

# SLICE-DHV Dual-Channel High-Voltage Amplifier

The SLICE-DHV is a low-noise, high-bandwidth, high-voltage source with DC bias control and sweep capabilities. It is designed for controlling piezoelectric transducers used for precision positioning, with particular application to laser frequency stabilization. The high-voltage output can range from 0 to 200 V, has a voltage noise  $<500 \mu\text{V rms}$ , can drive  $\pm 200 \text{ mA}$ , and has an unloaded small-signal ( $\pm 10 \text{ V}$ ) bandwidth  $>1 \text{ MHz}$ . The SLICE-DHV also has a user-settable voltage limit for safe operation at voltages less than 200 V.

The SLICE-DHV features two Gain values:  $G=1$  and  $G=20$  for the input modulation signal. When  $G$  is set to 1, the output range is limited to  $\pm 10\text{V}$  from the user-settable DC bias voltage. When the Gain is set to 20, the modulation input signal allows access to the full range of the SLICE-DHV (0-200 V). When the Gain is set to 1, the SLICE-DHV has better noise performance than when the Gain is set to 20.

The SLICE-DHV is not recommended for applications that require a large-signal bandwidth greater than 20 Hz, defined for modulation amplitudes more than 10 V.

Model No. SLICE-DHV

Document Revision: 1

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Please read [Limited Warranty](#) and [General Warnings and Cautions](#) prior to operating the SLICE-DHV.



Potential for electrical shock hazard. The SLICE-DHV can deliver up to 200 V at its output. Use caution when device is turned on & enabled.

## Useful Links

Click here for the [Vescent manuals page](#).



Click here for the [SLICE-DHV API](#).

Click here for the [SLICE-DHV web page](#).

Click here for the [Github page for SLICE-DHV firmware revisions](#)

Please check back for added functionality. Contact [sales \[at\] vescent \[dot\] com](mailto:sales@vescent.com) for questions and corrections, or to request added functionality.

## List of Warning Symbols

|   |   |
|---|---|
|  | Warning. Pay special attention to procedures and notes. If procedure is not followed carefully, damage to the SLICE-DHV or devices connected to it may occur. |
|  | Potential for electrical shock hazard.  |
|   | Important. Pay close attention to manual instructions for optimum results and in order to not damage the device.  |

Tab. 1: List of warning symbols

|  |   |
|--|---|
|  | The SLICE-DHV High-Voltage Amplifier is intended for, among other tasks, driving tuning elements in external cavity diode lasers. When using lasers, particular care must be given to avoid radiation exposure hazards. |
|--|---|

Tab. 2

## Description

The SLICE-DHV ([figure 1](#)) is a high-bandwidth, low-noise, high-voltage amplifier. It is intended to supply a voltage to a piezoelectric transducer (PZT) for precision motion control, including cavity length control for laser frequency stabilization applications.

Fig. 1: The SLICE-DHV



Purchase Includes

- SLICE-DHV Dual-channel High Voltage Amplifier
- AC power cord with appropriate wall plug for you location (if known)
- Final Test Documentation

If your shipment is missing any items from the above list, [please contact the factory](#).

Absolute Maximum Ratings and Power Input

Note: All modules have been designed to be operated in a laboratory environment as described in [table 3](#).

| Parameter                     | Rating          |
|-------------------------------|-----------------|
| Environmental Temperature     | 15°C < T < 30°C |
| Environmental Humidity        | <60%            |
| Environmental Dew Point       | <15°C           |
| Maximum AC Line Input Current | 2 A             |

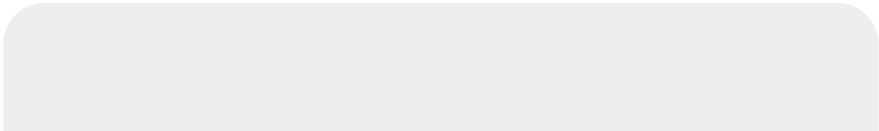
Tab. 3: Absolute Maximum Ratings



The SLICE-DHV will accept input line voltages within the ranges shown in [table 4](#). The SLICE-DHV is powered by Vescent's proprietary power supply technology which allows a range of voltage inputs, but retains the noise qualities of a linear supply.

| Parameter                           | Value          | Units |
|-------------------------------------|----------------|-------|
| Input Line Voltage                  | 100-240        | VAC   |
| Frequency                           | 50-60          | Hz    |
| Phase                               | 1 phase        |       |
| User-serviceable fuse <sup>1)</sup> | T 2.0 A L 250V |       |

Tab. 4: Input Voltage Specifications

Proper Usage



|   |  |
|---|--|
|  | If this instrument is used in a manner not specified by the manufacturer in this manual or other relevant literature, protection provided by the instrument may be impaired.                         |
|  | Use caution when connecting the SLICE-DHV to your device. The SLICE-DHV can output up to 200 V without an input signal. It is advised that you power off the device before making connections to it. |



Always power down the SLICE-DHV completely before making connections to a laser. Never connect or disconnect the SLICE-DHVs to/from a laser with the SLICE-DHV energized.


As with **any** flexible instrumentation, improper usage can cause irreparable damage to the device. Please take note of all warnings and cautions.

