



IE-45

Audio Analysis System

Owner's and Operator's Manual

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Introduction

Congratulations! With your purchase of the Ivive IE-45, you not only have one of the most powerful, versatile, and accurate audio spectrum analyzers available, but you also have an analysis system that is capable of expanding as your needs expand. The supplied microphone is a Type II microphone, making the standard IE-45, a Type II measurement system. For those needing Type I accuracy, two optional microphone preamplifier and microphone capsule combinations are available to convert the IE-45 analyzer to a Type I measurement system. With reasonable care, the IE-45 will provide a long period of useful service.

This manual is intended to familiarize you with the basic operations of the IE-45, and to whet your appetite concerning some of its possibilities. It is in no way intended to be the total description of all the possibilities of this unit.

The computer supplied with the IE-45 is a Samsung® Q1, Windows® XP machine. However, this specific computer is NOT required. The IE-45 software will run on many Windows® XP machines with USB ports for connection to the IE-45 Input Module, as long as they have sufficient processing power and speed to run the software at optimum performance. If you prefer to use your laptop, for example, simply connect the IE-45 IM to it using an appropriate USB cable, load the IE-45 software and you're off and running!

IE-45 Software Options

A number of different software packages are available for the IE-45. Each can be purchased separately and run independently, depending upon your measurement needs. These software packages include:

IE-45 RTA: *Comprehensive real time analysis software. Comprises multiple functions from RTA to SPL meter, to oscilloscope, to volt meter and many others. The bulk of this manual is dedicated to a description of the functions of this software package. Where appropriate, applications are discussed as well.*

IE-45 Leq: *Full Featured Leq survey software. This independent software package comes with its own manual and a separate PC software package for formatting and printing measured data.*

IE-45 RT-60: *RT-60 measurement software. This software package runs within the IE-45 RTA software package, but must be purchased separately.*

IE-45 STIPA: *Intelligibility measurement software. This software package runs independently.*

IE-45 Record: *Independent WAV file recording software. Recorded WAV files can be injected into the IE-45 RTA software program for analysis.*

Additional software packages will become available in the future as the functionality and measurement capability of the IE-45 continues to expand.

IE-45 IM Inputs

As demonstrated across the page, the IE-45 Input Module (IE-45 IM) has four different inputs: Microphone (Mini QG, 4-pin), two line level inputs (RCA /phono) and an additional line (SMA) input. Two of the four inputs can be simultaneously active. The variety of input connectors allows for the convenient input of a number of different signals from external devices.

For those wishing to remote the microphone some distance away from the IE-45, microphone extension cables of varying lengths up to 200 feet are available from Ivive.

IE-45 Input Module (IE-45 IM)**IE-45 M Microphone.**

The IE-45 M is a Type II, electret microphone. As options, the IE-5P Microphone Preamplifier, with the model 1201, 1/2 inch microphone capsule, or the IE-6P Mic Preamp with the 1133, or 1134 air condenser capsules are available. With either of these options, the IE-45 offers true Type I performance.

Microphone Input Jack

Switchcraft® Mini QG, 4 pin.

Note: The 1/1 octave, 1/3 octave, 1/6 octave and 1/12 octave digital filters of the IE-45 are Class 0.

Mini-B USB Jack

This connector is used for connecting IE-45 IM to a computer. The IE-45 IM is self powered over USB.

Auxiliary Line Input

This input is a gold plated SMA connector.

While not presently employed in the current features of the IE-45, it is intended for use in future software packages for the IE-45 such as vibration measurement.

Channel 1 and Channel 2 Line Level Inputs

These inputs are gold plated RCA (Phono) jacks.

These line level inputs are used for measuring voltages when employing the Volt Meter function of the IE-45.

They are also used when employing the Oscilloscope function of the IE-45, whether single trace, dual trace or oscilloscope XY measurements.

IE-45 Controls

As demonstrated across the page, the IE-45 makes use of a number of different controls, both software and hardware based. The controls can be divided into three categories: 1) Hardware Buttons, 2) Software Defined Stylus Buttons and 3) Pull-down Menus. Like the stylus buttons, the pull-down menus are touch-activated using the stylus.

Hardware Buttons

The IE-45 software defines the use of some of the Samsung® Q1 hardware buttons, as shown across the page. The “joystick” up/down button can be used, for example, to move the displayed signal up or down on the Q1 display. It changes the gain up or down in increments determined by the setting of the dB scale. The left/right “joystick” button can be used, when the display has been stopped, to move the cursor left or right for selecting a band of interest. Frequency and amplitude information is then displayed for the band selected.

Stylus Buttons

The stylus buttons contain many of the most used features of the IE-45. They are clearly labeled and very intuitive. Some duplicate the function of hardware buttons, as in the Zoom In and Zoom Out functions, shown in the illustration across the page. The stylus buttons allow selection of the RTA display in octave, one third octave, one sixth octave or one twenty-fourth octave. The Decay stylus button adjusts the display averaging time. Successively tapping rotates it from Decay 1, to Decay 2, to Decay 3 and back to Decay 1 again. Many of the averaging functions and memory functions are controlled by the stylus buttons.

These buttons also control the functions of the SPL meter, such as switching between A weighted, C weighted and unweighted measurements, or selecting Fast, Slow, Peak or Impulse measurements. The use of stylus buttons is covered extensively in the sections of this manual dealing with specific IE-45 functions.

Pull-down Menus

The pull-down menus add tremendous flexibility to the IE-45. Tapping the “Function” pull-down menu, for example, allows you to select one of the many functions of the IE-45. Choices include RTA, RTA with an LED display appearance, SPL Monitor, Seat to Seat (SPL variation), Strip Chart function, Polarity measurement, Oscilloscope function, Signal Generator, Volt Meter and RT-60, if the RT-60 software module has been purchased.

The “Options” pull-down menu allows the setting of display scale and the dB level located center screen (Set dB Scale). It also provides for RTA display weighting, allows the display of Peak Hold on the RTA screen, and allows the selection of NC and NR measurements. The new “Spectrograph” display can also be selected from within the “Options” pull-down menu. Additionally, entering a “Preferred Curve” is possible. It is also possible to Play a Test WAV file, or continuously loop through a WAV file (Play Test Loop). The frequency cursor can be activated from the “Options” pull-down menu as well, which tracks the highest amplitude on the spectrum analyzer and indicates the frequency of that highest level. This can prove extremely useful when chasing feedback phenomenon.

The menu items in the “Options” pull-down menu are interactive with the “Function” pull-down menu. As different functions are selected, different options for the selected function will appear in the “Options” pull-down menu.

“Joystick” Button:
It “slides” Left/Right or UP/Down:
Left/Right = Frequency Selection.
Up/Down = dB Range or dB Level.

Pull-down Menus:
These menus allow the selection of IE-45 functions and options within the selected function.

IE-45 Microphone:
Microphone shown is the optional IE-5P with 1201 microphone capsule for Type I performance.

Q1 Power On/Off, Slider Switch:
Important Note:
Slide to the Right to turn on. Sliding Left brings up Windows® Media.

IE-45 Input Module (IE-45 IM)

Over Range and Under Range Indicator:
A downward pointing arrow here indicates under range; an upward pointing arrow indicates over range. The arrow is solid while the conditions exists, but blinks when corrected. It will continue to blink until tapped with the stylus to remove it.

dB/Division Readout

Audio Output Jack:
3/5mm stereo.
Can be used as a headphone jack, or as the output for the Signal Generator.

Stylus Buttons:
Many of the functions of the RTA and the SPL Meter are controlled by the Stylus Buttons. Each function of the IE-45 will have its own set of Stylus Buttons specific to that function.

Scratch Memory Stylus Buttons:
Tapping one of these buttons (1 - 9) stores and displays a memory. Red indicates an empty memory. Green indicates a displayed memory. Blue indicates the last memory manipulated and displayed. Buff indicates there is data in a memory, but it is not being displayed.

Status Window:
Red = Function stopped by user.
Green = Function running. The Status Window also indicates the microphone selected for use.

Zoom In, Zoom Out Hardware Buttons:
These buttons function like the Zoom In, Zoom Out Stylus Buttons. They change the dB/Div. which affects the IE-45 display resolution.

Save Screen Button:
When tapped, this button saves a “snapshot” of the IE-45 display screen. It is saved to the “My Documents” folder as a bitmap (.bmp) file. It is named “Ivie Screen” with a number. Each successive screen save increments to a higher number.

Sound Pressure Level Readout:
This readout shows SPL to a resolution of .1 dB, and indicates the SPL weighting applied. Tapping the dB section will cause it to readout voltage. Successive taps will cause the readout to toggle from volts rms, to volts pp (peak to peak) and so on, back to dB SPL.

Note: The hardware Button controls for the IE-45 are unique to the Samsung Q1 computer. If any other computer is used, the IE-45 RTA Software is not intended to support any hardware button functions. The hardware buttons of the Samsung Q1 make the operation of the IE-45 more convenient, but they are not required for operation. All of the functions of the Q1 hardware buttons are duplicated in the functions of the software Stylus Buttons.

Getting Started with Your IE-45

If you purchased the IE-45 complete, you will not need to install the software in the Samsung Q1, or calibrate the microphone to the unit. All the software options you purchased will have already be installed and your unit will have been calibrated and tested. However, if you purchased just IE-45 IM Input Module, you will need to do some preliminary work before you can begin using your analyzer. You are probably already familiar with installing software on a Windows® XP computer, so the following information will simply confirm what you already know.

IE-45 Input Module (IE-45 IM)

If you purchased the IE-45 IM with the software packages of your choice, you will need to install the software packages into the computer you wish to use. It must be a Windows® XP machine. The software packages must be "enabled" before they will run. This enabling authorization is stored in the IE-45 IM. The IE-45 IM will be shipped to you with each software package you have purchased already enabled. If you purchase additional software later, it will need to be enabled. Included with the software packages is a small software program entitled "Ivive Register." You must have your computer connected to the IE-45 IM via a proper USB cable to successfully run "Ivive Register." This little program will interrogate the IE-45 IM and generate a number on your computer screen. That number can be emailed to Ivive (a phone call will work as well). From that number, Ivive can generate a second number which you must enter into the "Ivive Register" program to activate the software package. This procedure must be followed for each additional software package you purchase.

Important Note: *The software package you purchased will be "married" to your specific IE-45 IM. It will not run unless it detects the presence of your IE-45 IM. However, the software will run on any Windows XP computer that is properly connected to your IE-45 IM.*

Beginning to Use the IE-45

As shown in the illustrations across the page, firing up an IE-45 is simple. After making sure the USB cable is properly attached between the IE-45 IM and the Samsung® Q1, (or the computer of your choice), plug in the microphone. Turn on the Q1 using the power slide switch. Slide it to the right, hold it for a moment, then release it. Using the stylus, select IE-45 from the menu to begin running the software. Next, select the function you wish to use and you're off and running.

Microphone Calibration

Whether you purchased the IE-45 complete, or just the IE-45 IM, the microphone - or microphones, if you purchase more than one - will have already been calibrated to the unit before it left the factory. The calibration information resides in the IE-45 IM. If you purchase another microphone later, you will need to calibrate that microphone. For the calibration procedure, consult Appendix I of this manual titled "IE-45 Mic Calibration."

The supplied microphone for the IE-45 is chrome plated in color. The gold colored microphone of the IE-35 and the silver colored (clear anodized aluminum) microphone of the IE-33 will not work with the IE-45, even though they will plug into the IE-45 IM. The IE-45 uses a higher "phantom" voltage at the microphone input, which will permanently damage an IE-33 or IE-35 microphone. The chrome colored IE-45 microphone is a Type II, electret microphone. Other microphones may be successfully used with the IE-45. Obviously, whenever a new or different microphone is used, your unit will need to be recalibrated. The IE-45 is capable of storing microphone calibrations for up to six different microphones. When a different microphone is used, it's stored calibration adjustment can simply be selected without having to go through a calibration procedure all over again.

These instrumentation grade microphones are sensitive instruments and should be carefully handled to avoid damage.

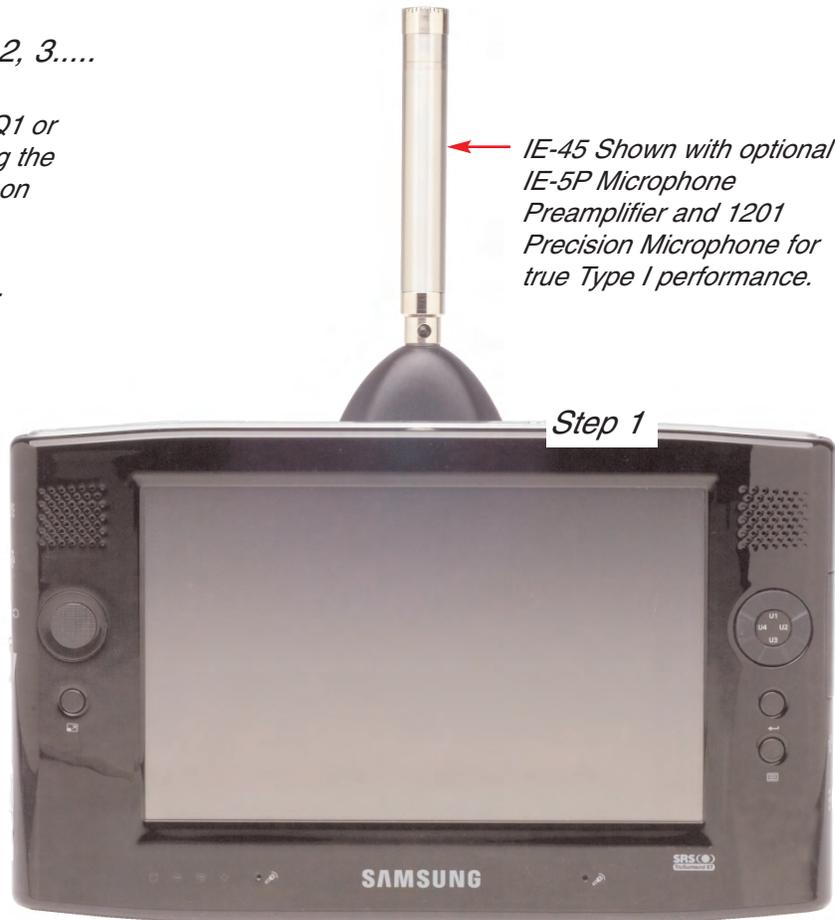
Getting started is as easy as 1, 2, 3.....

Step 1: Connect the IE-45 IM to the Q1 or computer of your choice using the supplied USB cable and turn on the computer.

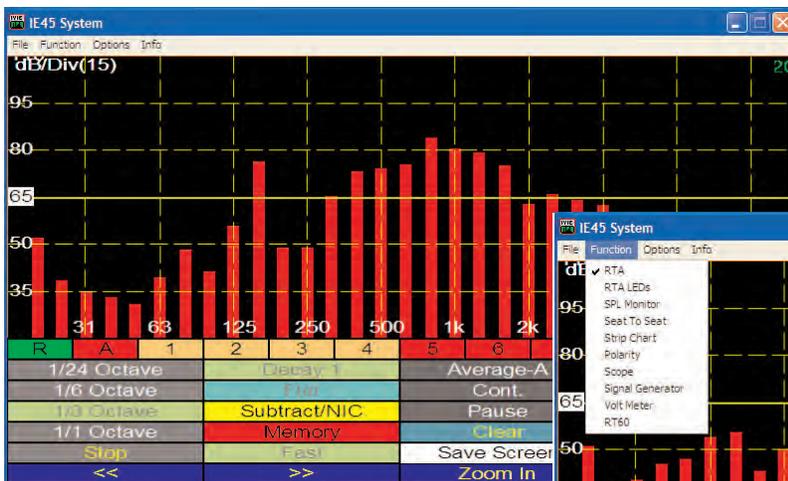
Step 2: Open the IE-45 RTA program.

Step 3: Tap the "Functions" pull-down menu and select the function you wish to use.

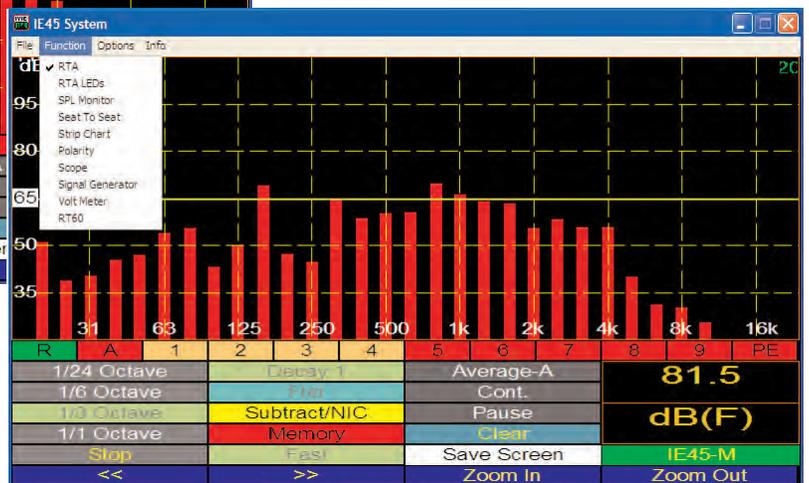
← IE-45 Shown with optional IE-5P Microphone Preamplifier and 1201 Precision Microphone for true Type I performance.



Step 2



Step 3



You're off and running!

Real Time Analyzer Controls

Stylus Buttons: The IE-45 is several instruments in the same package: Real Time Analyzer, Sound Level Meter, Signal Generator, Oscilloscope etc. One of their most powerful functions is Real Time Analyzer (RTA). To make operation simple and intuitive, the most often used controls for the RTA are labeled stylus buttons. The illustration across the page shows the stylus buttons associated with the RTA. Displays of octave, one third octave, one sixth octave and one twenty-fourth octave are selectable as shown.

To set the level at the center of the screen (dB Level) and to adjust the dynamic range of the screen (dB per Division), tap the "Display" menu. Next, from the pull-down menu, select "Set dB Scale." The window shown on the IE-45 at the bottom of the opposite page shows this feature. The other functions of the pull-down menus are covered in detail in other sections of this manual.

Decay: Display speed (averaging time) is controlled by the stylus button titled "Decay." Decay 1 is the fastest response time available, with Decay 2 somewhat slower and Decay 3 being the slowest. Decay 3 is intended for use with pink noise.

Start/Stop Stylus Button: This button stops (freezes) the RTA and SPL displays and starts them again when tapped a second time.

RTA Display On/Off: The RTA display can be turned on or off using the stylus button illustrated across the page. Green button indicates "On," and brown button indicates "Off."

Average Display On/Off: The Average display (when the Average function is active) can be turned on or off using the stylus button. Green button indicates "On," and brown button indicates "Off." A red button indicates the Average function is not active.

Memory Stylus Buttons: The IE-45 has 9 "scratch" memories (see the "Memory" section of this manual for more information on memory and data storage). To store data in a scratch memory, tap the numbered stylus button. A "snapshot" will be stored. If you are in the Average mode, the average curve will be stored. When a memory is empty, its stylus button is red. Memories with data in them have green stylus buttons when being displayed and brown when not being displayed. The last memory stored or activated for display always has a blue stylus button. Several memories can be displayed simultaneously and each will have its own color on the display so it can be differentiated.

Preferred Curve: The last stylus button in the row of memory status buttons is the memory status button for "Preferred Curve." This is a very powerful function and its use is covered extensively in the section of this manual titled "RTA-Preferred Curve, Display Weighting, LED Display."

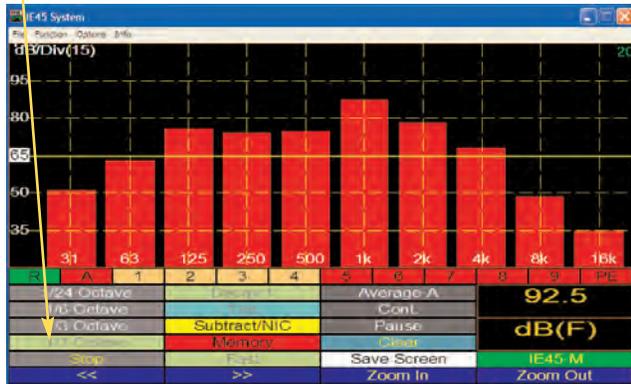
SPL Readout Stylus Button: Tapping the SPL readout area will cause the analyzer to step through its electrical measurement modes. This is very useful for looking at voltage levels simultaneously with spectral content. Obviously, this feature should be used when measuring electrical signal, not acoustic signals through the mic.

