# 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:

LED indicator: 5V power supply connected



LED indicator: USB cable connected

## BANDWIDTH10

### BW10-310A

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 shiels 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:

Eigenschaften von B	Eigenschaften von Bw10RefDesignGUI				
Sicherheit Allgemein	Details Verknüpfung	Vorgängerversionen Kompatibilität			
Bw10Reft	DesignGUI				
Zieltyp:	Anwendung				
Zielort:	bin				
Ziel:	"C:\Program Files\Java\jr	re1.8.0_191\bin\javaw			
Ausführen in:					
Tastenkombination:	Keine				
Ausführen:	Normales Fenster	$\sim$			
Kommentar:					
Dateipfad öffnen	Anderes Symbol	Erweitert			
	ОК	Abbrechen Übernehme	n		

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).

Bandwidth10 Reference Design	Software Ver 2.5		-	×
BANDWIDTH 10	COM Port Select 2 REFRESH 1	BOARD CONNECTED     Pin Protection ENABLED     Wavelength Select       1060 1550     Selected       1654     Selected       1654     Select       SELECT     1550		
4	1			





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.

Bandwidth10 Reference Design Software Ver COM Port Sele COM10 COM10 REFRESH	22.5 Firmware Version: 1.09	Pin Pro ENA	VUNLOAD	Velength Select 0 0 4 Wavelength, nn ECT 1550	n:		- C	1
Main	· ·	Select V1	t Type					
VCSEL		Manual			SOA			
Enable TEC Control		Arbitrary	Selection:		TEC Control			
Limits - Min: 15 SET Max: 35		SELECT	M		Limits - Min: 15	T Max: 30		
	Vt Sweep							
25,0 UPDATE	Select Arbitrary Wav	eform	Sweep Cycles		25,0	UPDATE		
Read VCSEL Temperature	Sinusoid Triangle Selected Sq Root Waveform	l Type:	Number of Sw	ep Cycles	Read SOA Temperature			
Enable Current/Vt	SELECT Sinusoid		START S	WEEP	Enable Current			
Set LD Current, mA	Vt Sweep Settings		Set Frequency		Set Driver Current, mA	<b>\</b>		
Limits - Min: 0 SET Max: 20.0	Min Voltage, V -0.0 Max Voltage, V -19.84	2	Choose Freq Units Hz kHz	Enter Frequency Use Selected Units 120	0	UPDATE		
	Max  >  Min  UPDAT	E		ENTER				
Set Vt Voltage, V								
Limits - Min:         0         SET         Max:         -20           0 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>								





4. 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					-	>
BANDWIDTH 10	CT BOARD CONNECTED RESET USB	Pin Protection ENABLED	Wavelength Select 1060 1550 1654 Wavelength, n SELECT 1550	m,			
Main							_
VCSEL		Select Vt Type Manual Arbitrary Selection	n:	SOA TEC Control			
Set TEC Temperature, C		SELECT		Set Temperature, C			
Limits - Min: 15 SET Max: 35	Vt Sweep			Limits - Min: 15	<b>SET Max:</b> 30		
25,0 UPDATE	Select Arbitrary Way	veform Sweep	Cycles	25,0	UPDATE		
Read VCSEL Temperature READ 25.0 C	Sinusoid Triangle Sq Root SELECT Sinuso	nd Type:	r of Sweep Cycles	Read SOA Temperatu READ 25,0 C	re		
Enable Current/Vt	Jaccer January		IART SWEEP	Enable Current			
Set LD Current, mA Limits - Min: 0 (SET Max: 20.0) 0 UPDATE Set Vt Voltage, V	Vt Sweep Settings Min Voltage, V -09 Max Voltage, V -19.84 [Max] > [Min] UPDA	Set Freque Choose Fre Hz kHz TE	q Units Enter Frequency Use Selected Units 120 ENTER	Set Driver Current,	MA UPDATE		
Limits - Min: 0 (SET Max: -20)	)						



5. 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.

