THORLABS

TL1300-B/TL1550-B

INTUN Series Tunable Lasers

User Guide

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Chapter 1 Safety

Prior to operating the INTUN tunable laser, you should read this chapter to avoid damage to the unit, connected circuit, or personnel. The safety instructions given herein must be strictly adhered to at all times. All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

WARNING

This unit can deliver radiation that can cause eye damage. Make sure to strictly adhere to the safety recommendations of the appropriate laser safety class. The laser safety class is marked on the laser unit.

SHOCK WARNING

Mobile telephones, cellular phones, or other radio transmitters are not to be used within the range of three meters of this unit, since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to EN 50 082-1.

INVISIBLE LASER RADIATION

Avoid exposure to the beam.

Class 3B laser product
700 – 1000 nm <500 mW

Avoid direct eye exposure.

Class 3R laser product.
1150 – 1700 nm <50 mW

Chapter 2 Description

In order to ensure that the INTUN system will operate correctly and meet the stated specifications, requirements regarding handling and operation stated within this manual must be met.

2.1. What is a Tunable Laser Source (TLS)?

A Tunable Laser Source (TLS) is a laser whose output wavelength can be swept (continuous or random access) over a certain wavelength range. The INTUN laser's tuning range typically varies from 15 nm to 150 nm, depending on the model chosen. The TLS can be thought of as an optical equivalent to the conventional electrical sweep oscillator. Although the acronym TLS is sometimes used interchangeably with ECL (External Cavity Laser), ECL actually refers to the technical design of the laser itself. Therefore, TLS encompasses a larger number of products than ECL, since an ECL is not necessarily tunable.

TLS's are frequently used in various measurement applications to record some quantity (e.g., intensity) as a function of wavelength. Each application requires detailed knowledge of some or all of the parameters that characterize a TLS (e.g., wavelength range, side mode suppression levels, spontaneous noise levels, linewidth, and sweep characteristics).

2.2. Littrow External Cavity Laser (ECL) Geometry

As shown below in Figure 1, the INTUN TLS is based on a semiconductor laser mounted in Littrow external cavity laser (ECL) geometry. This tuning arrangement allows for high output power while maintaining a large mode-hop-free tuning range. The INTUN configuration offers a lower noise floor and a robust cavity.

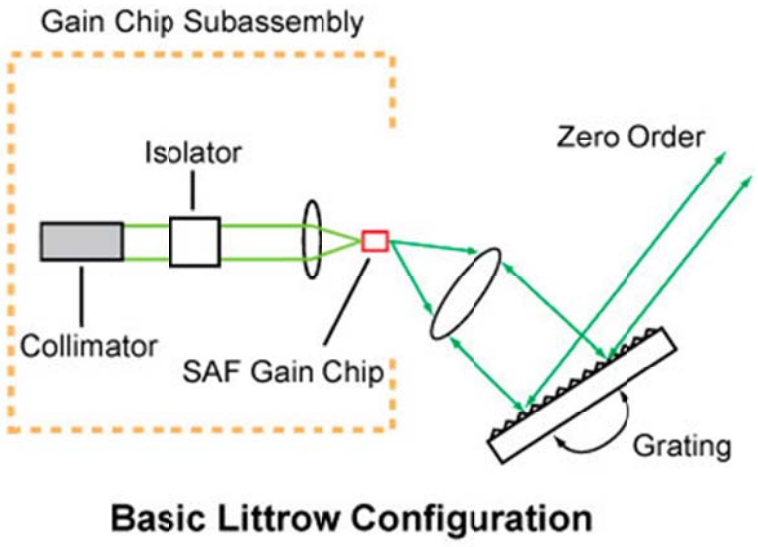


Figure 1 Schematic of the INTUN system

2.3. Components

- **Shutter**: The optical port is protected by a mechanical shutter, which slides sideways using a small handle.
- **Beam**: The beam exiting the INTUN laser is collimated with a diameter of less than 5 mm.
- **30 mm Cage System**: The INTUN laser is equipped with four threaded 4-40 holes, allowing for easy integration into a 30 mm cage system. Fiber coupling is normally done using the cage system.

- **SM1 Thread**: The INTUN laser is equipped with internal SM1 threading on the optical exit port, thus enabling seamless integration into a SM1 lens tube system.

2.4. Features

The INTUN laser offers continuously tunable mode-hop-free operation. This system is controlled via a USB interface. The USB port is treated by the host software as a serial com through virtual com port drivers (VCP). The set of commands for the INTUN laser are based on the MSA standard for tunable lasers and includes additional commands to improve functionality.

The INTUN laser series comes with a LabVIEW™ software package that enables the user to control the laser via a computer. The software package contains a standalone graphical user interface (GUI) and drivers that can be run from within LabVIEW™. Dynamic link library drivers (DLL) are available upon request and enable driver integration into a large number of programming languages.

