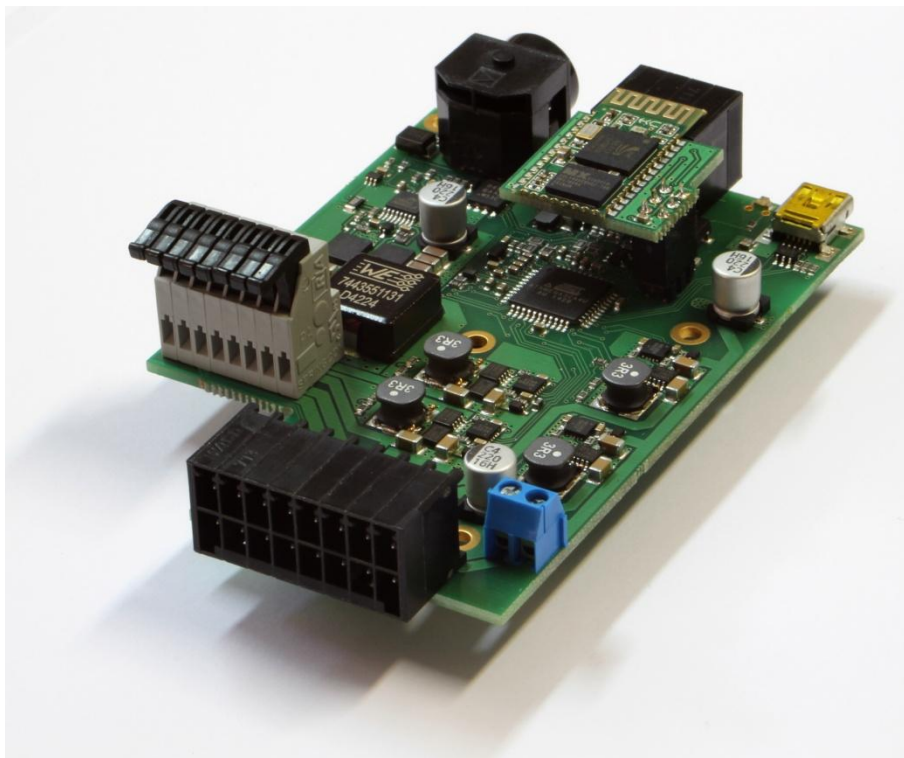


LD-SMART

Laser Diode Driver



User Manual

Version 1.1
3. March 2016

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Read this manual carefully before operating the device!

Check the contents of the box for transport damage and completeness. In case of irregularities contact Impex HighTech GmbH immediately!

The LD-SMART is an OEM product. As such, it is intended only for integration into other equipment. The customer is responsible for certification of any kind.

Meet all necessary precautions to except damages through ESD (electrostatic discharge)!



Always wear suitable laser goggles to protect your eyes when working with lasers!

Before turning the laser on, check all parameters and settings for tolerability by the connected components!



Do not open the case of the LD-SMART! High voltages inside! Warranty voids, if the case label was removed!

Terms and product names may be registered trademarks of their owners.

Warning!

Exposure to laser radiation may be harmful. All apertures which can emit laser light in excess of levels which are considered safe are identified with appropriate labels shown later in this section. Take extreme care when working in areas where these labels are placed.

Warning!

Always provide protective eyewear suitable for the laser's emission wavelength. The emission wavelength of your laser model is given on the DANGER sticker at the top of the laser head.

Warning!

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. The use of optical instruments with these products will increase eye hazard.

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1. Introduction

Congratulations on your purchase of the Impex HighTech LD-SMART laser diode driver with or without integrated laser diode. The LD-SMART includes all necessary components to utilize a semiconductor laser diode or a diode pumped solid state laser system. This manual is intended to provide some more detailed information on how to operate these devices properly.

Features

- Laser diode current driver with several modulation options: continuous wave, pulsed (with internal pulse generation), external pulse (with internal pulse generation). In pulse modes an adjustable off-current and an external gate input is available.
- Three integrated PID temperature controllers (one Bipolar and two Unipolar) with outputs for thermoelectric cooler (TEC/ peltier) elements provide determined temperature operating point of laser diode and laser crystal or SHG-crystal.
- Several interfaces to integrate the device into existing configuration: external TTL input for pulse generating.
- Bluetooth and USB control interface with documented ASCII protocol and device drivers for all common operating systems (Microsoft Windows 98SE...Vista 32/64bit, CE.NET, Windows 7/8, Linux, Mac OS 8...X PowerPC/Intel).
- User friendly PC software for control allowing quick access to common parameters and to set all values and data logging included (Microsoft Windows only. For other operating systems, please ask Impex HighTech).
- Security components including: laser state indicating LEDs, current limit, specified temperature window.

Package contents

- LD-SMART Laser Diode Driver
- Integrated Laser Diode (optional)
- CDROM with LD Control software and drivers for Microsoft Windows, this user manual in Portable Document Format (PDF).
- Power supply cable
- USB - Mini cable

Optional components

- Power supply



Figure 1. Optional power supply.

2. Specifications

Laser diode driver

Parameter	Unit	Min	Type	Max
Laser diode current	A	0,8		10
Current setting step	mA		1	
Current measurement accuracy	%		5	
LD compliance Voltage	V	0		8
LD pulse width LMW	μs	10		LMPmax-10
LD pulse period LMP	μs	LMWmin+10		32000
Pulse repetition rate	Hz	32		10000
TTL Low level	V	0		1.2
TTL High level	V	3		5.5
Temperature setting range	°C	10		60
Temperature stability	°C		±0.1	±0.2
TEC controller voltage	V	-11		11
TEC controller current	A	-4		4
NTC sensor resistance at 25°C	kΩ		10	
Power supply voltage	VDC	9		13.5
Operating temperature	°C	10		40
Relative humidity (non condensing)	%	5		90
Dimensions (B/H/T)	mm		100/80/142	

Power supply

Input

Input Voltage	• 90-264 VAC
Input Frequency	• 47-63 Hz
Input Current	• 2.0 A max at 90 VAC
Inrush Current	• 110 A max at 230 VAC, cold start at 25 °C
Earth Leakage Current	• <500 μA at 230 VAC/50 Hz
Power Factor	• >0.95 at 230 VAC and full load
No Load Input Power	• <0.3 W
Input Protection	• Internal T3.15A/250 V fuse in line

Output

Output Voltage	• See table
Initial Set Accuracy	• ±5% at 50% load
Minimum Load	• No minimum load requirement
Hold Up Time	• 20 ms typical at 115 VAC, full load
Start Up Delay	• 3 s max
Start Up Rise Time	• 60 ms max
Overshoot	• 3% max
Transient Response	• 4% maximum deviation, recovering to less than 1% within 500 μs for a 50% step load change
Line Regulation	• ±0.5% max
Load Regulation	• 3% max
Ripple & Noise	• 1% pk-pk max, 20 MHz bandwidth (see note 1)
Overvoltage Protection	• See table
Overload Protection	• 130-180%
Short Circuit Protection	• Continuous (hiccup/trip & restart mode with auto recovery)
Temperature Coefficient	• ±0.04%/°C

