



C450 LASER DRIVER

OPERATING MANUAL

Document Abstract

This document provides detailed information relating to the purchased hardware/system. It includes specifications; physical attributes and if required installation/setup instructions.

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INTRODUCTION

Redwave Labs' C450 is a compact and affordable integrated laser driver and temperature controller. It combines an integrated temperature driver and laser driver in one package with full digital control. The laser driver has modulation bandwidth of 250 kHz; with separate fast TTL compatible switching. The laser current has variable hardware limit which can be set remotely. All control loops can be configured via USB or Ethernet, and all settings are stored on the C450. Analog modulation input can be mixed with internal current set point with different mixing ratios. An additional laser plugin PCB allows easy customization for various laser diodes.



Features

- 250 mA max Laser Current
- External modulation signal can be applied via SMB connector
- Many different Laser/TEC packages can be accommodated
- Full digital control with Software included

Applications

- Spectroscopy
- Gas Spectrometry
- Precision Instrument
- Laser
- OEM applications

SPECIFICATION

Specifications	Parameter	Value
Power	Single	+12 V, 5A
Laser Current Control	Laser current	0 - 250 mA. Set in software or using external voltage.
	Compliance voltage	> 4.0 V
	Current setting accuracy	2 % fs
	Noise (RMS)	< 2 μ A
	Drift	< 20 μ A
	Temperature coefficient	50 ppm/C
	Current limit	Hardware-enforced, set by on-board DAC (software-programmable)
	Setting accuracy of current limit	2 % fs
Laser External Control	Voltage range	0 – 7.5 V default, laser dependent
	Input impedance	10 kOhm
	Modulation coefficient (I const)	35 mA/V, laser dependant
	3dB Bandwidth	DC ... 48 kHz
	TTL modulation, rise / fall-time	250 ns
	Modulation	External; Internal; variable External/Internal combination
	External modulation	Up to 90 kHz
	Internal modulation	Up to 250 kHz
	Interlock	Yes
Photodiode	Gain	100; 1k; 10k; 100k V/A
	Bandwidth	50 kHz
	Control	Digital
TEC Control	TEC current	0 ... $\pm$ 2.0 A
	TEC Voltage	> 4.5 V
	Max output power	9 W
	Current limit	0 – 2.0 A, digitally controlled
	Input sensor	10k Thermistor, 7 excitation current settings

		10; 50; 100; 250; 500; 1000; 1500 μ A
	PID control	Fully digital. Typical stability 1mK RMS
Connectors	Laser	Integrated Azimuth Electronics 14 pin connector with heat sink. Multiple pinouts can be accommodated with different plug-in PCBs. Can be replaced with optional DB15 connector
	Power	Molex MicroFit 2 pin
	Control	Molex MicroFit 12 pin
Digital Control		Computer control via USB or Ethernet. Can be programmed to start independently without computer connected
Dimensions	W x D x H	120.65 x 92.7 x 40.6 mm (4.75 x 3.65 x 1.6 Inch) (Height varies dependent on laser package variant)
	Weight	250-290 g (dependent on laser package variant)
	Storage Temp	-55 to 100 C
	Operating Temp	-40 to 85 C

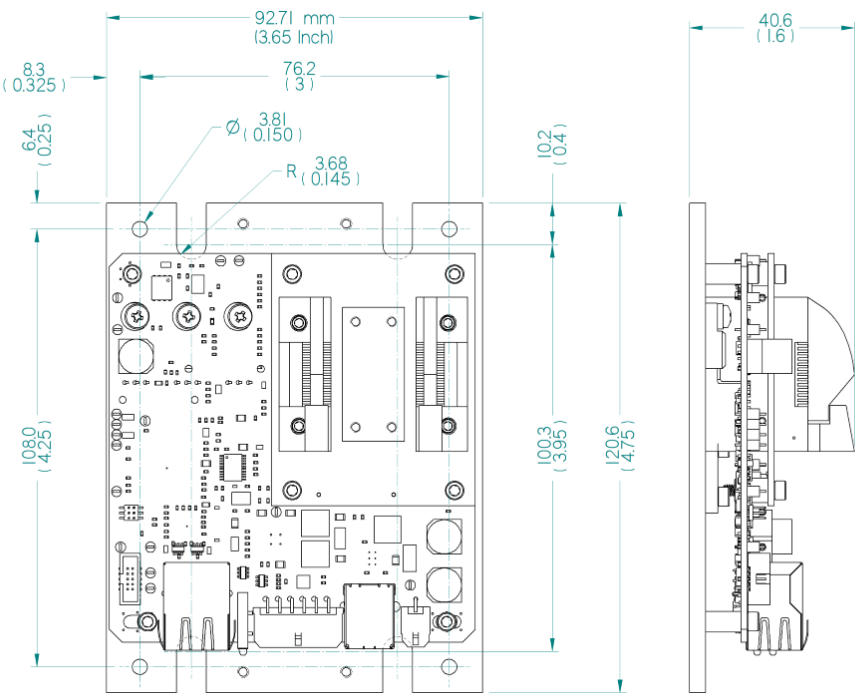
RedWave Labs Ltd keeps improving its products and therefore some specifications can vary.

