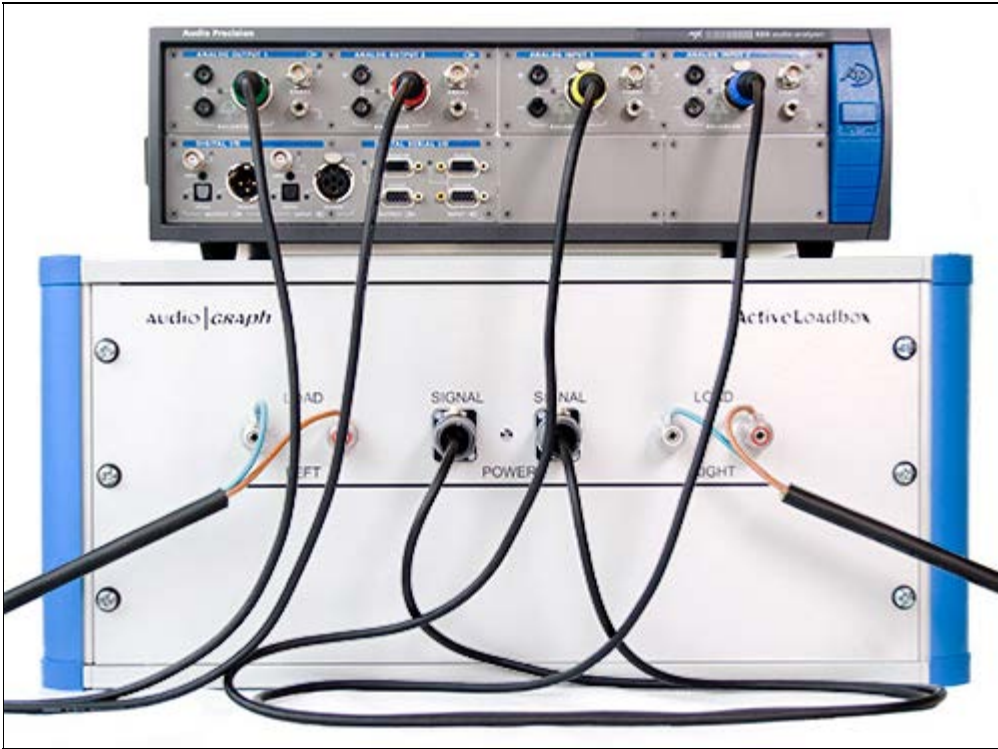


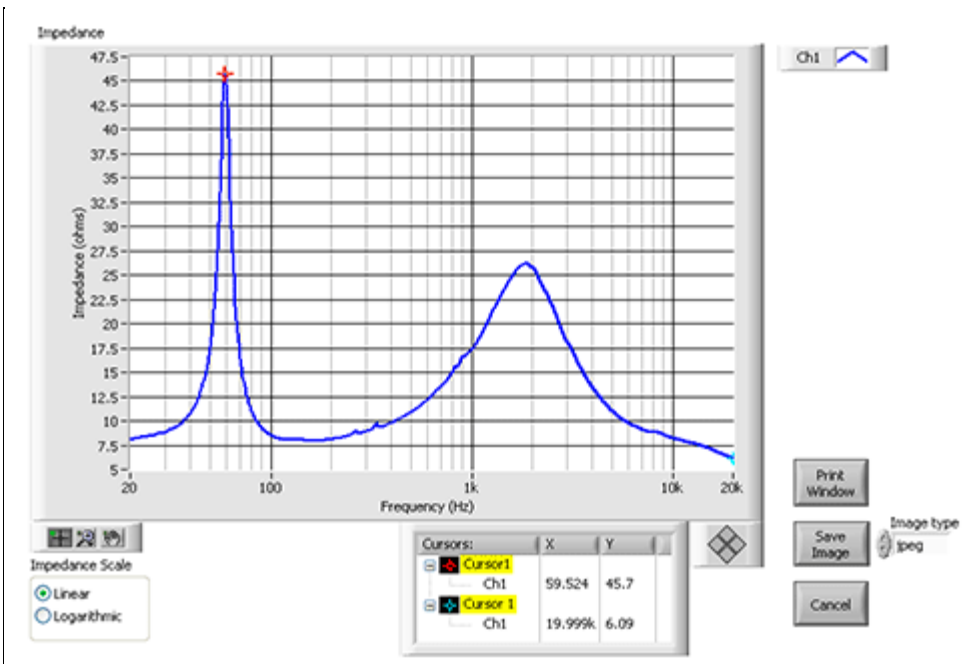
# Measuring Power Amplifiers with Reactive Loads

