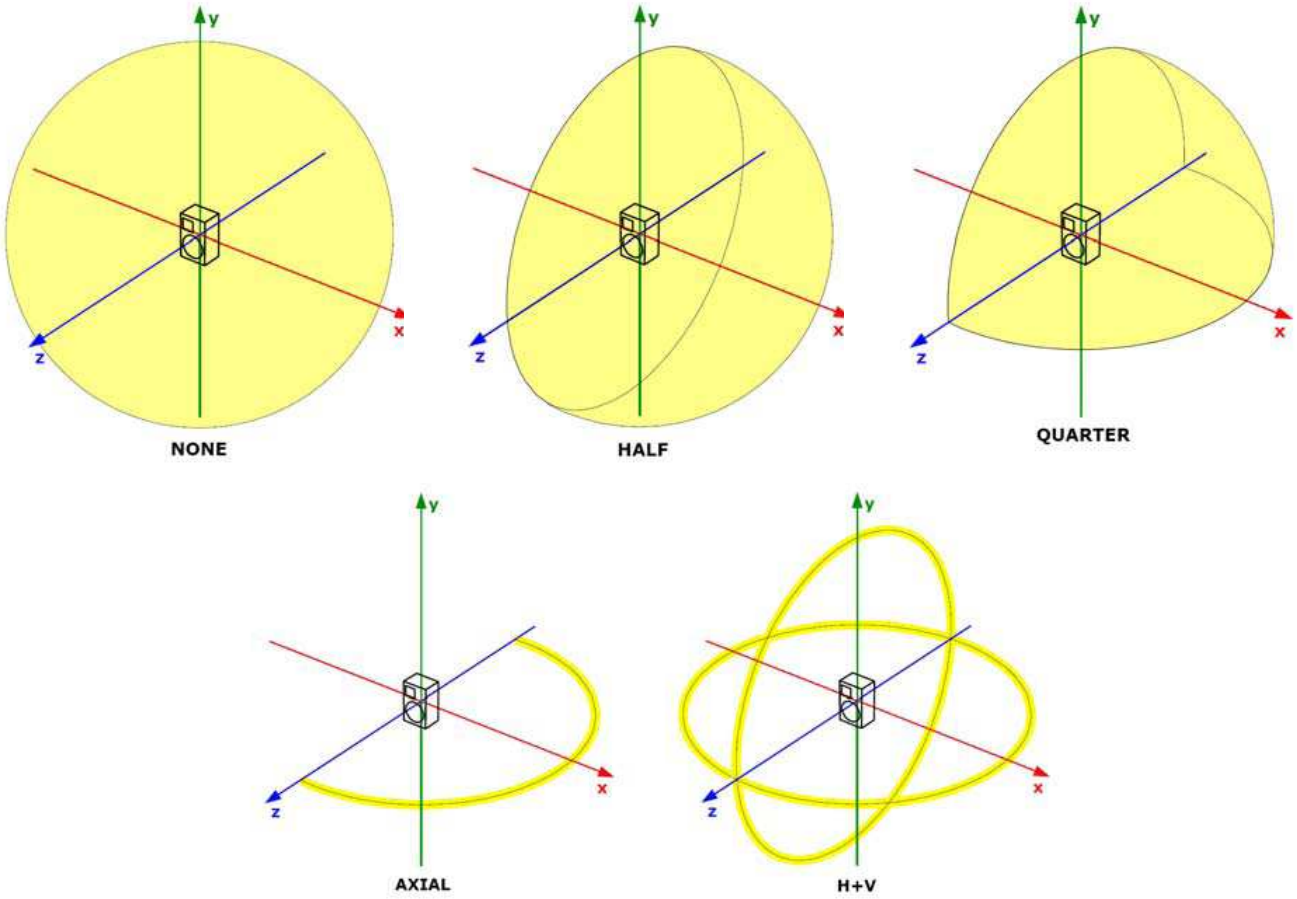
The autosaving and naming capabilities of CLIO render the job of measuring and creating a complete 3D directivity data set an easy and automatic task (see later 12.9 and 12.10 for examples).

