Cumulative Software Release Notes:

MLSSA versions 10WI thru 10WI Rev 9

Windows XP, 2000, NT — **Analysis Mode Only**
Male & Female STI Updated — **Third Edition (2003-03) of IEC 60268-16**
Last Filename Recall — **Speeds Creation of QC limits Files**
Calculate Acoustic-center command — **Speed of sound in REVERB.INI**
MLSSA SPO Automatically Initiates DC Resistance Calibration
MLSSA SPO Configures RCAI for Z Measurements — **QC Driver Response + T/S Parameters**
MLSSA SPO Documentation Update — **Test Box Volume Corrections for Closed-Box Method**
Go Impedance Command Always Uses Rectangular Time Window
QC Polarity Checking Supported with the Adaptive Window
Auxiliary Reference Impedance Options
Enhanced Screen Capture Command
Enhanced Dump Command — **Printing to the Windows Printer**
Exporting Waterfall Data to Excel — **Circular Polar Plots**
Enhanced Frequency Domain Import Features
Default Directory Options for Macro and Setup Files
Support for the MLSSA Remote Controlled Analog Interface
Vertical Scaling Options for Overlays
Splice and Import Huge Files
Calculate Weighted-level Command
Auxiliary Reference Corrects for Test Lead Residual Impedance

Windows XP, 2000, NT — **Analysis Mode Only**
MLSSA version 10WI Rev 9 will run under Windows XP, 2000 and NT in analysis mode only. You cannot perform actual measurements under these Windows versions but you can load and analyze TIM and FRQ data files. Whenever *MLSSA* detects it is running under Windows XP, 2000 or NT it automatically enters analysis mode. Note that under Windows XP, 2000 and NT printing is significantly slower than under Windows 98SE, both when printing direct from *MLSSA* and when using the *Pizazz 5* printer driver. In addition, *MLSSA* only runs full screen on these Windows versions but can be minimized to allow you to run other Windows programs without having to Quit *MLSSA*. WARNING: If you create a shortcut to *MLSSA* under XP, DO NOT select the Full Screen option under the Screen tab of the shortcut Properties as that will result in *MLSSA* not starting successfully: Use the default Window option only.

Male & Female STI Updated — **Third Edition (2003-03) of IEC 60268-16**
MLSSA version 10WI Rev 9 updates the Calculate STI Men and Calculate STI Women commands to conform to IEC 60268-16 Third Edition (2003-03). There are two changes. First, the absolute threshold of hearing is accounted for. Thus, STI values will decrease with decreasing signal levels at the listening position, even in cases where there is negligible interfering noise. Second, the auditory masking correction factor now depends upon the absolute SPL level in each octave band at the listening position. In prior versions, the auditory masking correction factor was not a function of the absolute SPL level

within each octave band but depended only upon each octave band level *relative* to the next lower octave band level. Because both changes require knowledge of absolute SPL levels at the listening position, that is, where the measurement microphone is positioned, you must use the Library Microphones command to enter your microphone sensitivity and preamp gain and you also need to select this microphone/preamp combination prior to performing measurements. If no microphone/preamp combination was defined and selected prior to performing measurements, the Calculate STI Men and Calculate STI Women commands will refuse to perform the analysis. In cases where you have archived old TIM files that do not contain microphone calibration data, use the Library Microphones Modify-file command to enter, as best as can be determined from memory or from notes, your best estimate of the microphone sensitivity and microphone preamp gain existing at the time when the original measurement was performed.   Whenever the Calculate STI Women or Calculate STI Men commands are executed, the second row in the MTF matrix previously labeled "m-correction" (masking-correction) is replaced by the new label "m/thresh-cor" (masking/threshold-correction). This new label indicates that the displayed correction factors now include two corrections: the new more sophisticated auditory masking correction as well as the absolute hearing threshold correction, both according to IEC 60268-16 Third Edition. The Calculate STI Full and Calculate STI Rapid commands are not affected by these changes: Both commands operate the same as in prior versions and therefore do not require microphone calibration data.