Q1 Buttons: The IE-45 makes use of some of the buttons found on the front of the Q1. Their use is defined as shown across the page. The "joystick" up/down function can be used to quickly adjust the display to bring the signal to the center of the screen. Either the stylus "Zoom In" and "Zoom Out" buttons, or the two push buttons on the right of the Q1 can be used to adjust screen resolution.

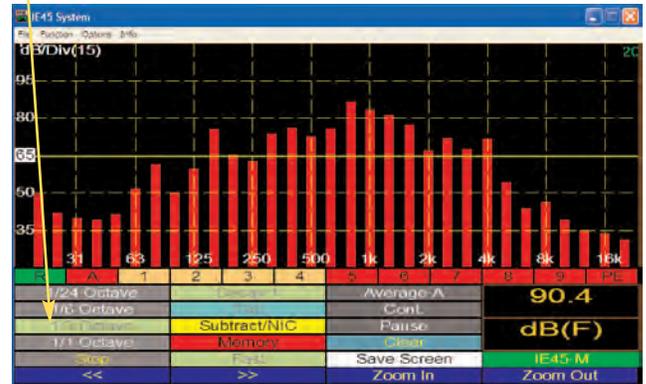
Pull-down Menus: Additionally, pull-down menus provide more features and selection capability. Tapping the "Function" menu at the top of the screen with the stylus allows the selection of the RTA function. The various displays of the RTA function are shown in the illustration across the page. Below RTA in the Function menu is "RTA LEDs." Selecting this function will provide a display that looks like an LED bar graph that many are so familiar with. The advantage of this display is that the screen resolution can be adjusted so each LED represents 1dB, 2dB or 3dB. These increments are very useful when equalizing a sound system.

The RTA can display four different resolutions over its 20 Hz to 20 kHz bandwidth: 1/1 octave, 1/3 octave, 1/6 octave and 1/12 octave. When a memory is stored, all four resolutions are stored. This allows a recalled memory to be viewed or printed in any resolution the user desires.

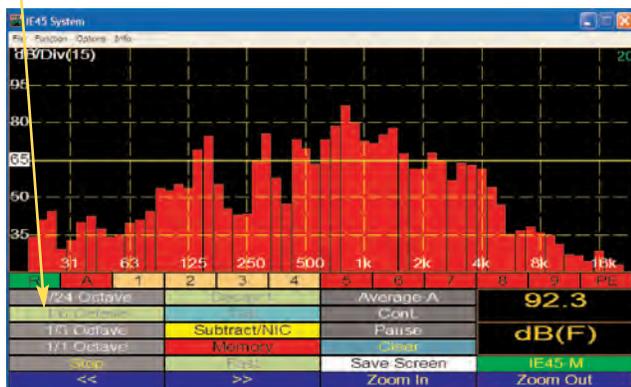
1/1 Octave



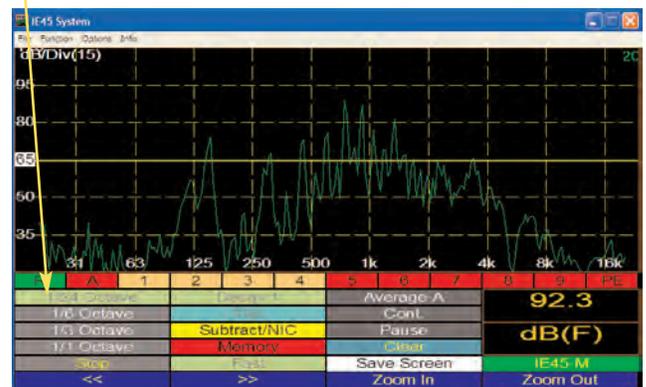
1/3 Octave



1/6 Octave

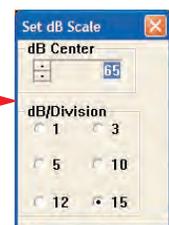


1/12 Octave



RTA & SPL Meter Controls

To set dB Center and dB per Division, tap "Options" Pull-Down Menu and select "Set dB Scale."



Preferred Curve Overlay

The Preferred Curve overlay is an IE-45 feature that allows the user to create a target overlay which can be displayed on the screen. This can be a valuable aid to the equalization process. Users often use a target curve to contour the frequency response of a system to a desired result.

Creating a Preferred Curve: The preferred, or target curve, is nothing more than a line created by the user that is overlaid on the screen to help visualize a desired result. To create a Preferred Curve, tap the PE memory stylus button to the far right of the row of memory stylus buttons. The background on the PE button will change to white, and the RTA display will move to a special 1/3 octave display with all bars touching the center reference line. Use the "joystick" button to move the blue 1/3 octave bar right or left to a 1/3 octave you wish to change, or tap the desired 1/3 octave bar with the stylus. Use the joystick up/down to change the level of the 1/3 octave. Move to the next 1/3 octave and change that level, and so on. You can create a roll-off target curve or other special spectra targets in this way.

Tap the Preferred Curve stylus button again and the background will turn green, the button text will change to PT (preferred target), and the preferred target curve overlay will appear on-screen. Tap the button again and the background will change to buff while the target curve is removed from the display. Tap the button again and it changes to white as the Preferred Curve entry screen again appears so further editing, if desired, can be done. Tap the button one more time and it turns green while the Preferred Curve is displayed.

Saving a Preferred Curve: The Preferred Curve you have created can be saved to the analyzer memory very easily. You can save several Preferred Curves and call them back from memory as needed. To save a Preferred Curve, tap the main screen Memory button, which will bring up the Memory Management screen. Note that the default name of the Preferred Curve is "Preferred.ivv." Tap the "Store" button immediately to the right of the file name and you will see a dialog box that allows you to change the name of the file to something more descriptive (you can also change the file storage location if you wish). When finished editing, tap "OK" to store the curve.

Loading a Preferred Curve from Memory: To load a previously stored Preferred Curve from memory, simply tap the main screen Memory stylus button to bring up the Memory Management screen. Memory slot # 9 is used for storing and recalling Preferred Curves. Tap the button labeled "Load" for the Preferred Curve memory location and you will see a dialog that allows you to select the desired preferred curve. Tap "OK" and the curve will be loaded into the Preferred Curve memory location. The IE-45 comes with one pre-loaded Preferred Curve, labeled "Preferred.ivv" that can be loaded into the display. It is a high end roll-off curve used as a target for large venue sound system EQ.

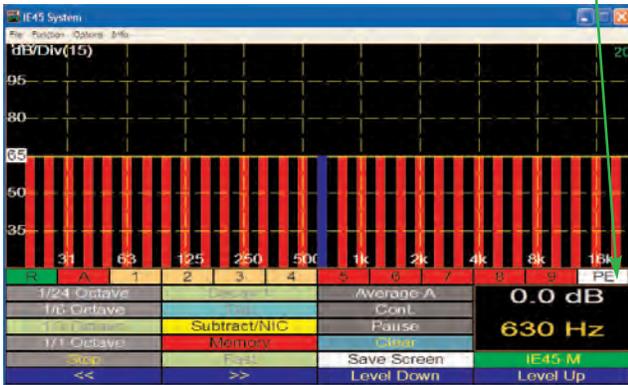
LED Display: Many users are familiar with the LED display of Ivive's IE-30A analyzer. To have the IE-45 emulate the IE-30's LED display, tap the "Function" pull-down menu at the bottom of the main screen and choose "RTA LEDs." The RTA display changes to "LEDs." **Tip:** The LED display can be useful in interpreting amplitude information on the analyzer screen. By setting the dB scale to 5 dB/division each LED represents one dB of amplitude. By setting 10 dB/division each LED represents 2 dB of amplitude, and by setting 15 dB/division, each LED represents 3 dB of amplitude change.

SPL Weighting and the RTA Display: Some users prefer to see the normal weighting filters that are applied to SPL measurements also applied to the visual spectrum of the on-screen RTA. The IE-45 allows you to choose whether or not the RTA display will show an unweighted display or a weighted display. To apply weighting filters to the RTA display, tap on the "Options" pull-down menu at the bottom of the screen and select "RTA Weighting." Whatever weighting filter is selected for the SPL meter when in RTA mode (the SPL meter is in the small windows in the lower right of the screen) will then be applied to the RTA display. Unchecking (by again tapping) this selection will remove weighting from the RTA display.

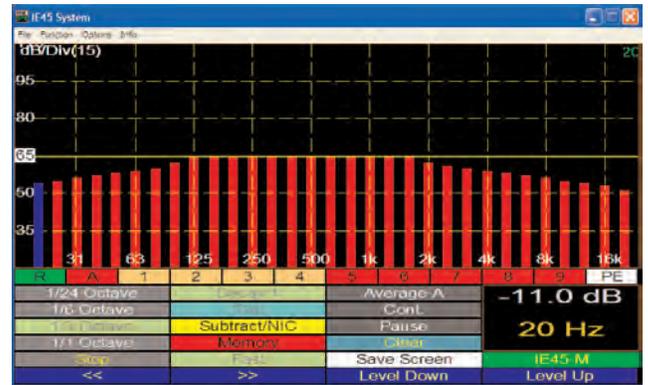
Entering a Preferred Curve Overlay

The Preferred Curve Overlay is a valuable aid in the equalization process. It is the electronic equivalent of drawing a Preferred Curve on the RTA screen with a grease pencil. The Preferred Curve provides you with an on-screen target curve for equalization.

Step 1: To enter a Preferred Curve, tap the red PE (Preferred Entry) stylus button. The Preferred Curve Entry screen will appear:



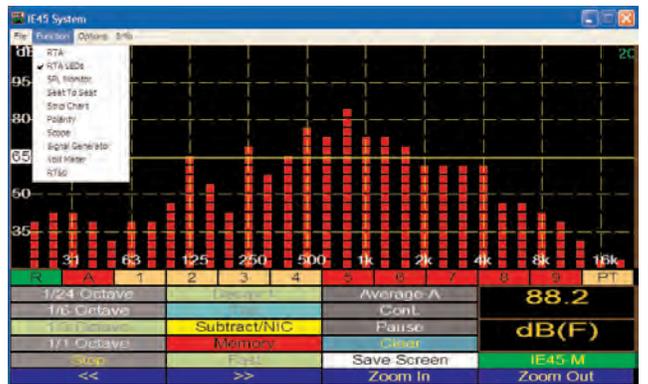
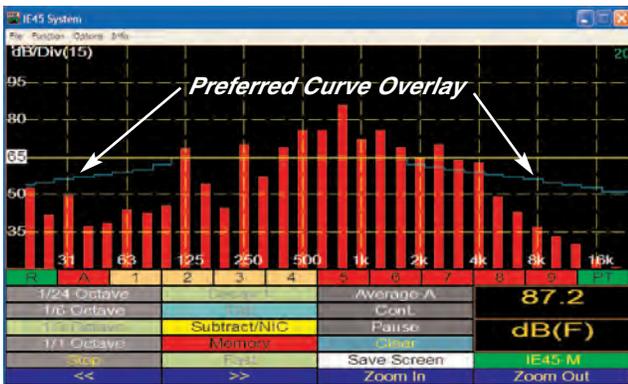
Step 2: Use the Joystick Left/Right, or the stylus to select frequency (blue bar) and the Joystick Up/Down to set amplitude until the curve entry is complete.



Step 3: Tap the "PT" Button to display the Preferred Curve Overlay. To turn off the Preferred Curve Overlay, tap the green PT Button. To edit the curve, tap the buff colored PT button. Tapping the white PT Button will again display the edited Preferred Curve.

RTA LED Display

The RTA Display can be set to an LED style display using the Function Menu. In this mode, 5 dB/Div = 1 dB/LED, 10 dB/Div = 2 dB/LED and 15 dB/Div = 3 dB/LED.



Applying "A" or "C" SPL Weightings to the RTA Display (Using the "Options" Pull-Down Menu)



Peak Hold Curves

The IE-45 will display peak information in addition to real time information in all of the display modes, 1/1 octave through 1/12 octave. The peak curve is shown in violet for the 1/1 octave, 1/3 octave and 1/6 octave displays, and in white for the 1/12 octave display screen, as shown in the illustration across the page. The peak curve data represents the highest levels that have been reached across the spectrum. In addition to peak data, real time information is also displayed.

To activate the Peak Hold function and display the peak hold curve, tap the "Options" pull-down menu and select "Peak/Hold Curve." You can toggle through the various display formats (1/1 octave to 1/3 octave, etc.) while the Peak Hold function is active. However, when selecting different display formats, the peak hold information will not be preserved from display to display. Instead, it will initialize and begin again as though it had just been activated. To turn the Peak Hold function off, select "Peak/Hold Curve" again. **Note:** If you store spectral data in a scratch memory when the Peak Hold function is activated, real time data, not the peak curve, will be stored.

Frequency and Amplitude Detection

Several different modes of frequency and amplitude detection are provided by the IE-45. All of them, including the Frequency Detect indicator, operate in all resolution settings, 1/1 octave, 1/3 octave, 1/6 octave and 1/12 octave.

For real time data, a frequency detect cursor can be activated which constantly searches the spectra and displays the frequency of the highest level found in the spectrum. Real time data, or peak hold data, can also be frozen using the "Stop" stylus button, and then be interrogated for frequency information using a provided cursor, as demonstrated in the illustration across the page. The cursor can be moved using the stylus or the joy stick. Additionally, any recalled and displayed memory can be interrogated for frequency information in the same manner.

Frequency Detect: To activate the Frequency Detect mode (especially useful when searching for feedback frequencies), tap the "Options" pull-down menu and select "Freq. Detect." The Frequency Detect indicator will appear on screen and begin to search for and identify the frequency registering the highest level. To turn off the Frequency Detect indicator, select "Freq. Detect" again.

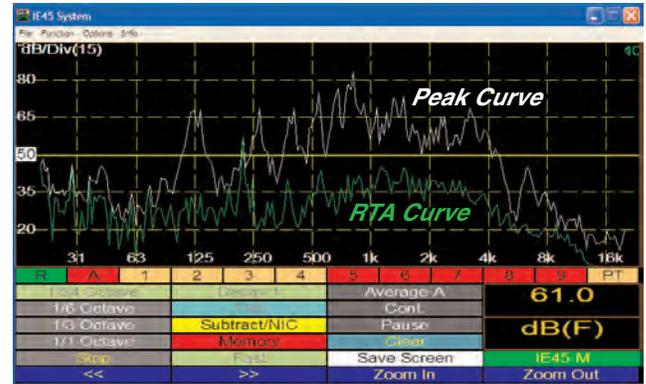
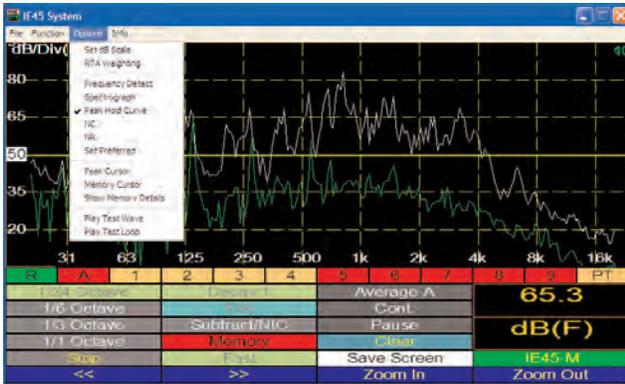
RTA Cursor: To activate the RTA Cursor, first tap the stylus button on the bottom left labeled "Stop." This will "freeze" the RTA display and the bar below the SPL readout will change from green to red. Next, press the left or right joystick. The frequency cursor (a red + in 1/12 octave or a green bar in 1/1 octave, 1/3 octave or 1/6 octave) will appear on the curve. The cursor can be moved left or right using the left and right controls of the joy-stick, or by using the stylus to tap, and thereby select, a new position. As the cursor moves, frequency and amplitude will be indicated in the SPL readout window and all areas of interest can be interrogated. To turn off the RTA Frequency Cursor, tap the "Start" stylus button to return the analyzer to its real time display.

Peak Cursor: When the "Peak Hold Curve" is being displayed, peak hold data can be interrogated using the Peak Cursor. To accomplish this, first, turn on the Peak Hold Curve by selecting it from the "Options" pull-down menu. Next, tap the "Stop" stylus button. When the display has been stopped, select "Peak Cursor" from the "Options" menu. The joystick, or stylus, can then be used to move left or right along the spectrum to interrogate the Peak Curve for frequency and amplitude information. Selecting "Peak Curve" again turns off this function.

Memory Cursor: This function works identically to the Peak Cursor. To activate the Memory Cursor, tap a memory stylus button to recall the memory of interest. With the memory display on the IE-45 screen, tap the "Options" pull-down menu and select "Memory Cursor." The Memory Cursor will appear on the curve. The cursor can be moved left or right along the curve by using the left and right controls of the joystick, or the stylus. As it moves, frequency and amplitude will be indicated. To turn off the Memory Cursor, select "Memory Cursor" from the "Options" menu again.

Displaying the Peak Hold Curve

To display the Peak Hold Curve, use the "Options" pull-down menu and select "Peak Hold Curve." The Peak Hold Curve will be displayed in white for the 1/12 octave display, or in pink for the 1/1 octave, 1/3 octave and 1/6 octave displays.



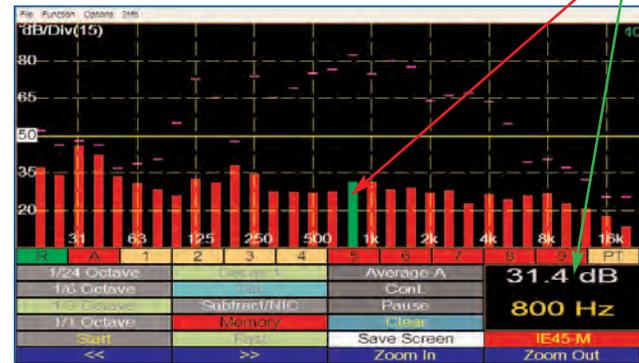
Frequency Detect

Frequency Detect has been turned on (using the "Options" Pull-down menu) for this 1/12 octave display. The frequency with the highest amplitude will be indicated.



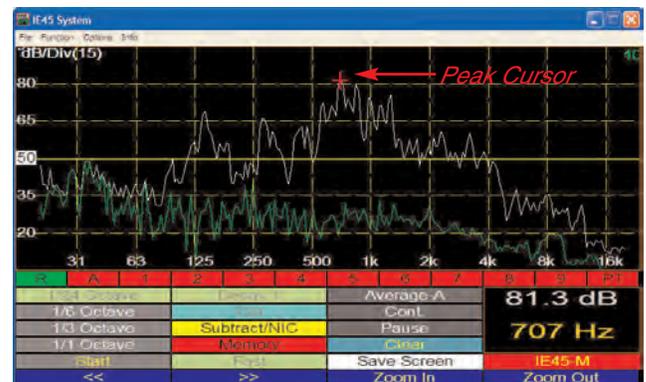
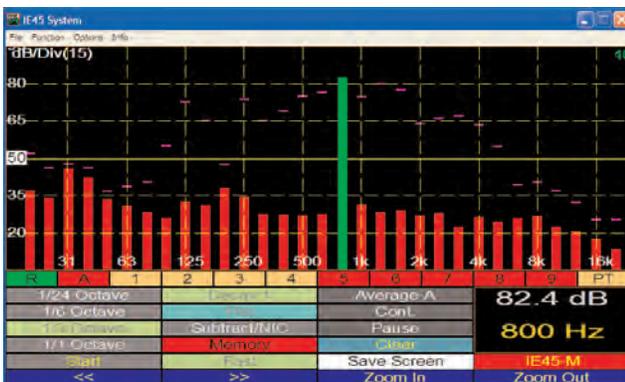
RTA Cursor

Tapping the Start/Stop cursor button will "freeze" the RTA display. The "Joystick" or stylus can be used to select a band whose frequency and amplitude will be displayed.