In order to reduce the number of files needed to describe the directivity pattern of a source, it is possible to use the source **symmetry** if any.

There are five different symmetries available:



The **None**, **Half**, **Quarter** and **Axial** symmetry modes are self explanatory.

The **H+V** mode refer to a slight different scheme and is supported to permit users with one turntable to create directivity balloons by means of mathematical interpolation of the missing data. The **H+V** mode require a set of 144 measurements, collected over the horizontal and vertical complete polars from -180 to 180 degrees (instead of half polars from 0 to 180 that are used elsewhere).

12.9 MEASURING LOUDSPEAKER SINGLE POLAR DATA (3D MODE)

Using a single PC controlled turnable (Outline ET2503D or LinearX LT360) under CLIO's control and automation is it possibile to easily collect a single loudspeaker polar with a naming convention equal to the 1D Mode (refer to 12.6 and 12.7).

12.9.1 PREPARING AUTOSAVE AND THE MLS CONTROL PANEL

The MLS measurement should be set in a particular way in order to automatically acquire the responses at various polar angles. **To do this we will use the turntable control and the autosave dialog.**

Let's start with setting the autosave function (see also 5.3). Pressing **Alt-F2** we recall the Autosave Setting dialog (fig.12.20); here we choose the 3D mode and input the desired filename ('RogersHalfChirp'), polar start (-180), polar step (5), polar stop (180), azimuth start (0), azimuth step (0) and azimuth stop (0).

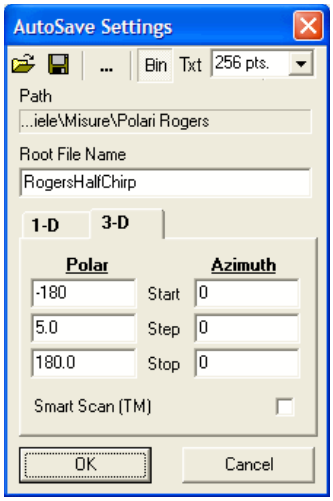


Figure 12.20

By setting the azimuth angles at zero CLIO will save the files as: **<NAME><THETA*100>.MLS.** where NAME is a common file name and THETA is the azimuth angle. These quantities are separated by **spaces**, it is possible to give negative numbers to THETA.

The MLS menu is now ready to start taking measurements; we only need to properly set the turntable and its control.

12.9.2 PREPARING THE TURNTABLES

We assume that an ET250-3D turntable is properly connected to your PC (refer to 4.7 for details). To prepare for this measurement session you need to link the turntable. At the beginning of the measurement session or by clicking the sync button on the turntable CLIO will move the turntables to the -180 angle. Thus the turntable must be setted up to be in the 0 position with the loudspeaker on-axis with the microphone.

12.9.3 TAKING THE MEASUREMENTS

You are now ready to begin the measuring session. We suggest you to take an initial measurement (with the speaker in place over the turntables in position 0 - on-axis - and with the turntables link button not pressed) to verify all the parameters, especially viewing the acquired impulse response and setting the start and stop values of the measurement window. These values will be applied to all the measurements taken; consider, in this respect, the problem of the trajectory of the acoustic center of the speaker during the rotation.

The last thing to do is to start the procedure by clicking the start button on the turntables control dialog:

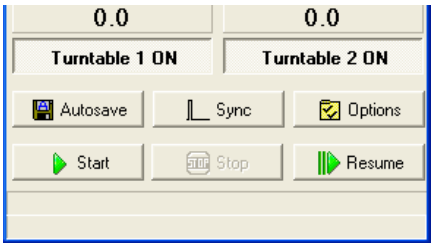


Figure 12.21

A message box alerting about the number of measurements that will be taken is showed:

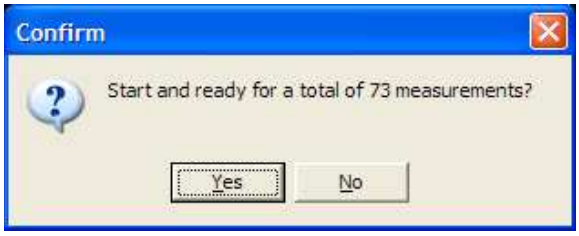


Figure 12.22

After the 73 measurements are taken the session should end while the autosave reset. The procedure can be halted and restarted from the point where it stopped using the stop and resume buttons in the turntables control dialog.

