Chapter 2. Operation

Calculators and Entering Data

BoxCad is equipped with seven versatile calculators, selectable from the main menu under “Calculators”. Since the models are based on acoustic impedance or electrical impedance parameters, the calculators are designed to provide such data. **Calculators must also be used for entering data**. Typically, the user would enter a known Small/Thiele parameter in to the calculator, then obtained its acoustical equivalent which should be keyed-in the schematic parts list as an acoustical (or electrical) circuit component. Parameters entered into the calculators will be stored to datafile.

1. Driver Calculator (Fig2.1).

There are nine basic parameters required for the input: (1) Effective piston radius, (2) BL factor, (3) Voice coil DC resistance, (4) Voice coil inductance Le @ 1kHz, (5) Qm, (6) Qe, (7) Equivalent compliance volume, (8) Free air resonant frequency Fs and (9) Rated power.

In order to calculate mechanical mobility parameters, press button labelled “2.Expand”. Mechanical parameters can be edited, if required prior calculating acoustical parameters. Acoustical parameters can be obtained by pressing button labelled “3.Calculate”. Voice coil DC resistance Re is transformed into series acoustic resistance Rea and voice coil inductance Le is transformed into shunt acoustic capacitance Lea. These two components are always connected at the input of the acoustical model and together with other elements are responsible for -12dB roll-off at higher frequencies.

It can be observed, that the program recalculates Qm, Qe and Fs under the Acoustical Parameters header. This is performed on purpose since the mechanical parameters entered could be erroneous. Small difference between entered and re-calculated Qm, Qe and Fs arise from large number of intermediate calculations followed by number rounding.

2. Rear & Front Box, Port Calculator (Fig 2.2 & Fig 2.3).

Two separate calculators are provided: one for the front box and port and one for the rear box and port. These calculators are identical and provide the user with the means for entering separate set of parameters for front, rear or rear enclosure.

Nine parameters are required as input data for the Box calculator: (1) Port radius, (2) Port length, (3) Front baffle area, (4) Box volume Vb, (5) Distance d between driver’s and port centres, (6) Effective piston area, (7) Box absorption Q-factor Qb or (8) Box absorption loss Rab and (9) Box leakage loss Ral.

If the attempted design uses number of enclosures, their acoustical parameters also can be calculated using the two calculators provided.