3. Hardware Description

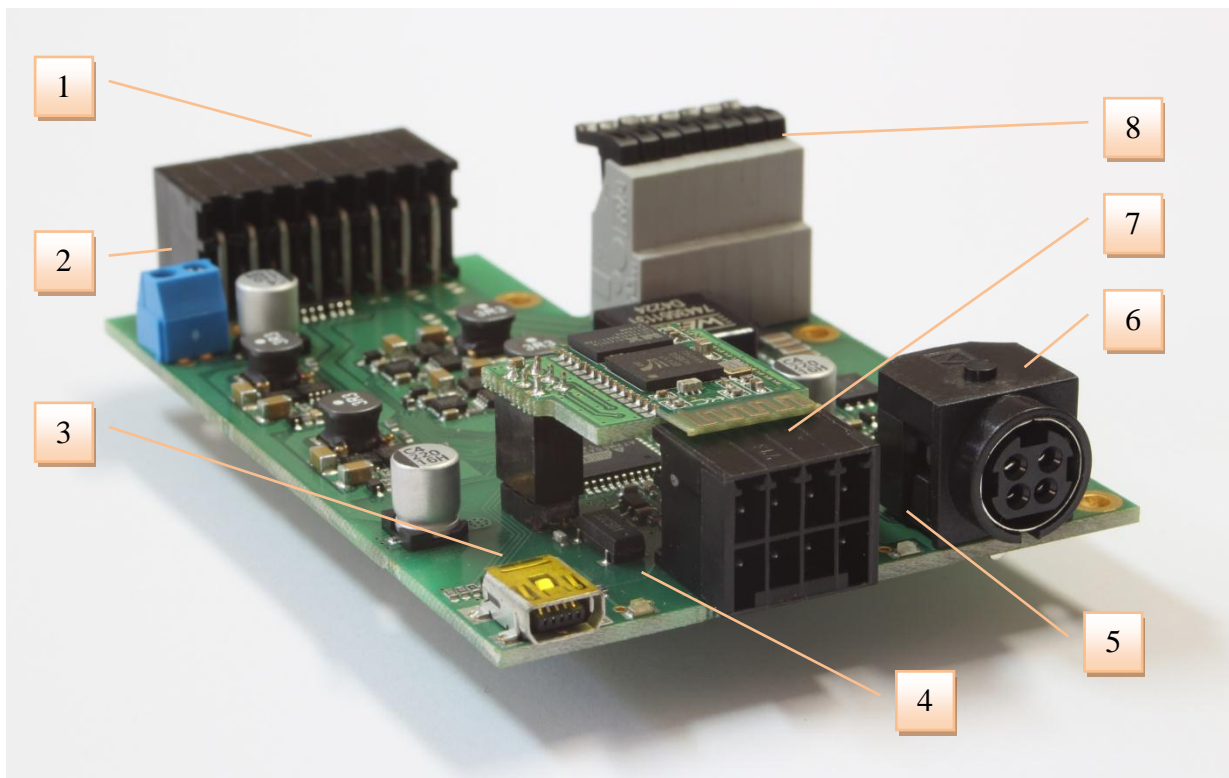


Figure 2. Front view

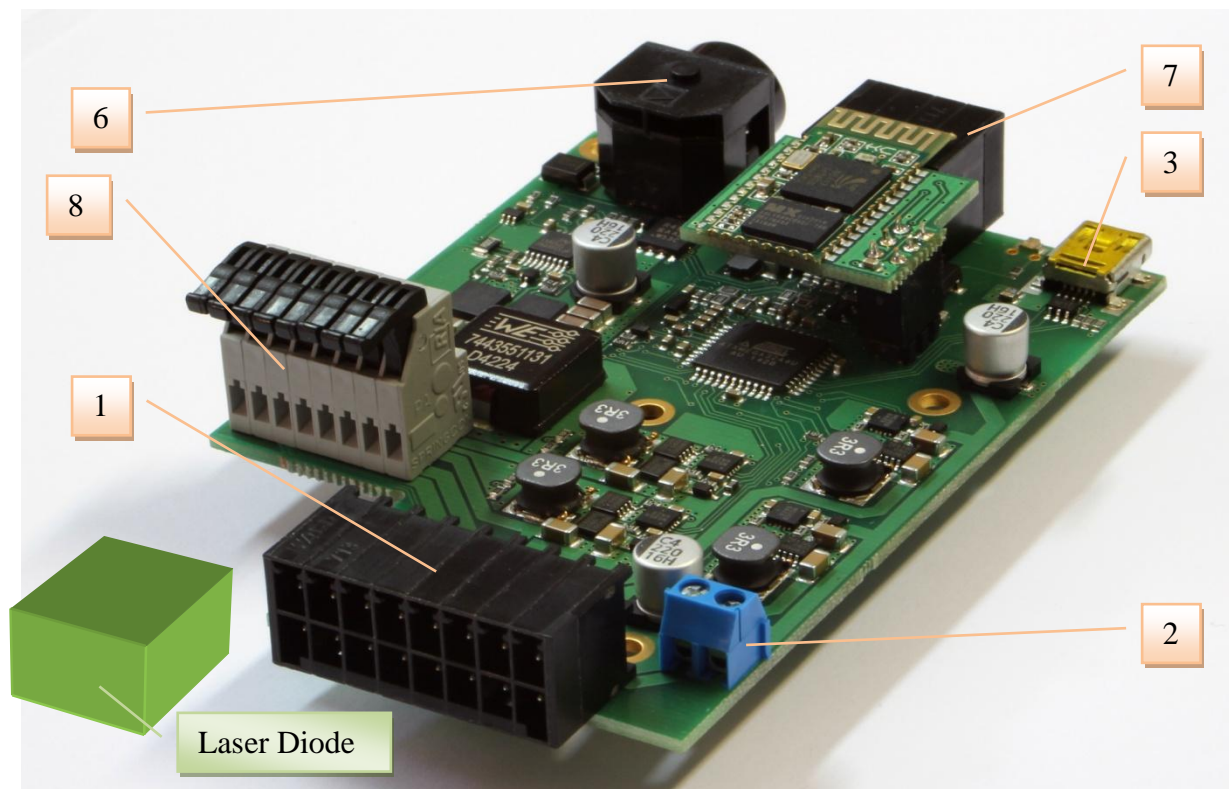


Figure 3. Back view

Sockets

Pos.	Description	Pos.	Description
1	External Connection LD/TEC/NTC	5	LED Driver on/off
2	Ventilator Connection +12v	6	Power Supply Connector
3	USB Mini connection	7	Trigger in/out RS232
4	LED Laser on/off	8	Internal Connection LD/TEC/NTC

