



manufactured for Laser Lab Source by **OSTECH** 

# PRODUCT MANUAL

## LDX-1064nm-30W

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# Overview

The LDX Laser Diode Source System Series laser driver and temperature controller series is a high precision safe and cost effective solution for driving diode lasers and peltier elements, combined with a high-reliability laser diode source module, integrated to the internal temperature controlled mount. The driver's microcontroller based digital control unit offers full control over all laser diode operating parameters. The system is operative via the front panel display and keypad, and with the standard RS232 digital interface.

Safe operating limits are factory-set, and the user can set arbitrary limits for currents, voltages, and temperatures. The device can be modulated internally by the on-board oscillator, or the laser can be modulated by an external source. Multiple protection circuits are always engaged to avoid any potential damage to the laser module. The temperature controller utilizes a PID control loop for fast and accurate temperature stabilization.

Every system controller has passed our full power burn-in and safety tests for proving static discharge and transient protection.

## Features

- fully digital control, standard interface RS232
- non volatile preconfiguration (EEPROM)
- controllable internal and external fan supplies
- hardware interlock
- temperature protection

### Laser driver features

- precise current controlled CW and pulsed laser operation modes
- low power dissipation by active voltage control in CW mode
- multiple laser safety options
- internal digital modulation
- external analog and digital modulation



- bias current option for modulation modes
- contains adjustable driver for pilot laser
- overvoltage and transient protection
- voltage, current and temperature limits

### **TEC driver features (if available)**

- Polynomial and Steinhart-Hart sensor model
- up to 4 PID temperature controllers for TEC coolers
- voltage, current and temperature limits
- target temperature sequencer on request

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# 1 Introduction

This product is a precise and advanced laser driver. These devices have a multitude of configuration parameters available that you can set by display or serial interface.

Therefore, it is important to read the manual thoroughly before turning on the device for the first time. The instructions must be followed exactly for safe operation and optimum performance of the laser diode.

In case of questions or problems, please contact our service staff.

**Please note that unauthorized opening of the device cancels the two year warranty. Don't break the calibration seal.**



## 2 Safety Instructions

Your safe and effective use of this Laser Source is of utmost importance to us. Please read the following laser safety information before attempting to operate the laser. Note that Laser Lab Source and OsTech bear no responsibility for the result of operation caused due to incorrect or inappropriate use of this product.

### 2.1 Laser Safety

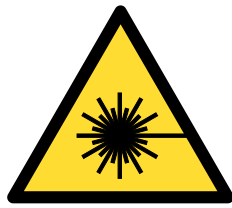
This is a Class 4 Laser system. The laser radiation emitted from this unit is harmful. Always follow these precautions:

1. Avoid exposure to the beam.
2. Always wear protective eyewear appropriate for working with laser light. Make sure eyewear is rated for the laser wavelength and output power.
3. Avoid looking at the beam directly even with eyewear.
4. Be aware of the warning and safety labels (examples are shown in figure 2.1 on page 9).

Do not open the laser system. There are no user-serviceable parts inside the unit. Unauthorized opening of the LDX-unit will void the warranty and may result in burns, electric shock and/or irreparable damage to the internal components.

### 2.2 Label Identification

The following figures show the warning labels used on this product. Please be aware of them and use caution when working with the laser.



(a) Aperture label on the back of the laser.



(b) Laser warning labels on the back of the laser.

**Figure 2.1:** Examples for laser warning labels.

Do not remove these labels. If you have any questions regarding warning labels, please contact us.

## 2.3 Environmental Concerns

To maximize the long-term performance of this instrument, the following environmental safeguards should be considered.

1. Avoid dust and direct sunlight.
2. Do not block fan ventilation. Ensure free air flow around the system.
3. Avoid excess vibration that might compromise the mechanical integrity of the unit.
4. The recommended operating temperature is 10 – 35 °C.
5. Before switching on the main supply give the unit time for warming up if it comes from a cold environment.
6. Keep original packing material for transport or shipment.
7. **It is recommended that the optical connectors be cleaned before every connection.** Periodic inspection of the fiber tip for scratching or pits is important for safe operation of the laser diode. If the fiber surface is damaged replace it. If you need help with fiber handling or fiber cleaning equipment please contact Laser Lab Source.
8. Before inspecting the fiber surface shut off the laser device every time.



## 3 Hardware setup

### 3.1 Unpacking

Inspect shipping box for damages immediately after receiving it. If something seems to be damaged inform the shipping company for insurance issue. Please keep the shipping box until the whole device is tested. While unpacking, check part list and delivery note.

### 3.2 Connecting the Fiber

Almost all LDX-systems have an SMA905 fiber connector/receptacle. Use metal armoured fiber cable. Check fiber surface. Connect fiber only with clean surface. Tighten the cap nut thoroughly. Replace fiber cable if there is any indication of damage. Avoid connections that will result in direct back reflections.

In some configurations you may have a direct fiber output without metal armoring. Take care regarding the fiber bend radius: As a rule of thumb you can use a bending diameter 300 times the fiber core diameter under working conditions and 150 times the fiber core diameter under storage conditions. A fiber break may immediately cause hazardous laser radiation in unwanted directions.

