

# DC Connect™

## DC Supply and Measurement Interface Instruction Manual

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Transforming Sound into Knowledge

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## Introduction

DC Connect™ is a DC Supply and Measurement Interface that can operate in any of the following modes:

1. DC voltage source, with current measurement
2. DC current source, with voltage measurement
3. DC voltmeter, or
4. DC ammeter.

The level of voltage or current output from DC Connect is controlled by SoundCheck. The maximum voltage and current ranges are  $\pm 10$  V and  $\pm 300$  mA respectively. SoundCheck sends either a command from a USB port or an AC voltage from a sound card. The output level can be changed rapidly by the computer, as may be required in fast, complex test sequences.

DC Connect fills a number of technical needs for DC stimulus and measurement:

- Connect in place of a battery to measure the current drawn of the device under test
- Test a device over the voltage descent of a battery's lifetime
- Measure resistance, typically using the current source mode
- Apply a DC voltage ramp
- Acquire the I-V characteristic curve of a device
- Measure current draw synchronized with an audio stimulus
- Acquire a current draw vs. audio level curve
- Measure the dynamic response of current draw to a step-change in audio level
- Monitor test point DC voltages

## Front panel

The Output connector is an XLR male. Pin 2 is + and Pin 3 is – with Pin 1 connected to Chassis ground. Separate connections are available for Voltage and Current Monitoring using an external multimeter.

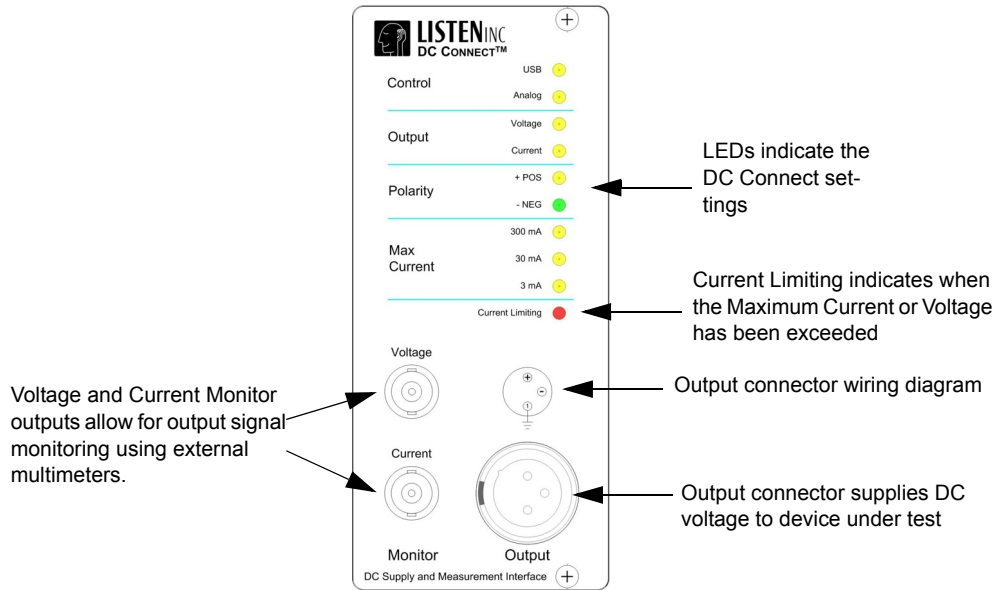


Figure: 1-1 DC Connect Front Panel

DC Connect is configured using the Hardware and Stimulus Editors in SoundCheck. LEDs on the front panel indicate the current settings of the unit.

## Back panel

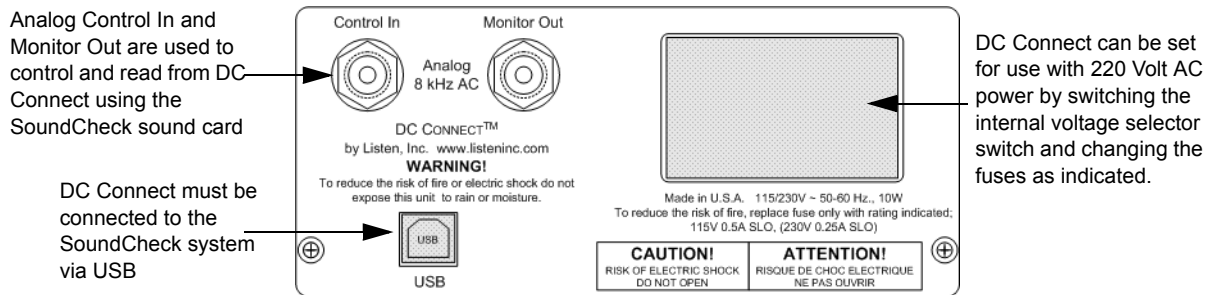


Figure: 1-2 DC Connect Back Panel

DC Connect is controlled from SoundCheck by connecting the USB connector on the unit to an available USB port on the computer. This must always be connected in order for SoundCheck to identify and configure the settings in DC Connect.