Control connection

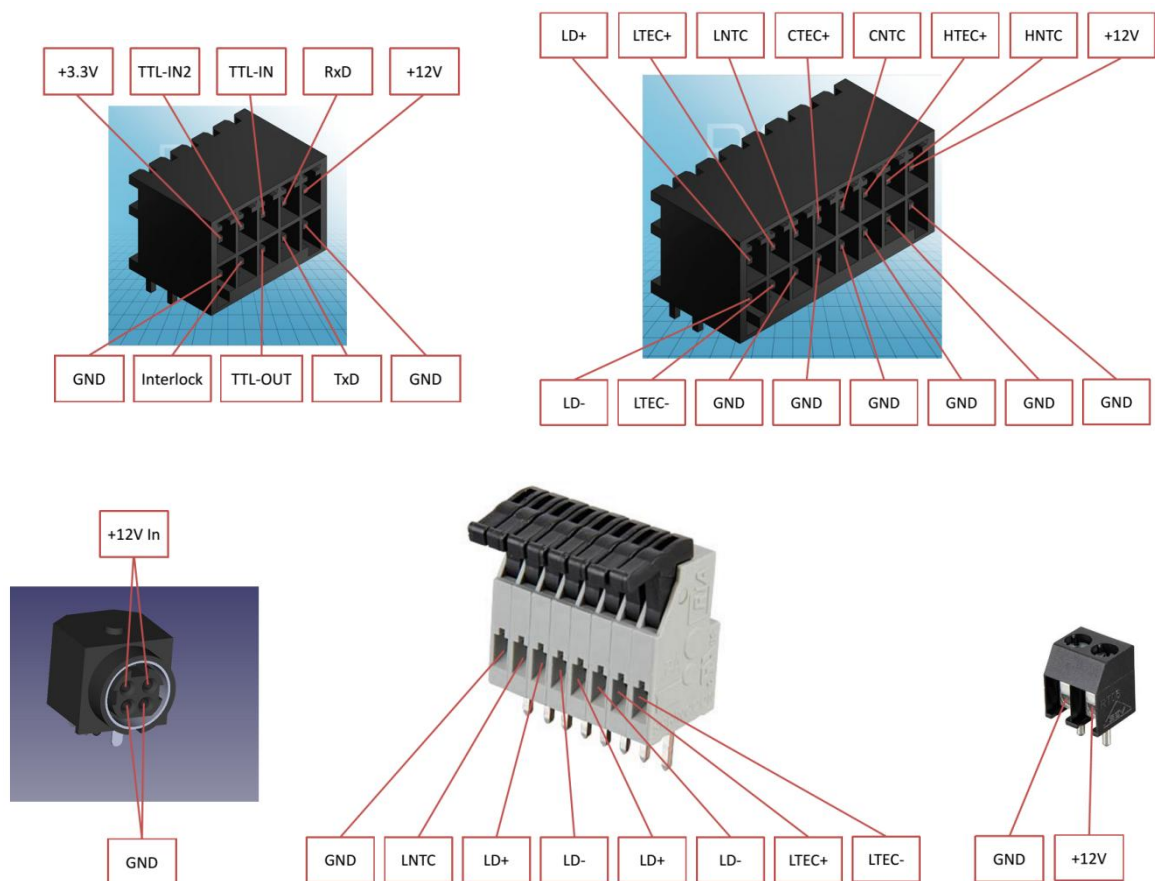


Figure 4. connector pin-out

Dimensions

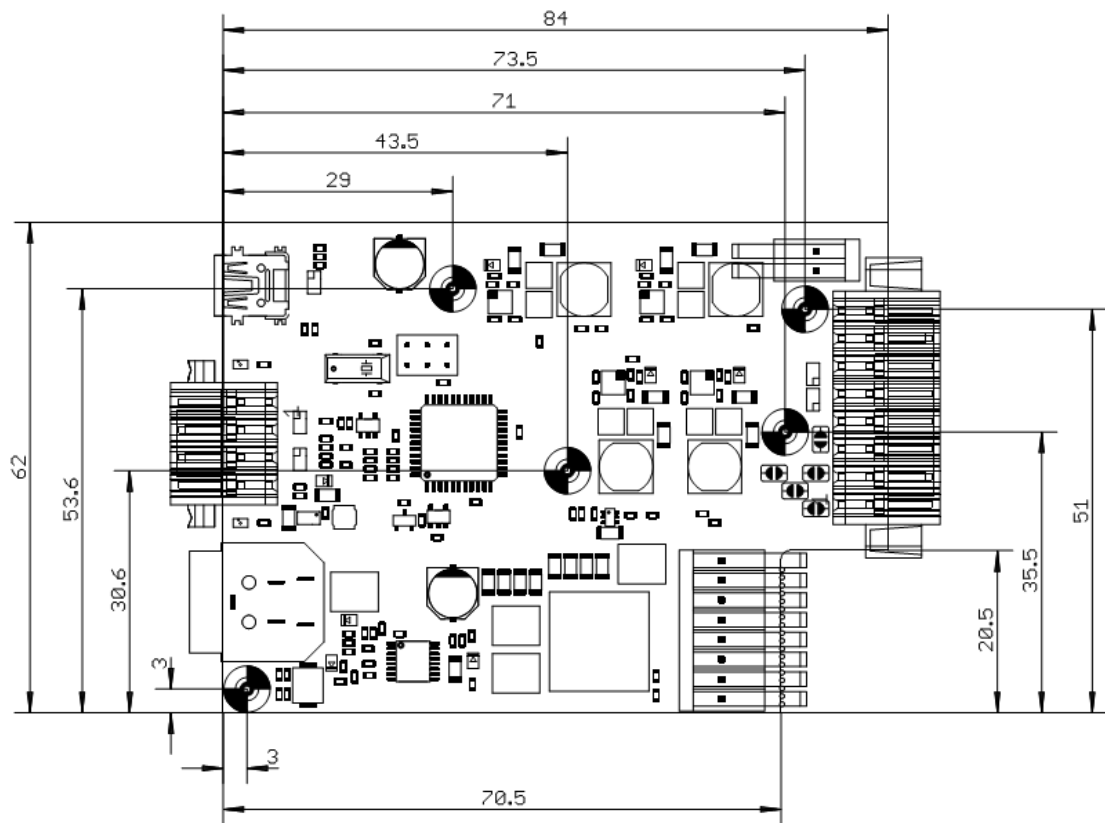


Figure 5. Dimensions

4. Principles of operation



Before turning on the laser, check all parameters and settings for tolerability by the connected components!



Before turning on the laser and possible peripheral equipment, please check for correct polarity of the connections, you may have done.

The LD-SMART can be controlled through LD-control software through the USB interface or Bluetooth.



