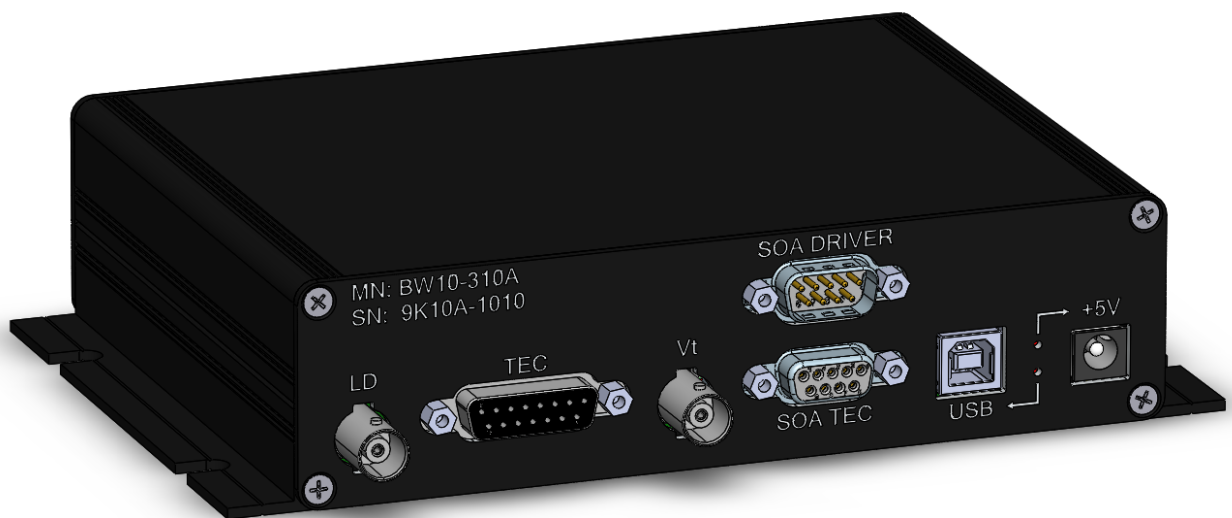


# APPLICATION NOTE

BW10-310A VCSEL driver with TEC control and swept voltage generator

Software revision 2.5, firmware revision 1.09



## Features of BW10-310A VCSEL driver

- Anode grounded VCSEL driver up to 30mA for BW10 VCSEL. Supports 1060 nm, 1550 nm and 1654 nm family
- Integrated TEC controller for BW10 VCSEL
- Integrated swept voltage generation for BW10 VCSEL. Supports up to +40V for 1060 nm VCSEL family and up to -20V for 1550 nm and 1654 nm products.
- Designed to be used with BW10-420C fixture.
- Swept voltage source supports:
  - sinusoidal shape (50 Hz to 120 KHz)
  - triangular shape (50 Hz to 100 KHz)
  - square root shape (50 Hz to 75 KHz)
- 60Msamples 8bit arbitrary waveform generator for up to 120KHz sweep signals.
- Integrated pin protection
- Single 5V power supply (included)

