



# Operating Manual

## High Power Laser Diode Source & Control Systems

### DSC11 / LDX / MCS Series



## Overview

The model DSC11 / LDX and MCS source and control systems are high power, turn-key laser diode systems designed for R&D lab and manufacturing applications. These systems include a high power fiber coupled laser diode source with an output power level up to 100 watts.

The customer specifies the laser source wavelength and the required power level up to 100 watts. Source modules are available from most industry leading manufacturers, including Coherent Lasers, nLIGHT, LUMICS and DILAS. In addition to the fiber coupled laser module, these instruments offer the user a simple to use high power control chassis with an integrated cooling system. The control chassis includes the laser diode current source, thermal control and water cooled base plate assembly integrated into a 3-U high 19 inch rack-mount / bench top enclosure. These instruments can be rack-mounted or used on a lab bench.

The control unit chassis is capable of dissipating up to 600 Watts of heat by utilizing a water cooled base plate combined with high power TEC elements. The mounting plate for the laser is accurately controlled to your desired set-point temperature by TEC coolers. The heat is dissipated into a cooling block which dumps the heat to copper water tubes.

In addition to a standard user defined current limit, the high power laser diode is protected from transients and surges through a factory set current clamp limit. Also, there is a factory set temperature "safe operation" mode which keeps the laser module working within a pre-set range.

These units ship with RS232 or USB interface and come with control software and a simple to use GUI interface



### **Laser Diode Source and Control System Features:**

- Both CW and QCW laser drive modes
- Low system power consumption by active voltage control in CW mode
- Multiple laser diode protection features and options
- External analog and digital modulation or internal modulation
- Bias current option for modulation
- Adjustable driver for red or green pilot laser
- Transient and ESD protection
- Voltage, current and temperature limits

### **TEC Driver Features:**

- Thermal sensor input for NTCs (standard 10 k $\Omega$ ), PT100, PT1000
- Polynomial and Steinhart-Hart model temperature control
- PID temperature control loop
- Temperature limits (upper and lower)
- Target temperature sequencer software available on request



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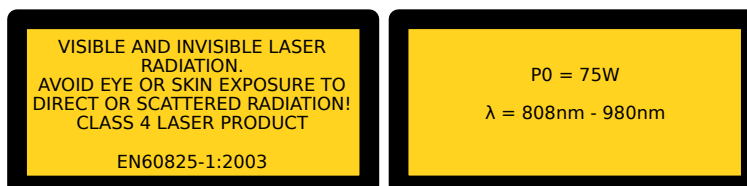
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# 1 Introduction

Please read this operation manual carefully before switching on the device, and pay attention to the safety instructions. In order to obtain optimum performance from your driver module follow the installation and operating instructions. In case of questions or problems, please contact our service staff.

**Please note that unauthorized opening of the device or breaking the warranty seal cancels the warranty.**

Our advanced laser power supply is microprocessor controlled with many safety features for reliable operation of the laser diode. The serial interface of the power supply allows external computer-controlled operation for elaborate experiments.



## 2 Safety Instructions

Your safety is our top priority. Please read the following laser safety information before attempting to operate the laser. Note that OsTech and Laser Lab Source bear no responsibility for any injury or damage which is a result of using this laser source system.

### 2.1 Laser Safety

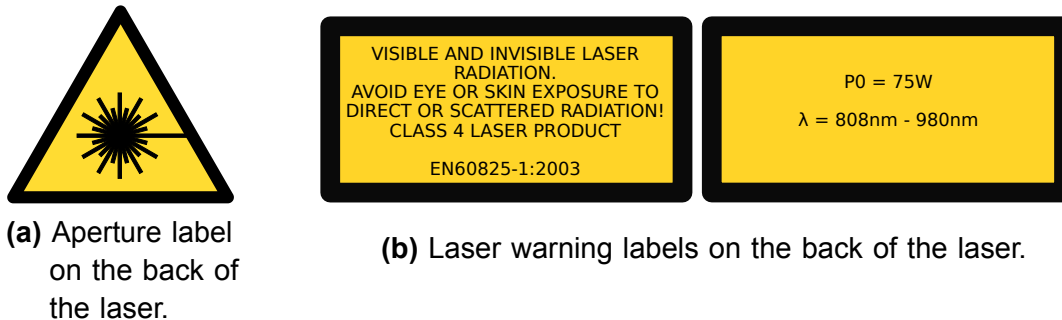
**This is a High Power Laser System. The laser radiation emitted from this unit is harmful. Always follow appropriate precautions:**

