



Elastomer Analysis Module

Version 2.00

User Manual

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1. Introduction

The Elastomer Analysis Module (EAM) is a stand-alone programme capable of reading test runs from file and calculating material properties and test statistics.

The data files supported are: *.cvp; *.pvp; *.mcr; *.ctr

Other formats can be added without changing the structure of the software. To be able to successfully analyse the test results, the following information should be available from the test files:

- Sample rate for each channel
- Signals (Displacement, Force & velocity) at least 3 complete cycles at constant amplitude/velocity.
- Signal units
- Signal names

Optional information:

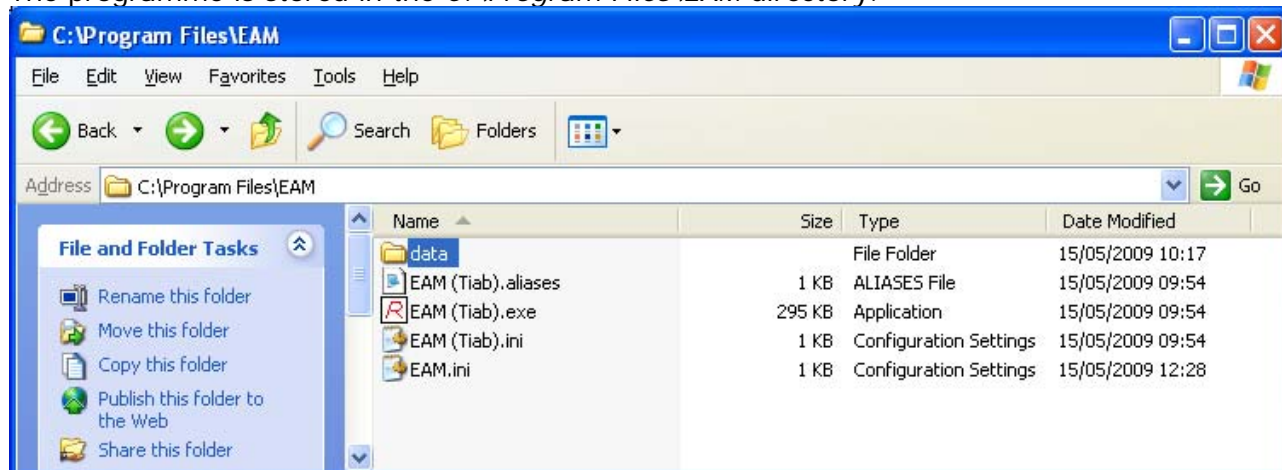
- Temperature measurements
- Test descriptors (Rig, date, part name, part no, operator name...)

2. Setting up the software

The software can run under Window XP or Vista. It is necessary to install the Roehrig Shock software which will install all the necessary DLL's and dongles.

From the supplied EAM zip file run *setup.exe*.

The programme is stored in the *C:\Program Files\EAM* directory.



The software can be started from the Windows Start Programs : Elastomer Analysis Module

3. User interface

The Elastomer Analysis Module uses standard Windows drop-down menus and toolbars. The window can be stretched to best fit the available screen viewing area.

The user interface comprises **two main panes** (See Figure 1).

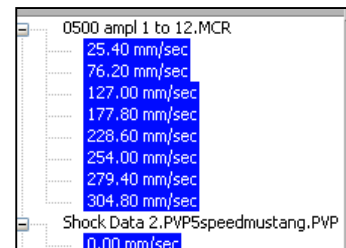
1. File Selection pane
2. Forms pane

3.1 File Selection Pane

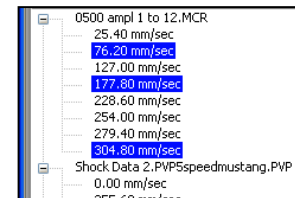
Suitable data files can be drag and dropped from Windows Explorer into the File Selection pane or loaded individually or in groups from the tool bar or pull-down *File Open* commands.

When opened the **files** appear in the File Selection pane and each individual **run** is automatically listed. This tree structure can be contracted and expanded by clicking the + and – controls.

A consecutive group of runs can be selected by selecting the first run, hold down SHIFT and selecting the last run. All selected tabs will have a blue back backing.



Alternatively separate individual files can be selected by holding down the CTRL key.

