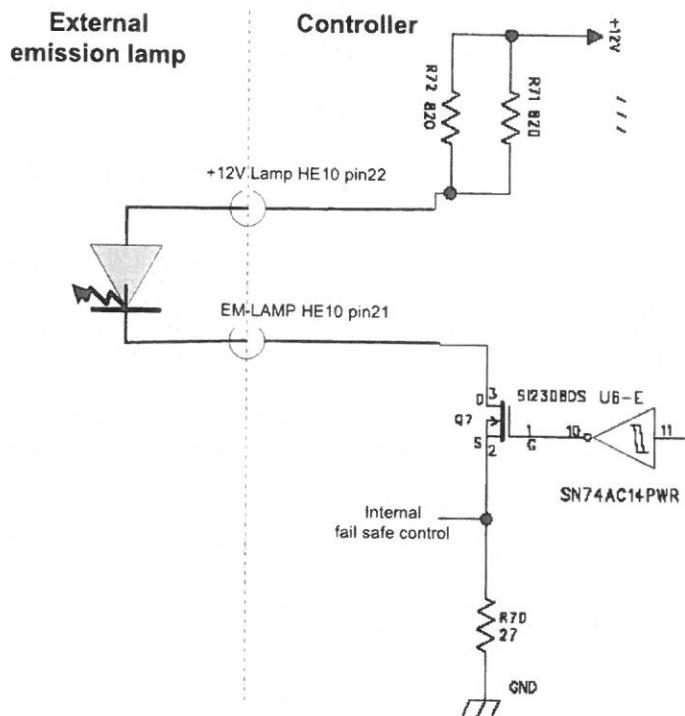
Computer On/Off diagram



MOD-EXT Diagram (Pulse control, triggered controllers MLC-03A-xP1 only):



Failsafe lamp connection:



#### 4.9 Turning off the laser controller (OEM and CDRH)

Before turning the laser controller off it is **mandatory** to switch the laser emission off.  
Press the laser start/stop button on the front panel of the controller OR send suitable command [suitable signal] to RS232 [Utility connector] (See details in section 5 on pg 23 of this manual).  
To turn laser controller off, depending of your controller, proceed as follow :

- For CDRH, use key switch. Turn off the key into the up-right position.
- For OEM system, remove the 12V from line supply.

Your system is now turned off.

## 5. Interface command description

The serial interface can be used to control the laser or read information from it. For programming purpose, please find here after the protocol description.

Connection and communication configuration has been described on §4.7 section.

### 5.1 Frame definition

A frame starts by a 4 bytes command composed by a keyword (CMDKey) character (S for set or G for get) followed by a 3 byte CMD string and ends with CR (carriage return). The command and data bytes are alphanumeric characters.

The frame template used is the following: ( \_ mean space character, LF means line feed)

| 1 Byte | 3 Bytes | _ | Byte 1 | _ | Byte 2 | _ | ... | Byte x | 1 Byte | 1 Byte |
|--------|---------|---|--------|---|--------|---|-----|--------|--------|--------|
| CMDKey | CMD     |   | DATA   |   | DATA   |   |     | DATA   | LF     | CR     |

### 5.2 Description

The controller always acknowledge the received frame by echoing the frame for all 'Set' keyword with the addition of a ">" character after "CR".

The list of the three digit CMD sub commands is given hereafter.

The external equipment always initiates the communication by sending a command to the controller. Then the controller executes the command and sends back an echo frame or a frame containing the answered parameters (Get command). It is mandatory to wait for the answer frame (this frame always finishes with a prompt character ">") from the controller or a timeout of 1s, before issuing another command.

### 5.3 Command definition

The space character is represented by " \_ " in the table below.

Not represented in the table below:

All frames from external equipment finish by "LF" (line feed) "CR" (carriage return)

All frames from Controller finish by "LF" (line feed) "CR" (carriage return) and ">" (prompt character)

These characters become directly after the last data character

### 5.4 Command list

**EMT Emitting Time**, can be obtained through this command, both diode running time and laser emitting time info are returned.

