MBH15xx Series Benchtop Laser Diode Controllers

LASER DIODE DRIVER CONTROLLER

- Three Models Available:
  - 15 Amp, 10 Volt
  - 30 Amp, 10 Volt
  - 12 Amp, 40 Volt
- Fast Crowbar Circuit Protection
- Soft-Start Current Ramp, Current Limit, Reverse Voltage Protection
- NTC Thermistor Input for Laser Over-Temperature Fast Shut-Down
- GUI Control Software Included

LASER DIODE CONTROLLERS

v1.0.0, 2020

www.LaserDiodeSource.com
www.LaserDiodeControl.com
part of the **Laser Lab Source Group**

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670 South Ferguson
Bozeman, MT 59718

1. Laser diode driver features

- **Low current ripple**
- **No need to adjust compliance voltage**
- **Soft-start**
- **Adjustable overcurrent limit**
- **Thermal warning and shutdown**
- **Reverse current protection**
- **Crowbar circuit protection**
- **Universal controls**
- **NTC thermistor input**
- **GUI software**

2. Applications

- **Supplying laser diodes, bars and arrays**
- **Supplying high power LED arrays**

3. Description

The MBHXXXX is series of precision high power laser diode controllers. It is optimized for driving laser diodes or high power LED arrays with an output current range up to 250A, output voltage range up to 40V. Multiple built-in protection features ensures safety work. Digital control is provided via an USB 2.0 interface. Free software is included in the delivery set.

4. Package set

- **Laser diode power supply – 1 pcs;**
- **Power cord – 1 pcs;**
- **USB cable – 1 pcs;**
- **9-pin d-sub plug - 1 pcs;**
- **15-pin d-sub plug – 1 pcs;**
- **Interlock connector – 1 pcs;**
- **Datasheet & User Manual – 1 pcs.**

5. Overall dimensions and weight

MBH has overall dimensions of 257 x 271 x 117 mm and a weight of 3.6 kg.

6. Versions

Device	Max output current, A	Max output voltage, V
MBH1510	15	10
MBH3010	30	10
MBH1240	12	40

7. Electrical characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Vin		100		240	V
Consumption power	Operative		45	50	W
Interlock threshold				1	V

8. Electrical characteristics LD power supply channel

MBH1510

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage		1		10	V
Output current		0		15	A
Current ripple			12	15	mA
Current set step			0.01		A
Current set accuracy	2A < I_{out} < 5A		± 5		%
	5A < I_{out} < 15A		± 1		%

MBH3010

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage		1		10	V
Output current		0		30	A
Current ripple			12	15	mA
Current set step			0.01		A
Current set accuracy	5A < I_{out} < 10A		± 5		%
	10A < I_{out} < 30A		± 1		%

MBH1240

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage		5		40	V
Output current		0		12	A
Current ripple			15	25	mA
Current set step			0.01		A
Current set accuracy	2A < I_{out} < 5A		± 5		%
	5A < I_{out} < 15A		± 1		%

9. Typical Performance Characteristics

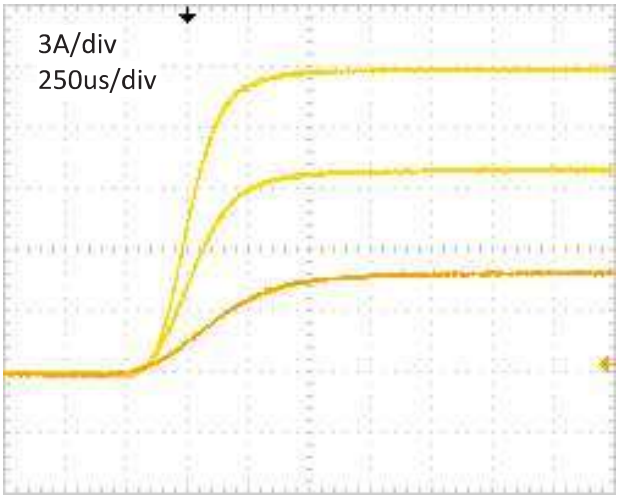


Figure 1 – Typical start up sequence MBH1510

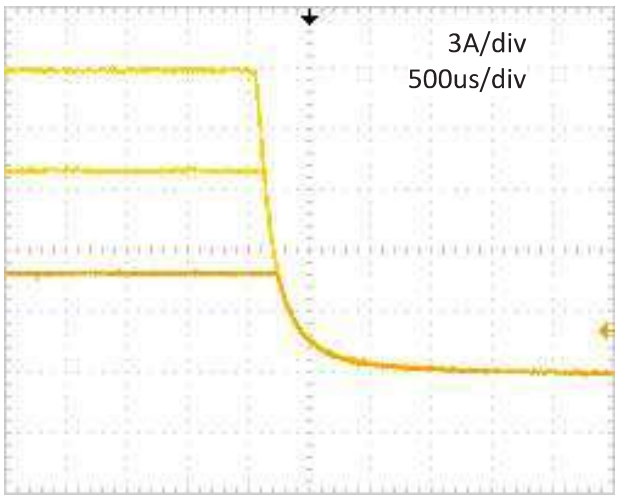
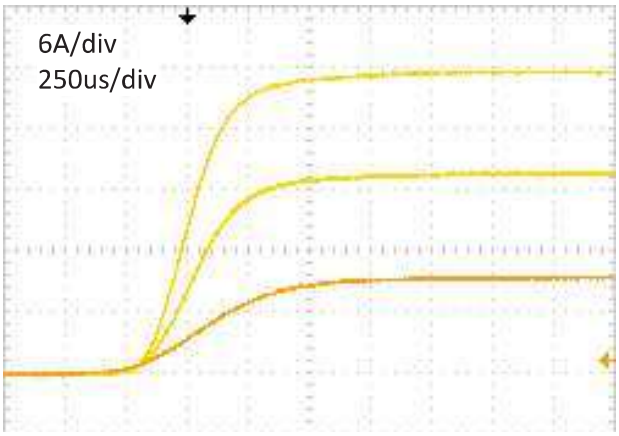
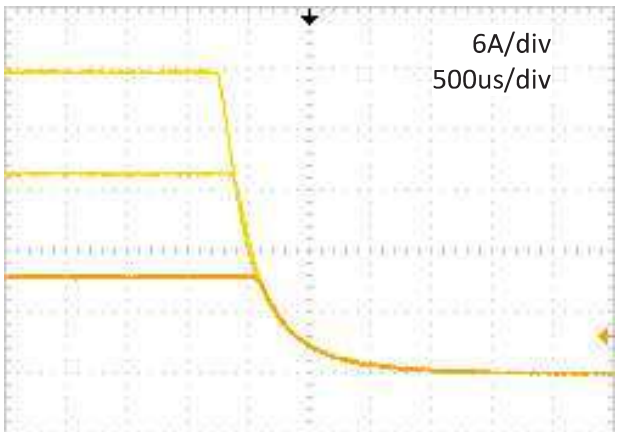


Figure 2 – Typical stop sequence MBH1510





10. Protections

The power supply includes various protections that prevent damage to the LD.

