TINY LDD LASER DIODE DRIVER

Operation manual

Firmware versions 1.4.1

Workshop of Photonics

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TINY LDD

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INTRODUCTION

The **Tiny LDD Laser Diode Driver** is an electronic device that contains high power current source (up to 10A) for laser diode (LD) and two controllers for Peltier thermoelectric coolers (TECs). Compact and highly-efficient design limits power dissipation and simplifies heat-sinking requirements. IT is perfectly suited for OEM applications. The Laser Diode Driver incorporates LD protection features like slow current ramp-up (soft start function), current limit, temperature limit and overheating protection.

***Figure 1**. TINY Laser Diode Driver.*

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I. FEATURES

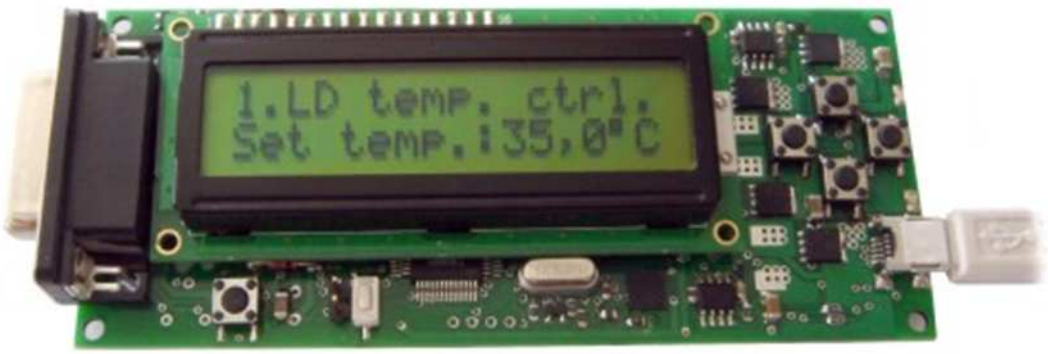

Figure 2. *TINY OEM with 1.4.1 version firmware.*

- Extremely high efficient laser diode (LD) current source more than 96% at 8A (max.10A).
- Laser diode voltage limit feature.
- Soft start feature.
- Two channel high efficiency TEC driver. Max. 4A each.
- Smooth temperature stabilization adjustable parameters to avoid temperature oscillations.
- Over temperature protection for laser diode and laser crystal.
- Interlock, external start/stop, internal pulse generator.
- Remote control via USB
- High reliability.
- Constant optical power mode.
- Extremely low heat dissipation. Capable to work fanless.
- Very compact. Size 119mm (with DB15 socket 128mm) x 51mm x 20mm. (With DB15 socket, 5in x 2in x 0.79in).

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II. SAFETY

Symbols

WARNING!
Sections marked with this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully, before performing the indicated procedure.

ATTENTION!
Paragraphs preceded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

NOTE
This manual also contains "NOTES" and "HINTS" written in this form.

Regulation

WARNING!

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

Before applying power to your TINY LDD device, make sure that the power supply power cord is correctly connected to the protective earth contact of the socket outlet! Improper grounding can cause electric shock with damages to your health or even death!

TINY LDD laser diode and temperature controllers must not be operated in explosion endangered environments! Do not remove covers! Refer servicing to qualified personnel only!

WARNING!

Laser modules in connection with TINY LDD laser diode and temperature controllers can deliver up to several Watts of visible/invisible laser radiation! When operated incorrectly, this can cause severe damage to your eyes and health!

Be sure to pay strict attention to the safety recommendations of the appropriate laser safety class! This laser safety class is marked on your external laser source used.

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ATTENTION!

Laser output, sensor inputs, and control inputs and outputs must only be connected with duly shielded connection cables. Do not obstruct the air ventilation slots in the housing! Only with written consent from ALTECHNA R&D may changes to single components be carried out. This precision device must be shipped in its complete original packaging, including the foam parts. If necessary, ask for a replacement package.

ATTENTION!

The following statement applies to the products and firmware versions covered in this manual, unless otherwise specified herein. The statement for other products or firmware version will appear in the accompanying documentation.

Latest manual versions can be downloaded from www.wophotonics.com.

These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

ALTECHNA R&D is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by ALTECHNA R&D. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.
The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

ATTENTION!

Cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.

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III. GETTING STARTED

Unpacking

The device is packed in a rigid case, dedicated for portable applications. Inspect the packaging and the case for damage before opening.

If the packaging or the case appears to be damaged, keep it until you have checked the contents and you have inspected the enclosed device mechanically and electrically.

Verify that the case contains:

- One TINY LDD.
- One 40W power supply, with wall socket connector according to ordering country (for EU countries, others by request).
- One USB cable (A-B) 2 m.
- One instrumentation flash memory stick (containing manuals, drivers, tools and software).

Preparation

1. Connect the power supply connector to the power connector on the right side of the device (refer to Figure 1).
2. Connect the optical setup to the LDD device using a supplied adapter cable.

ATTENTION!

If you are using a custom made cable for connecting the optical setup to our LDD products, please consult with us in advance in order to avoid damage.