## Specifications

| Performance <sup>2)</sup> |  |
|---------------------------|--|
| Parameter                 | Value  |
| Number of Channels        | 2  |
| Control Interfaces        | Touch screen, USB 2.0  |
| Output Voltage Range      | 0-200 V  |
| Gain Ranges               | Unity Gain: $\pm 10$ V around a user-settable voltage<br>Full Range: 0-200 V |
| Modulation Gains          |  |
| Unity Gain                | 1 V/V  |
| Full Range                | 20 V/V   |
| Bandwidth                 |  |
| Small Signal              | $>1$ MHz, unloaded   |
| Large Signal              | $<20$ Hz, $C_{load} < 0.5 \mu F$   |
| Performance               |  |
| Output Current            | $\pm 200$ mA   |

|                                |   |
|--------------------------------|---|
| Modulation Input Voltage Range | $\pm 10\text{ V}^{3)}$                          |
| Voltage Noise                  | $<450\text{ }\mu\text{V rms (10 Hz - 100 kHz)}$ |
| Accuracy                       | $<1\%$  |
| Drift                          | $0.2\text{ mV}/^{\circ}\text{C}$                |
| Triggering                     | 5V TTL  |

Tab. 5: Specifications of SLICE-DHV



Most PZTs should not be driven with negative voltages, and the user should consult the specified safe operating voltage range for their PZT. Be aware that the high-voltage output can be driven to a minimum of -10 V when applying a modulation.

Tab. 6

| Load Capacitance | Approximate Bandwidth |
|------------------|-----------------------|
| 1 nF             | 200 kHz               |

Tab. 7: Approximate bandwidth of SLICE-DHV as a function of load capacitance

## Front Panel

An image of the front panel of the SLICE-DHV is shown in [figure 2](#). The functions and connections are as follows:

1. Channel indicator; touch for [Channel parameter settings](#)
2. [High-voltage ON/OFF](#)
3. [Bias set point](#)
4. [Output voltage indicator](#)
5. [Parameter adjustment rotary knobs](#)
6. [Maximum voltage indicator<sup>4\)</sup>](#)
7. Front-panel [control signal inputs](#)

8. Control bar
9. Internal ramp amplitude
10. Internal sweep ON/OFF/SWEEP TUNE selection
11. Visual output voltage indicator
12. Signal monitor outputs

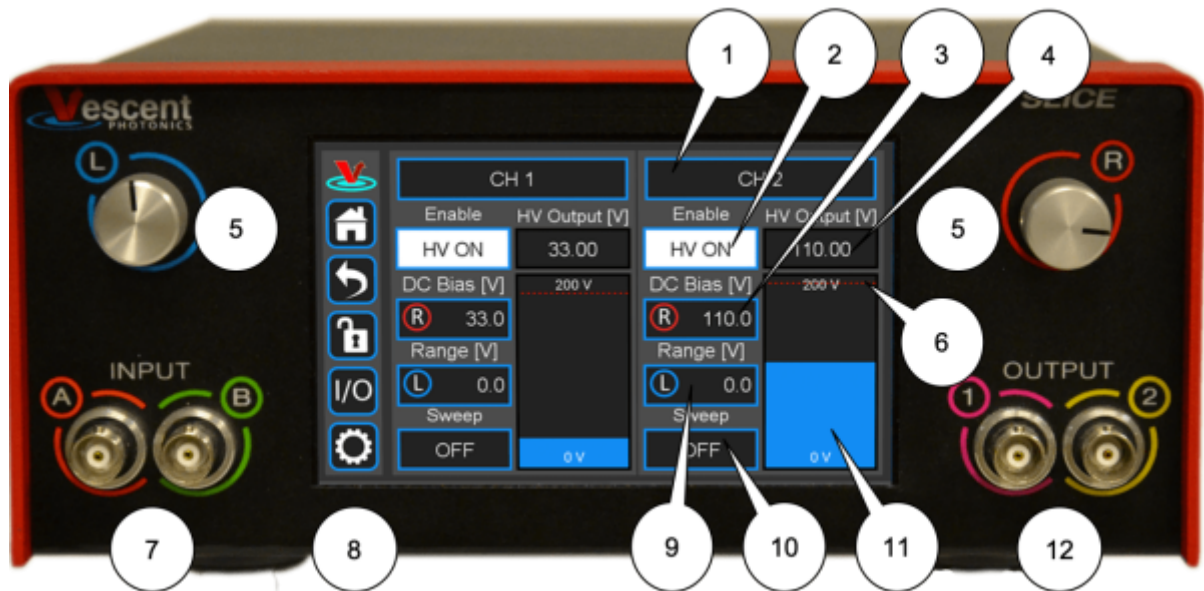


Fig. 2: Front of SLICE-DHV

## Rear Panel

An image of the rear panel is shown in [figure 3](#). The functions and connections are as follows:

1. Serial Number location
2. High Voltage output (CH 2; BNC)
3. [Modulation input](#) (CH 2; SMA)
4. Main On/Off power switch
5. Fuse location<sup>5)</sup>
6. AC line power in<sup>6)</sup>
7. [Output trigger](#) (BNC)
8. [Input trigger](#) (BNC)
9. USB port for [serial communication](#) (Type B)