12.10 MEASURING FULL SPHERE LOUDSPEAKER POLAR DATA (3D MODE)

Using one or two PC controlled turnables (Outline ET2503D or LinearX LT360) under CLIO's control and automation is it possibile to easily collect sets of loudspeaker (complete or partial) impulse responses balloons.

The Autosave control panel allows for a simple setup of the measurement set, then CLIO manage the whole process:
- send positioning commands to the turntables and monitor their status
- perform MLS measurements and save the results with the naming rules

12.10.1 PREPARING AUTOSAVE AND THE MLS CONTROL PANEL

We will use two PC controlled turntables (Outline ET250-3D) under CLIO's control to gahter the full sphere balloon response of a loudspeaker.

The MLS measurement should be set in a particular way in order to automatically acquire the responses at various polar and azimuth angles. **To do this we will use the turntable control and the autosave dialog.**

Let's start with setting the autosave function (see also 5.3). Pressing **Alt-F2** we recall the Autosave Setting dialog (fig.12.23); here we choose the 3D mode and input the desired filename ('RogersHalfChirp'), polar start (0), polar step (5), polar stop (180), azimuth start (0), azimuth step (5) and azimuth stop (355).

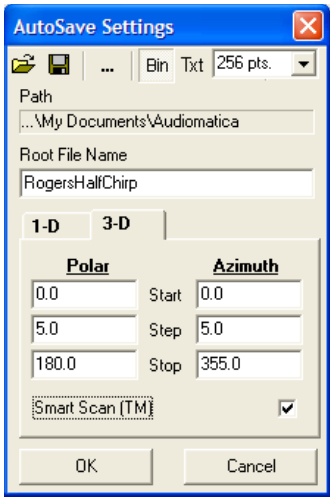


Figure 12.23

The MLS menu is now ready to start taking measurements; we only need to properly set the turntable and its control.

12.10.2 PREPARING THE TURNTABLES

We assume that the ET250-3D turntables are properly connected to your PC (refer to 4.7 for details). To prepare for this measurement session you need to link the turntables. At the beginning of the measurement session or by clicking the sync button on the turntable CLIO will move the turntables to the 0,0 angle. Thus the turntables must be setted up to be in the 0,0 position with the loudspeaker on-axis with the microphone.

12.10.3 TAKING THE MEASUREMENTS

You are now ready to begin the measuring session. We suggest you to take an initial measurement (with the speaker in place over the turntables and with the turntables link button not pressed) to verify all the parameters, especially viewing the acquired impulse response and setting the start and stop values of the measurement window. These values will be applied to all the measurements taken; consider, in this respect, the problem of the trajectory of the acoustic center of the speaker during the rotation.

The last thing to do is to start the procedure by clicking the start button on the turntables control dialog:

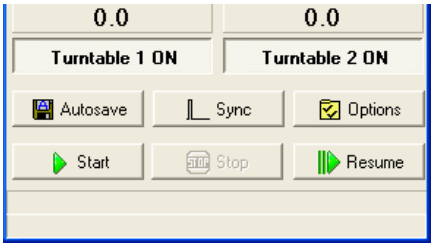
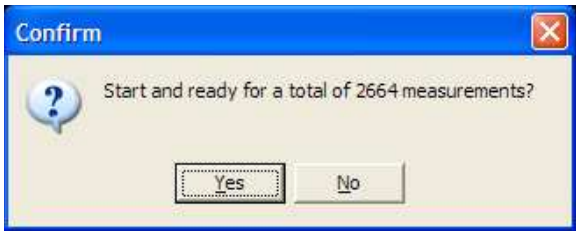


Figure 12.24

A message box alerting about the number of measurements that will be taken is showed:



Press Yes. After each MLS measurement is taken you will see the turntables rotating and CLIO waiting the specified delay time before automatically taking the next measurement. Should this time be insufficient you have to reset the turntable delay value accordingly. The autosave function will refresh the filename after each measurement (Fig.12.25).