External interlock

External interlock function provides multiply protections at the same time:

- Prevents inadvertent use;
- Allows to connect an external emergency switch;
- Allows to connect an external auto protect device (e.g. over-temperature switches).

The laser can be turned on only with the Interlock shorted.

Soft-start

The soft-start function protects against unwanted current overshoot in the power up process.

LD max current limiting

LD max current limit (*LD max current*) is described in paragraph 14.7. You cannot set the operating current above the programmed LD max current.

Over-temperature protection

The MBHxxxx has automatic overheating protection. If the set *external NTC max temperature* is exceeded, the LD current will be automatically turned off. After the temperature returns to normal, the LD current can be switched on again.

State after switching on

After turning on the MBHxxxx with the *Standby* button the LD power supply and TEC (if equipped) will always be turned off.

Memorization of parameters

In case of an interruption/unplanned shutdown, the MBHxxxx remembers the settings that were set at the time of the last On/Off Laser command.

11. Controls

Front panel

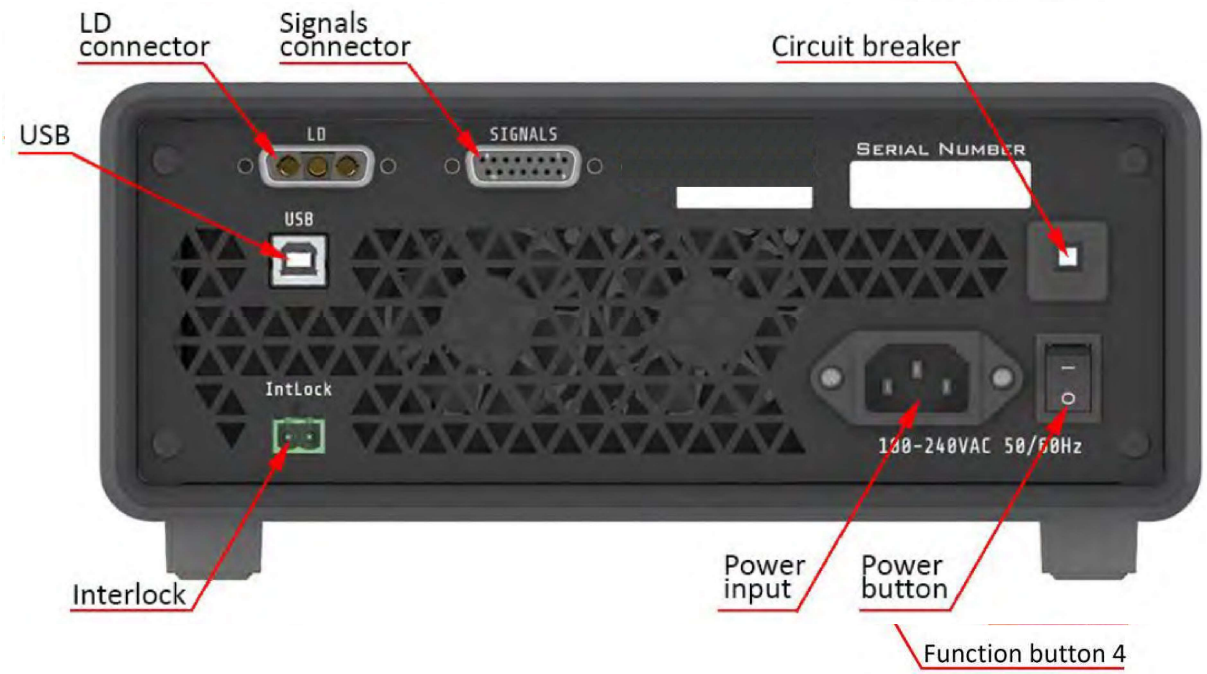
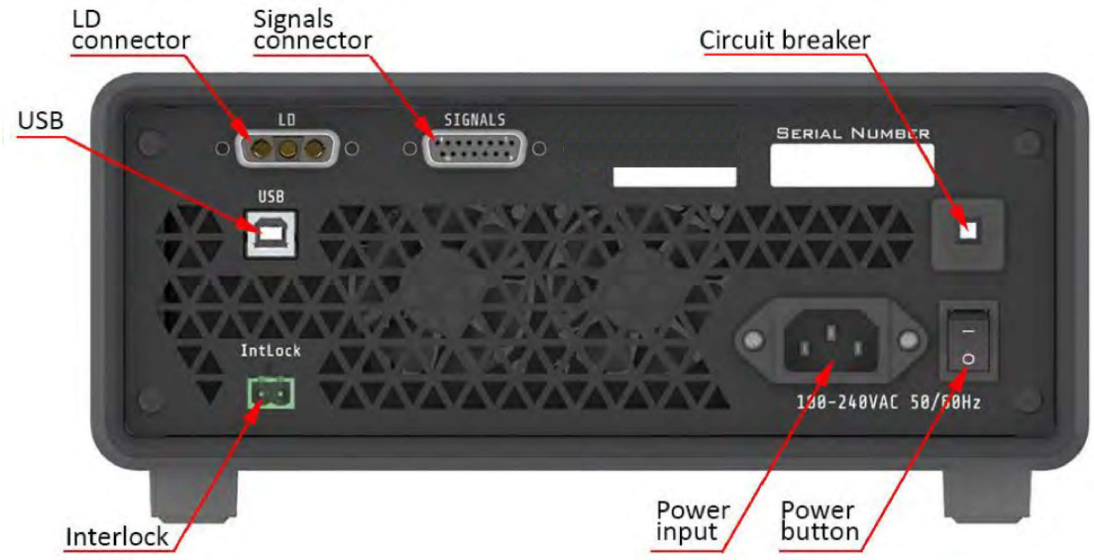


Fig. 3 – Front panel description

Back panel



12. LD connection

ALWAYS SWITCH OFF THE UNIT POWER BEFORE ADJUSTING THE CONNECTORS.