ABSOLUTE MAXIMUM RATINGS

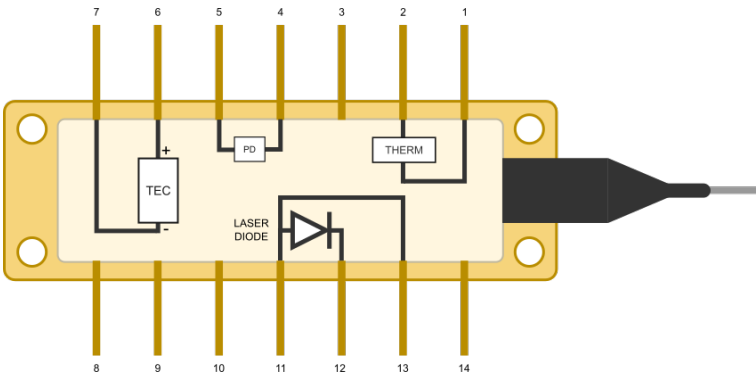
Symbol	Parameter	Ratings	Unit
V _{dd}	Supply positive voltage / Laser driver and TEC	+12 ±10%	Volt
T _{op}	Operational Temperature	-40 to 85	Deg C
T _{st}	Storage Temperature	-55 to 100	Deg C
T _c	TEC Current	-2 to +2	A
I _l	Laser Current	250	mA

