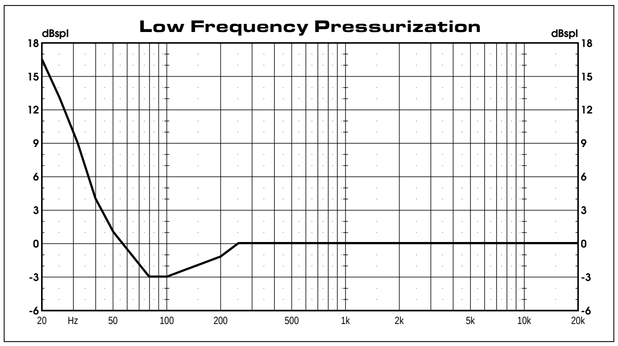
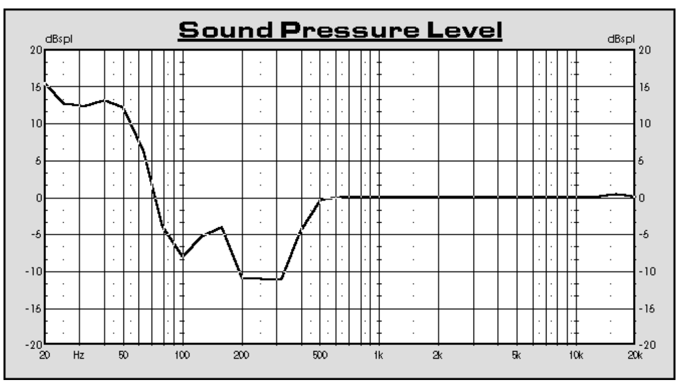
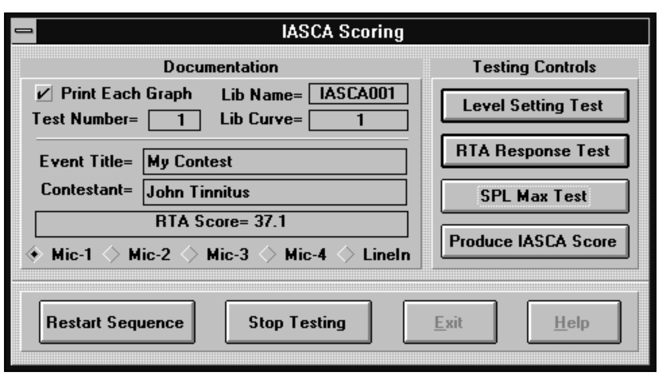
Car Audio

Addendum







1: Measuring System Response

This addendum to the manual assumes that the installation is complete. All components of the system should be in place and functioning before you begin system measurements.

There are many different ways to think about the installation of a system in a car. The most important consideration is what you want the end result to be. Some people want to reproduce exactly what the mixing engineer heard in the control room when the recording was made. Others want the car to vibrate the pavement as much as possible. Some may try to achieve a happy medium between these two extremes.

When your goal is to realistically reproduce the original recording, you will want to spend most of your time working towards a flat frequency response with good balance between the left and right channels.

When dynamic music is being played, such as classical or jazz, the noise floor of the system becomes very critical. Special attention should be paid to road noise and the electrical noise of the system with no music playing.

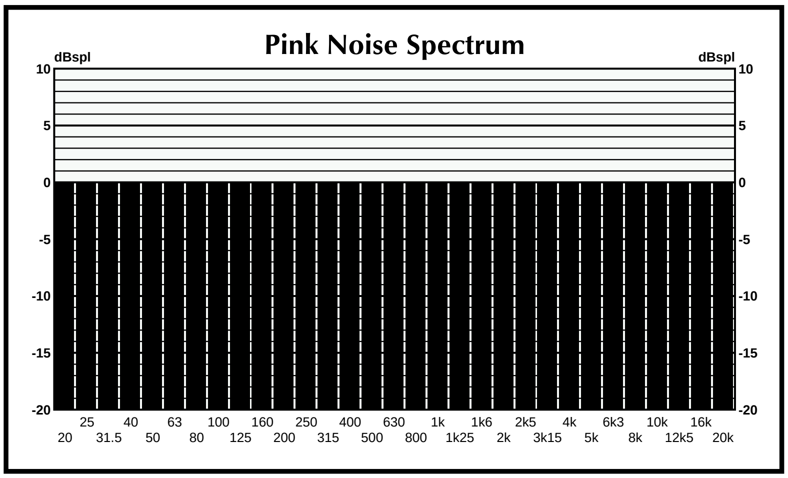
If you want to win a high SPL competition, you will want to create a curve with most of it's energy in the low frequencies, because you can take advantage of the low frequency pressurization effect that occurs in small acoustic spaces to generate higher SPL scores.

Whether you want a ground-pounding bass generator or an audiophile's dream vehicle, the measurement process includes the same basic steps. For system measurements, the process is simple. Make noise with the system and measure it with pcRTA.

With the real time measurements being displayed on the screen, you can adjust the electrical components and/or the acoustic environment and watch the changes appear as you make them.

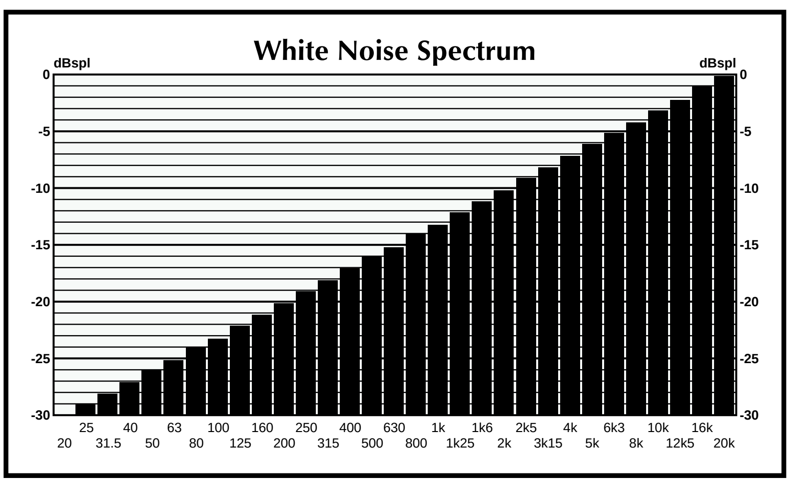
Pink Noise

The most common noise source used is Pink Noise. You may be asking: What is Pink Noise and Why Should I Use It? The simple answer is that pink noise will produce a flat line on the pcRTA when averaged over time. Pink noise is equal energy per octave (log frequency) and white noise is equal energy per linear frequency. The pcRTA displays in octaves (log frequency), so a pink noise signal produces a flat line, while a white noise signal produces a line that rises with frequency at a rate of 3dB per octave.



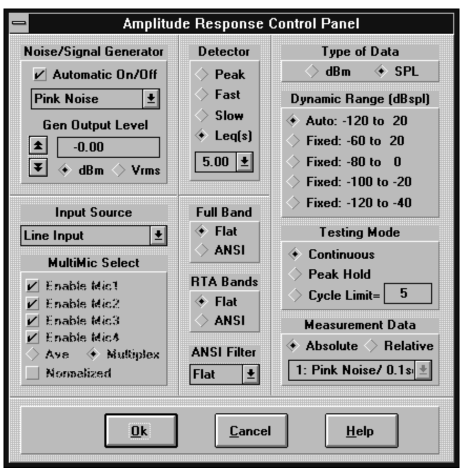
The ocean produces a natural pink noise. White noise is the sound you hear from the electronic components in a sound system when no music is playing.

These graphs show what pink noise and white noise look like on the pcRTA screen.



You can use the internal generator in pcRTA, or an external source such as a CD or tape with pink noise on it. Using the internal pink noise source is highly recommended, because it is very precise (repeatable). Using any other pink noise source can give misleading results. Test disks may not have true pink noise on them, they may have just a close approximation.

If you want to verify the precision of any pink noise source, you can measure it with pcRTA. To measure an external source, plug it into the **Line Input**. Set the **Input Source** on the **Control Panel** to **Line Input**. Set the **Detector** on the **Control Panel** to **Leq** with an averaging time of at least **5.00 Seconds**. Longer average times will yield more accurate results. When you run a test with these settings, you should see a flat line across the screen. The flatter the line, the more precise the pink noise source.



If you must use an external pink noise source, you can use the relative measurement mode to compensate for any problems in the response of the source. To do this, store the measurement of the pink noise source in one of the curve library entries. Go to the **Control Panel** and set the **Measurement Data** to **Relative**. Click on the list box in the **Measurement Data** section of the **Control Panel** and select the library entry that contains your measurement of the external pink noise source. This curve becomes the reference for any measurements taken while in the relative mode. Click **OK**.

The measurements taken under these conditions will respond as if the external pink noise source is flat, even if it isn't. Keep in mind that these measurements do not relate to absolute SPL values, but are related to the original signal level of the external pink noise source.

An alternative to using the relative measurement mode is to divide the measured curve that you want to correct by the stored measurement of the external pink noise source. This will remove any variations in frequency response that were present in the external pink noise source.

Setting Up For Measurements

The first step is to connect a noise source to the system. If you are going to use the internal pink noise source, you will need to find a place to 'patch' into the system. Usually, you can just disconnect the head unit and plug the pcRTA into the cable that leads to the rear of the car. Make sure that the total cable length from the pcRTA to the first piece of electronics in the system is no longer than 100 feet.

The next step is to set up the microphone(s). The MDF files for each microphone must be loaded into the pcRTA software. If you have not done this, refer to the pcRTA manual and load the MDF files. The microphone(s) should be placed in the approximate position of the driver's head. The mic stand should be a cylinder with the smallest possible diameter. Any flat surface near the microphone will cause a reflection at some high frequency.

When running cables into and out of the vehicle, you should use a part of the window, door or trunk that has a rubber seal on it. This will provide some measure of padding to prevent damage to the cables.

NOTE: *Care should be taken to start with a low level of output from the internal noise source, because it is very easy to send a full level signal into the amplifier(s). This could be dangerous to loudspeakers and human ears.*

2: Vehicle Acoustics

The goal of this discussion is to point out the major aspects of vehicle acoustics. Later sections will show you how to measure them with the pcRTA.

The acoustic space inside a vehicle is one of the most difficult and demanding environments in which to install a sound system. The small size of the space and the varying reflective and absorptive surfaces within it create many problems when optimizing a system for sound quality.

On the other hand, the small size makes it possible to create Sound Pressure Levels (SPL) at low frequencies that would require much more power and many more speakers in a larger space.

Standing Waves

When designing a car audio system, you must take into consideration the effect of standing waves. Sometimes known as 'modes', they are a major problem in car audio situations.

Whenever there is sound in an enclosed environment, there will be standing waves within that environment. Standing waves occur at frequencies whose wavelengths correspond to twice the distance between the walls of the space. In cars, standing waves typically occur between 50Hz and 200Hz depending on the size of the vehicle.

It is important to understand that there are several modes (standing waves) in any car, and when these modes are combined they can cause large *peaks* or *dips* in the frequency response curve. This is because the standing waves will be at different phase angles. When two waves at the same frequency and *equal* phase combine, they *increase* the SPL at that frequency. When two waves at the same frequency and *opposite* phase combine, they *decrease* the SPL at that frequency.