Peak Cursor

With the RTA Display "Stopped" and the Peak Hold Curve function turned on, the Peak Cursor can be turned on using the "Options" pull-down menu. It will interrogate the peak curve in the same manner that the RTA Cursor interrogates the RTA Curve. The Peak Cursor is a green bar for the 1/1, 1/3 and 1/6 octave displays and a red + for the 1/12 octave display.



Memory Functions

The IE-45 memory system provides all the tools necessary to save various types of files to memory, rename files, load files from memory, examine memory data, and subtract one curve from another. Most memory system operations are performed using the memory stylus buttons and the memory management screen.

Memory Control Buttons: The memory stylus buttons are located immediately below the RTA display screen. The row of twelve buttons allows both control of what is viewed on-screen, and the ability to store data in "scratch memories." The far left "R" button toggles "on" or "off" the real time display. The "A" stylus button controls the display of the Average curve. Stylus buttons 1 - 9 alternately store, remove from display, and restore to display the contents of the nine Scratch memories. The "PE" stylus button controls "Preferred" or "Target Curve" functions.

Stylus Button Colors: If a stylus button is red, there is nothing stored in the memory or display location associated with the button. If the button is green, there is data present and it is being displayed. Blue is identical to green, that is, there is data present and it is being displayed. However, blue also indicates that this is the last memory location to be manipulated. This blue color is very useful in keeping memories straight, especially when several memories have data stored in them. Finally, if a button is buff colored, there is data stored in that memory location, but not displayed on-screen (tapping a buff stylus button will display the data associated with that button and change the button color to blue).

Scratch Memories: Scratch memories are "scratch pad-type" storage memories where you can temporarily store curve data until you decide to rename and store the data permanently. You can store the RTA data you are observing to a scratch memory by tapping a scratch memory stylus button. Regardless of the resolution setting of IE-45, tapping a scratch memory stylus button saves all resolutions, 1/1 octave, 1/3 octave, 1/6 octave and 1/12, into scratch memory.

Memory Management: Tap the "Memory" stylus button to access the memory management screen. The memory management screen allows you to store, load, and clear files from scratch memories, Preferred Curve memory, subtraction memory, and peak memory. Select a memory location you wish to store and tap the adjacent "Store" button. You will be prompted to provide a more descriptive name for the file you are about to store. You can also change the location to which the file will be stored, if you wish. Tap "OK" and the contents of the scratch memory will be stored under the name and in the location of your choice. To clear a scratch memory with or without storing it, tap the adjacent "Clear" button. A stored curve data file may be loaded into a scratch memory location by tapping the "Load" button, selecting the file to be loaded, and tapping on the file name. Stored Peak and Subtraction data files may also be loaded into scratch memories.

Subtract Feature: The IE-45 provides a powerful function which allows the user to subtract one curve from another. A stored scratch memory curve can be subtracted from the real time display, or one scratch memory curve can be subtracted from another, or from an Average curve. Tap the "Subtract" stylus button to access the subtract control screen. From here, choose which spectrum you wish to subtract from another. Upon tapping "S1 - S2," the RTA display returns with a "0" center reference and blue RTA bars. You are viewing the one spectrum subtracted from the other. To return to normal RTA, tap the Subtract stylus button, then "Cancel."

Peak Storage: When displaying the "Peak Hold" curve in the RTA, you can open the Memory Manager and tap "Store Peak" to store this peak information in the peak spectrum scratch area. From here you can rename it and store it permanently. Stored peak curve data can be loaded into any of the nine scratch memories via the Memory Manager. Just select a scratch memory and tap "Load." Next, select the peak memory to be loaded.

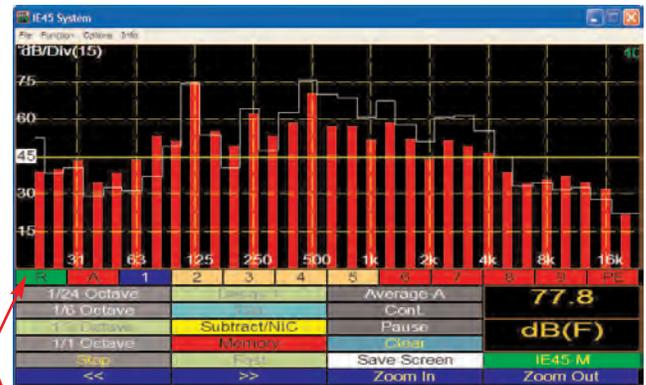
Memory Files: Data stored in files can be moved to a PC using the standard Microsoft protocol from transferring data between PC's. The analyzer always stores in all resolutions, 1/1 octave, 1/3 octave, 1/6 octave and 1/12 octave regardless of the resolution setting of the IE-45 when the memory was stored. Using Ivive's supplied "IviveXLS-45" software, you can display, manipulate, and print data.

Store a Curve to Memory

To store a curve to memory, tap an empty (red in color) Scratch Memory stylus button (1-9). The memory curve will appear on screen and the stylus button will turn blue, indicating that it contains data and is displaying it.

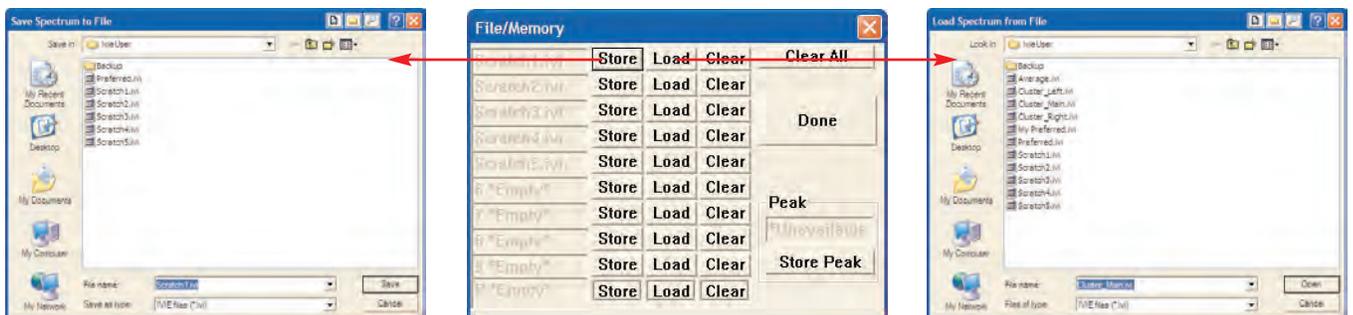
If you do not to display the curve, tap the button again. The curve will vanish from the screen and the button will turn buff in color indicating there is data in the memory, but not displayed. Both green and blue mean the data is being displayed, but blue indicates it was the last memory to be activated. There can be several green and/or buff buttons, but there can be only one blue one - the last one activated.

To store a Scratch memory to main memory, tap the "Memory" stylus button to activate the memory management window.



From left to right, the row of memory and display associated stylus buttons mean: R = Green; RTA display active. A = Red; Average display not on. 1 = Blue; data in memory being displayed. 2 - 5 = Buff; data in memory, but not displayed. 6 - 9 = Red; memories empty. PE = Red; no data in Preferred Curve Entry memory.

Storing a Scratch Memory to Main Memory and Loading Data from Main Memory to Scratch Memory



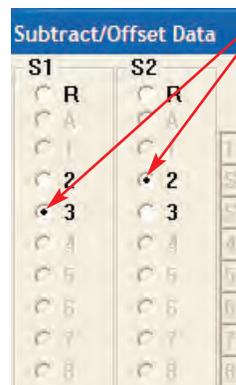
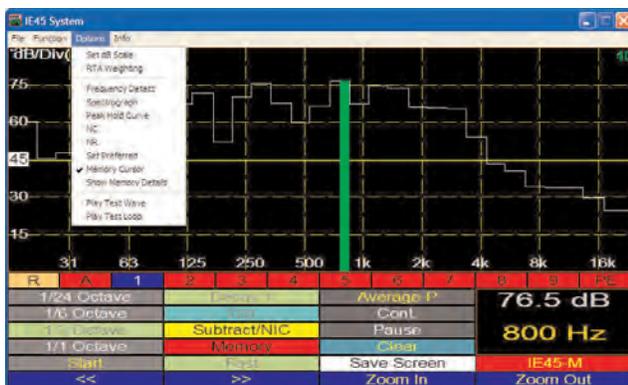
Tapping the red colored "Memory" stylus button brings up the main "Memory Management" window in the center above. From this window, memories can be cleared, stored or loaded. Tapping "Store" brings up the window on the left that allows the storing and naming of memories. Tapping "Load" brings up the window on the right that allows loading memory files from the main memory into the various memory locations such as Scratch memory, Preferred Curve memory or Average memory.

Memory Cursor

To use the Memory Cursor, use the "Options" menu and select Memory Cursor. Next, tap the "Stop" stylus button to "freeze" the RTA display. Use the stylus or the Left/Right Joystick to select the frequency of interest.

Subtract One Memory from Another and Display Result

To subtract one memory from another and display the result, first tap the yellow "Subtract" stylus button to bring up the subtract window. Select the two memories for comparison and tap "Subtract." The "difference" will be displayed in blue.



1. Select memories for comparison.
2. Tap "Subtract." The blue display would be "flat" at the 0 dB center line if the memories were identical.
3. To exit, tap "Subtract" > "Cancel."



NIC Measurements

Sound transmission field testing of operable walls and field partitions is almost exclusively done using ASTM E336 as the standard. The IE-45 is capable of making Noise Isolation Class (NIC) measurements. NIC measurements are normally specified rather than Field Sound Transmission Class (F)STC measurements because they are faster, easier, and therefore, less expensive to make. Field Sound Transmission Class ((F)STC) measurements require RT60 information for the calculation, as well as receiving room absorption in all sixteen 1/3 octave bands of interest. The IE-45 is capable of making RT60 measurements (if the optional RT60 software module is purchased) as well as measuring receiving room absorption in the required sixteen 1/3 octave bands. However, since RT60 measurement capability is an option, not a standard feature, Ivie has chosen not to integrate (F)STC measurement capability into the IE-45 measurement suite. The following instructions are therefore limited to the theory of NIC measurements and making NIC measurements.

NIC is a single-number acoustical rating of sound isolation between two different spaces separated by a sound barrier. A typical measurement example would be determining the sound isolation provided by a wall or movable partition separating two rooms. To make the measurement, an omni-directional sound source would be placed in the Source Room to energize it with pink noise. Averaged (power averaged), 1/3 octave RTA spectrum measurements would then be made on both sides of the wall (Source Room and Receiving Room) and each room average would be stored to separate memory locations. The NIC calculation would begin as the stored spectrum of the Receiving Room is subtracted from the stored spectrum of the Source Room to create a Transmission Loss (TL) curve.

The NIC rating would then be determined by comparing and shifting the TL curve relative to the standard NIC contour such that the TL curve is never more than 8 dB below the NIC contour in any 1/3 octave band; and the sum of the deficiencies below the contour over the 16, 1/3 bands, does not exceed 32 dB. Once the TL curve is shifted to meet these criteria, the NIC rating is determined by the value of the NIC contour at 500 Hz. Once the Source Room and Receiving Room curves are stored, the curve fitting and NIC calculation are all done automatically by the IE-45. Only a few taps of the stylus are required to complete the measurement and display the results.

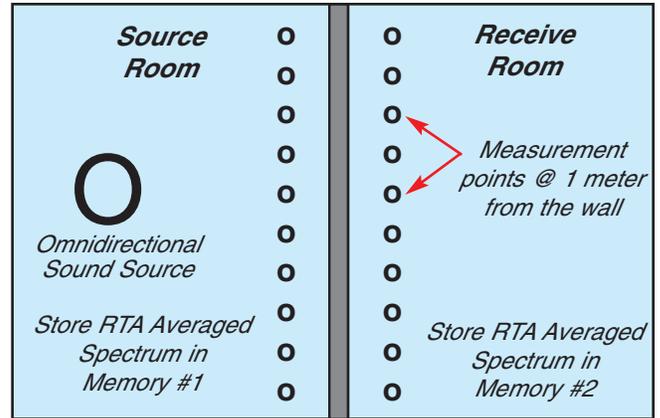
*The step-by-step process for making an NIC measurement is demonstrated by the illustrations on the opposite page. **Note:** Of particular interest in NIC measurements is the requirement for power averaged data. The IE-45 "default" operating mode is "Arithmetic Average," so "Power Average" will need to be selected.*

Real Time NIC Measurements

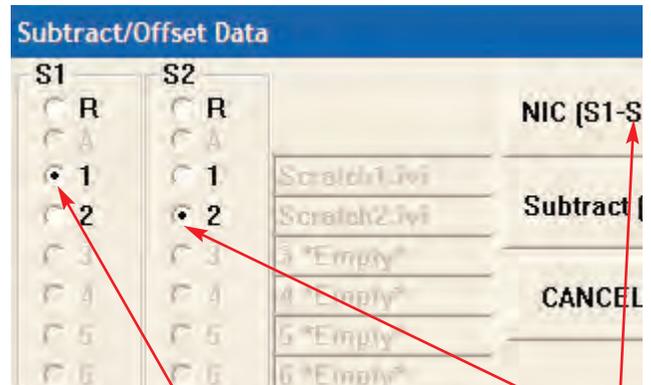
This is a very useful diagnostic tool offering, unique to Ivie instrumentation. This mode allows the user to compare the stored average curve in the Source Room to real time data in the Receive Room, thus providing a running calculation of NIC in real time. While in the Receive Room, the microphone can be moved to any position around the sound barrier to find "sound leaks", weak isolation areas, strong isolation spots, etc. Because the NIC curve and calculated number are continuously updated in real time, it is easy to quickly compare different areas, thereby determining deficiencies relative to location.

Making an NIC Measurement

- Step 1.** Select RTA from the Function pull-down menu.
- Step 2.** Make sure the Average mode is set to power average (Average-P).
- Step 3.** Turn on the sound source in the Source Room. With the RTA in Average mode, take several sets of samples along the wall (use the Pause/Resume button) at a distance of 1 meter. End by tapping Pause.
- Step 4.** Store the Average to Memory #1. Press the Count= button to clear the Average accumulator.
- Step 5.** Go to the Receive Room and, from a distance of 1 meter from the wall, gather averaged samples as in the Source Room.
- Step 6.** Store the Average you have gathered in Memory #2. Press the Count= button to exit the Average Mode.
- Step 7.** Press the yellow Subtract/NIC button to bring up the Subtract/NIC window.
- Step 8.** In the S1 column, select the number 1 (Memory #1). In the S2 column, select number 2 (Memory #2). Next, tap the NIC (S1-S2) button. The NIC contour will be displayed and the NIC number will be shown in the SPL window.
- Step 9.** To exit this measurement display window, tap the NIC (S1-S2) button again, then tap the Cancel button.



For NIC measurements, store the Source Room curve in Memory #1, and the Receive Room curve in Memory #2. Next, tap the yellow Subtract/NIC stylus button.



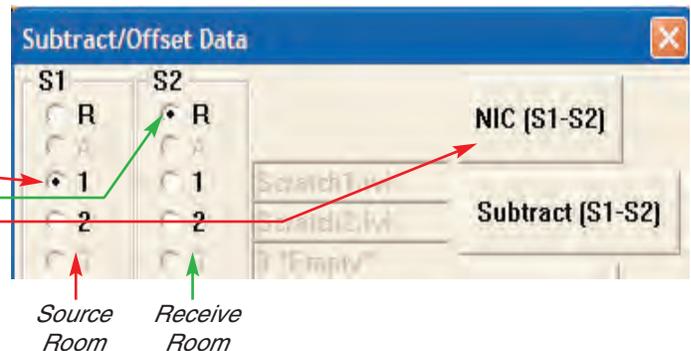
Select Memory #1 from the S1 column and Memory #2 from the S2 column. Next, press the NIC (S1-S2) button.

Real Time NIC, or "Sniffer" Mode

The IE-45 can perform "Real Time" NIC measurements. The real time spectrum measurement in the Receive Room is subtracted from the spectrum of the Source Room stored in Memory #1. This measurement mode is unique to Ivie. You can use it as a "sniffer" to help locate leakage paths.

Making a Real Time NIC Measurement

- Step 1.** Store the Average curve from the Source Room in Memory #1.
- Step 2.** Tap the Subtract/NIC stylus button.
- Step 3.** Select Memory #1 from the S1 column. Select "R" (Real Time) from the S2 column.
- Step 4.** Tap the NIC (S1-S2) stylus button.
- Step 5.** With the IE-45 in this mode, move along the wall searching for sound leakage points. You can get closer to the wall in this mode, to help pinpoint problem areas exactly.



Average Mode

The IE-45 Average Mode offers very powerful features that allow you to create continuous or triggered averages of various types, as well as select the type of average that best suits your measurement.

Continuous Average Mode

In the RTA mode, tap on the "Average-A" stylus button. The default condition for the stylus button below the Average button is "Cont.", which indicates that you will be starting with a continuous average. When you tap the Average-A button, the button text changes to "Count = X," where "X" is the number of samples so far collected. You will see the sample number increment as the number of automatically collected data samples increases.

A blue line will immediately form on the RTA screen, which is the graphic representation of the average that is being collected. The more samples collected, the slower this average display will change as short duration acoustic events are encountered.

In Continuous Mode, the data sample collection can be paused by tapping Pause/Resume stylus button. Tapping the stylus button again continues the sample taking process.

You may switch the screen presentation between 1/1 octave, 1/3 octave, 1/6 octave and 1/12 octave at any time during an Average measurement. However, doing so will reset the data sample counter to zero and start the averaging process over again.

Triggered Average Mode

Tapping the "Cont." stylus button will switch it to "Trigger." In this mode, data samples for averaging are taken only when the user manually triggers a sample. Triggering a sample can be done by tapping the "Add" stylus button. Each time a data sample is added by triggering a sample, the sample count on the Average button will increment by one.

You can manually clear an Average Curve and reset the data sample counter to zero at any time by tapping the "Clear" button. To exit the Average mode tap the "Count-X" stylus button.

Average Type Selection: *The IE-45 Average Mode offers the power of two types of averaging. The Arithmetic Average (Average-A) does straight arithmetic averaging. This type of average is probably best when you are viewing the RTA screen while doing active equalization, or other dynamic, spectral adjustments. You may switch the averaging mode to "Power Average (Average-P), which is probably more useful in measurements where the total sound power is of prime importance - measurements such as transmission loss, or noise isolation. Switching from Average-A to Average-P is done by tapping the "File" pull-down menu. Select "Preferences" next, and from that menu, select either Power Average or Arithmetic Average.*

Viewing an Average Curve: *While the average is being taken, the blue average line is seen in the RTA screen. To see this line more clearly, you can temporarily remove the real-time data from the display. This is done by tapping the green "R" button immediately below the RTA display (see figure on the opposite page). **Don't forget to turn the real-time display back on when you're done . . .** It'll save you a call to Ivive Tech Support!*

Storing and Loading an Average Curve: *When an Average Curve is displayed on the RTA screen, it is what will be stored when you choose to store a curve. With this in mind, an Average Curve is stored in the same way any other spectrum is stored. Simply select an empty scratch memory location (red stylus buttons indicate empty memory locations) and tap it. The Memory Manager ("Memory" stylus button) allows the storing of any scratch memory as a file. Similarly, stored curves can be loaded into any standard scratch memory location by opening the Memory Manager and selecting "Load" for any of the scratch memory locations.*

Average Mode

The Average Mode of the IE-45 allows taking samples one at a time, or continuously, as desired. The IE-45 also provides the ability to do an arithmetic average, or a power average. To begin an Average measurement, tap the "Average" stylus button.

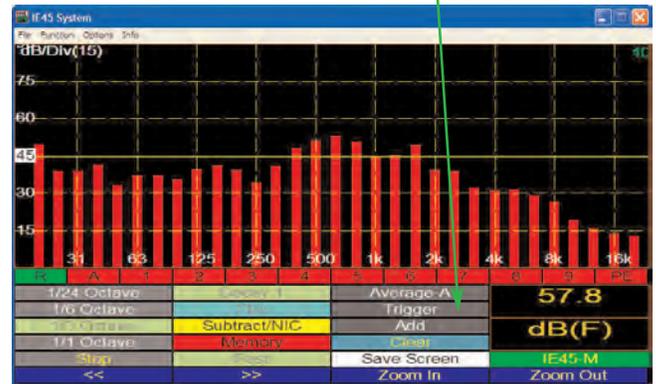
Note: The Average button will read "Average-A" if in the arithmetic average mode, or "Average-P" if in the power average mode.