ELECTRICAL AND MECHANICAL INFORMATION

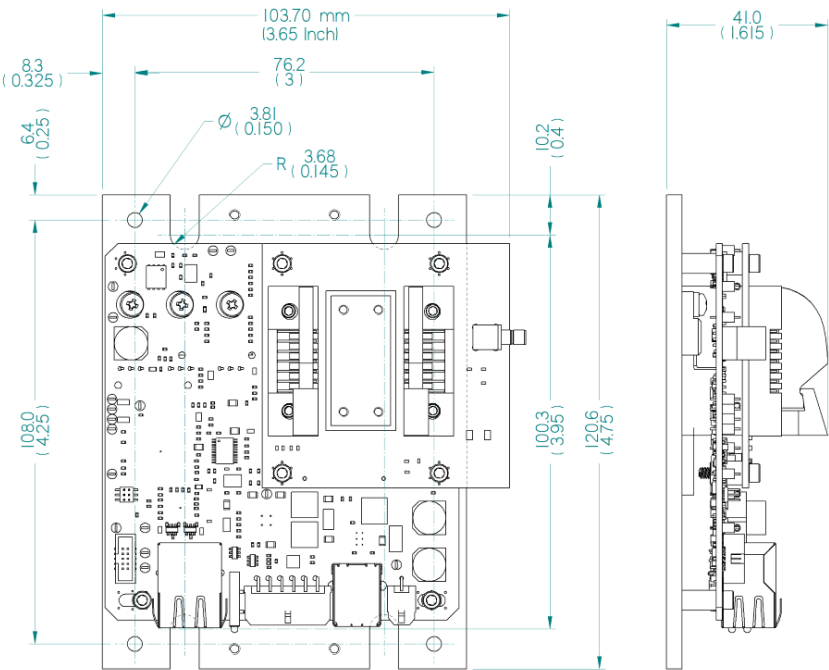
BUTTERFLY LASER VARIANT



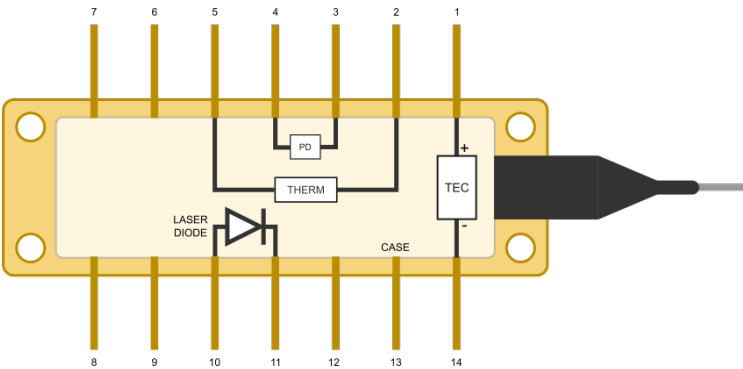
Laser Pinout



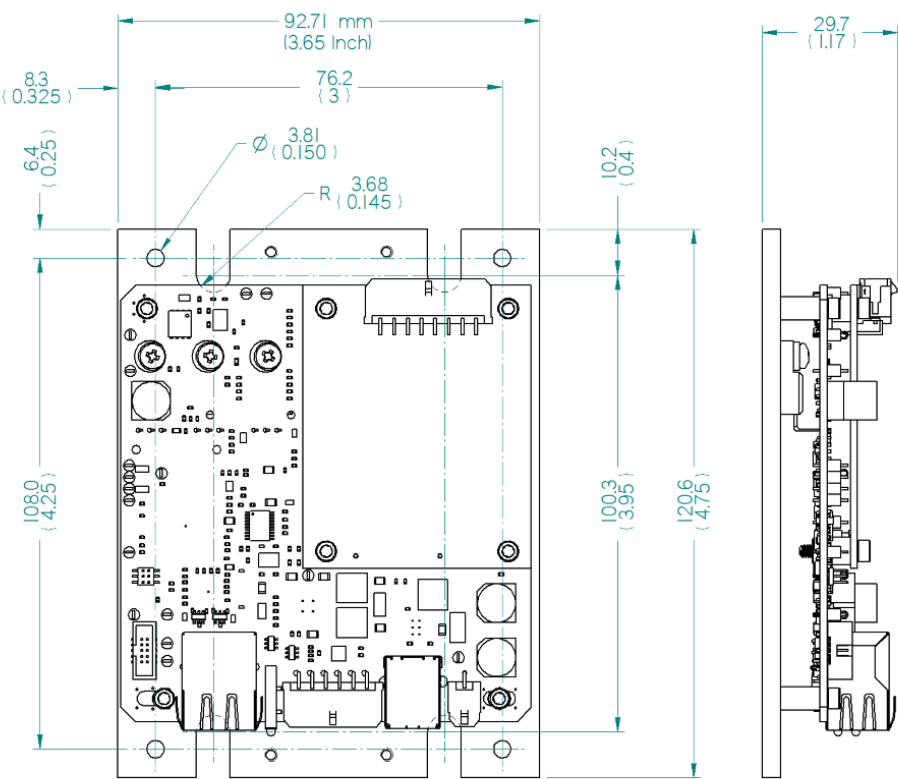
BUTTERFLY LASER WITH BIAS TEE VARIANT



Laser Pinout



EXTERNAL DIODE VARIANT



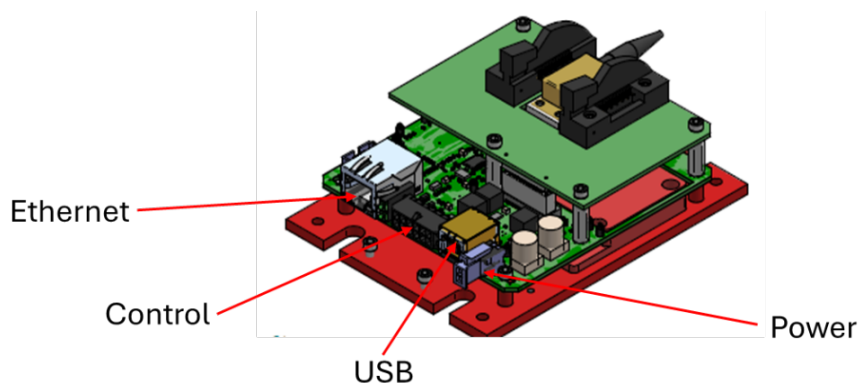
Laser Connector Pinout

Molex Part Number 2125281600

PIN#	Description
1, 8	Ground
2-3, 9-11, 15	N.C.
4	PD+
5	PD-
6	Thermistor+
7	Thermistor-
12	LD-
13	LD+
14	TEC+
16	TEC-

Appropriate mating parts: Molex 2064611600

CONNECTIONS



Connection	Name	Description
Molex 2 way	Power	12V 5A
Ethernet	Ethernet	Allows the board to be driven using Redwave Labs software or API
USB B	USB	USB Type-B Allows the board to be driven using Redwave Labs software or API
Molex 12 way	Control	Contains: LD enable; interlock; external laser control pins

POWER CONNECTOR

Molex part number 0430450201.

PIN#	Description
1	+12 V
2	Ground

Appropriate mating parts: Molex 430250200.

CONTROL

Molex part number 430451200.

PIN#	Description
1 – 5	Ground
6	+ Interlock
7	LD Control External
8	LD Enable
11	Error
12	- Interlock

Appropriate mating parts: Molex 430251200.

MODES OF OPERATION

LASER DIODE

Constant Current

The laser diode can be run in constant current mode with the setpoint either defined using software or the external control input, or a combination of both.

Modulated Current

The laser diode current can be modulated, up to the device bandwidth, using the external modulation input.

SETUP

SOFTWARE CONTROL (WINDOWS ONLY)

Install the Control Software

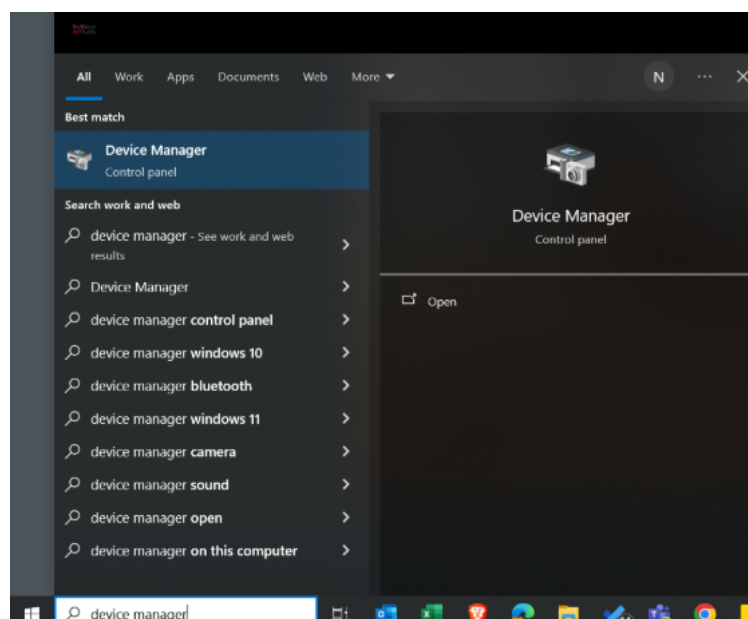
On a Windows computer Install the 'Term Tool' control software via the installer 'TermTool_vXXXX.XX.X.msi' (Version dependent on hardware version)