Standing waves are very apparent when measuring at a single point in space. As the point of measurement is changed, the peaks and dips caused by the standing waves will appear at different frequencies across the spectrum. For this reason it is recommended that measurements be taken at several different points in space and then averaged. This technique is called *spatial averaging*, and is explained in greater detail in a later section.

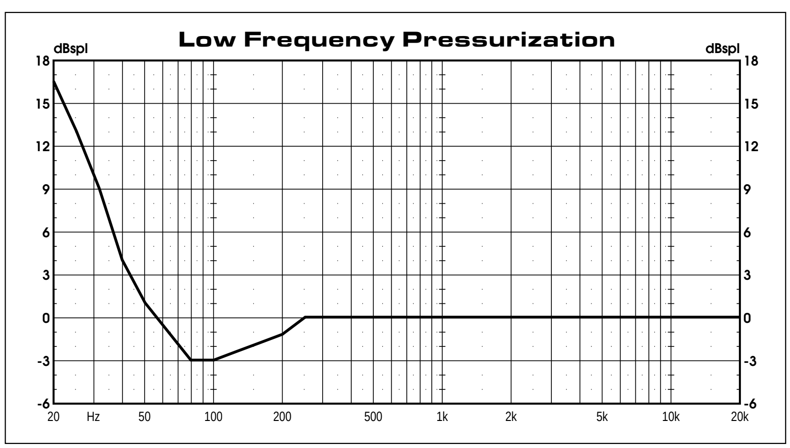
Low Frequency Pressurization (Cabin Gain)
Another major factor affecting low frequency response in vehicles is the pressurization caused by the speakers being in an enclosed environment. When a volume of air is sealed, it will have an effect on the low frequency response of speakers in that space.

The effect of this sealed environment is a dramatic boost of sound at the lowest frequencies. This rising response can be used to help flatten the low frequency rolloff of a cabinet.

The extent of the effect depends on the size of the passenger compartment and how much leakage there is. Leakage is the amount of pressure which escapes to the outside, and is caused by the sheet metal of the body flexing and other leaks such as open windows and holes.

The volume (cone area) of the speakers used to pressurize the space will also have an effect on the amount of low frequency boost. A large cone area will create more boost than a small one. This is true whether you are using a single very large speaker or a number of smaller speakers.

This graph shows the response change caused by a 110ft³ space with 20in² of leakage using a single 15" speaker. This curve does *not* include any changes caused by standing waves.



External Noise
Noise from outside the vehicle's compartment has a negative effect on the listening experience. Road noise and engine noise can become a very significant part of the sound inside the vehicle. This noise can be reduced greatly by the use of dampening materials in the doors and on the surfaces of the passenger compartment.

Electrical Noise
Noise from the ignition system and electromechanical devices such as heater fans can be extremely annoying even at very low levels. These noises are usually present only when some part of the system is improperly grounded.

Calculation vs. Measurement
While it is possible to estimate the effects of standing waves and closed-field low frequency pressurization mathematically, the results would be only an approximation. Accurate calculation of these effects would require so much raw data about the vehicle that it would not be practical. Also, there is no way to predict the amount of external noise and electrical noise you will observe.

The fastest, easiest and most accurate way to account for all factors in the vehicle's environment is to measure them. Standing waves and closed-field pressurization can be measured together as a single *transfer function*. Troubleshooting noise problems is much easier when you can check your progress against a reference measurement.

3: Measuring Transfer Functions

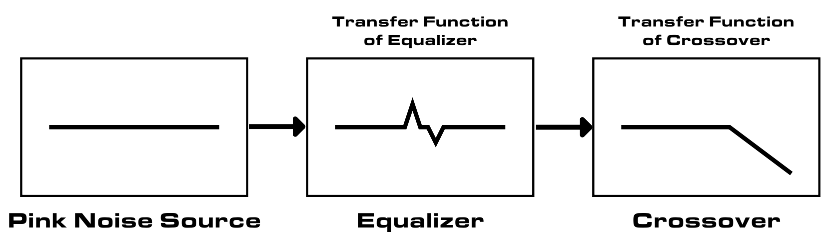
What is Transfer Function?

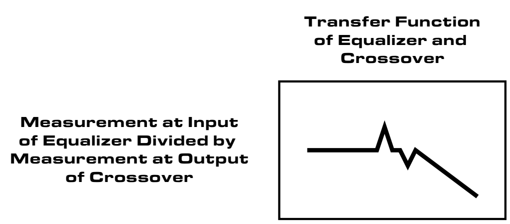
Transfer function is the ratio of two measurements. It can be determined by dividing one measurement by another. Commonly the transfer function of a device is simply the output divided by the input. Crossovers, equalizers, amps, speakers, wires, and acoustic environments all have transfer functions. Some of these devices have transfer functions which can be ignored, such as large gauge speaker wire and high quality amplifiers.

Measuring the transfer function of a passive crossover can be very useful when designing a system. It will show you if your crossover is working correctly, and what the crossover is doing to the signals fed to it.

Knowing the transfer function of the acoustic environment of the vehicle is extremely helpful when designing woofer enclosures. With a measured curve of a vehicle's transfer function, you can accurately predict the response of a cabinet in a vehicle before you actually install it. This can save enormous amounts of time and money.

If you know that the frequency response being fed to a device is flat, you can just measure the output of the device to determine it's transfer function. The difference that the device causes is then directly measured. If the response being fed to a device is not flat, then that response must be saved for later use in a division process to determine the transfer function through the device.

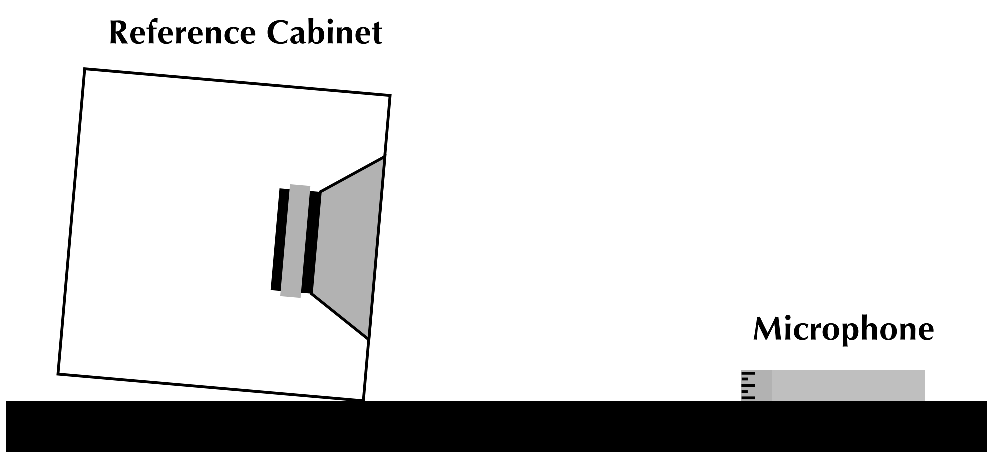




Transfer Function of Acoustic Environments
To measure the transfer function of the acoustic environment inside the vehicle, you will need a test cabinet and an amplifier. It is not necessary for the test cabinet to have an extremely flat response, because it will be used as a relative reference only. The test cabinet should, however, have about the same volume of speakers as the final installation. It should also have very close to the same air volume and port tuning as the final cabinet. This will assure accuracy of the low frequency pressurization.

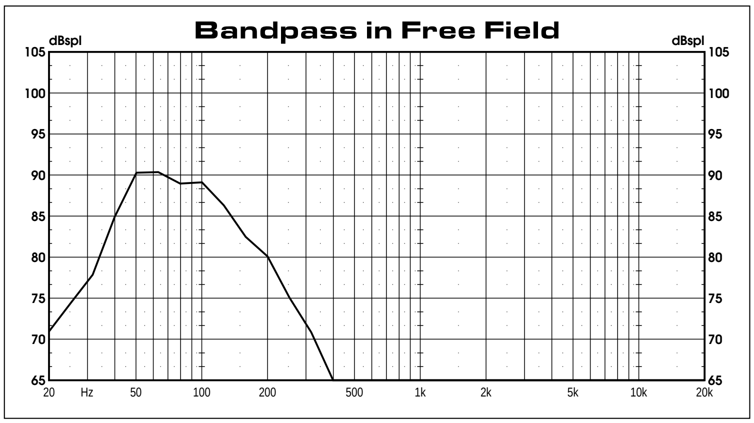
This technique will not provide much valuable information at the higher frequencies, because you cannot place the midrange drivers and tweeters where they will be in the final installation. For this reason, you may elect to use just a woofer cabinet and concentrate on the frequencies below 200Hz.

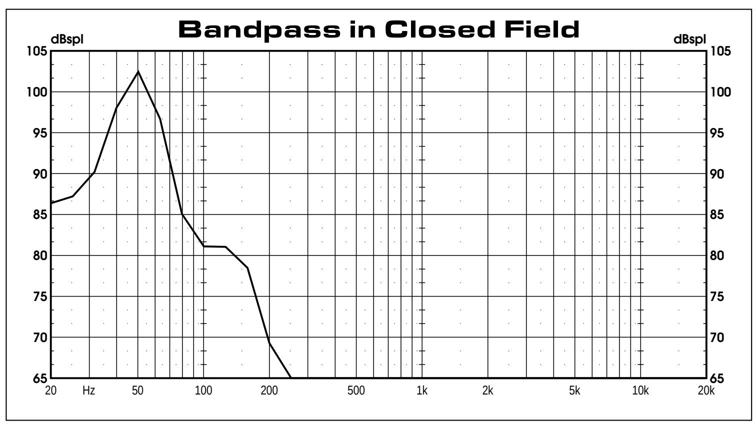
You must first measure the reference cabinet in a free field environment. The recommended method is to take a ground-plane measurement. This means to place the reference cabinet on the ground and the microphone on the ground 1 meter away. Using a low output level (about 1 Watt), measure the speaker with pink noise. Save the response curve as a reference.



Ground Plane Measurement

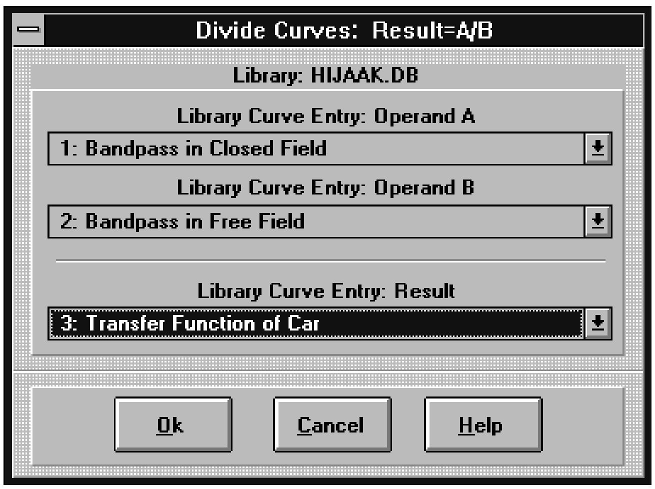
Next, place the reference cabinet inside the vehicle (closed field) and measure it again with the same pink noise signal at the same level. Save the response curve for comparison.