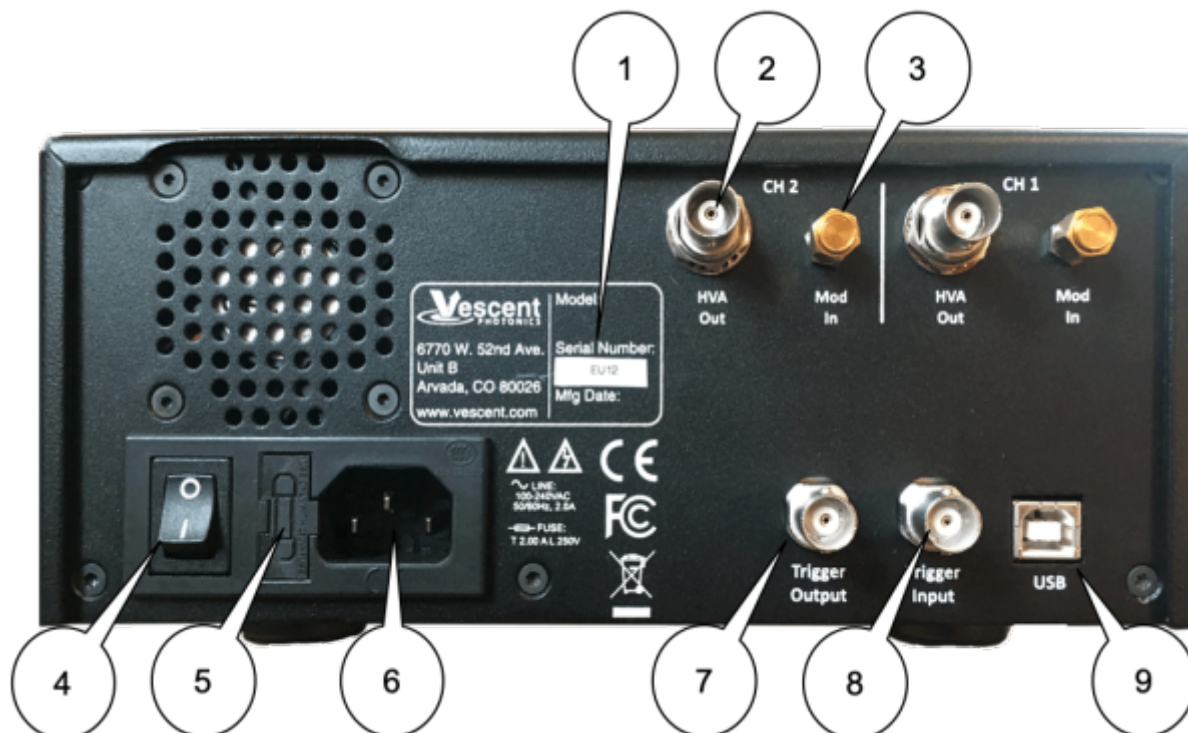
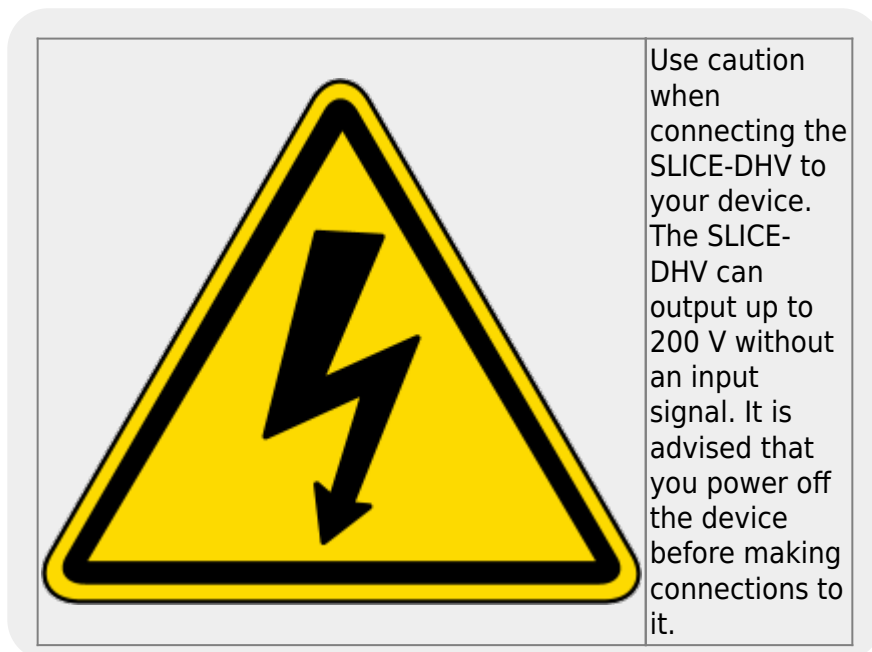


Fig. 3: View of rear of SLICE-DHV



## Getting Familiar with the SLICE-DHV

The SLICE-DHV is designed to be operated from the touch screen GUI and/or [serial commands](#) delivered from a Windows® 10 PC over the USB connection on the back of the chassis. Both the touch screen and serial commands allow access to all of the SLICE-DHV functionality.

### Screen Navigation

## Home Screen

When presented with a given view, it is possible to select the functionality or edit the values in any field bordered in blue. When a particular field is actively being edited, its border will change to yellow. The ability to edit a yellow-bordered field will automatically time out after about 60 s and the border will turn back to blue. The Home Screen of the SLICE-DHV is shown in figure 4 and is reached by touching the home button (figure 5) in the upper left corner of the touch screen. From the Home screen, summary control over each of the two channels is possible, including setting the bias voltage. From the Home screen, you can edit the control parameters for each channel.

In general, the status displayed in an editable field is the current status (not the result of touching the button). Touch the button to select a new value/status. For instance, in figure 4 both channels are ON. Touching the ON button will stop voltage output to the given channel.

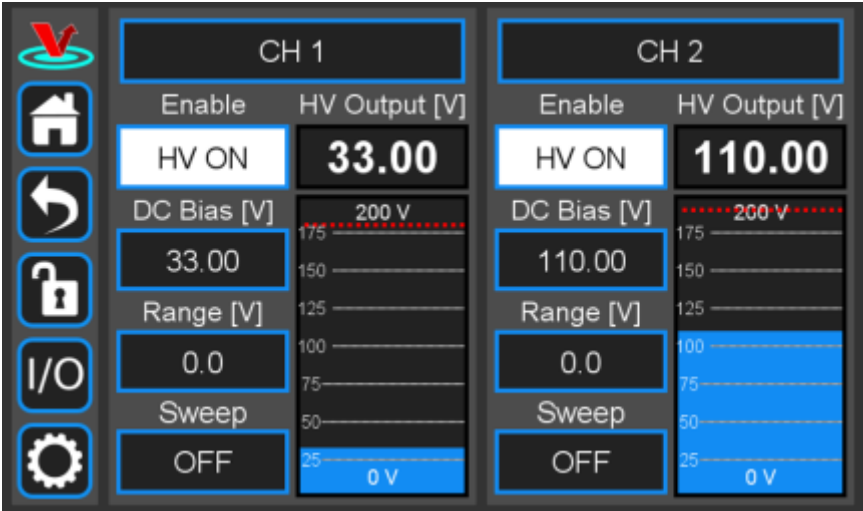


Fig. 4: Home screen of SLICE-DHV

## Control Bar

On the left edge of the screen is the Control Bar. At any given time, these buttons will have the following effect.