Connect power cable to the socket "12 V" and plug to the mains see Figure 4.

Warning!

Always provide protective eyewear suitable for the laser's emission wavelength. The emission wavelength of your laser model is given on the DANGER sticker at the top of the laser head.



4.1 Operational Methods

The LD-SMART is offered as Stand-alone or as built-in. At the built-in version, a laser diode is implemented in the drivers housing and is directly connected to the laser drivers board. The laser diode temperature adjustment is done with internal mounted TEC's and NTC's. Whereas in stand-alone, the driver can be used to drive an external laser diode with on board temperature control unit of LD-SMART through one bipolar 'TEC laser/NTC laser' for laser diode temperature controlling (see Figure 4. connector pin-out).

There are two additional on board unipolar temperature control units (just cooling!), one for laser crystal or bonded crystal 'TEC Cryst 2/NTC Cryst 2' and the other temperature control unit for second harmonic generation crystal 'TEC Harm 3/NTC Harm 2' or other preferred components.

TTL input

In case of an external pulse generation (command), the LD-SMART will wait for TTL signals (command) on pin TTL_IN as shown in Figure 4. Connectors pin-out. The level at this pin determines whether the laser should be driven with the Target current (High) or the Base current (Low).

TTL output

In case of synchronizing with any other external systems (see chapter 4.3 - 30. and 40. both internal or external modulation mode), the level at this pin indicates whether the laser is driven with the Target current (High) or the Base current (Low).

4.2 The LD Control software

The LD Control software application gives you the ability to adjust parameters quickly, to view values on the screen and to save these values into a file for documentation.



Since the remote control feature qualifies to operate the laser without intervisibility, special considerations and precautions must be met! Do not operate the laser in rooms, where no sufficient laser safety is guaranteed!

Installing LD Control (Windows)

To install LD Control software, run setup.exe from the supplied CD-ROM. This will install the application itself and some additional runtime components. Follow the instructions of the installer software.

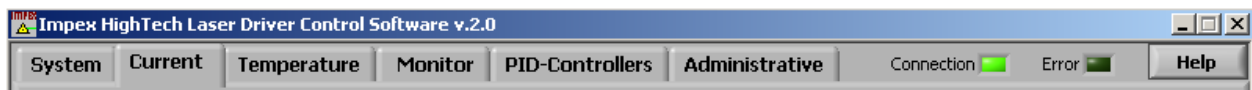
Installing USB driver (Windows)

When you first time connect the LD-SMART to the PC, the operating system will ask for a driver. Select the option “**Search in other places**” and point to the folder **USB Driver\Windows** on the CD-ROM. The device is equipped with a USB-serial converter module, [so a connection is done through a virtual COM Port](#). The number of the COM Port interface is being assigned by the operating system automatically. To find out the corresponding COM Port number, start the Device Manager (Start – Run... - devmgmt.msc) and look for “USB Serial Port” entry in the Ports section, the assigned COM Port number is shown in parentheses.

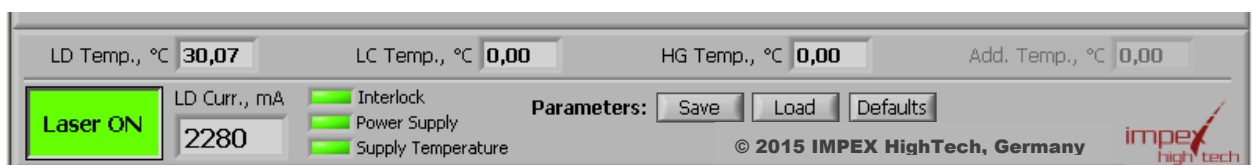
Overview

Every control and indicator is equipped with online description. Get the [mouse cursor](#) over an element for a few seconds and the description will pop up.

The application is divided into six parts, represented by a card index. On the **System** card you can setup the communication interface and some basic parameters. On **Current** and **Temperature** cards you can set all adjustable values to run the laser properly. The **Monitor** card shows and logs actual values such as laser diode current and temperatures.



Right to the card tabs there are indicators for **Connection** and an eventually occurred **Error**. When a connection to the device cannot be established (the Error indicator is lit and the Connection indicator is dim), then the other indicators and parameters are not valid and are greyed out. See description of the System card in such case.



The most important element in the lower part of the user interface is the **Laser ON/OFF** button at the bottom left corner. This button is also an indicator for laser is on (green button) and laser is off (red button).

All parameters and setting can be saved to a file and loaded afterwards by the buttons **Load** and **Save** accordingly. You can also create multiple settings-files for different lasers and load them

when using the appropriate laser. The button **Defaults** loads default values, that are programmed into the device by manufacturer.

The **Copyright** notice and the **Impex HighTech** logo are linked to the Impex HighTech website.