In addition to the USB connection, the Control In and/or Monitor Out jacks can be connected to the SoundCheck sound card for Analog Signal control.

## Control of DC output level

The DC output voltage or current source level is controlled by the Stimulus step(s) in a SoundCheck sequence. From this step, DC Connect is set to use one of the two control methods; USB and Analog. In Analog Control the source level is Dynamic. With USB Control the output is a fixed level.

With Analog Control, an 8 kHz tone is generated by SoundCheck through the sound card output. This signal is used to control DC Connect. A 2.5 Vrms tone amplitude equates to full scale DC output level, which is 10 V in voltage source mode and 300 mA, 30 mA, or 3 mA in current source mode.

With USB Control the level is set in SoundCheck and sent directly to DC Connect through the USB connection.

## Source Type and Monitor Type

The DC output can either be a voltage or a current source. In voltage source mode, current draw is measured with the maximum current being 300 mA. A 8 kHz AC voltage appears on the Analog Monitor Output that is proportional to the current draw. A 10 Vrms amplitude equates to the Max. Current setting. The current draw can be read instantly by SoundCheck utilizing the USB connection to the computer. Note: The current draw is hard limited to  $\pm$  Max. Current, at which point the output becomes a current source at that current.

In current source mode, the voltage that the DUT draws is measured. The voltage is hard limited to  $\pm$ 10 V. At the Analog Monitor Output, 10 Vrms amplitude equates to 10 volts DC.

The Broadband RMS algorithm must be utilized in the SoundCheck Analysis Step when connecting the Analog Output Monitor to the sound card. See **Figure: 2-7: Analysis Editor Settings** in the SoundCheck Setup Chapter.

The time envelope feature in SoundCheck can be used to verify the quality of the Analog Monitor Out of DC Connect. This is enabled by selecting "Add Recorded Time Waveform" in the Play and Record Acquisition Step (Acq) and then selecting "Time Envelope" in the Analysis Step (Ana). Please refer to the SoundCheck Instruction Manual for more information on the Time Envelope function.

## Resolution and Noise Floor

Voltage source and measurement: 1 mV resolution. That's 1/10,000<sup>th</sup> of the 10 V full-scale range.

Current source and measurement: 100 nA resolution at the 3 mA setting.



## SoundCheck Setup

### Connecting DC Connect to the computer

The DC Connect power switch should be turned on prior to its connection to the computer, when it is controlled via USB. The first time it is connected, a New Hardware Prompt will appear. Drivers for DC Connect are installed with SoundCheck, so no further action is required. The drivers will also install if DC Connect is moved to a different USB port. This must be done prior to starting SoundCheck.

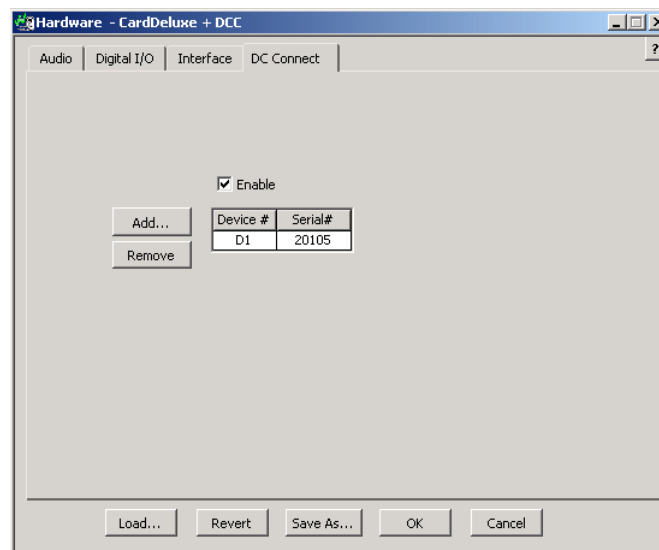
### SoundCheck Control

DC Connect is controlled from within SoundCheck by using the Stimulus and Acquisition Editor panels.

