ICE Box Quick Start Guide

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Please read Limited Warranty and General Warnings and Cautions prior to operating the ICE Box.

Links

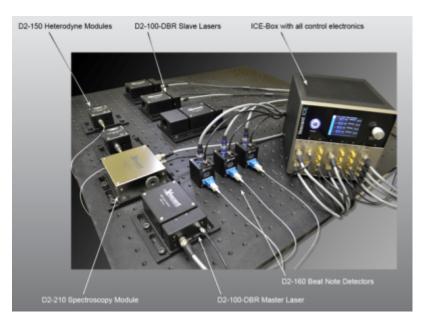
Click here for specifications on the ICE Box Card Chassis. Click here for the ICE GUI Installation. Click here for the ICE-QT1 Board. Click here for the ICE-CS1 Board. Click here for the ICE-QT1 Board API. Click here for the ICE-CS1 Board API. Click here for the ICE-PB1 Board API.

Contact sales [at] vescent [dot] com for questions and corrections, or to request added functionality.

Description

The ICE (Integrated Control Electronics) box is a compact suite of digitally controlled electronics that will precisely drive and stabilize our D2-100 DBR lasers and an associated array of photonics tools. It will simplify your experimental design and reduce SWaP while still providing the same high performance we offer in our D2 modular units. The ICE-Box conveniently houses and interfaces up to eight ICE daughter boards plus the Master and Control board to allow integrated control over complex laser experiments. Easily control four lasers and more (figure 1) from a single device through serial commands, the front-panel, or a GUI.

Fig. 1: The ICE Box controlling an atomlocked 4 laser system in maser/slave configuration



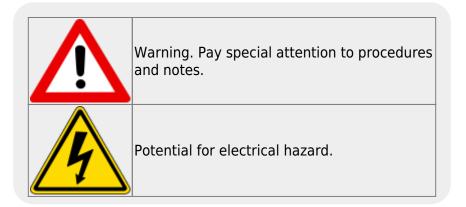
Overview

This guide will walk you through getting started with the ICE Box, setting up GUI controls, and locking a D2-100 DBR laser to spectroscopy using the ICE CS1, PB1, and QT1 cards. Preparing and aligning the laser system associated with obtaining this lock will not be covered in this quick start guide, but information on doing so can be found here. Further information on the functionality of individual ICE cards not covered in this guide can be found in their respective manuals (coming soon!).

Purchase Includes

- ICE-box Integrated Control Electronics Card Chassis
- USB Type-B Cable
- Power Cable (if purchased with ICE PS2 Power Supply)
- All cables required to make connections to installed ICE Cards.

List of Symbols



Getting Started

After unpacking your ICE Box and ICE PS2 Power Supply, you should begin by familiarizing yourself with the connections on the back of the box. The sections below will guide you through setting up the ICE box, and obtaining a lock to spectroscopy using the ICE box GUI. The laser system used in this example is a D2-100 (780nm) DBR laser, and a D2-210 (Rb) spectroscopy module.

Powering on the ICE Box

To power on the ICE box, connect the ICE PS2 power supply to a mains power wall outlet, then connect the ICE box with the included power supply cable. Toggling the rocker switch on the back of the ICE PS2 power supply will turn the power supply on, after which the front rocker switch can be

toggled to place the ICE system into standby mode. In standby mode, the ICE box is not powered on, but can activate either by serial API commands, or by pressing the circular power button on the front of the ICE box. The four LEDs on the front of the ICE PS2 power supply indicate whether the ICE box is in standby mode (top LED on), or receiving full power (bottom three LEDs on).

Making Connections to a Laser System

The ICE-CS1 and ICE-QT1 boards each have two connections, and the ICE-PB1 board has four. Not all connectors on each card are used in the configuration described in this guide, but all connections on each card can be used at the same time. While the ICE box is fully powered off, connect the Hirose temperature control of the D2-100 to the "Ch 1 & 2" Hirose connector on the ICE-QT1 card using an 8-pin Hirose cable. Attach an SMA cable to the "Laser Out" SMA on the ICE-CS1 card, then remove the 50Ω shorting cap from the D2-100 and connect the SMA cable. Finally, connect the top 6-pin Hirose power connector on the ICE-PB1 card to the power connector of the D2-210 spectroscopy module. Power on the ICE system. Descriptions of each card can be found below.