1. **Avoid exposure to the laser beam.**
2. **Always use protective eye wear appropriate for laser light. Make sure the eye wear is rated for the laser power and wavelength exposure.**
3. **Avoid looking at the beam directly even with protective eye wear.**
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 DSC/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 location of the warning labels used on this product. Please be aware of them and use caution when working with 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 employed:

1. Avoid exposure to dust and direct sunlight.
2. Do not block the fan ventilation ports. Ensure free air flow around the system.
3. Avoid excess vibration that might compromise the mechanical integrity of the system.
4. Maintain the operating temperature in the range of 10 – 35 °C.
5. Give the unit time to warm up if it is transferred from a cold environment.
6. Allow one minute warm-up to reach full specs if the device is maintained at room temperature. If the device has been exposed to storage temperature extremes, it can take up to five minutes for the unit to stabilize.
7. Keep original packing material for transport or shipment.
8. **It is recommended that the optical connectors be cleaned before every connection.** Periodic inspection of the fiber for scratching or pits is important for safe operation of the laser diode. If the fiber surface is damaged it must be replaced. If you need help with fiber handling or fiber cleaning equipment please contact Laser Lab Source or OsTech.





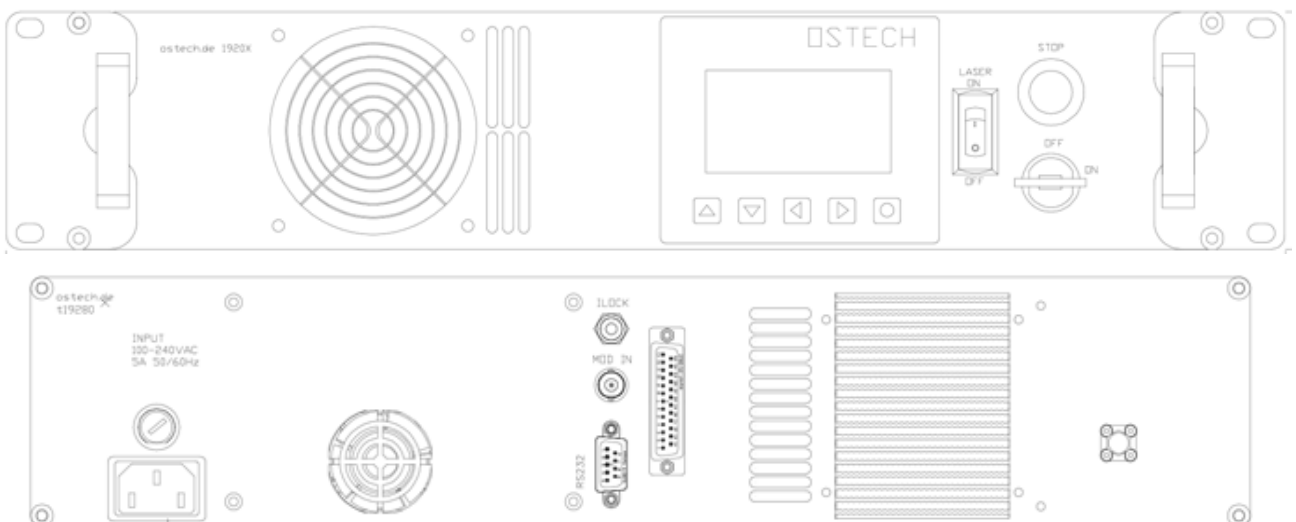
## 3 Hardware setup

### 3.1 Connecting the Fiber to the System

All DSC/LDX systems have an FSMA fiber connector/receptacle. Use metal armored high power fiber optic cable. Check and clean the fiber surface. Tighten the cap nut thoroughly. Replace damaged fiber cable. Avoid direct back reflections.

### 3.2 Turning on the System

- Make sure that all necessary connections are properly made (See [Section 10.1](#)).
- **Make sure that the interlock connector is closed.**
- Make sure that the emergency button (the large red button at the front side) is unbolted by turning it to the OUT position.
- Please ensure laser safety regulations and precautions are followed.
- Turn the key switch to ON.
- The laser cooling fan and temperature controller will start.