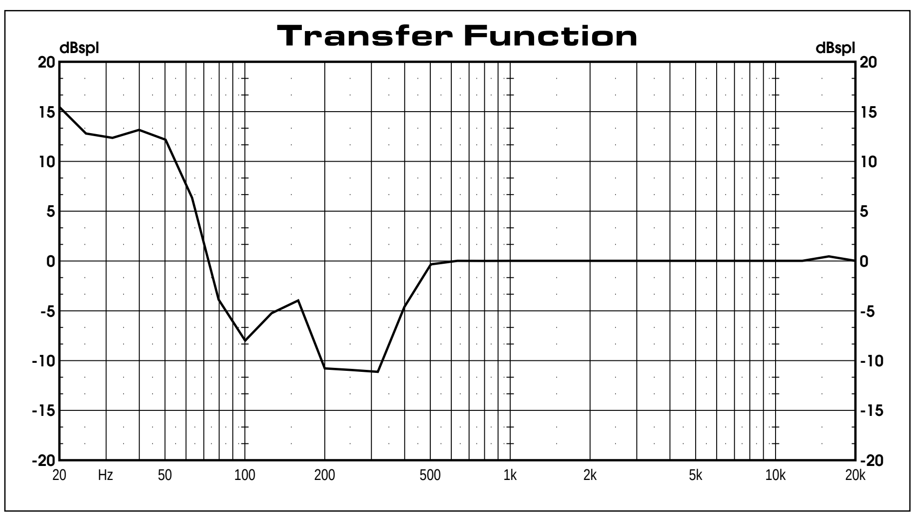
These graphs show the response curves of a bandpass cabinet in free field and inside the car. Note the extreme SPL boost at 50Hz on the closed field response. This is typical of bandpass cabinets in cars.

Now, go to the **Processing** menu of the pcRTA software and select **Divide**. Divide the comparison (closed field) curve by the reference (free field) curve. The result is the transfer function of the vehicle. This is the change in response that any speaker of the same volume as the reference will exhibit when placed in this particular vehicle. It includes the closed field pressurization and the standing waves that are present in the vehicle's acoustic environment.



This transfer function can be saved for future reference when designing systems for the same type of vehicle. To see the response of a woofer cabinet with the same volume of speakers and the same port tuning in this particular vehicle, measure the cabinet in a free field environment and then multiply the measured curve by the previously saved transfer function.

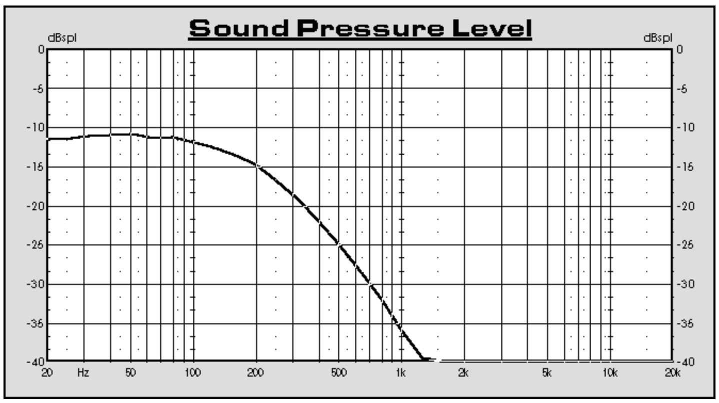
The graph below shows the transfer function that resulted from the two bandpass cabinet measurements shown on the previous page.



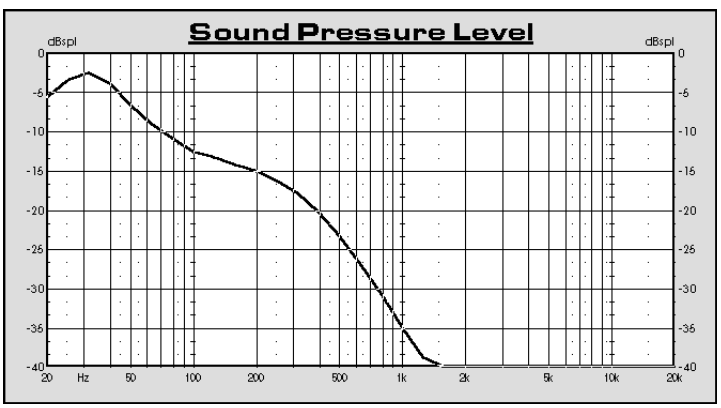
Transfer Function of Passive Crossovers

To measure the transfer function of a passive crossover, you need a power amplifier and the speaker(s) that the crossover will be attached to.

Passive crossovers should be measured with the speaker load. The speaker presents a *reactive* load, meaning that the impedance of the speaker changes depending on frequency. When measured with a *resistive* load, you will see the theorectically 'perfect' response from the textbook as demonstrated in the top graph. Because speakers are not purely resistive loads, this type of measurement is not very useful. The bottom graph shows the same crossover with an 8 Ohm speaker load.



NOTE: *When measuring the output of a power amplifier, be very careful not to exceed the maximum input voltage of the pcRTA. Voltages in excess of 5.8VRMS will DESTROY the electronics.*



Connect the **Line Out** of pcRTA to the input of the amplifier. If you are using an amplifier that is known to have flat frequency response, connect the **Line In** of pcRTA to the speaker terminals. The resulting measured curve will be the transfer function of the crossover. This is the voltage input to the speaker after the crossover.

If you suspect that your power amplifier does not have a flat frequency response, you should measure the transfer function of the amplifier. Set the amplifier's gain control to a low setting. Connect the pcRTA's **Line Out** to the amplifier's *input* and the **Line In** to the amplifier's *output*. The resulting curve will be the transfer function of the amplifier. If you find that the amplifier does not have a flat frequency response, divide the measured curve of the amp by the measured curve of the crossover to correct for the error introduced by the amplifier.

NOTE: *It is important to observe the maximum input voltage of the pcRTA. NEVER allow the voltage at the Line Input to exceed 5.8VRMS or severe damage will result.*

4: Measuring Road Noise

Road noise is the background noise level caused by the tires against the road, the air flowing over the car, and mechanical noises from the engine and drive train. These noises must be measured while the vehicle is being driven.

To measure road noise inside the vehicle you will need a portable computer and the PAC3 (Portable Analyzer Chassis - 3 slot) from LinearX. The PAC3 is a battery powered slot card holder which interfaces with the serial port on PC compatible computers. It will run for several hours without AC power.

Characterizing Road Noise

You can localize the source of various road noises by moving the microphone to different locations in the vehicle while it is being driven. If you save the measurements with a note about where each was taken, you can compare them to measurements after adding dampening materials to the passenger compartment.

With an RTA, you can get an idea not only of where the noise is, but what is causing it. If you see a peak in the high frequencies, it might be wind coming through a leak in the weather-stripping. A constant low frequency peak is probably caused by the drive train and the tires moving on the pavement. A mid-low peak that changes in frequency when you rev up the engine is probably mechanical engine noise.

5: Measuring Electrical Noise

Electrical noise is the background noise level caused by the electrical energy generated by the car's engine and other electrical devices. This type of noise is only present while the engine is running or while one of the other devices is running.

To measure electrical noise, connect the output of the power amplifier to the **Line Input** of the pcRTA. Measure the system noise with the engine off by turning the volume all the way up with no signal. Use a long averaging time (at least 5 Seconds). This is the background noise or *noise floor* of the electronic components in the system.

This type of measurement can be very dangerous, because power amplifiers are capable of **COMPLETE DESTRUCTION** of the circuitry of the pcRTA, and might damage your computer as well. If you are uncertain of the need for this test, **DO NOT ATTEMPT IT!** Your warranty will not cover repairs of this type of damage.

CAUTION: *NEVER allow the voltage at the Line Input of the pcRTA to exceed 5.8VRMS or severe damage will result.*

Start the engine and take another measurement. You can use the relative mode, or divide the measured curve by the stored curve of the noise floor. Any difference observed is the noise caused by the engine's electrical systems.

It is usually very easy to determine which device is causing the noise, because the noise will have a frequency which corresponds to the frequency of the device. For instance, if the noise has a higher frequency when you rev up the engine, it is probably ignition noise. If the noise changes when you change the heater fan from low to high, it is noise from the fan.

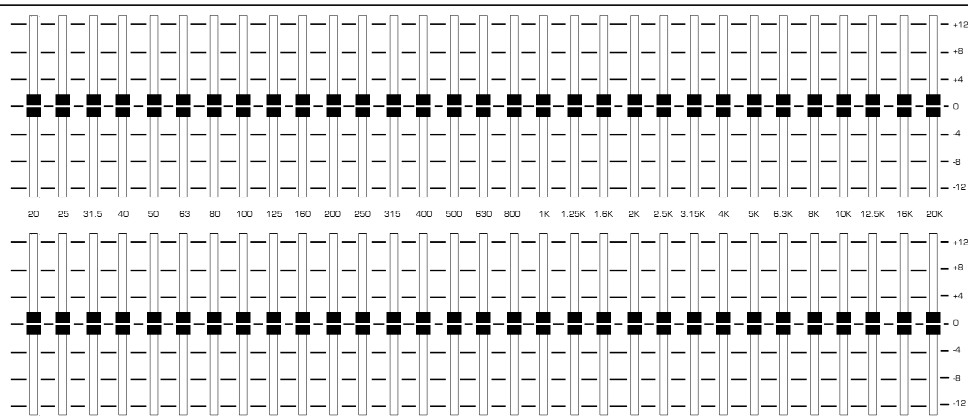
Electrical noises in cars are usually due to improper grounding schemes in the stereo installation. The solutions for these problems is beyond the scope of this manual.

6: Adjusting With an Equalizer

Equalizers

The ideal equalizers for tuning with pcRTA will be stereo (or two separate mono) 1/3 octave units, meaning that they have two sets of 31 adjustments. Most equalizers of this type have their bands centered at the same frequencies as pcRTA, which makes adjustment very easy. If your equalizer has less than 31 bands you can still measure and adjust it with pcRTA.

Another feature to look for in an equalizer is the 'graphic' style of adjustment. This simply means that the unit has linear sliders instead of rotary knobs. When you make an adjustment on such a unit, it leaves a 'graphic' representation of the frequency response change being added by the equalizer. This is much more intuitive than several rows of round knobs.



Stereo 1/3 Octave Graphic Equalizer

Programmable Equalizers

In recent years, equalizers have been developed that can be adjusted by a computer. These equalizers typically do not have any controls on the front panel, with the occasional exception of a few buttons which allow for adjustment if no computer is present. These equalizers can be automatically programmed by pcRTA while measurements are being taken, so that pcRTA actually adjusts the eq to achieve the operator's ideal target response. This process is called *optimization*. For more information, see the help file in the pcRTA software.

Adjusting for Flatness

Set the volume of the system to a moderate level, around 90dB SPL on the full range band of the pcRTA. Turn off the right channel of the system by using the balance control or disconnecting the signal. Adjust the equalizer on the left channel for a smooth, flat response from 20Hz on up to 20kHz. Frequencies below 200Hz require special attention because of the unique demands of the acoustic environment of vehicles, as discussed in an earlier section. Save the curve now for use when tuning the right channel of the system.