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IV. SPECIFICATIONS

Parameters	Value
Power supply voltage	+4.6V to +5.4V
Laser diode current source current range	+0.4A to +10A
Laser diode current increment/decrement step	0.004A
Laser diode voltage limit range	1.5V to 4V
Laser diode voltage limit increment/decrement step	0.001V
NTC (termoresistor) value	10 kOhm
TEC driver current	Up to 4A*

* Max current flow via TEC is determined by its voltamperic characteristics. In case of 5V power supply and voltage drop in driver and TEC wires, voltage close to TEC can achieve maximum 4V. For best TEC performance it is recommended to use TEC with max voltage from 2V to 4V (17 or 31 couples).

Parameter	Min value	Max value
Power consumption (LD-2.5V@10A & 2 TEC x 4V @ 4A)		60 W
Storage temperature	0°C	+70°C
Operating temperature (air or case pad temperature)	+15°C	+40°C
Temperature of separate board elements		+80°C

- Board is not protected against long term over voltage! Negative voltage will damage board!
- Red input power wire is always positive (+5V) other wire is ground (GND)!
- We recommend using only original power supply!
- TEC driver stabilizes laser diode or crystal temperature only by cooling.
- There are no fuses on board. If necessary add fuse serially on laser diode power wire. Use very fast fuse.
- For OEM version: Air flow is necessary in any case, but you should know that air flow gives lower temperature changes and this gives better output power stability, and protects driver from emergency overheating turn off.

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V. HARDWARE

TINY LDD on-board hardware

- Laser diode driver CW.
- Mini USB port. Compatible with USB 2.
- Two NTC inputs.
- Two lines text LCD screen.
- TEC controller

Connections

Left side connectors:

- D-SUB15.

Right side connectors:

- Mini USB 2.0.

Top side (for version with metal casing)

- On/Off button.
- Power connector x2.

NOTE: For OEM versions power cord is on the top (~15 cm length), red line on the cable means positive wire.

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VI. PINOUT D-SUB15

PIN	Name	Description
1,2	LD+	Laser diode anode
3	Crystal NTC	Second NTC 10kOhm for laser crystal
4	Crystal TEC (-)	Laser crystal peltier element negative wire
5	Crystal TEC (+)	Laser crystal peltier element positive wire
6	LD NTC	Laser diode NTC 10kOhm
7	PulseGen/interlock	User selectable pulse generator or interlock
8	LD TEC (+)	Laser doped peltier element positive wire
9,10	LD (-)	Laser diode catode
11	Crystal NTC	Second NTC 10kOhm for laser crystal
12	+5V (100mA)	+5V for optional external electronics
13	LD NTC	Laser diode NTC 10kOhm
14	Optical Feedback	For photodiode or optical power meter
15	LD TEC (-)	Laser diode peltier element negative wire

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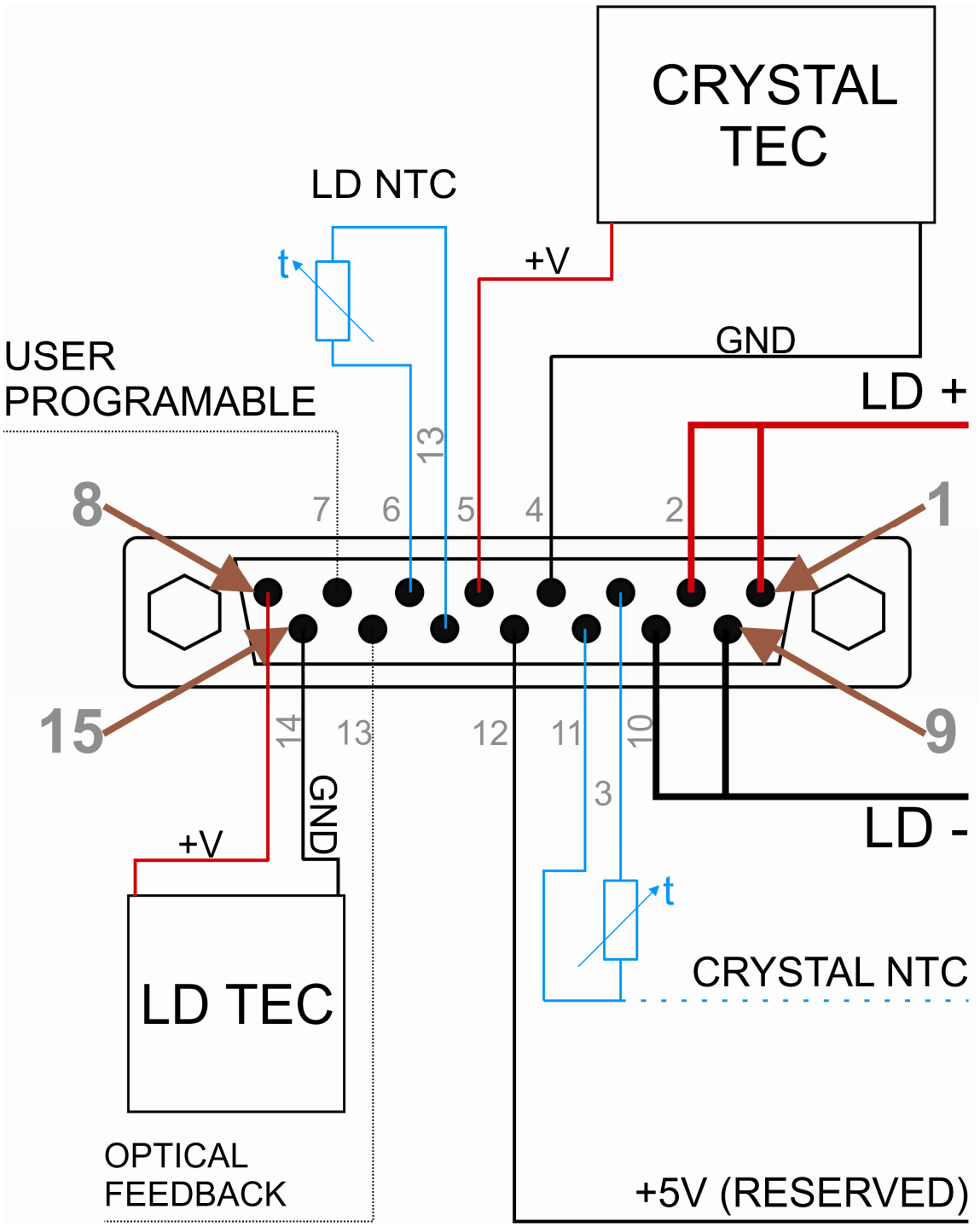