Configuration commands and even DC Output Signal “turn-on”, can be set up to occur upon sequence load, before the sequence is run. This can be used to “Turn On” the Device Under Test when it is powered by DC Connect, allowing the device to warm up and stabilize before a measurement is made.

### Hardware Editor

DC Connect must be enabled in the Hardware Step of the SoundCheck measurement sequence.



**Figure: 2-1 Hardware Step Setting**

Once enabled in the Hardware Step, the Device number and Serial number of DC Connect will be indicated. Currently, only one DC Connect can be controlled from SoundCheck.

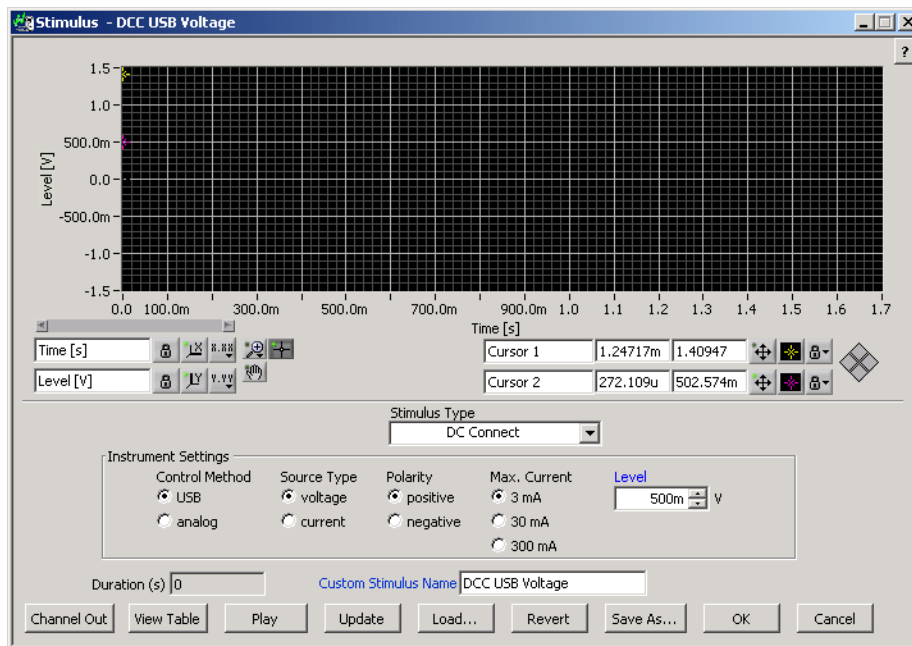
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**Note:** Communication between SoundCheck and DC Connect is lost when DC Connect is turned off or the USB connection is unplugged. It may be necessary to re-start SoundCheck in order to re-initialize DC Connect. In some cases, simply toggling the Enable check box in the Hardware step will initialize DC Connect.

---

## Stimulus Editor

### DC Voltage



**Figure: 2-2 Stimulus Step set for USB control and Voltage out**

#### Control Method: USB

This method is used to produce a steady voltage or current output from DC Connect.

The Stimulus Step example in **Figure: 2-2** will set up the DC Connect™ device assigned to this "channel" with the following settings:

- Control Method - USB
- Source Type - voltage
- Polarity - positive
- Max. Current - 3mA

Use the Level Entry Field to set the output voltage source or current source level. That level will be output when the Stimulus step runs, which again may be when the sequence is loaded. If the Source Type is set to "voltage", the Level unit is "V" volts. If the Source Type is set to "current", the Level unit is "A" Amps.

#### DC Output - rate of change

When controlling DC Connect via USB with SoundCheck, the maximum source level stepping rate is about 5 steps per second. When controlling the source level with a sound card (Analog Control), the maximum stepping rate is 500 steps per second. This means that the Time/Step, as set in the Stimulus Editor, can be as small as 2 mS.

### Single Output Setting When Sequence Loads

If the Sequence Configuration is set to “Preload Stimulus” (which is the default setting), the first Stimulus Step of the sequence will load when the sequence is loaded. If this is a DC Connect stimulus, DC Connect will switch to the settings for that stimulus step and output the voltage or current selected in the step. The DC Connect LEDs will show all the settings designated in the Instrument Settings field of the Stimulus Editor.

**By selecting Preload Stimulus, DC Connect will be operational even if the sequence “Start” button has not been clicked.** For example, if DC Connect is set to provide 9V DC to power the DUT, the 9V will be applied to the DUT once the sequence is loaded into memory. This will take place BEFORE “Start” is clicked.