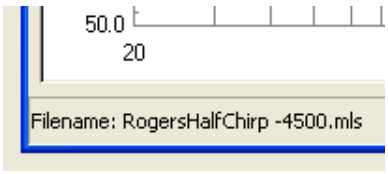


Figure 12.25

After the 2664 measurements are taken the session should end while the autosave reset. The procedure can be halted and restarted from the point where it stopped using the stop and resume buttons in the turntables control dialog.

12.11 REPRESENTING 3D BALLOON DATA

To represent and export the measured 3D directivity data we need to select the 3D mode in the Waterfall, Directivity & 3D control panel. Then enter the 3D settings dialog and press the browse button. Entering our data directory we find the situation in Fig.12.26:

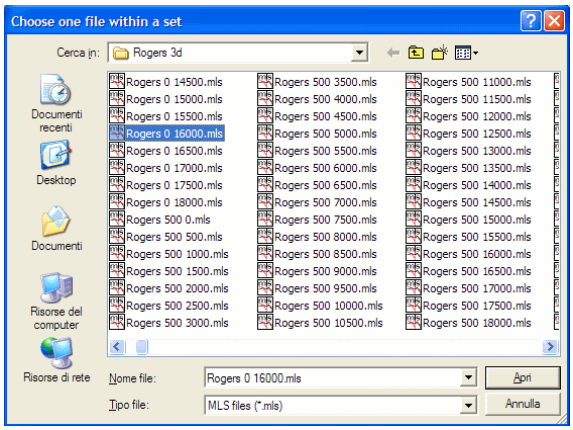


Figure 12.26

The set of files is composed by a certain number of files; it is sufficient to choose one of them. It is now important to set the symmetry mode and the rotation angle for the data set, this is done using the combo box for the symmetry and editing the rotation angle as in Fig.12.27. We choose None for the symmetry and 0 for the rotation, since we are analyzing a complete full sphere measured set.

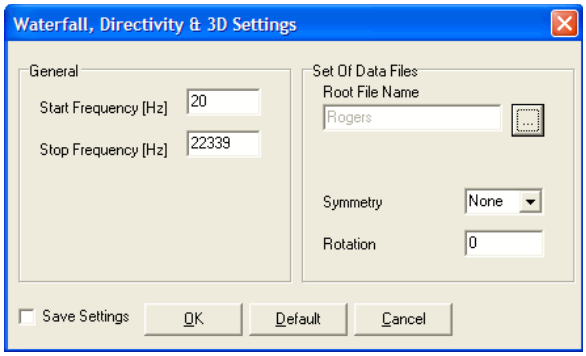


Figure 12.27

We are, at last, ready to start a 3D analysis.

The result is in Fig. 12.28 as color balloon at 1 kHz.

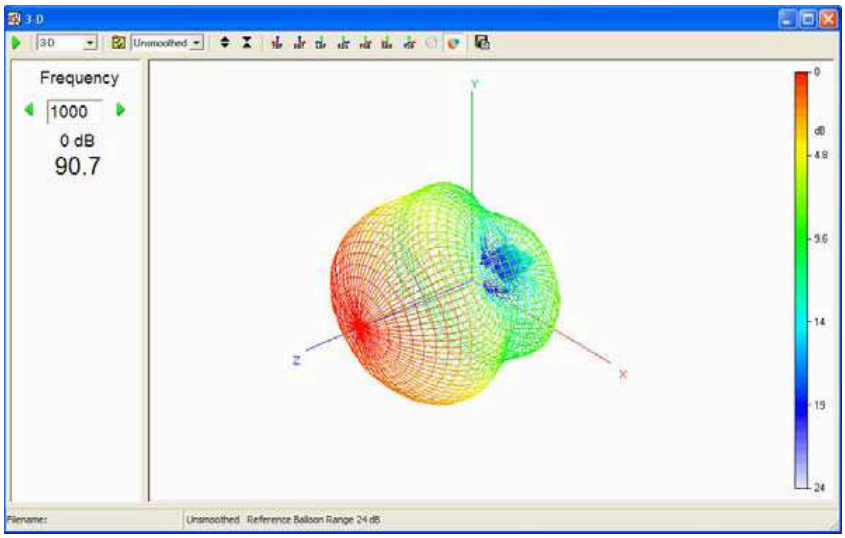


Figure 12.28

It is possible to inspect the 3D directivity of the souce selecting a 1/3rd octave band from 20 Hz to 20 kHz and rotating the balloon view. To rotate the balloon it is possible to select one of the predefined views by pressing the view buttons, or click and drag the balloon.