ICE-QT1

On the ICE-QT1 board there are two 8-pin Hirose connectors labeled "Ch 1 & 2", and "Ch 3 & 4" respectively. Each Hirose connector can control two TEC plants for a total of four plants per QT1 board. One ICE-QT1 board is able to temperature control two D2-100 lasers.



Fig. 2: The ICE QT1 Board

ICE-CS1

On the ICE-CS1 board there are two SMA connectors: "Error In" and "Laser Out". The "Error In" SMA takes the error signal from a photodetector such as the one in the D2-210, and the "Laser Out" SMA is for current controlling a laser diode such as the D2-100. Each D2-100 laser in your system needs its own ICE-CS1 or ICE-CP1 card to act as a current controller, depending on whether it's being locked to spectroscopy, or to a maser laser in an offset phase lock.



Fig. 3: The ICE CS1 Board

ICE-PB1

The ICE-PB1 board has Four 6-pin Hirose power connectors. A table of the connectors pinout can be found below. This ICE card is primarily used to power system auxiliaries, such as the D2-210 spectroscopy module, or the D2-260 beatnote detector. Each connector on the ICE-PB1 board can power one auxiliary device, allowing four devices per board.



Fig. 4: The ICE PB1 Board

Installing and Using the ICE Control GUI

The ICE Control GUI can be found on our gethub page here, and installed by scrolling to the bottom of the page and choosing between the three file formats. If you are using a Windows 10 machine, it will be easiest to download "ICE_Control_v1.2_32bit.zip", which includes an executable file. Once you have downloaded the .zip file, extract it to whichever directory will be most convenient to run an executable from. The executable must be left in the extracted folder, as it will have trouble finding some of its dependencies if you move it. It is important to note that you must both save the file (the Windows Default is to "Open" files), and also extract the file before the ICE Control GUI can be used. You will not be able to open the ICE Control GUI if you do not.

I.2 Release of ICE-GUI Software	Company +
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upports Windows XP or greater. Below are 12-bit Windows binaries. The software is written in Python using PyQt5 bindings. It is distribute wecutable for Windows, so there is no need for the user to have Python installed on the system nor will it imarfere with pre-existing install over it system. The user interface are stored in as scripts in the UI sub-directory, allowing user to freely modify the user installace without re- resprese.	ations of Python on th
nstallation	
kete: If you are running an older version of Windows 7 or XP, you may need to download and run the Microsoft DirectX End-User Runfin potate your OpenSL driver. If you install the KE GUI program and it disearct run (usually signified by a console window briefly opening a norm resuspay), you lively need to update your DirectX drivers with this runtime installer. Iownload: DirectX Runtime Web Installer	
he program is distributed as a pipped executable, his installation is needed, just untip the file to a folder of your choice and run "ice_com econtended to untip the folder somewhere writable by the user (as opposed to Program Piles) so that log Nes and UI script Nes patient.	
lote: Binaries for other OSes can be compiled using Pylnstaller following the instructions on the Readme.md	
Drivers	
he KE Box uses an PTDL USB to Serial converter to present Itself as a Virual COM Port (VCP) to the host computer. If you are using Wind ther should be installed automatically by Windows upon plugging in the ICE Box. However, if your PC is not connected to the internet to ownloaded from PTDL's website here: http://www.fblichip.com/Drivers/VCP.htm	
hanges from Previous Version	
Danges between version 1.1 and 1.2 are faily minimal, main by now supports file saving and file loading. A new plot component has bee omponents available in the ui folder. A GUI for a new product, OPL1, is also included in this release.	n added to the
eginning in version 12, we are packaging a firmware update utility for use with ICS. Please see the RSADME in the update utility folder for	information on its use
ind User Application Development	
he software is witten in Python using QSI bindings and distributed in source form allowing the user to modify or expand the program as with against Bython 3.5.2 and Bytot 5.6. The program uses Pytheles to do seriel communications with the ICE Box and the Urigit is prime reactify utilities the QD-action based of Pytho. Boxinologing Python 35 or genetar and installing Python for generar should allow the u regram in their own Python environment. In this case, they should run "main,py" from the source code via laytion (add), all	rily written in QML (with
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Fig. 5: The download page for the ICE Control GUI