## Home Button



Fig. 5: Home button Returns to Home screen.

## Back Button





Fig. 6: Back button Returns to previous screen. Changes will be lost if not accepted before using the Back button.

## Lock Button



Fig. 7: Lock button (shown in unlocked mode) Locks out further modification of operation parameters. Touch to lock or unlock parameter entry. When in lock mode, it is still possible to toggle the ramp on and off, but it will not be possible to turn on the high voltage, change the bias voltage, or edit other operation parameters.

## I/O Button



Fig. 8: I/O button Enters the screen for programming the [front-panel I/O](#).

## System Settings Button



Fig. 9: System settings button Enters screen for [system operational settings](#) (brightness, volume, etc.).

## Entering Values

In most instances, there are two methods for entering parameter values: the physical rotary knobs on the front panel and the pop-up keypad on the touch screen. When using the knobs to change the value of a parameter, changes take effect immediately. When using the keypad, changes do not take effect until the Enter key is touched.

## Rotary Knobs

If you touch an editable field for a brief moment, the border of the field will change from [blue](#) to [yellow](#) and a cursor will appear under one of the digits of the parameter value ([figure 10](#), CH 1 DC

Bias [V] field). By turning the right knob, it is possible to increase (cw) or decrease (ccw) the value of the underlined digit. Turning the left knob will change which digit is editable (cw to move to the right and ccw to move to the left). Changes made with the rotary knobs take effect immediately. Touch the yellow-bordered field again to exit the edit mode.



Fig. 10: Knob adjustment of Bias Voltage set point for CH 1

Keypad

If you touch an editable field for a longer period of time (~3 s), a numeric keypad will appear as seen in figure 11. You can enter in the full value of the desired parameter with this keypad. Changes entered through the keypad are not enacted until the Enter key is touched.



Fig. 11: Pop-up Keypad

The action initiated by each button of the keypad is described below.

Escape

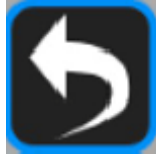


Fig. 12: Escape button Exits keypad without accepting changes.

### Clear



Fig. 13: Clear button Clears value in field being edited.

### Delete



Fig. 14: Delete button Deletes last character entered.

### Enter



Fig. 15: Enter button Accepts parameter edits and exits keypad.

## Extendable Legs

The SLICE-DHV has four extendable legs ([figure 16](#)). Extending the front legs allows easy viewing from above ([figure 1](#)) and extending the rear legs ([figure 17](#)) allows easy viewing from below, for instance, when placed on a shelf above a laser table. Extending both the front and rear legs makes the SLICE box look like a very strange bug.

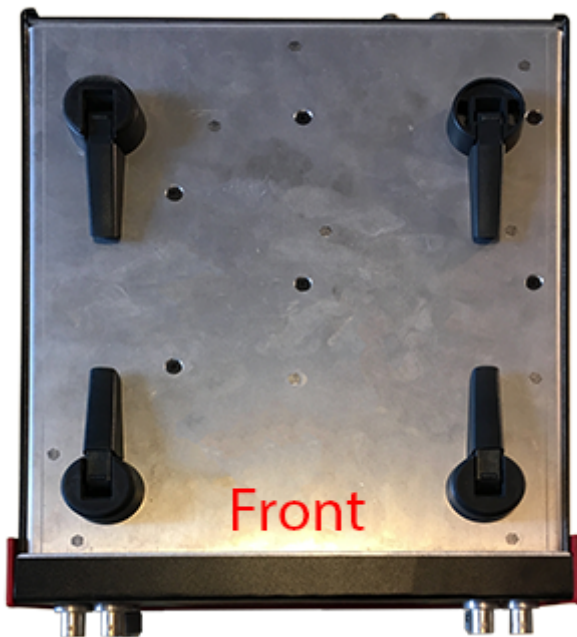


Fig. 16: Underside of SLICE-DHV



Fig. 17: Side view of SLICE-DHV configured for viewing from below

## SLICE-DHV Operation

The Home screen displays the status of both channels ([figure 4](#)). The data for each channel is arranged vertically. At a glance, for each channel, the ON/OFF status, the output voltage, the nominal bias voltage, the Sweep Range (amplitude) for the internal Sweep function, and internal Sweep function status can all be read.

### Bar Graph and Output Voltage Indicator

The blue bar graph and output voltage indicator (bubbles 11 & 4 in [figure 2](#)) report the high voltage output. This display is intended to display the “DC” value of the output with an update rate of about 4 Hz and will not capture faster transient behavior of the output. These displays offer quick visual identification of the output voltage and can help visualize drift in feedback control applications.

### Setting the Gain on the Input Signal

The Gain on the input control signal can be set to either 1 or 20. When the gain is 1, the input modulation signal is directly summed with the DC Bias to produce the high voltage output. This mode is useful for limiting the voltage range of the high voltage output to  $\pm 10$  V around the DC bias operating voltage.

When the Gain is set to 20, the input signal is multiplied by 20 and then summed into the DC bias. This mode allows the modulation input to drive the high voltage output over the entire 0 to 200 V range of the SLICE-DHV. In this mode the DC Bias defaults to zero voltage but can be adjusted to add a DC Bias to the modulation signal if desired. Note that the large-signal bandwidth will be limited when the Gain is set to 20 to less than 20 Hz, but that the small-signal bandwidth ( $\pm 10$  V) will be identical to that when Gain = 1.