Figure 12.29 show the balloon response at 5 kHz.

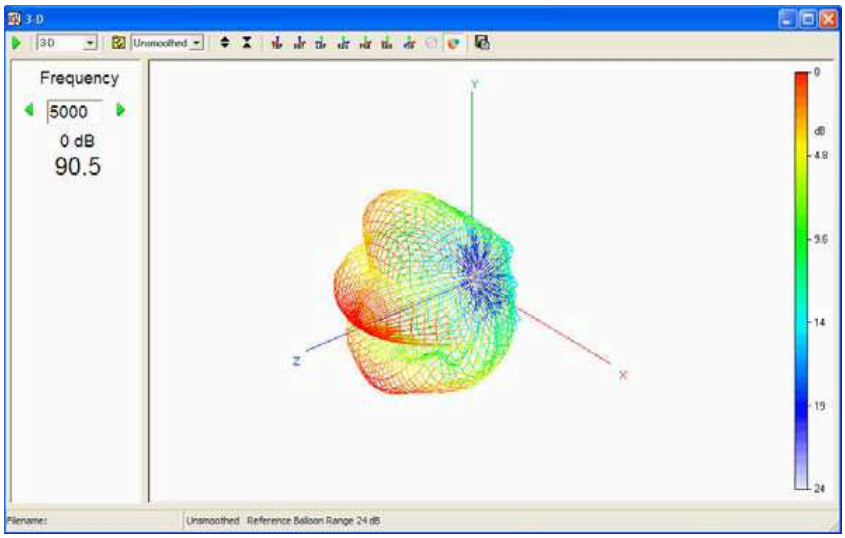


Figure 12.29

Figure 12.30 and 12.31 are showing different views (top and right) of the same balloon response at 3150 Hz.