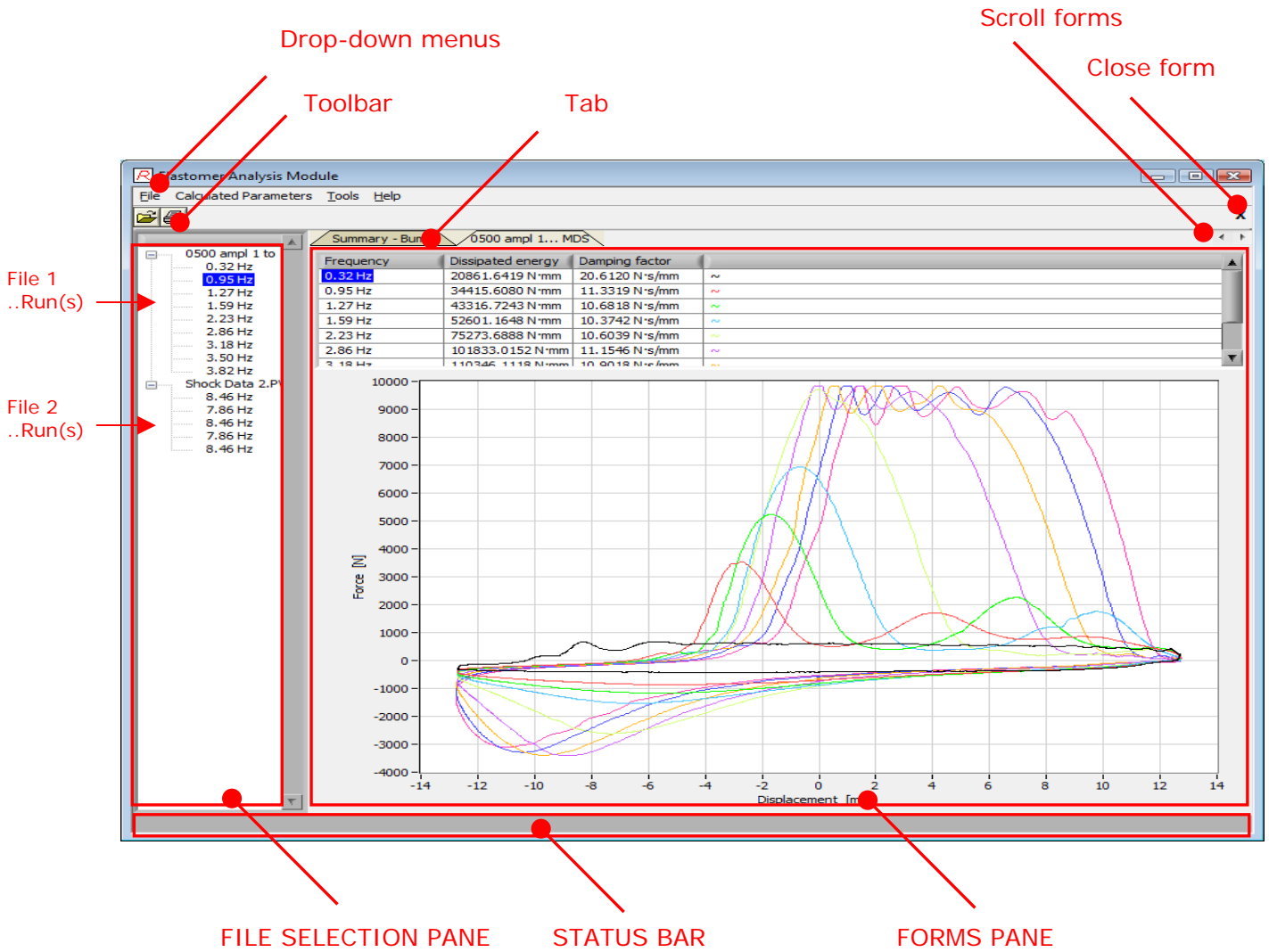


3.2 Forms Pane

When the required analysis option is selected (see Section **Error! Reference source not found.**: Calculated Parameters) the analysis results will appear in the **Forms Pane**. Each form has a standard Window tab at the top that allows them to be individually selected. The forms can be scrolled with CTRL-Tab or CTRL-SHIT-Tab. The **Scroll forms** arrows allow tabs off the current view to be scrolled into view. Tabs can be closed with the **Close form** button. Up to 28 Tabs can be open at one time.

The **Status bar** at the bottom of the Window records file specific information.

Figure 1 : The Elastomer Analysis Module – User Interface



3.3 Pull-down menus

File
 Calculated parameters
 Tools>Units

- standard window options
- see Section 4
- Allows displayed units of Force, Displacement and Velocity to be changed.