To change the Gain, touch the CH 1 (or CH 2) field at the top of the channel column. You will be presented with figure 18. Touch the Modulation Mode field to drill down to figure 19 and select either  $G=1$  V/V; Range =  $\pm 10$  V or  $G=20$  V/V; Range = 0-200.

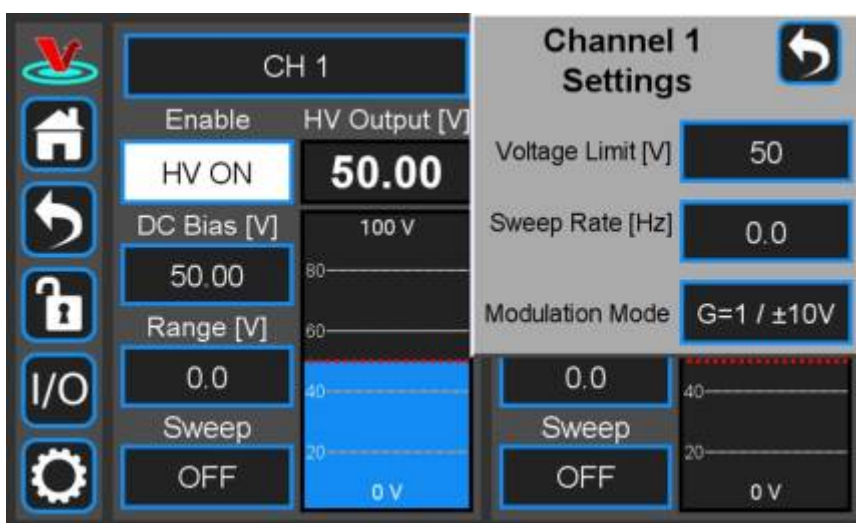


Fig. 18: Setting parameters of individual channel

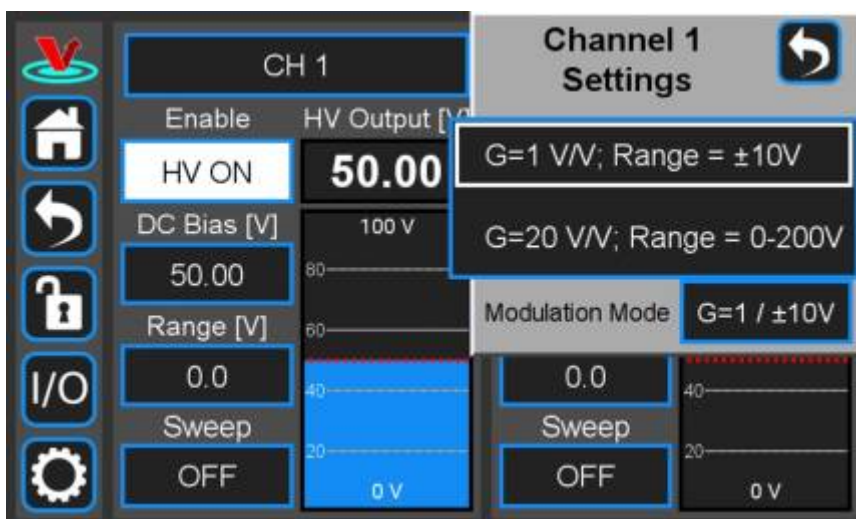


Fig. 19: Select modulation mode

## Choosing Current Limited or Full Bandwidth

On newer models of the SLICE-DHV, a feature was added which allows the user to switch the Modulation Mode of their unit between Current Limited, and Full Bandwidth. These two modes control the amount of drive current which can be sent through the output op-amp to modulate the load attached to HV out. In Full Bandwidth mode, the current through the op-amp is not limited, giving the SLICE-DHV a larger modulation bandwidth. The drawback, however, is that the output op-amp will occasionally go into thermal shutdown, or show distortions when driven especially hard, or with larger loads. In Current Limited mode, the output op-amp is throttled slightly to prevent the thermal shutdown and distortions seen in Full Bandwidth mode. However, using Current Limited mode slightly reduces the overall bandwidth of the system.

It is recommended to use the Full Bandwidth modulation mode if in the small signal regime ( $G=1$  output mode,  $< 20$  Vpp modulation), and to switch the SLICE-DHV into its Current Limited modulation mode if larger modulations ( $G=20$  output mode,  $> 20$  Vpp modulation) are required. This will help to prevent thermal shutdown. Certain systems may require different settings than these, though,

depending on their specifics. For a more in depth discussion of choosing between Full Bandwidth and Current Limited, see our application note “Load Size Selection and Limiting Factors of the SLICE-DHV’s Modulation Output”, which can be found on our website under “Application Notes”.

## Setting the Voltage Limit

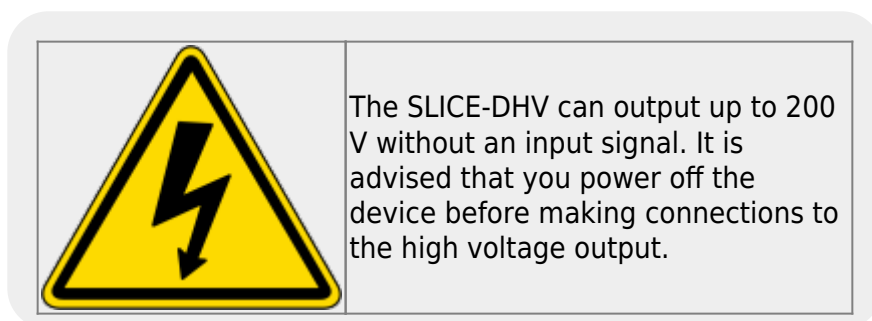
The user can set the maximum voltage output on a given channel so as not to exceed the rated maximum for their device. From the Home screen, touch the CH 1 (or CH 2) field to see [figure 18](#). Touch the Voltage Limit [V] field to set the maximum voltage output. The bar graph output indicator on the Home screen will scale automatically with the maximum voltage set point.