**Important!** DC Connect levels and settings cannot be changed with subsequent Stimulus Steps when Preload Stimulus is selected. DC Connect will use the settings of the first Stimulus Step until a new sequence is loaded. Subsequent Stimulus Steps will be ignored.

### Dynamic Control In Sequence

If “Preload Stimulus” is not selected in the Configure Sequence menu, DC Connect will switch to the settings of each DC Connect Stimulus Step as they occur in the sequence. This can be useful if the output of DC Connect needs to change during the operation of the sequence.

The example sequence in [Figure: 2-3](#), shows a DC Connect stimulus set to output 1.5 VDC when the sequence is started. After the Broadband RMS Analysis is complete a second DC Connect Stimulus switches to 0 VDC, shutting the device under test off, until another test is made. The Configure Sequence window for the overall sequence shows that Preload Stimulus is not checked.

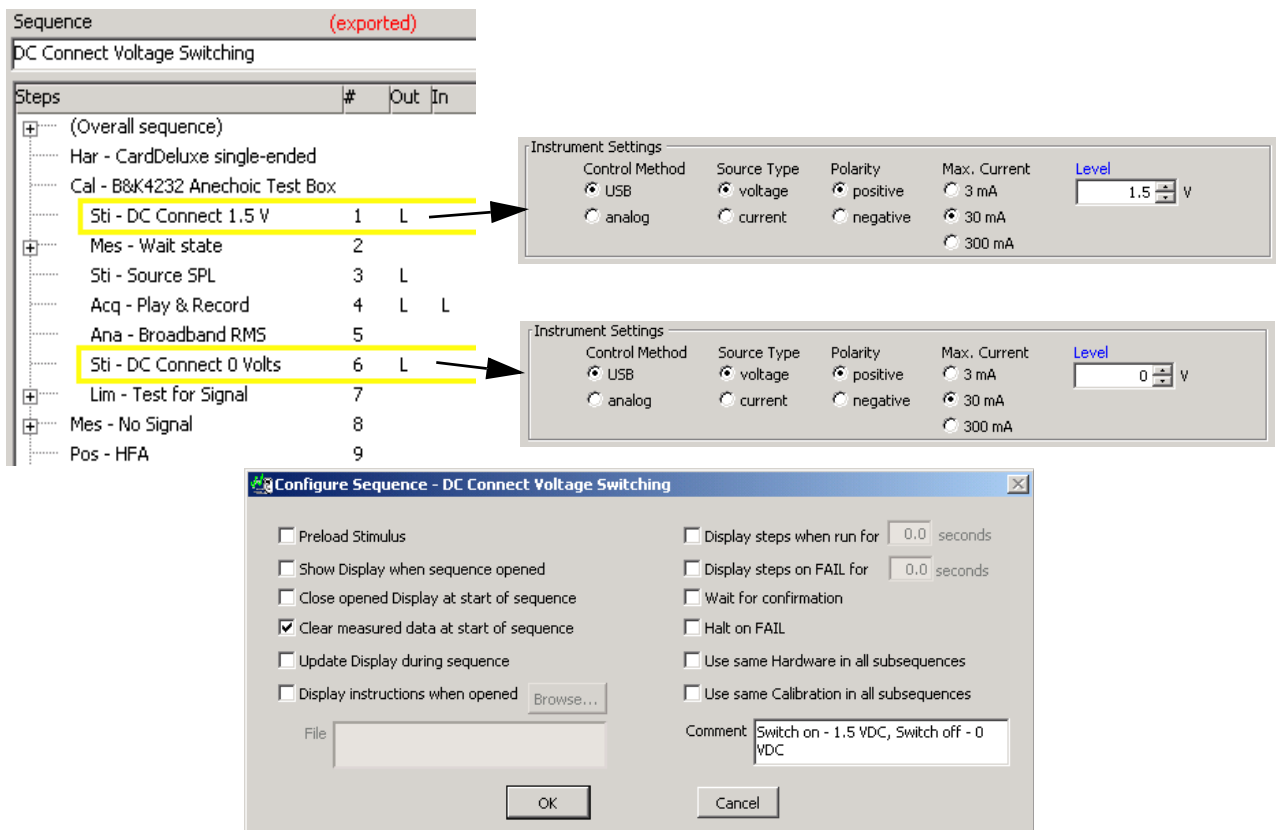


Figure: 2-3 DC Connect Voltage Switching in Sequence

## Control Method: Analog

This method allows you to have Dynamic control over the output level of DC Connect. Analog Control provides a much faster rate of change than what is available with USB control. See “DC Output - rate of change” on page 8.