Turn off the left channel of the system and turn on the right channel . Using the saved curve from the left channel as a reference, adjust the right channel until the left and right channels are as close to identical as possible. It will require different settings on the equalizer's left and right channels to make the two channels match on the pcRTA display.

Now turn on the left and right channels together. Adjust the equalizer for a flat response again, making the same relative changes on both channels. For example, if you move the left channel's 1kHz band down 3dB from 0dB to -3dB and the right channel's 1kHz band is at -2dB, move the right channel's 1kHz band down 3dB also to -5dB. This will maintain the relative flatness between the left and right channels.

It is best to keep the bands of the equalizer as close to 0dB as possible, and not to have any drastic changes between one band and the next. If your system requires drastic equalization, chances are that something in the system needs to be reworked. Check for major problems in the installation.

The one exception to this is in the frequencies from 50Hz to 200Hz. Because of standing waves, you may see dramatic peaks and/or dips in the response at these frequencies. For the most accuracy possible, you should use *spatial averaging* to tune the system. The next section discusses this technique.

7: Spatial Averaging

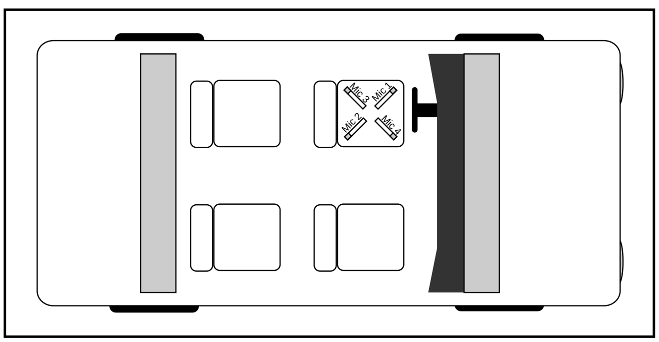
What is Spatial Averaging?

When measuring acoustic environments, a single microphone will read the sound pressure at only one tiny point in space. Errors in measurement occur because of standing waves and combing, which create peaks and dips in the response curve that vary with different mic positions. Spatial Averaging is a method of reducing the error due to this effect.

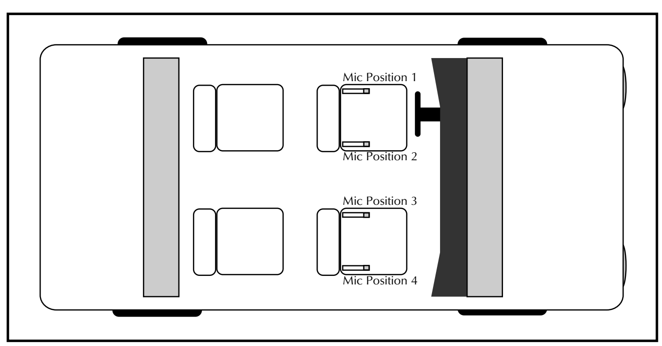
This technique is quite simple. Take measurements at several points in space with the same stimulus and average the measurements.

The pcRTA has the built-in capability to do spatial averaging in real time. You must have at least two microphones to take advantage of this feature, however. If you have only one microphone, you can manually perform spatial averaging, but it is more time consuming.

Make your measurements in zones around the listening position(s). Small distances between the microphones will provide averaging at high frequencies. For low frequencies, the mics must be several feet apart to provide averaging. Also, it is best to use long averaging times when you are striving for high accuracy in your measurements.



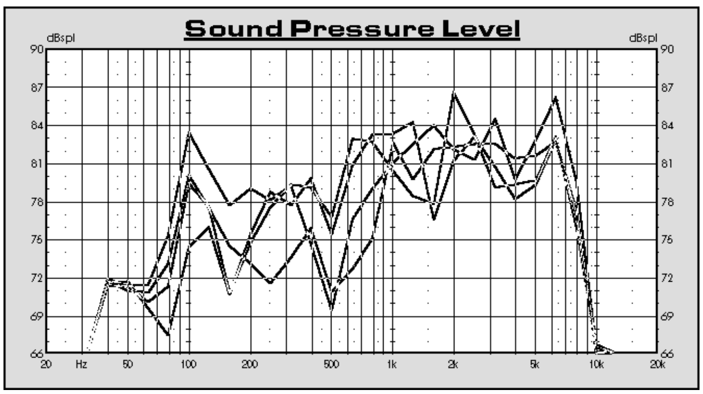
Spatial Averaging - driver's seat



Spatial Averaging - both front seats

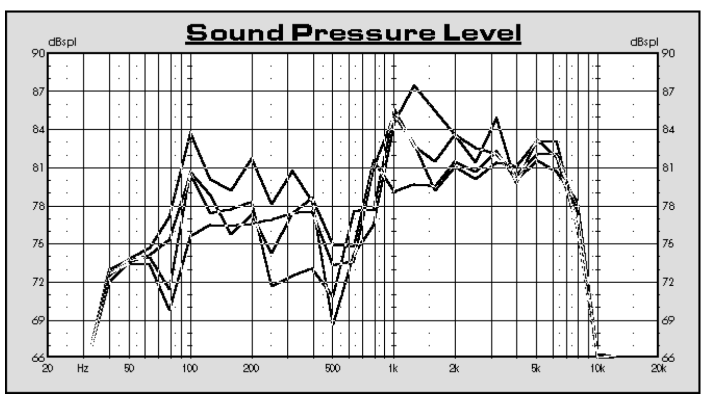
The measurements shown here were taken at four positions across the car in the front seat as shown in the lower diagram on the previous page. The mics were placed at head level.

The following two graphs show four curves, one from each of the four separate mic positions. These graphs illustrate what you would see with four mics set to measure in the Multiplex mode. Each mic is displayed separately and the data is saved separately in the first four curve entries. This can also be done with a single microphone, by moving it to each position to take four separate measurements, but it is a very tedious procedure.



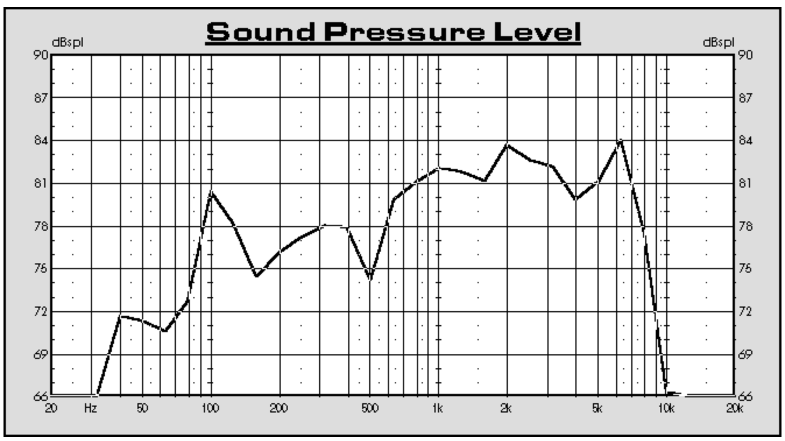
The first graph was taken with the left channel of the sound system turned on and the right channel turned off.

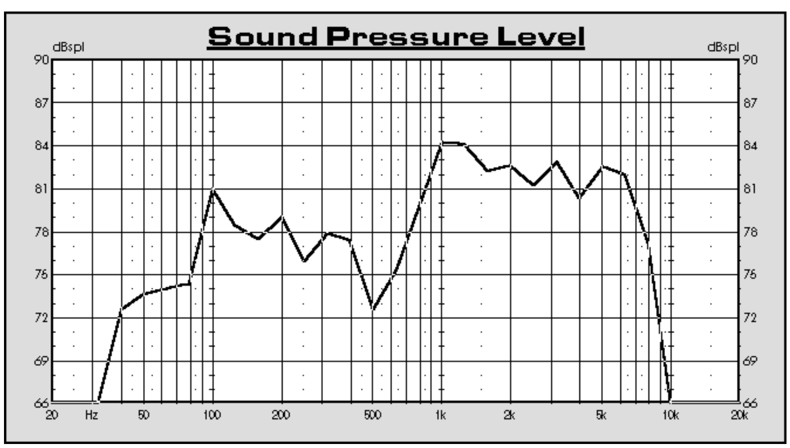
The second graph was taken with the left channel off and the right channel on.



These graphs illustrate what you would see with four mics set to measure in the Average mode. The data from the four mics is averaged in real time and displayed as a single curve.

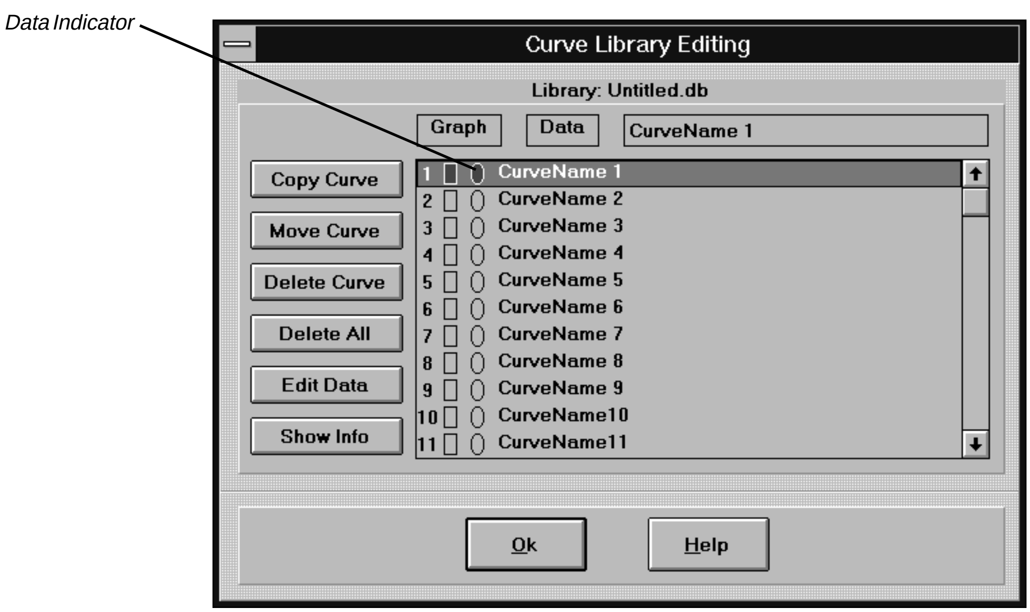
The upper graph is the average with only the left channel of the sound system turned on and the lower graph is the average with only the right channel turned on.





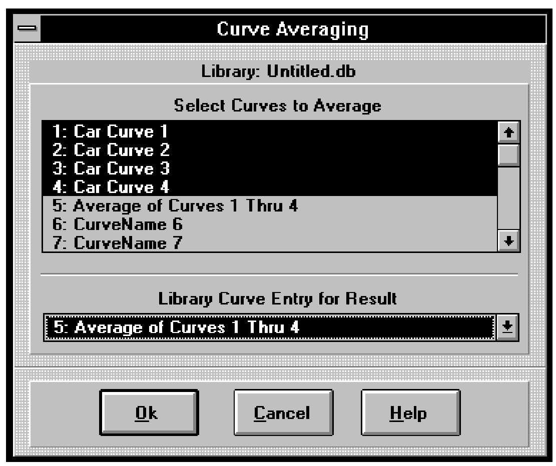
If you have only one microphone, you will need to average the measurements manually after running the individual tests.