Some fiber configurations may need additional instructions.

### 3.3 Turning on the device

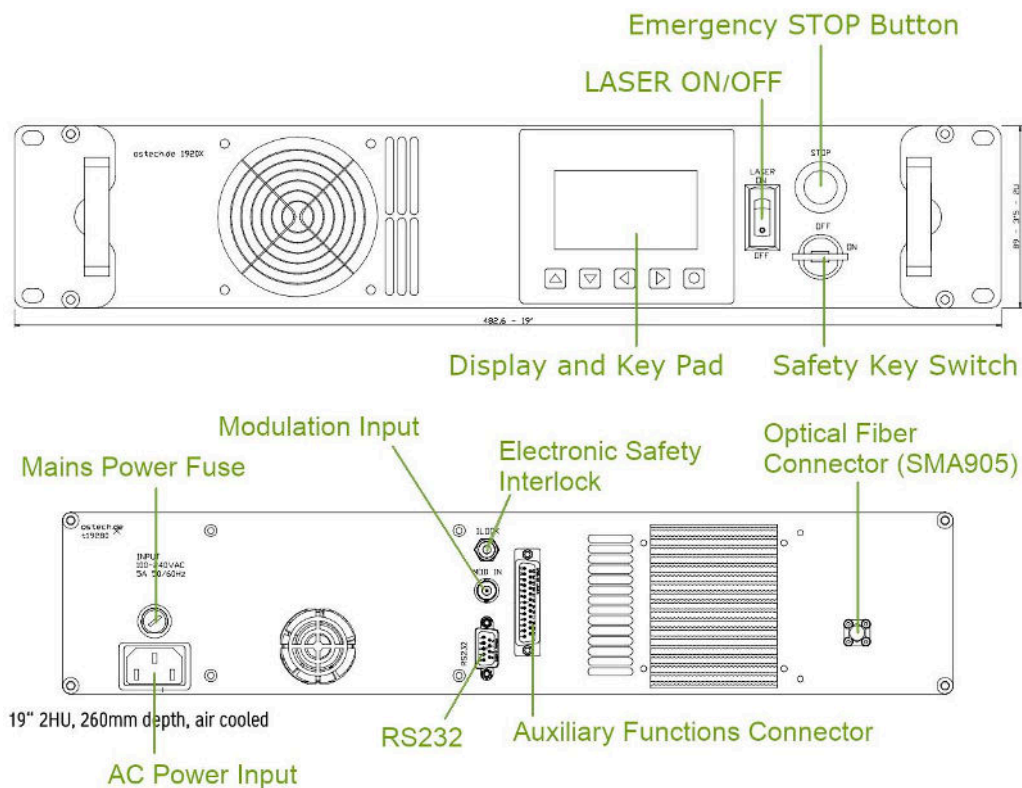
Refer to Figure 3.1 for the front-panel layout of the LDX controller.

Follow these steps to turn on the LDX controller.

- Install the laser device in a safe environment. Take care about safety regulations, especially the laser safety.
- Initial start-up of the device should always be done by trained staff.



- Make sure that you connect everything necessary to the support connector (described in section 10.2)
- Make sure that all interlock connectors are closed.
- Make sure that the emergency button (the large red button at the front side) is unlatched and in the ON position by turning and pulling on the button.
- Please note laser safety regulations.
- Turn the key switch to ON.
- For air-cooled lasers the cooling fan and temperature controller will start.
- For water-cooled devices check that the water chiller is working and water flow is appropriate for the laser diode.
- Before enabling the laser radiation, all interlocks have to be closed and the laser temperature has to be within the limits
- After turning on, the device CW mode is entered by default.
- Check the laser operation with a low current value near the laser threshold.



**Figure 3.1:** Front Panel Layout

## 4 Technical Parameters

### 4.1 General Parameters

input voltage	DST11: 110–220 V AC
ambient temperature	0 . . . 35 °C
humidity	< 95%
<i>housing size</i>	<i>width×height×depth (depth without connectors)</i>
19 inch, 2 HE	483 mm × 88 mm × 260 mm (19 in × 3.5 in × 10.2 in)
19 inch, 3 HE	483 mm × 132 mm × 340 mm/400 mm (19 in × 5.2 in × 13.4 in/15.75 in)
remote control	PC serial interface RS232

### 4.2 Laser Module

laser diode power	2 HE air-cooled	up to 60 W optical
	3 HE air-cooled	up to 110 W optical
	water-cooled	on request
current noise		1 % . . . 0.1 % of $I_{\max}$ rms, better on request
<i>internal pulse mode</i>		
pulse width	range	1 $\mu$ s . . . > 48 h
pulse period	range	(pulse width + 1 $\mu$ s) . . . > 48 h
time base	accuracy	$\pm$ 1%
pulse to pulse	accuracy	300 ns
rise/fall time	max.	30 $\mu$ s
	typ.	20 $\mu$ s
	on request	< 5 $\mu$ s

#### **4.2.1 Safety Breakdown Conditions That Result in Automatic Laser Diode Shut-Down**

- Interlock open
- Internal supply failure
- Abnormal transients
- Output open circuit
- Output short circuit
- Laser diode over-temperature
- System internal over-temperature
- System beyond maximum power dissipation capacity

## 5 Keypad and Display Menus

Operation of the system using keypad and display is enabled by default. To avoid unauthorised input it is possible to disable keypad via RS232 (send GM2S4 to disable and GM2C4 to enable keypad and LASER ON/OFF switch).