This voltage limit circuit in the DHV hardware limits the voltage (including the modulation input) to the user defined limit when using the  $G=20$  V/V mode. However, this hardware limit does not cap the modulation input in the  $G=1$  V/V. Therefore, when operating in the  $G=1$  V/V mode, if the user were to set the nominal voltage set point to the user-defined maximum voltage output point, the output with a +10 V modulation input would exceed the user-defined limit by 10 V

## Setting the Bias Voltage

To set the bias voltage about which the SLICE-DHV will operate on a given channel, touch the DC Bias [V] field on the Home screen. Depending on the length of the touch, either a view similar to [figure 10](#) allowing rotary knob input or a keypad similar to [figure 11](#) will be displayed. Set the nominal bias voltage.

## Turning on the High Voltage



To turn on (turn off) the high-voltage output touch the HV OFF (HV ON) field on the Home screen.

## Internal Ramp Function

The SLICE-DHV has an internal ramp function for sweeping the voltage output. The ramp is a sawtooth wave.

To set the sweep rate<sup>7)</sup> of the ramp, touch the CH 1 (or CH 2) field to see [figure 18](#). Touch the Sweep Rate [Hz] field and set the desired rate.

To set the amplitude of the ramp<sup>8)</sup>, touch the Range [V] field on the Home screen and set the desired ramp amplitude.



To turn on (or turn off) the ramp, touch the Sweep OFF (or Sweep ON) field to see [figure 20](#). Choose the desired operation mode.



Fig. 20: Controlling the internal ramp

**Sweep Tune Mode of Internal Ramp**

The Sweep Tune mode allows interactive control over the internal ramp parameters. This mode can be used to center the output of the SLICE-DHV on a particular feature of the experiment.

When in Sweep Tune mode, the Home screen will change to appear similar to [figure 21](#), with an R in a red circle in the DC Bias field and an L in a blue circle in the Range field. In Sweep Tune mode, the user can turn the right knob to actively adjust the bias and the left knob to actively adjust the range. The rotary knob will affect the underlined digit in the respective parameter field. To change which digit is affected by rotation of the knob, push to click the knob and the cursor under the active digit will cycle through from right to left, selecting the next most significant digit after each click.



Fig. 21: Sweep Tune mode

Only one Channel can have Sweep Tune mode active at any given time.

When in Sweep Tune mode:

- The rotary knob edit method is not available for the DC Bias and Range fields. Only keypad editing is allowed.
- DC Bias and Range readouts for the channel react to rotary knob actions while the Settings menu is displayed but no rotary edit is in progress on that menu.

## Modulating the SLICE-DHV Output

The user can input an analog voltage signal to control the output of the SLICE-DHV. Before introducing a modulation signal, make sure you have selected the [desired modulation gain](#).

The default modulation input port is the SMA connector on the rear panel (bubble 3, [figure 3](#)). The user can also program the SLICE-DHV to accept the modulation signal from the front-panel INPUT A for Channel 1 and INPUT B for Channel 2. Only one modulation input for a given channel can be active at any given time. To toggle between modulation input locations touch the I/O icon on the control bar and then the relevant INPUT field (A for CH1 or B for CH 2; [figure 23](#)). Select OFF for rear-panel input or Modulation Input for front-panel input.

While similar in performance, the rear-panel SMA input will have minimum noise. Use this input when possible.

## Programmable Input & Output

The SLICE-DHV has two programmable inputs (labeled A & B, bubble 7 in [figure 2](#)) and two programmable outputs (labeled 1 and 2, bubble 12 in [figure 2](#)) on the front panel. It also has a rear-panel trigger input and trigger output. Touching the I/O icon on the control bar will open a screen similar to that seen in [figure 22](#)

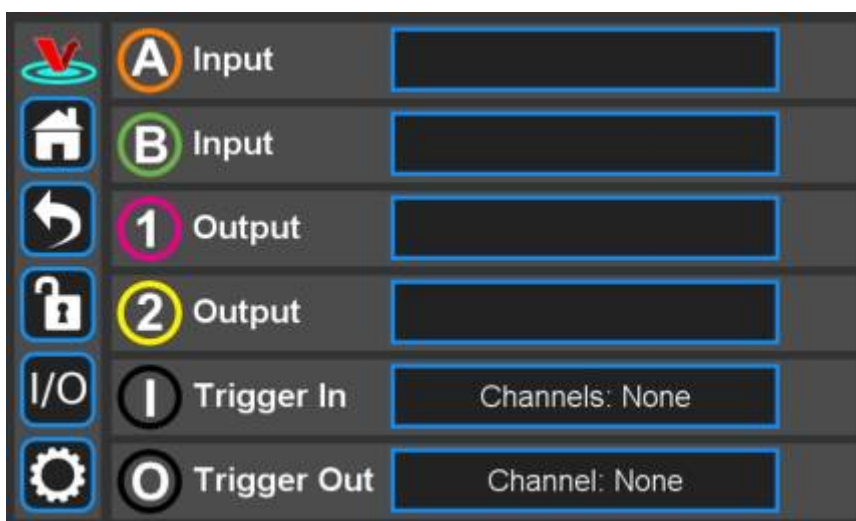


Fig. 22: I/O programming window

### Programmable Input

From [figure 22](#), it is possible to assign the front-panel input as the source of the modulation/control input signal (normally assigned to the SMA connector on the rear panel of the SLICE-DHV). Touching the A Input field displays the menu seen in [figure 23](#). From here, rear-panel modulation input (default;



blank field) or front-panel modulation can be selected.