*Audio Precision's APx Active Loadbox Utility integrates APx with AudioGraph's Active Loadbox for automated and comprehensive power amplifier load measurements. This article explores the importance of making reactive load measurements, and gives instructions for using and installing the utility.*



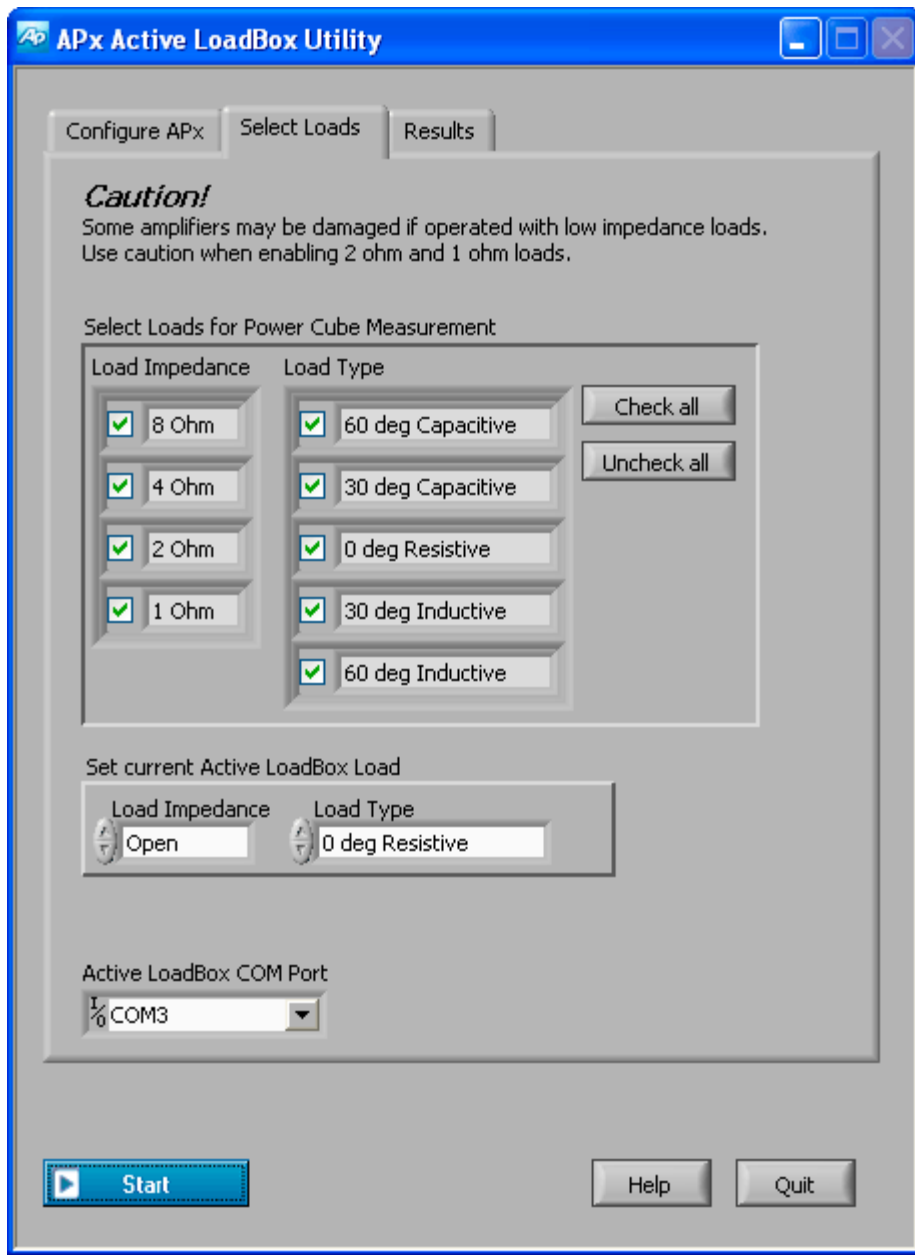
**APx525 analyzer with the Active LoadBox (AudioGraph, Sweden).**

Measuring a power amplifier under both resistive and reactive load conditions is an essential part of the design process. Resistive load testing is commonly done by designers, and involves hooking a power amplifier up to non-inductive load resistors. It's used to derive the power output ratings seen on specification sheets.