Figure 3. *TINY LDD pin-out D-SUB15.*

WARNING! Double check pin numbers, as wrong connection can damage LDD driver or setup.

NOTE: D-SUB15 plug is shown as it is on the TINY LDD driver.

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VII. LCD MENU CONTROL

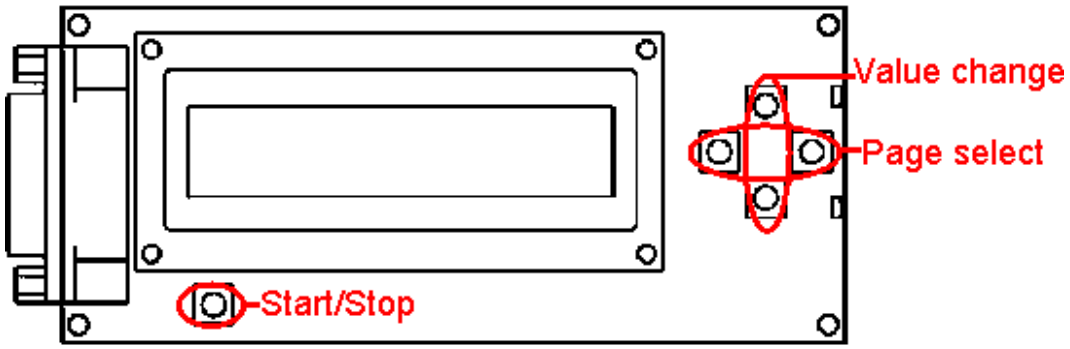

Figure 4. *TINY OEM buttons.*

Menu view	Comments
Current: 8.504 A Voltage: 2.321 V	Laser diode current monitoring. Accuracy 0.004A Laser diode voltage measured on board. It's always greater value than near laser diode.
LD:35.0C 2.089 A Xt: Not detected	Laser diode temperature and measured current value crossing TEC. Crystal temperature and measured current value crossing TEC. If NTC (termoresistor) is not connected you will see 'Not detected' message.
1. LD temp. ctrl. Set temp.: 35.0 C	Temperature setting for laser diode. 0.1 C accuracy. Range: 10.0 C to 50.0 C
2. Xtal temp. Set temp.: 20.0C	Temperature setting for crystal. 0.1 C accuracy. Range: 10.0 C to 50.0 C
3. Current ctrl. Set I: 8.500 A	Current setting for laser diode. Accuracy 0.004 A. Range: 0.400A to 10.000A
4. Voltage limit Set U: 2.799 V	Voltage limit for laser diode. Accuracy 0.001 V. Range: 1.500V to 3.000V **NOTE:** This value always must be greater than laser diode operating voltage in case of voltage drop in wires.
5. LDTECParam1 Set P1: 5	Temperature stabilization speed parameter. Range 1 to 20. For slower temperature stabilization set greater value. This is necessary when temperature oscillating. For most of standard systems should fit 5 or similar value.
6. Limit LD TEC Current: 2.8A	Current limiting for laser diode TEC. Range 1.0A to 4.0A. Strongly recommended to limit TEC max current to avoid overloading of main power supply.
7. Xt TEC Param 1 Set P1: 5	Temperature stabilization speed parameter. Range 1 to 20. For slower temperature stabilization set greater value. This is necessary when temperature oscillating. For most of standard systems 5 or similar value should fit.
8. Limit Xt TEC Current: 2.8A	Current limiting for crystal TEC. Range 1.0A to 4.0A. Strongly recommended to limit TEC max current to prevent overload in main power supply.

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9. Two unipolar TEC drivers	This page is to select TEC driving mode “Two unipolar TEC “ or “Single bipolar TEC driver”.
10. Cooling when LD is off: no	If set “no” then TEC drivers work only when LD is turned on. If set “yes” TEC starts working all the time after first LD start.
11. Soft start *ON OFF	Laser diode soft start means that current will be increased step by step from zero to set value. We recommend always use this function to avoid damage to laser diode and increase lifetime.
12. Int. trigger Single shoot	Driver have internal pulse generator. Output is on 7 pin in DB-15 connector. When selected “Single shoot” on every “Down” button pressing 7 pin transmits 500us positive pulse. Also user can select constant pulse generation 1kHz, 2KHz, 5KHz, 10KHz and 20kHz.
13. PCB board temp.: 28.9 C	This page shows driver’s internal NTC temperature. Max temperature that can be achieved is 75C. At 75C driver stops.
14. Op.pr.1364mW Feedback disabl.	Laser diode driver can show optical power 1mV at 14 pin in DB-15 connector equals 1mW. Driver supports constant optical power mode. This mode is for compensation optical power drift. This function works at software level. Program can change current to get closer to selected value, but not more than selected current value in page “3”. Value is selected using “Up” and “Down” buttons. “0mW” equals disabled feedback.
15. 7 pin act as Pulse generator	7 pin in DB-15 connector can be used for several tasks: Pulse generator, external start/stop, interlock. When selected “extrn. start/stop” driver starts when 7 pin is connected to GND (9 or 10 pin) and stops when circuit is open. When selected “interlock” LDD can’t be started if interlock is open.
16. Firmware version v. 1.4.1	Shows current version of the firmware of this device.