**EXT EXTerinal**, or HyperTerminal mode (default is Hyperterminal mode – passive information).

**FVE Firmware Versions**, for both Laser head and controller are returned.

**MTE Measured Temperatures**, the temperatures of diode, crystal, electronics and laser head base plate are returned.

**SEN Serial Number**, the laser head serial number is returned

**SER Status and Error Registers**, this command retrieves the status and the error register (see § 5.5 for description).

**SSD Start Stop Diode**, this command enables the user to switch On and Off the laser by computer control (same action as laser start button).

**TCO Temperature Control**, allows user to enable or disable temperature regulation of spare energy consumption.

| Action   | KEY + CMD                    | Read only | DATA Value  | Data description  |
|--|------------------------------|-----------|---|---|
| Emitting time                                      | EMT                          |           |   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GEMT<br>GEMT_dddd_dd_dddd_dd | X         | Data1: Diode supply hours<br>Data2: Diode supply minutes<br>Data3: Emitting hours<br>Data4: Emitting minutes                                | 0 < Data1, 3 < 65535<br>0 < Data2, 4 < 59   |
| Exit "hyperterminal" mode                          | EXT                          |           | In "Hyperterminal mode", error messages are written on hyperterminal.   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GEXT<br>GEXT_d               |           |   |   |
| <b>SET</b><br>Ext → Controller<br>Controller → Ext | SEXT_d<br>SEXT_d             |           | Data1: 0 Hyperterminal mode<br>1 External mode-Non Hyperterminal  |   |
| Firmware version                                   | FVE                          |           |   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GFVE<br>GFVE_ddd_ddd         | X         | Data1: ddd personality board firmware<br>example : 112 => V11.2<br>Data2: ddd controller board firmware                                     |   |
| Measured temperature                               | MTE                          |           |   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GMTE<br>GMTE_dddd_dddd_dd_dd | X         | Data1: Diode temperature<br>Data2: Crystal temperature<br><br>Data3: Electronic heat sink temperature<br>Data4: Laser heat sink temperature | Represented by 4 digits (0 to 9) and unit is 0.01°C for Data1, 2<br>Represented by 2 digits (0 to 9) and unit is 1°C for Data3, 4 |
| Start/stop laser diode                             | SSD                          |           |   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GSSD<br>GSSD_d               |           | d = 0 Stop or non emitting<br>d = 1 Start or emitting   |   |
| <b>SET</b><br>Ext → Controller<br>Controller → Ext | SSSD_d<br>SSSD_d             |           |   |   |
| Serial number                                      | SEN                          |           |   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GSEN<br>GSEN_ddddddddddd     | X         | Data1 : 16 digits Serial number   |   |
| Read status and error registers                    | SER                          | X         |   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GSER<br>GSER_hh_hh_hh_hh_hh  |           | Data1: Error reg1<br>Data2: Error reg2<br>Data3: Error reg3<br>Data4: Info reg1<br>Data5: Info reg2<br>Data6: Info reg3                     | Each register is eight bits and represented by 'hh' hexadecimal number  |
| Temperature Control                                | TCO                          |           |   |   |
| <b>GET</b><br>Ext → Controller<br>Controller → Ext | GTCO<br>GTCO_d               |           | d = 0 TEC1 OFF and TEC2 OFF<br>d = 1 TEC1 ON and TEC2 OFF<br>d = 2 TEC1 OFF and TEC2 ON<br>d = 3 TEC1 ON and TEC2 ON                        |   |
| <b>SET</b><br>Ext → Controller<br>Controller → Ext | STCO_d<br>STCO_d             |           |   |   |

## 5.5 Error and info registers

N/A is reserved for future implementation

The register bit description is 1 if the condition is met.