Before you take the first measurement, go to the **Curve Library** and give names to the all of the curves you will use. This will simplify the process of saving multiple data curves. Set the first curve number to be the data curve by pressing the oval next to the curve name in the **Curve Library**. Run the test, and then move the microphone to it's next position. Go to the **Curve Library** to set the next curve as the data curve. Continue this procedure until you have as many measurements as you want for your average.



Once you have several curves measured, go to the **Processing** menu and select **Averaging**. Click on all the curves you want to average, and select an empty entry for the result curve.

The results will be the same as the graphs on previous pages, however with only one mic the average cannot be observed in real time without post processing of the data.



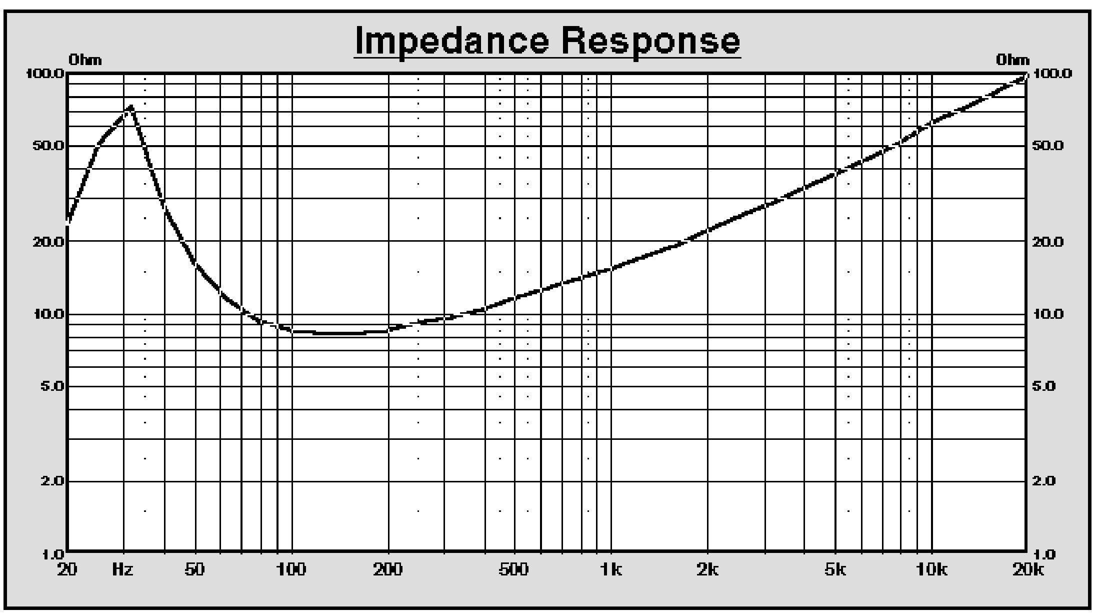
8: Measuring Impedance

There are two different types of impedance measurement available in the pcRTA. They are 2-wire and 4-wire.

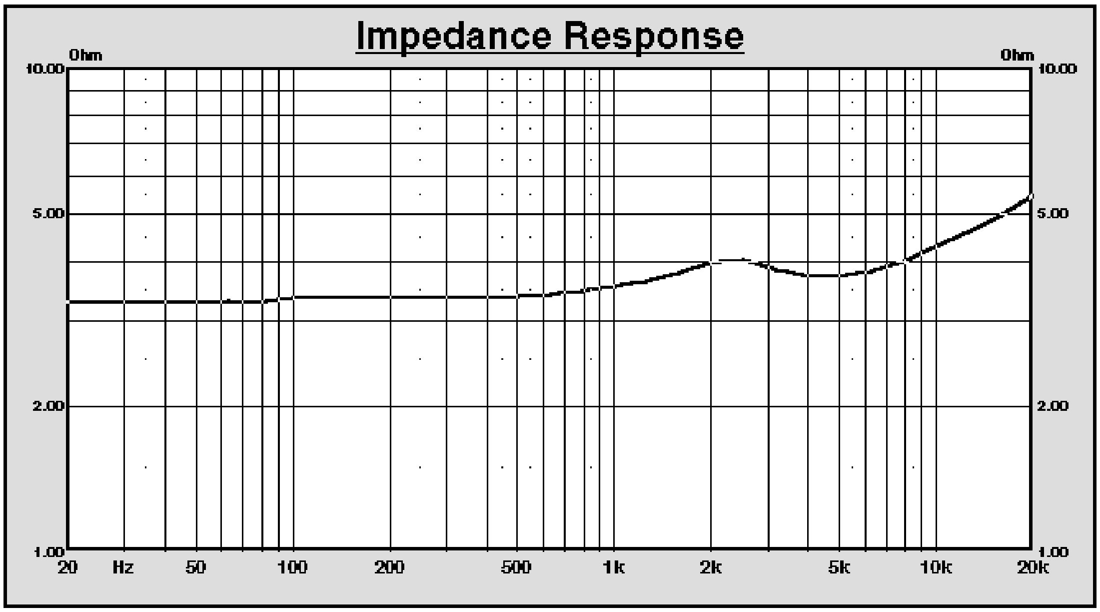
The 2-wire method uses only the **Line Output** of the pcRTA. It requires only one cable with two leads connected to the device to be tested. The accuracy of measurements taken with the 2-wire depend on the user subtracting the short circuit impedance of the cable from the measured curve.

The 4-wire method uses the **Line Output** and the **Line Input** of the pcRTA. It requires two cables with two leads each connected to the device to be tested. The measurements that are taken with this method do not require any processing. All examples in this section were measured with the 4-wire method.

The impedance measurement capability can be used on individual speakers as shown in these graphs. The first is an 8 Ohm woofer with an Fo (resonant frequency) of about 30Hz. The general shape of the curve is the characteristic one seen on nearly all loudspeakers, with a narrow peak or 'hump' at the low end and an upward slope at the high end.

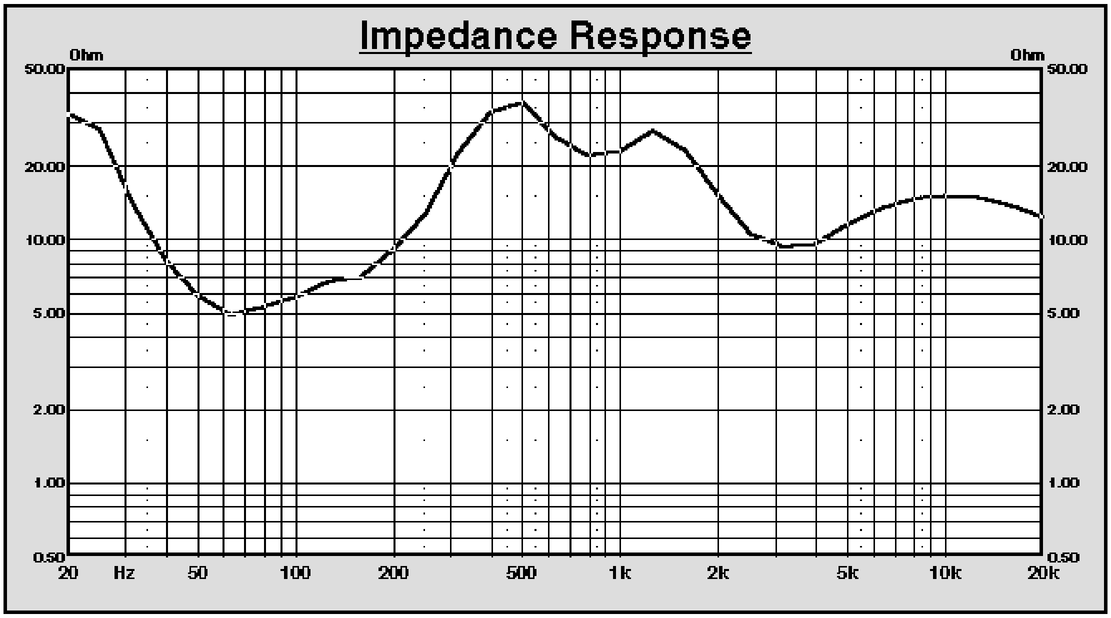


Impedance Response of 8 Ohm Woofer



Impedance Response of 4 Ohm Tweeter

This graph shows the impedance response of a 4 Ohm metal dome tweeter. It has an Fo of about 2.3kHz. The resonant frequency 'hump' is difficult to pick out because it's magnitude is only about 1/2 Ohm higher than the nominal impedance. This is a very common type of curve seen on tweeters.

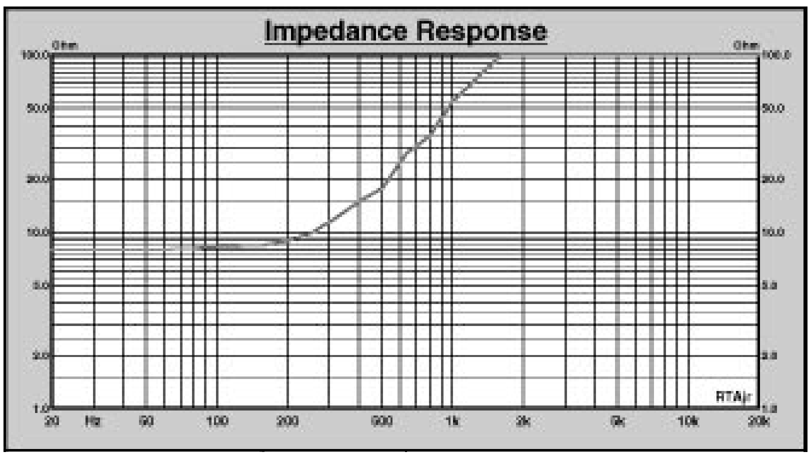


Impedance Response of Three-way System

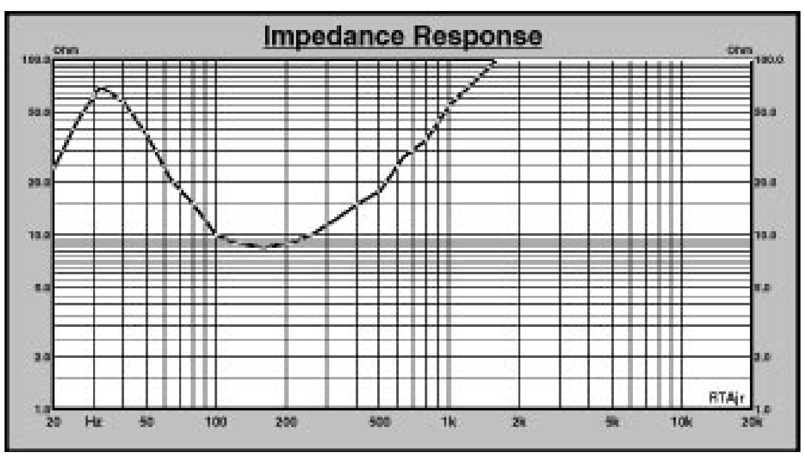
This graph shows the impedance response of a three way system with a passive crossover. It was measured at the input to the passive crossover circuits. This type of measurement is useful for determining whether the amplifier will see an impedance at any frequency that could cause it to go into protection. It will also alert you to possible wrong connections and short or open circuits.