VIII. LASER DIODE DRIVER OPERATING

- Laser diode driver will not run if LD NTC is not detected.
- Laser diode driver will not run if LD temperature is 15 degrees higher than selected temperature. Firstly it will cool down LD and then will start it.
- If LD temperature becomes higher by 5 degrees than selected temperature LD will be turned down and “LD temperature out of range” message will appear.
- Top LED means that LD is slow started or already working.
- Bottom LED: blinking shows that electronics is working, white LED freezes for a second when displays a message.
- Don’t use large bolt type NTC. Use small and fast response time NTCs to avoid temperature oscillations.
- It is recommended to put NTC between LD and TEC.

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IX. CONNECTION OF PERIPHERALS

Optical power measurement

LDD supports constant optical power mode. This function is for optical power drift compensation. Constant optical mode is organized at software level. Optical power is checked and LD current adjustment applied 1000 times per second. Feedback can be organized using analog optical power meter or photodiode. Below optical feedback schematics using photodiode are presented. R1 variable resistor to adjust scale 1mV=1mW. R1 recommended value range 200 - 10 kOhm. To enable feedback user has to set value greater than 0 in the menu.

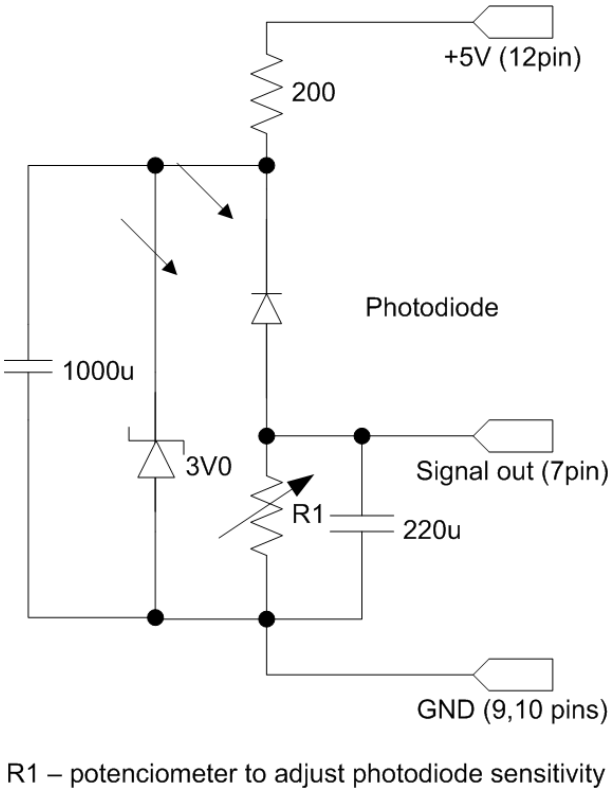

Figure 5. *Optical power measurement scheme.*

Power supply jack

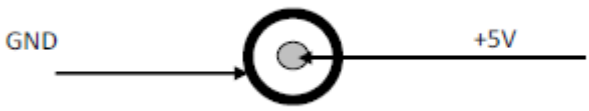

Figure 6. *Power supply jack.*

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Bi-directional mode

This mode supports single bi-directional TEC and it is selectable in a menu on page ‘9’ by pressing “up” button (“Single bipolar TEC driver”). When you turn on this mode, “Xl” channel automatically is disabled On menu page zero TEC are indicated as ‘LD’ TEC.

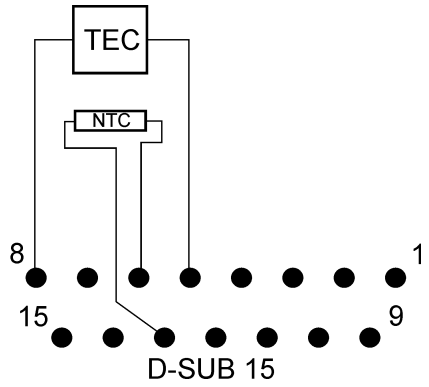

Figure 7. *Single bi-directional TEC.*

This mode supports two unidirectional TECs using LD channel power. At this mode laser diode can’t be used. User in LDD menu page ‘9’ has to select mode named “Two unipolar TEC drivers”. User has to set current 4 – 8 Amps and 1.5-2.5 V. For example if 1.5 V is set on page ‘4’ this means that heating max voltage is 1.5 V. In case of cooling 4.5 - 1.5 = 3 V.