## Instrument Settings

When the Control Method is set to "analog", the Level Entry Field disappears and a Settings/Sweep selector appears. The remaining settings allow for selection of Source Type, Output Polarity and Maximum Current. Confirmation of these settings is indicated by LEDs on the DC Connect front panel.

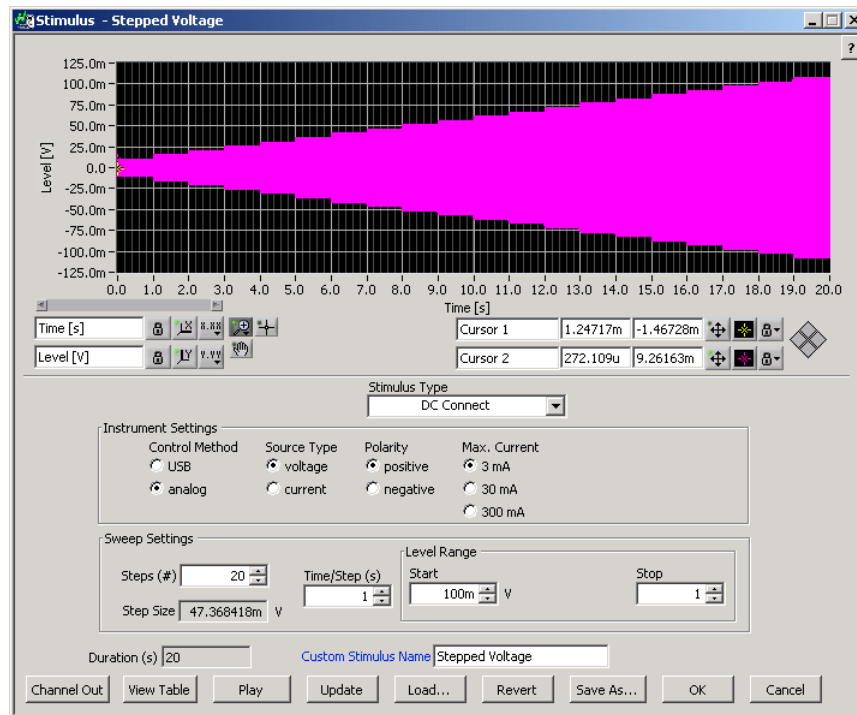


Figure: 2-4 Analog Stepped Sweep settings for DC Connect

## Sweep Settings

When “Analog” is selected, you are given the controls to construct a voltage source or current source stepped waveform. These are the same controls used in the audio Amplitude Sweep Stimulus Type, and they operate in the same way regarding number of steps, Start and Stop levels, and Time per Step. Here the units are "V" or "A", and a Time/Step control to set the number of seconds (or fraction of a second) per waveform step.

The example in **Figure: 2-4** shows the Control Voltage that is sent to the DC Connect Analog Control In. The Start and Stop points are set to 100mV and 1 V. With the Step Number set to 20 and the Time/Step set to 1 second, the resulting output from DC Connect is a 20 second long output ending with a maximum voltage of + 1V DC.

## DC Output - rate of change

When controlling DC Connect via USB with SoundCheck, the maximum source level stepping rate is about 5 steps per second. When controlling the source level with a sound card (Analog Control), the maximum stepping rate is 500 steps per second. This means that the Time/Step, as set in the Stimulus Editor, can be as small as 2 mS.

## Acquisition Editor

### Read from DC Connect™

When you set Mode to "Read from DC Connect", your Acquisition step will read a single measured value from the DC Connect device over the USB interface. Ignore the channel assignment since the communication with the device is by USB. This type of Acquisition step would likely follow a Stimulus step that sets the DC Connect output voltage or current source level via the USB Control method. ([See Control Method: USB - page 6](#))

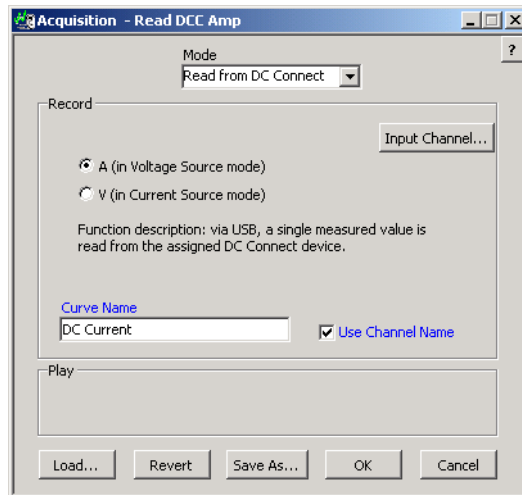


Figure: 2-5 Acquisition Step Settings - USB Control

If you have set up the DC Connect as a voltage source, choose units of "A" because you're measuring the current draw of the load. If you've set up the DC Connect as a current source, choose units of "V" because you're measuring the voltage across the load that results from the applied source current.