4. Calculated Parameters

To perform data analysis selected the required run or runs and then press:

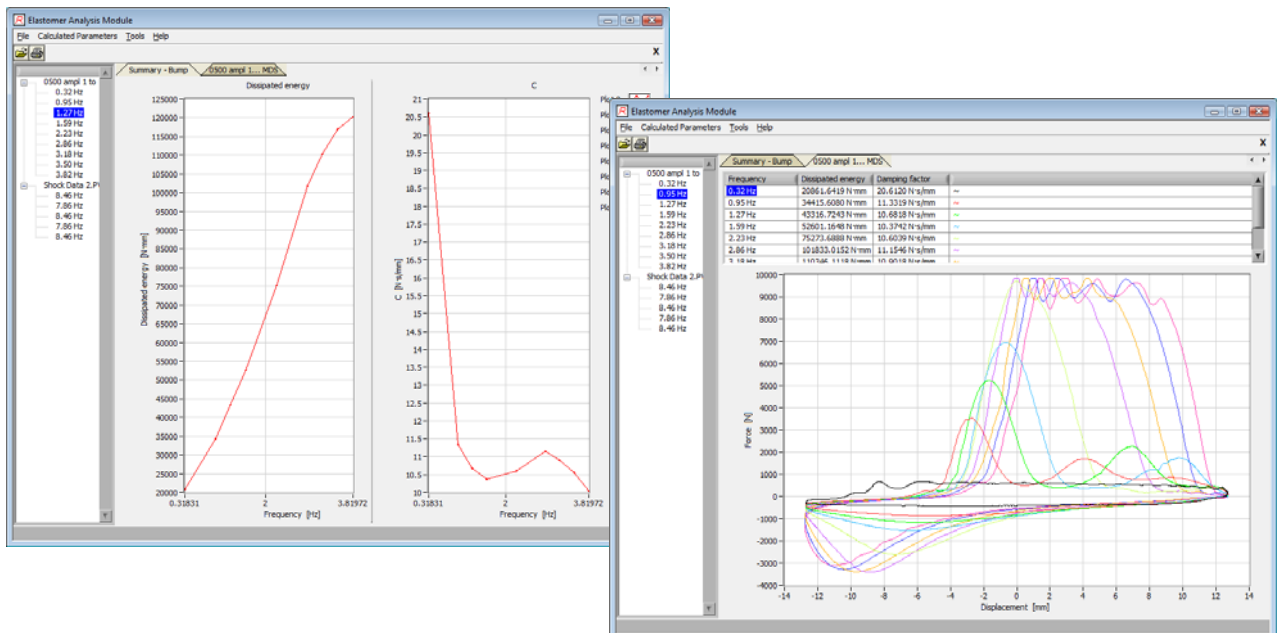
1. F10 for Rubber mount, Dynamic spring characteristics (Section 4.1)
2. F11 for Rubber bush, Dynamic stiffness & damping (Section 4.2)
3. F12 for Damper force measurements (Section 4.3)

4.1 Rubber mount, Dynamic spring characteristics

Shortcut - F10

If any run in a file is selected the F10 will produce two forms.

1. **Summary form** - plot of dissipated energy and damping coefficient
2. **Table & plot form** - for all data in file