The stylus button directly below the Average button allows selection of either continuous ("Cont.") or "single-shot" ("Trigger") measurements. The next button down allows a pause or resumption of measurement when in the "Continuous" mode, or adding a single "shot" to the averaging accumulator when in the "Trigger" mode.

"Continuous" Mode Selected

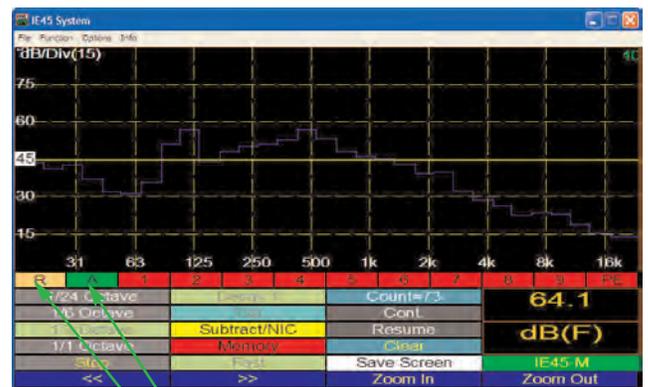
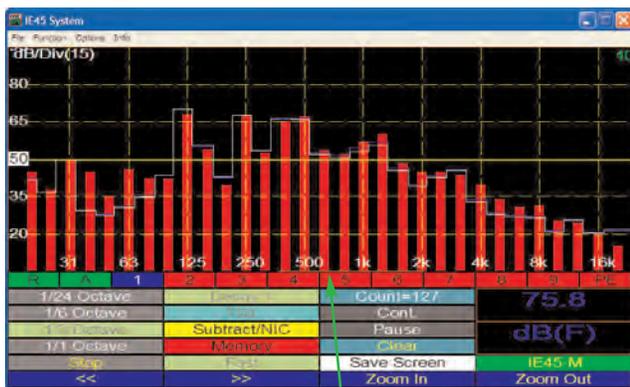
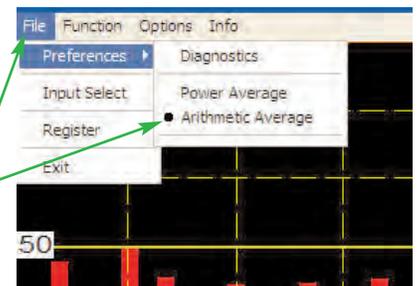


"Trigger" Mode Selected



Average Measurement Steps

- Step 1.** Select either the Continuous (Cont.) or Trigger mode for averaging. The Continuous mode will automatically take sample after sample until the "Pause/Resume" button is pressed. The Trigger mode will take only one sample each time the "Add" button is pressed.
- Step 2.** Select either Power Average or Arithmetic Average. This is done using the "File" pull-down menu > Preferences > Power or Arithmetic Average.
- Step 3.** Tap the "Average" stylus button to enter the Average mode. The "Average" will be relabeled "Count=X." "X" equals the number of samples taken and will increment with each tap of the "Add" button, if in the Trigger mode, or will automatically increase as samples are added, if in the Continuous mode. Tapping the "Pause/Resume" button will pause or restart sample taking.
- Step 4.** Store the Average Curve, if desired, as shown below.



With Average Curve displayed, tap an empty (red color) Scratch Memory to store the Average Curve.

Green = Average Display On.
Buff = Real-Time Display Off.

Spectrograph Display

An example of the Spectrograph Display is shown across the page.

To select the Spectrograph Display, the IE-45 needs to be in the RTA mode. The steps to select the Spectrograph display are: First, tap "Functions" to activate the Functions pull-down menu. Select RTA. Next, from the "Options" pull-down menu, select "Spectrograph."

The Spectrograph Display shows frequency along the X axis and time along the Y axis. At the bottom of the screen is the strip of color that shows the spectral response as it is occurring. The next strip up the screen (going back in time) is the previous measured spectral response. The strip behind it is the measurement previous to that, and so on, all the way back in time to the top of the screen.

The number of strips is controlled by the left/right paddle buttons on the Samsung® Q1 as shown across the page. Increasing the number of strips makes each strip more narrow, hence, there are more strips on the screen. The range of selection available is from 2 strips to 256 strips on the screen. The time represented by a full screen depends upon the number of strips selected. The middle of the screen thus corresponds to half the time of a full screen, and is time marked. For example, a screen marked in the center as "1.5s" would represent a full screen of 3 seconds of elapsed time between the real time measurement displayed at the bottom of the screen and the oldest measurement displayed at the top of the screen. In addition to marking elapsed time, the information at the center of the screen details the number of strips, half-screen, that have been selected. Thus, a marking of "1.5s(64) indicates a full screen of 3 seconds, a half screen (where the marking occurs) of 1.5 seconds and 128 strips of measurement data on a full screen, or 64 strips on a half-screen. Obviously, increasing the number of strips displayed increases the full-screen time represented.

Each strip is split into bands whose width depends on the display mode you have selected in RTA - 1/1 Octave, 1/3 Octave, 1/6 Octave or 1/12 Octave. So, for example, if you have selected 1/1 Octave mode, the strip has 10 bands. Amplitude in each band is represented by color. The color is red when the amplitude in that band exceeds the level indicated by the top of the screen when in standard RTA mode. The color is blue when the amplitude is lower than the level at the bottom of the screen in the RTA mode. So, for example, when in the standard RTA mode you have the scale set so that 50dB is at the bottom and 100dB is at the top, when you switch to Spectrograph, any band lower than 50dB will show blue, and anything higher than 100 will show red, with a spectrum range from blue to red in between.

You can, of course, adjust the dB limits while in Spectrograph mode by using the Options Menu and selecting "Set dB Scale." You can also use the Zoom In/Out buttons on the Samsung® Q1.

While in Spectrograph mode you can, as usual, stop the display, or start it again by using the Stop/Start, stylus button.

Spectrograph Usage

One use of the spectrograph display is to graphically capture short duration, or transient phenomena - such as cymbal crash, or the sound emitted by an impact hammer. The spectrograph display allows the exploration of spectral content of such short duration events.

Another potential application for the spectrograph display is loudspeaker testing. Feeding an impulse signal into a loudspeaker while watching the spectrograph display can help identify cabinet resonances, as well as providing other valuable information.

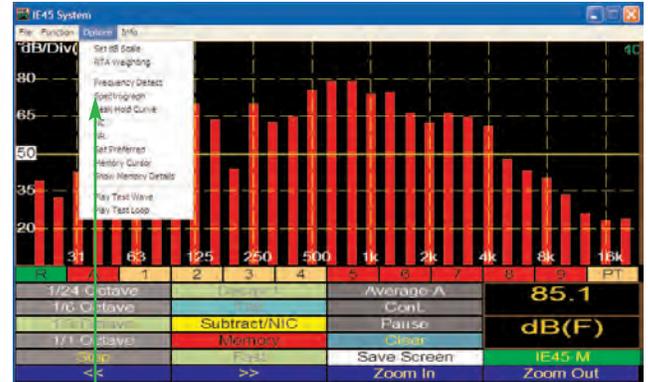
Spectrograph displays are routinely used by speech analysts.

1201 Microphone Capsule

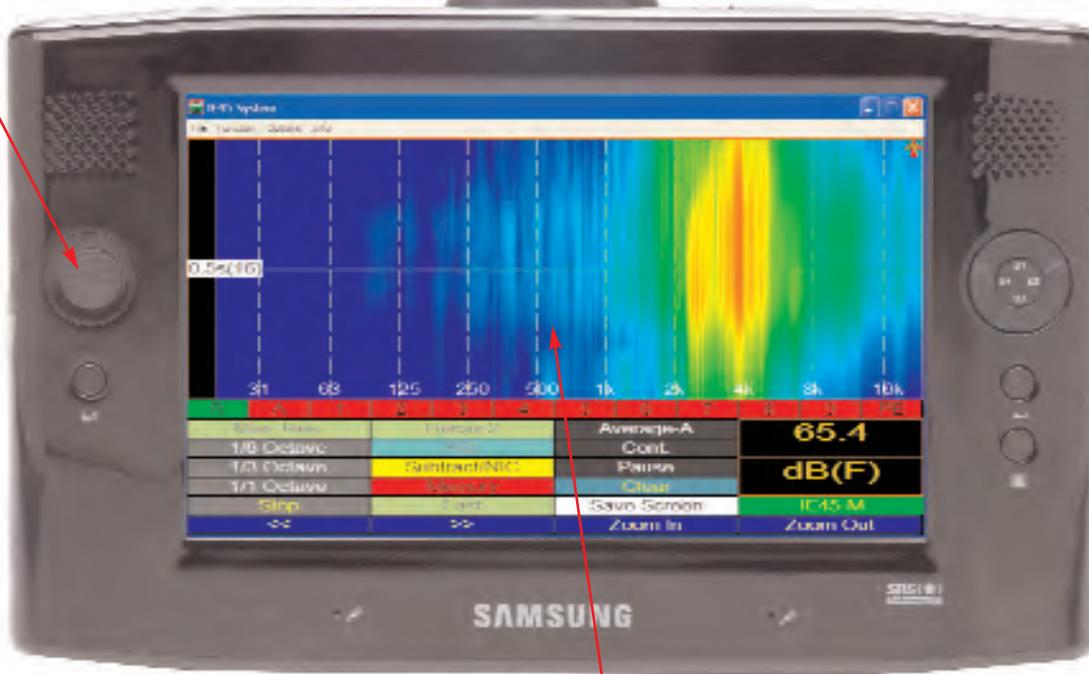
IE-5P Microphone Preamplifier

IE-45 Shown with optional IE-5P Preamplifier and 1201 microphone capsule for Type I measurement performance capability.

Left/right "Joystick" controls the number of lines displayed on screen. The more lines displayed on the screen, the greater the time represented by a full screen and the slower the screen rolls upward.



To select the Spectrograph Display, tap the "Options" Pull-down menu and then select "Spectrogram" from the menu.



IE-45 Spectrograph Display

In the example above, the spectrograph shown by the IE-45 Spectrograph Display represents an elapsed measurement time of one second. The center marker window indicates that the measurement bar of data at the center of the screen is 0.5 seconds displaced in time from the bottom of the screen (real time). It also indicates that the number of measurement bars displayed on the half-scale screen is ten (10), or twenty (20) full screen..

The display is set in the Maximum Resolution mode. The display range and scale are set using "Set dB Scale" function found in the RTA "Options" pop-up menu. Using "Set dB Scale," the selected display settings are: 60dB center scale and 5dB per division. This translates to a top-of-the-screen amplitude of 75dB and a bottom-of-the-screen amplitude of 45dB. Therefore, any amplitude equal to or below 45dB in a 1/12th octave channel is shown in blue. Any amplitude equal to or higher than 75dB in a 1/12th octave band is shown in red. Amplitudes in between 45dB and 75dB fall into the color spectrum between blue and red.

Noise Criteria (NC) and Noise Rating (NR) Measurements

The IE-45 is equipped to make quick, accurate Noise Criteria (NC) and Noise Rating (NR) measurements. NC and NR are measurement protocols which allow the consultant or contractor to quantify the ambient, or quiescent noise level of the room being measured. Many rooms that are designed by consultants are designed to an NC or an NR specification, and NC/NR measurements are designed to confirm or certify that the acoustic and mechanical designs meet the required "level of quiet."

Making an NC measurement with the IE-45, is very simple. From the RTA screen, tap on the "Options" pull-down menu at the bottom of the screen. Then tap on "NC" to activate the NC measurement screen. The RTA screen then automatically configures for NC measurements. You will note that the IE-45 switches to the one-octave display and the RTA/SPL weighting reverts to "Flat." Both of these settings are required for NC measurements. You will also notice that the "NC Overlay Contours" are shown on the screen. These lines represent the spectral contours that denote the various NC levels.

The NC contours can be "manually read" to determine the NC level. Making certain that there are no extraneous noise sources in the room (the room should be as quiet as it can be), activate the NC screen. Determine the NC line that is closest to, but not touched by, the octave RTA display bars. This line represents the NC level of the noise in the room or space being measured.

Note: *NC levels are read in 5 dB increments. For example, there is technically no such thing as an NC 47. Only NC 45 or NC 50. Many individuals, as a matter of practice, refer to NC numbers between the 5 dB levels, and this can be useful, but it is not technically correct.*

The IE-45 makes the job easier. Instead of interpreting the movement of the octave bars, you can observe the NC number which your IE-45 calculates and displays in the lower-right SPL window. This number will show the NC measured in 1 dB increments, although the "official" measurements are in 5 dB increments. To make a "correct" NC measurement using the NC numbers calculated by the IE-45, one need only round up to the nearest 5 dB increment.

Another Note: *The maximum NC number in the NC protocol is NC 65. Any level above that does not fit in the range of NC measurement. If the noise level of the space being measured is above NC 65, the calculated NC number will display "NC++".*

NR Measurements are made in exactly the same way NC measurements are made, but the NR Overlay Contours are slightly different. Neither NC nor NR is better than the other; they are just slightly differing standards. In various regions and countries, one is favored over the other. The consultant or contractor needs to be able to measure to both standards in order to meet the needs of both specifications.

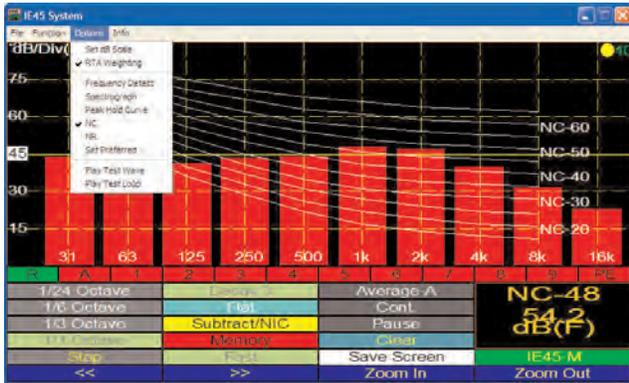
To activate the NR measurement screen, go to the "Options" pull-down menu and select "NR." From that point, the instructions for NC and NR are pretty much interchangeable.

NC & NR Averaging: *It may be useful to use an averaged octave spectrum for making NC or NR measurements. To do this, activate the NC or NR screen, then tap the Average button. Activate the Continuous Average button (see instructions for Averaging). The average function will begin taking samples and create a blue average spectrum line. When the Continuous Average function is active, NC and NR measurements are being calculated from the relationship of the average octave display (blue line) to the NC or NR Overlay Contours.*

If you switch off averaging, the calculated NC or NR number will revert to making its calculations from the real-time octave bars.

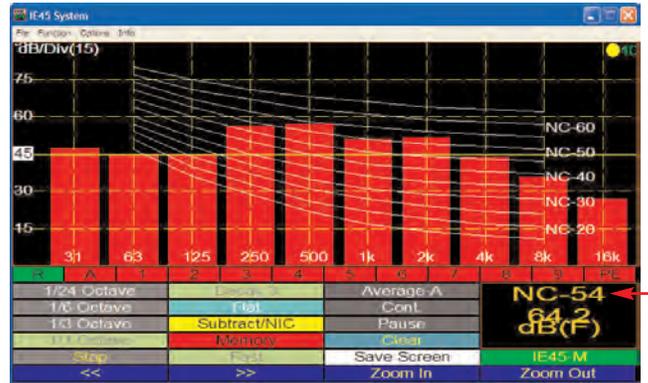
Making a Noise Criteria (NC) Measurement

Step 1. While in the RTA Function, select "NC" from the "Options" menu. This will set the RTA weighting to Octave, unweighted, and bring up the NC contour overlay.

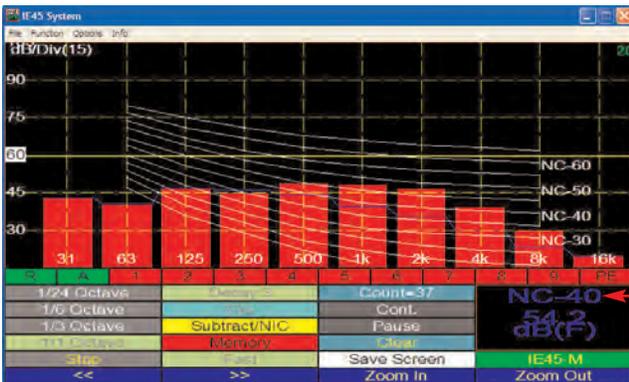


Step 2. Read the NC value in the SPL Window.

Note: An NC value over 65 will be displayed as NC++

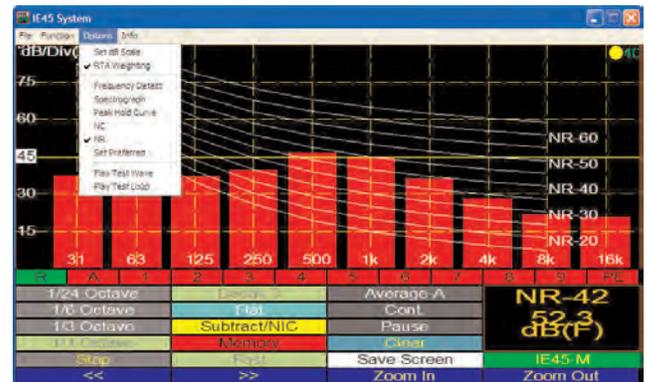


Should you desire, you can activate the Average function. The NC value will then be calculated from the Average Curve (note the blue colored NC value, indicating Average).



Making a Noise Rating (NR) Measurement

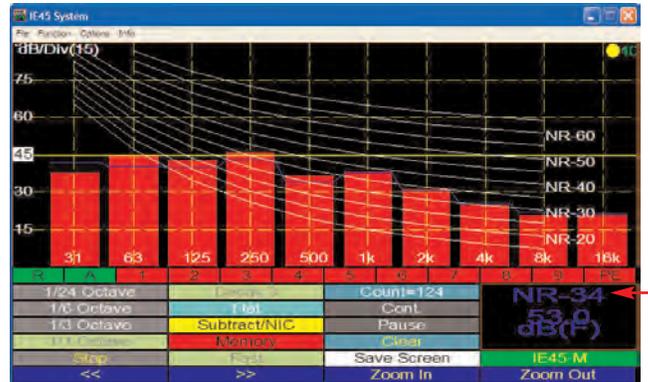
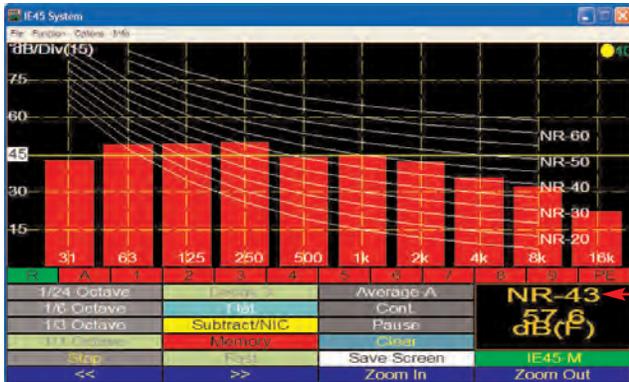
Step 1. Select "NR" from the RTA "Options" menu.



Step 2. Read the NR value in the SPL Window.

Note: An NC value over 65 will be displayed as NR++

Should you desire, you can activate the Average function. The NR value will then be calculated from the Average Curve (note the blue colored NR value, indicating Average).