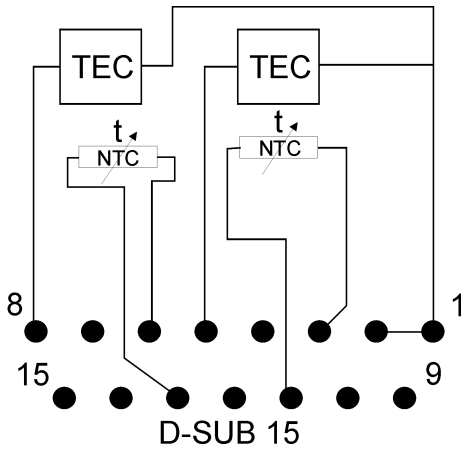

Figure 8. *Two uni-directional TEC drivers.*

This mode supports two bidirectional TEC using external power. User in LDD menu page ‘9’ has to select mode named “Two unipolar TEC drivers”. If external power supply voltage for TEC is 1.5 V, this means that heating max voltage is 1.5 V. In case of cooling 4.5 - 1.5 = 3 V. This rule is for both TEC channels. External power supply for TECs have to be capable to pass current in both directions otherwise TEC driver will be capable to heat only.

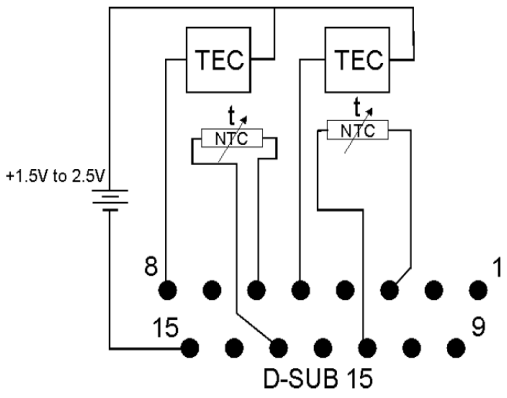

Figure 9. *Two bi-directional TEC drivers using external power supply schematics schematics.*