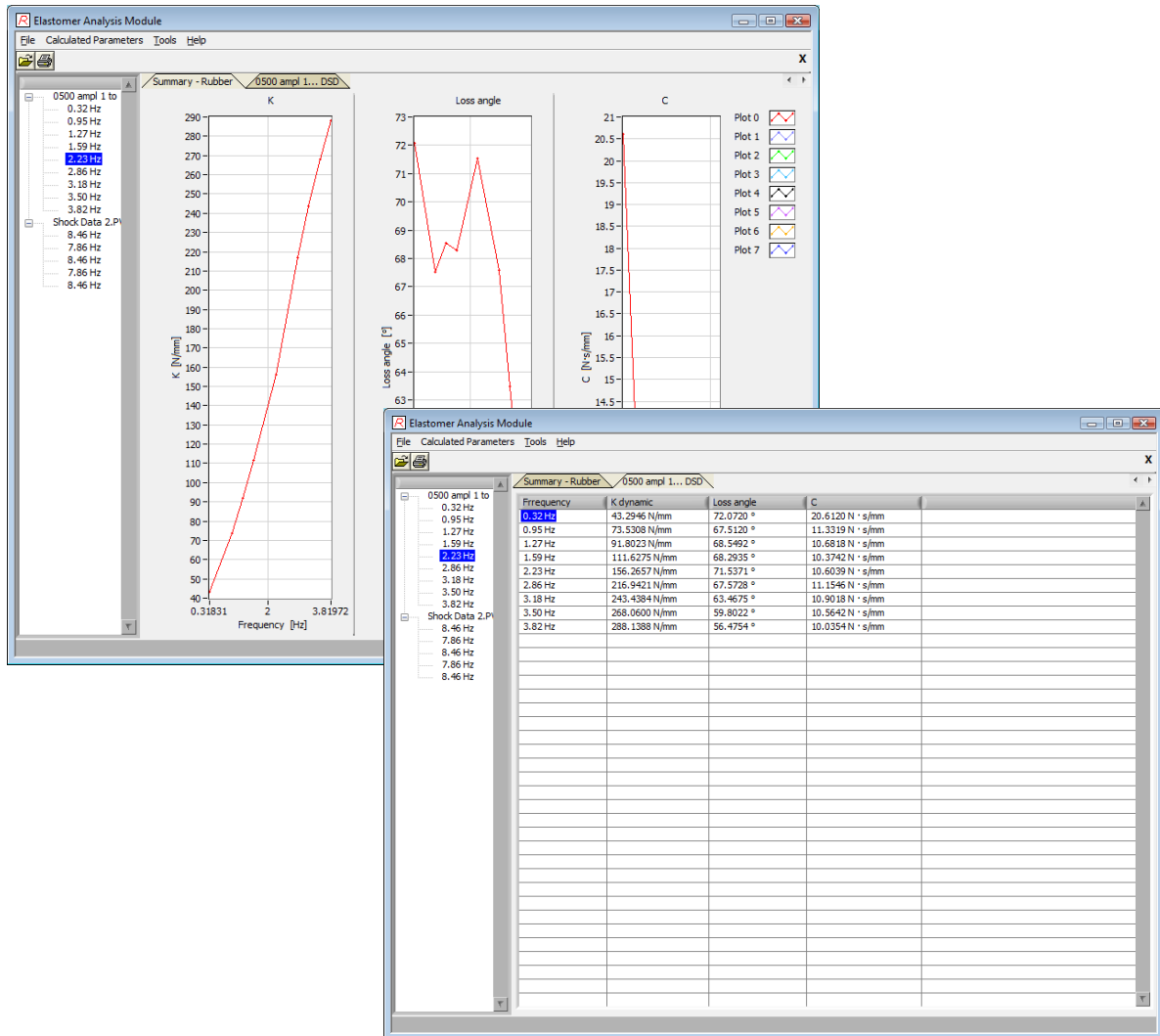
If F10 is selected for any other runs in another file then a new **Table & plot form** is created and the original **Summary form** is over plotted with the new data.

4.2 Rubber bush, Dynamic stiffness & damping

Shortcut - F11

If any run in a file is selected the F11 will produce two forms.

1. **Summary form** - plot of dynamib stiffness, loss angle and damping coefficient
2. **Table data form** - for all data in file



If F11 is selected for any other runs in another file then a new **Table data form** is created and the original **Summary form** is over plotted with the new data.