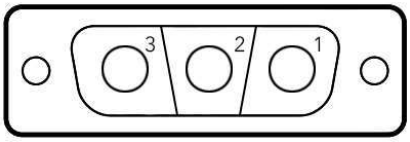


Fig. 5 – Pin functions of LD connector

Table 1. Pin functions of LD connector

№	Description
1	LD Cathode
2	n/c
3	LD Anode

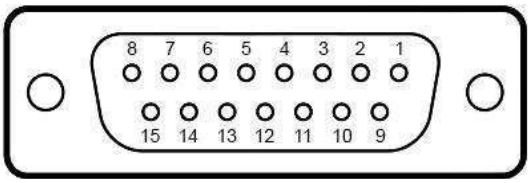


Fig. 6 – Pin functions of signals connector

Table 2. Pin functions of TEC connector

№	Description	№	Description
1	NTC	9	GND
2	12v	10	GND
3	12v	11	GND
4	CM	12	GND
5	VM	13	GND
6	n/c	14	GND
7	n/c	15	GND
8	n/c	shield	chassis ground

13. How to get started

1. Unpack the MBHxxxx;
2. Connect the LD (paragraph 12. LD connection); Schottky dummy load is recommended
3. Connect the power cord. Plug the power cord into the outlet;
4. Check the Interlock connection. The Interlock status bar should not be highlighted in red (paragraph 14.1 The *Main* screen);
5. Press the power button on the back panel;
6. Press the *Standby* button. A splash screen will appear. The Main screen loads. The function buttons should be white. *Laser* button should be red. *Lock* button should be green;
7. Set the required parameters and settings (paragraph 14. Screen description);
8. To turn on, press the *Laser* button. The button will light up in green. Status bar *Laser* will light up in green. If the laser does not switch on, check the status bars *Error* and *Interlock*. They should not be highlighted in red (paragraph 14.1 The *Main* screen);

9. Press the *Lock* button to lock the device. Touchscreen and all buttons except *Lock* will be disabled. Press the *Lock* button again to unlock the device and enable all on-board controls;

10. To turn off, press the *Laser* button again. The button will light up in red. Press the *Standby* button. Turn off the power by button on the back panel.

14. Screen description

Before switching on the Laser, set the parameters and settings for the MBHxxxx in accordance with the specification of the laser diode. The next section describes setting parameters and settings in detail.

14.1. The *Main* screen

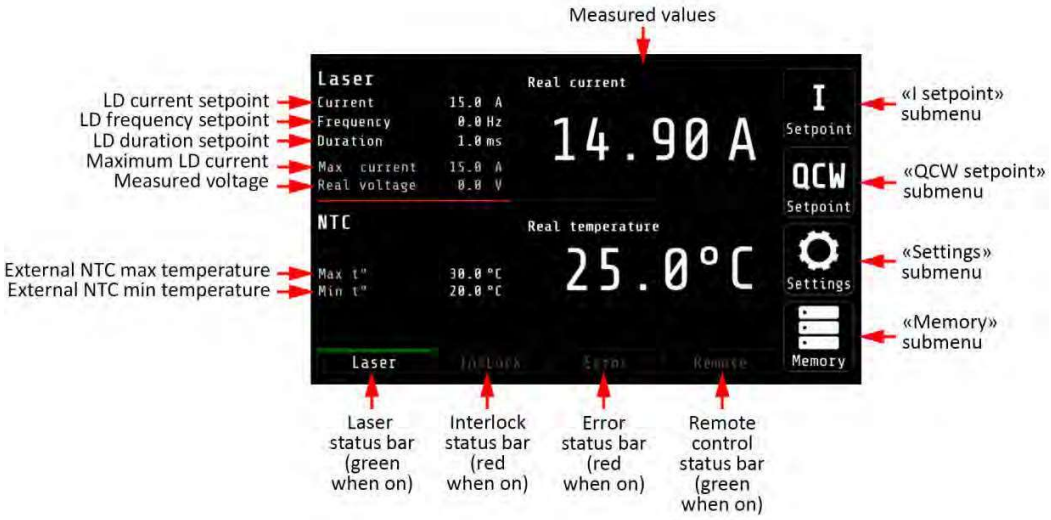


Fig. 7 – The Main screen

External NTC temperature limits are only displayed when NTC protection is enabled.

MBHxxxx has a duplicate control using buttons and encoder and/or touchscreen. Button control will be described at first. Touchscreen control will be described later, as an option.

Table 3. The Main screen submenus description

Submenu	Description
I Setpoint	Allows to change LD current *(Function button 1)*
QCW Setpoint	Allows to change frequency and duration *(Function button 2)*
Settings	Allows to set limits, calibrate LD current, adjust screen brightness, get general information, disable/enable touchscreen, etc. (*Function button* 3)
Memory	Allows to save the set parameters (*Function button 4*)

Control with buttons and encoder

To go to the submenu, press the *Function button* that corresponds to the required submenu.

Control with touchscreen

To go to the submenu, tap the button icon on the screen that corresponds to the required submenu.