### EREG1 = Error register 1

| <b>BIT name</b> | <b>Condition</b>  |
|-----------------|---|
| E1              | Heatsink or PCB too hot                                 |
| E2              | +12V DC voltage too low (<10V)                          |
| E3              | Interlock connector removed or interlock contact opened |
| E4              | Laser head too hot                                      |
| E5              | Laser diode temperature too low                         |
| E6              | Laser diode temperature too high                        |
| E7              | Crystal temperature too low                             |
| E8              | Crystal temperature too high                            |

### EREG2 = Error register 2

| <b>BIT name</b> | <b>Condition</b>                    |
|-----------------|-------------------------------------|
| E9              | TEC cooler overload for 1 minute    |
| E10             | Wrong data read from the laser head |
| E11             | Diode temperature out of boundaries |
| E12             | +12V DC voltage too high (>14V)     |
| E13             | TEC diode open circuit              |
| E14             | TEC diode short circuit             |
| E15             | TEC crystal open circuit            |
| E16             | TEC crystal short circuit           |

### EREG3 = Error register 3

| <b>BIT name</b> | <b>Condition</b>  |
|-----------------|---|
| E17             | Laser diode open circuit  |
| E18             | Laser diode short circuit   |
| E19             | Failure on emission lamp  |
| E20             | Wrong laser head identification   |
| E21             | Crossed laser head cables   |
| E22             | Wrong hardware configuration (option laser head with no option driver or reverse) |
| E23             | Communication error with laser head   |
| E24             | Crystal temperature out of boundaries   |

### IREG1 = Information register 1

| <b>BIT name</b> | <b>Condition</b>  |
|-----------------|---|
| I1              | N/A   |
| I2              | Diode current not within +-50mA to the spec                   |
| I3              | Diode temperature is OK                                       |
| I4              | Crystal temperature is OK                                     |
| I5              | Diode temperature higher than setting (TEC is cooling down)   |
| I6              | Diode temperature lower than setting (TEC is heating up)      |
| I7              | Crystal temperature higher than setting (TEC is cooling down) |
| I8              | Crystal temperature lower than setting (TEC is heating up)    |

**IREG2 = Information register 2**

| <b>BIT name</b> | <b>Condition</b>   |
|-----------------|--|
| I9              | Laser diode current is ON                                  |
| I10             | Laser diode emission stopped due to an error               |
| I11             | Temperature regulation is OK - laser is ready for emission |
| I12             | Changing settings is authorized                            |
| I13             | Laser in autostart mode                                    |
| I14             | Laser in internal mode                                     |
| I15             | Laser in free running mode                                 |
| I16             | Laser has two TECs   |

**IREG3 = Information register 3**

| <b>BIT name</b> | <b>Condition</b>                            |
|-----------------|---|
| I17             | TEC diode is operating                      |
| I18             | TEC crystal is operating                    |
| I19             | Diode temperature regulation is activated   |
| I20             | Crystal temperature regulation is activated |
| I21             | N/A   |
| I22             | N/A   |
| I23             | N/A   |
| I24             | N/A   |

## 6. Servicing, cleaning

No specific servicing is required for this equipment that includes no serviceable parts.

Avoid using the laser out of the environment specified in the Specification Control Document attached in Part II.

For cleaning, never use liquid or solvent, just wipe with a clean, soft dust cloth, never clean or touch the laser output window.

## 7. Trouble Shooting

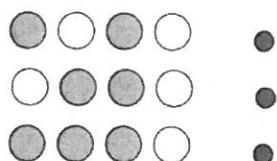
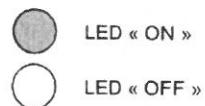
### 7.1 No LED light:

If NO led lights when switching ON the laser, check:

- The position of the key switch
- The availability of the AC mains voltage
- The connection of the power cord
- The protection fuse

### 7.2 Failure during initialization (start-up and auto-diagnostic):

When powered up, a LED sequence starts to verify the operating conditions of the system. Sequence is described as below:

**LEGEND :**

The time to complete the auto-diagnostic is approximately 3 seconds.