The graphs below show the impedance response of a 2nd order passive lowpass circuit, first into an 8 Ohm resistor, and then into an 8 Ohm woofer.

It was measured at the input to the passive crossover circuits. Again, this type of measurement can alert you to possible wrong connections and short or open circuits.



2nd Order Lowpass into 8 Ohm Resistor



2nd Order Lowpass into 8 Ohm Woofer

9: Scoring Routines

This section is a judge's guide to using the car audio competition scoring routines. The IASCA routine will be used as an example, but you should be able to use this guide with all of the scoring routines. There are routines for CMAA, USAC, and dB Drag racing.

The scoring routines in the pcRTA are based on the current rules from each of the sanctioning bodies. If the rules change, the software is changed to reflect the new rules. Updates of the software are available from the LinearX BBS and on the World Wide Web at the LinearX home page.

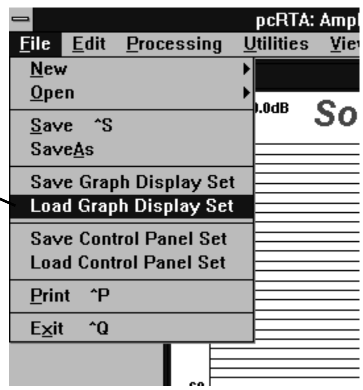
LinearX BBS: 1(503)598-9326

LinearX Web Address: http://www.linearx.com/~linearx

Figures are used extensively in this section, so that you will know what the software should look like at each step.

There are many graphic elements of the pcRTA software that can be adjusted or manipulated by the user. To duplicate the look of a particular graphics setup can be challenging. For this reason, we have incorporated the Graph Display Set (GDS) files feature. GDS files keep track of all colors, fonts, window locations and window sizes. Using these files, you can recall the exact look that you saved previously, and there are some generic files included with the software.

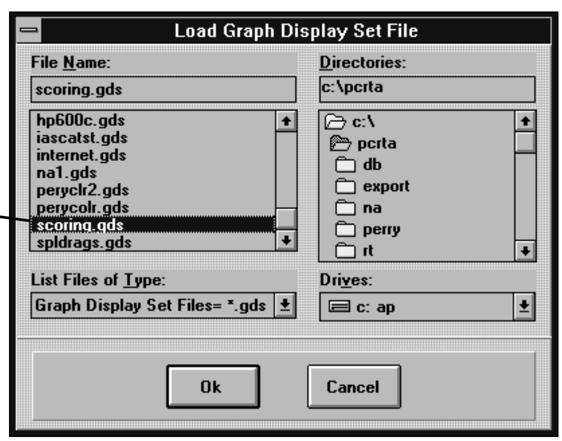
Load Graph Display Set

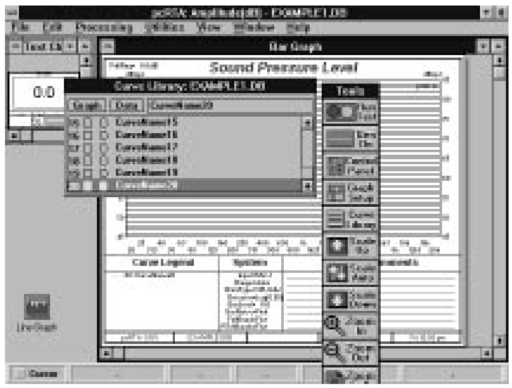


The first step in this section will be to load the GDS file called **scoring.gds**. To load the GDS file, go to the **File** menu and select **Load Graph Display Set**.

The **Load Graph Display Set File** dialog box opens. Select the GDS file **scoring.gds** by double clicking the file name.

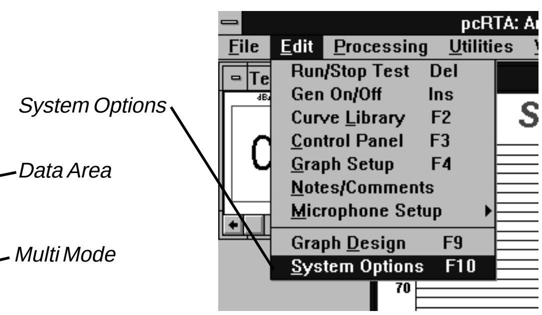
Double Click

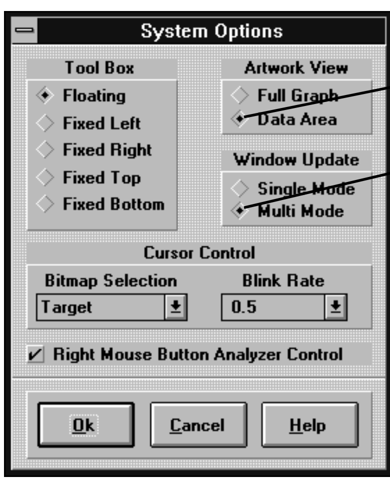




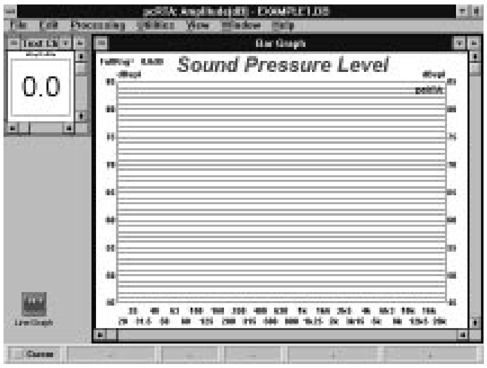
Your screen will look something like this:

Next, hide the **Curve Box** and the **Tool Bar**. Go to the **View** menu and select **Hide Curve Box**. Go to the **View** menu again and select **Hide Tool Bar**.



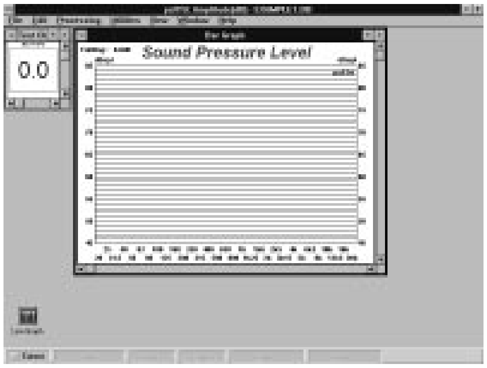


Now, select **System Options** from the **Edit** menu. Set the **Artwork View** to **Data Area** and the **Window Update** to **Multi Mode**. Click **OK**.



VGA 640x480 Display

It is important to understand that the window locations and sizes in this file were set on a VGA screen resolution of 640x480. If your computer is running in a SuperVGA mode (800x600, 1024x768, or higher), the graphs will use a smaller portion of the screen. The figures on this page illustrate the same GDS file at three different screen resolutions.



Super VGA 800x600 Display

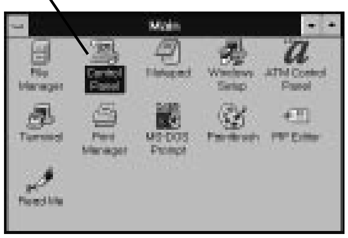
If your screen resolution is higher than VGA 640x480, you will probably want to drag the corners of the windows out to fill the screen. Once you have the screen set up the way you like it, save your settings in a GDS file so that you can recall them any time.

Super VGA 1024x768 Display

When running the scoring routines in pcRTA, it is critical that there are no screen saver programs running, and that the print spooling options are disabled. These options tie up the CPU during tests and can cause invalid readings from pcRTA.

In Windows 3.x, go to the **Main** window and open **Control Panel**. Double click on the **Desktop** icon and click on the **Screen Saver Name** drop down list. Select **(None)** and click **OK**. Now double click on the **Printers** icon. Turn off the **Use Print Manager** option and click **Close**.