## Shipping list

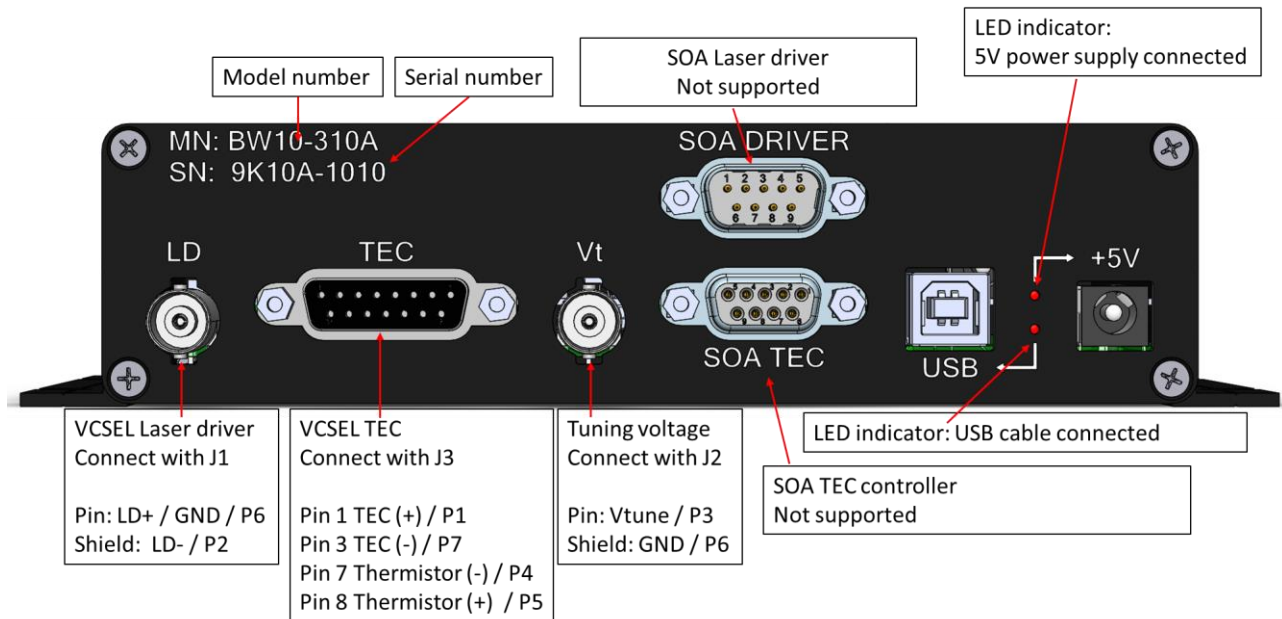
- Transport case
- BW10-310A driver box
- BW10-420C test fixture
- 5V / 4A wall mount power supply with interchangeable AC blades for global use. Barrel plug with positive center, 5.5mm outer diameter, 2.5mm inner diameter, 9.5mm length. (CUI Inc. / SMI24-5-V-P6)
- 1 pc. 1.5m USB 2.0 cable (USB A to USB B)
- 2 pcs. 1.5m BNC cables
- 1 pc. 1.5m D-Sub 15 cable (Amphenol CS-DSDMDB15MF-005)
- Optional for SOA connection (not included in standard package): 2 pcs. 1.5m D-Sub 9 cable (Phoenix Contact 2300009)

## Driver box connections

Frontside:



Backside:



## Hardware setup

Please follow the steps in order, “**DO NOT**” proceed to a next step without completing a previous step

1. Please ensure proper ESD precautions. Please wear an ESD wrist strap and use an ESD protection mat.
2. Do not insert laser in the fixture at this stage.
3. Connect LD with J1 of the TO fixture –

**You must not use BNC couplers to extend the BNC cable length. When using BNC couplers and the metal housing is placed on an optical bench you will generate a short or ground loop which will damage the laser.**

4. Connect Vt with J2 of the TO fixture – Do not use BNC couplers to extend the BNC cable length.

**You must not use BNC couplers to extend the BNC cable length. When using BNC couplers and the metal housing is placed on an optical bench you will generate a short or ground loop which will damage the laser.**

5. Connect TEC with J3 of the TO fixture
6. Optional: Connect SOA Driver and TEC outputs with a Thorlabs LM14S2 fixture
7. Connect the 5V power supply to the wall outlet, connect the power connector with the barrel connector. The LED should be on.
8. Connect the USB cable with the box and the computer. Connect only if +5V LED is on
9. Start GUI
10. Insert Laser according to instructions in the GUI section.

Please note that LD pin and LD shields as well as Vt pin and Vt shield are shorted when the pin protection is on.

## Software installation

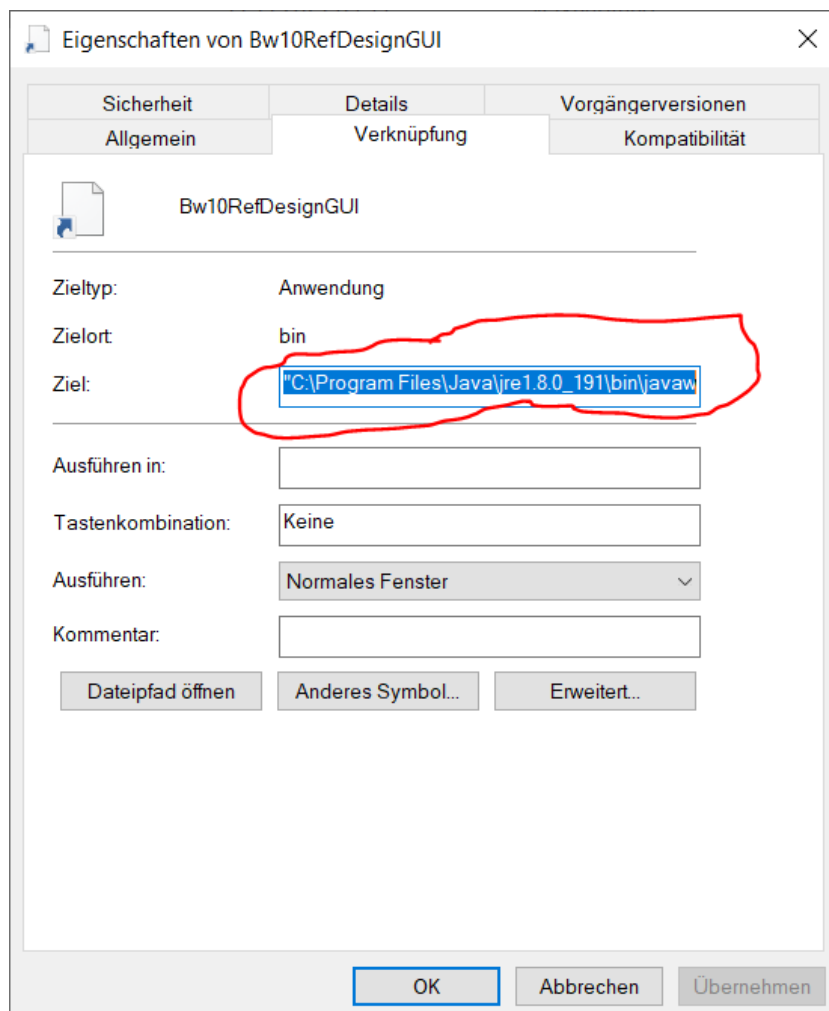
The GUI required Oracle's Java 8u191 version or earlier. The V8 update 191 is the last version without licensing fees which is supporting the serial communication library. Please do not update to a more recent version. Bandwidth 10 is working for a solution. You can download the JRE directly from Oracle:

<https://www.oracle.com/java/technologies/javase/javase8-archive-downloads.html>

Please scroll down to "Java SE Runtime Environment 8u191" and download and install the correct Windows version. Please remember the installation folder.

The GUI does not need an installation. Simply unzip the files to a folder the user can access easily and start the GUI using the batch file *Bw10RefDesignGUI.bat*. If the GUI is not started it might be that you have multiple java versions installed on your system. In that case you can use the *Bw10RefDesignGUI* link file instead. Simply select the GUI file *Bw10RefDesignGUI* with a left click (the background becomes light blue) right click afterwards and select properties. In the dialog window you can edit the path to the link target. The JRE is typically installed in folder:

C:\Program Files\Java\jre1.8.0\_191\bin\javaw.exe:



Once you changed the link please start the GUI with a double click on the link file (not the bat file).

## Graphical User Interface (GUI)

The GUI has implemented several restrictions ensuring that the user cannot accidentally damage the laser by using wrong operation conditions and the GUI is also obeying the turn-on and turn-off procedures described in the laser application notes. As an example, the user cannot enable a current not suitable for the device or cannot enable the laser current if the TEC circuit is not enabled. If the user still tries to enable the current without enabling the TEC first, a pop-up window will explain the exception.

The hardware also contains a circuit which shorts J1 and J2 to GND. This mechanism is referred to the pin protection. The pin protection is disabled once the user loaded a component and clicks the load / unload button. Note that the maximum / and minimum operating conditions as well as the wavelength or box type can only be changed if the component is unloaded and the pin protection is on.

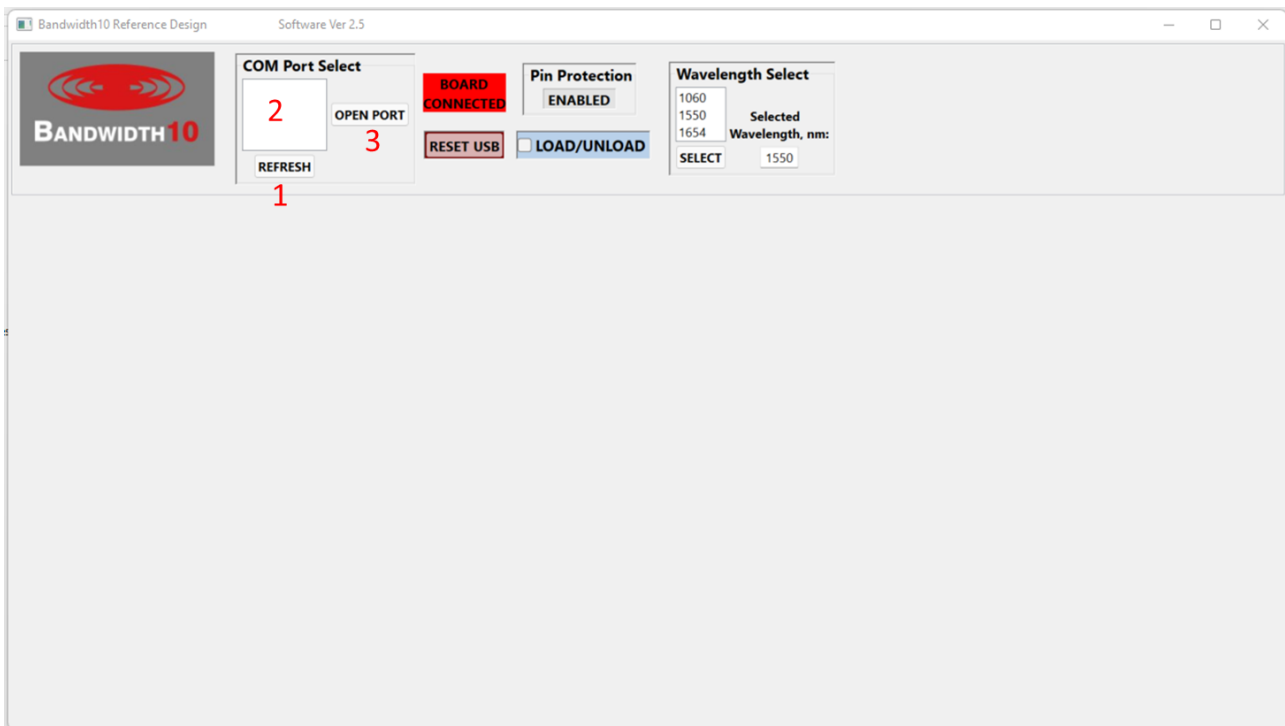
Note that the GUI cannot ensure that the Lasers are not damaged by ESD or if the cables are not connected correctly to the fixture / laser.