14.2. The *LD Setpoint* screen

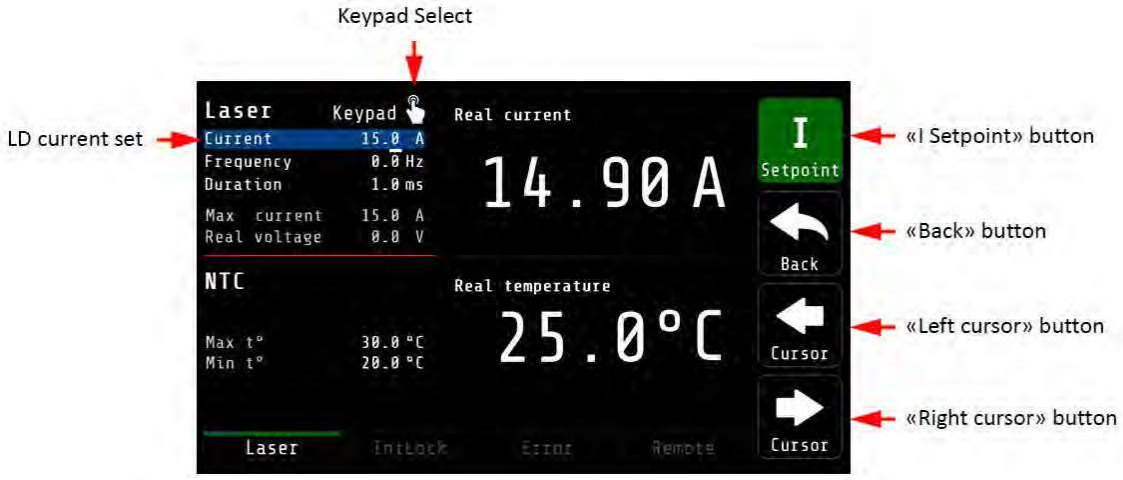


Fig. 8 – The I Setpoint screen

Fig. 9 – Parameter change cursor

Table 4. The LD Setpoint screen submenus description

Submenu	Description
I Setpoint	Allows to return to the *Main* menu *(Function button 1)*
Back	Allows to return to the *Main* menu *(Function button 2)*
Left cursor	Moves the change cursor to the left (*Function button* 3)
Right cursor	Moves the change cursor to the right (*Function button* 4)

Control with buttons and encoder

Use the *Left cursor* and *Right cursor* buttons to select the integer or fractional part of the LD current that you plan to change. Turn the encoder to change the current (clockwise to increase, counterclockwise to decrease). To return to the *Main* menu, press the *I Setpoint* or *Back* button.

Control with touchscreen

To set the current, tap on the field next to the *Keypad Select* icon. To return to the *Main* menu tap the button icon on the screen that corresponds to the required submenu or action.

14.3. The *Current Keypad* screen

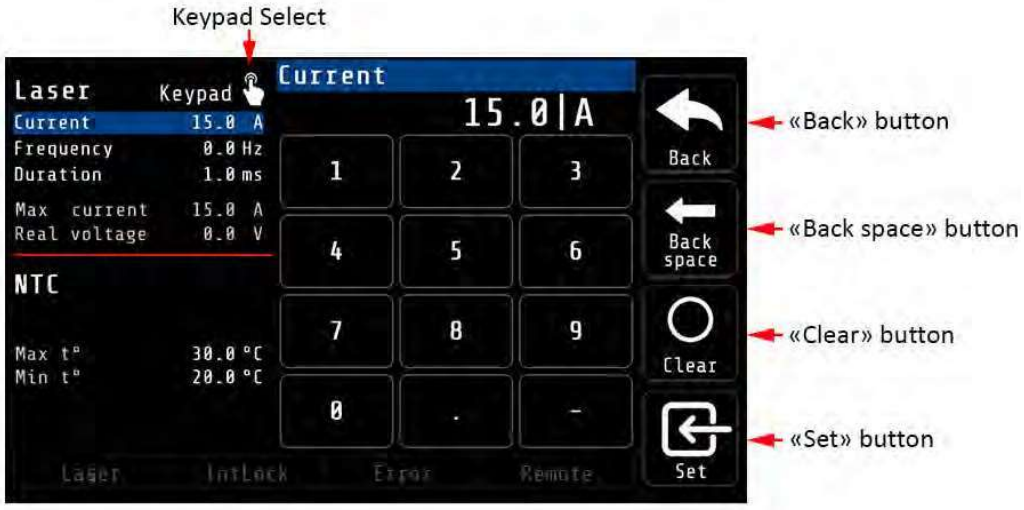


Fig. 10 – The Current Keypad screen

Table 5. The Current Keypad screen submenus description

Button	Description
Back	Allows to return to the *I Setpoint* submenu *(Function button 1)*
Back space	Delete symbol *(Function button 2)*
Clear	Clear input window *(Function button 3)*
Set	Set value *(Function button 4)*

Control with touchscreen

If you need to set a new value, clear the input window using the *Clear* button. If you only want to edit the value, use the *Back space* button to remove unwanted symbols. Set the required value using the numeric keypad. Use the *Set* button to set the value. To return to the *I Setpoint* submenu, tap the *Back* button or tap the field next to the *Keypad select* icon.

Control with buttons and encoder

To go to a submenu or perform an action, press the *Function button* that corresponds to the required submenu or action. Changing the current in the *Current Keypad* submenu is possible only with a touchscreen.

14.4. The *QCW Setpoint* screen

Fig. 11 – The QCW Setpoint screen

Table 6. The QCW Setpoint screen submenus description

Button	Description
Back	Allows to return to the *Main* menu (*Function button* 1)
QCW Setpoint	Allows to return to the *Main* menu (*Function button* 2)
F Frequency	Allows to change the frequency *(Function button 3)*
Ton Duration	Allows to change the duration *(Function button 4)*

Control with buttons and encoder

To go to the *F Frequency* or *Ton Duration* submenu, press the *Function button* that corresponds to the required submenu. To return to the *QCW Setpoint* submenu, press the *Back* button.

To return to the *Main* menu, press the *QCW Setpoint* button.

Control with touchscreen

To go to the submenu, tap the button icon on the screen that corresponds to the required submenu.

14.5. The *F Frequency и Ton Duration* screen

The *F Frequency* and *Ton Duration* screens have the same ergonomics and control principle as the *I Setpoint* screen (paragraphs 14.2 and 14.3). While setting the frequency and duration, it is necessary to take into account a rise and fall times of MBHxxxx. If the pulse duration is short, the current will not have time to increase and you will not receive a pulse of the required shape.