### 5.1 Keypad

---

- |  |   |
|--|---|
| <input type="checkbox"/> ▲ UP          | ▪ increases the digit under the cursor  |
| <input type="checkbox"/> ▼ DOWN        | ▪ decreases the digit under the cursor  |
| <input type="checkbox"/> ◀ LEFT        | ▪ move to the previous input field, unsaved changes are discarded             |
| <input type="checkbox"/> ▶ RIGHT       | ▪ moves to the next input field, unsaved changes are discarded                |
| <input type="checkbox"/> ● OK or Enter | ▪ triggers actions  |
|  | ▪ toggles checkboxes  |
|  | ▪ saves a changed value   |
|  | ▪ moves the cursor position if pressed on an unchanged or already saved value |
- 

### 5.2 Display Menus

The display always shows one of two menus. Some fields can be used to change settings of the device, others only show the current state.

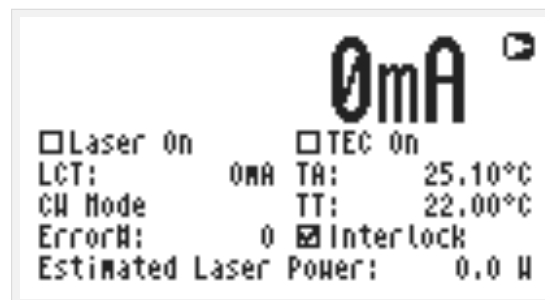
You can switch to the next menu with the arrow in the upper right corner. The first menu shown after power-on is the main menu. The second menu is the laser and device menu.

#### 5.2.1 Main Menu

The main menu gives an overview over the current state and allows to control some basic settings. The layout of the main menu is shown in [figure 5.1](#). The big number shows the actual laser current.

The following fields are available in the Main Menu:

Laser On	shows if the laser is on or off
LCT	laser current target
CW Mode, ... Mod.	modulation mode
TEC On	shows if the TEC controller is on or off
TT	target temperature
TA	temperature actual
Error#	error number (0 = no error)
Interlock	if the interlock is closed
Estimated Laser Power	Estimation of the current laser power based on laser current (LCA), laser threshold (LCH) and laser slope (LCS)

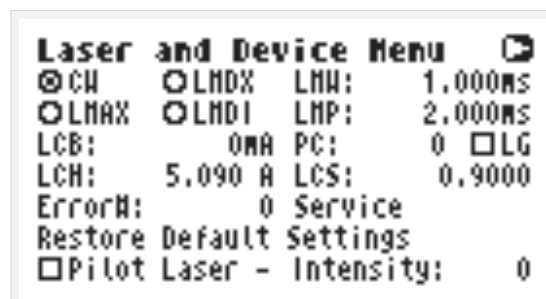


**Figure 5.1:** Main menu layout

### 5.2.2 Laser and Device Menu

The laser menu is shown in figure 5.2. Here you can change laser and general settings and find out the type and serial number of your device. The following fields are included:

CW Mode	no modulation
LMAX	external analog modulation
LMDX	external digital modulation
LMDI	internal digital modulation
LMW	laser modulation width
LMP	laser modulation period
LCB	laser current bias (for modulation)
PC	pulse count (= LMDIC command) <ul style="list-style-type: none"> <li>▪ PC = 1: single pulse</li> <li>▪ PC = 2: burst of 2 pulses . . .</li> <li>▪ PC = 0: continuous pulses</li> </ul>
LG	gate option
LCH	Laser Current Threshold
LCS	Laser Current Slope
Error#	error number (0 = no error)
Service	Show type, serial number and software version
Restore Default Settings	Reset all settings in the device to their default values.
Pilot laser (optional)	Switch the pilot laser on and off
Intensity (optional)	pilot laser intensity (0 . . . 16)



**Figure 5.2:** Laser and Device Menu

## 6 Laser Control

### 6.1 CW Mode

The mode of operation can be selected in the laser menu. The CW mode is active when all the modulation modes (LMDI, LMDX and LMAX) are unchecked.

#### 6.1.1 Switching The Laser On and Off

In the main menu and adjust the laser current target in the LCT input field. The selected value has to be within the laser current limit and the maximum operating current of the laser module. Activate the laser by pressing the LASER switch to On; the switch is located near the display on the front panel. The LED on the front panel will start blinking and the actual current will be displayed. Press the LASER switch to Off to switch off the laser. When you turn off the laser the LED on the front panel will stop blinking and the actual current 0.00 A will be displayed.

Pressing the emergency STOP button at the front panel interrupts the power supply immediately; the button will latch on the Off position. Unlatch it by twisting the button and pulling it outward front the front panel.

When using the RS232 interface the command LR may be used to switch the laser on. The command LS switches the laser off.