Last Filename Recall — Speeds Creation of QC limits Files
MLSSA commands such as Transfer Load and Transfer Save have long offered a time saving feature using the Up arrow key. When these commands are prompting you to enter a filename, pressing the Up arrow key causes the last filename you had loaded or saved the last time to be re-entered for you. *MLSSA* version 10WI Rev 8 adds this feature to the Transfer Import and Transfer Export commands in both the time and frequency domains. This feature was also added to the Waterfall Text-export-file command, the QC-limits Load command as well as *MLSSA SPO* commands: Export, QC Limits Load and QC File Open. The last filename recall feature is useful for the various Save and Export commands if you need to continually overwrite the same TIM, FRQ or TXT file with new measurement data. Another application is in the creation of the QC upper and lower limit curves, as specified within QC limits files. Since *MLSSA* normally uses cubic spline interpolation when loading QC limits curves (and also when importing text files into the frequency domain), there is a possibility of overshoot or ringing if too few data points are specified to describe the desired curve near sharp changes in its slope. To add more data points from Windows minimize *MLSSA* by pressing Alt-Space-bar then start Notepad (Programs Accessories Notepad) to load and edit the QC-limits file in question. After editing, click File then Save but do not exit Notepad. Click on *MLSSA* to maximize then execute QC-limits Load followed by the Up and Enter keys to re-load the modified QC limits file. Next, execute QC-limits Compare to see if your changes solved any ringing or overshoot problem. If not, simply minimize *MLSSA* once again, go back to Notepad, make further changes and save again. Repeat as many times as needed until the displayed limit curves are what you want, then exit Notepad. When running under DOS, the procedure is a little more involved: From *MLSSA* execute DOS Shell and use a DOS text editor such as EDIT to edit the QC limits file. Exit the text editor with changes saved and from DOS type Exit followed by the Enter key to resume *MLSSA*. Execute QC-limits Load followed by the Up and Enter keys to re-load the modified QC limits file. Execute QC-limits Compare to see if the limit curves are what you expected.

Calculate Acoustic-center command — Speed of sound in REVERB.INI
The Calculate Acoustic-center command is a frequency domain command which, when applied to the measured excess phase curve, determines the acoustic center of loudspeaker drivers relative to the measurement microphone position. The result is displayed as both a distance in meters and as a delay in milliseconds shown in parentheses. In prior *MLSSA* versions, the speed of sound was assumed constant and could not be changed. This could lead to a significant error in the displayed acoustic-center distance if the air temperature is significantly above or below 22 °C, and/or when the distance to the measurement microphone is large. The speed of sound in air varies somewhat with temperature and much less so with relative humidity. *MLSSA* version 10WI Rev 8 allows you to change the speed of sound *MLSSA* uses for the Calculate Acoustic-center command. The speed of sound is now stored near the end of text file REVERB.INI located in the main *MLSSA* directory. Therefore, you can edit REVERB.INI and enter a more accurate value for the speed of sound that applies to your particular circumstances. Several calculators are available on the Internet that determine the speed of sound based on temperature and/or humidity inputs.

MLSSA SPO Automatically Initiates DC Resistance Calibration
MLSSA SPO version 4WI Rev 8 automatically calibrates itself for accurate DC resistance measurements whenever necessary. In previous versions, when in the Measure DCR mode and when executing the Go or Calc commands for the first time, *SPO* would respond with the message "Execute DCR-mode Calibrate Auto". Thus, the user needed to manually execute the DCR-mode Calibrate Auto command in order to calibrate *SPO* for accurate driver DC resistance measurements. In *MLSSA SPO* version 4WI Rev 8, this calibration cycle is entered automatically whenever such calibration is deemed necessary by *SPO*, thus saving time and keystrokes. When issuing a Go or Calc command for the first time while in the Measure DCR mode, you will be prompted to open and then to short your test leads. The first step allows *SPO* to measure the exact DC gain of the signal path. Shorting your test leads allows *SPO* to measure their residual DC resistance. (Note if the *MLSSA RCAI* is connected, you will only be prompted to short your test leads briefly to measure their residual series resistance; the *RCAI* is automatically configured to measure the DC gain.) After completing these steps, the Go command will next prompt you to reconnect your test leads to the driver terminals in order to measure its DC resistance and then its impedance to determine its T/S parameters. Further Go or Calc commands will not initiate a new DCR calibration cycle unless something in the *MLSSA* setup was changed (e.g. a new reference measurement). In addition, if the DC resistance of your test leads measures over 3 ohms an error will be issued and the calibration aborted. This resistance check was added to avoid possibly erroneous DC resistance measurements that will result if the test leads were accidentally left open or, left connected to the driver during the calibration step requiring they be shorted. A high residual test lead resistance reading could also indicate a poor electrical connection due to an internal wire break or due to corrosion or residue on the test clips. If you receive this error, repeat the command being careful to follow all prompts exactly. Note also that you can get a high test lead resistance reading due to the test clips not being fully open during that step of the calibration. If the calibration is still unsuccessful, check all connections and clean the test clips with acetone or similar solvent to remove any oils or other non-conductive residue. If no problem is found you may need to substitute heavier gauge test leads in order to reduce the total series resistance of your test leads and test clips down to less than 3 ohms.