Quick start:

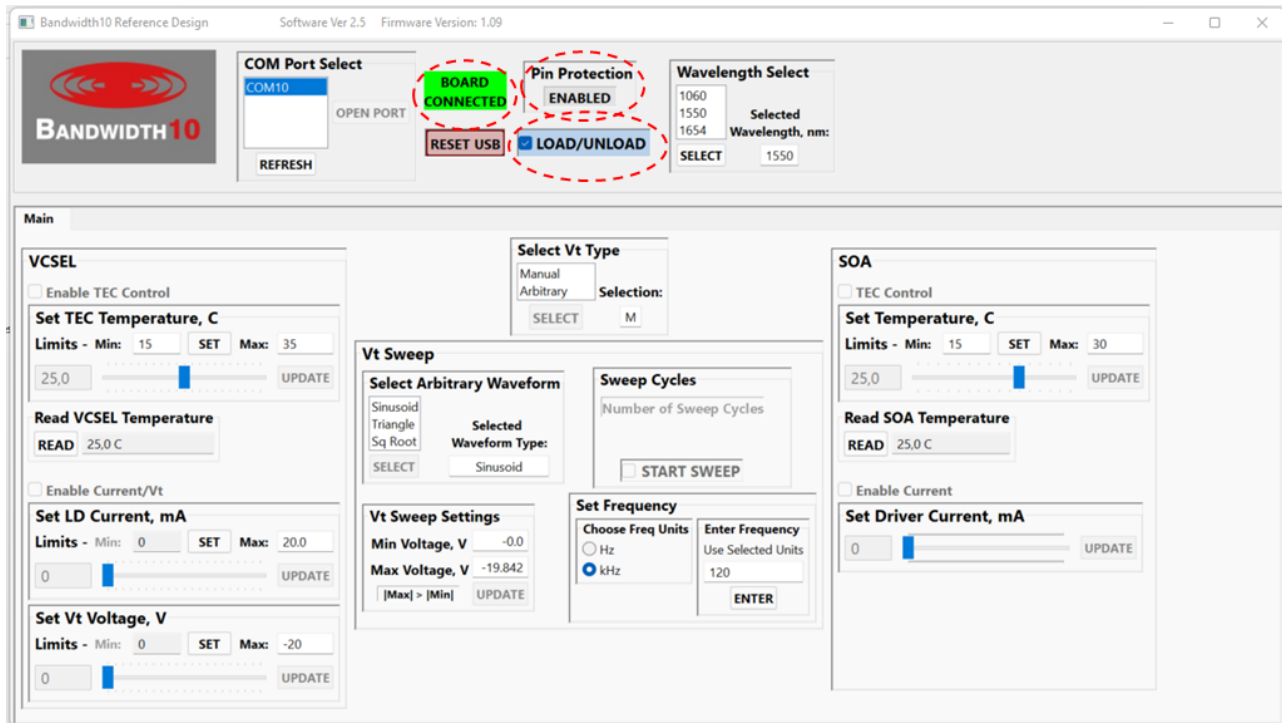
1. Open the GUI folder and double click “Bw10RefDesignGUI.bat” .