Once you are finished downloading and unzipping, navigate to the extracted file and double click "ICE_Control", which should be an executable with the Vescent Logo as its icon. A blank command prompt window will appear, and the ICE Control GUI will take a minute or two to open. It is not necessary to type any commands into the command prompt window.

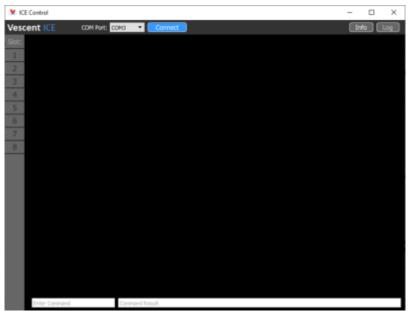


Fig. 6: The ICE Control GUI before Connecting to an ICE Box

Now that the ICE Control GUI is open, you must plug your powered on ICE box into your computer using a USB Type-B to USB Type-A adapter, and determine which COM port was assigned to it. To find the ICE box's COM port on Windows, type "Device Manager" into the search bar at the bottom of the screen, press enter, and then expand the "Ports (COM & LPT)" drop down menu (figure 7). Unplug the

USB cable from your ICE box and watch the list of COM ports to see which one disappears. Plug your ICE Box back in and observe the new COM port device appear in the menu. The COM port of each device is listed in paranthesis at the end of each line. Select the correct COM port from the Drop Down menu in the ICE Control GUI and press "Connect".

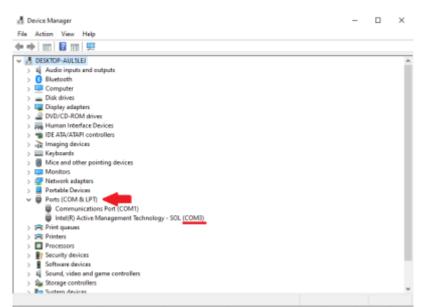


Fig. 7: Device Manager window highlighting the Ports drop down

The list of board slot numbers on the left hand side of the ICE Control GUI will illuminate, indicating which boards are installed. Boards can be selected from this list by clicking on the numbers to navigate to the control options for the corresponding ICE board.

Locking a Laser to Spectroscopy

After making all the necessary connections you will need to find spectroscopy. This can be done by setting the **Laser Current** to a value which gives the desired output power, and then modifying the setpoint temperature of the QT1 card. If using a D2-100 DBR laser purchased from Vescent, refer to the documentation which came with the laser to find the approximate Ch 2 setpoint. If your paperwork is unavailable, start with the temperature at 15°C and increase the setpoint slowly up to 30°C until spectroscopy is found. If using a 3rd party laser, refer to its documentation to find suggested transition setpoints.

Vescent ICE COM Port: COM12 Disconnect	- C	X
Slot: 1 2 3 4 5 6 7 8 1 1 2 3 4 5 6 7 8 1 1 2 3 4 5 6 7 8 1 2 1 2 1 2 1 2 0.00 0.02 0.00 0.00	_	
Enter Command Command Result		

Fig. 10: Rb Spectroscopy (top) and Peak Lock Differential signal (bottom)

Once spectroscopy has been found, turn **Ramp** on and align the feature you want to lock to with the center line on the GUI plots. You can do this either by changing the **Laser Current** supplied to the diode, or by shifting the **Center** dial in the **Ramp** box. Turning **Range** up and down will make your ramp amplitude larger or smaller and show you more or less of your spectroscopy. Whatever is lined up with the center line on the plots is the feature the ICE box will try to lock to. If you want to lock to a peak, align the top graph with the peak you want, and note that the bottom graph should be near the middle of a slope.