MLSSA SPO Configures RCAI for Z Measurements — QC Driver Response + T/S Parameters
MLSSA SPO version 4WI Rev 8 automatically configures the *MLSSA RCAI* to measure impedance whenever *SPO* is entered and *MLSSA* is currently *not* in the Impedance FFT mode. This feature can be

used to perform QC PASS/FAIL testing of driver frequency response followed immediately by QC PASS/FAIL testing of the same driver's T/S parameters via *SPO*. For example, suppose *MLSSA* and the *RCAI* are both configured to measure speaker driver frequency response using a microphone and the pink-MLS stimulus. Upon entering *SPO* the *RCAI* is automatically re-configured to measure impedance using the white-MLS. Therefore, upon entering *SPO* you can straight away perform driver T/S parameter measurements even if you were previously measuring driver frequency response. Upon exiting *SPO*, the *RCAI* is restored to its original state, thus allowing you to immediately resume measuring driver frequency response or, whatever measurement *MLSSA* was configured to perform prior to entering *SPO*. You can also fix the *SPO* analysis window frequency range in order to free up the marker and cursor for other purposes, such as to define the QC PASS/FAIL frequency range for QC testing of driver frequency response. To set and store the *SPO* analysis window, execute Go Impedance to measure the driver's impedance. Set the marker and cursor positions for the desired *SPO* analysis window frequency range and execute Library Parameters to enter *SPO*. *SPO* will respond with a high-pitched beep and the message: "SPO analysis window stored: " followed by the analysis window frequency range you had selected using the marker and cursor. Press Esc to return to the frequency domain. Execute Go Once to perform a frequency response or other non-impedance measurement. From this point, you can set the marker and cursor as desired for any other purpose without affecting the *SPO* analysis window, as long as you enter *SPO without* a displayed impedance curve that was previously measured using the Go Impedance command. Note that when *MLSSA* is displaying an impedance curve loaded from disk or, even one previously measured by *SPO* itself, the current marker and cursor positions are ignored by *SPO,* thus preventing inadvertent changes to the *SPO* analysis window. To set a new *SPO* analysis window, execute Go Impedance, set the marker and cursor positions for the new analysis window frequency range and then enter *SPO* again to store the new analysis window. Choose an FFT size large enough to ensure sufficient frequency resolution for accurate *SPO* measurements. The recommended setup file is LOUDS-Z.SET, which programs a 20 kHz measurement bandwidth and a 16,384-point FFT. This setup file optimally configures *MLSSA* for both acoustic frequency response measurements up to 20 kHz, as well as T/S parameter measurements via *SPO*. If a *MLSSA RCAI* is not connected, *SPO* operates as before, that is, *MLSSA* must already be in the impedance FFT mode upon entering *SPO* to perform T/S parameter measurements.

MLSSA SPO Documentation Update — Test Box Volume Corrections for Closed-Box Method
For highest accuracy using the closed-box method you should account for the volume of the mounting hole in your test box as well as the volume enclosed by the driver cone. The driver should be mounted to the test box with its magnet assembly located outside of the test the box to facilitate these corrections. The opening hole into the test box should have a diameter large enough to completely clear the driver's surround but small enough to ensure a good seal to the driver's mounting face. The volume added by the mounting hole is simply the volume of a cylinder, which is calculated as the product of the area of the mounting hole and the thickness of the box material. To this must also be added the enclosed volume of the frustum of a cone formed between the driver's opening face and its dust cap. This cone frustum volume can be calculated according to:

$$V_{cone} = \frac{1}{3} h \left(S_O + S_C + \sqrt{S_O S_C} \right)$$

In this equation, So is the area of the driver's cone. The value of So is calculated from a measurement of the cone diameter that excludes all of the surround material. Sc is the area of the driver's dust cap, which is calculated from a measurement of the dust cap's diameter. Finally, h is the depth of the dust cap

relative to opening face of the driver. The value of h can be found by placing a flat reference, such as a ruler, across the face of the driver. Use calipers to measure perpendicular from the bottom of this reference surface down to the top of dust cap. It is suggested that all linear measurements be in centimeters with the result that the calculated volume will be in units of cubic centimeters (cc). Multiplying the result by 1000 yields liters. In summary, the total effective volume of the test box is the sum of the basic internal test box volume plus the volume of the mounting hole plus the volume enclosed between the driver's opening face and its dust cap. Enter this total effective volume of your test box into the Library Parameters Method Box-loaded command to ensure the highest degree of accuracy for the closed-box method.

Go Impedance Command Always Uses Rectangular Time Window
The Go Impedance command, when invoked in conjunction with the *MLSSA RCAI,* allows you to perform impedance measurements at any time, even when *MLSSA* is configured to measure acoustic frequency response. In prior software versions, the Go Impedance command would apply whatever time window shape (for example, the half-Cosine window) you had previously selected through the FFT Window command. Acoustic measurements may benefit from non-Rectangular window shapes to avoid truncation effects. Impedance measurements, in contrast, are most accurately calculated using a Rectangular window shape. Therefore, staring with *MLSSA* version 10WI Rev 7, the time window used by the Go Impedance command is always the Rectangular window regardless of the window selected through the FFT Window command. Note that this change only affects the Go Impedance and the QC Go Impedance commands. When *MLSSA* is configured to perform impedance measurements through the Go Once command, the time window you select through the FFT Window command will be applied,

QC Polarity Checking Supported with the Adaptive Window
The QC Compare and QC Go Once commands support optional polarity checking of the impulse and step responses. In all prior versions, QC polarity checking was not supported when the Adaptive Window was selected or when the FFT size exceeded 4096 points. *MLSSA* version 10WI Rev 7 adds support for automated polarity checking when the Adaptive Window is selected and well as for FFT sizes greater than 4096 points, provided there is sufficient memory available. Since the polarity checking algorithm considers only the time domain data lying between the marker and cursor positions, selecting a smaller time window decreases the amount of memory required. Note that, as in all prior versions, QC incoherency checking is not supported when the Adaptive Window is selected or when the FFT Size exceeds 4096 points.