- USB interface with extensive set of PC host software
- High-resolution wavelength tuning with modulation functions (coherence control)
- High-resolution optical power control with modulation functions
- Continuous and mode-hop-free sweep capability over entire wavelength range
- Robust design
- High-performance, single-mode, low noise spectral characteristics
    - o High spectral purity
    - o Signal to source spontaneous emission ratio
    - o Side mode suppression

2.5. Operating Elements

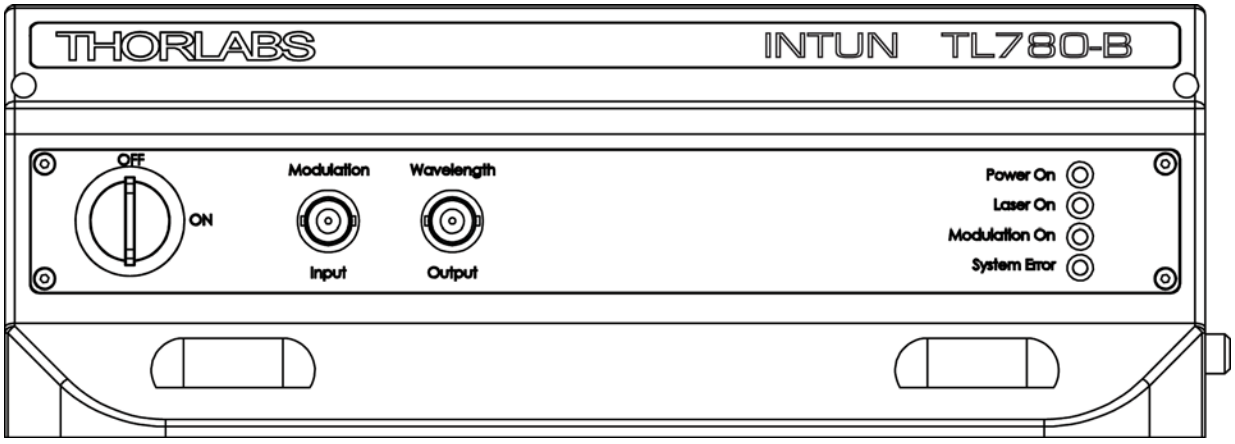


Figure 2 INTUN Laser Front Panel

The INTUN laser is switched on and off with a key and controlled by software optimized for a Windows™ PC. Please see Section 3.1 for information on software installation.

- **Modulation Input:** Modulation input for analog optical power modulation. Maximum signal amplitude is 2 $V_{P-P.}$
- **Wavelength Output:** Analog output signal representing the actual wavelength. The output amplifier is 0 to 4 V. The load should have an impedance of 10 kΩ or higher.
- **Power On:** LED indicates main power on.
- **Laser On:** LED indicates laser optical power on.
- **Modulation On:** LED indicates *Analog Dither* enabled. The optical power can be modulated with the modulation input BNC connector.
- **System Error:** LED indicates a fatal failure.

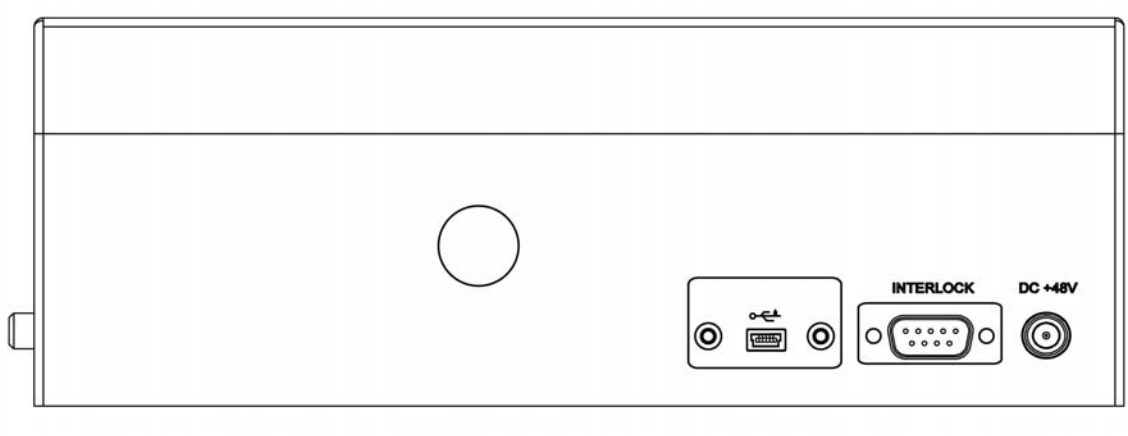


Figure 3 INTUN Laser Rear Panel

- **USB:** This is the communication interface to the host controller (Windows™ PC). Use an A to type mini B USB cable.
- **Interlock:** To enable laser output, the DB9 connector pin 1 and pin 2 must be connected. This feature should be used to comply with safety requirements where applicable.

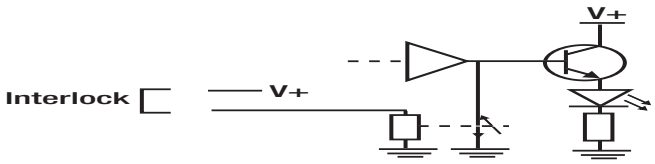


Figure 4 Interlock Circuit Schematic

- **DC +48 V:** 48 V DC Main Power Input (48 V power supply included).

Chapter 3 Setup

3.1. Software Installation

See the INTUN-B software installation guide included in the host software CD package (right click the CD drive).