If the GUI does not start, please check if the Java path is set correctly.

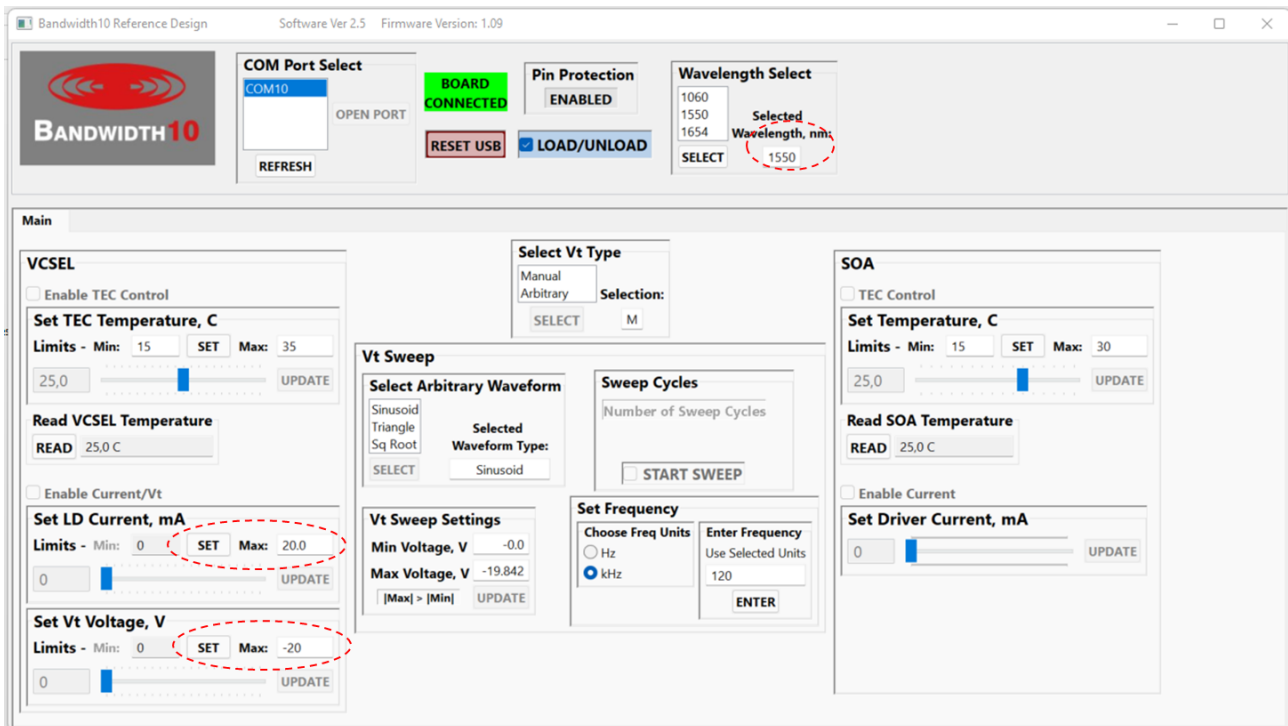
2. Next click *refresh* (1) in the COM port selection and select the COM port (2) and click *open port* (3).



- Now the comport is opened and the lower section of the GUI appears. Please check first if the firmware of the unit is 1.09. If not please contact your FAE for update instructions. The box *board connected* will change to a green background. You can also notice that the *pin protection* is enabled and the *load / unload* box is checked. If the GUI crashes, please check if you really have installed a JRE version V8 update 191 or older.



- Next click in the *wavelength select* section on the VCSEL wavelength / type you want to drive (i.e. 1550) and click *select*. Please check if the selected wavelength is correct.  
At this stage you refine the max laser drive and tuning voltage limits to ensure that you do not damage your specific laser. Just enter the limit in the *set LD Current* section and *set VT Voltage* section and hit *set*. Note that the driver box uses an anode grounded configuration, i.e. the 1550 and 1654 voltage limits needs to be entered with a “-“ sign. The limits can be found in the test document sent with the laser.