The intuitive thing to do is to center right on the feature you want, but you actually want to be a little bit offset from that. The ICE box gives a slight kick when the servo is engaged, so if you're right on the center it will sometimes bump you over to the next peak. It doesn't matter which side you offset from (a little right or left will be fine) as long as you're still on the correct slope. It will always kick towards the center of the selected slope. It is recommend to aim for a roughly 5% offset from center when aligning the feature you wish to lock to.

V ICE Control	-		×
Vescent ICE COM Port: COM17 Disconnect		nfo (Log
Stet 1: ICE-CS1: Peak Lock Servo and Current Controller Ramp 0,5 0,1 1: Datapoints 256 Channel 3 1: Desc Current Limit 0: 0,5 0,1 1: 0,1 0: 0,5 0,1 0: 0,1 0: 0,0 0: 0,0 0			
Enter Command Command Result			

Fig. 11: TEXT

Engage the **Servo** button and watch the signals. The top graph should go to a value that corresponds to the feature you were trying to lock to, and the bottom graph should go to zero.



Fig. 12: TEXT

If these do not happen, it might mean that your **Op Offset** and **Gain** settings are not optimal like in figure 13. To optimize these, turn your gain down as low as it will go without losing lock, and then adjust the **Op Offset** so that the signal on the bottom graph goes to zero. You may not be able to get it exact due to the digitization of that setting, but there will be a setting for which it is closest and changing up or down will flip what side of the line you are on. Once you've done this, turn **Gain** back up until the signal looks nice. Getting **Gain** to the right setting is a little difficult to do with just the ICE box, but a good way to approximate it is to increase **Gain** until you lose lock, and then back off by ~40-50%. The optimal **Gain** setting ultimately comes down to your measurements of noise on externals such as a beat note between two lasers.

VEC Control Vescent ICE COM Port: COM17	sconnect	Info L	×
Side: 1: ICE-CS1: Peak Lock Servo an Ramp Range Center 0:5 0.1 Trig 0.5 0.1 Trig Datapoints 256 Channel 3 Laser Current Laser Servo ON ON ON Current Limit 120.0 Gain Servo Offset DC Offset 5 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	Graph Events (IVDiv(-) (IVPos.(-):0.87V I started messing with the Op Offset and gain here and my signal went up and down as a consequence. Branp Writige (0.05 VDiv) Note: Serie toda to positive stope. H WDiv(-) Ramp Voltage (0.05 VDiv) Ramp Voltage (0.05 VDiv)		

Fig. 13: TEXT

Front Panel

The front panel can be seen in figure 14. The functions and connections are as follows:

- 1. Power Button
- 2. Interchangeable ICE Cards
- 3. ICE Box On Board GUI Monitor
- 4. Rotary Knob and Button for On Board GUI Navigation
- 5. ICE Card Slot Indicator



Fig. 14: Front Panel of the ICE Box

Rear Panel

The rear panel can be seen in figure 15. The functions and connections are as follows:

- 1. DB-9 Connector for TTL Serial Communications ¹⁾
- 2. USB 2.0 Type-B port for Serial Communications
- 3. BNC Interlock
- 4. 5V/500mA fan connection pins
- 5. D-Sub Combo Power Connector

The DB-9 Connector (1) is **NOT** for powering the ICE box. Do not confuse it with the daisy chain power system used in the D2 product line. Attempting to use this connector for power may damage your ICE box.

Use the D-Sub Combo Power Connector (5) and the ICE-PS2 power supply as described here.



Fig. 15: The Rear Panel of the ICE Box

Contact sales [at] vescent [dot] com for questions and corrections, or to request added functionality.

1)

not compatible with RS-232

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