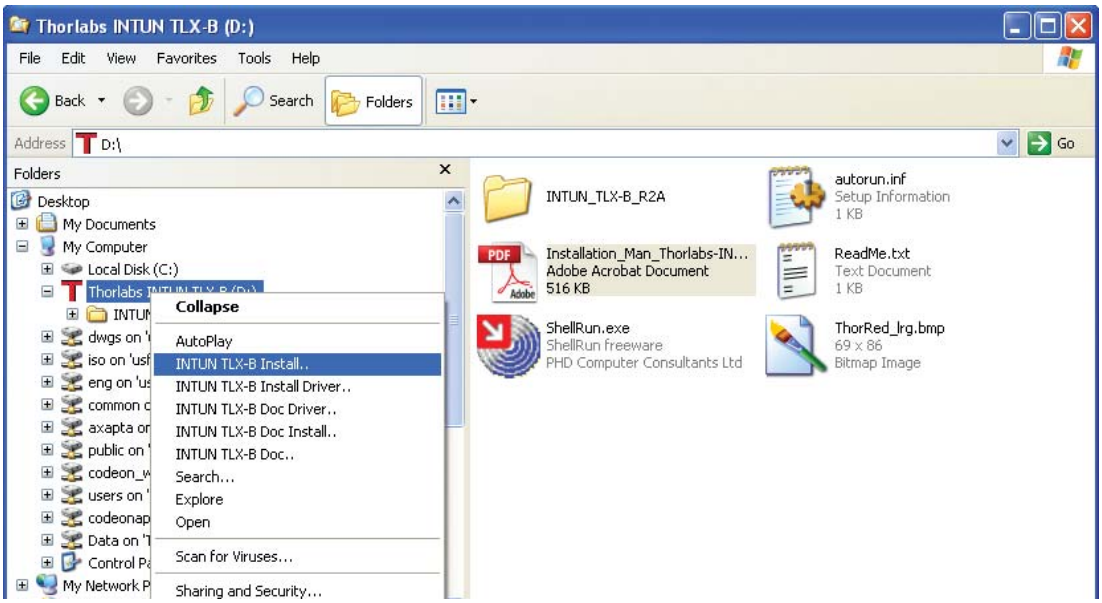


Figure 5 Software Installation

3.2. General Information about GUI

The GUI executable is a ready-to-use graphical user interface where all laser features can be controlled from within five tabs. All of these features can also be controlled from within the control software (right click the CD drive to access the installation and driver documentation- see Figure 5 above). See pages 10 to 14 for more information.

- ***Main* tab:** Control wavelength and power; read the actual wavelength through a laser wavelength sensor.
- ***Parked* tab:** Tune the wavelength in three different modes: closed loop, step, and piezo/fine tuning, features that allow both fast and ultra-high-resolution tuning.
- ***Sweep* tab:** Set a wavelength continuous mode-hop-free sweep between two different wavelengths with a specific tuning speed. (0.02 to 100.00% of max tuning speed, see model-specific max tuning speed).
- ***Dither* tab:** Set digital dither to internally generate modulation signals for optical power (frequency and depth) and wavelength (depth). Supports simultaneous modulation of both power and wavelength. Enable analogue dither for external modulation control of optical power through front panel BNC connector.
- ***Status* tab:** Laser status; cleared when exiting the tab.

White controls and slides are adjustable (when not grayed out). Items on the GUI with yellow background or yellow parts are read-only indicators.

3.3. Getting Started

After installation of the INTUN software, connect the unit following the steps below:

1) Connect the power supply adapter and USB cable.
2) Connect the interlock at the rear panel.
3) Turn on the INTUN laser (the system will be lasing at this point).
4) Start the INTUN GUI from the start menu.
5) Select the INTUN in the USB devices list.
6) A pop-up dialog will pause the GUI during the laser initiating process. The INTUN-B startup time is less than one minute, after which the GUI is enabled.
7) The GUI will be initiated with current laser settings and ready to use.

NOTE

When the laser is started, the lasing will be activated during the start-up sequence and will remain activated until you switch it off.

3.3.1. First-Time Operation

Once the INTUN laser and GUI are started, set power and wavelength with the knobs or enter values in white digital controls.

If turned off/on or reset, the laser will go through the start-up sequence again, during which the GUI will be paused for less than one minute (typically around 20 seconds).