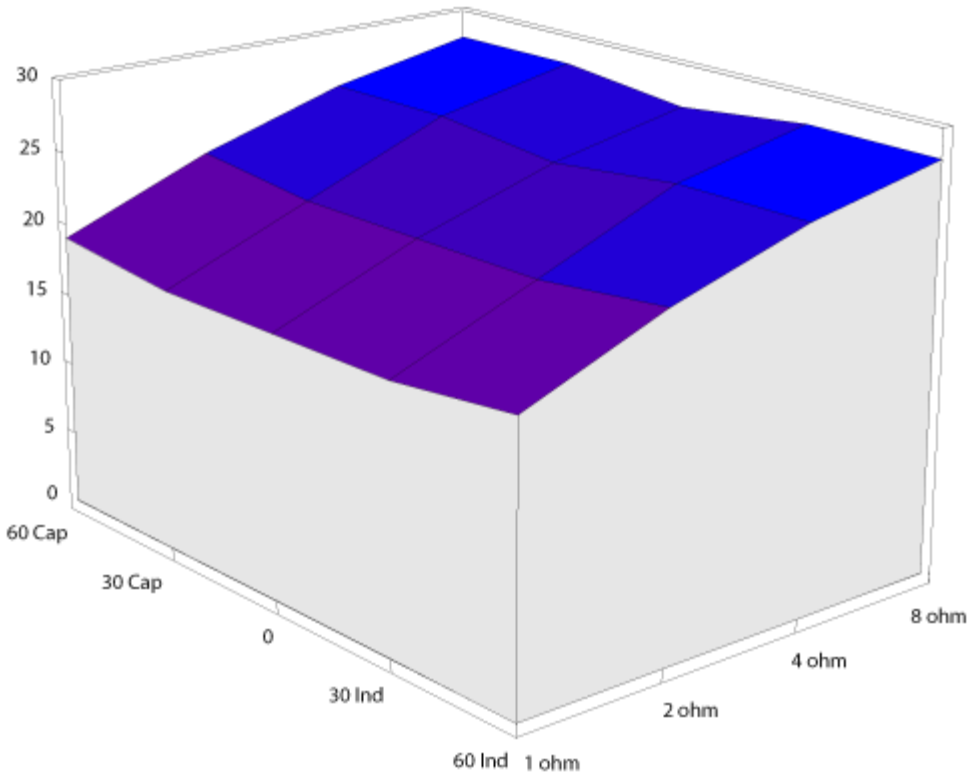
**Actual speaker impedance can vary considerably.**

Reactive testing, where the load includes inductive and capacitive components, is not as commonly performed. Real world speakers, however, often have significant inductance and capacitance. Neglecting to test an amplifier with reactive loads means we can only speculate about its performance in actual use. An amplifier that has good resistive power output ratings, but poor drive into low impedances or reactive loads, may produce distortion well before it reaches rated output.



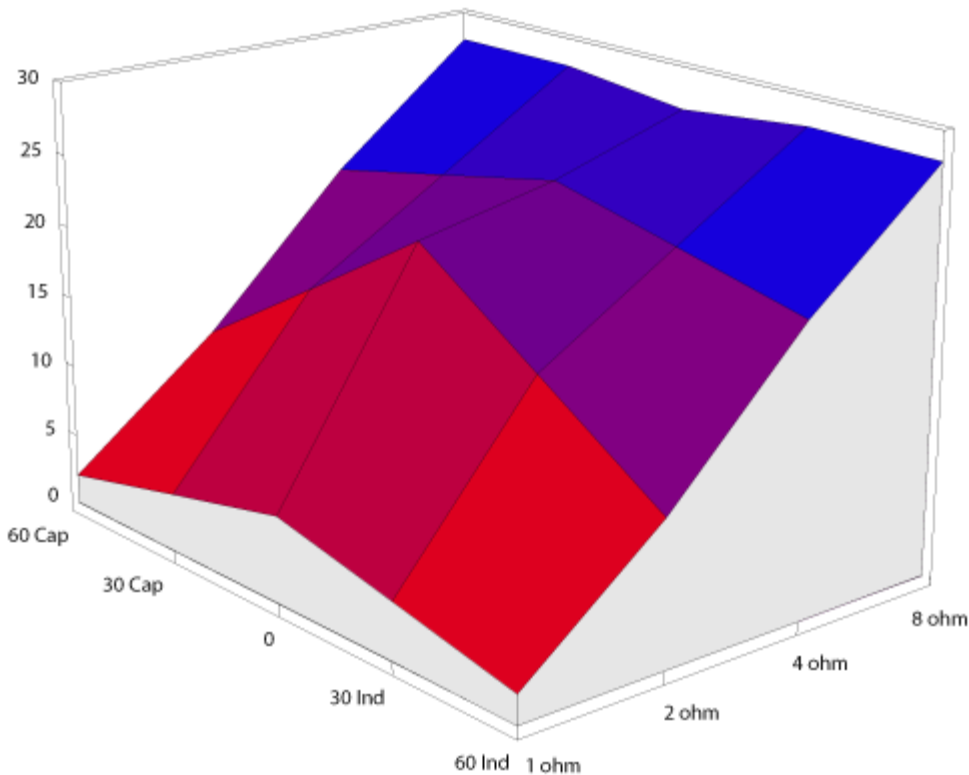
**APx Active LoadBox Utility.**

Audio Precision's Active LoadBox Utility integrates AudioGraph's Active LoadBox with APx, providing automated and comprehensive resistive and reactive load measurements. The Active LoadBox contains resistive loads of 1–8  $\Omega$ , as well as capacitive and inductive loads that are calculated for a current phase shift of 30° and 60° at 1 kHz. This combines for a total of 20 different possible loads.