Bandwidth 10 Reference Design Software Ver	2.5 Firmware Version: 1.09 Ct BOARD CONNECTED DIS RESET USB LOA	rotection ABLED D/UNLOAD	avelength Select 60 50 Selected 54 Wavelength, nm		-	0 X
REFRESH		se	1550			
VCSEL	Select	Vt Type		SOA		
Enable TEC Control	Arbitrary	Selection:		TEC Control		
Set TEC Temperature, C	SELEC	M T		Set Temperature, C		
Limits - Min: 15 SET Max: 35	Vt Sweep			Limits - Min: 15 SET Max: 30		
25,0 UPDATE	Select Arbitrary Waveform	Sweep Cycle	5	25,0 UPDATE		
Read VCSEL Temperature READ 25.0 C	Sinusoid Triangle Selected Sq Root Waveform Type:	Number of Sw	veep Cycles	Read SOA Temperature READ 25.0 C		
Enable Current/Vt	SELECT	START	SWEEP	Enable Current		
Set LD Current, mA	Vt Sweep Settings	Set Frequency		Set Driver Current, mA		
Limits - Min: 0 SET Max: 18	Min Voltage, V -0.0 Max Voltage, V -19.842 Maxl > Mini UPDATE	Choose Freq Units	Use Selected Units	0 UPDATE		
Set Vt Voltage, V			ENTER			
Limits - Min: 0 SET Max: -18 0 UPDATE						



6. 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 S	2.5 Firmware Version: 1.09 tect PEN PORT RESET USB LOA	rotection ABLED D/UNLOAD	ielect isted ngth, nm: sco	- 0	×
Main VCSEL	Select	Vt Type	550 SOA		
Carlos Enable TEC Control  Set TEC Temperature, C  Limits - Min: 15 SET Max: 35 25,0 UPDATE  Read VCSEL Temperature READ 25.0 C	Arbitrary SELEC Vt Sweep Select Arbitrary Waveform Selected Sq. Root Selected Sq. Root Selected Salected Salected Salected Selected Salected Select Arbitrary Balance Selected Select Arbitrary Waveform Triangle Select Arbitrary Waveform Select Arbitrary Waveform Triangle Select Arbitrary Waveform Select Arbitrary Waveform Triangle Select Arbitrary Waveform Triangle Select Arbitrary Waveform Triangle Select Arbitrary Waveform Select Arbitrary Markeform Select Arbitrar	Selection: T M Sweep Cycles Number of Sweep Cycles	TEC Control Set Temperature, C Limits - Min: 15 SET Max: 30 25.0 UPDATE Read SOA Temperature READ 25.0 C		
Epable Current/Vt Set LD Current, mA Limits - Min: 0 SET Max: 18 0 UPDATE Set Vt Voltage, V	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 120 ENTER	Enable Current  Set Driver Current, mA  Units UDDATE		
Limits - Min: 0 SET Max: -18 0 UPDATE					





7. 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.

Bandwidth10 Reference Design Software V	er 2.5 Firmware Version: 1.09			- 0	×
COM Port Sele COM10 BANDWIDTH10	PEN PORT BOARD CONNECTED Pin	ABLED 1060 1550 Select Wavelength Select 1654 Waveleng SELECT 155	lect ted gth, nm: 50		
Main					
VCSEL C Enable TEC Control Set TEC Temperature, C Limits - Min: 15 SET Max: 35 25,0 UPDATE Read VCSEL Temperature READ 25,0 C C Enable Current/Vt Set LD Current, mA Limits - Min: 0 SET Max: 18	Select           Manual           Arbitrary           Select Arbitrary           Select Arbitrary Waveform           Sinusoid           Selected           Waveform Type:           SELECT           Sinusoid           Vt Sweep Settirfgs           Min Voltage, V	Selection     Selection     Selection     Selection     Selection     Selection     Selection     Set Frequency -     Choose Freq Units     Enter Frequen     Use Selected U	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		
15     UPDATE       Set Vt Voltage, V     Limits - Min:       0     UPDATE	Max Voltage V -17.85	KHz     I20     ENTER			

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 toad 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 swept 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.