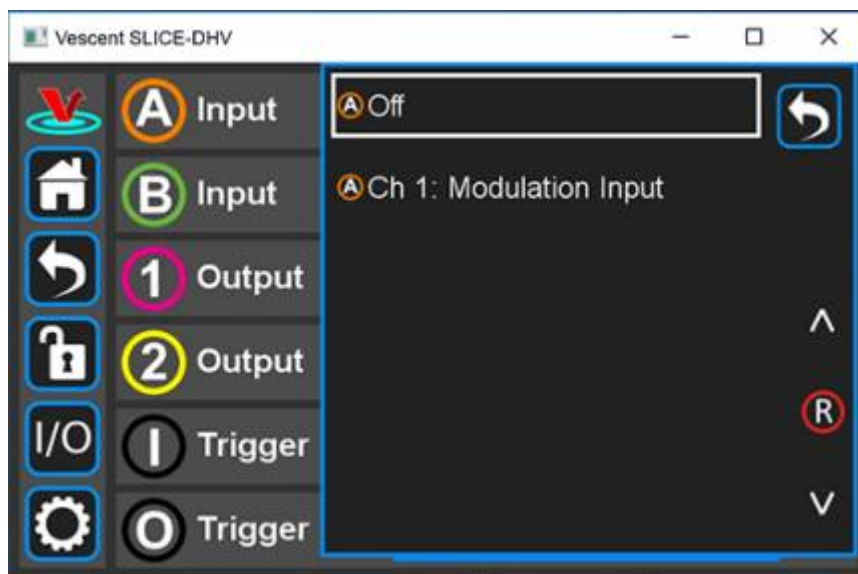


Fig. 23: I/O programming window

Only one modulation/control input can be active at any given time for a given Channel. If the front-panel modulation/control input is activated, the rear panel modulation/control input is deactivated & vice versa.

## Programmable Output

The front-panel output can be programmed to deliver a monitor of the high voltage output (figure 24). The transfer function is  $V_{\text{monitor}} = 0.05 * V_{\text{output}}$

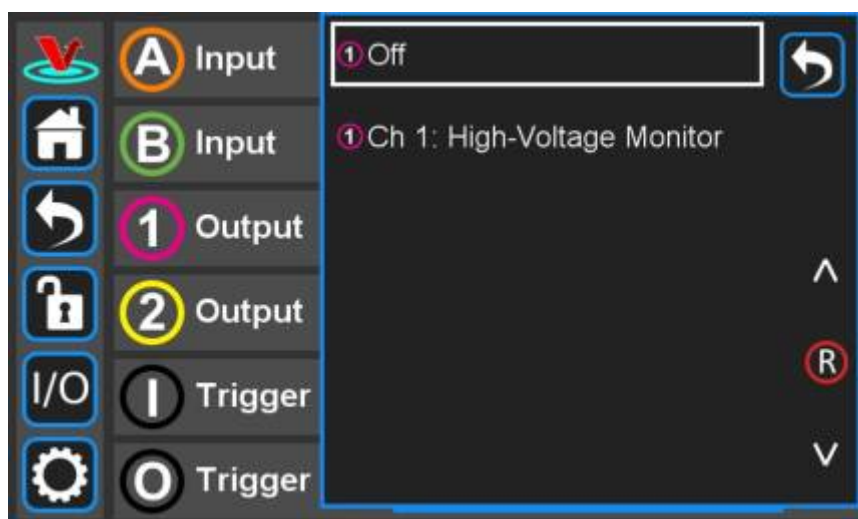


Fig. 24: Output programming window

These front-panel inputs and outputs are mainly intended for monitoring the performance of the SLICE-DHV and as such have slower, less quiet performance than the rear-panel connections.

CH 1 can only be assigned to Input 1 and Output A. Likewise CH 2 can only be assigned to Input 2 and Output B.

## Triggering

### Input Trigger

The HV output can be remotely activated and deactivated by a TTL trigger introduced at the back panel of the SLICE-DHV (bubble 8, [figure 3](#)). If the Trigger In on the back side of the SLICE-DHV is activated, the high-voltage output can be shut off by pulling the input low and turned on by allowing the input to go high. (With no input, this signal is pulled high and so the HV out is active.)

In order to activate the Trigger In, touch the I/O icon on the control bar to see the I/O screen ([figure 22](#)). Touch the blue field labeled Trigger In on the selection screen in [figure 25](#) and select which channels you wish to control with the input trigger.