Chapter 4 Operation

4.1. System Organization

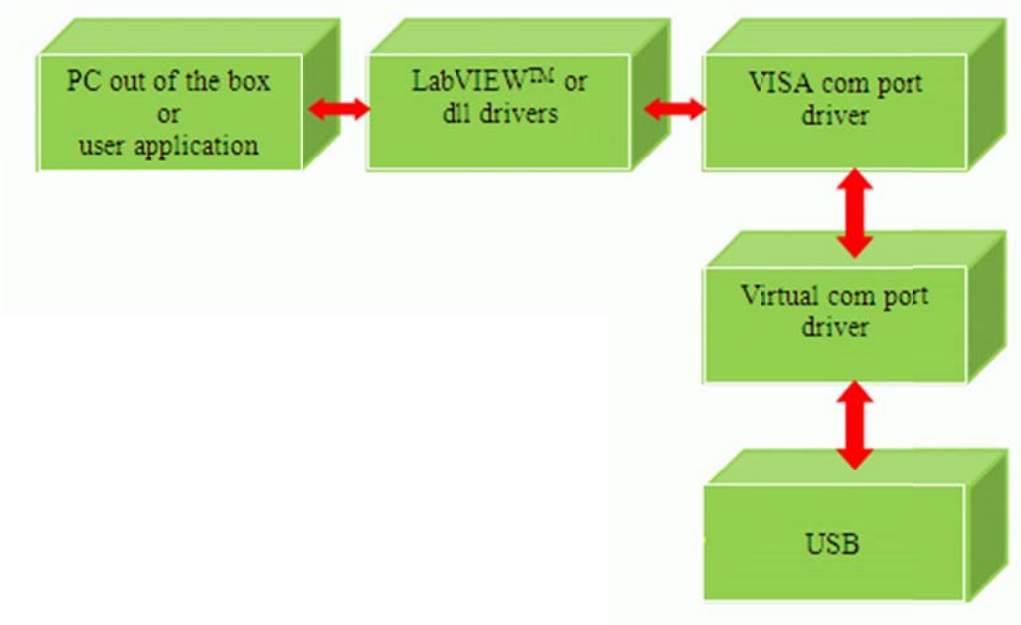


Figure 6 INTUN System Organization

A host PC initiates all actions after the laser start-up through the chain seen above. The user only needs to handle the application software or integrate high-level driver functions into control software.

Information between the INTUN laser and the PC is communicated through a USB cable. The INTUN drivers handle the USB interface through virtual com port drives and there is no need to develop USB-specific code.

4.2. INTUN Laser Operation

The INTUN TLS offers two principal modes of operation:

- **Parked Mode:** The laser is parked at any chosen wavelength (select the *Parked* tab).
- **Sweep Mode:** The laser is continuously tuned between two chosen wavelengths (select the *Sweep* tab).

4.2.1. Status Signals

- **Busy:** The software is busy.
- **Pending:** The laser is processing a command and will not respond to new commands until ready. Values or commands set during a pending operation will be qued by the GUI for later execution.
- **Error:** Operation time out of laser temperature is out of range.
- **Limit:** Set power exceeds reachable power at current wavelength (laser current limit).

4.3. Main Tab

This tab allows you to switch the laser on and off, control the optical power and wavelength, and displays the actual wavelength.

With the *save* button, current settings can be saved for later use. For example, wavelength, power, and sweep parameters can have saved values set from power-up or reset.

Figure 7 Main Tab

With the *reset* button, the INTUN laser will perform a hardware reset, equivalent to turning the power supply off and on.

4.4. Parked Tab

The *Parked* mode has three different types of wavelength tuning:

1) **Controlled Mode:** The wavelength is controlled by feedback to reach the desired wavelength. Wavelength resolution is around 5 pm (model-specific).

2) **Step Mode:** The wavelength is tuned in discrete steps of less than 0.5 pm.

3) **Fine Tune Mode:** The wavelength is tuned by a piezo actuator. Wavelength resolution is better than 0.1 pm. This mode cannot be used together with digital wavelength *Dither*.

In *Step Mode* and *Fine Tune Mode*, you can adjust the wavelength (closed-loop wavelength control deactivated) with a precision close to the effective line width of the laser.

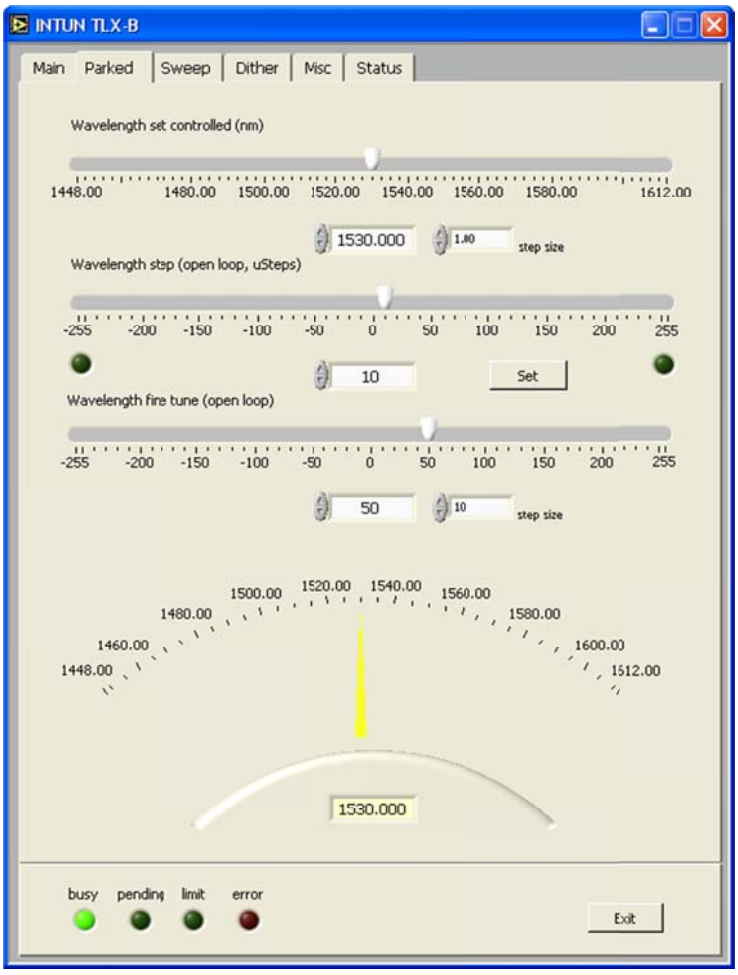


Figure 8 Parked Tab

4.5. Sweep Tab

In *Sweep* mode, you can set parameters for a sweep between two different wavelengths.