#### 6.1.2 Ramp-On Laser Current

In CW mode the laser ramp-on is activated by default, with a ramp-on time of 300ms. However, this function is not available over the display menus. For using it you need to control the driver over an RS232 interface. With e. g. LZTR2000 you can set the time to reach the maximum current of your driver. The slope of the ramp would be  $LCT_{max}/2000$  ms in this example. The laser stop ramp is disabled by default and can be enabled by the command LAM2S256 and disabled by LAM2C256. During the laser stop ramp, you can turn off the laser immediately by sending LS again. You can disable the ramp with LZTR0. The default value for LZTR is 300 ms. [Figure 6.1](#) shows how LZTR works. For a list of other commands see [chapter 9](#).



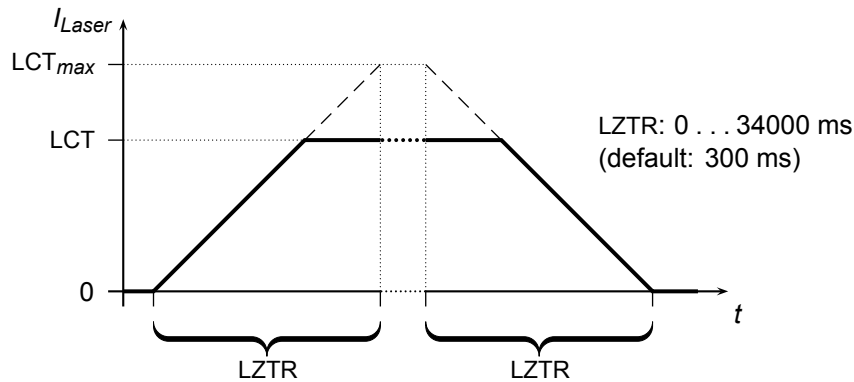


Figure 6.1: Laser current on-off ramp in CW mode. The ramp is active at any change of laser current.

## 6.2 Estimated Laser Power

An estimation for the Laser Power is shown in the display. You can also get this value by the LPE command. The estimated laser power is calculated as follows:

$$LPE = (LCA - LCH) \times LCS \quad (6.1)$$

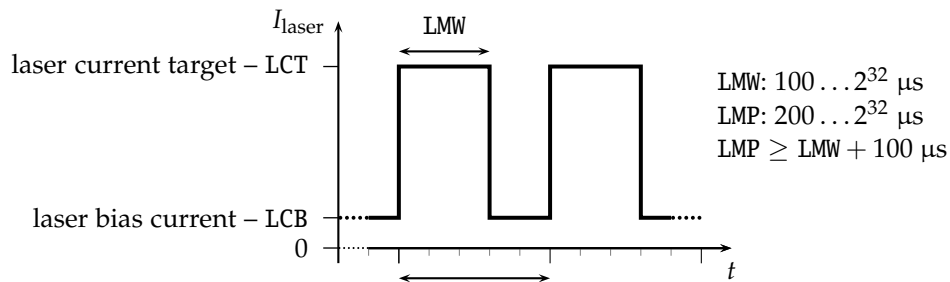
Here LCA is the actual laser current, LCH is the laser threshold current and LCS is the laser slope. If LCA is below LCH then LPE shows 0. Make sure to set LCH and LCS according to the laser and adjust it from time to time as the laser degrades.

Please note that this is just a power estimation calculated from the actual laser current. Temperature and other influences are not considered. You can not rely on it accurately reporting actual laser power.

It is not possible to directly control optical power because the controller acts as a current source. Optical monitor value (voltage or current) is only for information, and may vary with fiber bending and back reflections (20% is possible).

## 6.3 Gate Option

There is a gate option which can be used in CW mode as well as in internal digital modulation mode. You may switch on and off the internally generated laser current by the modulation input. Optionally, a separate gate pin may be layed out. In this case the gate option is also available in the external modulation modes. The gate option is activated by the command LGR and deactivated by LGS. Additionally, the LMDXNR command can be used to negate the modulation input.



**Figure 6.2:** Continuous Pulse Mode

## 6.4 Modulation Modes

The modulation modes can be selected in the Laser menu. Changing modulation modes turns off the laser. You may start the laser again in the Main menu.

In modulation modes the measured currents and voltages displayed in the main menu shows the mean values, not the peak values. These measured values may differ from the adjusted ones caused by the low speed of the A/D converter. Don't care about this. The real values are within the limits as described above.

### 6.4.1 Internal Digital Modulation Mode

The driver is able to modulate the laser current by internally generated pulses. This internal modulation mode may be activated by checking the LMDI input field in the laser menu or entering the LMDIR command.

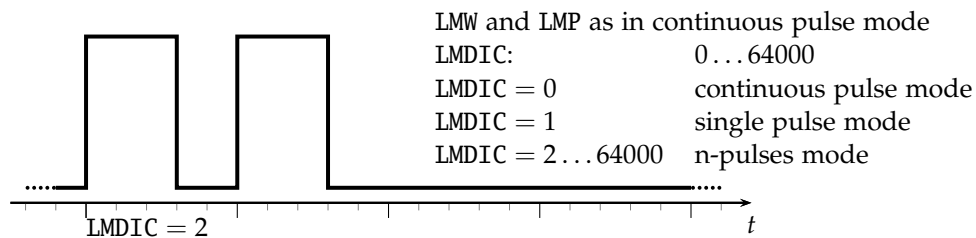
#### Continuous pulse mode

Unless configured otherwise, pulses are generated continuously as you can see in figure 6.2. You have to enter the pulse width (duration) and pulse period in  $\mu\text{s}$ . Take care of the right proportions of these values. The pulse width may be changed by the LMW command and the pulse period may be changed by the LMP command.