System card

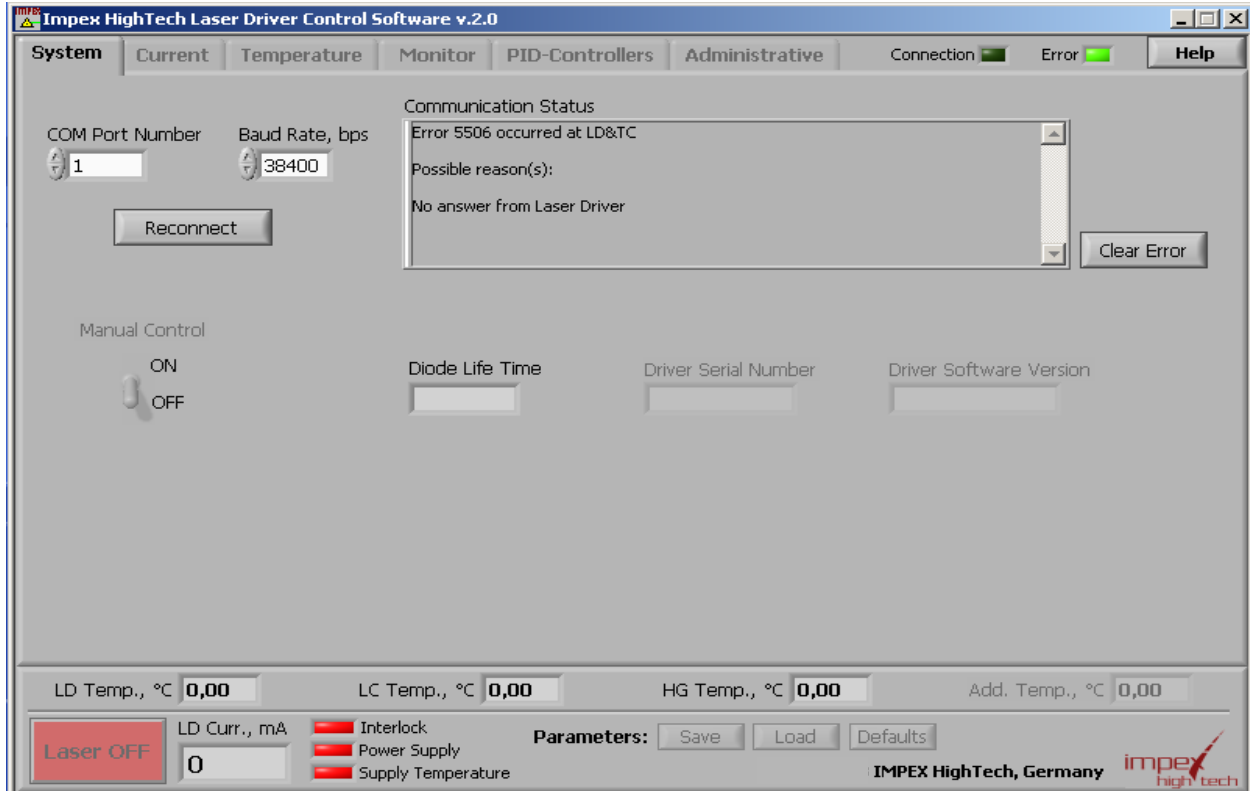


Figure 4. System card

COM Port Number sets the number of the virtual COM Port that is given by the USB or Bluetooth to serial converter driver (see chapter Installing USB driver or searching for Bluetooth).

Baud Rate sets the transfer speed and should be set to 115200 bps in the current revision.

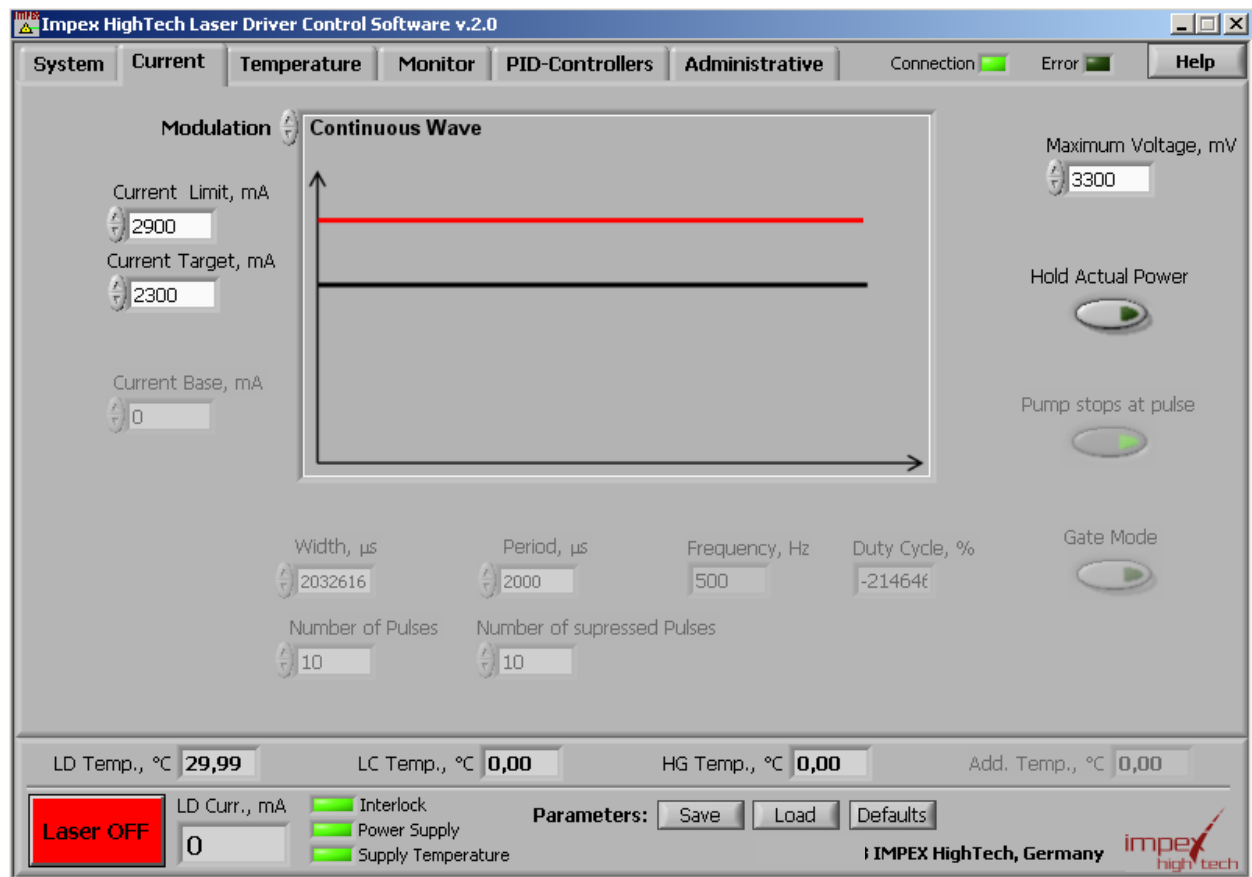
The window **Communication Status** shows the error messages if some communication error occurs. The **Error** indicator lights up in such case.

The **Clear Error** button clears the Communication Status, if the Error is not present and the Error indicator turns off.

If the device is turned off or USB cable was removed, the connection is lost. After the problem is solved and the driver is connected properly, press the **Reconnect** button to reactivate communication.

The switch **Manual Control** enables or disables keys and the knob at the front panel of the device. This function is used to prohibit a change of values if the laser is operated remotely.

The fields **Laser Diode Life Time**, **Driver Serial Number** and **Driver Software Version** are self-explanatory.

Current card**Figure 5. Current card**

First of all the **Modulation** method and source should be set (see chapter 4.3 Laser modulation modes). This can be done either with the small arrows right to the word Modulation, or by clicking the picture and choosing the corresponding pictogram from popped up table. According to the modulation method, other controls of this tab are activated or deactivated.

Here you also can set the **Maximum Voltage** of the laser diode. If this value is achieved, the laser turns off automatically and the LD Voltage Error indicator (green, rectangular) lights up.