Control Panel icon



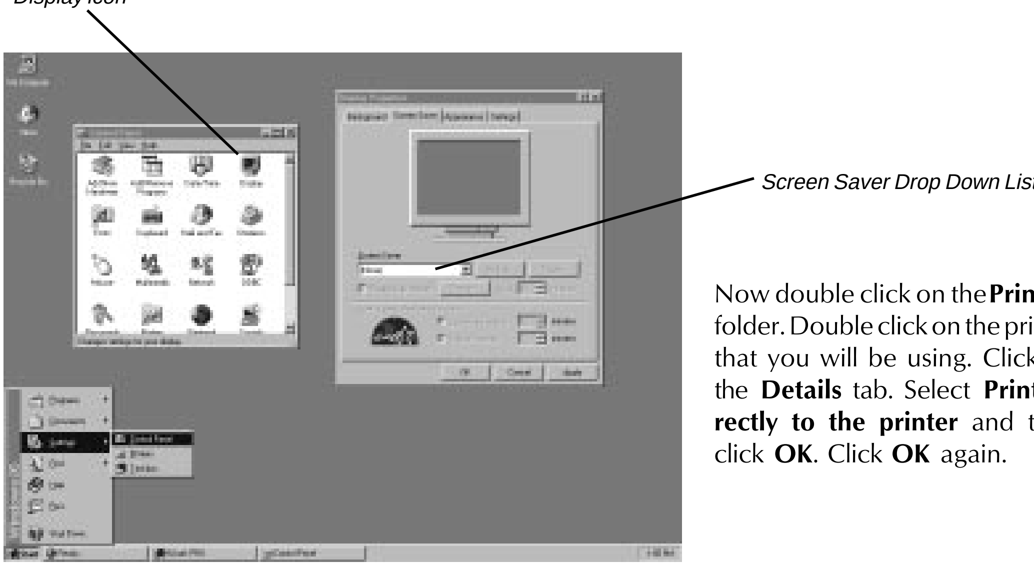
Desktop icon

Printers icon

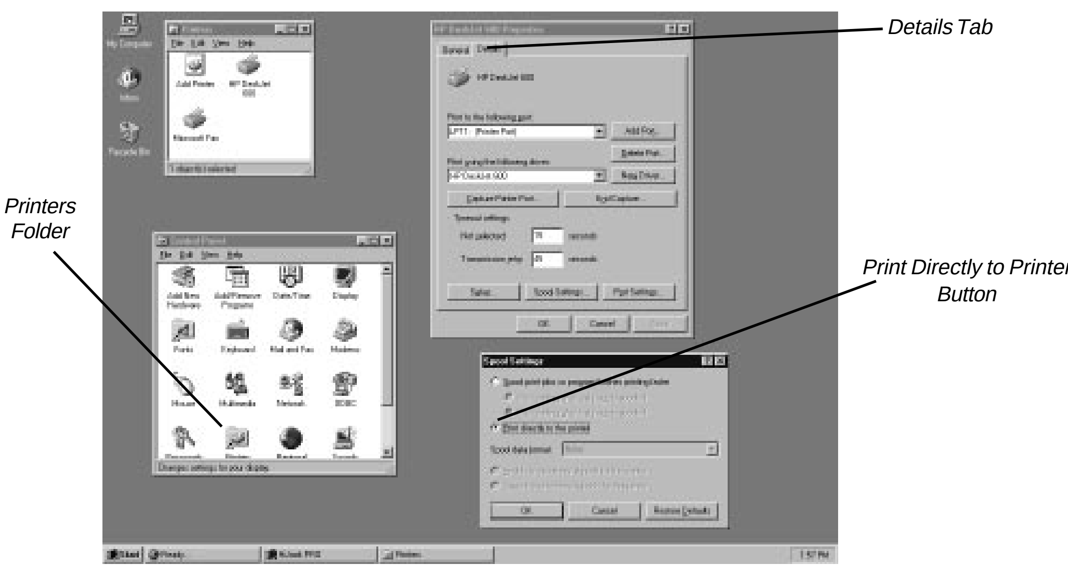
Use Print Manager Button

Screen Saver Name drop down list

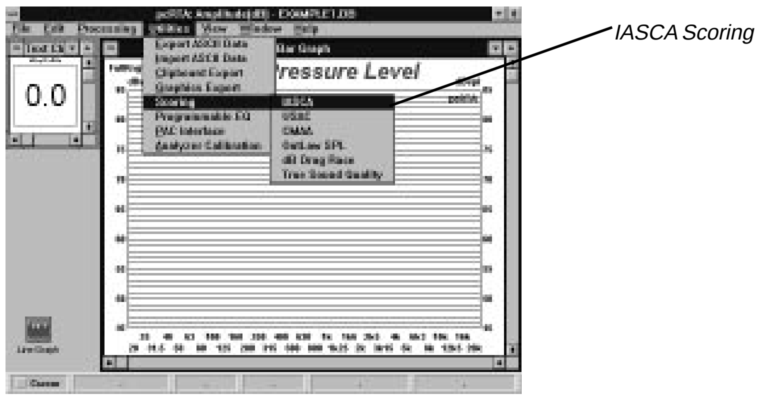
In Windows 95, use the **Settings** button on the **Start** bar to open **Control Panel**. Double click on the **Display** icon. Click on the **Screen Saver** tab, and then select **(None)** on the **Screen Saver** drop down list. Click **OK**.



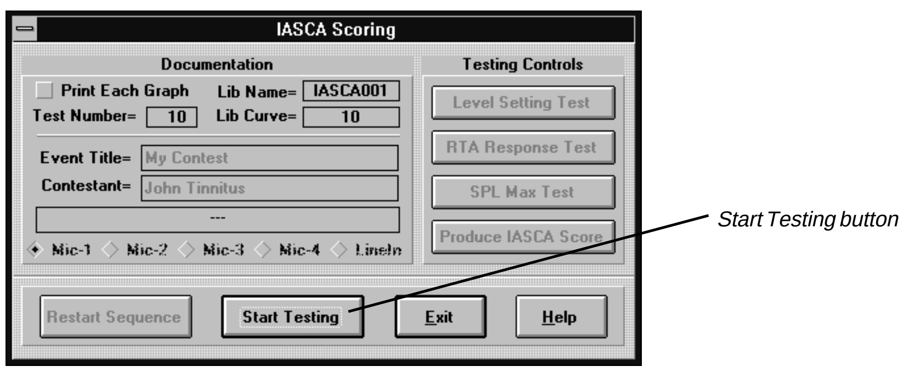
Now double click on the **Printers** folder. Double click on the printer that you will be using. Click on the **Details** tab. Select **Print directly to the printer** and then click **OK**. Click **OK** again.



Go to the **Utilities** menu and select **Scoring**. A drop down menu appears. Select **IASCA**.

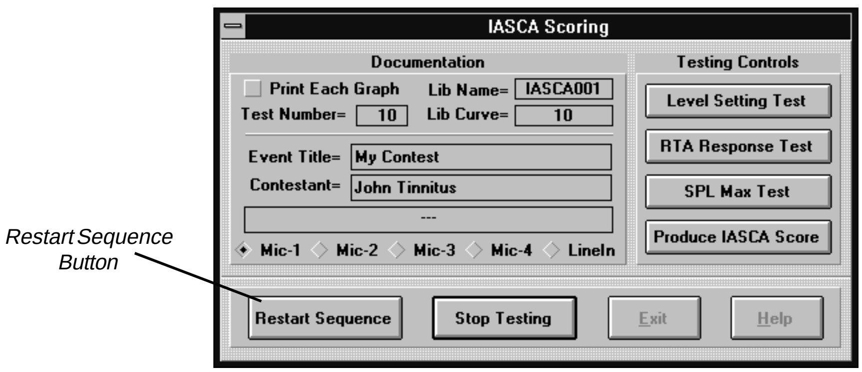


The **IASCA Scoring** dialog box opens. Click on **Start Testing**.



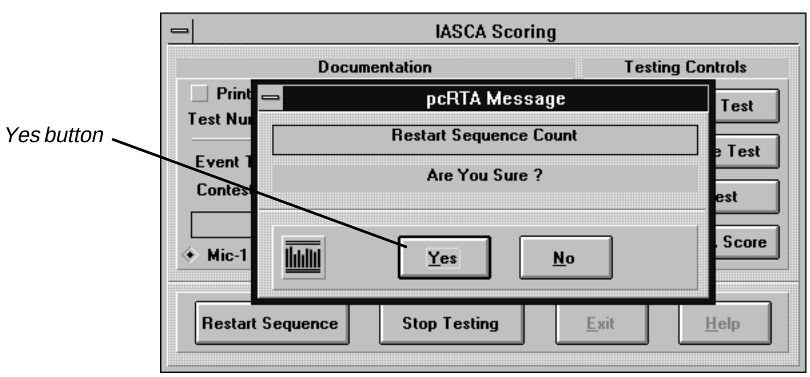
IASCA Scoring Dialog Box

Note that the **Start Testing** button now says **Stop Testing**.



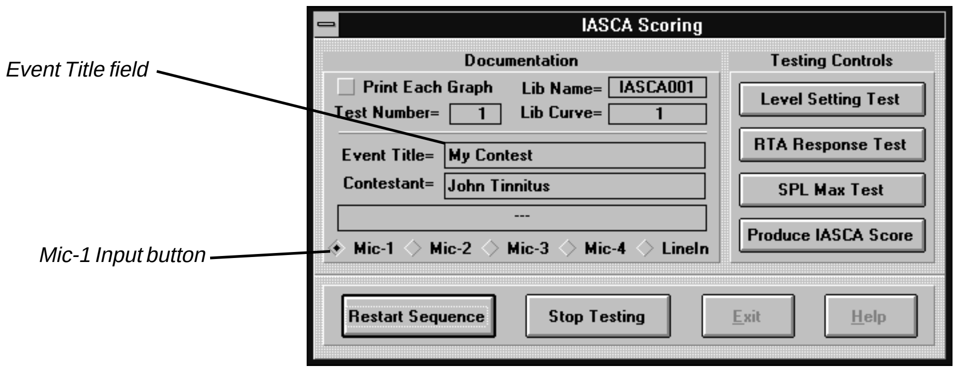
When starting a new competition, you will want to use the **Restart Sequence** button. This button should only be used once, before anyone has been scored. If the sequence is restarted during a competition, some of the scores of previous competitors will be erased and replaced with new ones.

Click the **Restart Sequence** button.



A message box will pop up asking if you *really* want to restart the sequence. Click the **Yes** button.

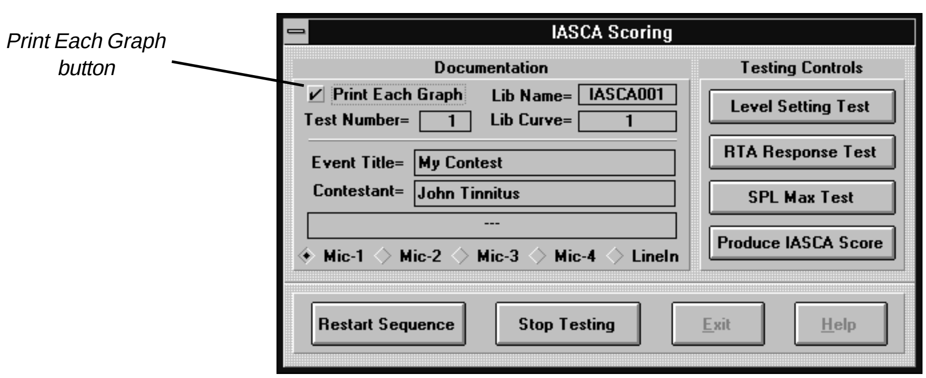
Now, enter the name of the competition. To do this, click the mouse inside the area that says **Event Title**. Erase the old name and type in the name of the competition.



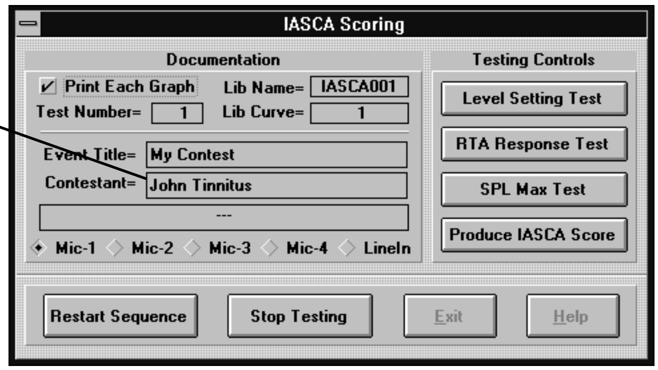
The pcRTA has the ability to use any of the four mic inputs or the **Line Input** as sources for the scoring. This allows for multiple lanes to be measured with one pcRTA. For single lane testing, the **Mic-1** input should always be selected. Verify that this is true.

You are now ready to start scoring. The preceding steps should only need to be done once, at the beginning of a competition.

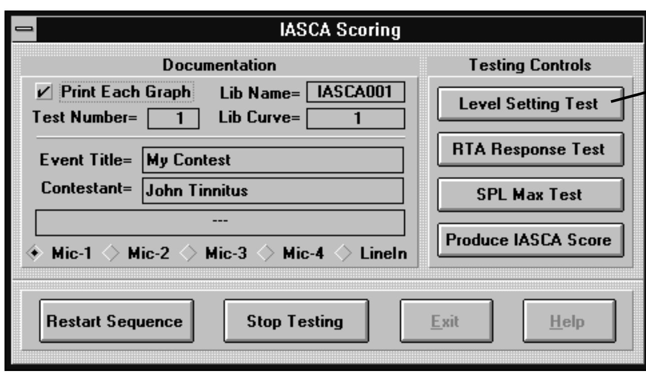
Click the **Print Each Graph** button if you want printouts of each competitor's results.