You can choose between *Cycle* and *Continuous* modes. In the *Cycle* mode, you choose the number of sweep cycles. In the *Continuous* mode, the sweep will go on until you stop it. You can use the *Stop cycle* button to stop the sweep after the ongoing cycle of the *Stop now* button for an immediate stop. You can also set the speed for the tuning as a percent of the maximum speed.

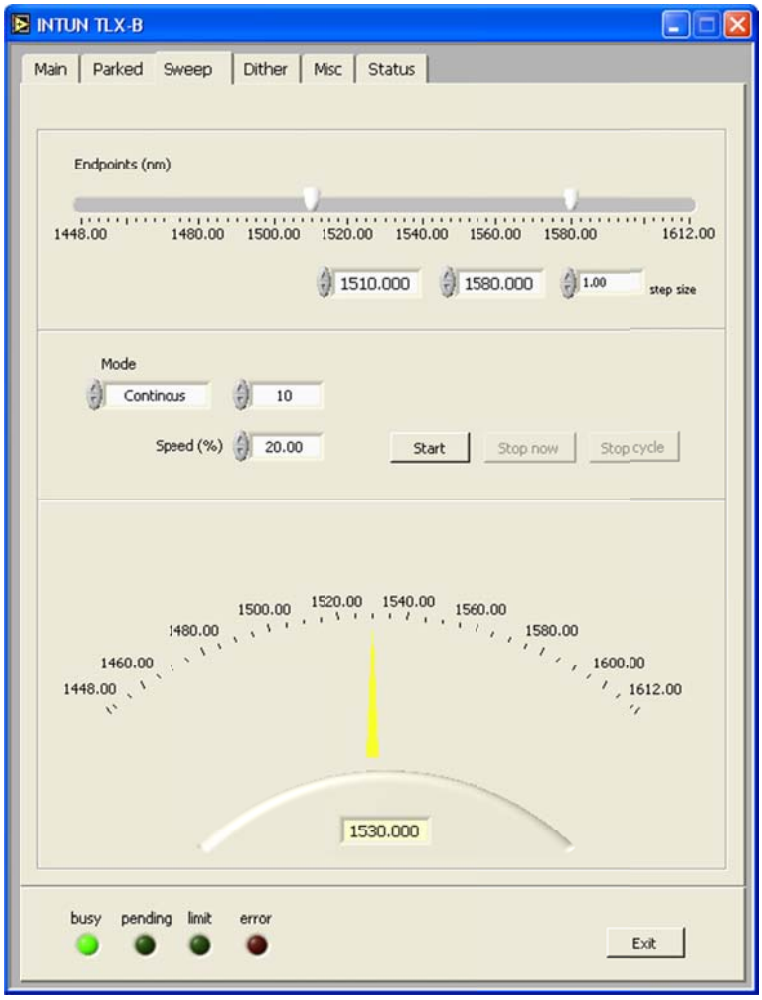


Figure 9 Sweep Tab

The difference between the two wavelengths (in pm) divided by the tuning speed (in %) must be a factor greater than 7.5.

- Example: A sweep between 778.750 nm and 782.250 nm with 100% tuning speed will generate a factor of [(782250-778750)/100]=35.

This software does not allow you to set invalid numbers.

4.6. Dither Tab

In the *Dither* tab, you can choose between *no dither, digital dither*, and *analog dither.*

In the *digital dither* mode, you can choose between power dither (AM) and wavelength dither (FM). In power dither, you can set the frequency and depth of the power modulation. In *wavelength dither*, the modulation can be set to one of two preset wavelength amplitude values, and the modulation repetition rate is fixed. Wavelength dither and fine tune cannot be active at the same time.

In *analog dither* mode, the power can be modulated from the modulation input BNC connector.

Figure 10 Dither Tab

4.7. Misc Tab

In the *Misc* tab, you can see the laser serial number, host application software release, and the communication port number.

