Setting up your Quantum Cascade Laser Kit

This is a brief 'how-to' for setting up a new Quantum Cascade Laser System. More detailed documents are on this link:

- [QC Laser Kit Instructions](#)

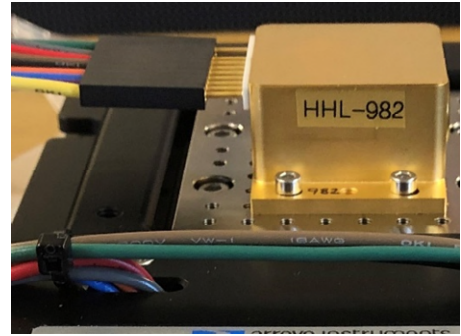Your Quantum Cascade Laser System consists of:

QCL chip inside hermetic "HHL" housing approx. 45x32x19 mm with TE cooler and collimation lens inside behind ZnSe window from Alpes Lasers SA	#15-960 has a 2311 cm^{-1} laser for CO_2 measurement: with test data
	#15-958 has a 1900 cm^{-1} laser for NO measurement: with test data
	#15-959 has a 2206 cm^{-1} laser for N_2O measurement: with test data
All three Kits include all the items below	
Heat Sink onto which the HHL is bolted to dissipate heat from the TE cooler inside. Arroyo Instruments 262.	Suitable mounting screws and electrical harness for HHL included.
Drive electronics for laser chip and TE cooler controller in one enclosure. Arroyo Instruments 6310-QCL.	Cables included connect the 6310-QCL to the heat sink and harness. Software included for computer control.
Infrared detector suitable for detection of the laser light after interaction with user sample. DC to 1 MHz. Vigo System S.A. PVI-2TE-6+AIP-DC-1M.	Integrated detector set with detector, TE cooler, cooler controller, detector signal amplifier in one housing. AC adaptor included.

To Get Started

1. Verify that the items mentioned in the table above were received.
2. Using the screws provided, mount the laser in its HHL package on the Arroyo 262 heat sink. The HHL window should be aligned so that the light will emerge at a right angle to heat sink fan exhaust axis.
3. The following manuals and software are available included at the online links below:
   a. [Alpes Quantum Cascade Laser manual](#)
   b. [Arroyo Instruments 262 LaserMount heat sink manual](#)
   c. [Arroyo Instruments 6310-QCL ComboSource laser controller manual](#)
   d. [Arroyo Instruments 6310-QCL ComboSource laser controller software](#)
4. Unpack the 6310-QCL. After unpacking the unit, ensure that the voltage selection on the Input Power Connector (IPC) on the back of the unit is set to the correct voltage. This is critical, as incorrect voltages can damage the unit. The 6310-QCL is typically shipped in the 120V configuration from the factory, but always verify the voltage selection. Change the voltage as needed. For more information, refer to Changing the Voltage Selection in the main manual. Once the voltage selection has been completed, plug the AC cord into the unit and into the wall outlet. Turn on the power switch located on the front panel, and the unit will power up, displaying the model information, serial number, and firmware version number.
5. Connect the cables between the 6310-QCL controller and the 262 heat sink. Only one way is possible.

6. Remove the antistatic jumper from the HHL leads and carefully connect the captivated harness on the heat sink to the leads. Only one way is possible.

7. Verify that the 6310-QCL is set to use the factory-preset limits of the Alpes HHL by pressing the **MENU** button to enter the main menu, turn the knob to select the _TEC Menu_, then the knob to press enter the menu. Scroll down to _Mount_ setting, press the knob to begin adjustments, and scroll until "Alpes HHL QCL" is displayed. Press the knob again to save.

8. Program in the current limit that is appropriate for your laser by consulting the QCL test data. Enter the _Laser Menu_, set the _Io Limit_ value to the maximum current from the QCL test data + 5 mA (the extra 5 mA is still safe for the laser).

9. Turn on/enable the TE cooler by front panel control and set the target temperature to some reasonable value found in the QCL data of wavelength and power versus temperature and current. Observe the 6310-QCL display as it locks on to the target temperature.

10. Be sure that the output window of the laser when started is pointed in a safe direction.

11. Turn on the Laser by front panel control and set the current to a value BELOW the max current shown for the temperature and approximately midway ABOVE the threshold value for emission as shown in the QCL data of wavelength and power versus temperature and current.

At this point if things went right you have an invisible infrared laser beam of a few milliwatts CW power which is collimated and about 4 mm in diameter emerging from the laser package and ending in some safe place. Your first check on this is:

a. Verify from the 6310-QCL display that the temperature of device and the target temperature are the same [or very close and converging].

b. Verify that the laser voltage (the "Vf" reading on 6310-QCL display) matches very closely the voltage in the laser test data for that temp and current.

Finally, check to confirm that the infrared detector is operational and can 'see' your laser.

DO NOT simply shine the laser into the window of the detector. The detector is very sensitive and its maximum output voltage of 2V will be reached with an optical signal of approximately 20 microwatts on the 0.1x0.1 mm active area (< 2E-3 W/mm^2). Since the laser power is > 5E-4 W/mm^2 minimum, and can be higher, the detector can easily be saturated. This is even more likely if any optical element like a lens is used to concentrate the light on the detector.

Our suggestions are:

- Watch the detector set output on an oscilloscope. Expect to see noise in the low mV range with no laser signal on the detector.
- Any signal at or greater than 2V means that you have too much light on the detector set and are saturating it. So be cautious and direct the laser in a little at a time.
- A modulated optical signal, for example on-off as with a rotating disc chopper, make it easy to unambiguously recognize that the detector is seeing your laser. Breaking the beam with your hand is safe and also works.

Although all functions can be accessed through the front panel of the 6310-QCL, we recommend that you install and use the software that is provided as a more convenient control interface. Install the Arroyo Control software, which you will find in the **Software\Arroyo Control** folder of the CD. The _Mount_ setting in step 7 above must be changed at the instrument front panel, but all other settings can be adjusted using Arroyo Control software.

We understand that the user's intent is to detect and measure the concentration of the gas for which the QCL is targeted. The particulars of each measurement will vary according to whether the measurement is to be in a gas cell or over some open path, for gas mixtures at normal atmospheric conditions or at exotic temperatures and pressures. Those details are left to the user.

We recommend that users add a function generator to the set up and use it to control the tuning of the QC Laser (by varying the current while the laser is at a fixed temp to repetitively scan the laser thought the target gas absorption line). The 6310-QCL accepts a 0 to 10V modulation signal via BNC on the front panel. It is also possible to write a script that can tune the laser by ramping the current, but the current sweep rate is typically too slow for most measurements and no sync signal is generated. For these

reasons, the tuning of wavelength versus time by injecting an external control signal is recommended.

We do also expect that MOST USERS will digitize the detector output and merge it with current/wavelength versus time data from the function generator to construct the data set for analysis.