Auxiliary Reference Impedance Options
Starting in version 10WI, the Auxiliary reference behaves differently when it is used to store impedance measurements. When the main and Auxiliary reference are both impedance data, the Auxiliary reference is subtracted from, rather than being divided into, the main data, on a complex basis. However, there are some QC applications in which dividing the Auxiliary reference into the main data makes sense for impedance measurements. In version 10WI Rev 6, you can force the Auxiliary reference to always be divided into the main data, on a complex basis, even for impedance data. To do this first Quit *MLSSA* and edit the text file MLSSA.INI, located in the main *MLSSA* directory. You'll need to change the sign of the entry for the "ISA bus recovery time" from a plus to minus. After saving this file with the change, you'll next need to re-start *MLSSA* for the change to take effect. With this change in effect you can no longer use the Auxiliary reference to correct for the residual impedance of your test leads (see below).

Enhanced Screen Capture Command

The Alt-4 utility command allows you to capture any *MLSSA* screen and save it to a PCX graphics file. This PCX file can then be imported into other applications such as word processors. The Alt-4 capture command now includes a new option to adjust the screen colors for later printing on white paper. This option reverses black and white and then adjusts all remaining colors for optimum contrast when printed on white paper. Additionally, when invoking the Alt-4 command and pressing the Up arrow key, the last PCX filename used is automatically entered. This option eliminates the need to keep re-typing the same filename repeatedly when making multiple captures to the same PCX file.

Enhanced Dump Command — Printing to the Windows Printer

One disadvantage of the Alt-4 screen capture command is that it captures the screen without allowing you to enter any comment. This shortcoming is rectified in version 10WI Rev 5 by changing the way the Dump command works. Normally, the Dump commands are used to print through the Pizazz 5 for DOS (PZ5) printer driver supplied with *MLSSA* versions 10W and above. In *MLSSA* version 10WI Rev 5, all Dump commands can optionally be re-directed to invoke the Alt-4 capture command. The advantage is that the Dump commands allow you to enter a comment, which will be captured as well. This new feature is enabled through the new Printer Driver Mode command. The Capture-to-PCX-file mode re-directs all Dump commands to the screen capture utility. The PZ5 mode directs the Dump commands to the Pizazz 5 printer driver as in past versions. Note that if *MLSSA* does not detect Pizazz 5 at start up, then the mode is automatically set to Capture-to-PCX-file. This new mode also allows you to use Pizazz 5 Edit to print any captured *MLSSA* screen to the Windows printer. To do this, simply use the Printer Driver Dump command to capture a *MLSSA* screen with an optional comment to a PCX file. Next, from Windows, start Pizazz 5 Edit and click File Open to open that PCX file. Print this file using the File Print command. To print another screen, return to *MLSSA* and Dump another *MLSSA* screen to the same PCX filename. Next, return to the Pizazz 5 Edit program and click on the same PCX file as before, which will be listed in the File menu. This same PCX file, containing the new image data, will be re-loaded and can then be printed. Although more cumbersome than normal printing, this method allows you to print to any printer supported by Windows, even USB printers not supported by *MLSSA* or by Pizazz 5 for DOS.