In case of system trouble, it can be detected during the auto diagnostics sequence and then stop at one of the 3 lamp configurations.

The best way to get information on the origin of this trouble is to connect a PC in HyperTerminal mode onto the RS232 connector, switch off and on the system and simply read the self explanatory information:

(c)TEEM PHOTONICS 2006-ELDR13A  
Controller V5D.91  
Laser head V1.4

TEST 1: SUPPLY  
9V => 9.10V  
5V => 4.98V  
5V ref => 5.00V  
Test SUCESSFUL

TEST READ EEPROM18 :  
Test SUCESSFUL

TEST 1: COM WITH LASER HEAD  
Test SUCESSFUL

TEST : PIC12 Identification :  
\$41:\$IN7->0V  
Test SUCESSFUL

TEST 5: Read EEPROM12 :  
Test SUCESSFUL

TEST 7: DAC  
3.97V -> DAC Idl\_nominal (U18) = Test SUCESSFUL  
0V -> Fast ON/OFF = Test SUCESSFUL  
2.97V -> DAC Idl\_offset (U17) = Test SUCESSFUL  
HODINT = Test SUCESSFUL  
D0403 (U7) = Test SUCESSFUL  
Test SUCESSFUL

TEST 9: TEC1  
207 -> 1810mA  
-10mA  
Test SUCESSFUL

TEST 10: TEC2  
180 --> 1860mA  
-20mA  
Test SUCESSFUL

=====  
TESTS END :Test SUCESSFUL  
=====

See §4.6 and §5.5 for further details.

**Important!!**

**When using Computer on/off, if Computer on/off is off during start-up, the auto-diagnostics stops at test 7 and the laser will not start. For recovery, change the computer on/off state to “on” then restart the laser controller.**

### 7.3 Error during laser emission or after auto diagnostics (yellow LED quick flashing):

In case of a good initialization, any error during operation may lead to a quick flashing yellow “Laser On” lamp.

The reason of the trouble can be found in looking at the state of the temperature and power on LED.

Check that the interlock is not open.

If the trouble reason is temporary (limited loss of temperature regulation or temporary bad supply voltage) then pressing the start button will restore the proper operation.

Detailed operation can be obtained by the HyperTerminal passive mode that indicate the error number (real time) whose signification is given on § 5.5.

#### 7.4 Error during operation (yellow LED slow flashing)

This can occur only when laser is left without emission and if temperature control is not successful. If the trouble is permanent, reset the system (switch off and on) and if trouble still occur, then the laser heat sinking or base plate temperature has to be checked.

#### 7.5 No temperature regulation

If the red LED lights ON and the green LED doesn't comes on after the temperature regulation delay of few seconds, check:

The laser head connection (after switching off the laser controller)

The laser head proper heat sinking

The laser base plate temperature relatively to the specification

Try switching off then on, to reset the temperature protection.

#### 7.6 Bad DC voltage (red LED blinking)

Check the DC power supply ( $10V < V_{supply} < 14V$ )

### 8. Specifications

Make sure by reading the part number that your controller is adapted to your laser system.

For each option specified with your laser head please refer to the dedicated page in the MicroChip Laser head document as well as in your MicroChip Laser controller document.

Description of your specific option can be found in part II of the referred manuals.

## PART II. Information pertaining to your MicroChip laser head and laser controller.

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)

**Document reference:** 210 596 24  
**Revision:** 006  
**Date of the edition :** July 2014

| <b>Revision</b> | <b>Date</b> | <b>Modification</b>   |
|-----------------|-------------|---|
| 000             | Sept 04     | Creation by Dbo, LGs and ThF                                |
| 001             | Nov 04      | Dbo, LGs, SV, ThF   |
| 002             | Sept 07     | LBr   |
| 003             | Jan10       | HHn   |
| 004             | Jan13       | FT  |
| 005             | Oct13       | Revised Product offering edition, FT                        |
| 005             | May 14      | Change in information registers designation, FT             |
| 006             | July 2013   | Removed SCDs from the list of documents sent with the laser |