4.3 Damper force measurements

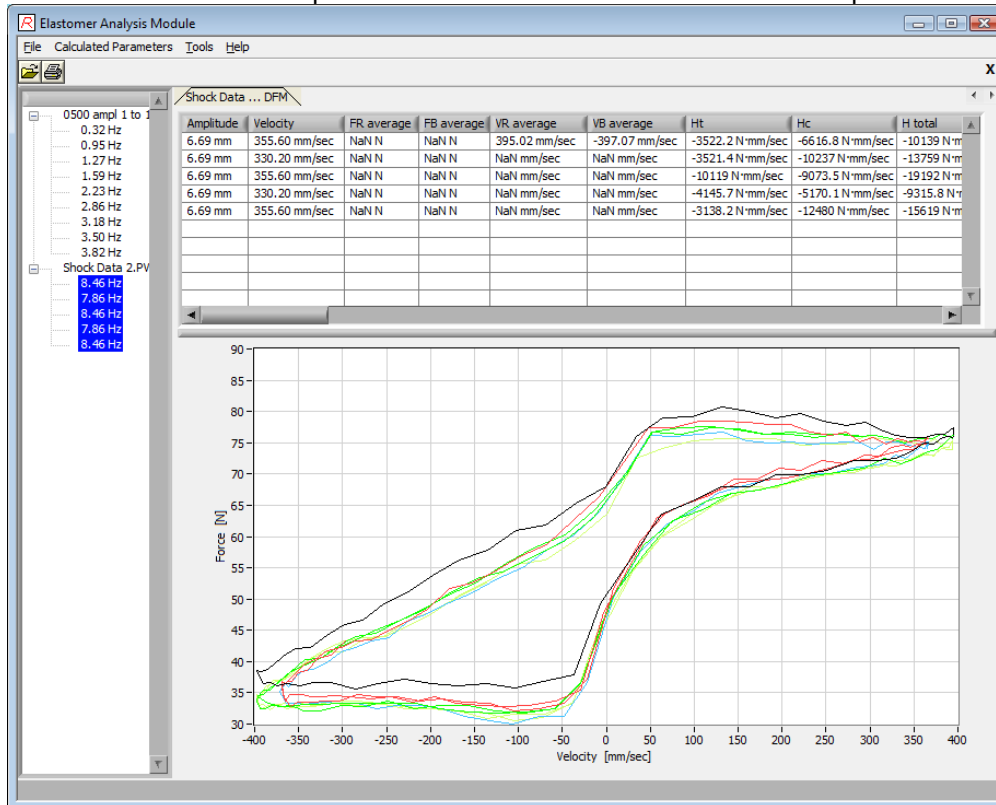
Shortcut - F12

For whatever runs are selected in a file the table data is populated and plot shown in the **Damper force form**.

A group of all runs can be selected then F12, or each run individually and F12.

Data is always sorted in increasing velocity.

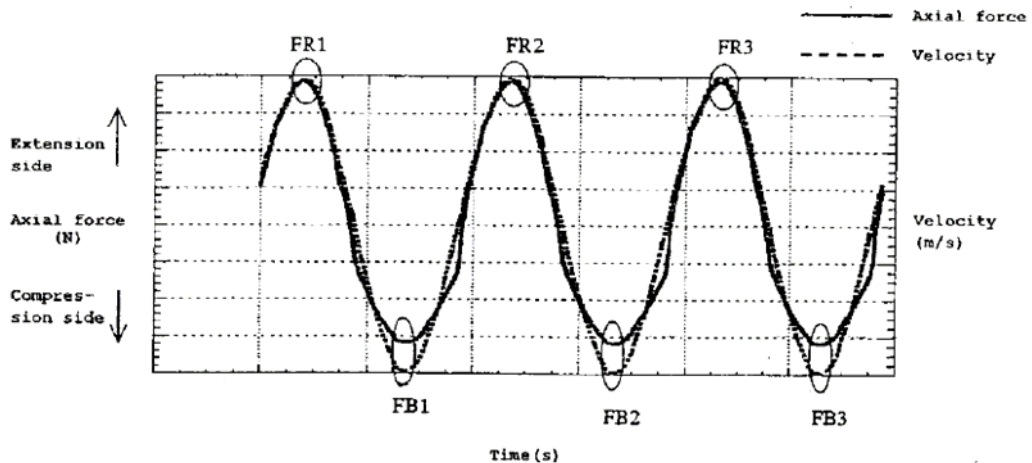
If a run or runs in a separate file are selected then a new Damper force form is created.



5. Calculations

5.1 Damping Force Measurement

5 cycles at each specified sinusoidal amplitude and velocity. From three complete waves of damping force (time waveform) and velocity (time waveform), identify each three peak values of axial force on the extension side (FR), axial forces on the compression side (FB), velocity on the extension side (VR) and velocity on the compression side (VB).



Note : These need five cycles of data to be computed.

$$FR_ave = (FR1 + FR2 + FR3) / 3$$

$$FB_ave = (FB1 + FB2 + FB3) / 3$$

$$VR_ave = (VR1 + VR2 + VR3) / 3$$

$$VB_ave = (VB1 + VB2 + VB3) / 3$$

(assume 1.4.2 intended velocities CAN be achieved, so disregard)

$$DEt = \text{Damping Energy extension}$$

$$DEc = \text{Damping Energy contraction}$$

$$DEt = \text{Damping Energy Total}$$

$$Ht = \text{Hysteresis Extension}$$

$$Hc = \text{Hysteresis Contraction}$$

$$Ht = \text{Hysteresis Total}$$

$$\text{Extension Response} = Ht/DEt \times 100\%$$

$$\text{Contraction Response} = Hc/DEc \times 100\%$$

$$\text{Total Response} = Htc/(DEt + DEc) \times 100\%$$

5.2 Rubber bush, dynamic stiffness and damping

(at available frequencies)

$$K_{dyn} \text{ [N/mm]} = \text{dynamic stiffness}$$

$$LA \text{ [}^\circ\text{]} = \text{Loss angle}$$

$$C_{dyn} \text{ [-]} = \text{damping factor}$$

$$\text{Ratio of dynamic stiffness to static stiffness } R = C_{dyn, 100 \text{ Hz}}/C_{dyn, 1 \text{ Hz}}$$

5.3 Rubber mount, dynamic spring characteristics

(at available frequencies)

$$\text{Dissipated energy } Wd$$

$$\text{Damping factor } \Psi$$