You can run and stop the laser by the commands LR and LS.

#### Single Pulse Mode, n-Pulses Mode

This mode—which is illustrated in figure 6.3—is useful if you want to generate only a single pulse or a certain number of pulses. To activate it first select the internal digital modulation mode as stated above. Then enter the command LMDIC  $n$  where  $n$



**Figure 6.3:** single pulse mode, n-pulses mode

is the number of pulses you want to be generated. After entering the LR command the number of pulses will be generated. Afterwards, the driver enters the *OFF state* automatically. You don't need to enter LS.

Assigning 0 to LMDIC switches to the continuous pulse mode described above.

### External Trigger Mode

To switch to this mode activate the gate option in single pulse mode/n-pulses mode. The gate option (see [section 6.3](#)) has a different meaning in this mode. Activating it enables you to trigger the beginning of the generated pulses externally. If LGR is activated and LR was entered the driver generates the defined number of pulses as soon as a low-high transition at the modulation input occurs.

### 6.4.2 External Digital Modulation

The external digital modulation mode may be activated by entering the LMDX com-mand. If this mode is active and the laser is run (LR) then the laser is activated by a TTL high-level at the modulation input and vice versa. The command LMDXNR negates this logic so that the laser will be activated by TTL low-level. This mode is similar to the CW mode with the gate option activated. However, in this mode you can set a laser bias current (LCB).

### 6.4.3 External Analog Modulation

The external analog modulation mode is selected by entering the LMAX command. In this mode the laser current can be controlled by the voltage at the AMOD input where 4 V/10 V corresponds to  $I_{max}$  of the current source. The current will be limited by the laser current limit that can be changed by the LCL command. The compliance voltage (LVC) has to be set before and the laser has to be run by LR.



The input has an internal terminating resistor of 10 k $\Omega$ /25 k $\Omega$ . If you have a 4 V input and want to connect e.g. a 10 V signal, you should use a 15 k $\Omega$  resistor in series externally.

## 6.5 Pilot Laser Control

The device supports controlling a pilot laser. This function is only available if a pilot laser function is included in the laser. In *ON state* a voltage between 4.0 and 5.0 V is applied. The maximum output current is 150 mA. In *OFF state* the output is near 0 V level. With PLR and PLS you can turn the pilot laser *ON* and *OFF*. With the command PP *n* you may set the pulse width modulation value with a base frequency of 62 Hz. The modulation parameter *n* can take values between 0 and 16. The meaning of those values is as follows:

---

<i>n</i> = 0	pilot laser OFF
<i>n</i> = 1	duty cycle 6.25 % - ON duration 16 ms
<i>n</i> = 2	duty cycle 12.5 % - ON duration 32 ms
...	...
<i>n</i> = 16	pilot laser ON

---

## 7 Remote Control

The LDX system may be controlled over a serial (RS232) interface. The transfer parameters of the serial interface are fixed to 9600 baud 8N1.

### 7.1 Standard Mode

In *standard mode* you can send commands and parameters to the device in text format and the device answers in the same way. The answer of the device always contains comments and the parameters and values are given back. This mode is optimal for working at a PC using any terminal program.

After sending a character you will receive an echo of your input, i. e. all sent characters return immediately. All characters are changed to upper case. All inputs have to be finished by `(CR)` to process the input; `(CR)` is also returned. If a command returns a value, the answer is also finished by `(CR)`. No linefeed `(LF)` is added after the `(CR)`, but most terminals are able to generate this automatically. You may invalidate any sequence by sending `(Esc)`. Single characters may be deleted from the buffer by backspace `(←)`. Between commands and their parameters you can insert as many spaces as you want (no space is also okay). But note that the whole command line must not be longer than 14 characters.

sent command: LCT222.3 `(CR)` every character is returned  
 received answer: Laser Current Target: 222.3 mA `(CR)` verbose answer

### 7.2 Reduced Mode

The *reduced mode* works similarly to the standard mode. The difference is that you merely receive the values and numbers without any comment or unit.

sent command: LCT222.3 `(CR)` every character is returned  
 received answer: 222.3 `(CR)` short answer

For a single command this mode can be reached by simply adding the prefix R. So LCT222.3 would become RLCT222.3. To switch to this mode permanently use the command GMS32768. The command GMC32768 switches back to standard mode.