Temperature card

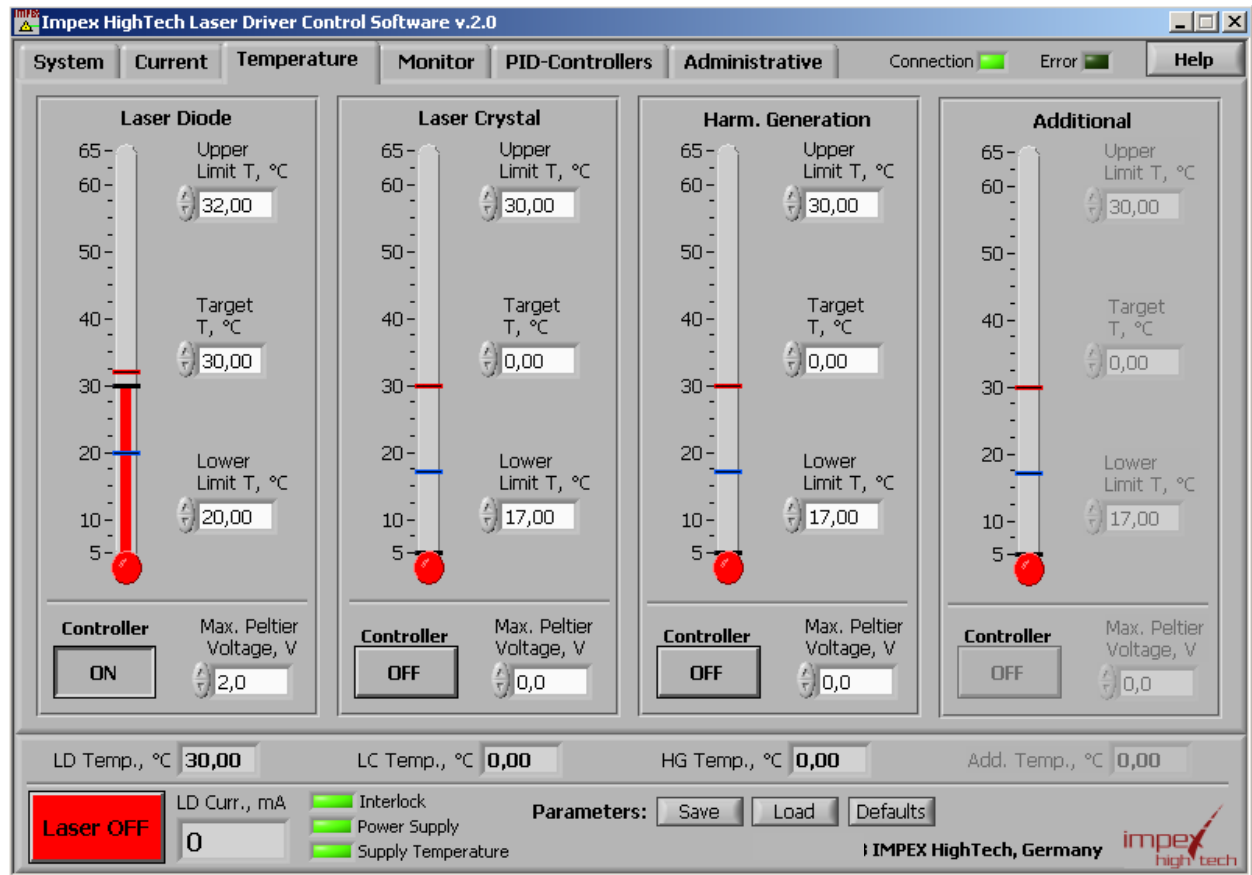


Figure 6. Temperature card

This card is divided into four equal parts, one for each of the built-in temperature controllers. By LD-SMART, there are three built-in temperature controllers one Bipolar and two Unipolar. You can activate or deactivate the controller with the **ON/OFF** button.

Max. Peltier Voltage is to limit the controller output, not to damage the connected TEC module (Thermo Electric Cooler, Peltier Element). Please refer to the datasheet of the present TEC module for this value.

The **Target** temperature is set on the right side of the thermometer symbol. On the left side you have to specify the **Upper and Lower Limits**. Within this window the laser operation is ensured. When the temperature exceeds these limits, the laser and the corresponding temperature controller are turned off automatically. Please normalize the temperature or readjust the limiting values before turning the laser and the temperature controller on again.

PID Controllers Card

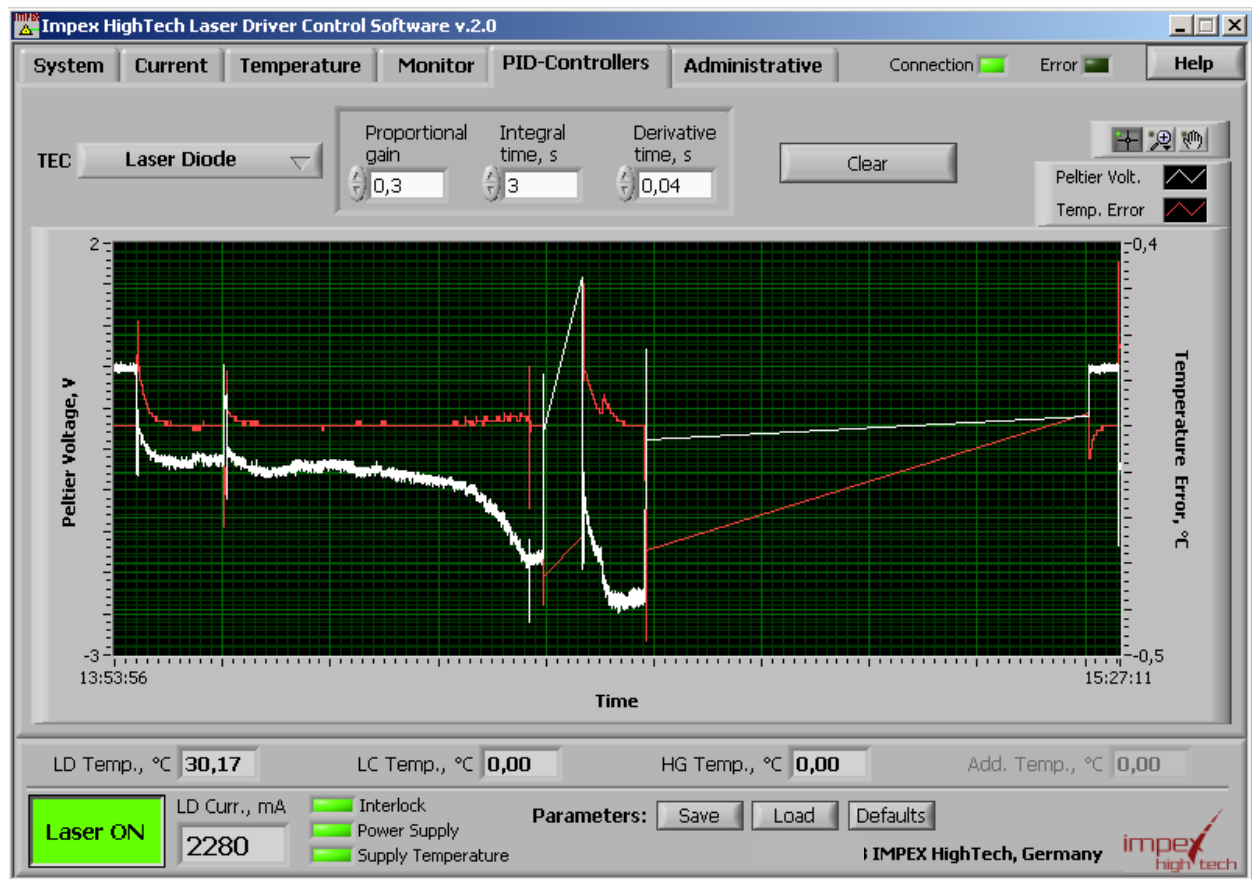


Figure 7. PID Controllers card

For fine-tuning of the temperature controller settling speed, the PID parameters can be adjusted. The parameters are labeled as Factors, this means that they do not have units. The values of the factors range from 0 to 255. There is no equation to find optimal values, they depend on much physical parameters and can be found intuitively.