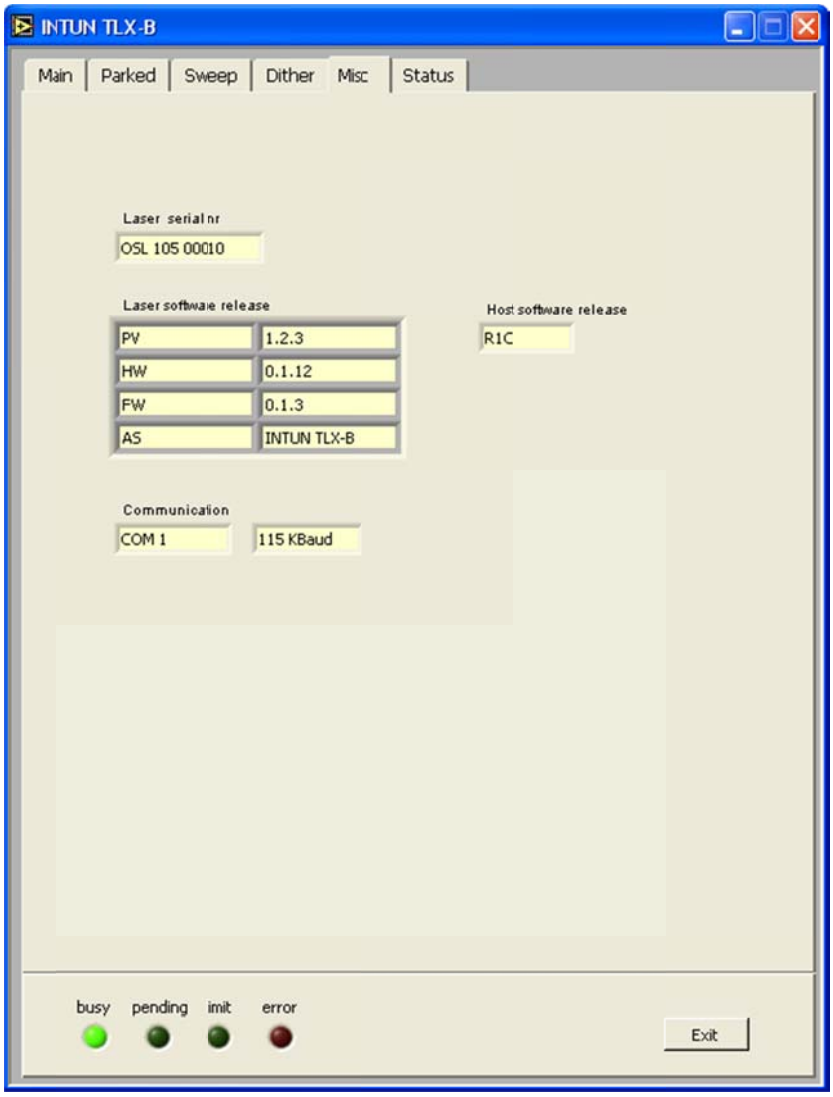


Figure 11 Misc Tab

4.8. Status Tab

The top display indicates whether any error has occurred during a measurement. In the event of an active status indicator, the top display will futher explain an error or warning. If the temperature inside the unit is out of a specified range, you will also get a warning state in the display.

Upon leaving the *Status* tab, information will be cleared, unless the error or warning remains. The status is categorized as either a warning or a fatal state.

The *Current* to the laser is shown as a 14-bit digital number proportional to the current.

The output *Power* from the laser is shown as a 14-bit digital number proportional to the power.

The *Wavelength* is shown as a 14-bit digital number and is used by the laser to track the wavelength.

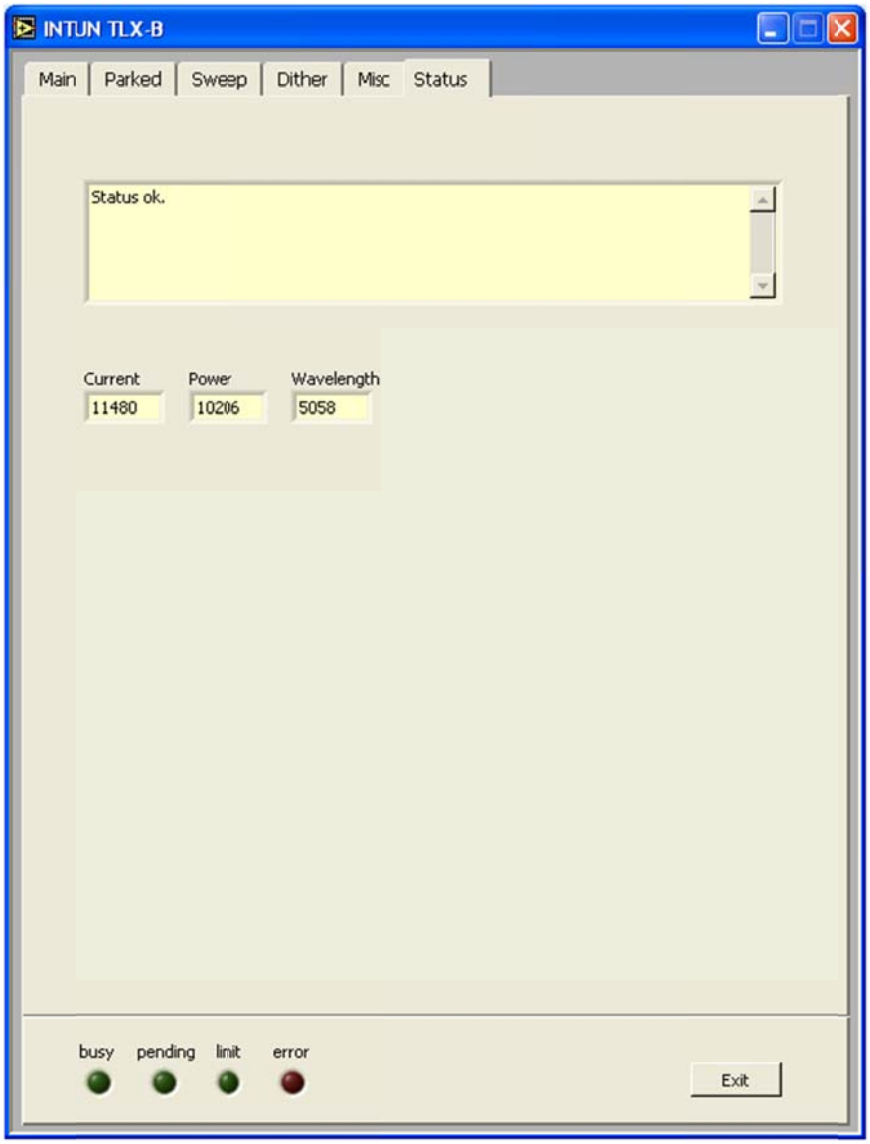


Figure 12 Status Tab

4.9. SW Drivers

Documentation

Right click on the CD rom drive and select the driver's documentation (see below):