## 7.3 Binary Mode

In *binary mode* no comments are returned and values are sent binary coded (MSB first) with a checksum following. This mode is optimal if you want to control the device automatically by a master computer. The checksum is computed by adding every single byte of a word or float value to the fixed value 0x55 (ignoring the overflow). For e. g. a float value whose four bytes are all 0x00 (= 0.0) the checksum is 0x55. If all bytes are 0x01 then the checksum would be 0x59 and so on.

sent command: `LCT222.3` CR every character is returned  
 received answer: `MSB...LSB,checksum` binary coded answer

There are four data types with the following return structure:

- float 4 bytes + checksum
- short or word 2 bytes + checksum
- string 1 ... 225 bytes + 00x0
- boolean 1 byte:
  - 0xAA for *run* or *on*
  - ~0x55 for *stop* or *off*

The device always starts in standard mode. Binary mode is initialized by setting a bit in the general mode variable of the device as follows:

sent command: `GMS8` CR set bit 0x08 of mode variable

To return to standard mode this bit has to be cleared:

sent command: `GMC8` CR clear bit 0x08 of mode variable

## 7.4 Software

At <http://www.ostech.de> you may download software to interact with OsTech devices.

- the terminal program *OSTERM*
- LabVIEW™ VIs, including a runtime version

Sample routines in C and C++ are also available on request.

## 8 Error Codes

When an error occurs, the driver generates an error code. The error code can be determined by the GE command. Furthermore, the error is shown on the display. A list of error codes and their causes follows:

error code	cause
0	no error, everything ok
1	interlock open
2	laser compliance voltage not OK or no laser connected
3	internal supply voltage not OK
4	laser temperature sensor open
5	crystal temperature sensor open
6	laser temperature exceeds upper limit
7	laser temperature lower than lower limit
8	laser short-circuit or no laser connected
9	device temperature (GT) too high
10	laser temperature exceeds maximum laser temperature (LTM)
11	crystal temperature exceeds upper limit
12	crystal temperature lower than lower limit
16	laser current greater than maximum current limit (LCLM)
17	current error
18	total power limit exceeded

## 9 Command Reference

cmd	type	min	max	default	unit	description
L	bool	S	R	S		laser stop/run
LTM	float	-99	200	35	°C	laser temperature maximum
LG	bool	S	R	S		gate option

### 9.1.1 Laser Current Commands (LC)

cmd	type	min	max	default	unit	description
LCL	float	0	$I_{\max} + 5\%$	$I_{\max} + 5\%$	mA	current limit
LCT	float	0	$I_{\max}$	0	mA	current target
LCA	float	— no parameter —			mA	actual current
LCB	float	0	$I_{\max}$	0	mA	base or bias current

### 9.1.2 Laser Voltage Commands (LV)

cmd	type	min	max	default	unit	description
LVA	float	— no parameter —			V	actual laser voltage
LVC	float	1.3	6	3	V	compliance voltage

### 9.1.3 Laser Photo Current (LPC) and Power (LP) Commands

cmd	type	min	max	default	unit	description
LPCA	float	— no parameter —			μA	laser photo current actual
LCH	float	0	$I_{\max}$	0	mA	laser threshold current
LCS	float	0	100	1	$\frac{W}{A}$	laser slope
LPE	float	— no parameter —			W	laser power estimated



### 9.1.4 Laser Modulation Commands (LM)

cmd	type	min	max	default	unit	description
LMDI	bool	S	R	S		internal digital modulation
LMDX	bool	S	R	S		external digital modulation
LMAX	bool	S	R	S		external analog modulation
LMW	float	1	> 48 h	1000	μs	pulse width
LMP	float	LMW + 1	> 48 h	2000	μs	pulse period
LMDIC	word	0	65534	0		number of pulses
LMDXN	bool	R	S	S		negate modulation input

### 9.1.5 Laser Sequencer Commands (LZ)

The LZTR command is available in every laser driver:

cmd	type	min	max	default	unit	description
LZTR	float	300	34000	300	ms	ramp time (refers to $I_{max}$ )

The following commands are optionally available on request:

cmd	type	min	max	default	unit	description
LZR	bool	— no parameter —			ms	sequencer run (stop with LS)
LZP	word				ms	sequencer point select
LZPT	word				ms	subsequence time (duration)
LZPC	float				ms	subsequence current (end)

### 9.1.6 Pilot Laser Commands (P)

cmd	type	min	max	default	unit	description
PL	bool	S	R	S		pilot laser stop/run
PP	word	0	16	0		pilot laser modulation

## 9.2 Temperature Sensor and TEC Commands (xT)

In these commands x has to be replaced by a digit (or letter) to select the temperature sensor or TEC. The first temperature sensor or TEC corresponds to 1, the second to 2, the third to 3 and so on.

As the first temperature sensor or TEC is usually used for a laser and the second

for a crystal, a deprecated option for selecting them is the use of the letters L and C, respectively.