Exporting Waterfall Data to Excel — Circular Polar Plots

As in previous *MLSSA* software versions, the Waterfall Text-export-file command exports waterfall data to the specified text file whenever Waterfall Execute is invoked. The format of this text export file has been enhanced in version 10WI Rev 4 for easier importing into MS Excel.
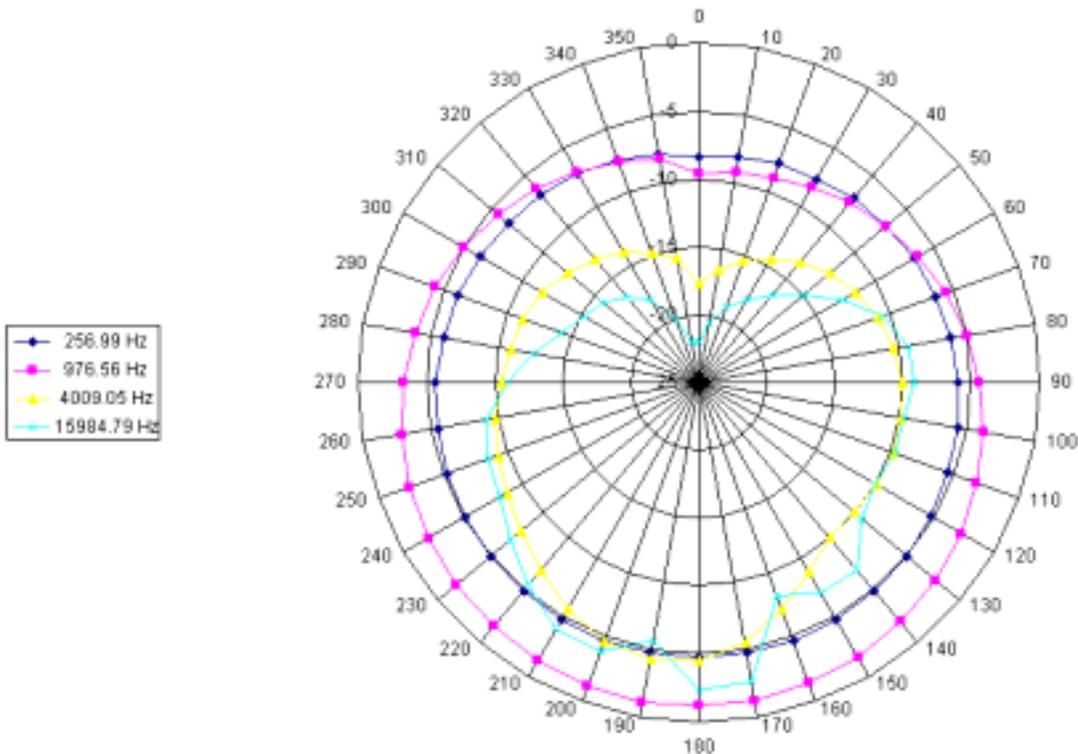
Example Circular Polar Plot using Excel

The exported text file now includes an extra column preceding the first column of data, which labels each row of data. For example, if the exported data is loudspeaker polar response measurements, the first column will be a list of all the angles of the polar data. Similarly, an extra row is included above the first row of data, which labels each column of data. Each column always corresponds to a frequency in Hz. Once the waterfall data is imported into Excel, it's a simple matter to use Excel's radar chart option to plot polar data in a circular fashion. The waterfall data is exported in all waterfall modes including Frequency File Display (FFD) for polar measurements, Cumulative Spectral Decay (CSD), Energy Time Frequency (ETF) and Wigner distribution. Once imported into Excel, any and all of Excel's graphics and processing functions can be applied to the waterfall data.

The Waterfall Text-export-file command also prompts you for the desired frequency spacing of the exported waterfall data. Enter a fractional-octave value from 0.01 to 2.0 or, enter a value of zero to export the waterfall data at full resolution and with linear frequency spacing. Note that when the Waterfall FFT-size is large in the case of CSD, ETF and Wigner waterfall plots, or when the FFT size of the displayed FRQ files is large when in the Frequency File Display waterfall mode, a huge amount of data can be exported when linear frequency spacing is selected. When importing such files, Excel may not import many of the highest frequency data columns due to Excel's limit of 230 data columns maximum. By entering a small value such as 0.1 octave, *MLSSA* will export the waterfall data at a frequency spacing of 0.1-octave which greatly reduces the number of high frequency data columns thus overcoming Excel's upper limit of 230 columns. If you are only interested in graphing polar data at a handful of frequencies, enter a large value. For example, by entering a 2.0-octave frequency spacing, *MLSSA* will export the

data at frequencies spaced by two whole octaves; this is, at roughly 125 Hz, 500 Hz, 2 kHz, 8 kHz. This option is ideal for graphing polar data since all four columns can be selected at once to generate an Excel radar chart that includes all four frequencies.

From *MLSSA* invoke Waterfall Execute to generate and export the polar data to the specified text file. To import the text file, press Alt-space from *MLSSA* to switch to the Windows desktop. Start Excel and select Data then Get-External-Data followed by Import-Text-File. Enter or select the filename you entered previously into the *MLSSA* Waterfall Text-export-file command and click Import. The Excel import wizard will appear. Under "Original data type", click the Delimited option and then click Next. Click the Comma button to select comma delimiting and be sure to de-select all other delimiters. Click Finish then click OK. The exported text file is now in an Excel spreadsheet including the header information. The first line of the header will be the time domain comment, which can be modified in *MLSSA* by the Transfer Comment Enter command from the time domain. If no comment was defined prior to Waterfall Execute, the phrase "MLSSA waterfall data" will be displayed on the first line. In the FFD waterfall mode, row 13 of the Excel spreadsheet displays contains the exported frequencies in Hz while column A lists the exported z-axis values in units of "degs" (degrees) of angle. The waterfall z-axis units are "msec" (milliseconds) for CSD, ETF and Wigner plots. Note that you can switch at will from *MLSSA* to Excel and back again, re-export and re-import the same file repeatedly with different waterfall settings, different waterfall data or a different time domain comment until you get the results you want.