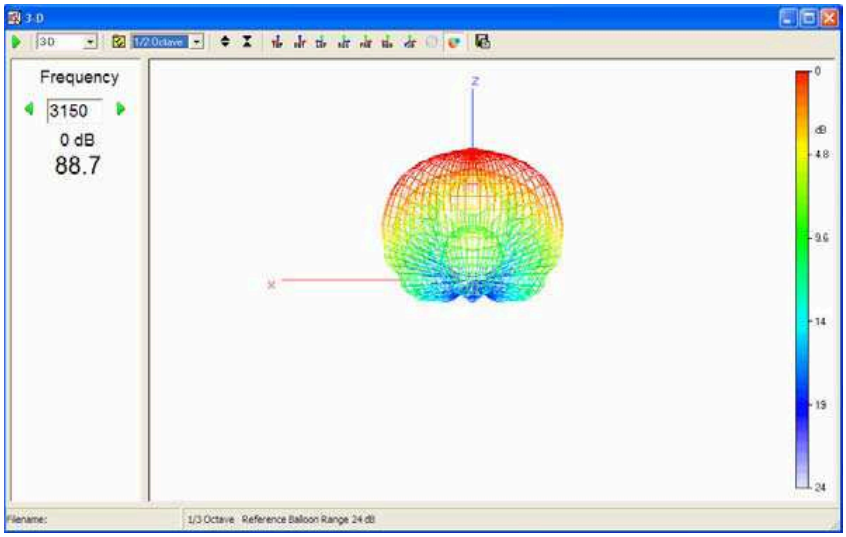


Figure 12.30

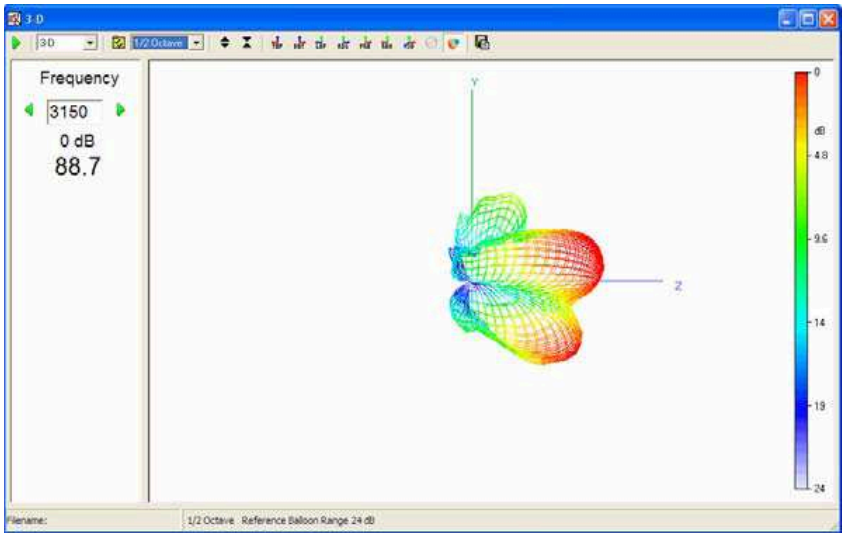


Figure 12.31

12.12 EXPORT 3D BALLOON DATA

The 3D mode feature a powerful tool to export the measured data towards the most common simulation software formats. The supported export format are:

EASE .xhn
EASE .xhn ASCII format (only module, no complex data).

CLF v2 .tab
Common Loudspeaker Format CLF v2 .tab ASCII format.

Impulse Responses
Set of Impulse Responses in ASCII .txt format ready to be imported with EASE SpeakerLab.

The process of creation of the louspeaker model for a simulation software require the measurement of the directional response of the loudspeaker. Please check 12.10 for more information.

Once the 3D data set is measured, with the 3D analysis tool it is possible to check data consistency and inspect the directional characteristics of a source.

The  Export Balloon button opens the Balloon Export form.

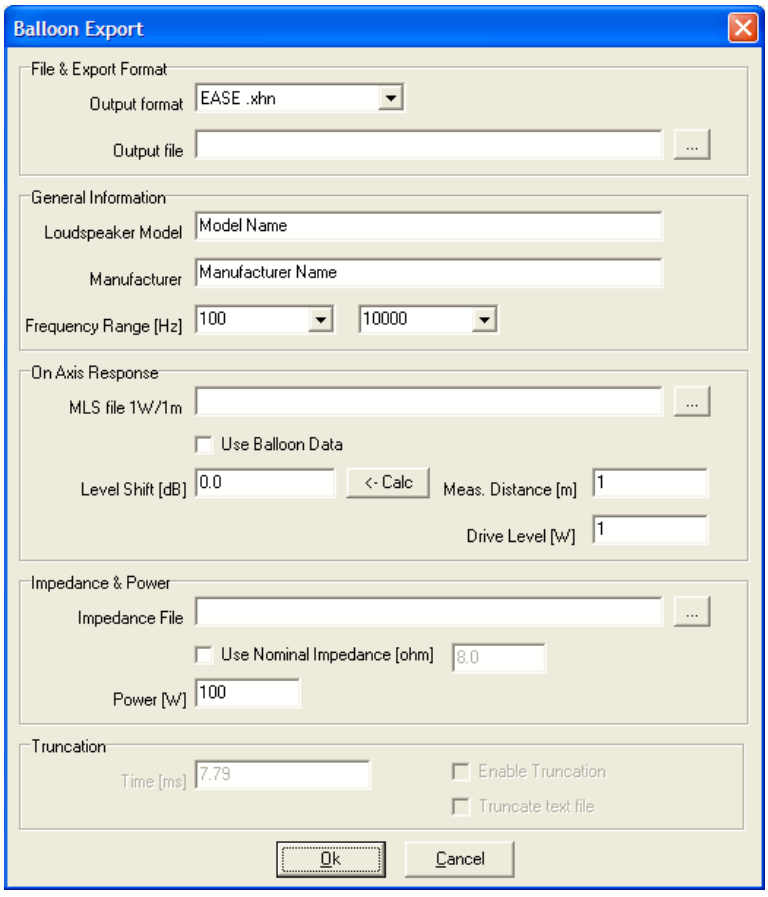


figure 12.32

12.12.1 EXPORT EASE .XHN AND CLF V2 .TAB FILES

In case of **EASE .xhn** and **CLF v2 .tab** format is selected in the File And Export Format Group then the General Information, On Axis Response and Impedance & Power groups are active.