## 4 Technical Parameters

### 4.1 General Parameters

input voltage	DSC11: 110–220 V AC
ambient temperature	0 . . . 40 °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 (19 in × 5.2 in × 13.4 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 Security Breakdown Conditions Which Result in System Shut-Down**

- Interlock open
- Internal power supply failure
- Abnormal transients
- Open circuit detected for the laser diode
- Internal system over-temperature
- System beyond maximum power dissipation capacity

# 5 Keypad and Display Menus

## 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        | ▪ moves 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 of the current state and allows control of primary / basic settings. The layout of the main menu is shown in [Figure 5.1](#). The big number shows the current 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

## 5 Keypad and display menus

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)

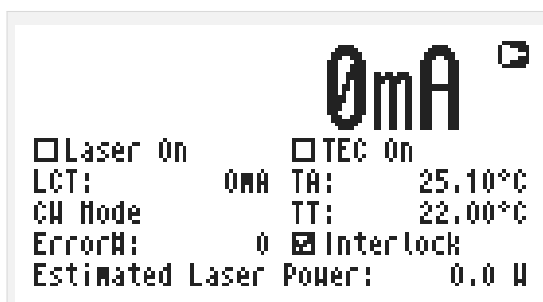


Figure 5.1: Main menu layout

### 5.2.2 Laser and Device Menu

The laser menu is shown in [Figure 5.2](#). This is where you can change the laser and general settings and find out the type and serial number of your system. 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)



## 5.2 Display Menus

Service	Show type, serial number and software version of the device.
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)


```
Laser and Device Menu   
⊗CH ⊗LNDX LND: 1.000ns  
⊗LNDY ⊗LNDI LND: 2.000ns  
LCB: 0mA PC: 0 LG  
LCH: 5.090 A LCS: 0.9000  
Error#: 0 Service  
Restore Default Settings  
Pilot Laser - Intensity: 0
```

Figure 5.2: Laser and Device Menu

## 6 Laser control

### 6.1 CW Mode of Operation

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. Instead of using the display menus, all functions of the laser driver can also be controlled over an RS232 interface as described in [chapter 7](#).

#### 6.1.1 Turning On the Laser

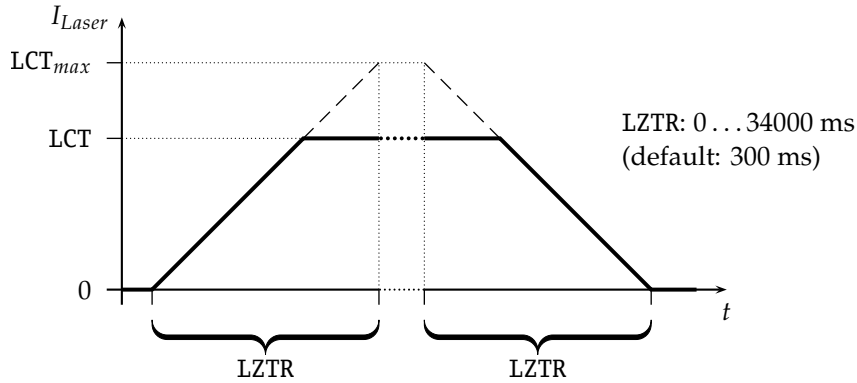
Go to the main menu (the first menu after turn-on) and adjust the laser current target in the LCT input field. The selected value must be within the laser current limit and the maximum operating current of your laser module. Turn on the laser switch (front panel) to switch on the laser. The red LED on the front panel will start blinking and the actual current will be displayed. Turning off the laser switch switches off the laser current and causes the red LED on the front panel to stop blinking. The actual current 0.00 A will be displayed.

Pressing the emergency button at the front panel will switch off the device immediately. The button will be bolted if pressed. Unbolt it by twisting.

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 Run and Stop

In CW mode one sub-function of the optional sequencer is always implemented, the Ramp on Laser Run and Stop. However, configuration of this function is not available over the display menus. To set the ramp parameters 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. During the laser Stop Ramp, you can turn off the laser immediately by sending LS again. You can disable the ramp by setting the Ramp Time to zero 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:

$$LPE = (LCA - LCH) \times LCS \tag{6.1}$$

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 being the actual laser power.