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X. MECHANICAL DATA

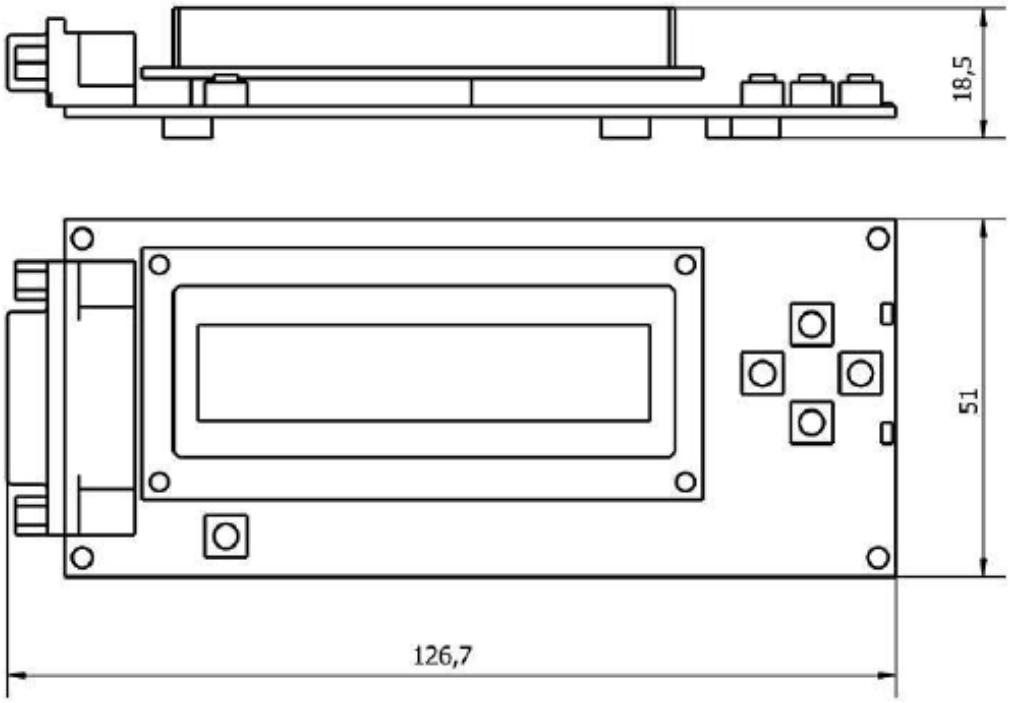

Figure 10. *TINY OEM measurements.*

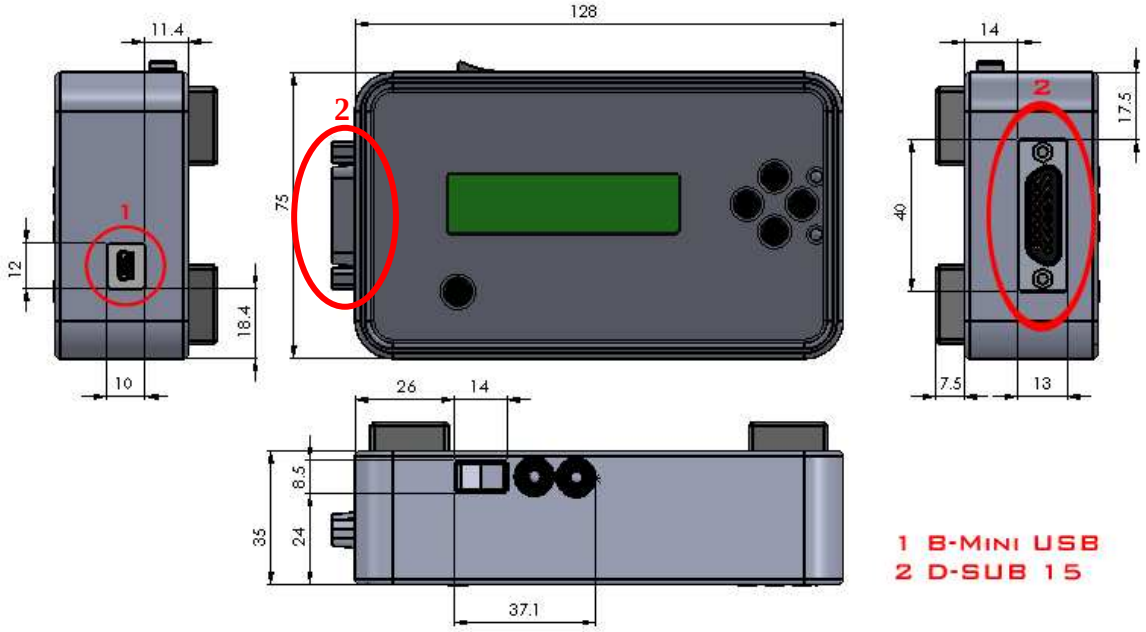

Figure 11*. TINY LDD measurements.*

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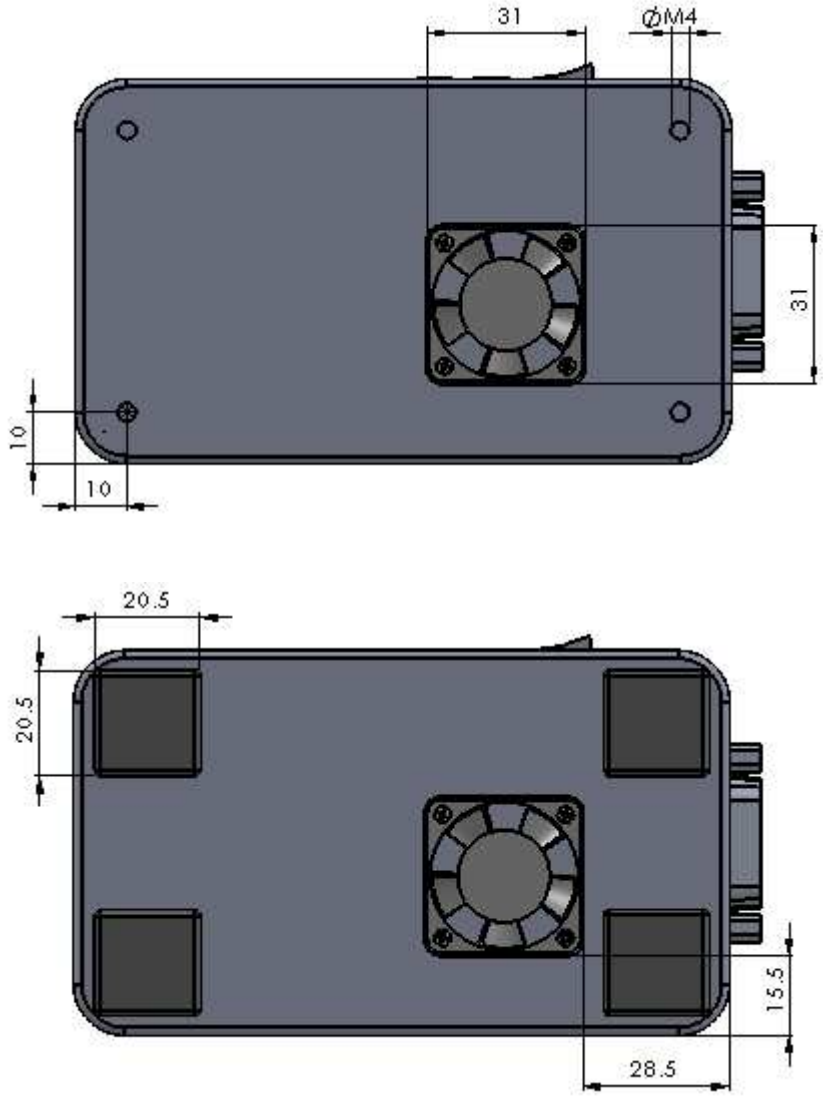

***Figure 12**.TINY LDD measurements, the lower part.*

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XI. SOFTWARE INSTALL MANUAL

Before installing LDD control software, user should install drivers for “CP210x USB to UART Bridge VCP”. For up to date version check www.wophotonics.com.

After installing drivers, follow these steps.