To plot polar data in a radar chart you need to first select one or more columns of polar data. Note that if less than a full 360 degrees of polar data is available in each column, you need to select a sufficient number of blank cells below the data cells to represent a full 360 degrees. For example, if there are just 19 cells of data in each column representing 0 through 180 degrees at 10-degree intervals, you need to include 17 additional blank cells below the data cells, that is, select 36 cells per column for a total range of 360 degrees. Even though the extra cells contain no data, selecting them along with the cells that do contain the data is necessary to produce a radar style graph with a full 360 degrees in a circle. To facilitate selecting the correct number of empty cells, return to *MLSSA,* invoke Waterfall Cycles and enter 36, assuming 10-degree resolution polar data. Next, invoke Waterfall Perspective and select the Reverse option. Waterfall Execute will now output 36 angles ranging from 0 to 350 degrees into the export file even though only 19 rows will contain polar data. Switch back to Excel and re-import the file. Note that column A now contains angles 0 thru 350 degrees. Select the column or columns of polar data you wish to include in the polar plot using the mouse while holding down the left mouse button being sure to select enough empty cells to make up a range of 360 degrees.

Once you have selected at least one column of polar data including the correct number of pad cells to make up a range of 360 degrees, click Insert then Chart then select the radar chart type and then click Next. Click the Series tab and then the "Category (X) axis labels" area so that the cursor appears there. Move the mouse back over the spreadsheet and select the column of angle values, which appear in column A and include 36 cells to make up a range 360 degrees. This last step labels the polar plot angles in degrees.

To add more columns of polar data, click the Add button then click the values area and press backspace several times to clear it. Select another column of polar data at a different frequency, being sure to select the same number of empty pad cells as before to make up 360 degrees. You can optionally rename each

data series according to the frequency value displayed at the top of each data column. Press Next twice. Click the button indicated to display the chart as a new spreadsheet.

The above procedure is not intended to be exhaustive in explaining how to use Excel to graph exported *MLSSA* waterfall data. See the Excel documentation and online help for making fine adjustments to the graphic presentation.

Enhanced Frequency Domain Import Features
In the frequency domain, the Transfer Import Text, Overlay iMport Text and Reference iMport Text commands will now read a wider variety of text file formats. In addition to standard comma delimited text files, space delimited text files can be imported. Additionally, any text preceding the data is ignored whether enclosed in double quotes or not. These changes allow for directly importing LEAP GDT files. Note that some exported LEAP GDT files contain duplicate frequencies. *MLSSA* will refuse to import such files and will issue an error message with the line number where the duplicate frequency lies within the file. In such cases, you must use a text editor to edit out the offending line before you can import the file successfully into *MLSSA*. Also, note that some other LEAP export files are in descending order of frequency. *MLSSA* does not import such files. *MLSSA* always presumes the data in a text file is listed in order of ascending frequency. Any duplicate or out-of-order frequencies will result in an error and the import command will abort.

Default Directory Options for Macro and Setup Files
Starting in version 10W, all *MLSSA* macro files and setup files are presumed to reside in the *MLSSA* program directory regardless of the current default DOS directory as controlled by the DOS change-Directory command. In version 10WI Rev 4 you can override this default on a case-by-case basis by entering the characters " .\ " before a setup or macro filename. In that case, *MLSSA* will look for the file in the default DOS directory. For example, when executing Setup Load and entering .\LOUDS, *MLSSA* will look for setup file LOUDS.SET in the default DOS directory.

In *MLSSA* versions prior to 10W, all files including setup and macro files were presumed to reside in the default DOS directory. *MLSSA* users who wrote macros under the older *MLSSA* versions and would like to run them unmodified under 10WI Rev 4 can force *MLSSA* to use the older convention. To do so, edit text file MLSSA.INI located in the *MLSSA* program directory and add a minus sign before the entry for the "Default macro buffer size in keystrokes". Upon re-starting *MLSSA*, all files, data, setup and macro will be loaded from the default DOS directory unless an explicit path is given.

Support for the MLSSA Remote Controlled Analog Interface
MLSSA version 10WI provides integrated control of the *MLSSA Remote Controlled Analog Interface* (*RCAI*). This external unit significantly enhances the functionality of *MLSSA* in several key areas. First, it permits virtually simultaneous measurement of loudspeaker frequency response and loudspeaker impedance. The new Go Impedance command instantly re-configures *MLSSA* and the *RCAI* to perform impedance measurements regardless of the current *MLSSA* setup. After the impedance measurement is completed, the *RCAI* is returned to its previous state ready to perform more frequency response measurements or whatever measurement *MLSSA* is currently configured to perform. Furthermore, impedance and frequency response measurements can now be graphed and printed simultaneously. See below under "Vertical Scaling Options for Overlays" for details.