## 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 laid 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.



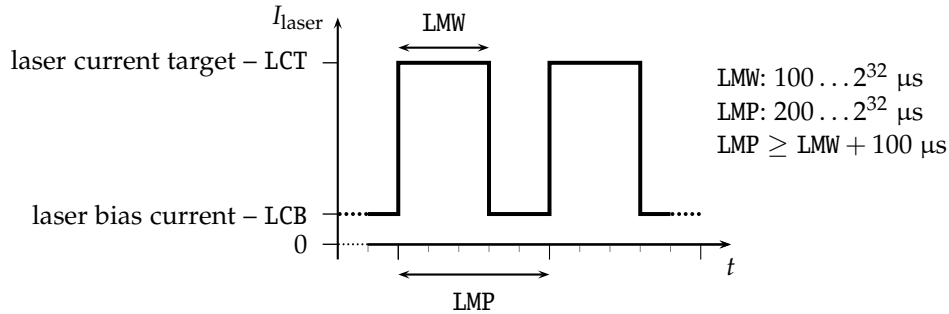


Figure 6.2: continuous pulse mode

## 6.4 Modulation modes of operation

The modulation modes can be selected in the laser menu. Changing modulation modes turns off the laser. You may switch it on again in the main menu.

In modulation modes the measured currents and voltages displayed in the main menu **show the mean values** not the peak values. These measured values may differ from the adjusted ones caused by the low speed of the AD 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 generating pulses. This internal modulation mode may be activated by checking the LMDI input field in the laser menu or entering the LMDIR command.

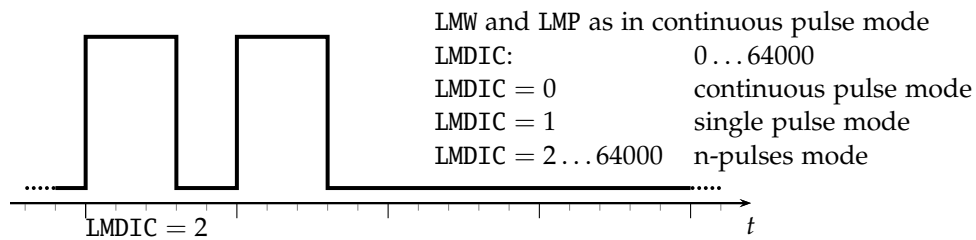
#### Continuous pulse mode

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 is in the range of

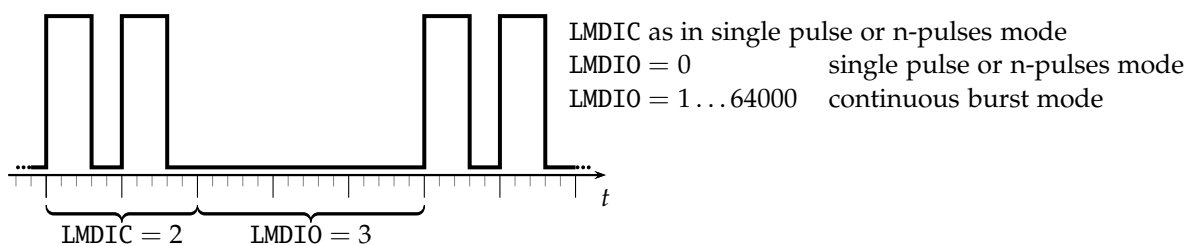
$100 \mu\text{s} \dots 4 \times 10^9 \mu\text{s}$  and may be changed by the LMW command. The pulse period (LMP command) is in the range of  $(LMW + 100 \mu\text{s}) \dots 4 \times 10^9 \mu\text{s}$ , so it is always at least  $100 \mu\text{s}$  larger than the pulse width.

You can run the Laser by LR and LS commands provided that the laser current and the compliance voltage are also entered.

## 6.4 Modulation modes of operation



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



**Figure 6.4:** Continuous Burst Mode

### 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  $n$  is the number of pulses you want to be generated. Assigning 0 to LMDIC switches to the continuous pulse mode described above. After entering the LR command the programmed number of pulses will be generated. Afterwards, the driver enters the *OFF state* automatically. You don't need to enter LS.

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. This is also called the *external trigger mode*.

### Continuous Burst Mode

The burst mode can be used to generate a sequence of bursts as illustrated in [figure 6.4](#). With the command `LMDIO` you can define the length of the pause (in number of pulses) between the bursts. The result is a continuous burst sequence.

### 6.4.2 External Digital Modulation

The external digital modulation mode may be activated by entering the LMDX command. 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 deactivated by a TTL low-level signal. 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 corresponds to  $I_{max}$ . The compliance voltage (LVC) has to be set before and the laser has to be run by LR.

## 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 device. In *ON* state a voltage between 4.0 V 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:

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

## 7 Remote control

This system is designed to be controlled remotely over a serial 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 system in text format. The system will answer in the same way. The answer from the system always contains comments and the parameters and values are always 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 15 characters.