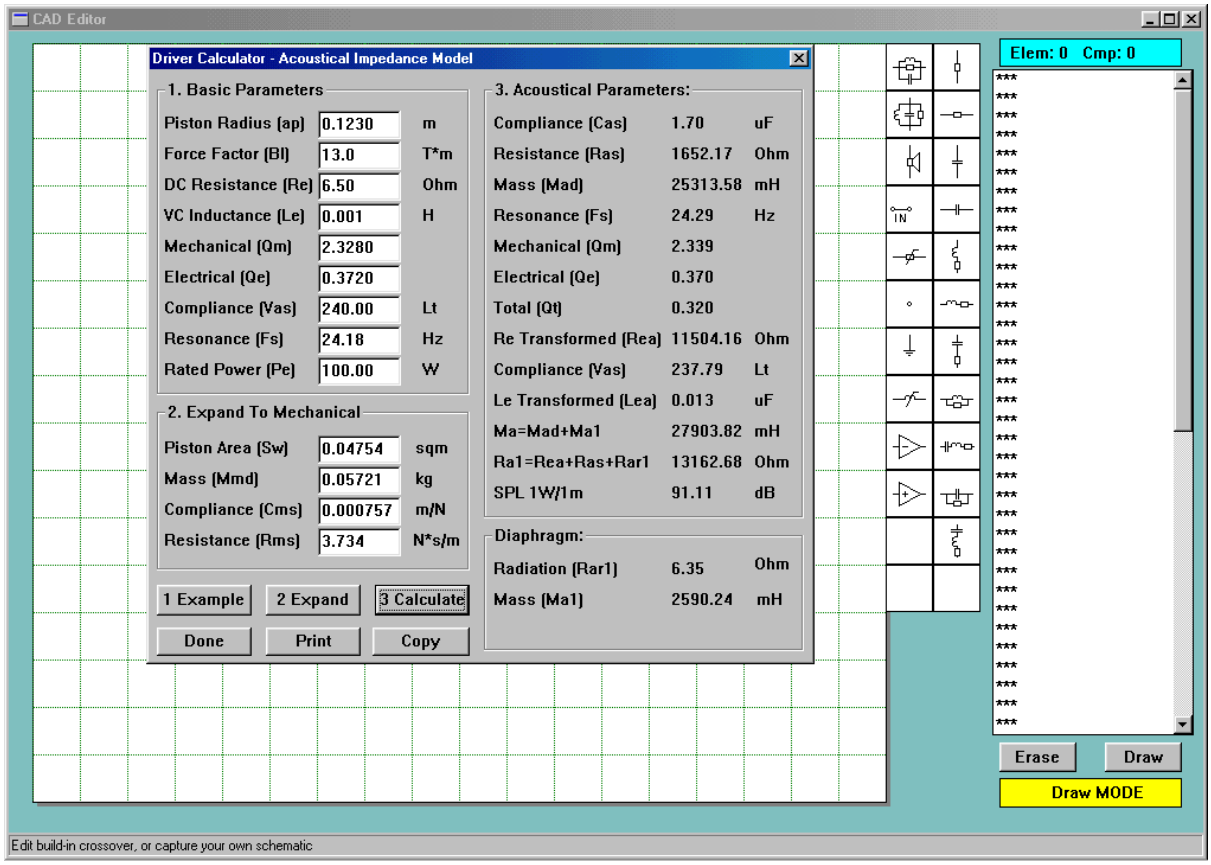

Fig 2.1 Driver Calculator

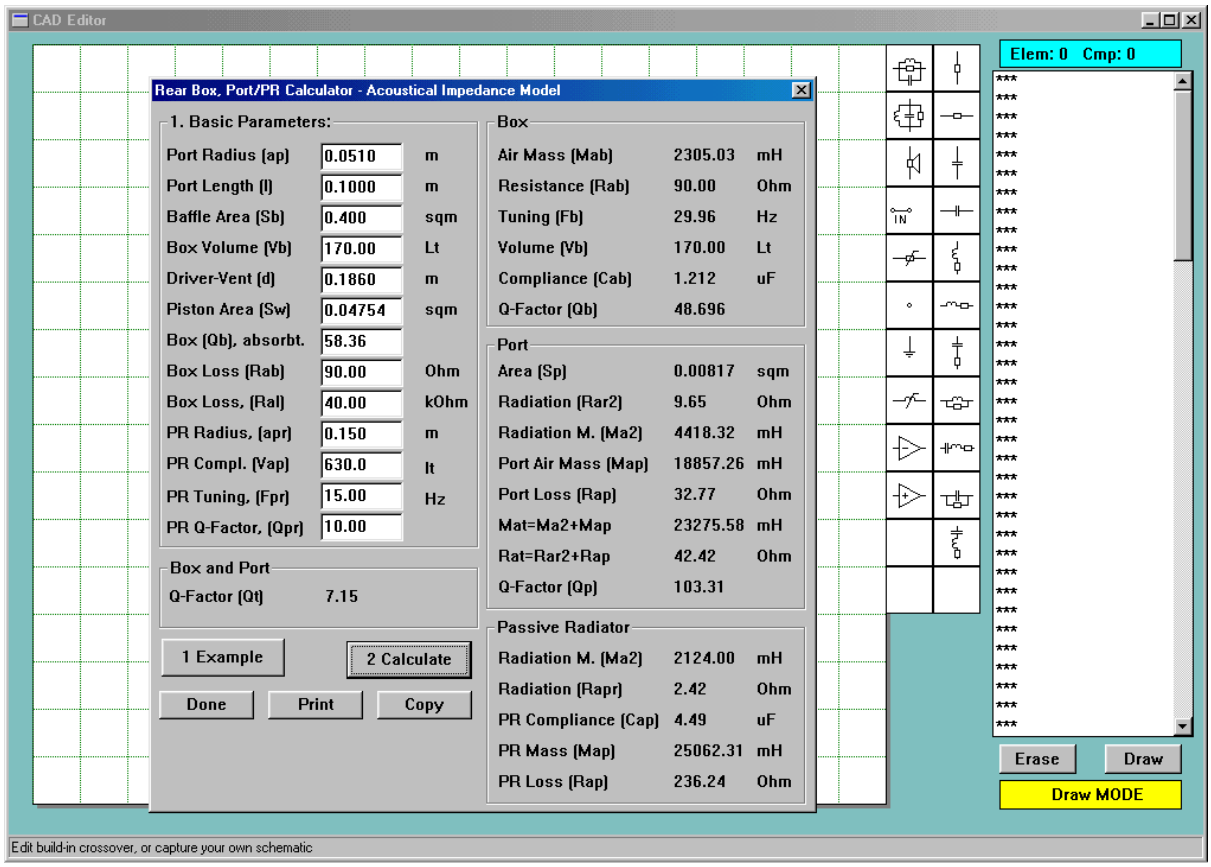

Fig 2.2 Rear Box, Port/PR Calculator

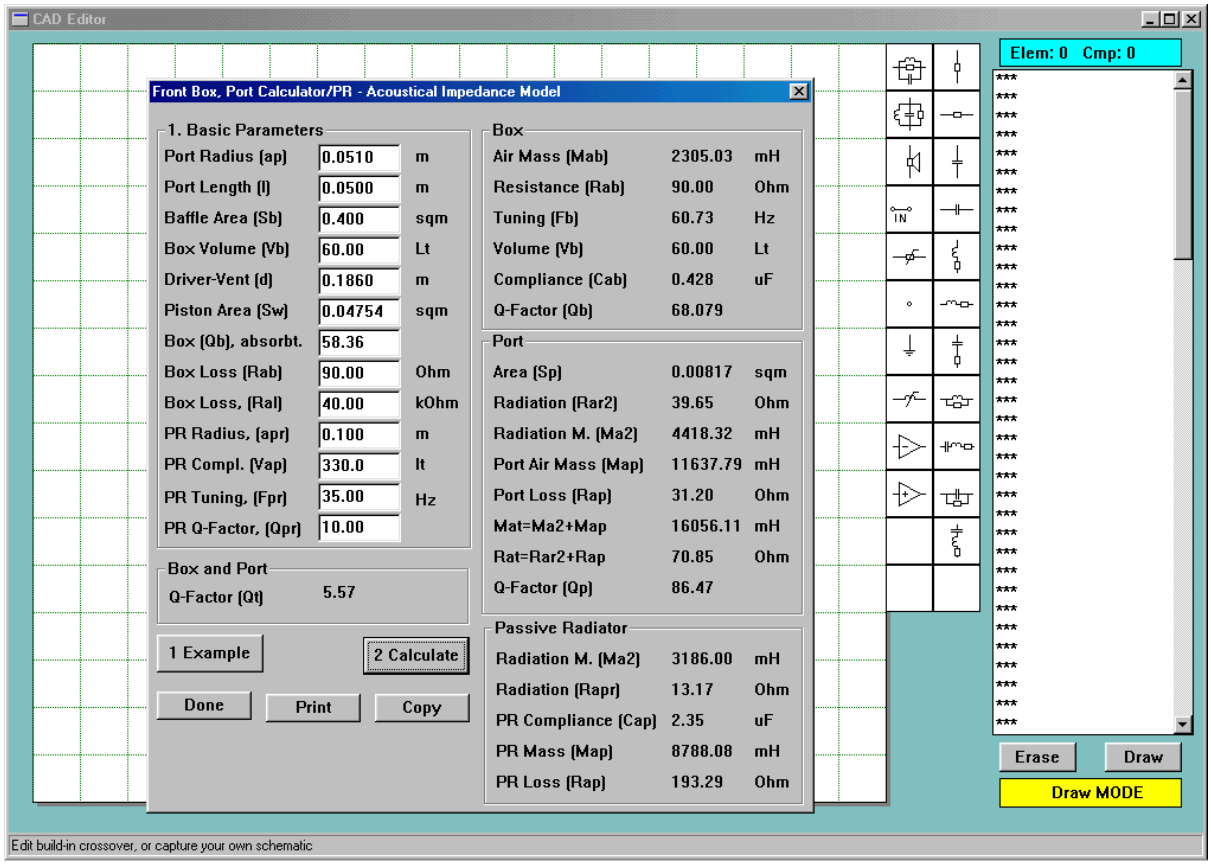

Fig 2.3 Front Box, Port/PR Calculator

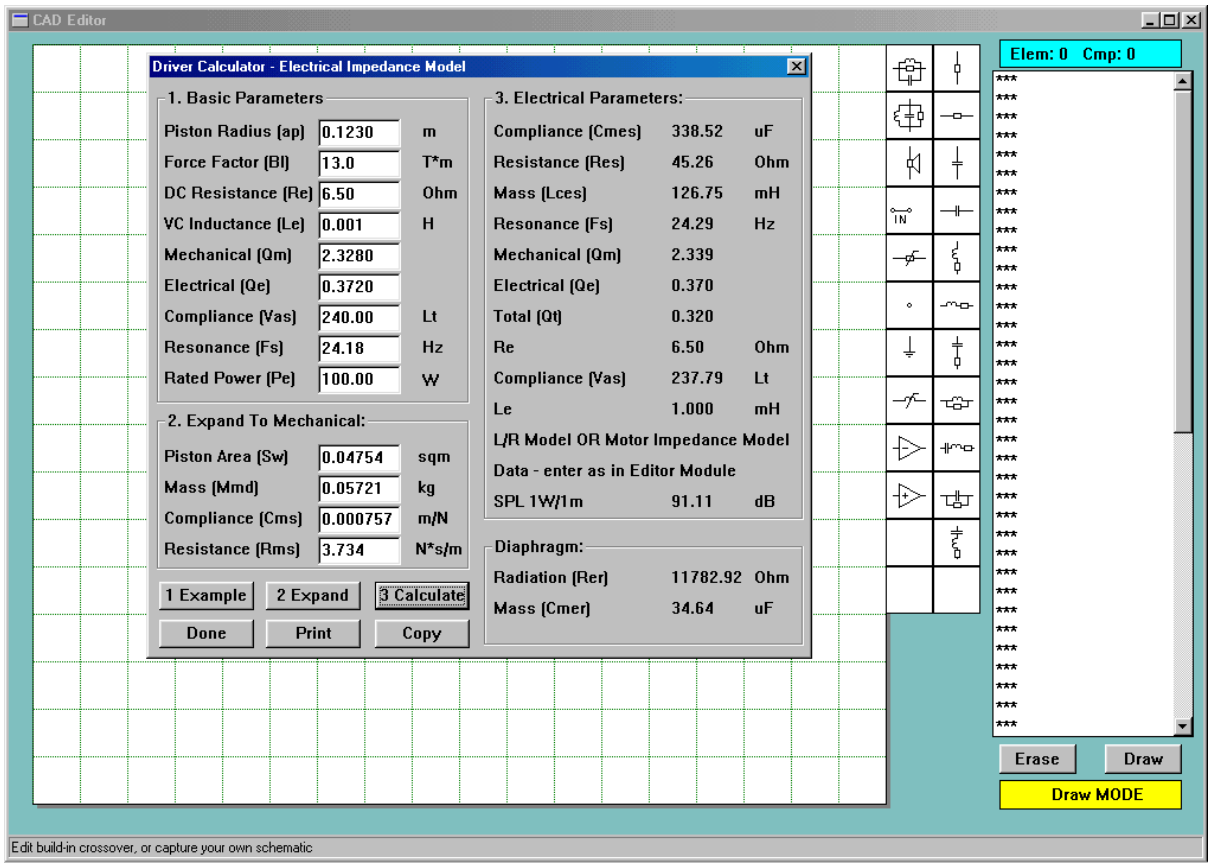

Fig 2.4 Driver Calculator – Electrical impedance