1. Run Setup.exe
2. Follow these steps:

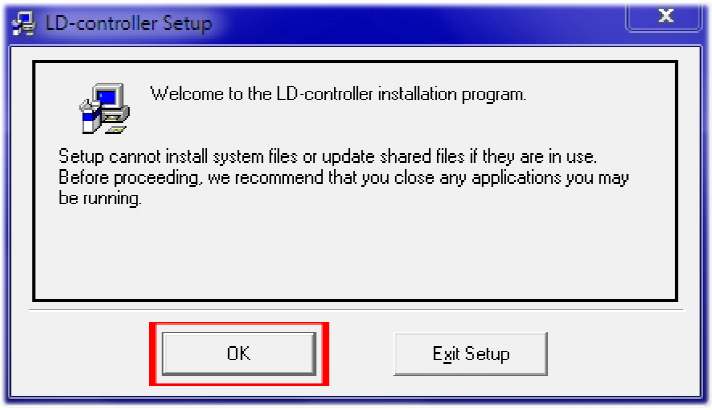

Figure 13. *Close any running applications and click OK.*

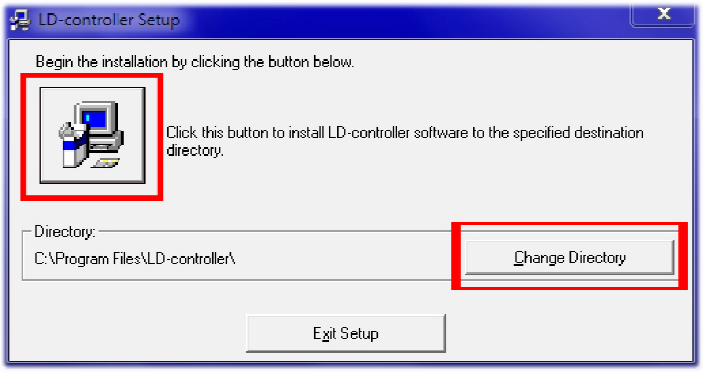

Figure 14. *Change or leave the default installation directory and click PC icon.*

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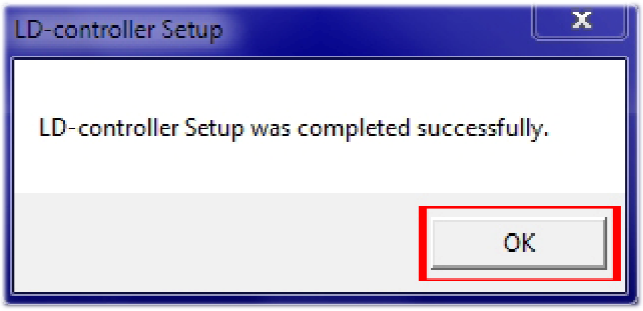

Figure 15. *Click OK.*

3. After installation while starting this program for the first time you will be prompted to select COM port number, you can obtain it in Windows device manager window (COM and LPT ports/ Silicon labs cp210x virtual com port).

   NOTE: Remember this port number, as at start of this program it will ask again for port number.

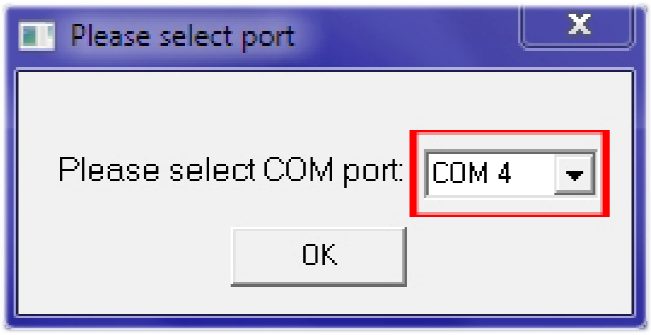

Figure 16. *Pop-up window with port selection.*

4. Run program “LDD control software”. In popped up window, select port number to which LDD is connected. Press OK button.

You are ready to use LDD control software.

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XII. SOFTWARE MANUAL

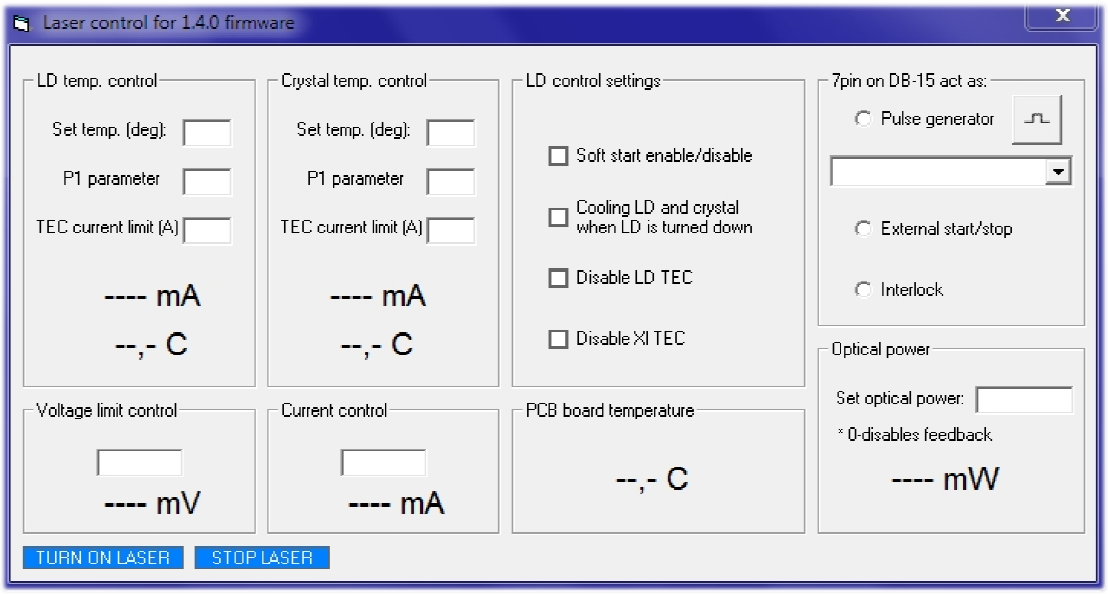
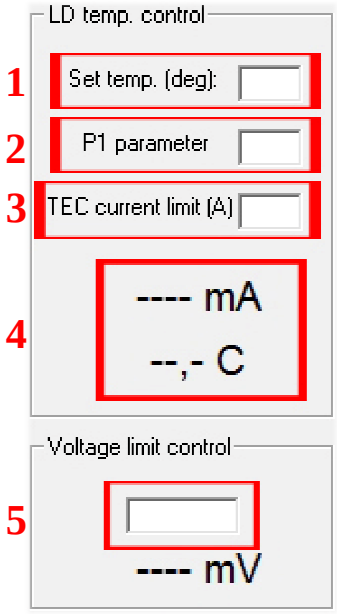