Sent command: LCT222.3 `(CR)` every character is returned  
Received answer: Laser Current Target: 222.3 mA `(CR)` - detailed 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  $\overline{\text{CR}}$  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... 255 bytes + 0x00
- 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  $\overline{\text{CR}}$  set bit 0x08 of mode variable

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

Sent command: GMC8  $\overline{\text{CR}}$  clear bit 0x08 of mode variable

### 7.4 Software

At <http://www.ostech.de> you may download the terminal program *OSTERM* and sample routines in the C language to interact with OsTech devices. Please find also LabVIEW™ VIs and runtime versions for remote control on our homepage.

## 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 by our new display software. 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

### 9.1 Laser Commands (L)

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
LCH	float	0	$I_{max}$	0	mA	laser threshold current
LCS	float	0	100	1	$\frac{W}{A}$	laser slope

#### 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	— <i>no parameter</i> —			μA	laser photo current actual
LPCT	float	0	20	0	μA	laser photo current target
LPCC	bool	S	R	S		laser photo current control
LPCCC	bool	— <i>no parameter</i> —				calibrate LPCC
LPA	float	— <i>no parameter</i> —			W	laser power actual
LPE	float	— <i>no parameter</i> —			W	laser power estimated
LPT	float	0		0	W	laser power target
LPF	bool	— <i>no parameter</i> —				laser power fix procedure

### 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
LMDIO	word	0	65534	0		number of suppressed 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	— <i>no parameter</i> —			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 General Commands

cmd	type	min	max	default	unit	description
GD	bool	— no parameter —				set defaults
GF	float	1	24	5	V	fan voltage (max. 300 mA)
GFD	float	1	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

### 9.2.1 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	LTLI not OK	0x2000	LTM not OK
0x0040	CTLU not OK	0x4000	LC ON
0x0080	CTLI not OK	0x8000	LC error



### 9.2.2 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)

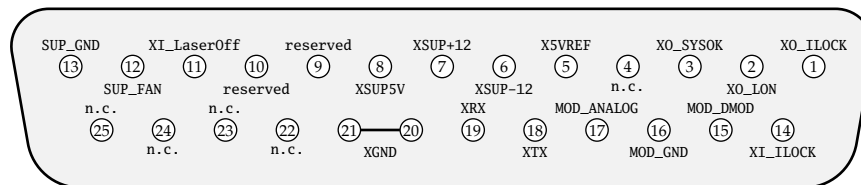
The mode bits have the following meanings:

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

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



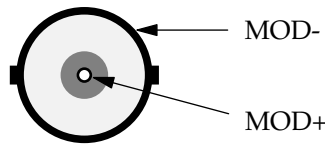
pin no.	abbr.	description
1	XO_ILOCK	Interlock Output, Max. 12 V 100 mA
2	XO_LON	Laser On – TTL output; High = Laser On (pull-up resistor at 5 V with 270 $\Omega$ for e. g.
3	XO_SYSOK	System ok – TTL output; High = Laser. Temp. & System ok (pull-up resistor at 5 V with 270 $\Omega$ )
5	X5VREF	External Reference 5 V $\pm$ 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 – TTL input; Low = Laser On, internally pulled up
12	SUP_FAN (optional)	Universal Supply 2 – 22 V for external fan ( <b>not isolated</b> )
13	SUP_GND (optional)	Universal Supply GND ( <b>not isolated</b> )
14	XI_ILOCK	Interlock Input – Must 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 $\rightarrow$ 0 A– $I_{max}$ ( $R_i = 10\text{ k}\Omega$ , for 0 – 10 V signal put 15 k $\Omega$ 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

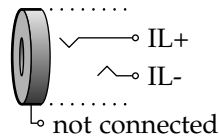
### 10.2 AMOD/DMOD Connector

This is a BNC connector for digital and analog modulation with TTL level. TTL low turns the laser off and TTL high turns the laser on. The command LMDXN reverses the meaning of these TTL levels. Input impedance: 10 kΩ.



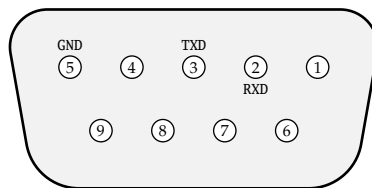
### 10.3 Interlock Connector

The interlock connector is a female 3.5 mm (1/8 in) TS connector (jack socket). The laser can only run when interlock is closed, i.e. IL- pin and IL+ pin have to be connected.



### 10.4 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	RXD	receive data
3	TXD	transmit data
5	GND	ground