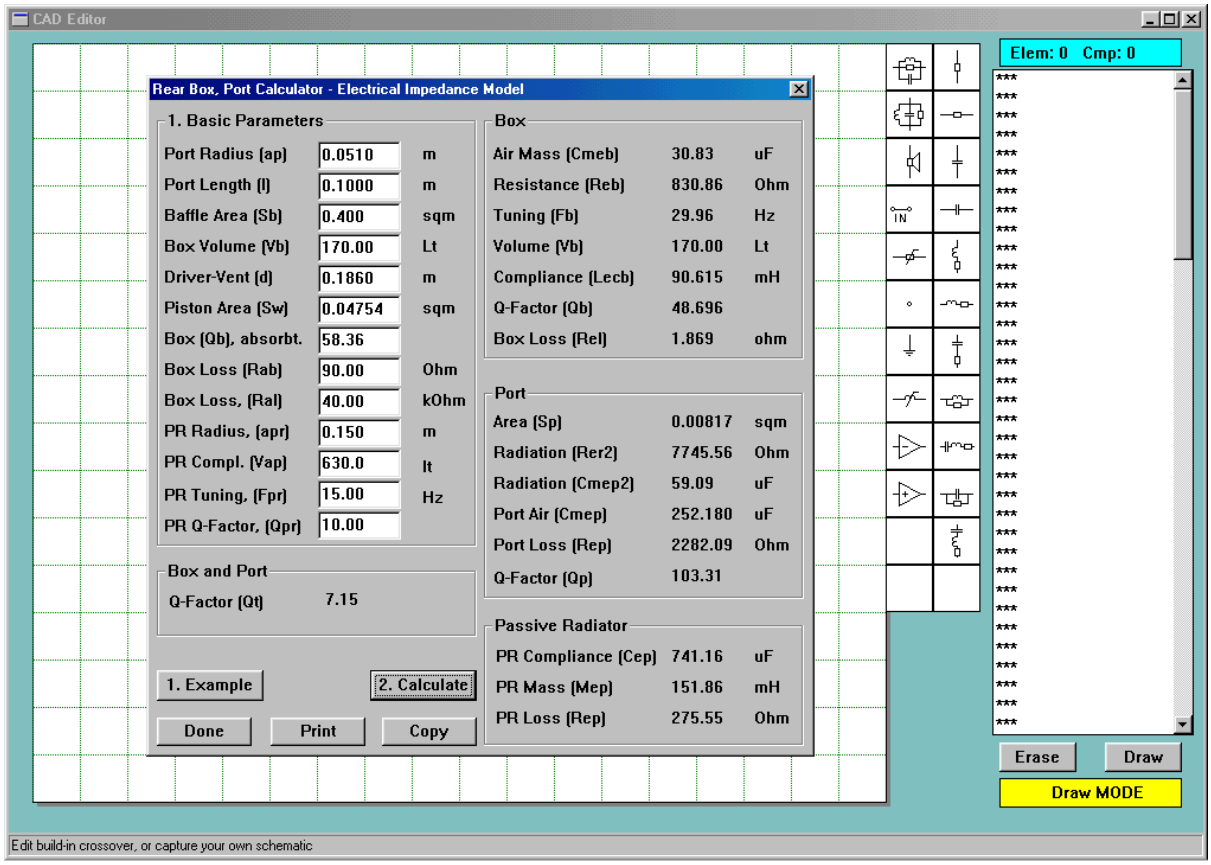

Fig 2.5 Rear Box – Electrical impedance

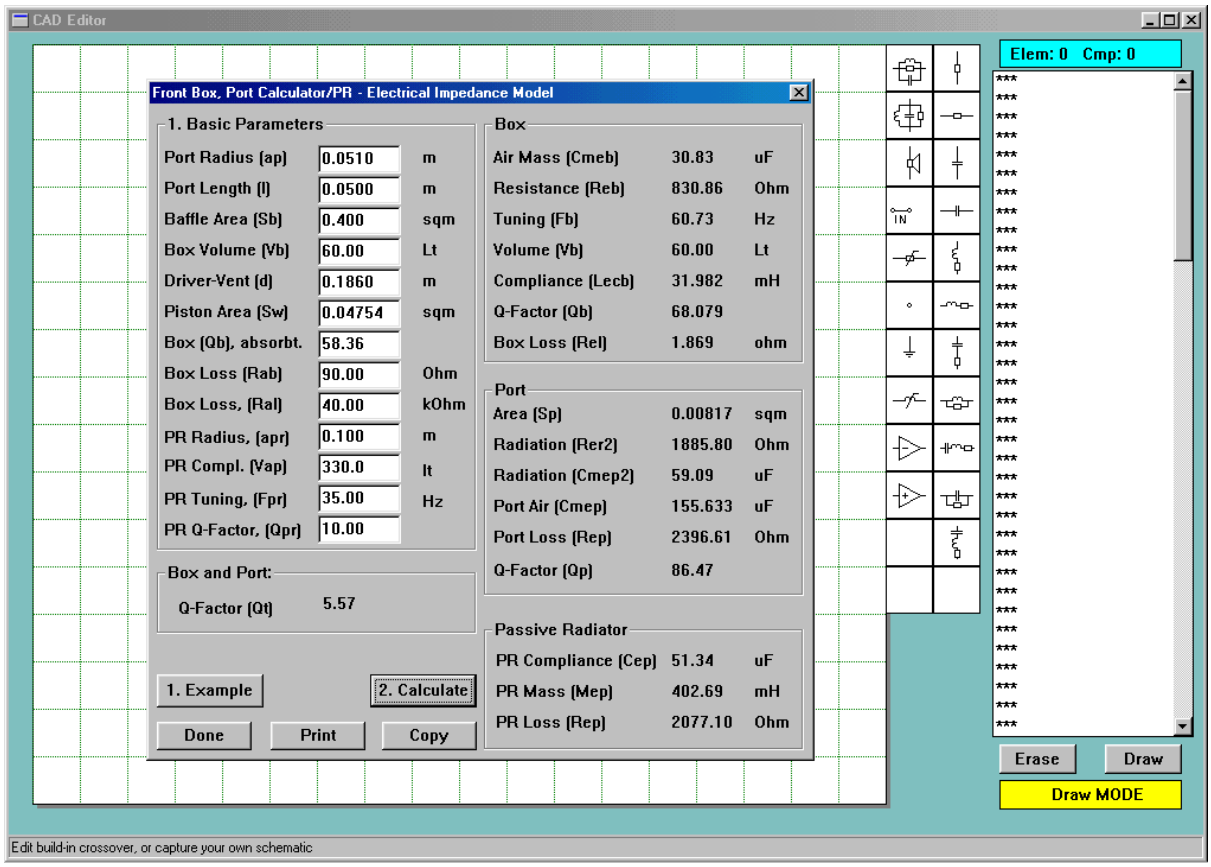

Fig 2.6 Front Box – Electrical impedance

3. Power Compression Analyser (Fig2.7).

Power Compression Analyser requires several thermal parameters for its input. Please refer to SoundEasy/SSD+ for detailed description of each parameter. This software release includes three magnet types most commonly used in today's loudspeakers.

It is important to realise, that voice coil, operating at elevated temperatures will exhibit increased Re. Also BL factor will be reduced due to rise in temperature. The analyser allows the user to obtain correct values of Re and BL at elevated temperatures. These new values need to be entered into the "Driver Calculator" in order to obtain new values for Rea and other parameters at higher temperatures. These new values need to be entered back into the schematic and transfer function re-plotted for given temperature. This is particularly important for plotting cone excursion curve.