Bandwidth10 Reference Design Software Ver 2.5 Firmware Version: 1.09

**COM Port Select**  
COM10  
OPEN PORT  
REFRESH

**BOARD CONNECTED**  
RESET USB  
LOAD/UNLOAD

**Pin Protection**  
ENABLED

**Wavelength Select**  
1060  
1550  
1654  
SELECT  
Selected Wavelength, nm: 1550

**Main**

**VCSEL**  
☐ Enable TEC Control  
**Set TEC Temperature, C**  
Limits - Min: 15 SET Max: 35  
25.0 UPDATE  
**Read VCSEL Temperature**  
READ 25.0 C  
☐ Enable Current/Vt  
**Set LD Current, mA**  
Limits - Min: 0 SET Max: 20.0  
0 UPDATE  
**Set Vt Voltage, V**  
Limits - Min: 0 SET Max: -20  
0 UPDATE

**Select Vt Type**  
Manual  
Arbitrary  
Selection: M  
SELECT

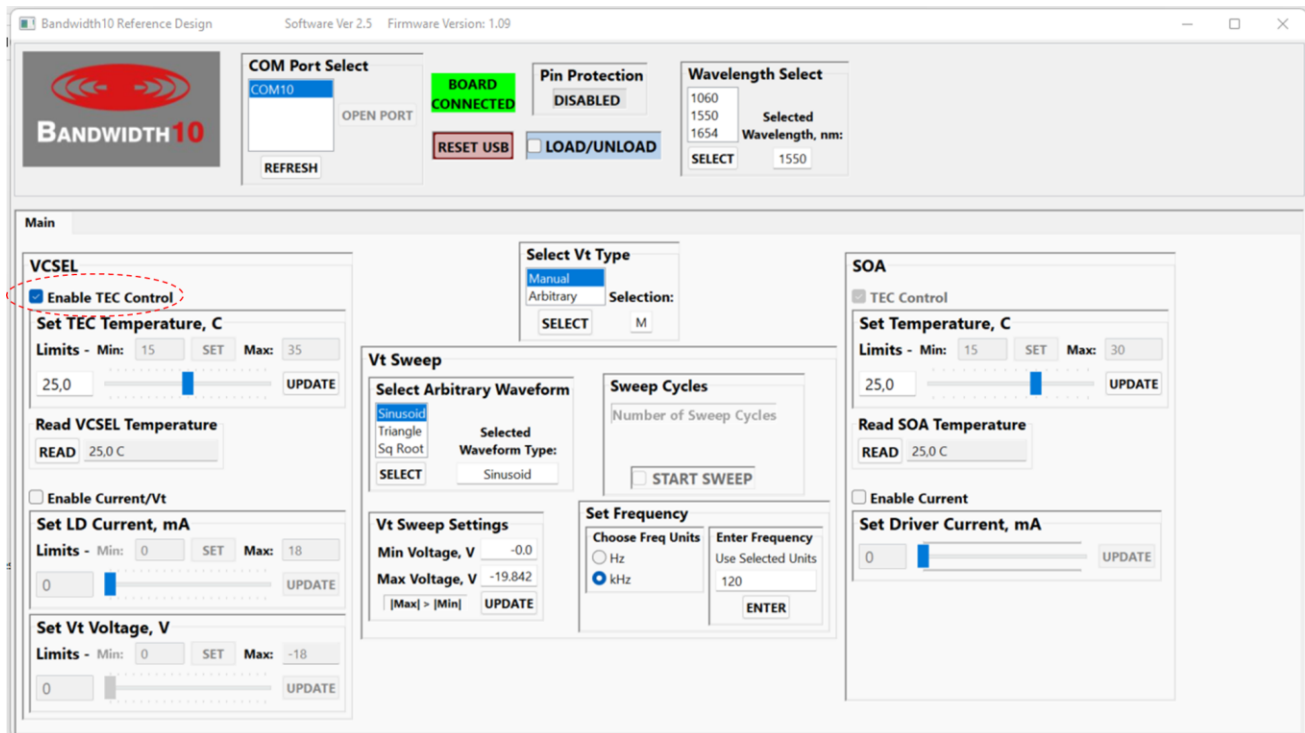
**Vt Sweep**  
**Select Arbitrary Waveform**  
Sinusoid  
Triangle  
Sq Root  
SELECT  
Selected Waveform Type: Sinusoid  
**Sweep Cycles**  
Number of Sweep Cycles  
START SWEEP

**Set Frequency**  
Choose Freq Units  
Hz  
kHz  
Enter Frequency  
Use Selected Units  
120  
ENTER

**Vt Sweep Settings**  
Min Voltage, V -0.0  
Max Voltage, V -19.842  
[Max] > [Min] UPDATE

**SOA**  
☐ TEC Control  
**Set Temperature, C**  
Limits - Min: 15 SET Max: 30  
25.0 UPDATE  
**Read SOA Temperature**  
READ 25.0 C  
☐ Enable Current  
**Set Driver Current, mA**  
0 UPDATE