If the control method used in the Stimulus Step is Analog, the "Play and Record" Acquisition Step should be used.

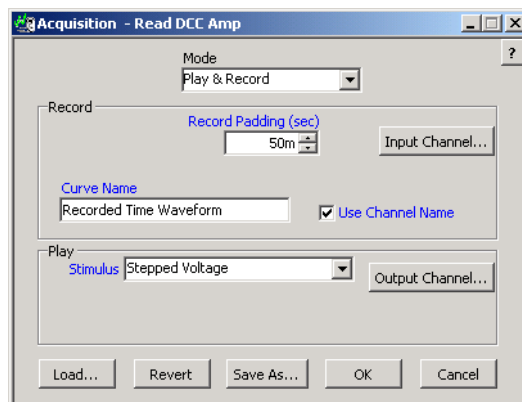
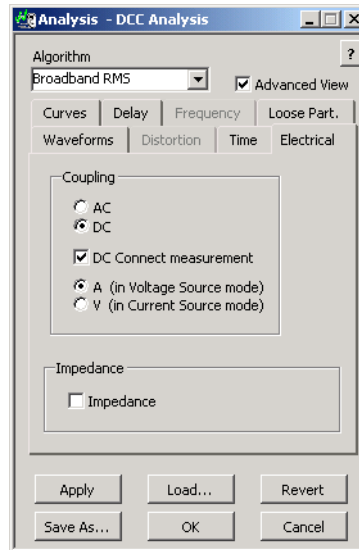


Figure: 2-6 Acquisition Step Settings - Analog Control

## Analysis Editor



**Figure: 2-7 Analysis Editor Settings**

You can read a DC current or voltage waveform from a DC Connect™† instrument using your sound card. The Analog Monitor Out on the back-panel of DC Connect is connected to the sound card input. The Analysis step is preceded by an Acquisition step set to Record or Play & Record. Be sure to assign the Analysis and the Acquisition steps Input Channels to the sound card input channel that you've connected to the DC Connect™.

When you check the "DC Connect measurement" checkbox, a "A" or "V" choice appears. Choose the "A" current measurement if you are operating DC Connect in voltage source mode, or choose the "V" voltage measurement if you are in current source mode. This step will create a "DC Current Waveform" or "DC Voltage Waveform" curve.

When this type of Analysis step follows a Play & Record Acquisition step, the X-axis of the DC Current Waveform curve matches the X-axis of the played stimulus, which will likely be an audio amplitude or frequency sweep, or a sweep of the DC voltage, for example.

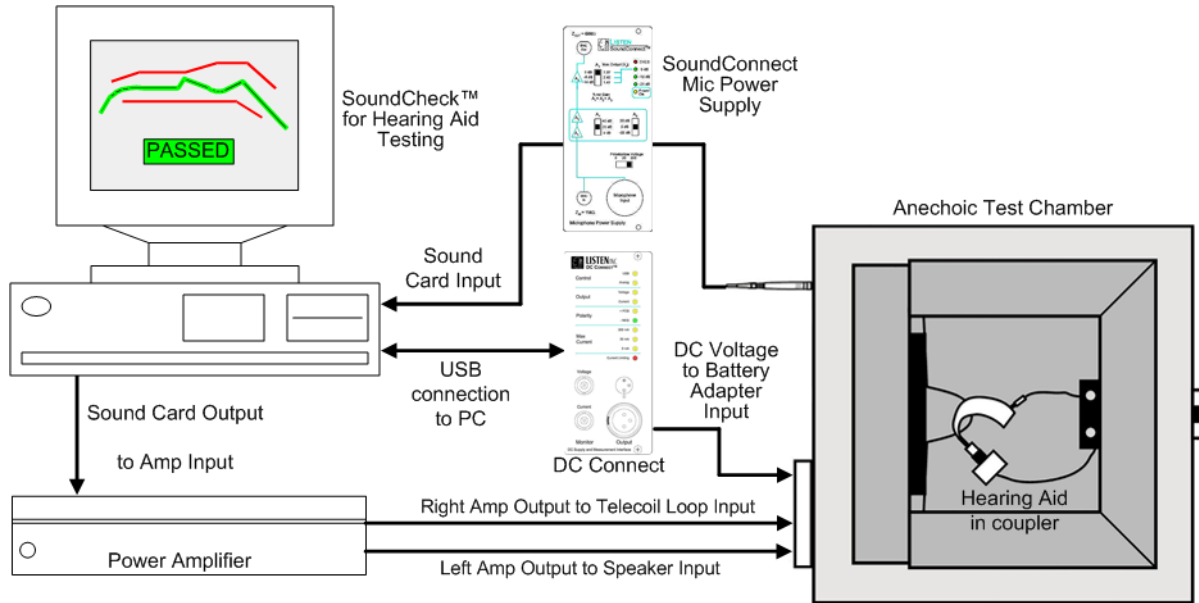
If you also check the Time Envelope checkbox, you create a "Time Envelope" curve whose units are also in A or V. The x-axis of this curve is time.