Connect the device

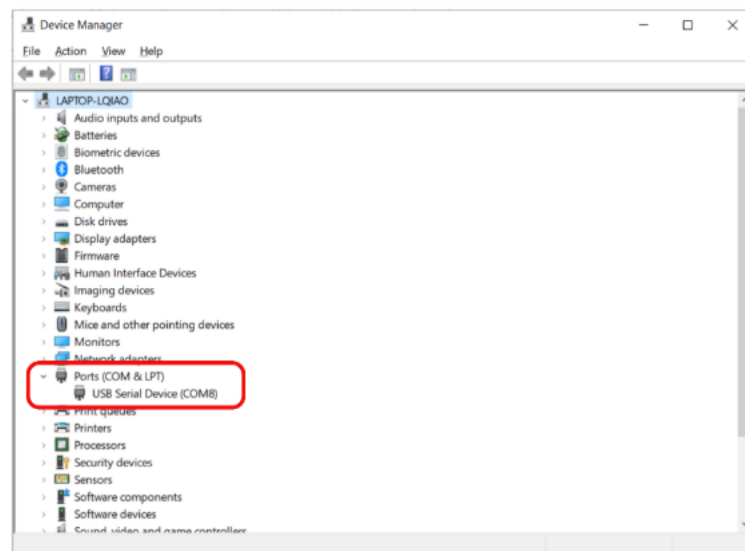
Connect the C450 to the supplied power supply, which will automatically power up the device. Connect a USB-B cable from the controlling computer to the C450.

Find the COM port assigned to the connected device, then select that port in the software:

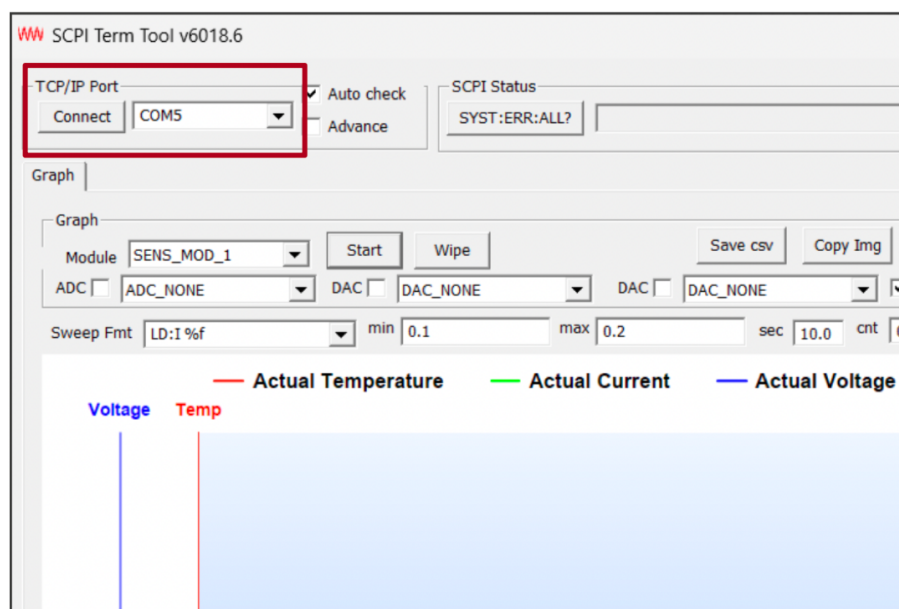
- Launch the device manager on the computer



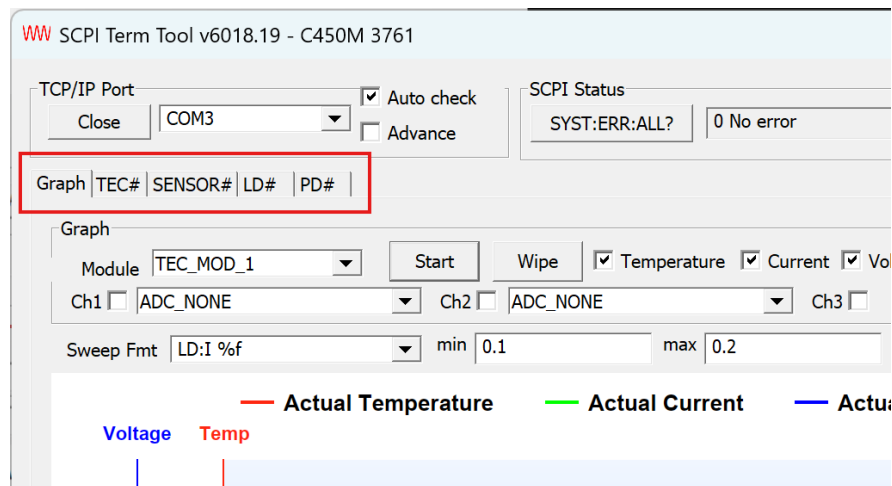
- Find the USB Serial Device (COM). USB Serial Device (COM?) can be found in the Device Manager (COM8 in the example shown).