**PowerCube graph of a good amplifier (image courtesy of AudioGraph AB).**

When the APx utility is started, it switches the LoadBox through each of the loads and instructs the APx analyzer to make a maximum output level measurement for each one. Either continuous or CEA-2006 burst signals may be selected. After the utility completes, it takes the measurement results and creates a 3-D surface graph, allowing the results to be easily interpreted. A perfect amplifier would produce a cube with a flat top, indicating that it can maintain constant voltage output over a wide range of resistive and reactive loads. Practical amplifiers will fall short of perfection, but it's possible for a good amplifier to come pretty close.



**PowerCube graph of an amplifier with current limiting (image courtesy of AudioGraph AB).**

To read the graph, note that the results in the center are purely resistive, with higher impedances in the back and lower impedances in the front. Moving to the left of center adds capacitance (current leads voltage by 30° and 60° @ 1 kHz), and moving to the right adds inductance (current lags voltage by 30° and 60° @ 1 kHz). Because actual speaker impedance can vary greatly from the nominal rating, it's important to observe the results over the entire graph.

## Installation

- Run the installer. The installer will install both the utility and the Silicon Labs CP210x USB to UART Bridge, which is necessary for the Active Loadbox to communicate with the PC.
- Go to the Start Menu, and navigate to and click on Audio Precision -> APx500 2.x -> Utility -> Silicon Labs CP210x VCP Drivers for Windows.
- Follow the prompts to configure the driver.
- Turn on the Active Loadbox and connect a USB cable between the Loadbox and the PC.
- Go to Start -> Settings -> Control Panel -> System -> Hardware -> Device Manager. Find the Ports section and expand it. The Silicon Labs CP210x USB to UART Bridge should be listed. Note the driver's serial port assignment.
- Run the APx Active Loadbox Utility and go to the "Select Loads" tab. Set the "Active LoadBox COM Port" to the COM port noted in the previous step. You may need to select Refresh in the dropdown box list to refresh the list of COM ports.
- On the same tab, go to the section "Set Current Active Loadbox Load" and change the impedance to various different settings. You should hear a click inside the Loadbox each time you change the setting. Return the selection to Open when finished checking the connection. If you do not hear a click inside the Loadbox, there is a communication problem between the box and the PC.

## Audio Connections

Connect the amplifier outputs to the Load terminals on the Active LoadBox. Be sure to use a short length of heavy gauge speaker wire so that wire resistance does not impact the results, This is especially important

when testing with a 1 Ω load. Connect the Signal jacks on the Loadbox to the analog inputs on the analyzer.

## Usage

Double click the desktop icon to run the utility. If APx is not already running, it will be automatically loaded. The utility has three tabs which function as follows:

**Configure APx:** Click Load APx Project File to load a project. The file browse box that appears will default to the location of the default Active\_LoadBox.approjx project that was installed with the utility. Select either Maximum Output or Maximum Output (Burst) as the measurement, as determined by your test requirements. Take precaution to not exceed the maximum continuous and CEA-2006 (burst) power ratings for the Active Loadbox. The Measurement Delay imposes a delay between each step of the maximum output tests. This is to allow the device under test time to stabilize and cool down before being driven again to full power. Adjust this as needed to protect the device from damage, and to prevent accumulated heat from affecting the results as the tests progress.

**Select Loads:** The section "Set Current Active Loadbox Load" sets the LoadBox load when it is idling and the Power Cube measurement is not running. For manually operated tests, set the Load Impedance and Load Type as desired. This setting will determine the load that is present both before and after the Power Cube measurement is run. "Select Loads for Power Cube Measurement" allows you to select which loads are included in the automated Power Cube measurement. All the loads must be checked to create a full Power Cube graph. Some amplifiers may be damaged by low impedance loads. Use caution when enabling 2 and 1 ohm loads. If in doubt, run the measurement without them first.

**Results:** This tab will show the measurement data after running the Power Cube measurement. From this page, you may export the data into Microsoft Excel, and/or produce and view the Power Cube graph. Once the graph is displayed, it may be saved as an image or printed.

Click the **Start** button at the bottom of the utility window to begin the Power Cube measurement. Make sure that you have properly connected the device under test, and have made the appropriate settings on the Configure APx and Select Loads tabs.

## Resources:

[AudioGraph, Sweden](#)