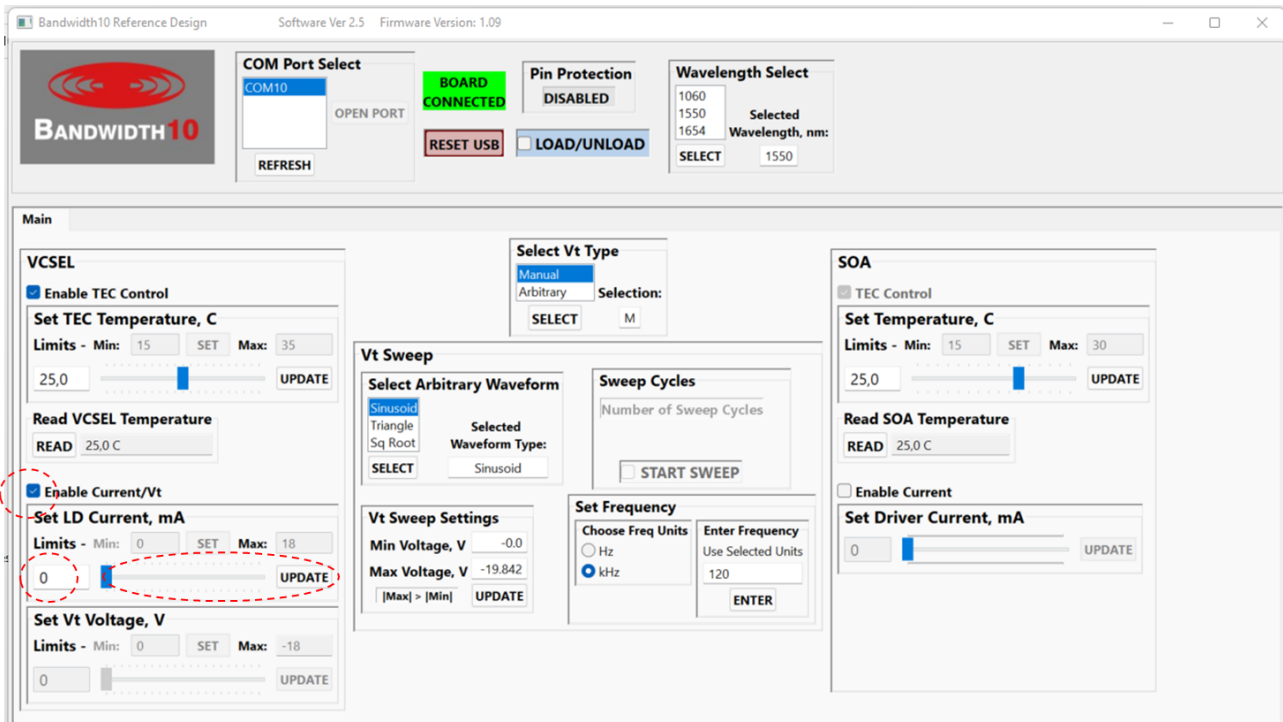
- Now insert the laser into the fixture. Use the clamp mechanism to fix the TOSA with the fixture and ensure a good thermal connection. Once the laser is inserted uncheck the *load / unload* box. GUI will disable the pin protection. Next you can enable the VCSEL TEC controller. Note that the VCSEL and SOA TEC controller are enabled with the same circuit.





- Now you can enable the laser current. First check the box enable current / Vt.  
You can change the laser current with the slider and clicking update or by clicking in the text field and entering a number with the keyboard followed by enter. If you do not click update or hit enter the new value is not written into the microcontroller. Note that you need to enable the laser current before you can change the tuning voltage.

You can change the tuning voltage accordingly. Setting a DC voltage is referred to Manual tuning, or DC-tuning.



Bandwidth10 Reference Design Software Ver 2.5 Firmware Version: 1.09

**COM Port Select**  
COM10  
OPEN PORT  
REFRESH

**BOARD CONNECTED**  
RESET USB

**Pin Protection**  
DISABLED  
LOAD/UNLOAD

**Wavelength Select**  
1060  
1550  
1654  
Selected Wavelength, nm: 1550  
SELECT

**Main**

**VCSEL**  
☒ Enable TEC Control  
Set TEC Temperature, C  
Limits - Min: 15 SET Max: 35  
25,0  
UPDATE  
Read VCSEL Temperature  
READ 25,0 C

☒ Enable Current/Vt  
Set LD Current, mA  
Limits - Min: 0 SET Max: 18  
0  
UPDATE  
Set Vt Voltage, V  
Limits - Min: 0 SET Max: -18  
0  
UPDATE