## DC Output - rate of change

When controlling DC Connect over USB with SoundCheck, the maximum source level stepping rate is about 5 steps per second. When controlling the source level with a sound card (Analog Control), the maximum stepping rate is 500 steps per second. This means that the Time/Step, as set in the Stimulus Editor, can be as small as 2 mSeconds.

## Connection Examples

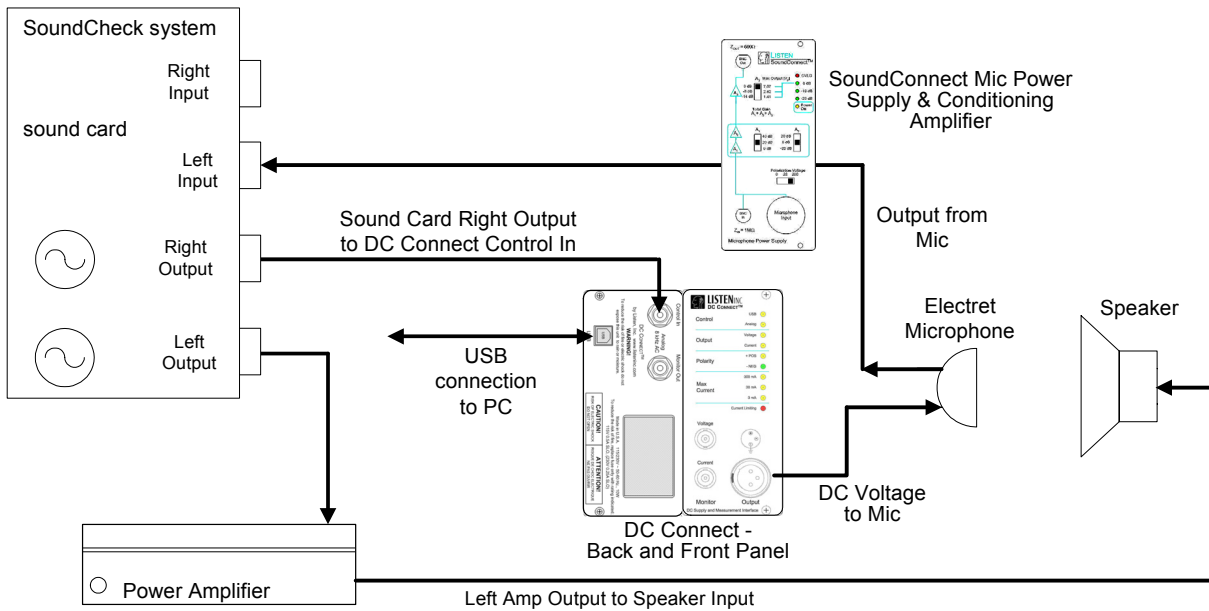
### Hearing Aid Test



**Figure: 3-1 Hearing Aid Test Connection Diagram**

The example in **Figure: 3-1: Hearing Aid Test Connection Diagram** shows DC Connect connected to the SoundCheck system via USB. DC Connect can be used to send a fixed voltage to power the device under test. In this case, a hearing aid. Different DC voltages can be sent to the device by using different DC Connect Stimulus Steps in the SoundCheck test sequence.