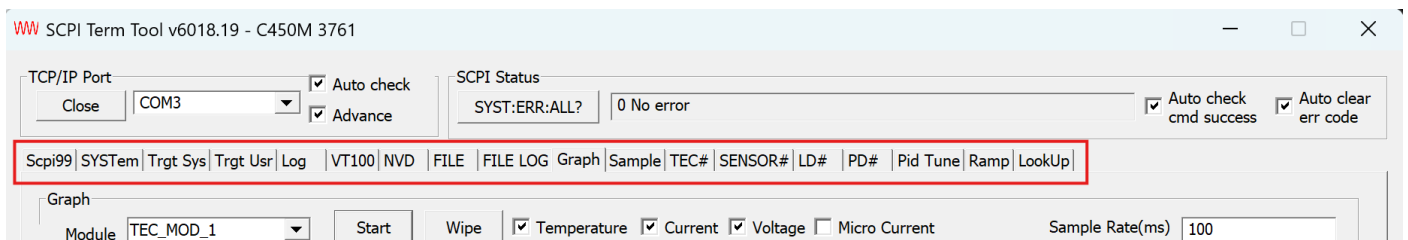
- Connection to the hardware via USB selecting the appropriate COM port.



- The menu is dynamic depending on the device that the term tool is connected to and limited to key features if Advanced is unticked.



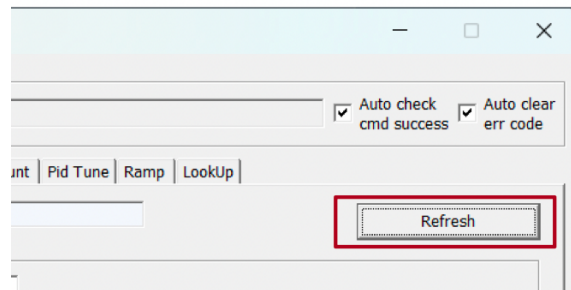
- Graph – A simple graph tool to assist with logging
- TEC# - Available TEC controllers and configuration
- SENSOR# - Temperature Sensor Readout
- LD# - Laser diode current controller.
- PD# - Photodiode configuration and readout.



- Log – Provides a log of commands sent to the HW
- Pid Tune - Can be used to tune the response of the TEC PID loop.
- Other tabs are specific to Redwave Labs development.

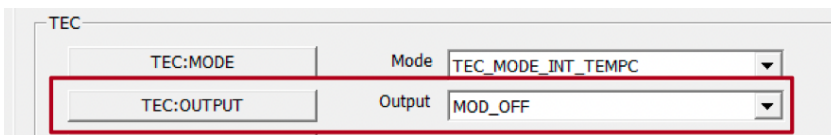
Read data from the device

Each tab (Module) has a refresh button. Clicking this will request the module the current data set configured.



Write Data to the device

Within the term tool most settings/controls have a transmit button and a value to transmit. They are named after the SCPI command referenced in the SCPI Manual. For example, to turn on the TEC, change the drop down option from MOD_OFF to MOD_ON (TEC Module on) and transmit this by clicking the 'TEC:OUTPUT' Button

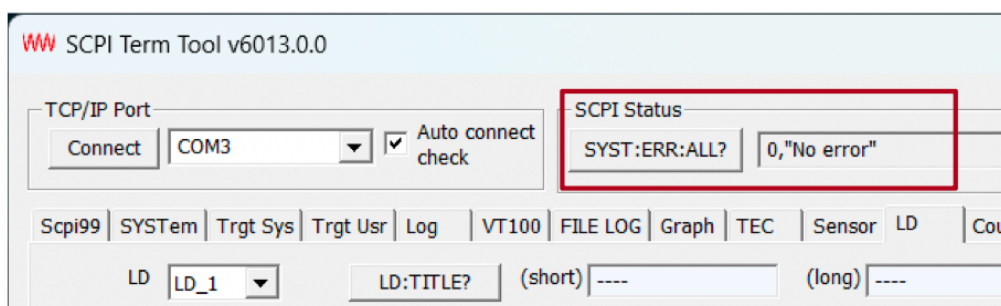


From the Log Tab you can see this command sent to the device

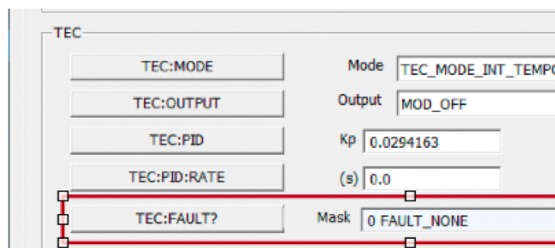
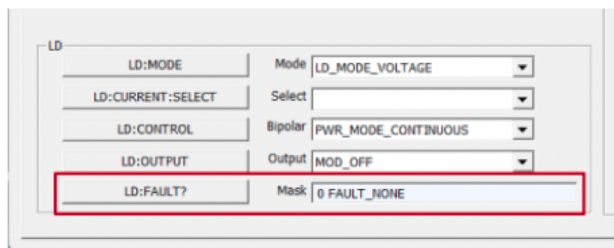
```
164 10:09.01 SCPI TX TEC:OUTPUT 1
cmd_TEC_OUTPUT_wr
w_state 1= 1(01) MOD_ON
```