**Select Vt Type**  
Manual  
Arbitrary  
Selection: M  
SELECT

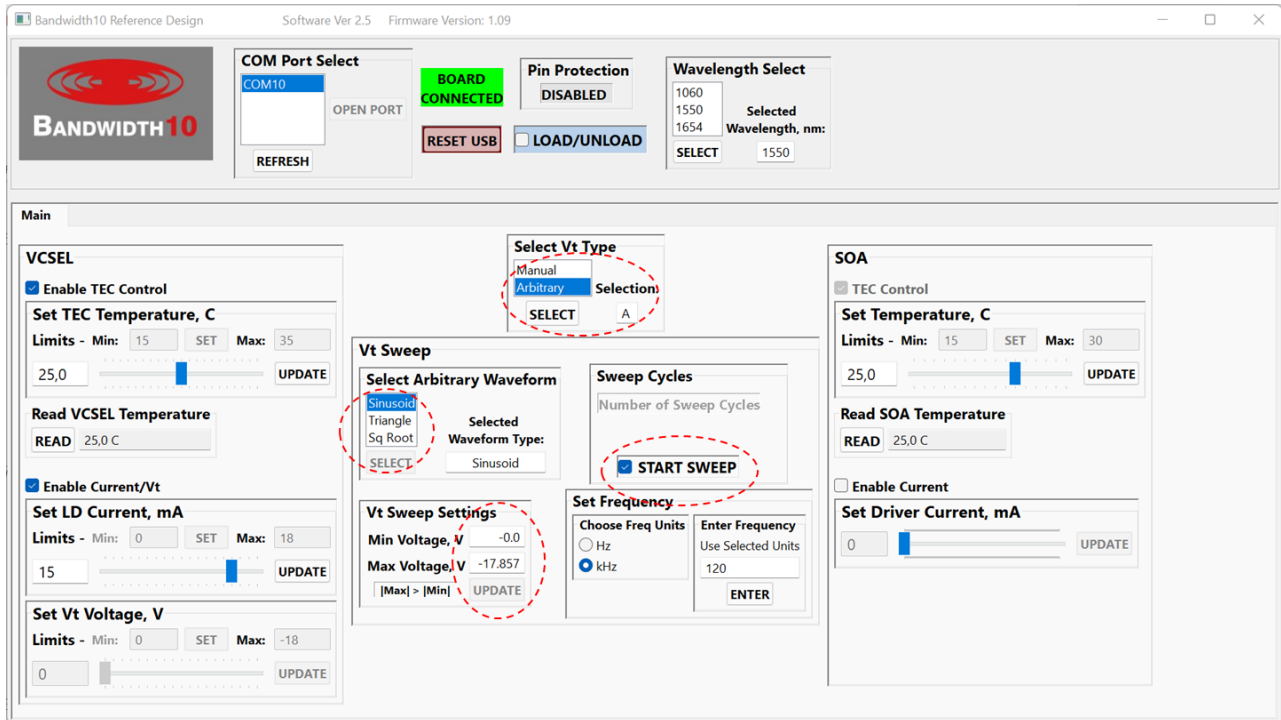
**Vt Sweep**  
Select Arbitrary Waveform  
Sinusoid  
Triangle  
Sq Root  
Selected Waveform Type: Sinusoid  
Sweep Cycles  
Number of Sweep Cycles  
START SWEEP

**Vt Sweep Settings**  
Min Voltage, V -0,0  
Max Voltage, V -19,842  
|Max| > |Min| UPDATE

**Set Frequency**  
Choose Freq Units  
Hz  
kHz  
Enter Frequency  
Use Selected Units  
120  
ENTER

**SOA**  
☒ TEC Control  
Set Temperature, C  
Limits - Min: 15 SET Max: 30  
25,0  
UPDATE  
Read SOA Temperature  
READ 25,0 C  
☐ Enable Current  
Set Driver Current, mA  
0  
UPDATE

- For AC-tuning i.e. sweeping the tuning voltage select *Arbitrary* in the Vt type box and click *select*. The *selection* will change to "A" and the manual tuning voltage will be greyed out.



Please select the preferred swept function and enter the upper and lower voltage limits. The upper and lower values are rounded to the nearest voltage setting supported by the hardware. Click *update* to load the values into the microcontroller.

You need to set the sweep frequency by entering a sweep rate from 50Hz to 120KHz. Please use only whole numbers, i.e. do not use comma / decimal points.

You can start the voltage sweep by clicking start sweep. The voltage settings and waveform shape cannot be changed once a sweep is in progress.

We recommend checking the sweep signal (i.e. shape, frequency and voltage) with an oscilloscope. Note that you cannot use BNC-T- adaptors to check the voltage on the oscilloscope while sweeping the laser.

Note that the voltage values entered in the GUI are just indications, i.e. the voltage is not calibrated and might be off by up to 2 Volts. Due to the low-pass filter of the amplification chain the box can currently support good SQRT shapes up to 75KHz.