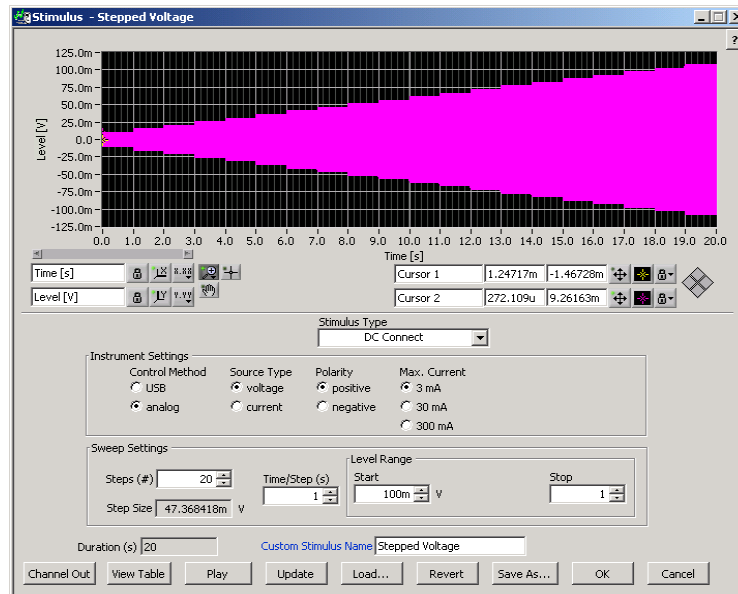
## Microphone Test



**Figure: 3-2 Electret Microphone Test Connection Diagram**

**Figure: 3-2: Electret Microphone Test Connection Diagram** shows DC Connect supplying voltage to an Electret Microphone. The Right output of the sound card is connected to the Control In of DC Connect. This will allow SoundCheck to send a control signal from a Stimulus Step to change the supply voltage and simultaneously measure the change in performance of the Microphone.

**Figure: 3-3: Stimulus Step Example** shows how the control signal to DC Connect would be configured for this test.



**Figure: 3-3 Stimulus Step Example**

## Functional and Performance Specifications (preliminary)

		3mA max current	30mA max current	300mA max current
<b>General</b>				
Modes	1. voltage source with current monitor 2. current source with voltage monitor			
Control input	USB <u>or</u> sound card (analog)			
Monitor output	USB <u>and</u> sound card			
Test load resistance		3000	300	30
<b>Voltage Source with Current Monitor</b>				
Output range, minimum	$\pm 9.8$ V			
Output resolution, nominal	1 mV			
Output noise, maximum	1 mVrms			
Output accuracy at test load resistance, USB controlled	$0.5\% + 0.05\%*$			
Output accuracy at test load resistance, analog controlled	$0.5\% + 0.05\%*$			
Monitor range, nominal		$\pm 3$ mA	$\pm 30$ mA	$\pm 300$ mA
Monitor resolution, nominal		100 nA	1 $\mu$ A	10 $\mu$ A
Monitor noise, maximum		100 nArms	1 $\mu$ Arms	10 $\mu$ Arms
Current limiting, nominal		$\pm 3$ mA	$\pm 30$ mA	$\pm 300$ mA
Monitor accuracy, USB controlled		$0.5\% + 0.05\%*$	$0.5\% + 0.05\%*$	$0.5\% + 0.05\%*$
Monitor accuracy, analog controlled		$0.5\% + 0.05\%*$	$0.5\% + 0.05\%*$	$0.5\% + 0.05\%*$

\* Accuracy is expressed as  $\pm(\%$  of output or monitor level +  $\%$  of output or monitor range)

Current Source with Voltage Monitor				
Output range, minimum		± 2.94 mA	± 29.4 mA	± 294 mA
Output resolution, nominal		100 nA	1 µA	10 µA
Output noise, maximum		100 nArms	1 µArms	10 µArms
Output accuracy at test load resistance, USB controlled		0.5% + 0.05%*	0.5% + 0.05%*	0.5% + 0.05%*
Output accuracy at test load resistance, analog controlled		0.5% + 0.05%*	0.5% + 0.05%*	0.5% + 0.05%*
Monitor range, nominal	± 10 V			
Monitor resolution, nominal	1 mV			
Monitor noise, maximum	1 mVrms			
Voltage limiting, nominal	± 10 V			
Monitor accuracy, USB controlled	0.5% + 0.05%*			
Monitor accuracy, analog controlled	0.5% + 0.05%*			

\* Accuracy is expressed as ±(% of output or monitor level + % of output or monitor range)

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