### 9.2.1 Temperature Sensor Commands

In new firmware versions the sensor commands are also available with prefix *ns* instead of *xT* where *n* corresponds to the number of the temperature sensor.

cmd	type	min	max	default	unit	description
xTA	float	— no parameter —			°C	actual temperature

### 9.2.2 TEC commands

cmd	type	min	max	default	unit	description
xTT	float	−99	200	20	°C	temperature target

## 9.3 General Commands

cmd	type	min	max	default	unit	description
GD	bool	— no parameter —				set defaults
GF	float	1.2	24	5	V	fan voltage (max. 300 mA)
GFD	float	1.2	24	5	V	default fan voltage
GX	bool	S	R	S		external control stop/run
GT	float	— no parameter —			°C	device temperature (head)
GVS	word	— no parameter —				software version
GVN	word	— no parameter —				serial number

### 9.3.1 Status Command

cmd	type	min	max	default	unit	description
GS	word	— no parameter —				get status

The status bits have the following meanings:

0x0001	interlock OK		
0x0004	driver supply OK	0x0400	LT sensor OK
0x0008	driver temperature OK	0x0800	CT sensor OK
0x0010	LTLU not OK		



0x0020	LILL not OK	0x2000	LTM not OK
0x0040	CTLU not OK	0x4000	LC ON
0x0080	CTLL not OK	0x8000	LC error

### 9.3.2 Mode Commands

cmd	type	min	max	default	unit	description
GM	word	— no parameter —				get mode
GMC	word					clear mode bit(s)
GMS	word					set mode bit(s)
GMT	word					toggle mode bit(s)

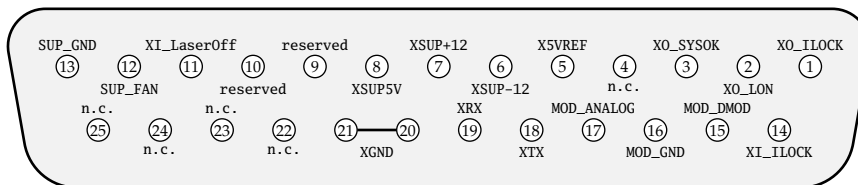
The mode bits have the following meanings:

0x0001	laser current ON	0x0100	first TEC (laser) ON
0x0002	input echo OFF	0x0200	second TEC (crystal) ON
		0x0400	pilot laser ON
0x0008	binary mode	0x0800	laser current control (LCC) OFF
0x0010	laser voltage control OFF	0x1000	use external interface after startup
0x0020	LMDI ON	0x2000	LMDX OFF
0x0040	LMDX ON	0x4000	gate option
0x0080	LMAX ON	0x8000	reduced mode

# 10 Hardware Interface Description

## 10.1 Support Connector 1st Version

The support connector is an isolated industrial interface. It is a female D-sub 25-pin connector.

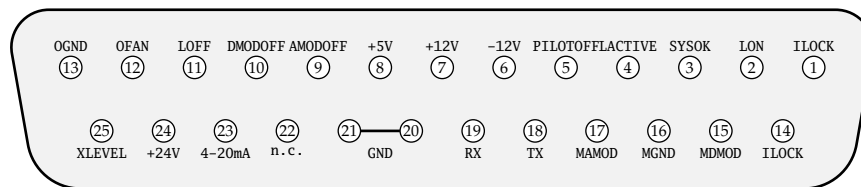


pin no.	abbr.	description
1	XO_ILOCK	interlock output, max. 12 V 100 mA
2	XO_LON	laser on – TTL output, high=laser on (pull-up resistor at 5 V with 270 Ω for e. g. LED)
3	XO_SYSOK	system ok – TTL output, high=laser. temp. & system ok (pull-up resistor at 5 V with 270 Ω)
5	X5VREF	external reference 5 V ±1%, max. 20 mA, e.g. potentiometer supply
6	XSUP-12	external supply –12 V, max. 250 mA
7	XSUP+12	external supply +12 V, max. 250 mA
8	XSUP5V	external supply 5 V, max. 250 mA
11	XI_LaserOff	laser on/off – TTL input, low=laser on, internally pulled up
12	SUP_FAN (optional)	Universal Supply 2 – 22 V for external fan (not isolated!)
13	SUP_GND (optional)	Universal Supply GND (not isolated!)
14	XI_ILOCK	interlock input – has to be closed to XO_ILOCK
15	MOD_DMOD	modulation digital input, TTL
16	MOD_GND	Modulation GND
17	MOD_ANALOG	Modulation Analog Input 0 – 4 V → 0 A – $I_{max}$ ( $R_i = 10\text{ k}\Omega$ , for 0 – 10 V signal put 15 kΩ in series)

18	XTX	RS232 – TX
19	XRX	RS232 – RX
20, 21	XGND	external GND
9, 10	reserved	reserved
4, 22-25	n. c.	reserved

## 10.2 Support Connector 2nd Version

The support connector is an isolated industrial interface. It is a female D-sub 25-pin connector.



pin no.	abbr.	description
1	ILOCK	output – interlock output, max. 12 V 10 mA (connect to pin 14 to close interlock)
2	LON	output – laser on, high = laser is in on state <sup>1)</sup>
3	SYSOK	output – system ok – high = system ok – laser ready for operation <sup>1)</sup>
4	LACTIVE	output – laser active – high = laser is emitting <sup>1)</sup>
5	PILOTOFF	input – if your laser has a pointer device it's switched ON when low <sup>3)</sup>
6	-12V	supply output –12 V, max. 250 mA for free usage <sup>2)</sup>
7	+12V	supply output +12 V, max. 250 mA for free usage <sup>2)</sup>
8	+5V	supply output 5 V±1%, max. 250 mA for free usage <sup>2)</sup>
9	AMODOFF	input – if low = external analogue modulation is ON (is changeable) <sup>3)</sup>
10	DMODOFF	input – if low = external digital modulation is ON (is changeable) <sup>3)</sup>
11	LOFF	input – laser off – low = laser is on <sup>3)</sup>
12	OFAN	optional (fan) supply – 2 – 22 V up to 1 A for external fan <sup>7)</sup>
13	OGND	optional internal GND <sup>7)</sup>
14	ILOCK	interlock input – has to be connected to ILOCK (pin 1) to close interlock