4. Calculators generating electrical model parameters operate the same way and for its input, require parameters explained above - see Fig 2.4, Fig2.5 and Fig 2.6.

5. Linkwitz-Riley Filter (Fig. 2.8).

Linkwitz-Riley Filter calculator requires the following parameters to be entered: (1) Fo, the frequency of the "dip" - this is the higher of the two required frequencies, (2) Qo, the Q-factor of "dip", (3) Fp, the frequency of the "peak", (4) Qp, the Q-factor of the "peak" and (5) C1, a selected component. Calculated component values and circuit configuration is shown on Fig 5.3. The Linkwitz-Riley Filter is drawn on the top section of the window and its output is node No 8. Filter formulas are shown Chapter 5.

All calculators are equipped with a "Copy" button. This function copies user selected area of the screen (including the dialogue box) to Windows (c) Clipboard and finds its use during project documentation. To activate this feature, click on "Copy" button then and click left mouse button anywhere within the box area. The cursor will change from the arrow to a cross-hair. Then move the cross-hair to the point, which marks top-left corner of your image and press left mouse button. While the button is pressed, drag the cross-hair down and right to mark the bottom-right point of your image. Then release left mouse button. During the mouse movement, the screen will blink

CAD System

The CAD system implemented in BoxCad operates exactly the same way, as the modules in the main program. Its description will therefore not be repeated here.

Three **different** models can be design using BoxCad: (1) acoustic impedance model,(2) electrical impedance model and (3) electrical transfer function model. As a result of this, operation of the CAD system has been design to accommodate specific transfer functions such as:

1. Passive enclosure transfer function, Kp - In the acoustic impedance model (driver and enclosure) output is represented by branch currents. Uses built-in formula.