Output File defines the file name and location where the file will be saved; it is possible to choose it clicking on the browse for Choose Output File button (...).

The **Loudspeaker Name** and **Manufacturer Name** fields will be used into the exported text file.

The **Frequency Range** can go from 100 Hz to 10 kHz in case of EASE .xhn, from 25 Hz to 20 kHz in case of CLF v2 .tab. The frequency range to export can be modified using the combo boxes.

The On-Axis Response group let the user decide to use the data set on-axis measurement or use an MLS file as on-axis reference. It is also possibile to apply a **Level Shift** to our measured response to correct for power and distance different from the required 1W/1m. A basic calculation that calculates the required level shift as function of the **Drive Level** in W applied and **Measurement Distance** between loudspeaker and microphone.

Similarly to the previous group, the Impedance & Power group let the user decide to use a real measured impedance in .sini format or a nominal value. Into the same group the user can specify a power level (valid for all bands) for the source.

It is clear that the functions of this export menu are minimal, but they succesfully meet the user need to create loudspeaker models used by the most common simulation softwares.

Once the output text file is saved, it may be necessary to preprocess with a text editor to add or modify informations.

Figure 12.33 report an example of a data set exported to CLF v2. tab format and imported by the CLF software.

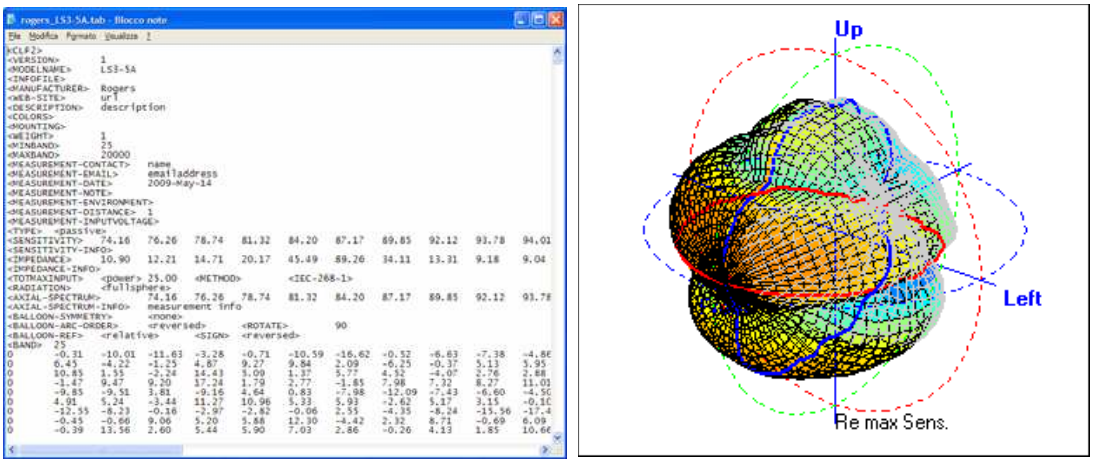


figure 12.33

12.12.2 EXPORT SET OF IMPULSE RESPONSES

If **Impulse Response** is selected only the last Truncation group is active.

The **Output Folder** define the path where the Impulse Responses in text format will be saved. The file will be saved as Time Data impulse responses with the naming convention requested by the EASE SpeakerLab:

IR <PHI*100> <THETA*100>.txt

If the **Enable Truncation** option is selected the time response is windowed with a rectangular window with **Time (ms)** duration.

If the **Truncate Text File** option is selected the exported text files are limited to the points inside the time window. This option reduce drastically the size of the exported data sets.