Status of the Device and Modules

The overall state of the system can be read by clicking the SYST:ERR:ALL? Button



Each tab (Module) has an Error check

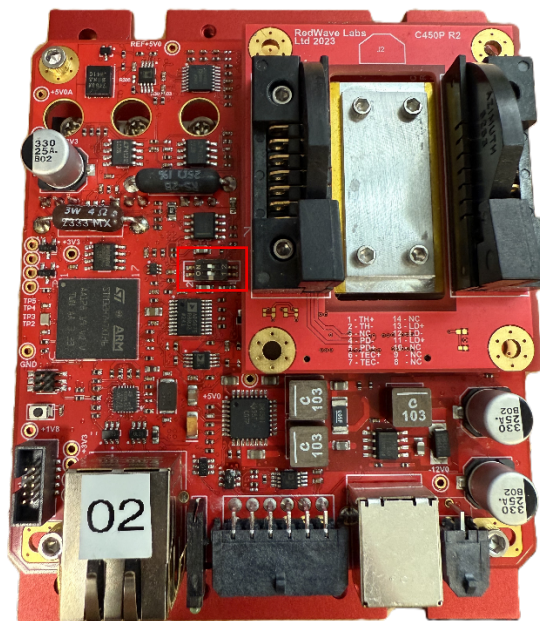


DEVICE MODULES

Interlock

The interlock of the device can be enabled by switching DIP switch 1 (see below) to the off position. The interlock is then triggered using the appropriate pins on the control connector. By connecting the pins together, the interlock will allow the laser to turn on. If the pins are disconnected, the laser will turn off and a fault will be visible in the LD panel of Termtool.

The default state of the device does not have the interlock enabled.



Temperature Sensor

The SENSOR tab shown below allows configuration of the temperature sensor monitoring the laser diode temperature.

Steinhart-Hart coefficients can be input into the SENSOR#:CONST boxes, and programmed to the driver.

The excitation current for the temperature sensor is set using SENSOR#:IEXC:SET. The default value is 50 uA. This is recommended to avoid thermistor self-heating effects.

The SENSOR#:INFO can be used to read out the resistance value of the thermistor and the converted temperature value.

The coefficient calculation can be used to calculate the appropriate A, B and C values from a thermistor beta value.

Default values for the laser driver are $A=1.129e-3$ $B=2.341e-4$ $C=8.78e-8$.

SCPI Term Tool v6018.19 - C450M 3761

TCP/IP Port: ☒ Auto check ☒ Advance

SCPI Status: SYST:ERR:ALL? ☒ Auto check cmd success ☒ Auto clear err code

Scpi99 | SYSTem | Trgt Sys | Trgt Usr | Log | VT100 | NVD | FILE | FILE LOG | Graph | Sample | TEC# | SENSOR# | LD# | PD# | Pid Tune | Ramp | LookUp |

SENSOR# SENSOR#:TITLE? (short) (long)

Sensor

SENSOR#:TYPE Type

SENSOR#:CONST	Ro	0.0	A	0.001129	B	0.0002341	C	8.78e-08
SENSOR#:IEXC[:SET?]	(uA)	50.0	SENSOR#:IEXC?	(uA)	50.0			
SENSOR#:INFO?	Res Ohm	12913.9	uA	50.0	V	0.645695	C	19.2929

Temperature

SENSOR#?

Temperature History

Range

SENSOR#:HISTORY?	Index	35	time	946684835	C	19.2929
SENSOR#:HISTORY:INDEX?	Index	0				
SENSOR#:HISTORY:INFO?	Rd	0	Wr	36		

Coefficient Calculation

Beta (K) T0 (C) R0 at T0 (R)

Diode Temperature Control

The TEC tab shown below allows configuration of the TEC used to control the temperature of the laser diode.

The PID parameters can be set using the TEC:PID parameters. Default values are $K_p = 0.65$, $K_i = 0.25$, $K_d = 0.07$.

The temperature is then set using the TEC:T[:SET] parameter shown below.

The PID controller can be enabled by setting TEC:OUTPUT to MOD_ON and disabled by setting to MOD_OFF.