14.6. The *Settings* screen

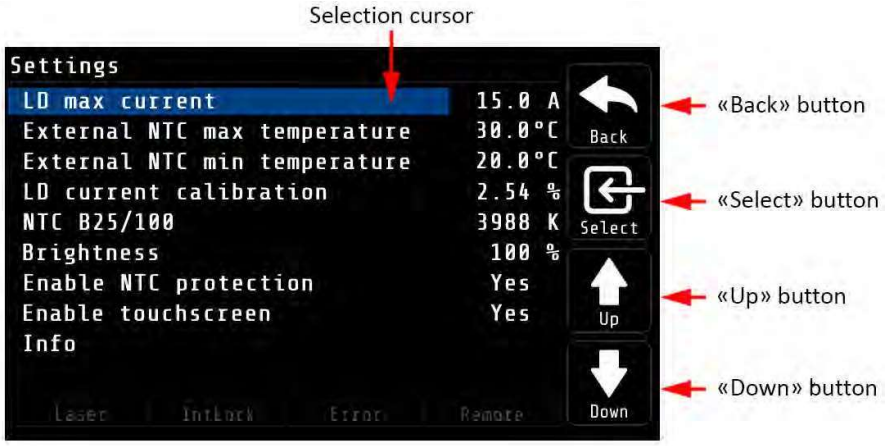


Fig. 13 –The Settings screen

Table 8. The Settings screen submenus description

Button	Description
Back	Allows to return to the *Main* menu *(Function button 1)*
Select	Allows to select the parameter to change *(Function button 2)*
Up	Scroll up *(Function button 3)*
Down	Scroll down *(Function button 4)*

Control with buttons and encoder

Use the *Up* and *Down* buttons to move the selection cursor to the parameter you want to change. Press the *Select* button to select a parameter. To return to the *Main* menu, press the *Back* button.

Control with touchscreen

Tap on the setting you plan to change to set the selection cursor. Tap again to select the setting option. Tap a third time to bring up the keypad. Set the required parameter value using the keypad (the principle of keyboard control is the same as in 14.3 The *I Current Keypad* screen). Tap the *Back* button to return to the *Main* menu.

14.7. The *LD max current setting* screen

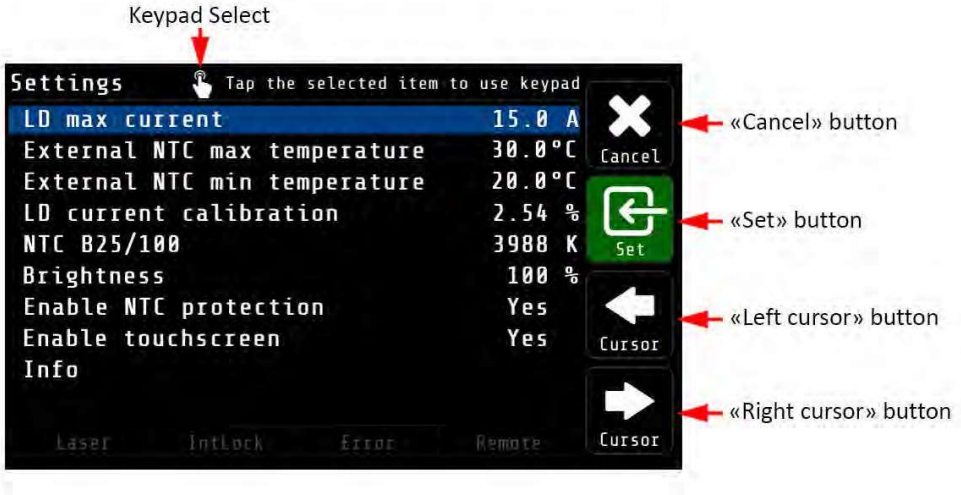


Fig. 14 – The Setting LD max current screen

Table 9. The Setting LD max current screen submenus description

Button	Description
Cancel	Cancel setting parameter *(Function button 1)*
Set	Set the value *(Function button 2)*
Left Cursor	Moves the change cursor to the left *(Function button 3)*
Right Cursor	Moves the change cursor to the right *(Function button 4)*

Control with buttons and encoder

Use the *Left Cursor* and *Right Cursor* buttons to select the integer or fractional part of the LD current you want to change. Turn the encoder to change the current (clockwise to increase, counterclockwise to decrease). Press the *Set* button to set the parameter value or the *Cancel* button to discard the changes.

Control with touchscreen

Tap on the setting you plan to change to set the selection cursor. Tap again to select the setting option. Tap a third time to bring up the keypad. Set the required parameter value using the keypad (the principle of keyboard control is the same as in 14.3 The *I Current Keypad* screen). Tap the *Back* button to return to the *Main* menu.

14.8. The *Memory* screen

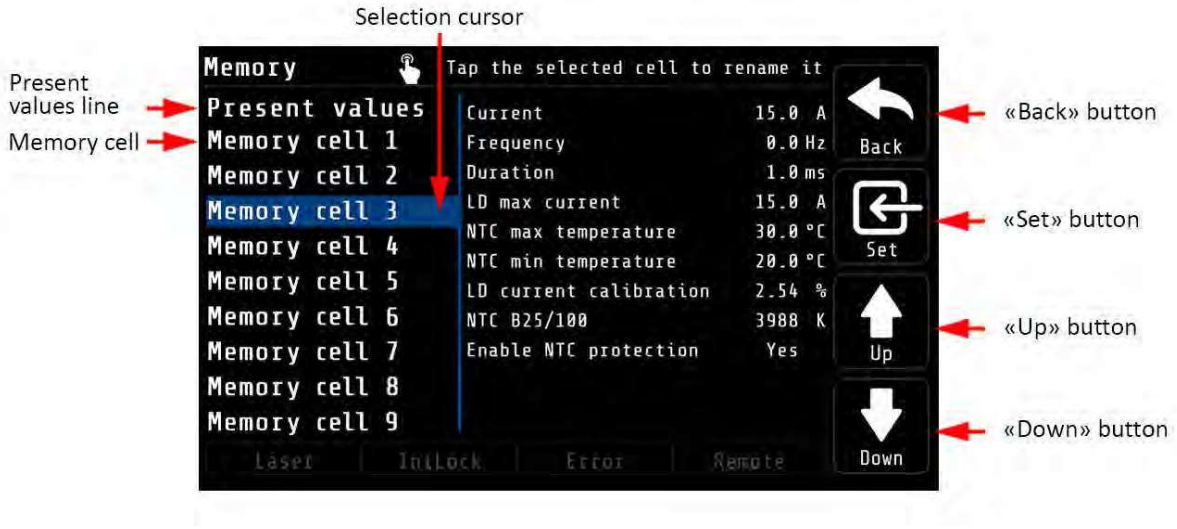


Fig. 15 – The Memory screen

Table 10. The Memory screen submenus description

Button	Description
Back	Allows to return to the *Main* menu *(Function button 1)*
Set	Set value *(Function button 2)*
Up	Scroll up *(Function button 3)*
Down	Scroll down *(Function button 4)*