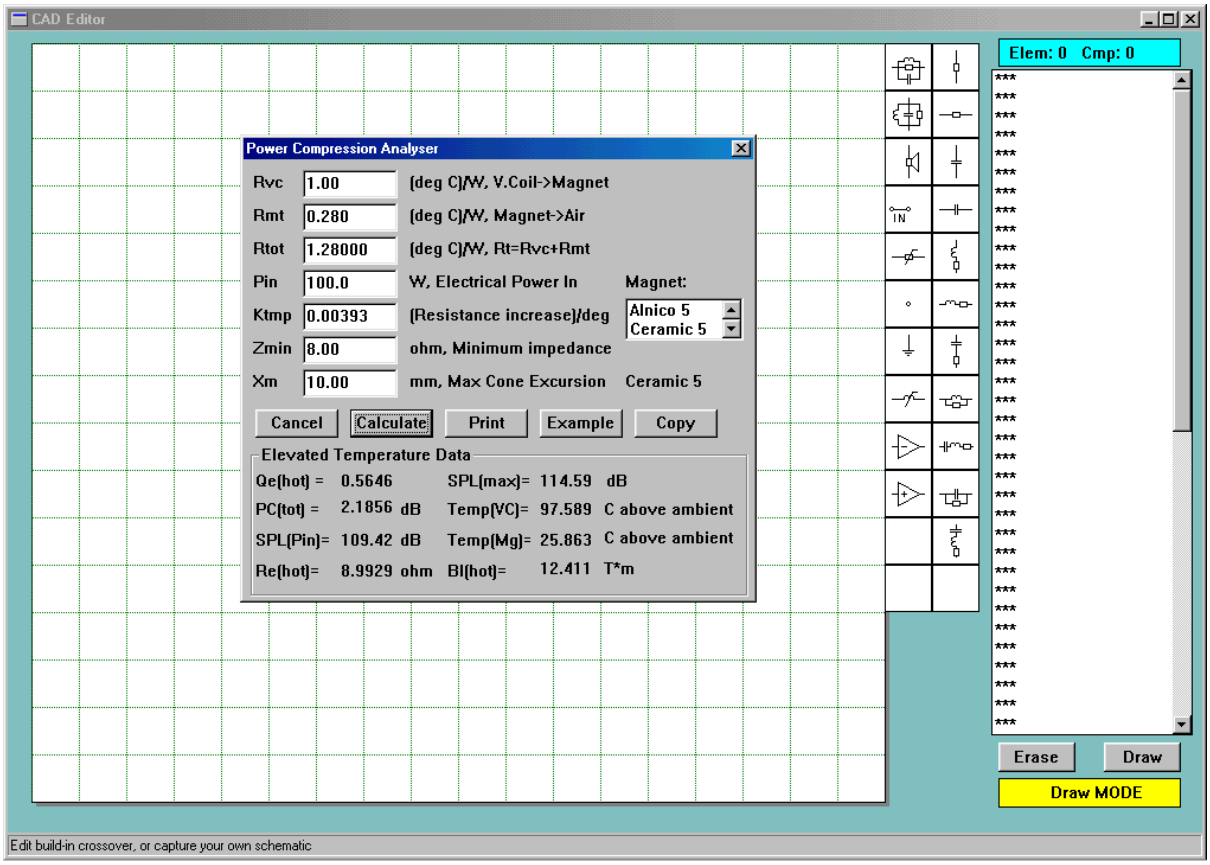

Fig 2.7 Power Compression Analyser

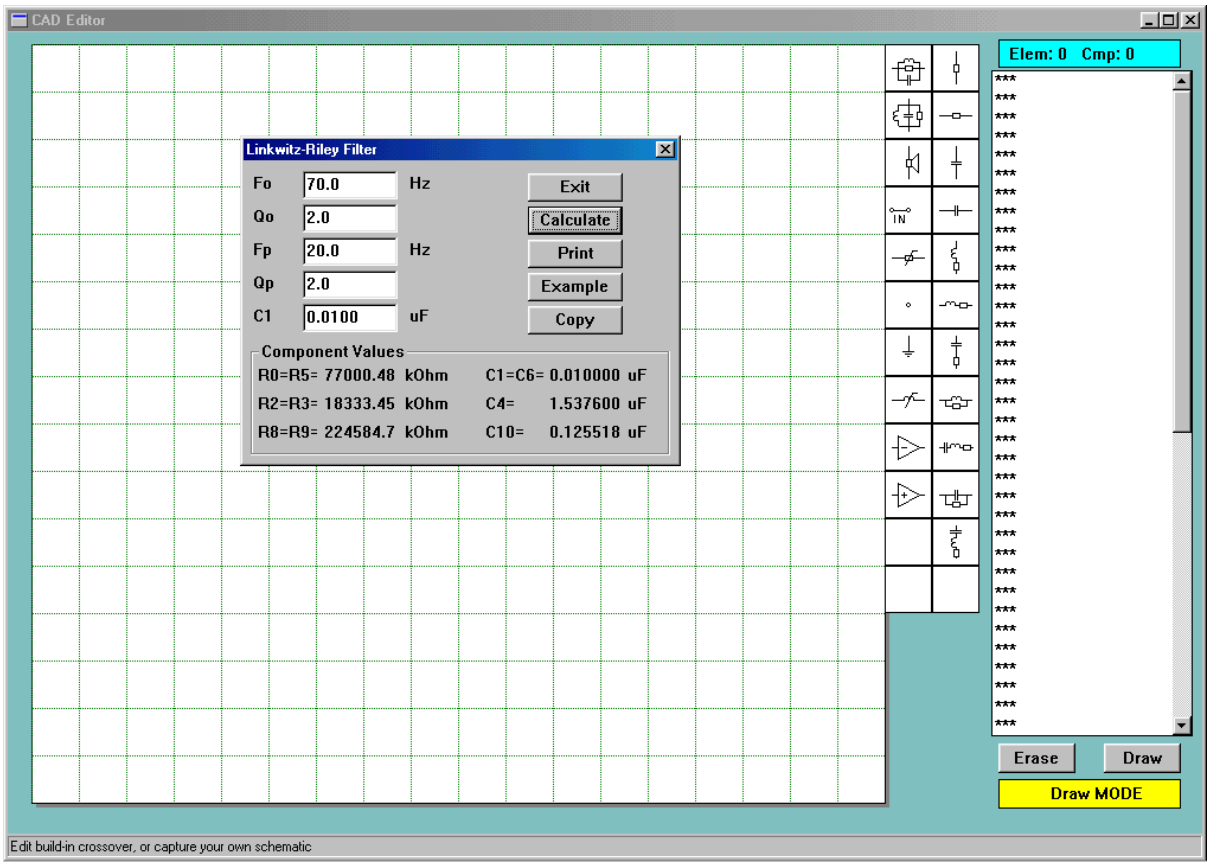

Fig 2.8 Linkwitz-Riley Filter

2. Electrical input impedance, Zin - Plotted as driving point impedance, Vin/Iin.
3. Cone excursion, Xm - Uses built-in formula.
4. Active/passive circuit transfer function Ku - Implemented as voltage gain, Vout/Vin.

It is important to understand differences between each function **and select appropriate transfer function option**. The transfer function selected MUST match the type of schematic being created on the CAD screen. For example: acoustic impedance model should be evaluated using passive amplitude/phase responses and cone excursion plots. All frequency domain plotting options are available from the floating menu of the "Frequency" screen. Selection of the components available for creating schematic includes components for all three models. However, it is again user's responsibility to select components accordingly to the type of model being created.