With the *RCAI* connected, the Reference Go command instantly re-configures it to perform a loopback reference measurement of your power amplifier. There is no need to change cables or perform any other manual steps. Once performed, this reference measurement is valid for both loudspeaker sensitivity as well as loudspeaker impedance measurements. The loopback reference measurement is made through a precision 13-dB attenuator allowing you to safely measure power amplifiers rated at up to 1000 watts. The *MLSSA* software automatically accounts for the 13 dB of attenuation in all subsequent analysis.

The *MLSSA RCAI* also provides a four-input microphone multiplexer. In the frequency domain, the Go Spatial-average command automatically steps through all connected microphones starting with the currently selected one. This feature eliminates the need to manually re-position a single microphone to perform spatially averaged room or loudspeaker measurements. Up to 16 microphones can be multiplexed by daisy chaining up to four *RCAI* units. Each microphone's unique sensitivity and preamp gain is automatically accounted for in the spatial averaging calculations.

The *MLSSA RCAI* also controls the stimulus. It selects between the pink-MLS, the white-MLS or an Aux signal source all under software control. The Aux source can be an external signal generator or music signal.

Turntable control is supported by the *RCAI*, as in past *MLSSA* versions, through the Macro Command Signal and Macro Command Wait commands. The only difference is that the turntable is connected to the TURNTABLE / EXPAND connector located on the front panel of the *RCAI*. The cable length to the turntable can be much longer when using the *RCAI* compared to connecting the turntable directly to J4 on the *MLSSA* card. This is due to high performance line drivers and receivers within the *RCAI* that buffer the turntable handshake signals.

See the *MLSSA Remote Controlled Analog Interface Reference Manual* supplied with the unit for detailed applications information.

Vertical Scaling Options for Overlays
In version 10WI, the vertical scale and units for overlays need not match the vertical scale and units of the main trace. For example, an impedance curve can be overlaid on top of a frequency response curve and both can be clearly seen simultaneously. The type of vertical scale for plotting overlays is controlled by the new Overlay Vertical-scale command, which is available in both the time and frequency domains. There are three options: Normal, Auto and Fixed. The Normal option causes overlays to be plotted, as in past versions of *MLSSA*, with same vertical scale as the main trace. The Auto option causes overlays to be autoscaled. In that case, the possibly different vertical scale labels for the overlay data are drawn just below the vertical scale labels for the main trace data. There are thus two vertical scales on the screen simultaneously, as shown in the figure below. In addition, a description of the overlay data is displayed in the lower-left inside corner of the graphics area. The units of the overlay data need not match the units for the main trace. The Fixed option allows you to enter your own arbitrary vertical scale for the overlay data.

The overlay vertical scale setting for time domain overlays can be different from the setting for frequency domain overlays. The current settings in both domains can be saved to a *MLSSA* setup file through the Setup Save command. The saved settings will take effect whenever that setup file is loaded in the future.

This allows you to define a fixed vertical scale for overlays for certain applications and save that fixed scale in a setup file.
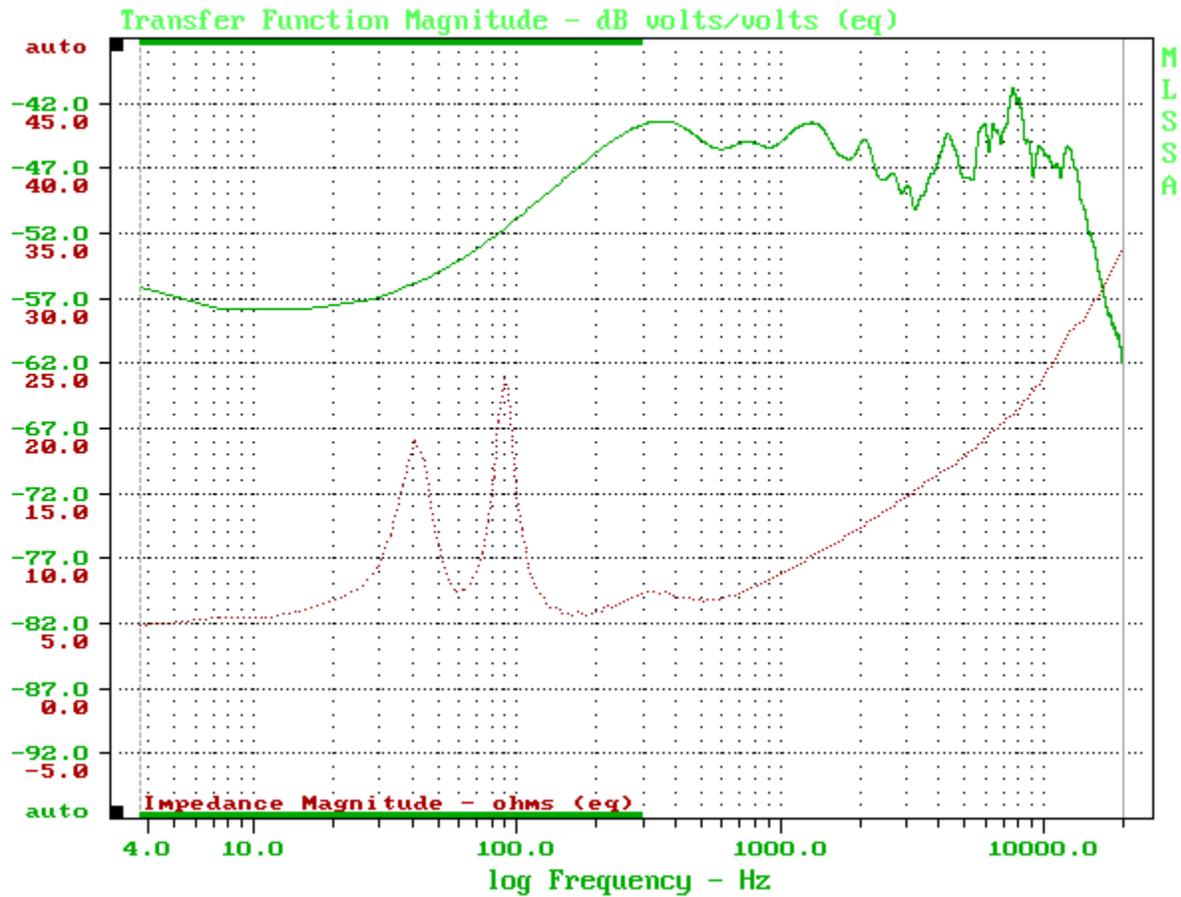
Simultaneous Display of Loudspeaker Frequency Response and Impedance