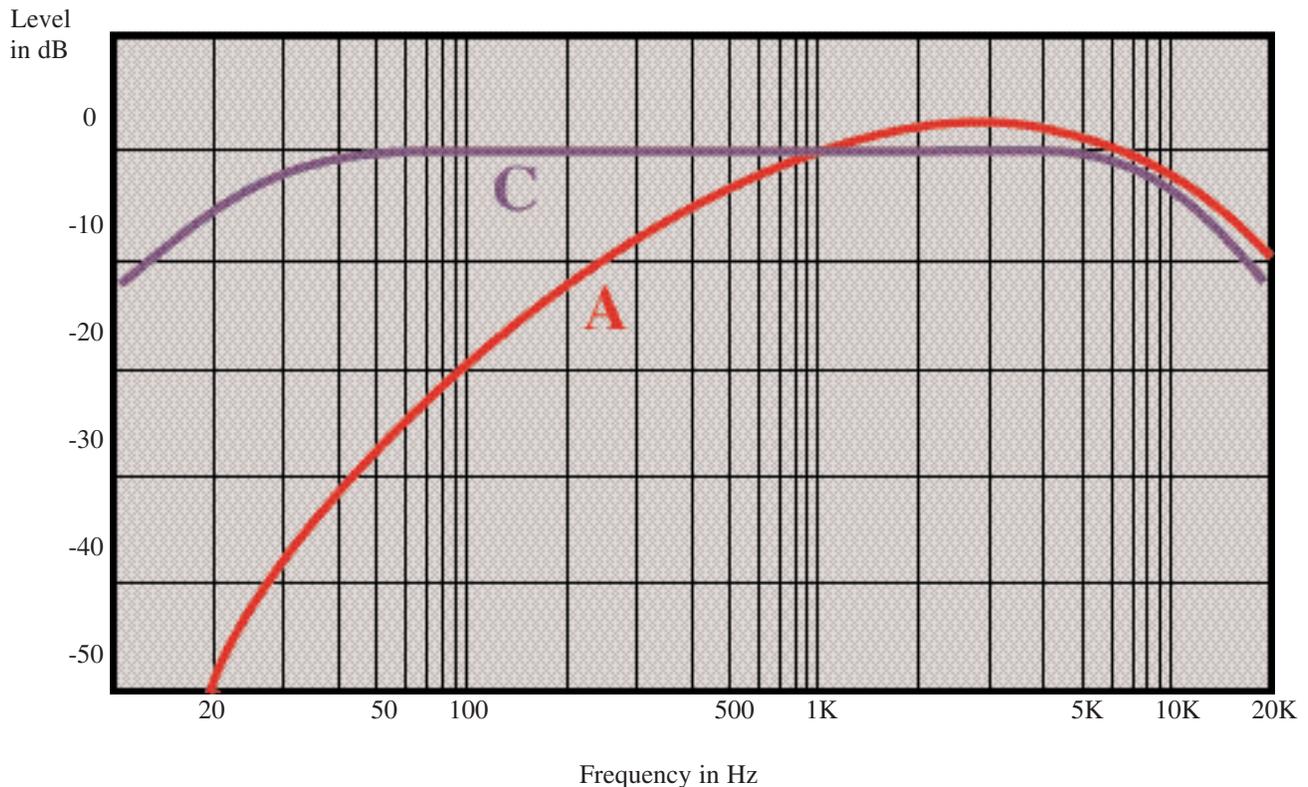


Sound Level Measurement

Introduction

The decibel (dB) scale has been adopted internationally for use with sound level meter testing. The scale begins at a reference of 0 dB in sound pressure level (0 dB SPL) which corresponds to the smallest sound that can be heard by a healthy human ear, and is equal to $2\mu\text{N/m}^2$, or perhaps more commonly, $20\mu\text{Pa}$. To get a better idea of relative sound levels, consider the following: Quiet outdoors in the country would measure around 10dB, a very soft whisper about 30dB and average conversation around 70dB. An automobile horn would weigh in at approximately 80dB, a jackhammer around 100dB and a small aircraft engine roughly 120dB. The threshold of pain is about 140dB.

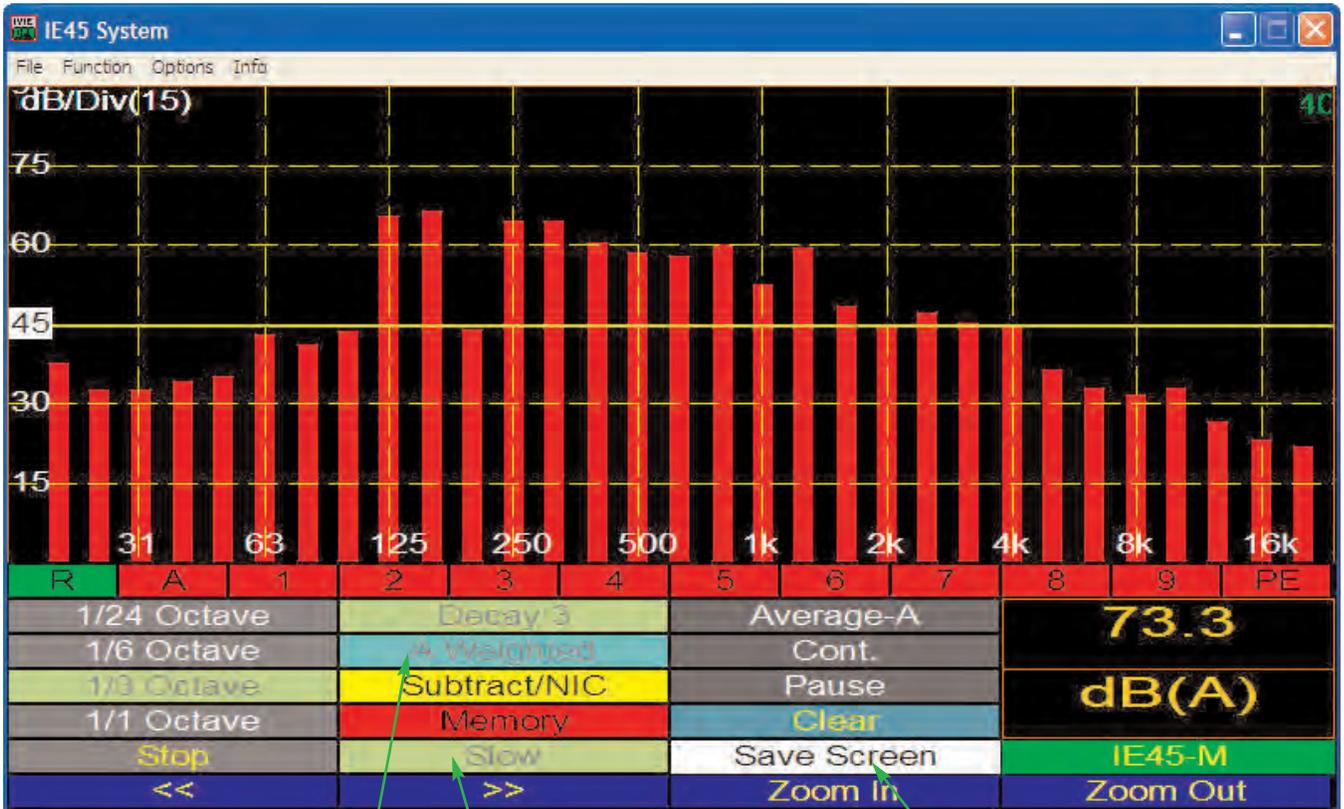
When studying sound level measurements, it is of major importance to understand the response characteristics of the human ear. Our ears do not respond equally to all the frequencies of the audio spectrum - in other words, they are not "flat" in their response. To further complicate matters, the response characteristics of human ears change with different SPL's. At relatively quiet SPL's, our ears attenuate high frequency sounds to some degree, and drastically attenuate low frequency sounds. As SPL's increase, our ears get more efficient at low frequencies and their response to sound becomes more "flat," although they never achieve a totally "flat" response. Following is a set of curves which approximate the "A" and "C" curves, or the hearing response of human ears. The "A" curve shows how ears hear, or perceive sound at low SPL's, while the "C" curve shows how we hear at relatively high SPL's.



These curves have been integrated into sound level meters for testing sound levels. "A" weighted (dBA) measurements use the "A" curve above, "C" weighted (dBC) use the "C" curve above, and "Flat", or "Z" weighted (dB SPL) measurements use no weighting at all.

Making SPL Measurements

To make an SPL measurement, turn on the IE-45 and select RTA mode. Using the SPL stylus button, select the desired SPL weighting: "A," "C" or "Flat". Using the other SPL Stylus button, select the desired SPL detector response: "Fast," "Slow," "Peak" or "Impulse." The application will determine the needed settings. For example, noise abatement, or OSHA related measurements will normally be made in Slow, A-weighted.



SPL Weighting Button

The SPL Weighting Button toggles through the suite of choices each time it is tapped with the stylus. The order of rotation is: "Flat," "A - Weighted," "C-Weighted" and back again to "Flat."

In the above example, as can be seen, the SPL meter is set to Slow, A-Weighted.

Notice in the SPL Readout window, A-Weighting is designated by the dB(A) designation.

SPL Response Button

The SPL detector response toggles through the suite of choices available each time it is tapped with the stylus.

The order of rotation for this stylus button is: "Fast," "Slow," "Peak," "Impulse" and back again to "Fast."

When "Peak" is selected, the SPL meter functions in a "Peak Hold" mode, freezing the highest peak SPL measured until a higher level measurement displaces it.

Clearing Peak Hold Readings

When Peak Hold measurement is selected, the white "Save Screen" stylus button turns olive green in color and reads: "==> RESET."

Tapping the ==> RESET button will clear the Peak SPL reading from the SPL display and allow a new Peak SPL measurement to begin.

Exiting "Peak" will automatically clear the Peak SPL reading shown in the SPL readout.

Making SPL Measurements

An IE-45, as shown on the opposite page, can make all the SPL measurements required by U.S. and international standards, including A, C and Z (unweighted, or flat) SPL measurements. In addition to weighting, various detectors, again specified by U.S. and international standard, can be selected for SPL measurement. These detectors include Fast, Slow, Peak and Impulse. The Fast and Slow detectors are true RMS with different averaging times. Peak is a true peak detector, and quite fast. Impulse is a combination of an extremely fast peak detector, followed by an RMS buffer and is intended for measurement of extremely short duration phenomena.

The Slow detector, in combination with A weighting, is normally used for making sound level measurements related to noise associated with hearing damage. OSHA and other regulatory SPL measurements are normally written around A weighted, Slow. It has been determined that high A weighted sound levels are more damaging to human hearing than C or unweighted levels.

System Calibration for OSHA Measurements

OSHA measurements generally require equipment that meets minimum specification standards - at least an ANSI Type II sound level meter, for example. The IE-45, with its supplied IE-45M microphone, is a Type II sound level meter, and therefore satisfies OSHA minimum requirements. The electronics of the IE-45 meet Type I response specifications, however. With the addition of an optional IE-5P preamplifier and the 1201 microphone, or the IE-6P and a Type I air condenser microphone, the IE-45 becomes a Type I measurement system.

In addition to the equipment meeting minimum specification standards, it must also be properly calibrated in order for an acceptable OSHA measurement to be made. What this normally requires is calibration prior to the measurement, and then a recheck of calibration after the measurement is made. In the case of SPL measurements, a calibration device (either a pistonphone or an acoustic calibrator) must be used. The standard IE-45M microphone is a 10mm diameter, electret condenser microphone. It can be calibrated with any quality calibration device that will accept a 10mm adapter (1/2 inch to 10mm adapters are available from Ivive). Most calibrators have a larger diameter opening to accommodate microphones up to one inch or slightly larger in diameter, and have plug-in adapters to reduce the opening size for smaller microphones. The Ivive Type I microphones, along with many other international standard air condenser microphones, are 1/2 inch in diameter and require the use of a 1/2 inch adapter when calibrating. With either Ivive microphone, the same calibration process applies. It is important that the microphone fit snugly inside the adapter to assure accurate readings during calibration.

For complete information on calibration, see Appendix I of this manual dealing with this subject.

Sound Pressure Level (SPL) Monitor

The IE-45 normally displays SPL readings in the lower-right corner of the display screen, as shown in the illustration across the page. Immediately below the level readout, the weighting is displayed (A, C or unweighted). The detector selected is displayed on the blue colored stylus button in the center column of stylus buttons (Fast, Slow, Peak or Impulse).

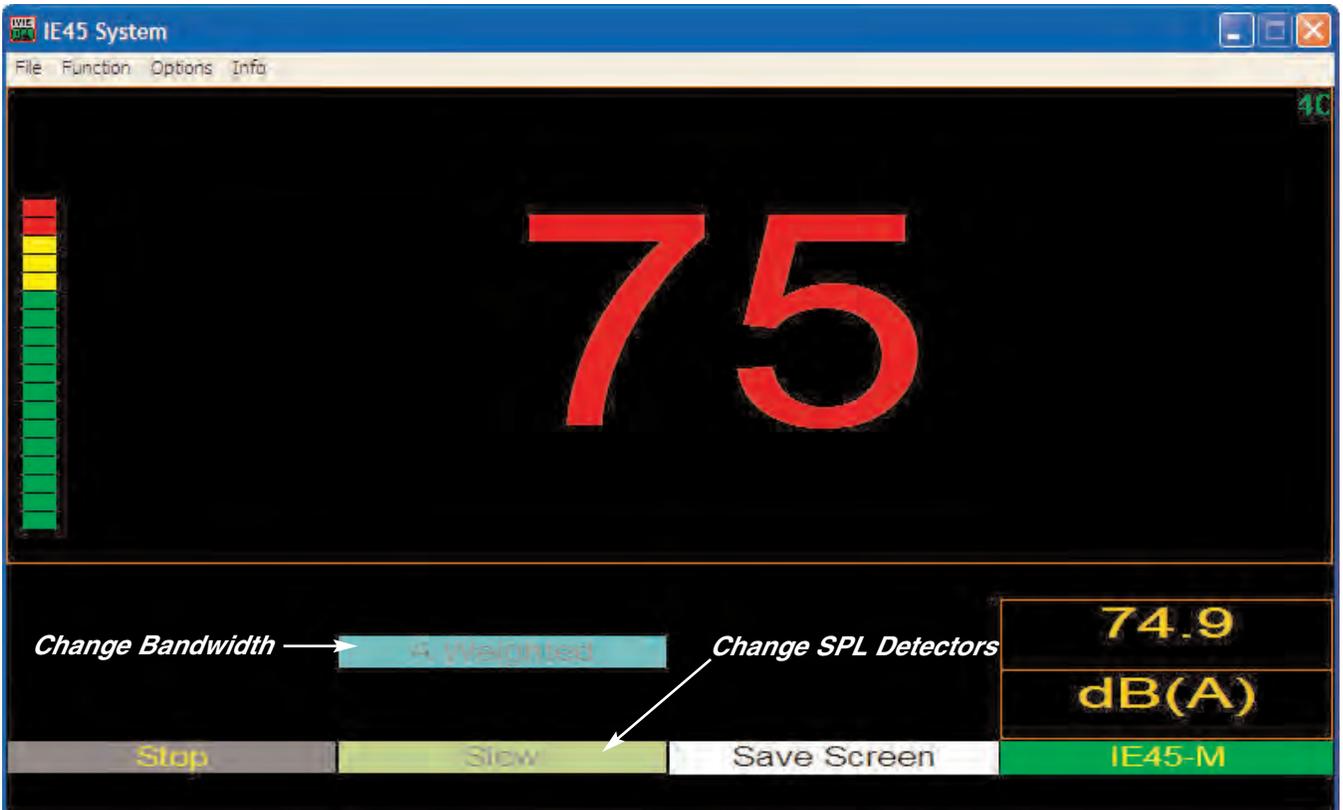
There are occasions when a much larger SPL display may be desirable. The "SPL Monitor" function provides this. To access SPL Monitor, tap the "Function" pull-down menu and then tap "SPL Monitor" to activate this function. The large SPL display shown across the page will appear. The SPL at a resolution of 1dB will be displayed in very large, easy to see numbers. The smaller SPL readout in the lower-right of the screen will also continue to function, providing its .1 dB resolution readout.

There is also a convenient bar graph display shown along with the large numerals. You can program this bar graph to change colors at specific sound pressure levels. To do this, while in the SPL Monitor mode, tap the "Options" pull-down menu and select "Set dB Levels." The level for color change can then be set as shown in the illustration across the page. The bar graph and large SPL readout number will change from green to yellow at the lower level programmed, and from yellow to red at the upper level programmed. This feature can be extremely useful in some applications.

Using the SPL Monitor Mode

The large SPL display of the IE-45 in the SPL Monitor mode, combined with a bar graph that changes colors at user definable set points, facilitates SPL monitoring of "live sound" events.

The SPL Monitor mode works most effectively when the SPL Meter is set to "Slow." This allows convenient viewing, whereas the "Fast" setting updates the large SPL readout faster than is comfortable for the eyes. Additionally, A-Weighting is most often used.



Selecting Weighted or Band Limited Sound for Monitoring

Just as with SPL measurement in conjunction with RTA function, the SPL detectors in the SPL Monitor mode can be set to "Fast," "Slow," "Peak" and "Impulse." The "Peak" mode is a "Peak Hold" mode, just as it is in the RTA function. When in the Peak Hold mode, the white "Save Screen" stylus button above becomes the ==>RESET button and can be used to clear the peak reading displayed.

However, in the SPL Monitor mode, octave band amplitudes can be monitored as well as broadband SPL. Successively tapping the blue SPL Weighting stylus button shown above, will cause it to toggle from "Flat" (broadband), to "A-Weighted" (broadband), to "250 Hz" (octave), to "4 kHz" (octave) and back again to the broadband "Flat" setting.

This provides great flexibility in monitoring either broadband SPL data, or octave band amplitude.



Entering Set Points

- Step 1.** Select "Set dB Levels" from the "Options" menu.
- Step 2.** Set dB Lower set point (yellow color begins here).
- Step 3.** Set dB Upper set point (red color begins here).
- Step 4.** Tap "OK" to exit.

The large numeral SPL reading reflects the SPL response of the detector selected (Fast, Slow, Peak or Impulse), and the weighting selected (A weighted, C weighted or Z unweighted). In addition, the SPL Monitor function provides level monitoring in octave band levels. Technically, octave band readings are level measurements and not SPL measurements, since SPL is, by definition, a broad band measurement.

Monitoring of octave band levels is possible in the following octaves: 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz. To select one of these octave centers, tap the green "Weighting" stylus button. It will toggle with successive taps from Flat to A weighted, to C weighted, to 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz, and back again to Flat.

Sound Pressure Level (SPL) Seat-to-Seat

One of the highly useful functions of the IE-45 is the measurement of Seat-to-Seat variation. This function can be used to measure the uniformity of sound level throughout a venue. The Seat-to-Seat function allows you to set a reference level, which then becomes equated to 0 dB. As you move throughout the venue, level in dB above or below the reference level is clearly indicated. As shown in the illustration across the page, Seat-to-Seat variation is displayed in large numerals.

Additionally, there is a bar graph that displays Seat-to-Seat variation up to plus or minus 12 dB. There is also a numeric readout which displays maximum deviation, the same data as the bar graph, except that it is not limited to a range of plus or minus 12 dB. Of course, absolute SPL is also shown immediately above the maximum deviation readout.

The large numeral SPL reading, as well as the bar graph and the maximum deviation readout, reflect the results of the detector selected (Fast, Slow, Peak or Impulse), and the weighting selected (A weighted, C weighted or Flat). In addition, just as in the SPL Monitor function, the Seat-to-Seat variation function provides level monitoring in octave band levels.

Monitoring of octave band levels is possible in the following octaves, as shown in the display across the page: 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz. To select one of these octave centers, tap the green "Weighting" stylus button. It will toggle with successive taps from Flat to A weighted, to C weighted, to 125 Hz, to 250 Hz, to 500 Hz, to 1 kHz, to 2 kHz, to 4 kHz and back again to Flat.

Making a Seat-to-Seat Measurement

To make a Seat-to-Seat deviation measurement, tap the "Function" pull-down menu and select "Seat-to-Seat." Next, with steady-state noise playing in the venue, select a representative spot as the reference. Once a representative spot is located, establish it as the reference by carefully tapping the "Reset" stylus button. (This "Reset" reference level will be remembered by the software even if Seat-to-Seat screen is left, but will not be retained once the analyzer software program has been exited). **Hint:** Tapping the "Reset" stylus button roughly will cause microphonic noise to travel through the unit (like tapping a microphone with your finger) which will elevate the noise level seen by the IE-45, thus setting a "false" reference level. Once the reference level has been set, walking the venue will clearly indicate the level variation at various locations within the venue.