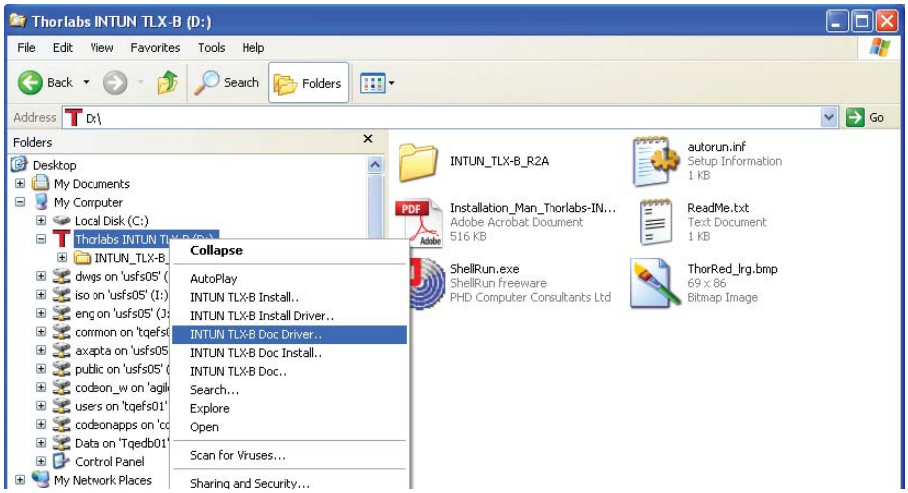


Figure 13 Finding Driver Documentation on CD Drive

In the driver's documentation overview, click on a link to open a pdf document (see below):

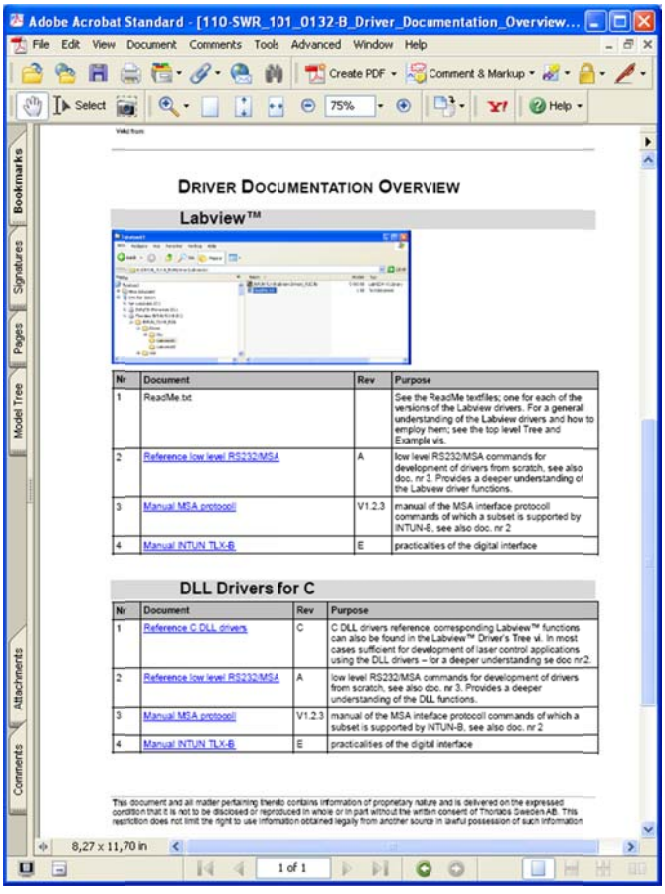


Figure 14 Documentation PDF

Chapter 5 Service and Maintenance

Protect the INTUN TLS from adverse weather conditions. The INTUN laser is not hermetically sealed.

You can perform a proper optical cleaning of the output window if necessary.

5.1. Troubleshooting

5.1.1. Communications Error

Check that the FTDI VCP drivers have been installed ('start/control panel/add or remove programs/FTDI CDM Driver Package'). Refer to the installation manual on the CD, appendices B and C. If reinstalling software, first be sure to uninstall existing software.

5.1.2. No Output Power

1) Check the interlock, see Section 2.5.

2) Check the power on and system error LEDs.

3) Check the current limit GUI indicator.

4) Check the top display in the GUI *Status* tab for information.

5.2. Service

In order to be within optical specifications, it is recommended to do service after 5 x 10^7 sweeps or one year, whichever occurs first.