Control with buttons and encoder

To save the present values, move the selection cursor using the *Up* and *Down* buttons to the *Present values* line. Click the *Save* button to save the values. Using the *Up* and *Down* buttons, select the memory cell from *Memory cell 1* to *Memory cell 9* to save the current values, and click the *Save* button. To load values, move the selection cursor using the *Up* and *Down* buttons to the line with the required memory cell. Press the *Set* button to load values from the memory cell. To go to the *Main* menu, press the *Back* button.

Control with touchscreen

To save the present values, tap on the *Present values* line. Tap the *Save* button to save the values. Select the memory cell from *Memory1* to *Memory9* to save the values and tap the *Save* button. To load the values, tap on the line with the required memory cell. Tap the *Set* button to load values from the memory cell. To go to the *Main* menu, press the *Back* button.

14.9. The *Memory Keypad* screen

Fig. 16 -The Memory Keypad screen

Table 11. The Memory Keypad screen submenus description

Button	Description
Back	Allows to return to the *Memory* menu *(Function button 1)*
Back space	Delete symbol *(Function button 2)*
Clear	Clear input window *(Function button 3)*
Set	Set cell name *(Function button 4)*

Control with buttons and encoder

The *Memory Keypad* screen is available only with a touchscreen.

Control with touchscreen

To go to the *Memory Keypad* screen in the *Memory* screen, double-tap on the cell from *Memory cell 1* to *Memory cell 9*. If you need to set a new name, clear the input window using the *Clear* button. If you only want to edit cell name, use the *Back space* button to remove unwanted symbols. Set the required name of the memory cell using the keypad. Use the *Set* button to set the name. To return to the *Memory* submenu, press the *Back* button.

14.10. The *Info* screen

The *Info* submenu provides general information. Tap on the touchscreen or press any button to exit.

15. Digital control description

When the input voltage is applied the driver is always in "analog current set, external enable and allowing interlock" state. Any other state is be set any time after powering the driver, if needed.

Default serial port settings:

Baud rate	Data bits	Stop bits	Parity	Flow control
115200	8	1	none	none

Data exchange between the driver and the PC is only initiated by the PC. All commands are sent in plain text format. All commands are sent with prefix. Number of command follows the prefix without any symbols. If there is the value after the command they separates with "space" symbol. The command ends with "carriage return" symbol.

Table 12. The format of the command to set the value (P-type)

Number of byte	Value	Comment
1	P (50h)	Set prefix
2-5	Number of parameter	Hex-number of the parameter. For example, 0100h
6	'space' symbol (20h)	
7-10	New value of the parameter	Hex-value of the parameter, 0000h
11	'return carriage' symbol <CR> (0Dh)	End of the command

The device does not respond to P-type commands by default. (see section "the protocol extension").

You can request the value of parameter by the J-type command. The device will return a value of requested parameter.

Table 13. The format of the command to get the value (J-type)

Number of byte	Value	Comment
1	J (4Ah)	Request prefix
2-5	Number of parameter	Hex-number of the parameter. For example, 0100h
6	'return carriage' symbol <CR> (0Dh)	End of the command

Table 14. The format of the response

Number of byte	Value	Comment
1	K (4Bh)	Response prefix
2-5	Number of parameter	Hex-number of the requested parameter
6	'space' symbol (20h)	
7-10	Returned value of the parameter	Hex-value of the parameter
11	'return carriage' symbol <CR> (0Dh)	End of the command

If the device could not recognize a command, it returns an error message with error code.

Table 15. The format and codes of errors

Error (returned command)	Reasons
E0000	1) Internal buffer of device is overflowed 2) Cannot find <CR> (0x0D) or\and <LF> (0x0A) 3) Format of command is invalid
E0001	1) Unknown command (it does not P- or J-type command) 2) The device failed to correctly interpret a command
K0000 0000	Request or set the parameter that does not exist.

Table 16. Available parameters and its description

Action			R/W	HEX-number of parameters
Frequency (0.1 Hz)	Value		R/W	0100
	Minimum		R	0101
	Maximum		R	0102
Duration (0.1 ms)	Value		R/W	0200
	Minimum		R	0201
	Maximum		R	0202
Current (0.01 A)	Value		R/W	0300
	Minimum		R	0301
	Maximum		R	0302
	Measured value (0,1 A)		R	0307
Current set calibration (0.01%)[1]	Value		R/W	030E
Voltage (0.1 V)	Measured value		R	0407
State of the device	Start (Enable)	0008h	W	0700
	Stop (Disable)	0010h		
	Internal current set	0020h		
	External current set	0040h		
	External Enable	0200h		
	Internal Enable	0400h		
	Allow Interlock	1000h		
	Deny Interlock	2000h		
	Deny NTC Interlock	4000h		
	Allow NTC Interlock	8000h		

[1] Default – 100.00% (2710h), calibration range is from 95.00% (251Ch) to 105.00% (2904h).

State of the device (bit mask)	0 bit	1 - Device is powered on (always = 1)	R	0700
	1st bit	0 – Stopped; 1 – Started		
	2nd bit	Current set: 0 – External; 1 – Internal		
	4th bit	Enable: 0 – External; 1 – Internal		
	6th bit	External NTC Interlock: 0 – Allowed; 1 – Denied		
	7th bit	Interlock: 0 – Allowed; 1 – Denied		
Serial number	Return the hex-value of the serial number		R	0701
Information about parameters that you can change (bit mask)	0 bit	1 – the device supports this option	R	0703
	1st bit	Frequency		
	2nd bit	Duration		
	3rd bit	Current		
Lock status (bit mask)	0 bit	Reserve	R	0800
	1st bit	Interlock		
	3rd bit	Over current		
	4th bit	Overheat (warning)		
	5th bit	External NTC Interlock		
NTC sensor temperature (0.1°)	Lower limit		R/W	0A05
	Upper limit		R/W	0A06
	Measured value		R	0AE4
	$B_{25/100}$		R/W	0B0E

Examples

1) For the current value parameter, 0300:

To request value, send the following command:

"J0300" in text or "4a 30 33 30 30 0d" in hex.