Monitor card

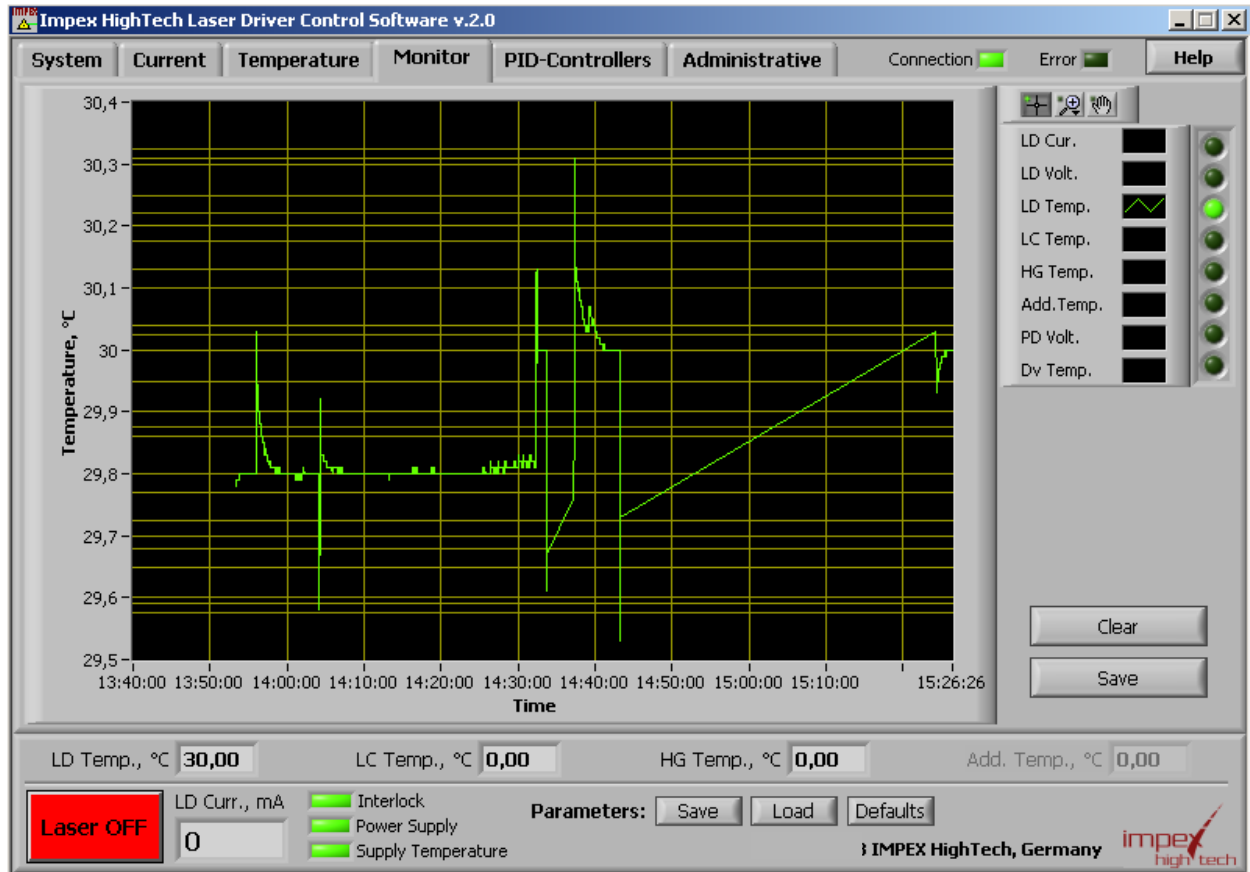


Figure 8. Monitor card

The monitor card shows the values, for which monitoring has been activated (round switch adjacent to the indicator is lime-green) graphically. Please note, that temperature values use the scale on the left side, current and voltages use the one on the right side of the graph by default. At the upper right corner you can set up display options such as line style and color for each value individually. Just click on the line pictogramm and choose the parameter you want to adjust.

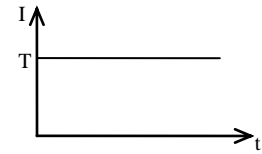
You can clear the display to start a new measurement using the **Clear** button.

With the **Save** button you can save the graphs to a text file. The values are separated by semicolon, so a common spreadsheet program can be used to work with the data later.

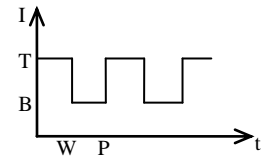
4.3 Laser modulation modes

There are six modes to modulate the diode current available (the numbers represent the code for the RLMM instruction, see chapter 5. Protocol description):

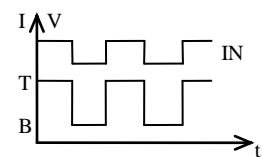
10. Continuous Wave (CW): the **T**arget current will permanently be driven through the diode.



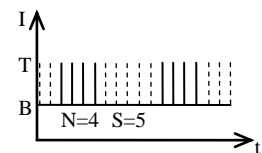
20. Internal Pulse: the current will change between **B**ase and **T**arget, following hereby the given pulse **W**idth and pulse **P**eriod times.



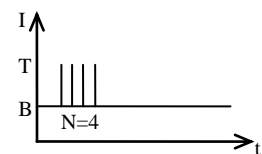
30. External Pulse: the current will change between **B**ase and **T**arget, following the IN-signal at TTL_IN connector (Figure 3). Low level means **B**ase current, high level means **T**arget current.



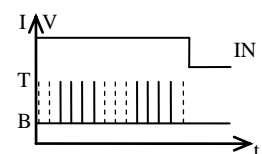
40. Periodic Burst: this mode is similar to the internal pulse mode, but the given **N**umber of pulses is followed by given number of **S**uppressed pulses. During suppressed pulses, the current is being kept at the **B**ase level. The pulses are formed with given width and periode.



50. Single Burst: in this mode, the device will operate with a given **N**umber of current pulses and stop afterwards, waiting for a further laser ON signal. That is: user click the Laser ON button or the TTL_IN (Figure 3) goes high in gate mode (s. below).



60. Gate Mode: In modes with internal pulse generation, the TTL input connector (Figure 3) can be used to turn the laser on or off. This behavior is called gate mode and can be entered using the corresponding button. Please make sure, that the external pulse frequency is much lower than the laser pulse frequency.