Figure 17. *Laser control window (after changing each value press Enter to make the change).*



1. Setting of temperature for laser diode. Accuracy: 0.1^{O} C. Range: 10.0^{O} C to 50.0^{O} C

2. Temperature stabilization speed parameter. Range: 1 to 20. For slower temperature stabilization set greater value. This is necessary when temperature is oscillating. Value of 5 should be suitable for most standard systems.

3. Current limiting for laser diode TEC. Range: 1.1 A to 4 A, accuracy 0.004A.

4. Current and temperature display at the moment.

5. Voltage limit for laser diode. Accuracy: 0.001V. Range: 1.500V to 3V. NOTE: This value always must be greater than laser diode operating voltage in case of voltage drop in wires.

Figure 18. *LD temperature control and voltage limit control.*

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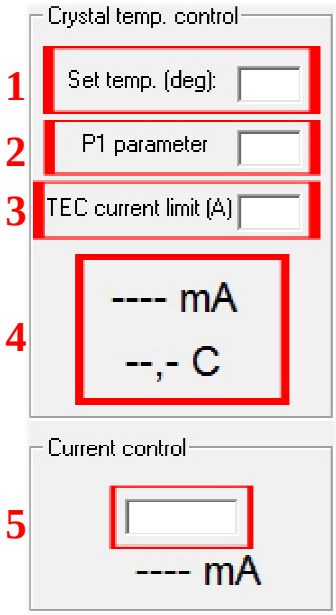
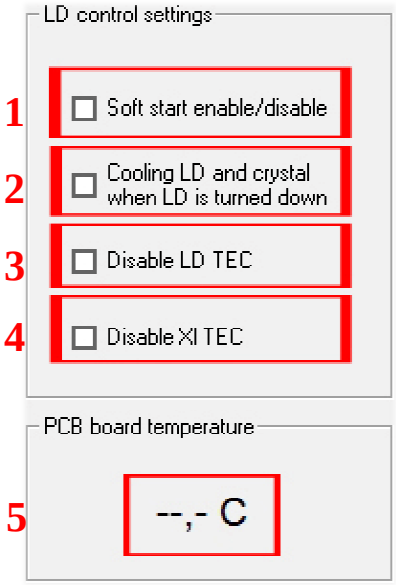


1. Setting of temperature for crystal. Accuracy: 0.1^{O} C. Range: 5.0^{O} C to 50.0^{O} C.
2. Temperature stabilization speed parameter. Range: 1 to 20. For slower temperature stabilization set greater value. This is necessary when temperature is oscillating. Value of 5 should be suitable for most standard systems.
3. Current limiting for crystal TEC. Range: 1.1 A to 4 A. Strongly recommended to limit TEC max current because it can overload main power supply.
4. Current and temperature display at the moment.
5. Setting of current for laser diode. Accuracy: 0.004 A. Range: 0.400 A to 10.000 A.

Figure 19. *Crystal temperature control and current control.*



1. Soft start function enabling LD to start gradually.
2. Cooling option for LD and crystal. Temperature values set by user remain constant even after LD is shut down.
3. Option for disabling the LD TEC.
4. Option for disabling crystal TEC.
5. PCB board temperature at the moment.

Figure 20. *LD control settings and PCB board temperature.*

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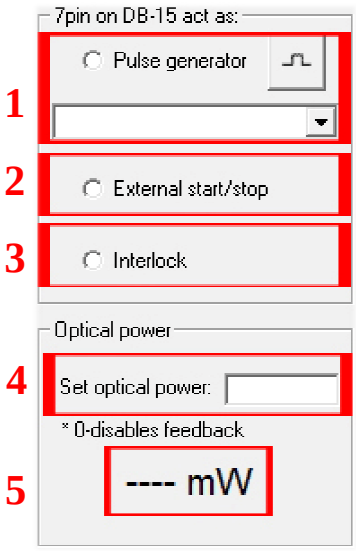

1. Pulse generator option with drop-down window letting user choose single pulse of 500ms up to 1KHz/ 20KHz pulse with duty cycle 50%.

2. External start/stop option.

3. Interlock option.

4. Optical feedback – controller contains constant laser power (for measurements see chapter IX) when LD current is being increased or decreased, but the current cannot be set higher than adjusted in laser diode current control menu. Specifying 0 means that this option is disabled.

5. Displays power at the moment if optical power is set and measuring scheme is connected.

Figure 21. *7pin on DB-15 function selection and optical power set window.*

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XIII. REVISION HISTORY

1. Rewritten manual (2012 March 21).

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XIV. NOTES

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