Answer will be:

"4b 30 33 30 30 20 30 33 45 38 0d" in hex, "K0300 03E8" in text, 03E8h > 1000 in dec > 10.00 A.

To set new value, for example, 13.5A (0546 in hex), send the following command:

"P0300 0546" in text or "50 30 33 30 30 20 30 35 34 36 0d" in hex.

2) For the state of the device, 0700:

To request value, send the following command:

"J0700" in text or "4a 30 37 30 30 0d" in hex.

Answer will be:

"4b 30 37 30 30 20 30 30 44 35 0d" in hex, "K0700 00D5" in text, 00D5h > 11010101 in bin > Device is powered on, stopped, internal current set, internal enable, denied external NTC Interlock, denied Interlock.

To set new state, for example, allow Interlock, send the following command:

"P0700 1000" in text, "50 30 37 30 30 20 31 30 30 30 0d" in hex.

3) Errors:

If a command with the wrong parameter number was sent, answer will be "K0000 0000" ("4b 30 30 30 30 20 30 30 30 30 0d").

If a command with the wrong format was sent, answer will be an error "E0001" ("45 30 30 30 31 0d").

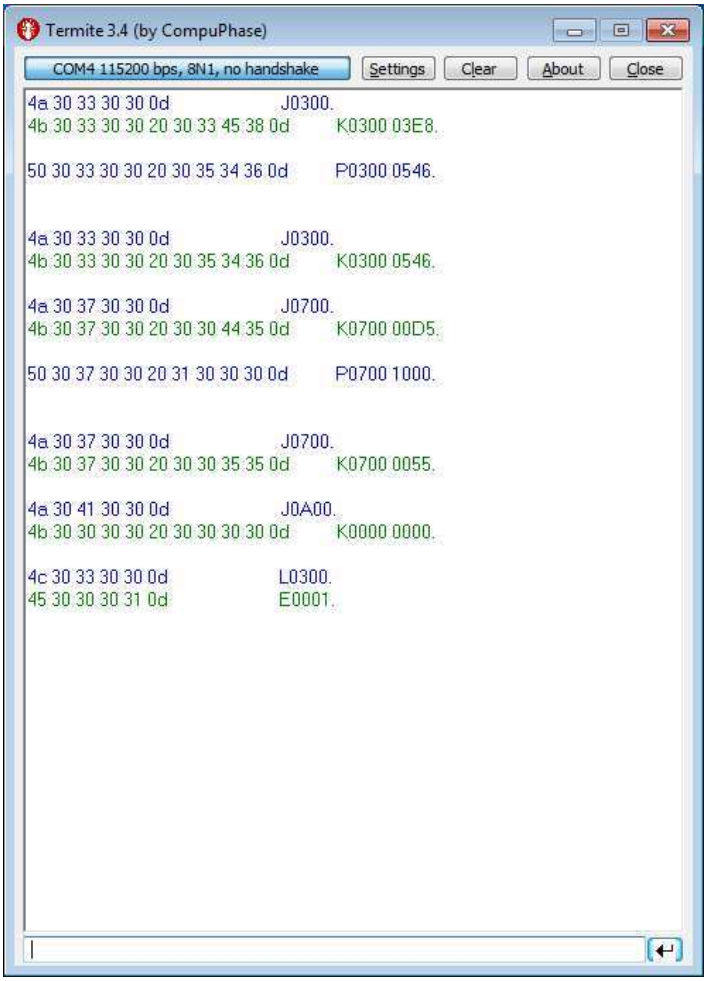


Figure 18 – Screenshot from the Termite terminal with commands and answers

The maximum duration depends on the set value of the frequency. When you change frequency, a new value of the maximum duration is compute automatically. The duration of pulse cannot be less than 2 ms and more than period of frequency minus 2 ms. For low frequencies the duration cannot be more than 5000 ms.

Set the zero frequency to switch the device into CW mode or set not zero frequency value to switch the device into QCW (long pulses) mode. If you try to set a value more or less than limits, then the value will be rounded to limit. Any attempts to set a new state of the device, except “start”, forcibly switch the device to the state “stop”. Some states of the device are mutually exclusive, for

example, if you set “Ext. Enable”, then you will not be able to set the state “start”. If you send “start” and “stop” commands to each other, the device will save all parameters in the internal memory. The saving process lasts about 300 ms. In this time the device does not respond to any actions. The device is able to save the next parameters in the internal memory:

- Frequency with limits;
- Duration with limits;
- Current with limits and calibration;
- Temperature limits and B25/100;

16. SCPI control description

Enter SCPI mode by using the command “P0704 0800”.

Exit SCPI mode by using the “SCPI OFF” command.

As in the standard protocol, all commands must be terminated with a carriage return symbol CR (0Dh).

The separation of command levels occurs with the “:” symbol. To request a value, use the “?” symbol without a space immediately after the parameter. To set the value, the new value is specified with a space after the parameter. The separator of the integer and fractional part is the point “.”. In the angle brackets < > specify the parameters for which you want to specify a numeric value. In curly brackets {} through the separator | specify the possible set of commands.

For example, line “freq:value {<frequency>|?}” means that the user can either set a new frequency value, or request the current.

Frequency request: “frequency:value?”.

Setting a new frequency value: “frequency:value 30.5”.

Some commands have a full and shortened version. The full version is shown in the table, and the shortened version is shown by UPPERCASE. For example, frequency value can be requested in two ways: “frequency:value?” and “freq:value?”.

The device responds using the command version that was used by the user, and the parameter value is specified in the full version.