5. Protocol description

The main microcontroller of the LD-SMART communicates using the UART (serial) interface. The device further has a built in serial to USB converter. The USB driver software implements a virtual serial interface at the PC side. So it comes out to a pure serial communication. At the current revision, the transfer parameters are fixed to 115200 baud, no parity, 8 data bits, 1 stop bit. The LD-SMART acts as a slave, i.e. it only answers to requests from a master (PC) and does not send any data by itself. Every transaction is terminated with the carriage return <CR> character (ASCII: 13). Every instruction is echoed and responded with the actual value. So to check a parameter, only the pure instruction is sent. To set a new value, the instruction followed by the new value is send and compared with the received answer. Please note, that some instructions are read-only, i.e. the possibly transmitted value is ignored. Decimal separator is the dot (.). In binary values, a single character T (true) means ON and an F (false) means OFF.

Examples

Set the laser target current to 1000mA

Master: RLCT1000<CR>

LD-SMART: RLCT1000<CR> 1000<CR>

Check the laser current

Master: RLCA<CR>

LD-SMART: RLCA<CR> 1000<CR>

Instructions list

Instruction	LCD Text	Target	Description	Type	Unit
RLMXN	Invert Gate	Laser	Invert Gate Signal	bool	
RLPCA	Photo Curr	Laser	Photo Current Actual	uint16	uA
RLPCT	Photo Curr	Laser	Photo Current Target	uint16	uA
RLPCC	Ph Cur Contr	Laser	Photo Current Control	bool	
RLMBN	Burst Pulses	Laser	Number of Pulses in Burst	bool	
RLMBS	Suppr Pulses	Laser	Number of Suppressed Pulses	bool	
RLTLU	LD Temp Max	Laser	Upper Temperature Limit	float	°C
RLTLL	LD Temp Min	Laser	Lower Temperature Limit	float	°C
RCTLU	LC Temp Max	Crystal	Upper Temperature Limit	float	°C
RCTLL	LC Temp Min	Crystal	Lower Temperature Limit	float	°C
RHTLU	LC Temp Min	Harmonic	Upper Temperature Limit	float	°C
RHTLL	LC Temp Min	Harmonic	Lower Temperature Limit	float	°C
RLTCP	LTC P-Factor	Laser	PID-Regulator P-Factor	uint16	
RLTCI	LTC I-Factor	Laser	PID-Regulator I-Factor	uint16	
RLTCD	LTC D-Factor	Laser	PID-Regulator D-Factor	uint16	
RLTCV	LTC Max Volt	Laser	Maximal TEC Voltage	uint16	
RLTCS	LTC SetLevel	Laser	PID-Regulator Set Level	uint16	
RCTCP	CTC P-Factor	Crystal	PID-Regulator P-Factor	uint16	
RCTCI	CTC I-Factor	Crystal	PID-Regulator I-Factor	uint16	

Instruction	LCD Text	Target	Description	Type	Unit
RCTCD	CTC D-Factor	Crystal	PID-Regulator D-Factor	uint16	
RCTCV	LTC Max Volt	Crystal	Maximal TEC Voltage	uint16	
RCTCS	CTC SetLevel	Crystal	PID-Regulator Set Level	uint16	
RHTCP	HTC P-Factor	Harmonic	PID-Regulator P-Factor	uint16	
RHTCI	HTC I-Factor	Harmonic	PID-Regulator I-Factor	uint16	
RHTCD	HTC D-Factor	Harmonic	PID-Regulator D-Factor	uint16	
RHTCV	HTC Max Volt	Harmonic	Maximal TEC Voltage	uint16	
RHTCS	HTC SetLevel	Harmonic	PID-Regulator Set Level	uint16	
RLCL	LD Cur Limit	Laser	Current Limit	uint16	mA
RLCT	LD Current	Laser	Current Target	uint16	mA
RLCA	LD Current	Laser	Current Actual	uint16	mA
RLCB	LD Curr Base	Laser	Current Base	uint16	mA
RLVA	LD Voltage	Laser	Actual Voltage	float	V
RLVC	LD Compl Vol	Laser	Compliance Voltage	float	V
RLMM	Modulation	Laser	Modulation Mode	uint16	
RLMW	Pulse Width	Laser	Pulse Width (internal)	uint32	us
RLMP	Pulse Period	Laser	Pulse Period (internal)	uint32	us
RLTT	LD Temp	Laser	Temperature Target	float	°C
RLTA	LD Temp	Laser	Temperature Actual	float	°C
RLTC	LD Temp Ctrl	Laser	Temp. -Controller Enable	bool	
RCTT	Crystal Temp	Crystal	Temperature Target	float	°C
RCTA	Crystal Temp	Crystal	Temperature Actual	float	°C
RCTC	Cryst T Ctrl	Crystal	Temp. -Controller Enable	bool	
RHTT	HarmGen Temp	Harmonic	Temperature Target	float	°C
RHTA	HarmGen Temp	Harmonic	Temperature Actual	float	°C
RHTC	HG Temp Ctrl	Harmonic	Temp. -Controller Enable	bool	
RGVS	Soft Version	General	Software Version	string	
RGVN	Serial No.	General	Serial Number	string	
RGLT	Laser OnTime	General	Diode Life time	uint32	min
RLG	Gate Option	Laser	Gate Option	bool	
RGD	Set Defaults	General	Set Defaults	bool	
RGS	Status Word	General	Get Status (1=TRUE)	string	
RGM	Manual Contr	General	Manual Control Enable	bool	
RGT	Device Temp	General	Device Temperature	float	
RL	Laser Diode	Laser	Laser On/Off	bool	

6. Warranty

Impex HighTech LD-SMART is warranted to be free of defects in material and workmanship for 12 month from date of shipment. The warranty shall not cover any damage incurred during shipping. When the product is received by the customers, the shipping container and its content should be inspected for any damage incurred during shipping. In order to obtain service under this warranty, the customer must notify **Impex HighTech** about the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. In all cases the customer will be responsible for properly packing and shipping the product back to **Impex HighTech**, with shipping charges prepaid. If the product is not properly packed, it will be damaged in shipping and the warranty will be avoided.

This warranty shall not apply to any defect, failure, or damage caused by improper use, failure to observe proper operating procedures per the product specifications (see chapter 2. Specifications), or improper/inadequate maintenance. **Impex HighTech** shall not be obligated to furnish service under this warranty 1) to repair damage resulting from attempts by personnel (other than **Impex HighTech** representatives) to repair or service the product; 2) to repair damage resulting from improper use or connection to incompatible equipment; 3) to repair damage resulting from operation outside of the operating environmental specifications of the product; 4) to repair damage resulting from improper packaging of the product in order to return it to **Impex HighTech**.

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3. March 2016

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