Using Main Screen Menus

1. File

* New - Clears screen, data storage and opens a new default CAD screen.
* Open Model File - Invokes file loading dialogue box.
* Save Model File - Invokes file saving dialogue box.
* Print - Opens printer dialogue box.
* Exit - To quit the program.
* About - Program release year.

2. Edit

* Copy - Allows selected portion of the screen or whole screen to be sent to Windows Clipboard. From there, the image can be copied to a compatible word processor, such as Word for Windows (c) and stretched to restore original size.
  To activate this feature, select "Copy" menu item from the main screen and click left mouse button anywhere within the window area. The cursor will change from the arrow to a cross-hair. Then move the cross-hair to the point, which marks top-left corner of your image and press left mouse button. While the button is pressed, drag the cross-hair down and right to mark the bottom-right point of your image. Then release left mouse button. During the mouse movement, the screen will blink.
* Clear CAD - Clears CAD screen, but does not erase data.
* Clear All - Clears CAD screen and clears datafile.

3. Analyse

* CAD - Opens CAD screen (if not opened already).
* Frequency - Invokes frequency domain window.
* Time - Invokes time domain window.

4. Calculators

* ACOUSTICAL
  * Driver - Opens data entry/calculator box for driver acoustical impedance model.
  * Rear Box + Port - Opens data entry/calculator box for rear enclosure and port for acoustical impedance model.

    * Front Box + Port - Opens data entry/calculator box for front enclosure and port for acoustical impedance model.

* ELECTRICAL
    * Driver - Opens data entry/calculator box for driver electrical impedance model.
    * Rear Box + Port - Opens data entry/calculator box for rear enclosure and port for acoustical electrical model.
    * Front Box + Port - Opens data entry/calculator box for front enclosure and port for electrical impedance model.

* Thermal Analysis - Invokes “Power Compression Analyser”.
* Linkwitz-Riley - Invokes built-in filter calculator - refer to Fig 2.8.

5. Models

* Load Model - Opens a dialogue box to allow the user to select built-in model or saved model. To obtain component values as well, the model should be loaded after the user finished with the calculators.
* Save options - Allow the model on the screen to be saved as: (1) acoustic impedance model, (2) electrical impedance model and (3) passive/active CAD model.

Using Main Screen Buttons

1. **Erase** - Must be pressed if a component or connection is to be erased.
2. **Draw** - (default) Must be pressed after erasing.

Printing Session Results

All images of the program’s windows within this manual have been developed using the program's graphics capabilities.

Printing session results is achieved by selecting the "Print Window" option from the window's menu. This selection opens printer dialogue box and the user may select orientation of the printout, scaling factor and location of the printout. Some users may give preference to smaller or half-size print-outs. The final dimensions of the print are a combination of the scaling factors entered and the resolution of the printer used. It is therefore recommended to perform a test print-out for the current printer settings and if the results are satisfactory, use the same scaling factor consistently throughout the program. All options selected from the printer dialogue box will be saved to the driver's data file.

The "Offset X" and “Offset Y” parameters can be used to move the location of the graph on the printed page independently in X and Y direction. Finally, a small window which appears on the screen and informs the user of the progress of the banded or non-banded print-out.

Printing capabilities of the program were developed for commonly supported printer drivers and tested on number of printers and emulators. If your printer is not operating properly, further customization may be needed as it is likely, that your printer driver file is supporting only limited functionality or it can not be invoked from within the application program.

Please contact Bodzio Software and be ready to provide us with your printer driver file. Also, in case of difficulties, we recommend to experiment with your printer DPI settings, size of the printout (30%, 50% 80% and 100%) and landscape or portrait orientation. Low DPI and smaller printout size will work better on lower memory hardware.

Saving a New Driver

It is recommended that you save intermediate data 3-4 times per session and then save final results of the session. To save data select the "Save Model File" option from the windows menu. You will then be required to enter the name of the file **without file extension** and click on "Save" button. Saving the driver data should be done using the "Save Model File" option.

Loading Data File

Loading driver's data file is achieved by using the corresponding menu option. Once the "Load Model File" option is activated, user may select the whole path, including drive, directory, sub-directories and finally the name of the file. Wildecards (*) are allowed and if used. BoxCad will follow normal DOS (c) rules applicable to the wildecards.

If the number if items displayed exceeds the capacity of the small display rectangle, the scroll bar will be attached automatically. The user can build the path with the mouse and the item names appearing in the display rectangle. Once the name of the file has been selected, the user can click the "Load" button and the required file will be loaded into the program data space.

File Compatibility

BoxCad data files are not directly compatible with SSD4.20-SSD4.25, SSD+ or SoundEasy data files. Future releases will see BoxCad program incorporated into SoundEasy.