Table 17. Available list of SCPI protocol commands

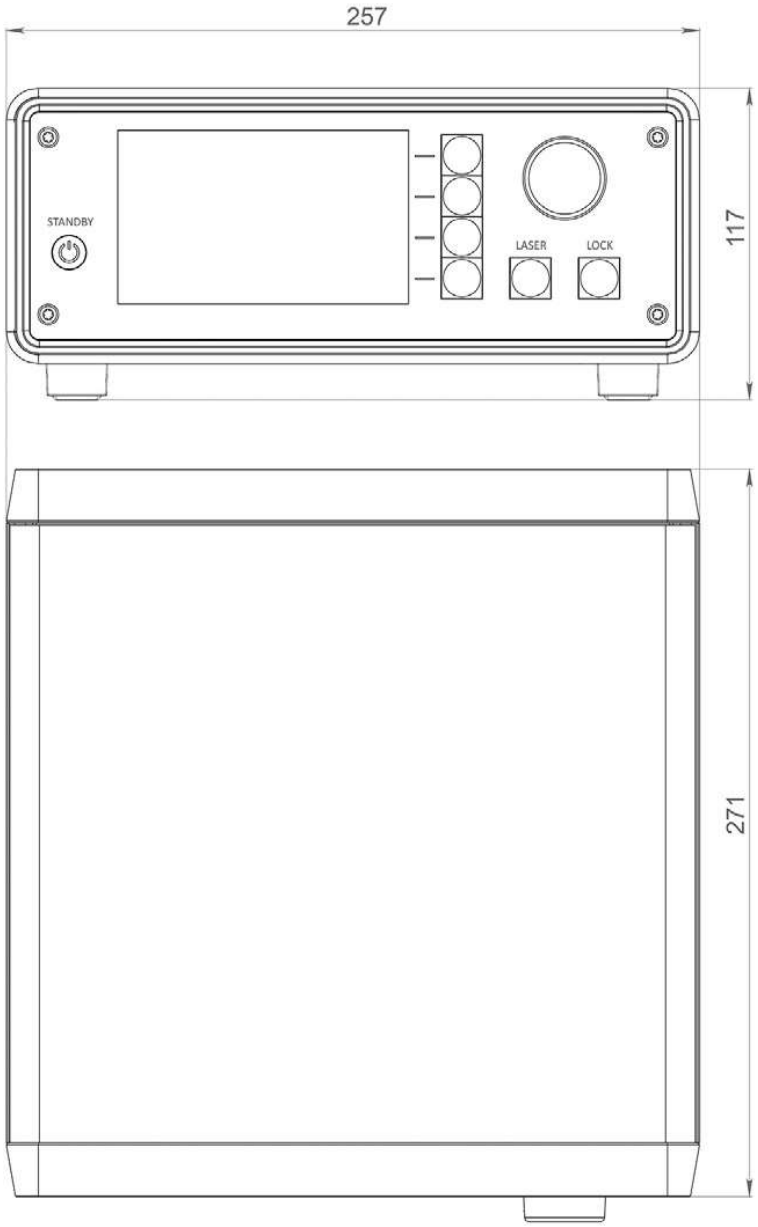
Commands level				**Description**	
SCPI	OFF			Exit SCPI mode	
FREQuency	:MIN	?		Minimum	Frequency (0,1 Hz)
	:MAX	?		Maximum	
	:VALUE	{<0.0>|?}		Value	
DURation	:MIN	?		Minimum	Duration (0,1 ms)
	:MAX	?		Maximum	
	:VALUE	{<0.0>|?}		Value	
CURRent	:MIN	?		Minimum	Current (0,1 A)
	:MAX	?		Maximum	
	:VALUE	{<0.0>|?}		Value	
	:REAL	?		Measured value	
	:CALibrate	{<>|?}		Current set calibration (0,01%)	

VOLTage	:REAL	?		Measured value	Voltage (0,1 V)
DEVice	:START	{?|ON|OFF}		Start/stop	Device state
	:CMODe	{?|INTernal|EXTernal}		Internal/external current set	
	:SYNC	{?|INTernal|EXTernal}		Internal/external Enable	
	:BLOck	{?|USE|IGNore}		Allow/deny Interlock	
	:TEMPBlock	{?|USE|IGNore}		Allow/deny NTC Interlock	
SERial	?			Serial number	
BLOCKs[2]	?			Lock status	
NTC	:BOTtom	{<0.0>|?}		Lower limit	NTC sensor temperature (0,1°)
	:UPper	{<0.0>|?}		Upper limit	
	:REAL	?		Measured value	
TEC	:TEMPerature	:VALUE	{<0.00>|?}	Measured value	TEC temperature (0,01°)
		:REAL	?	Measured value	
		:UPper	{<0.00>|?}	Upper limit	
		:BOTtom	{<0.00>|?}	Lower limit	
		:MAX	?	Absolute maximum	
		:MIN	?	Absolute minimum	
	:CURRent	:REAL	?	Measured value	TEC current (0,1 A)
		:UPper	{<0.0>|?}	Upper limit	
		:MAX	?	Absolute maximum	
	:VOLTage	:REAL	?	Measured value	TEC voltage (0,1 V)
		:UPper	?	Upper limit	
		:MAX	?	Absolute maximum	
	:CALibrate	{<0>|?}		Calibration coefficient	
	:START	{?|ON|OFF}		Start/stop TEC	
	:BLOck	{?|USE|IGNore}		Allow/deny Interlock	

[2] Several possible answers are separated by "|": Intlock, overcurrent, overheat, ntc block, tec error, selfheat or no blocks in the absence of blocks.

17. Mechanical dimensions

All dimensions are in millimeters. You can request the 3D-model of the driver by contacting us via our website at www.LaserDiodeControl.com.



18. Warranty

In compliance with the provisions of Conditions limited warranty the Buyer has the right to warrantee during the one year period. The warranty period comes into effect from the shipping date.

The warranty only concerns products that are applied according requirements and for the applications specified in the manual for the product. If you want to use the products for other applications, contact us by e-mail or via our website at www.LaserDiodeControl.com. This warranty does not apply to damage due to incorrect use, abnormal use, or use in violation of product manual.

PRODUCT WARRANTY:

This product is sold with a full one year warranty. It is warrantied to be free from defects in material and/or workmanship for a period of one year from the date of shipment. The warranty does not include damage to the product due to customer mishandling or use of the product outside of its specified maximum ratings.

INSTALLATION SUPPORT OR TECHNICAL SUPPORT FOR THIS PRODUCT:
800-887-5065 extension 1
contact@laserdiodecontrol.com

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