The type of venue will help determine the settings for the IE-45, when measuring Seat-to-Seat variation. The majority of venues will likely be measured in Slow response, as opposed to Fast or Peak. The bandwidth and weighting applied are more likely to change from venue to venue. If the system is intended for music reinforcement, you may want to measure Seat-to-Seat in the Flat mode to assure full-range uniformity from Seat-to-Seat. You may also wish to measure the same venue A weighted if there are concerns about it meeting local noise or sound level ordinances, which will likely be written around A weighted measurements.

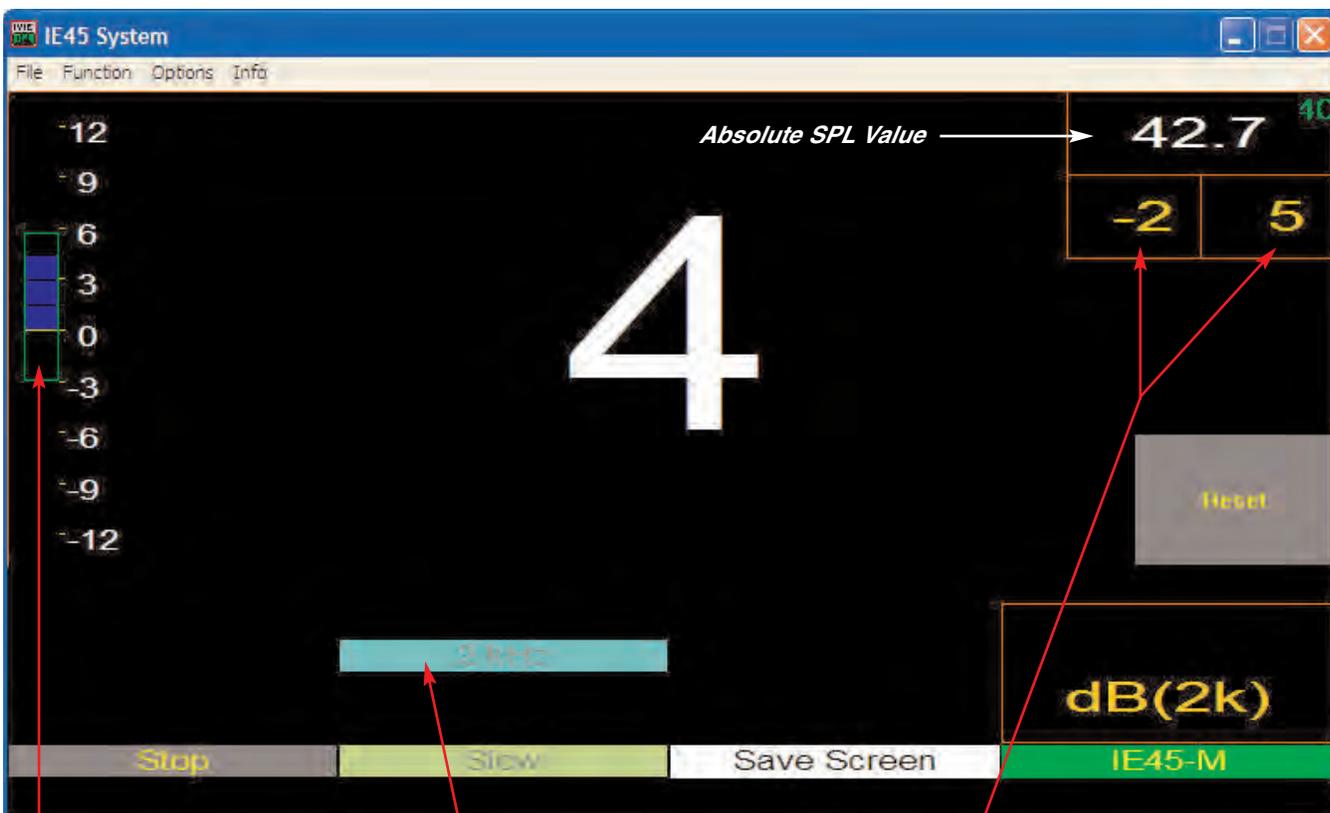
On the other hand, venues intended primarily for voice reinforcement may likely be "rolled off" on the high end as well as the low end. It is not unusual to encounter Seat-to-Seat measurement specifications written around band limited noise centered at 4 kHz. The IE-45 meets this requirement nicely.

Using the IE-45 Seat-to-Seat SPL Function

The Seat-to-Seat function of the IE-45 is intended for use in measuring sound level uniformity over the seating area of a venue. Setup of the Sound Level Meter may vary, depending on the type of venue, but the SPL detector will almost always be set to "Slow" in order to make the display more comfortable for the eye to follow.

In the example below, we will assume that the venue is intended primarily for voice reinforcement, so we will set up the SPL Meter accordingly:

- Step 1.** Set the IE-45 Sound Level Meter for "Slow" response and select the 4 kHz octave bandwidth for measuring. We select 4 kHz because speech intelligibility is profoundly effected by accuracy in the 4 kHz octave bandwidth. Therefore, this bandwidth is often specified for Seat-to-Seat measurements for voice reinforcement venues.
- Step 2.** Energize the sound system with pink noise to a level at least 10 dB above the ambient noise in the room (20 dB above ambient is even better, if sufficient gain is available).
- Step 3.** Go to a representative location in the room (two thirds back in the room, slightly to the left of center, is often suggested). Press the "Reset" stylus button to set this location as your "0 dB reference point." The large readout will say "0."
- Step 4.** Quietly walk around the room observing the information provided by the readout of the IE-45. Level variation for area-to-area (seat-to-seat) will be displayed both graphically and numerically.



Seat-to-Seat variation is graphically shown by this display. The "spread" is easily viewed and simple to understand.

Tapping "Reset" zero's this display.

Use this stylus button to select the 4 kHz bandwidth. The button will toggle from "Flat" (broadband), to "A-Weighted" (broadband), and then through octave bandwidths from 250 Hz to 4 kHz, and back again to "Flat."

Seat-to-Seat variation is numerically displayed by this readout as you walk the room.

Tapping "Reset" automatically zero's this display.

Strip Chart

The Strip Chart feature of the IE-45 harks back to the days of pen on strip chart paper. We still find this type of visual presentation to be one of the clearest and easiest to “digest” when looking at amplitude over time. With Strip Chart, it is possible to record and review variations in amplitude over times ranging from one minute to eight hours. Data collected in Strip Chart measurements can be viewed on-screen and/or on the PC, or can be stored for later analysis.

To begin making a Strip Chart measurement, first select the desired weighting or filtering for the recording. Unweighted (Z), A, or C weighting may be selected. Additionally the measurement can be band limited to one of several octave filters (125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, or 4 kHz). This can be useful in crafting a measurement that will be meaningful for the purpose intended.

Next, select the broadband SPL response detector. The standard Type I SPL detectors (Fast, Slow, Peak and Impulse) can be selected. Impulse would rarely be used. Fast and Peak provide very useful data for analysis, and Slow would be used for most environmental noise measurements, as many OSHA and other regulatory measurements specify A weighted, Slow measurements.

The final set-up requirement for making a Strip Chart measurement is to select the length of the recording desired. This is chosen by making a selection in “Chart Time” (Options> Chart Time). Additionally, you can set visual minimum and maximum indicators with the Set dB Levels (Options > Set dB Levels) boxes. This gives a visual indication when levels go above or below the levels you have set, and can be very useful locating “problem levels” at a glance.

In the “Options” Pull-down menu, you can also select the vertical display dB/division. The dB/Div and recording time are shown in the upper left of the main display window.

Once all the selections are made, you can “drop the pen” onto the “paper” by tapping “Start.” It is possible to stop the recording at any time by tapping “Stop.” At the end of the designated recording time it will automatically stop and present a screen to name and store the recorded measurement.

Reviewing a recorded Strip Chart measurement is intuitive. Follow the directions on the opposing page. Additionally, the following tips can be very helpful:

Tip #1:

In addition to using the software “slider” to page through the displayed data, you can also use the sliding “joystick” to walk the cursor to the left or right on the chart. When you reach the edge of the screen, the cursor will “bump” to the next page and reposition itself to the next pixel (it will appear to jump from one side of the screen to the other) on the chart.

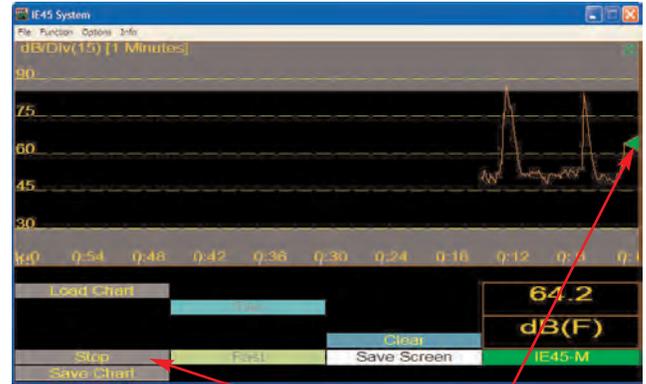
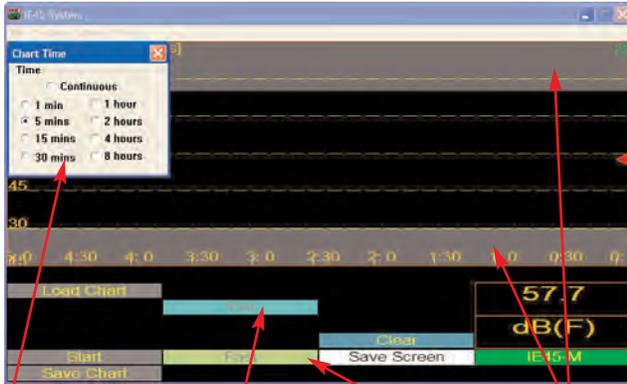
Tip #2:

When recording a Strip Chart with a longer chart time, you will want to consider the battery life of the Q1 or other computer you may be using. Additionally, depending on how you have your computer set up, you may encounter power management limitations. Before making extended Strip Chart measurements, check your battery status to assure you have the necessary operating time available. Also make sure the power management settings of your Q1, or other computer, are set such that they will not put your computer “to sleep” before your measurement is completed.

Power management settings can be changed using the standard Windows® XP interface.

Using the Strip Chart Recorder Function of the IE-45

The Strip Chart Recorder function can be selected from the "Functions" menu. After accessing the Strip Chart Recorder function, select the SPL weighting desired and the SPL detector response wanted. Next, choose the recording time required by tapping "Options" > "Chart Time" > and then the recording time wanted. Tap the "Start/Stop" button to begin recording.

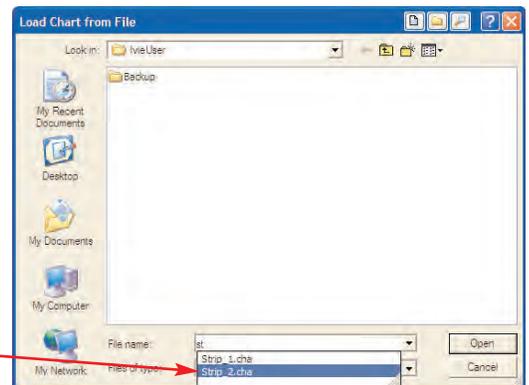


- Select Chart Time from "Options" > "Chart Time."
- Select SPL Weighting.
- Select SPL Detector Response.
- Set Gray Visual areas of Interest (Minimum/Maximum), using "Options" > "Set dB Levels".
- Press the "Start/Stop" Button to Begin.
- Pen is Green when Recording, Red when Lifted.

Viewing a Previously Recorded File



To view a saved chart, tap the "Load Chart" button. The screen to the right will pop-up allowing you to select the proper chart for viewing.



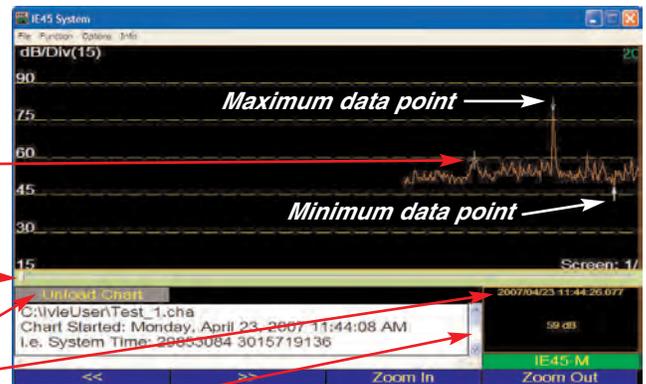
When the recording has finished, a "prompt" window will pop-up allowing you to save the recorded information. The recording can be stopped and saved at any time during the recording process by pressing the "Save Chart" button.

The cursor is controlled by the "Joystick," or by tapping on the screen with the stylus.

The Chart is displayed in an expanded form so that each data point is represented by one pixel. The slide is used to "Page" through the data one screen (page) at a time.

Tap to unload the file and return to the Recording screen.

Data at the Cursor point selected.



Scroll through data including: File name, Test date/time, Total number of data points, Sample interval, Weighting, Maximum SPL and time and Minimum SPL and time.

Polarity

The Polarity feature of the IE-45 allows the user to test for the polarity of a loudspeaker with respect to the signal source, or with respect to other loudspeakers.

Normally, in a correctly wired system, positive voltage on the "+" output of the signal source (amplifier) should generate outward speaker cone travel (away from the speaker housing and magnet). More important to the perception of the listener is the uniform polarity wiring of all speakers in a system.

The IE-45 can help the user to quickly test for correct polarity. In order to test for polarity, a pulse must be generated and sent through the speakers to be tested. The IE-45 can generate the special pulse needed to do the polarity test, though it may be desirable to generate the pulse external to these units (see Tip #2 below). To generate the pulse from the IE-45, connect the output (Q1 earphone output = 3.5 mm phone jack) to an input in signal processing chain going to the speaker system. From the Polarity screen (Function > Polarity), tap the "Pulse On" button in the lower part of the screen. A special pulse will begin to repeat.

In order to make a valid test, the IE-45 microphone should be in the direct field of the loudspeaker. As you move the microphone close enough to a loudspeaker to be in the direct field, the Polarity display will show "+" Positive Polarity, or "-" Negative Polarity, or "- -" No Lock. "Positive Polarity" means that the system is wired so that the loudspeaker is correctly reproducing the output of the amplifier with regard to polarity. "Negative Polarity" means the opposite. "No Lock" means that the microphone is either "confused" because it is not in the direct field and is seeing too high a level of reverberant energy relative to the direct field, or the overall level of the speakers is not sufficiently above the room's noise floor. These conditions can be corrected by either moving the microphone closer to the speaker or raising the output level of the loudspeaker.

The most important function of the Polarity test is to assure that multiple loudspeakers in a distributed speaker system are wired so as to be of uniform polarity. By starting the pulse signal and then moving from the direct field of one speaker to the next, the user can quickly confirm that the speakers are correctly wired for uniform polarity. The following tips may also prove useful:

Tip #1

When speakers are mounted in a ceiling more than eight feet above the floor, it may not be possible to move the microphone into the direct field of the speakers when the microphone is mounted to the IE-45 (unless the user is on stilts!!). Using a microphone extension cable and a means of elevating the microphone closer to the speakers can provide the solution (a broomstick and some tape works very well!).

Tip #2

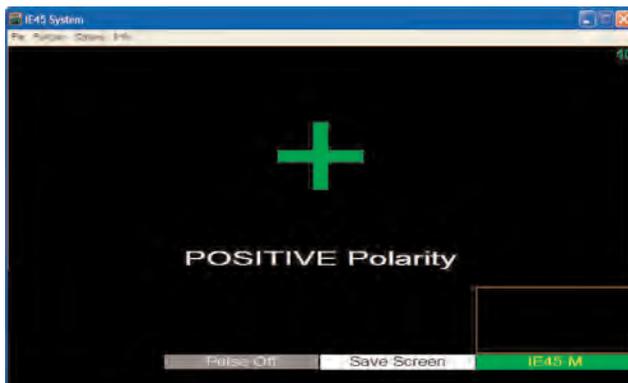
Often, using the pulse generated by the IE-45 can be impractical, since a long microphone extension cable, or a long output cable, or both, might be called for in order to get the pulse signal into the sound system while simultaneously moving the microphone close to the speakers. In most cases it is easier to use a separate pulse source instead of the IE-45. There are several ways this can be done.

One way to do this would be to record the pulse and play it back to the sound system with a player. Another would be to use the .wav file of the pulse provided on the CD that comes with the IE-45.

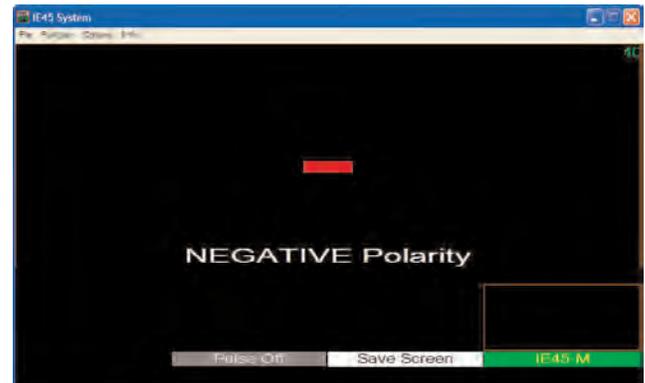
Yet another way would be to use an external generator that creates a pulse that is compatible with the Polarity feature of the IE-45. The Neutrik® "Minirator", for example, generates such a pulse.

Making a Polarity Measurement

- Step 1.** Connect the Polarity Pulse Generator output of the IE-45 (Samsung Q1 headphone 3.5 mm stereo jack) to the line-level input of the sound system. **Note:** The pulse generated by the IE-45 can be recorded to a WAV file, or a CD for injection into the sound system if you do not wish to have a cable running between your IE-45 and the sound system input. Also, other compatible signals, such as the one generated by the Neutrik® Minirator MR1, may be used.
- Step 2.** Select “Polarity” from the “Functions” menu of the IE-45 and tap the “Pulse On” stylus button to turn on the pulse. Adjust the level of the sound system so that it is at least 10 dB above the ambient level in room (if sufficient gain is available, 20 dB above ambient is even better).
- Step 3.** Position the microphone of the IE-45 in close proximity (in the direct field) of the speaker under test. If you are too far away from the speaker, the IE-45 may not be able to achieve a “lock” on the polarity.
- Step 4.** Read the polarity of the speaker.



In the example screen above, the IE-45 has “locked” on the signal and identified the polarity of the signal as “Positive.”



In the example screen above, the IE-45 has “locked” on the signal and identified the polarity of the signal as “Negative.”



In the example screen above, the IE-45 is unable to achieve a “lock” on the signal. Make certain the pulse signal level is at least 10 dB above ambient. Move the microphone closer to the speaker.

Preferences Menu

Diagnostics

Choosing Diagnostics provides a temporary setting (resets when the application is closed) that changes the green/red box under the SPL window in the Main Display to show a numerical indication of the measurement cycle time. The number represents the time required, in milliseconds, to complete a measurement cycle, as well as other data. The Diagnostics setting is not normally displayed, but can help Technical Support Engineers to better support you if you call the support center.

Power Average / Arithmetic Average

The IE-45 will perform two types of averaging, depending on the type of measurement and preference of the user. The default setting is "Arithmetic." Power Averaging is most useful when doing transmission loss and other such measurements where an average of sound power rather than sound level is required.

1/12 Octave Filter Set On/Off / Limit Display Screen Refresh Rate

Please see Appendix IV, page 45, for a full explanation of these Preference Menu features.

Oscilloscope (Scope)

The Oscilloscope Function is accessed under the "Functions" menu of the IE-45 and provides a single or dual channel (dual trace, or XY) audio frequency (20 Hz to 20 kHz) oscilloscope. The page to the right contains illustrations regarding control details. The oscilloscope is useful in viewing wave forms of various signals. To use the oscilloscope function, the "Channel 1" (Line Level) input must be selected if a single channel oscilloscope measurement is desired. If a dual channel measurement is required, the "Channel 1 & 2 Scope: XY/Dual Trace" inputs need to be selected. Input selection is done in the following manner:

Input Select

The Input Select menu is located under the "File" pull-down menu. There are several inputs on the IE-45 (a microphone connector, two RCA connectors and an SMA connector). This selection area allows the user to select the desired input or inputs. Remember that the IE-45 is a two channel device. The microphone input and Channel 1 line input are in parallel - both feed Channel 1.