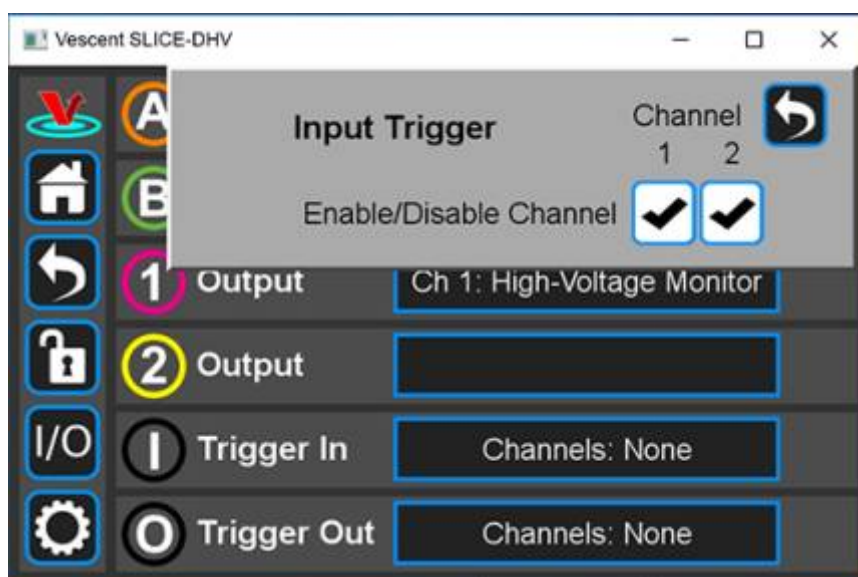


Fig. 25: Trigger In controls both CH 1 and CH 2

### Output Trigger

A TTL trigger output in sync with either of the internal ramps can be obtained at the Trigger Out (bubble 7, [figure 3](#)). Touch the I/O icon on the control bar to see the I/O screen ([figure 22](#)). Touch the blue field labeled Trigger Out for the selection screen in [figure 26](#) and select the ramp from which channel the trigger out signal shall be derived. The end of the ramp is in sync with the falling edge of the trigger.

Only a single Channel may be chosen for outputting a trigger at any given time.

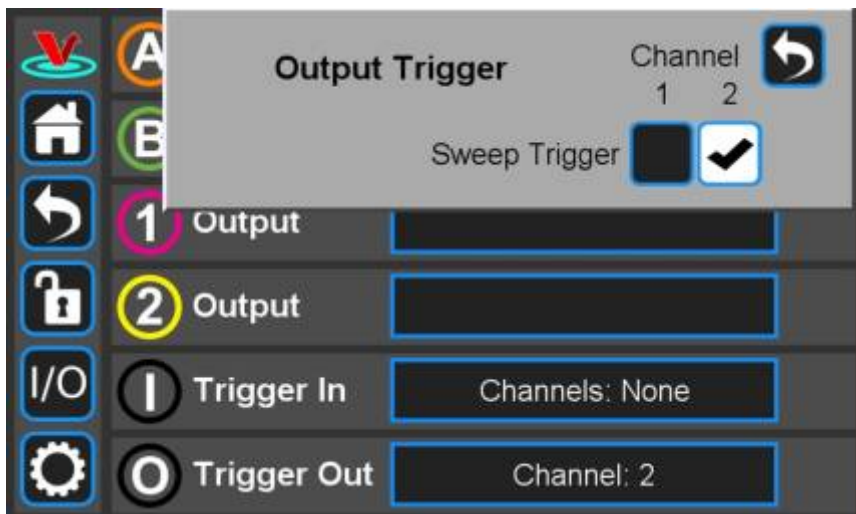


Fig. 26: Trigger Out is in sync with CH 2 ramp s

## System Settings

Touching the System Settings button on the Control Bar (figure 9) will open the System Settings screen as seen in figure 27.

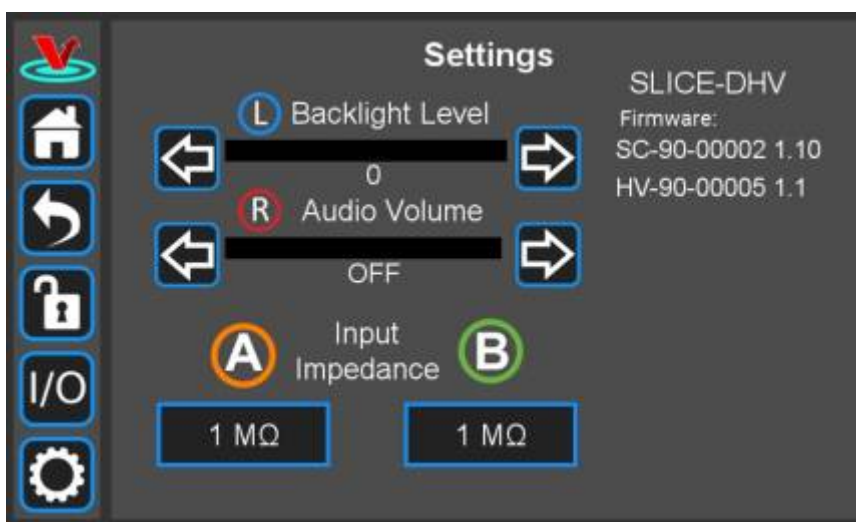


Fig. 27: User-programmable system settings

## Screen Brightness and Volume Adjustment

From this screen, adjustments to the brightness of the screen and the volume of the audio feedback can be made.

## Input Impedance

Change the input impedance of the two front-panel input ports. Select either 50  $\Omega$  or 1 M $\Omega$ . For most applications of the SLICE-DHV, a 1 M $\Omega$  impedance should be chosen.

## Using the PC Host GUI

Coming soon, please check back later.

## Firmware Update

From time to time, Vescent will upgrade the firmware for controlling the SLICE-DCC. The procedure to upgrade the firmware is given [here](#).

## Serial API

It is possible to control the SLICE-DHV through serial commands. Click here to access the [SLICE-DHV API](#).



Upgrading the SLICE-DHV firmware is not always necessary to use the Serial API. Check your installed firmware version in the settings menu against the most recent firmware version given [here](#).

Please contact [sales \[at\] vescent \[dot\] com](mailto:sales@vescent.com) for information.

## Maintenance

There are no user-serviceable parts inside this instrument. Refer all repairs to the manufacturer. Work performed by persons not authorized by Vescent Photonics may void the warranty.

<sup>1)</sup>

Located in power receptacle on rear panel, bubble 5 in [figure 3](#)

<sup>2)</sup>

Subject to change without notice

<sup>3)</sup>

see note in [table 6](#)

<sup>4)</sup>

as set by User

<sup>5)</sup>

User-serviceable fuse: T 2.0 A L 250V

<sup>6)</sup>

See [table 4](#) for acceptable input ranges

<sup>7)</sup>

0-30 Hz

<sup>8)</sup>

0-200 V

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