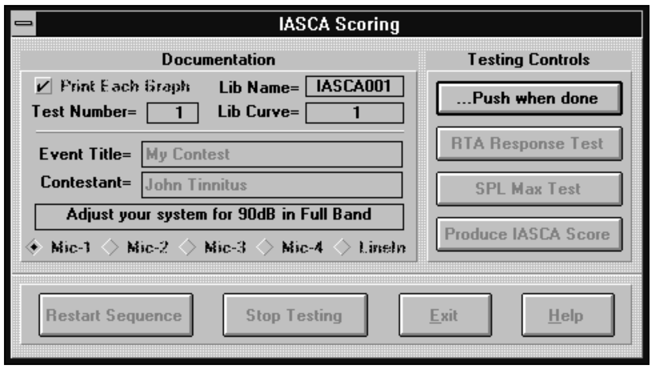
Enter the competitor's name in the area marked **Contestant**.



Press the **Level Setting Test** button.

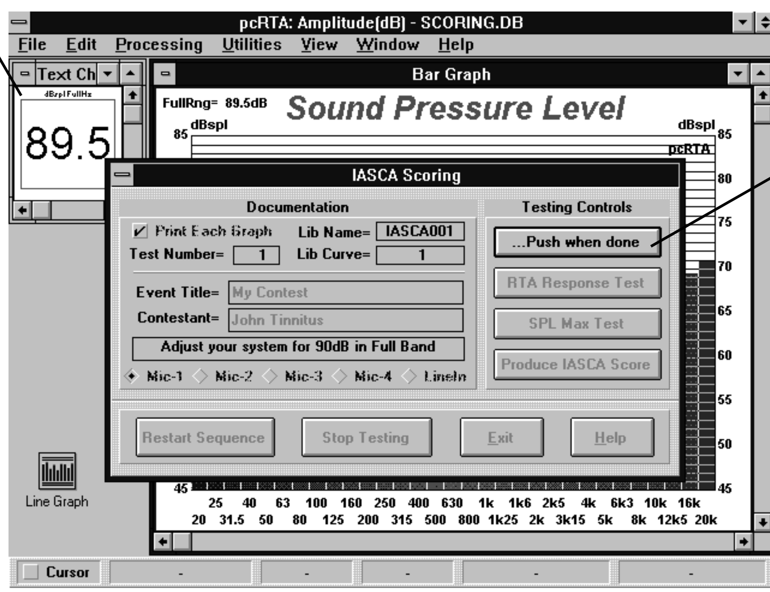


The text inside the button changes to **...Push When Done**.



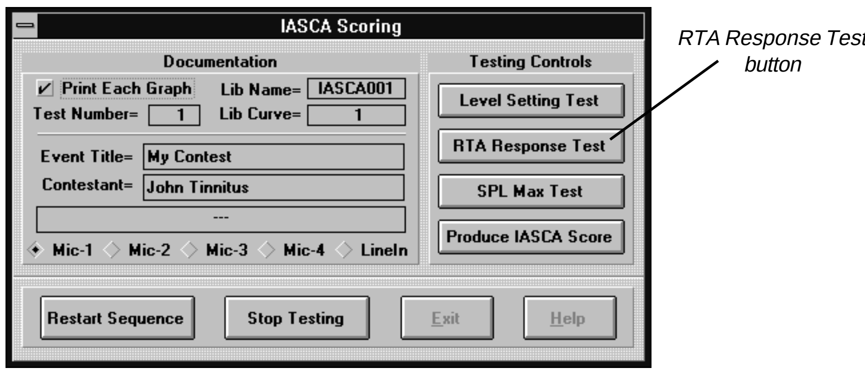
At this point, the pcRTA is measuring the pink noise in the car. Have the competitor set their system for a 90dB (+ or - 1dB) indication on the **Text Chart** in the upper left corner of the screen and then press **...Push When Done**.

Text Chart (Set for 90dB)



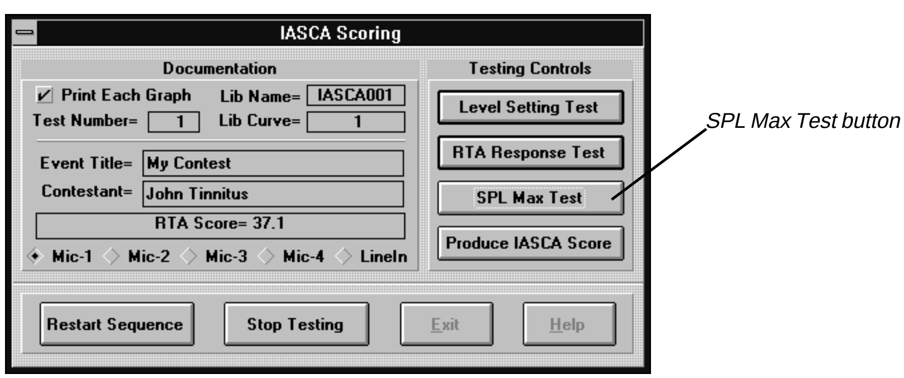
...Push When Done button

Have the competitor restart the pink noise track on the CD and press the **RTA Response Test** button.



The pcRTA now takes a 10 second average of the pink noise in the car. At first, the **Bar Graph** will update quickly, and then it will freeze for 2 seconds while the pcRTA is taking measurements. The graph will be updated 4 more times, 2 seconds apart. After ten seconds, the test is finished. The RTA score appears in the text box below the **Contestant** field. If desired, the test can be run again by pressing the **RTA Response Test** button again.

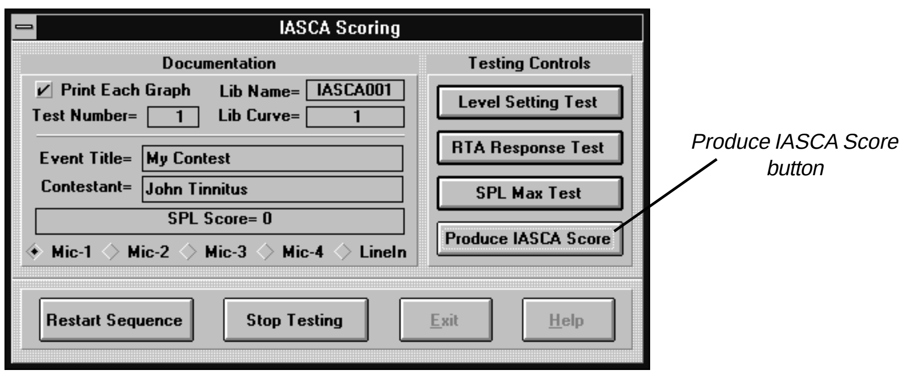
Now, if you are doing Sound Q+ on this competitor, press the **SPL Max Test** button.



The competitor now has 30 seconds to achieve the highest reading that they can. The pcRTA will capture the loudest signal and continue to hold that level until a louder level is measured, or 30 seconds elapses. The SPL score appears in the text box below the **Contestant** field. If desired, the test can be run again by pressing the **SPL Max Test** button again.

NOTE: *The competitor should not be allowed to open the doors of the vehicle while the test is running. This can sometimes result in higher SPL levels than would be possible with the doors closed.*

After the 30 second SPL Max test, press the button labeled **Produce IASCA Score**.

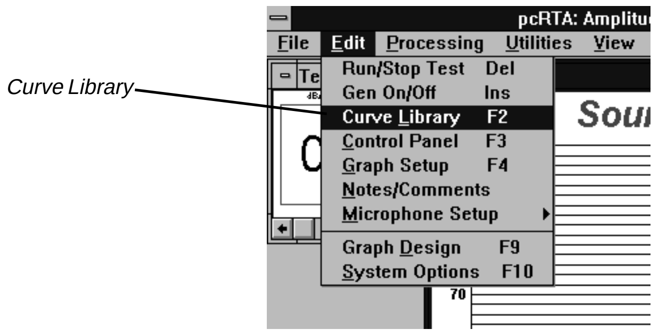


This button will cause the pcRTA to score the RTA curve (and SQ+ value) and place the score in memory. This is the last step in the procedure.

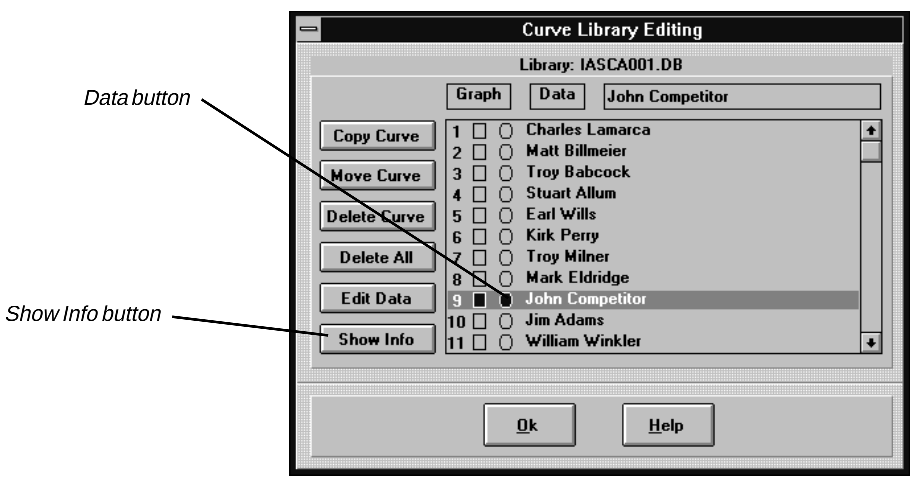
To score the next competitor, follow the procedure again starting from page 38.

If you need to print someone's score after the car has left the lane, follow the procedure on the next page.

To retrieve a previous score, go to the **Edit** menu and open the **Curve Library**.



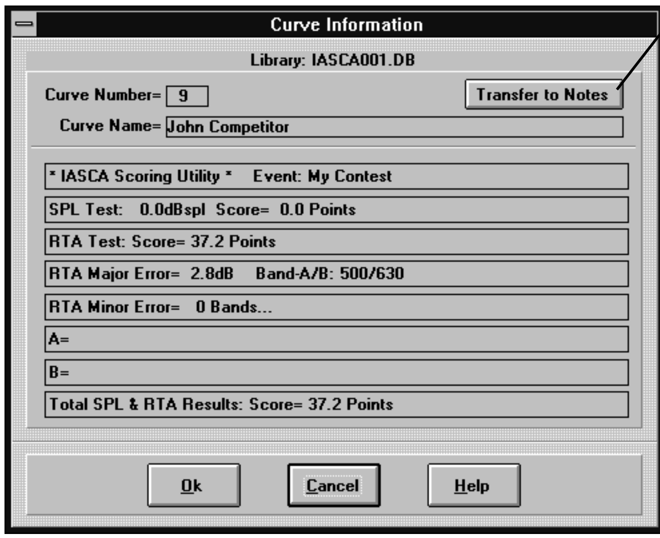
The **Curve Library** dialog box opens. Click on the **Data** button on the curve that you need.



Click on the **Show Info** button.

The **Curve Information** dialog box opens. This is the IASCA score that is saved in memory for this competitor.

Transfer to Notes button



Click on the **Transfer to Notes** button. Click **OK**. Click **OK** again. The competitor's score is now displayed in the **Notes and Comments** field of the graphs. To print, go to the **File** menu and select **Print**.

If you need to continue scoring, simply start the scoring routine again. The software will automatically start at the last curve entry and will not overwrite any of the previous scores (unless the **Restart Sequence** button is used).