The Channel 2 input is line level only.

Dual Trace or XY Measurements

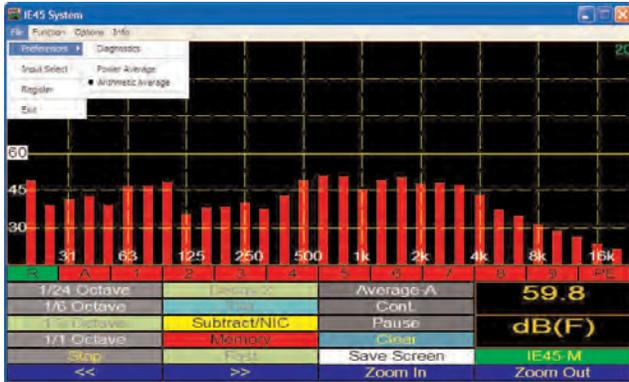
When making dual channel measurements in the oscilloscope mode, either dual trace or XY measurements can be selected using the "Options" pull-down menu.

Signal Generator

*The IE-45 provides a simple signal generator. The output of the generator is available at the Q1 headphone jack, and the level of this signal is controlled by the audio level output control of the settings of the Q1 or other computer you may be using. Sine, Square, and Triangle wave forms can be selected, as can Pink Noise and White Noise. The Main Display in this function shows the waveform of the selected signal type. See the page to the right for software controls for the Signal Generator. In addition to the software slider, frequency can also be selected with the Q1 "joystick" left/right controls. **Do NOT plug the output of the Q1 into a mic input that has phantom power active. The phantom power can blow your audio output.***

Preferences Menu

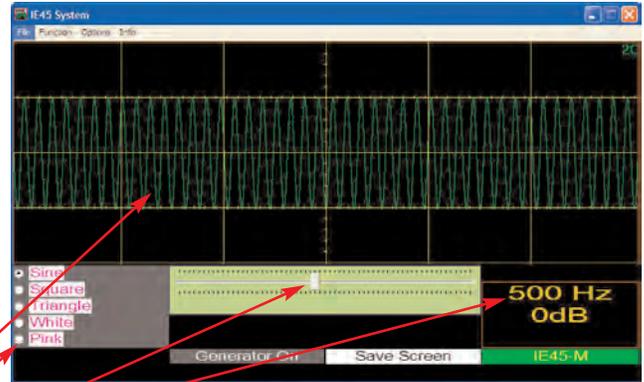
The "Preference" menu (in the "File" pull-down menu) is used primarily to select Power or Arithmetic averaging when the Average function is selected.



Waveform display of the selected signal source. Tap to select the type of signal to be generated.

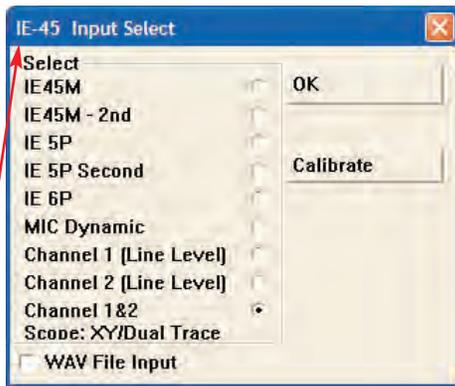
Signal Generator

The output of the Signal Generator is the headphone output of the Samsung Q1. The output level is controlled by the headphone volume control of the Q1.

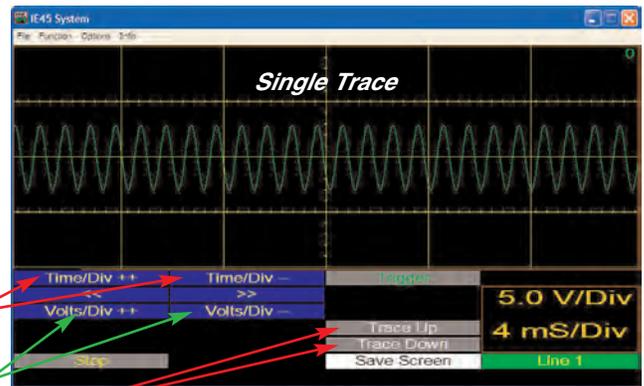


Display of frequency selected by the slider control. The slider controls the output frequency of the Generator.

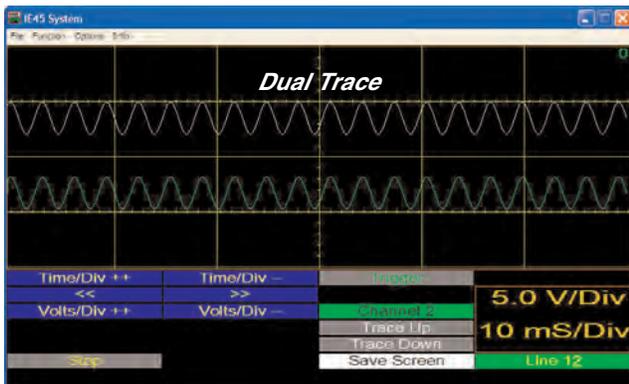
Oscilloscope



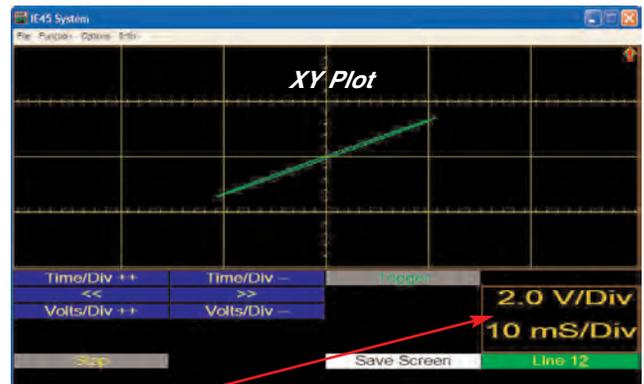
Use "File" > "Input Select" to select line level input(s). For Single Trace Scope, use either Channel 1, or 2 input. For XY/Dual Trace Scope, use "Channels 1 & 2" input.



Use these buttons to vertically position the trace on screen. Use these buttons to expand/contract waveform vertically. These buttons expand/contract waveform horizontally.



With Channels 1 & 2 Input selected, the "Options" menu allows selection of Dual Trace or XY.



This window indicates the selected settings for Volts/Division and Milliseconds/Division

Volt Meter

One of the most useful functions of the IE-45 is its ability to measure electrical signals as well as acoustic signals. This can be extremely effective for trouble-shooting and system setup. As an example, pink noise could be fed into the first component of a sound reinforcement signal chain. Using an IE-45 a technician, or consultant could step through each of the sound system components. Levels at inputs and outputs could be measured, along with the frequency response at every stage. Crossover points and slopes could be viewed, equalizer effects noted, level changes assessed and proper signal flow verified. A wealth of information would be available by simply probing the electrical inputs and outputs along the signal chain.

*The IE-45 is capable of directly measuring preamp level voltages (**not to exceed 7.5 volts**). **Feeding voltages higher than 7.5 volts (+19 dBu) directly into an IE-45 could cause damage and void the warranty.** Higher voltages may be measured only with the addition of an external pad.*

Volts RMS

When this mode is selected (see the illustration across the page for visual instructions on selecting various measurement options), the IE-45 functions as a true RMS volt meter. Measured voltages are shown simultaneously by a digital and an analog display.

Volts Peak-to-Peak (Volts PP)

In this mode, the IE-45 functions as a peak voltage meter. Measured voltages are shown simultaneously by a digital and an analog display.

dB Volts (dBV)

When this mode is selected, the IE-45 functions as a volt meter measuring in dB relative to 1 volt RMS. Measured voltages are shown simultaneously by a digital and an analog display.

dB Volts Unterminated (dBu)

In this mode, the IE-45 functions as a volt meter measuring in dB relative to .775 volts RMS. Measured voltages are shown simultaneously by a digital and an analog display.

Nixie Tube Readout

Using the "Options" menu, a more nostalgic Nixie tube digital display can be selected (see the illustration across the page). Choosing the Nixie tube readout effects the digital display only. The analog display continues to function without change.

Measuring Voltages and Viewing Spectral Information Simultaneously

When "Volt Meter" has been selected using the Function Pull-down Menu, only the voltage measuring displays shown across the page are available. If measuring voltages and viewing spectral information at the same time is desired, this is also possible.

To view spectral content and measure voltages simultaneously, keep the IE-45 in the spectrum analysis mode. Next, use the dB SPL readout box as a stylus button. Successively tapping this button will toggle the IE-45 from dB (A, C, or Z, depending on what has been selected) to Volts RMS, to Volts Peak-to-Peak, to dB Volts, to dBu and back to dB SPL. The dB SPL readout now becomes the Volt Meter readout.

Of course, for this type of measurement, a line input for the IE-45, should be selected.

Using the Volt Meter Function of the IE-45

CAUTION - To avoid damage to the IE-45, do not exceed the rated input voltage.

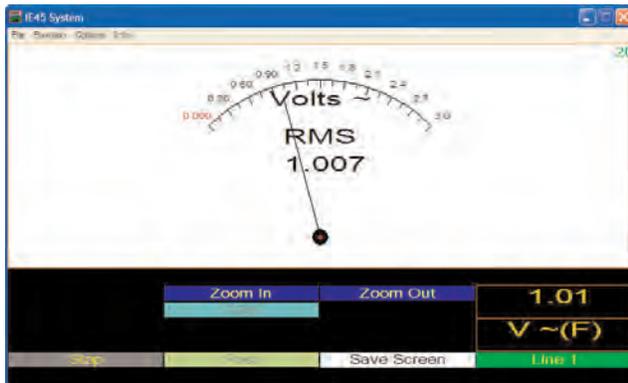
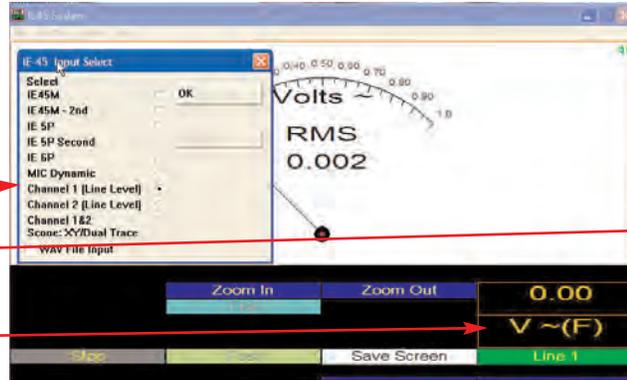
To Use the Volt Meter

Step 1. Under the "Function" menu, select "Volt Meter."

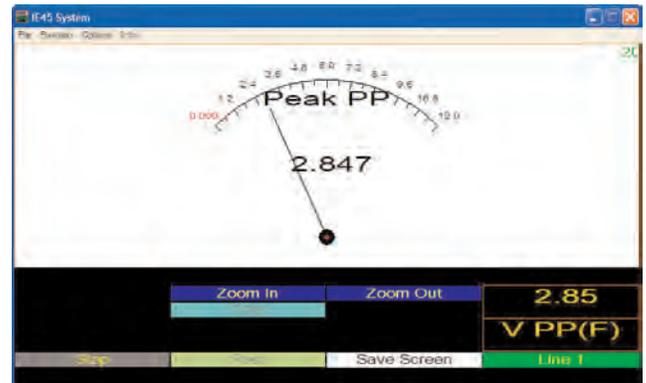
Step 2. Under the "File" menu, select "Input Select" > Channel 1.

Step 3. Connect to the "Channel 1" RCA plug of the IE-45 IM.

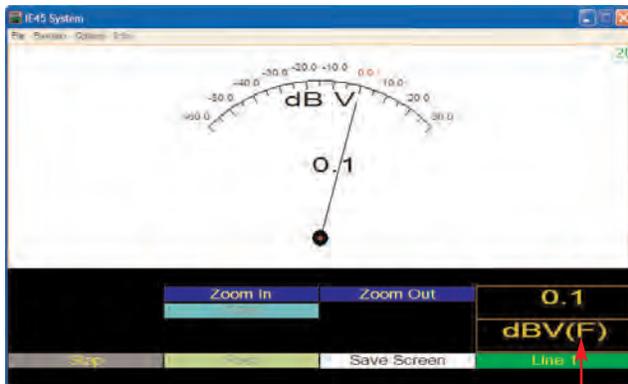
Step 4. Tap here to select Vrms, V peak-to-peak, dBV or dBu.



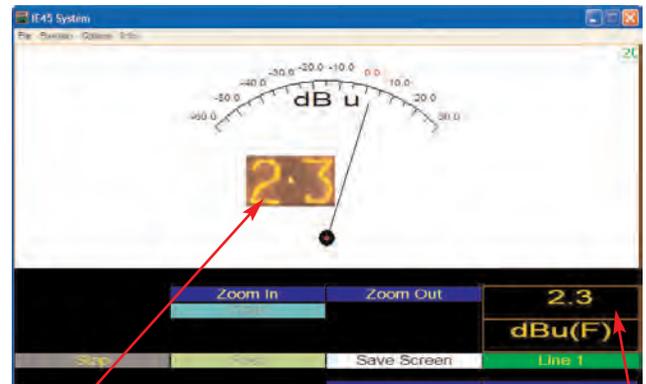
Measuring in AC Volts RMS.



Measuring in AC Volts Peak-to-Peak.



Measuring in dBV (dB relative to 1 volt rms).



Measuring in dBu (dB relative to .775 volts rms).

(F) = No Weighting Applied.
 (A) = "A" Weighting Applied.
 (C) = "C" Weighting Applied.

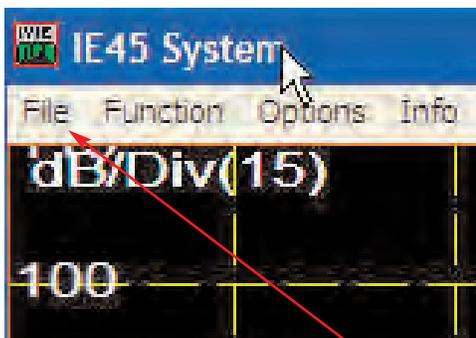
A more nostalgic Nixie tube readout may be selected from the "Options menu."
 Voltage or dB value +++ or --- = over range or under range.

Calibrating the Microphone of your IE-45

Whichever microphone is calibrated to your IE-45, it is calibrated to the IE-45 Input Module. The calibration information "lives" there, not in the computer, so the IE-45 IM remains calibrated even when switching computers. The IE-45 IM is capable of storing up to 6 different microphone calibrations, so, if you use more than one microphone with your unit, you will need to remember to "tell" it which microphone you are using.

Your IE-45 IM was calibrated at the factory for the standard IE-45 M microphone that was supplied with it. If you purchased other preamplifier/microphone combinations from Ivie as well, they will have been calibrated to your IE-45 IM also.

The IE-45 can be calibrated in the field, assuming you have a suitable calibration device (pistonphone or acoustic calibrator), and can be "manually" recalibrated without a calibration device if you know the "calibration constant," as described below:



To calibrate your IE-45, tap the "File" menu and select "Input Select." The calibration and input selection window will appear. It contains instructions for calibrating with a calibrator.

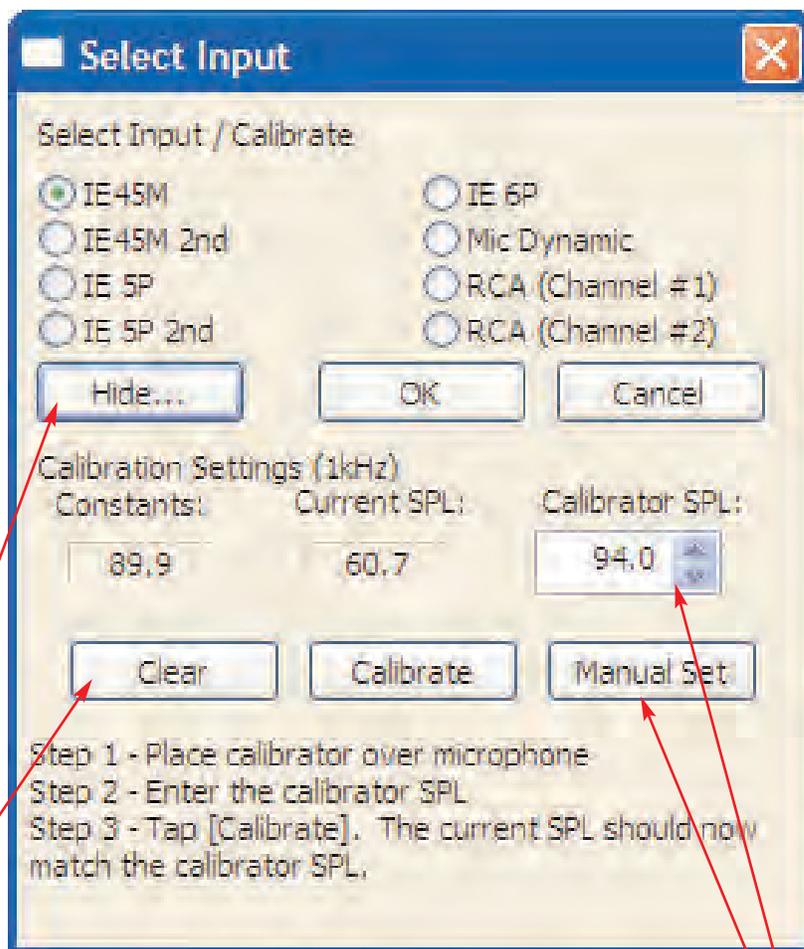
Just follow the three steps of the instructions and when finished, tap the "OK" button to return to the RTA screen. Your unit will have been successfully calibrated.

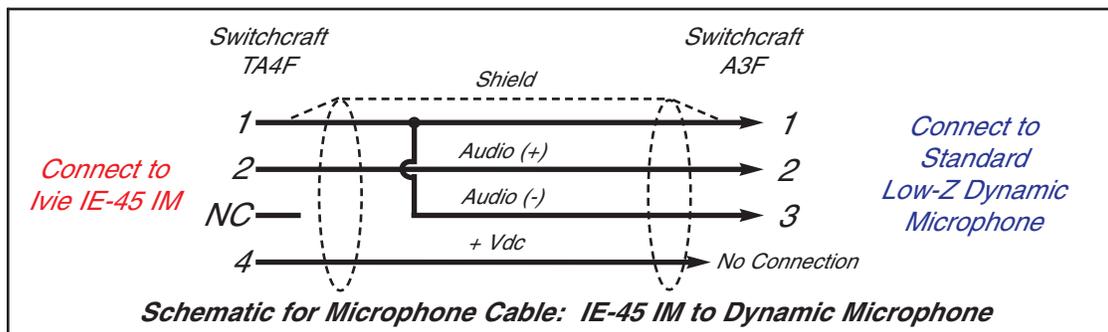
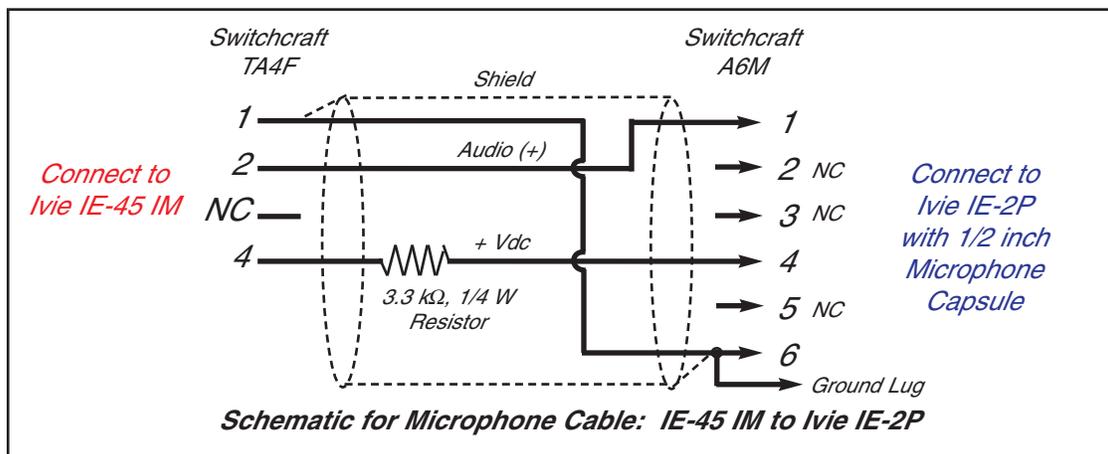
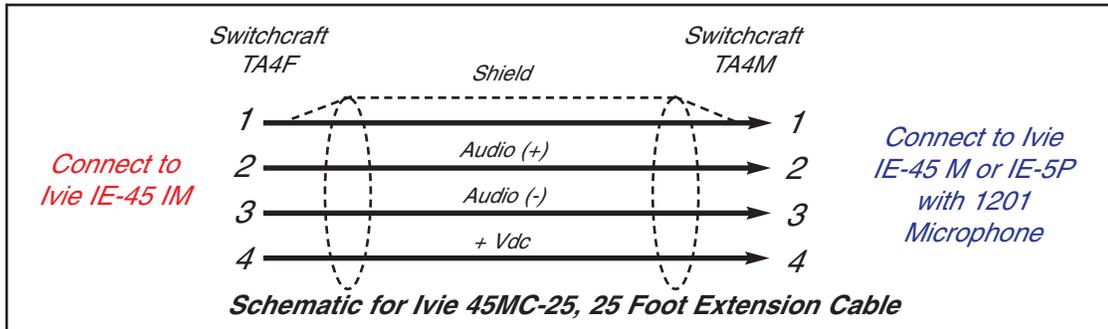
This button "hides" the bottom half of the window - all the calibration information. Tapping it again will restore the calibration section of the window.