5.3. Warranty

Thorlabs warrants material and production of the INTUN TLS for a period of 12 months starting with the date of shipment. Thorlabs will make the final determination as to the cause or existence of the defect and, at our discretion, repair or replace the products that prove to be defective during the warranty period. Products replaced under warranty will be warranted only for the balance of the warranty period of the originally supplied equipment. Additionally, any purchased replacement parts, i.e. laser tubes, power supply modules, etc., are warranted for a six-month (6) period.

Review the terms of your purchase and the date of shipment to determine the validity of your warranty claim. Warranty claims should only be made for products that are within the terms of the warranty policy. However, out-of-warranty items may be returned for evaluation at no charge.

Prior to returning any unit for repair or evaluation, please contact Thorlabs either by phone at (973) 300-3000 or by fax at (973) 300-3600 to obtain authorization to return the unit in the form of a Return Authorization number. This number is valid for a set period of time; 30 days for domestic customers, 45 days for foreign customers. If the unit is not received within this time frame, the authorization number will be closed out and you will need to call to obtain a new authorization number. For returns in foreign countries where representation is present, please contact your distributor. For customers in the U.S.A. and countries where distributorships and/or representation is not available, all claims and correspondence should be addressed to:

Thorlabs, Inc.
56 Sparta Avenue
Newton, NJ 07860
USA
Ref: Return Authorization Number

Please be prepared to furnish the following information when requesting an authorization number:

1) Product model number and serial number

2) Date of shipment/purchase

3) Brief description of problem/failure

4) Name and phone number of contact person at your organization

Obtain Thorlabs instructions for transportation and packaging, and ship the product (freight and insurance prepaid) with the proper documentation containing the authorization number and the information specified above. Please ensure that the authorization number is visible on the front of the shipping container.

Thorlabs will advise the purchaser of its evaluation results at the earliest possible time. Providing complete information as requested will help to expedite this process. For products outside their warranty period, an evaluation will be made at no charge, and a cost estimate for repair/replacement will be issued. Only after receiving authorization (in the form of a Purchase Order) will any repair/replacement work be performed. Charges for repair work will be billed at the current repair rate (available upon request from Thorlabs) plus the cost of any additional required parts. Repair work will be warranted for a period of 6 months from the date of shipment.

Restrictions of Warranty

Thorlabs warrants the hard and software for this unit to operatate fault-free, provided that they are handled according to our requirements. However, we do not warrant a fault-free and uninterrupted operation of the unit, hardware, or software for special applications and are not liable for consequential damages.

This warranty does not cover errors and defects resulting from misuse, software or interface not supplied by Thorlabs, modification, unauthorized maintenance, or operation outside of defined ambient conditions.

Thorlabs does not warrant the instruction manual to be error-free and reserves the right to change this manual or the technical data of the described unit at any time.

For more information, please refer to the general terms and conditions of sales that can be found at www.thorlabs.com**.**

Chapter 6 Specifications

Laser Specifications			
		TL1300-B	**TL1500-B**
Central Wavelength		1320 ± 10 nm	1575 ± 10 nm
Tuning Range		100 nm/min	110 nm/min
Optical Output Power		>20 mW	>20 mW
Tuning Speed (Continuous)		0 -50 nm/s	0 – 50 nm/s
Wavelength Resolution	**Controlled Mode**	12 bits of wavelength range	
	Free Step Mode	0.5 pm	1 pm
	Fine Tune Mode	0.1 pm	0.2 pm
Absolute Wavelength Accuracy		± 50 pm	
Wavelength Repeatability		10 pm	
Wavelength Stability (1 hr and 24 hr)		± 4 pm and ± 20 pm	
Power Set Resolution		25 μw	
Spectral Line Width		150 kHz*	
Effective Line Width		1.5 MHz	
Side Mode Suppression Ratio (SMSR)		45 dBc min	
Signal to Source Spontaneous Emission Ratio (1 nm Integration)		40 dB/nm (45 dB/nm Typical; 70 dB/nm Fiber Coupled)	
Signal to Total Source Spontaneous Emission Ratio (Full Integration)		25 dB (>65 dB Fiber Coupled)	
Relative Intensity Noise (RIN)		-140 dB/Hz	
Optical Output		Free-Space Collimated Beam	
Fiber Type		N/A	
Polarization Extinctino Ration (PER) at Output		16 dB	
Laser Classification		3R	

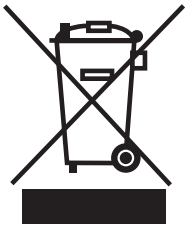
Measurement interval < 1 ms

Electrical and Interface Specifications		
	TL1300-B	**TL1500-B**
Input/Output		
DC Input	48 V / 20 W	
Analog Modulation Input	2 Vp-p, Max	
Analog Wavelength Output	0-4 V, Max	
Electrical Connectors		
DC Input Voltage	Rear Panel Socket	
Digital Status	0-5 V	
Interlock	DB9	
Communications	USB 2.0	
Analog Inputs	BNC	
General		
Operating Temperature Range	15 – 30 °C	
Operating Humidity	85% RH Non-Condensing	
Storage Temperature / Humidity	-20 to 60 °C, Non-Condensing Atmosphere	
Dimensions	242 x 87 x 142 mm (Free Space Beam) 243 x 87 x 142 mm (Fiber Coupled Output)	

Chapter 7 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

7.1. Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

7.2. Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 8 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.

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