## APPENDIX #1: Dissipative Spacers' description

|  |  |             |     |             |     |        |                 |
|--|--|-------------|-----|-------------|-----|--------|-----------------|
| PART NUMBER  | 42-30-0005   | REV         | 000 | ECO         | ENG | DATE   | DESCRIPTION     |
|  | 000  | -           | -   | -           | -   | -      | INITIAL RELEASE |
| <b>NOTES:</b>  |  |             |     |             |     |        |                 |
| (1)  | - MATERIAL: ALU 6061 T651<br>SUPPLIER TO PROVIDE A CERTIFICATE OF CHEMICAL ANALYSIS<br>TRACEABLE TO EACH PRODUCTION LOT.   |             |     |             |     |        |                 |
| (2)  | - FINISH: CHROMATATION IRIDITE 14-2 (YELLOW)<br>SUPPLIER TO PROVIDE A CERTIFICATE OF CONFORMANCE STATING<br>TRACEABILITY OF PROCESS TO EACH PRODUCTION LOT.          |             |     |             |     |        |                 |
| 3.   | - REMOVE ALL SHARP EDGES   |             |     |             |     |        |                 |
| 4.   | - PACKAGING: INDIVIDUALLY PACKAGE AND SEAL EACH UNIT<br>USING A POLY BAG, APPLY AN ADHESIVE LABEL CONTAINING<br>THE TEEM PHOTONICS ITEM NUMBER AND CURRENT REVISION. |             |     |             |     |        |                 |
| <b>SECTION A-A</b>   |  |             |     |             |     |        |                 |
|  |  |             |     |             |     |        |                 |
| <b>THIRD ANGLE PROJECTION</b>  |  |             |     |             |     |        |                 |
| INCHES   | MM   | INCHES      | MM  | INCHES      | MM  | INCHES | MM              |
| DRAWN BY   | Dominique Boulejoud  | REVIEWED BY |     | APPROVED BY |     | DATE   | 23/09/03        |
| DBO  |  | DBW         |     | DBP         |     | TIME   |                 |
| 1.6  |  | 1           |     | 2           |     | TEMP   |                 |
| DO NOT SCALE DRAWING   |  |             |     |             |     |        |                 |
| <b>DIMENSIONS ARE IN MILLIMETERS</b>   |  |             |     |             |     |        |                 |
| UNLESS OTHERWISE SPECIFIED<br>DIMS PER ISO 2768-CLASS 1<br>TOLERANCES ARE<br>OVER 400 (P TO 1000) = ± 0.5<br>OVER 1000 (P TO 10000) = ± 0.5<br>AND AS EX.<br>OVER 100 (P TO 320) = ± 0.1<br>OVER 320 (P TO 400) = ± 0.2<br>OVER 400 (P TO 4000) = ± 0.2<br>DO NOT SCALE DRAWING  |  |             |     |             |     |        |                 |
| Adress:<br>61, Chemin du Vieux Chêne<br>38240 Meylan, France<br>Tel : +33(0)4 76 04 05 06<br>Fax : +33(0)4 76 04 03 02<br><a href="http://www.teemphotronics.com">www.teemphotronics.com</a>   |  |             |     |             |     |        |                 |
| <b>Ech: 1/1</b><br>  |  |             |     |             |     |        |                 |
| <b>CONFIDENTIAL -</b> This drawing contains proprietary information and is the property of Teem Photonics and is transmitted in confidence. Neither recipient nor possession confers or transmits any right to reproduce, use or disclose in whole or in part, data contained herein for any purpose, without the prior written consent of an officer of Teem Photonics. |  |             |     |             |     |        |                 |
| PART NUMBER 42-30-0005 REV 000<br>REV 000<br>PART NUMBER 42-30-0005 REV 000<br>REV 000   |  |             |     |             |     |        |                 |