The "Clear" button clears the current calibration constant.

If your IE-45 should "lose" calibration for some unknown reason, it can be restored without the use of a calibrator, if you have memorized or recorded your "Calibration Constant."

To restore calibration, enter your Calibration Constant in the Calibrator SPL window (use the up/down arrows or keyboard) and tap the "Manual Set" button. Calibration will be restored and your Calibration Constant will appear in the "Constants" window.





IvieXLS-45 Instructions

The IvieXLS-45 software provided with the Ivie IE-45 is actually a template for the Microsoft® Excel® spreadsheet program. IvieXLS-45 will function properly with versions of Microsoft Excel version 2000 or newer.

Before You Start the Software

Before using IvieXLS-45, you will need to transfer the data files of interest that were measured with the IE-45 to the PC where you have IvieXLS-45 installed. This can be done using the standard Microsoft protocol for transferring data from one PC to another. Once the files of interest have been transferred to your PC, you are ready to begin using the IvieXLS-45 software.

Starting IvieXLS-45

When you are ready to start using IvieXLS-45, do not start the Microsoft Excel application! Instead, you need to start the IvieXLS-45 template. The template is the file installed to your computer when you install IvieXLS-45. That file is named something like "IvieXLS ver. x.x.xls". When you start the IvieXLS-45 template, it will automatically start Microsoft Excel. Note: If Excel is running when you start IvieXLS-45, the Ivie charting application will not run properly. You MUST begin your session by starting IvieXLS-45.

Upon starting up the IvieXLS-45 application, a "permission screen" will pop up which will allow you to "enable macros." You will need to enable macros in order for IvieXLS-45 to operate properly. If you don't see the enable macros screen during startup of IvieXLS-45, check the security settings in Excel. You may need to alter your security settings.

Once IvieXLS-45 starts, two windows will appear. The left window is the main chart screen, on which you will find the graphic depiction of your data. The right screen is a narrower control screen from which you will be able to set up the display in the main window.

Control Panel

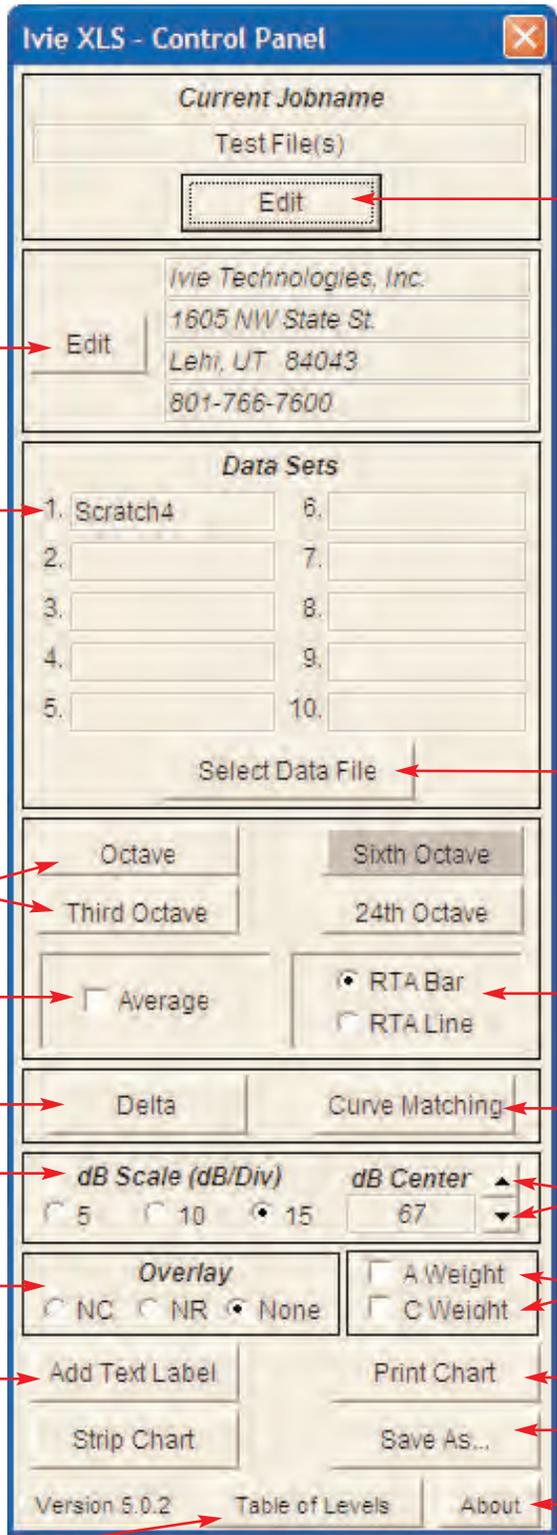
Most of what you need to know to operate IvieXLS-45 deals with the right-hand control panel shown on the next page. Let's examine the control panel, from top to bottom. When we're done with the control panel, you will know most of what you need to begin the next step of experimenting with the IvieXLS-45 application itself.

The upper-most panel on the control screen allows you to input the "Current Job Name." IvieXLS-45 will remember that name from session to session and you can change it as needed. The job name is the description you will choose for the particular measurement, or series of measurements you are making. It can describe the measurement itself, or the venue where the measurement is being made, or whatever you want to see on the chart when you print it out.

The "Edit" panel under Current Job Name is for entering your company information. The information you put here will be remembered from session to session, and will print on any of the forms you print using IvieXLS-45.

The next panel down is "Data Sets." This is the panel you will use to select the ".ivi" or ".cha" files you wish to display. The examples we will use in this instruction set will deal with ".ivi" files, as they are, by far, the most commonly used.

"Data sets" are just that. When you bring a file over from your IE-45, it consists of ASCII, alpha numerical



Use to enter or edit current job name.

Use to enter or edit current job name.

Up to ten different data sets may be imported.

Use to select data files for importing from the IE-45.

Use to select display resolution.

Use to average two of more displayed curves together.

Use to "select type of plot desired.

Use to subtract one curve from another.

Use to "overlay," or match one curve to another.

Use to select plot scale.

Use to select a plot center level.

Use to show NC or NR overlays.

Use to weight a plotted curve.

Use to add identifying notes to a data set.

Use to print a displayed plot.

Use to save a data set.

Use to display the data numerically.

Use to get information about the version of IvieXLS-45 you are using.

data that numerically represents all of the data recorded in that measurement. As you'll see a little later in this document, you can view the raw data as well as the graphical representations thereof.

As you see from the Data Sets panel, you can select up to ten data sets (or curves) to display in the main data screen at one time. While having ten curves displayed at one time can, in some cases, be convenient, most times there would be too much "going on" in the display screen, if you were showing ten curves. Most users will find either a single curve, or perhaps two, three, or four curves about right. Nevertheless, experiment and see what makes sense for your application.

To select a data file, click on the "Select Data File" button near the bottom of the Data Sets panel. You will be presented with a screen that facilitates file selection. In order to select the first file, click on the "1" button. You will be presented with a file navigation screen which will allow you to navigate through your PC's file folders to find the files you have transported from your IE-45 to your PC. Select the file of your choice.

As IvieXLS-45 works to create the display of your file, be patient. IvieXLS-45 is transferring data in four different resolutions for each "memory" file. This can take a few seconds, but it allows you to display and print the data in any resolution: 1/1 octave, 1/3 octave, 1/6 octave or 1/12 octave.

Once you've selected the first file you want to view, you can repeat the process to add other files to be viewed on the same screen.

Note that you can clear individual files from the control panel, replace files, add additional files, etc.

When you have finished selecting files, click on the "OK" button to come back to the main control panel.

One of the first things you will want to do is select the display resolution of your data. With the four buttons immediately below the Data Sets panel, you will be able to select display resolutions of 1/1 octave, 1/3 octave, 1/6 octave, or 1/12 octave.

Note: *The data brought across to your PC from the IE-45 consists of four data sets per memory. All four resolutions are stored and transmitted: 1/1 octave, 1/3 octave, 1/6 octave and 1/12 octave. The IvieXLS-45 template selects the data set for display as you specify. You can, therefore, look at any curve, in ANY resolution, even though the curve may have been stored when in the 1/1 octave mode. It was not just 1/1 octave data that was actually stored by the IE-45, but all resolutions from 1/1 octave to 1/12 octave. This stored data, then, can be viewed in any of the resolutions, either on the IE-45, or on your PC using IvieXLS-45.*

Once you have selected the resolution of the display (which you can go back and change at any time), you can select how you want to plot the information. "RTA Line" or "RTA Bar" selects how the information will be presented to you; in a line graph or a bar graph. Depending on the resolution you want, and the purpose for which you are creating the chart, select the type of display that best suits your needs.

You will note that there is a check box labeled "Average." If you have more than one curve on-screen, by checking Average, you can average the curves together to display one averaged curve. Uncheck the box and you will go back to the individual displays.

By clicking on the "Delta" button, you are presented with a control screen that allows you to select any two of the curves you have on-screen (you must have at least two curves on-screen for this feature to be useful) and subtract one from the other. Just follow steps 1, 2, and 3 on the Delta control panel, then click on the "Plot" button and you will see the result in the main display area.

Once the Delta curve is displayed, you can still change resolution, bar/line, scaling, etc. When you have the look you want, you can tap "Print Chart" and print out what is displayed in the main screen.

When you are finished with the Delta display, simply tap the "Return to Control Panel" button to return to the main control panel and the main display. Wait a sec!!! I've done that (you say) and the Delta display is still there. How can I get back to the regular display? You can't! (Just kidding) Simply tap any one of the resolution control buttons on the main control panel and you will be back to the main display.

Curve Matching

Let's talk about "Curve Matching." In the course of making measurements in the field you may end up recording curves of the same source that were measured at different distances from that source. Later, you may wish to put these similar measurements on-screen together to see how they compare (to determine HF loss with distance, or perhaps uniformity of coverage from one location to another, etc.). But when you do so, there may be a level difference due to the different distances at which the curves were recorded.

Curve Matching allows you to vertically move one curve with respect to the other on the screen so as to more closely overlay one on the other.

To use Curve matching you must have at least two curves on-screen. Then click on the Curve Matching button. You will be presented with a Curve Matching control panel. It is similar to the Delta control panel. Just follow steps one and two in order to select the curve you want to be the Master Curve (the one that doesn't move and becomes the master for the other[s]), and to select the "Curve to Adjust."

Step three allows you to adjust the one curve relative to the other. Select Major or Minor adjustment (adjusts the amount of movement per click of the up/down arrows) and then use the arrows to move the "Curve to Adjust" up or down to lay it over or "match" the Master Curve.

Tap the "Return to Control Panel" button to return to the main control panel. Tap any of the resolution buttons to remove the curve matching and return to the main display.

dB Scale

One of the adjustments you will want to experiment with is "dB Scale" selection. The dB Scale adjustment allows you to select 5, 10, or 15 dB per division on the amplitude display of the main screen. Depending on what you want to see (details or trends, for example) in your display, you can adjust the dB Scale.

In the same area of the main control panel you will find "dB Center." This allows you to move the displayed curves vertically on the screen by changing the dB value of the horizontal center line of the main screen display.

NC and NR Displays

NC and NR gives you the ability to display NC (Noise Criteria) or NR (Noise Rating) overlays on-screen. Read the IE-45 manual (page 24) for more information on NC and NR measurements.

A and C Weighting

The A Weight and C Weight selection boxes apply A or C weighting to the displayed curve(s). Sometimes you may wish to view the curve with weighting applied.

Add Text Label

The "Add Text Label" button brings up a sub control panel which allows you to create a text label and position it on the main display. This can be used to make special notes about particular characteristics of a curve, or just apply a general note on the main screen for printing or display. The note, or notes can be saved to the XLS file for future reference. Note that the "Add Text Label" function is just a simplified way of creating and adding notes. If one is familiar with Microsoft Excel, the normal methods of adding and locating notes, etc. can be employed.

Strip Chart

The "Strip Chart" function in IvieXLS-45 is used to display the special ".cha" files that are created when using the Strip Chart function of the IE-45. Tapping the Strip Chart button presents the special control panel for this function.

Use the "Select Data File" button to open the navigation screen in order to find the ".cha" strip chart file you want to display. Select the file and you will view its presentation in the main display window.

Using the "Edit" button in the Strip Chart control panel, you can, if you wish, attach a job name to the display chart.

Using the Zoom Level control in the Strip Chart control panel, you can choose the number of data points you want to view per page, and the number of pages or screens you want to view simultaneously on the display.

Use the "Screens Control" to move from one screen to the next. (The left and right PC keyboard arrows will also page from screen to screen. As you are looking at the screen, you will notice a time reference at the bottom of the screen and amplitude reference on the left vertical axis of the screen.

You can also use the "Add Text Label" control to put text notes on the screen to annotate certain events or areas of interest.

Printing, Saving, Viewing Numerical Data

Finally, you can print the chart or save it with your annotations for later review. Click on "Return to Control Panel" to come back to the main control panel.

Print Chart

"Print Chart" takes you automatically to the print function of your Windows based PC. Your main display screen will print.

Save As

"Save As" takes you to a standard Windows screen that will allow you to save your work to a file in the location of your choice on your hard drive.

Table of Levels

The "Table of Levels" function presents on-screen, the actual numerical data that is used to build the graphic displays for different resolutions. This is not the "raw" data, but rather the amplitude data for each of the octave band resolutions: 1/1, 1/3, 1/6 and 1/12. In some instances, it can be useful to view the numerical data. Table of Levels allows you to do this.

At this point, you should have most everything you need to begin navigating the IvieXLS application. It will take some experimentation and practice to determine the best way to format, display and print the data for your specific requirements.

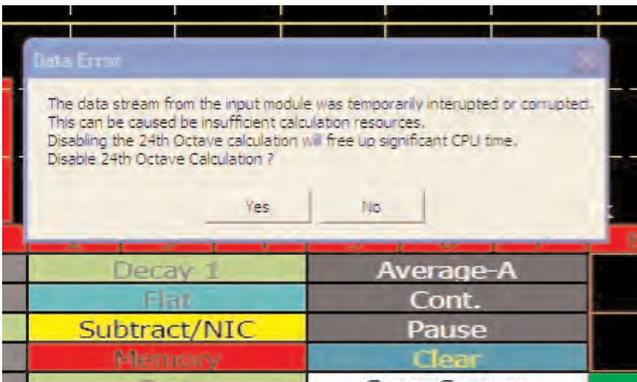
Speed and “Horsepower”

Because the IE-45 RTA software is simultaneously running four digital filter sets (octave, 1/3 octave, 1/6 octave and 1/12 octave) and an FFT (which facilitates the “Frequency Detect” feature), it can be quite CPU intensive. For those computers with the speed and processing power to handle the RTA software (the Samsung Q1, for example), this is never a problem. However, all Windows® XP machines are not created equally. Even if the same processor is used by two different machines, there may be, on one of them, hardware features associated with the processor, or software features that can’t be turned off, which compromise the processor’s capacity to run the IE-45 RTA software at optimum performance. This manifests itself as “dropped data” and, in some instances, degraded display ballistics.

IVIE has added a feature to the software that will never be seen unless data is being dropped. When this occurs, a warning window will pop up telling you that data is being dropped and giving you the option to deactivate the 1/12 octave filter set. The 1/12 octave filter set requires more processor capacity than the other three sets of filters combined, so disabling it dramatically lowers processor consumption, thus allowing the RTA software, with this slightly reduced feature set, to run smoothly on a less-than-optimum computer. When turned off, the 1/12 octave filter set processes no data whatsoever and the 1/12 octave display is non-functional. Once disabled, the 1/12 octave filter set will stay disabled until you make the conscious choice to enable it again.

Of course, you can choose not to disable the 1/12 octave filter set, even though you may occasionally drop data. This may not be a significant problem. If, on the other hand, the dropped data warning is constantly appearing and display ballistics are suffering, corrective action may be a good idea.

As an option, the display screen refresh rate can be slowed, as detailed below, to help disencumber the CPU.

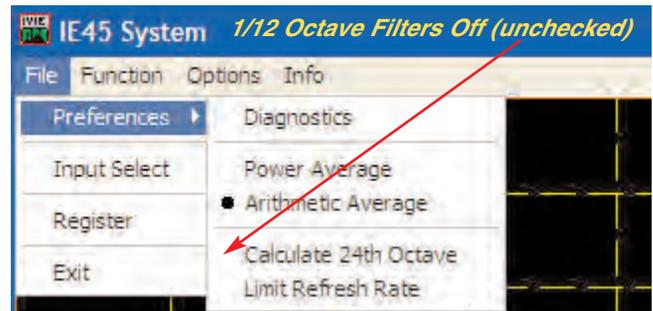


Dropped Data

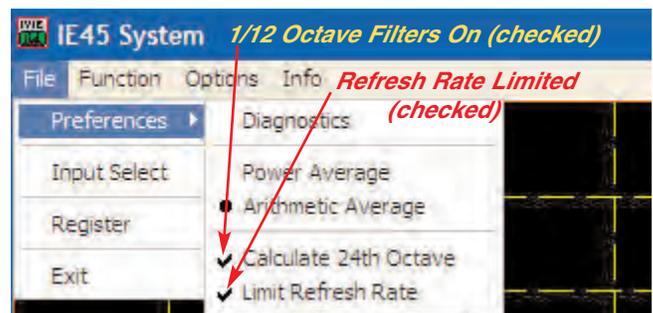
When the IE-45 RTA software detects that data is being dropped, the warning window shown above pops up. This window gives you the option of turning off the 1/12 octave filter bank, thus allowing the RTA software to run successfully on a less-than-optimum computer.

Once disabled, the 1/12 octave filter set will stay disabled until you make a conscious choice to enable it again. It can be enabled from the “Preferences” menu found under the “File” pull-down menu.

The pop-up “Preferences” window also provides for adjusting the display screen refresh rate, as detailed by the illustrations to the right.



You can activate (check), or disable (uncheck) the 1/12 octave filter set using the “File” > “Preferences” Menu. From this menu, you can also limit (check) the display screen refresh rate. This alone, without disabling the 1/12 octave filters, may be sufficient to improve the performance of some computer systems. As shown below, the 1/12 octaves filters are active, but the screen refresh rate has been limited.



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