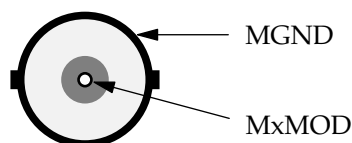


15	MDMOD	input – digital modulation <sup>4)</sup>
16	MGND	modulation GND
17	MAMOD	input – analogue modulation <sup>4) 5)</sup>
18	TX	RS232 – TX <sup>2)</sup>
19	RX	RS232 – RX <sup>2)</sup>
20, 21	GND	external GND
22	n.c.	
23	4 – 20 mA	additional 4 – 20 mA analogue modulation input <sup>7)</sup>
24	+24V	supply output +24 V max. 80 mA for free usage <sup>2)</sup>
25	XLEVEL	input for logical output level <sup>6)</sup>

- 1) logic output, high level = XLEVEL (default 5 V), low level < 1 V, see <sup>6)</sup>
- 2) to GND
- 3) input internally pulled up, input is tolerant up to 24 V for high level
- 4) to MGND
- 5) 0 – 4 V → 0 A– $I_{max}$  ( $R_i = 10\text{ k}\Omega$ )  
optionally: 0 – 10 V → 0 A– $I_{max}$  ( $R_i = 25\text{ k}\Omega$ )
- 6) XLEVEL is 5 V (TTL level) by default  
to change output high level to 12 V connect XLEVEL (pin 25) to +12V (pin 7) or  
to change output high level to 24 V connect XLEVEL (pin 25) to +24V (pin 24)
- 7) to OGND – signals are not isolated! take care!

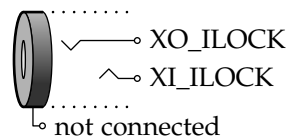
### 10.3 AMOD/DMOD Connector

This is a BNC connector for digital and analog modulation with TTL level/XLEVEL. In devices with a 2nd version support connector this BNC connector ist only for digital modulation. The MxMOD pin is internally connected to pin 15 and 17 of the support connector. TTL/XLEVEL low turns the laser off and TTL/XLEVEL high turns the laser on. The command LMDXN reverses the meaning of these levels. Input impedance: 10 k $\Omega$ /25 k $\Omega$ .



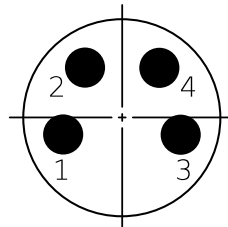
## 10.4 Interlock Connector 1st Version

The interlock connector is a female 3.5 mm<sup>1</sup>/<sub>8</sub> ( 1/8 in) TS connector (jack socket). The laser can only run when interlock is closed, i.e. XO\_ILOCK pin and XI\_ILOCK pin have to be connected. These pins are internally connected to their respective pins on the support connector.



## 10.5 Interlock Connector 2nd Version

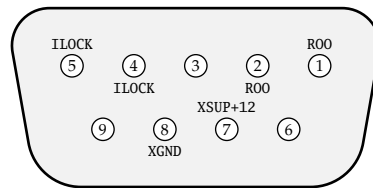
The interlock connector is a M8-round connector. It has two separate interlock circuits. The laser can only run when both interlocks are closed, i.e. IL1+ pin and IL1- pin have to be connected and IL2+ pin and IL2- have to be connected. This interlock connector is independent from the ILOCK pins of the support connector.



pin no.	abbr.	description
1	IL1+	
2	IL1-	
3	IL2+	
4	IL2-	

## 10.6 Water Chiller Connector (Water-Cooled Models)

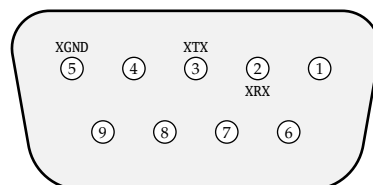
This D-sub 9-pin female connector can be used to connect the water chiller. The ILOCK pins (pin 4 and 5) have to be connected to operate the laser.



pin no.	abbr.	description
1	ROO	output – remote on/off (optional)
2	ROO	output – remote on/off (optional)
4	ILOCK	input – level/flow/temperature alarm, integrated into interlock circuit
5	ILOCK	input – level/flow/temperature alarm, integrated into interlock circuit
7	XSUP+12	external supply output +12 V max. 250 mA, internally connected to pin 7 of the support connector
8	XGND	external GND

## 10.7 RS232 Connector

This D-sub 9-pin female connector can be used to control the driver over a serial interface as described in [chapter 7](#).



pin no.	abbr.	description
2	XRX	receive data, the same as pin 19 on the support connector
3	XTX	transmit data, the same as pin 18 on the support connector
5	XGND	ground, the same as pins 20 and 21 on the support connector