SCPI Term Tool v6018.19 - C450M 3761

TCP/IP Port: Close COM3 ☒ Auto check ☒ Advance SCPI Status: SYST:ERR:ALL? 0 No error ☒ Auto check cmd success ☒ Auto clear err code

Scpi99 | SYSTem | Trgt Sys | Trgt Usr | Log | VT100 | NVD | FILE | FILE LOG | Graph | Sample | TEC# | SENSOR# | LD# | PD# | Pid Tune | Ramp | LookUp |

TEC# TEC_MOD_1 TEC#:TITLE? (short) TEC1 2A (long) TEC1 2A Settings Refresh

Current

TEC#:I:MAX	(-min A)	-2.0	(+max A)	2.0
TEC#:I:LIMIT	(-min A)	-2.0	(+max A)	2.0
TEC#:I[:SET?]	(A)	1.0	TEC#:I?	(A) 0.0

Current Slope

TEC#:I:SLOPE:MAX	(min A/s)	0.1	(max A/s)	5.0
TEC#:I:SLOPE[:SET?]	(A/s)	2.0	TEC#:I:SLOPE?	(A/s) 2.0

Voltage

TEC#:V:MAX	(-min V)	0.0	(+max V)	0.0
TEC#:V:LIMIT	(-min V)	0.0	(+max V)	0.0
TEC#:V[:SET?]	(V)	0.0	TEC#:V?	(V) 0.0

TEC#

TEC#:MODE	Mode	TEC_MODE_INT_TEMPC		
TEC#:OUTPUT	Output	MOD_OFF		
TEC#:OUTPUT:INIT	Init	INIT_OFF		
TEC#:PID	Kp	0.65	Ki	0.25
			Kd	0.07
TEC#:PID:RATE	(s)	0.0		
TEC#:FAULT?	Mask	0 FAULT_NONE		

Temperature

TEC#:T:MAX	(min C)	-30.0	(max C)	35.0
TEC#:T[:SET?]	(C)	17.527	TEC#:T?	(C) 27.7088

Diode Current Control

The diode current control settings are shown below. The diode current limit is set in hardware to be 250mA, but a soft limit can also be set using the LD:I:LIMIT parameter.

The LD current setpoint can be set using LD:I:SET parameter, and the measured diode current can be read out using LD:I?

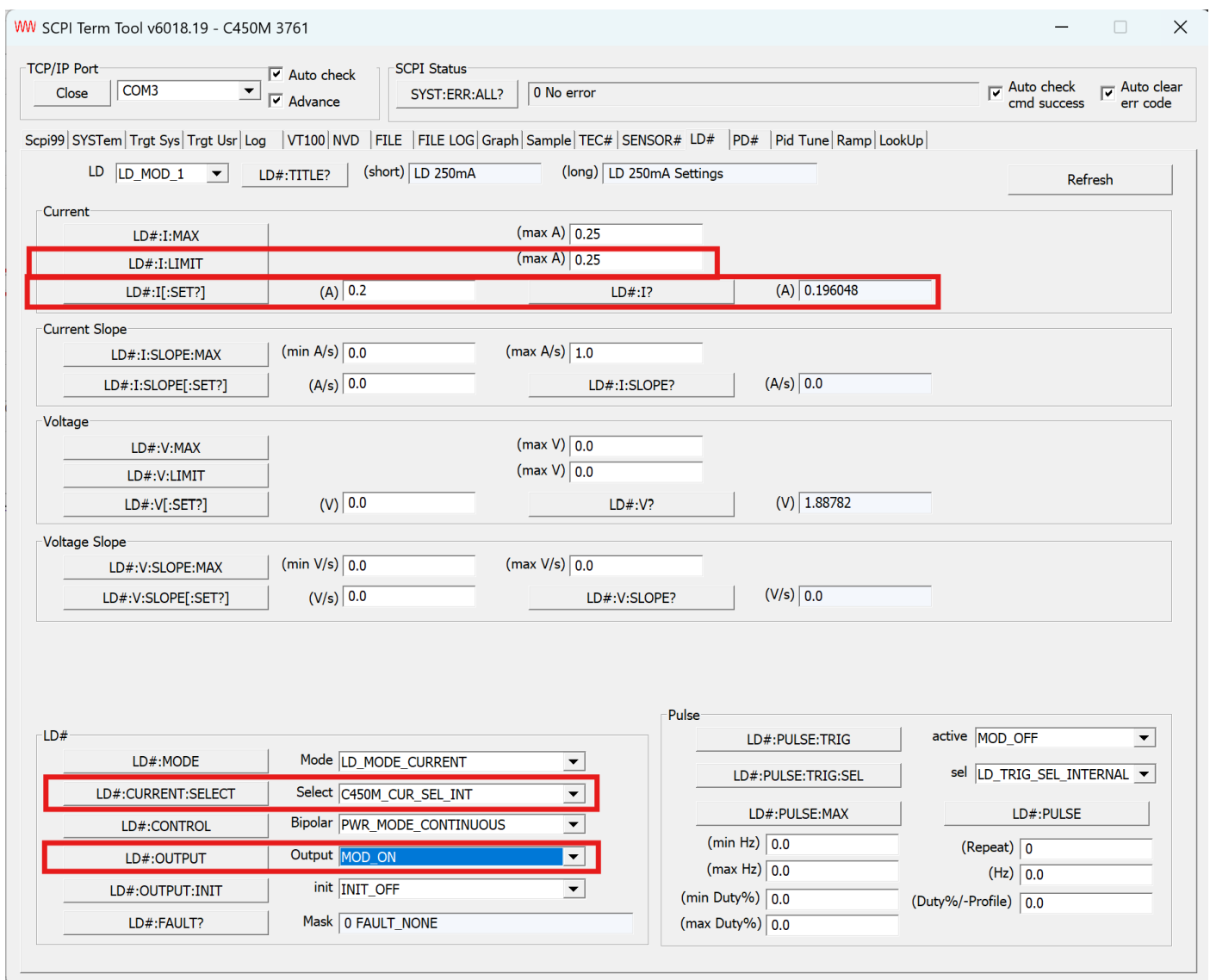
The source for the current setpoint can be chosen using the LD:CURRENT:SELECT parameters. The source table is as follows:

LD:CURRENT:SELECT	Description
C450M_CUR_SEL_INT	Internal Current Selection. LD:I:SET is used.
C450M_CUR_SEL_INT_EXT	Internal + External Current Selection, Diode current is sum of LD:I:SET and voltage on LD control external pin.
C450M_CUR_SEL_INT_EXTx50	Internal + External Current Selection, Diode current is sum of LD:I:SET and voltage on LD external control pin, including filtering and gain stage.
C450M_CUR_SEL_INT_PD	Not Implemented

LD:CURRENT:SELECT	Description
C450M_CUR_SEL_EXT	Not Implemented
C450M_CUR_SEL_EXT_PD	Not Implemented
C450M_CUR_SEL_EXTx50	Not Implemented
C450M_CUR_SEL_EXTx50_PD	Not Implemented

In order to use the diode current in purely external mode, the C450M_CUR_SEL_INT_EXT should be selected, and LD:I:SET set to 0A. The diode can then be modulated using the voltage from the external connector

In order to enable the diode current, the LD:OUTPUT should be set to MOD_ON, and to disable should be set to MOD_OFF.



SCPI Term Tool v6018.19 - C450M 3761

TCP/IP Port: COM3, Auto check, Advance, SCPI Status: SYST:ERR:ALL? 0 No error, Auto check cmd success, Auto clear err code

Scpi99 | SYSTem | Trgt Sys | Trgt User | Log | VT100 | NVD | FILE | FILE LOG | Graph | Sample | TEC# | SENSOR# | LD# | PD# | Pid Tune | Ramp | LookUp

LD: LD_MOD_1, LD#:TITLE?, (short) LD 250mA, (long) LD 250mA Settings, Refresh

Current

LD#:I:MAX (max A) 0.25

LD#:I:LIMIT (max A) 0.25

LD#:I[:SET?] (A) 0.2, LD#:I? (A) 0.196048

Current Slope

LD#:I:SLOPE:MAX (min A/s) 0.0, (max A/s) 1.0

LD#:I:SLOPE[:SET?] (A/s) 0.0, LD#:I:SLOPE? (A/s) 0.0

Voltage

LD#:V:MAX (max V) 0.0

LD#:V:LIMIT (max V) 0.0

LD#:V[:SET?] (V) 0.0, LD#:V? (V) 1.88782

Voltage Slope

LD#:V:SLOPE:MAX (min V/s) 0.0, (max V/s) 0.0

LD#:V:SLOPE[:SET?] (V/s) 0.0, LD#:V:SLOPE? (V/s) 0.0

LD#

LD#:MODE Mode LD_MODE_CURRENT

LD#:CURRENT:SELECT Select C450M_CUR_SEL_INT

LD#:CONTROL Bipolar PWR_MODE_CONTINUOUS

LD#:OUTPUT Output MOD_ON

LD#:OUTPUT:INIT init INIT_OFF

LD#:FAULT? Mask 0 FAULT_NONE

Pulse

LD#:PULSE:TRIG active MOD_OFF

LD#:PULSE:TRIG:SEL sel LD_TRIG_SEL_INTERNAL

LD#:PULSE:MAX LD#:PULSE

(min Hz) 0.0, (max Hz) 0.0, (min Duty%) 0.0, (max Duty%) 0.0, (Repeat) 0, (Hz) 0.0, (Duty%/-Profile) 0.0

CERTIFICATION

RedWave Labs Ltd certifies that: i) the parts and/or materials were produced in conformance with all contractually applicable Government and/or Buyer's specification as referenced in, or furnished with, the above purchase order and ii) all processes required in the production of these parts and/or materials are listed and were performed by a facility or by personnel specifically approved or certified by the seller's cognizant government quality control agency when such approval or certification is required by an applicable specification. RedWave Labs products are not authorized for use in safety-critical applications (such as life support) where a failure of the product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use of the products.

WARRANTY AND RETURNS

RedWave Labs Ltd products are warranted against defects in materials and workmanship for a period of 180 days from date of shipment. During the warranty period RedWave Labs Ltd will replace or repair products which prove to be defective or damaged. Our warranty shall not apply to defects or damages resulting from: i) misuse of the product or ii) operation beyond specifications detailed in the current manual.

RETURN PROCEDURE

Customer must obtain a valid RMA number by contacting RedWave Labs prior to the return. In all cases the customer is responsible for duty fees incurred on all received shipments and on all international returns for both warranty and non-warranty items; the customer is responsible for any duties, brokers fees or freight charges deemed chargeable to RedWave Labs Ltd.

REVISIONS

Revision 1.0: First revision