If an impedance curve is overlaid on top of a frequency response or other curve displayed in decibels, the impedance magnitude is displayed in units of ohms, not dB ohms. This makes it easy to display and print a loudspeaker's frequency response simultaneously with its impedance. An example is shown in the figure above. This feature is best used with the *MLSSA Remote Controlled Analog Interface,* which facilitates performing both loudspeaker impedance and frequency response measurements without swapping cables or changing the *MLSSA* setup.

The new Overlay Erase command erases any displayed overlay from the screen but not from memory. This command is equivalent to pressing Shift-F3.

Splice and Import Huge Files
In version 10WI, the cubic spline interpolation routines were re-written to implement virtual memory thus permitting splicing or importing huge frequency domain data and text files. In past *MLSSA* versions, the import and splice commands would often fail due to insufficient memory when attempting to import or splice large data or text files containing more than a few thousand data points. You can now import

frequency domain data files (FRQ) as well as frequency domain text files containing up to 32768 complex frequency points, equivalent to using a 65536-point FFT, the largest FFT size supported by *MLSSA*.

MLSSA employs cubic spline interpolation to change the frequency spacing of a frequency domain data file or imported text file to match some other desirable frequency spacing. For example, suppose the frequency spacing of an FRQ file you wish to overlay does not agree with the main data display. Rather than loading the file though the Overlay Load command, you should load it through the Overlay iMport Binary command. Importing the file interpolates the data to match the main display frequency spacing. Otherwise, you would not be able to plot the overlay.

In addition to the import functions, spline interpolation is used by the Library Operations Frequency-files spLice command. With the improved spline interpolation routines, there is no practical limit on the size of the two FRQ files to be spliced together.

Because virtual memory exacts a noticeable speed penalty on slower PCs, spline interpolation for the QC Limits-load command is still memory based for the highest possible speed when loading QC limits files in a production environment. QC limits files are typically quite small, containing only a few tens of data points so the amount of temporary memory required when interpolating them is too small to be of concern.

Calculate Weighted-level Command
In the frequency domain the Calculate Weighted-level command calculates the A-, B- and C-weighted average energy level over the entire audio band to 20 kHz or to the selected measurement bandwidth, if less than 20 kHz. This command can be applied to any curve displayed in decibels. Its main purpose is to compute B-weighted sensitivity from a calibrated sensitivity vs. frequency curve. Like the Calculate Level command, this new command compensates for the linear frequency spacing of the data points. Unlike the Calculate Level command, which is applied over a selected frequency range, the Calculate Weighted-level command is always applied over the entire audio band. The Calculate Weighted-level Flat command computes the unweighted average level over the entire audio band.

Auxiliary Reference Corrects for Test Lead Residual Impedance
In version 10WI, the Auxiliary reference behaves differently when it is used to store impedance measurements. Normally, the Auxiliary reference is divided into the main trace data on a complex basis. This results in a decibel difference curve being displayed for frequency response measurements. Since decibels make little sense for impedance data, the Auxiliary reference is subtracted, on a complex basis, from the main data when both contain impedance data. This allows you to use the Auxiliary reference to store the residual impedance of your test leads, which will then automatically be subtracted, on a complex basis, from subsequent impedance measurements. This correction not only accounts for the residual DC resistance of your test leads but also their inductance permitting the use of longer test leads for impedance measurements without compromising accuracy. You simply short together the test leads, measure their impedance and execute Reference Auxiliary Store. Subsequent impedance measurements will then be corrected for the residual impedance of your test leads.