

# **SUSPENSION ANALYSIS**

## **Basic Mode**



**Racing Data Power**

## INTRODUCTION

Starting from **Race Studio 2.30.04** a new function has been introduced. It concerns **Suspension Analysis** tool, included in **Race Studio Analysis** software.

This new function, called **Basic**, is additional to the **Advanced** one already available in the software previous versions.

**Basic** mode fits the need of an easy and quick using tool that shows all needed information as well.

Thanks to **Suspension Analysis, Basic mode**, in fact, it is possible to evaluate hydraulic setup in any “problematic” point of the track.

This way it is possible to analyze hydraulic setup highlighting the points where, in a complete track lap, dampers are more stressed.

Moreover, as for the other analysis tools, it is possible to compare more laps (bump and rebound for different dampers) so to achieve the optimum vehicle tuning.

In the following pages is explained **Suspension Analysis** in **Basic** Mode.

## 1 – How to open suspension analysis window

To open suspension analysis window, open the test to analyze and press suspension icon, shown here below.



Figure 1 – Suspension analysis icon.

Suspension analysis window appears (Figure 2):

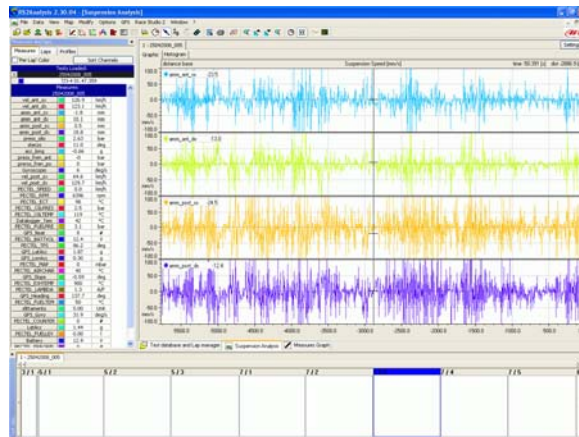


Figure 2 – suspension analysis window.

**WARNING:** suspension analysis is set on basic mode by default. To change this setting see “setting analysis options” paragraph.

This window is made up of two layers, corresponding to the available graphs:

- **Graphic:** represents punctual values of suspensions reached speeds based on time and distance (figure 3a).
- **Histogram:** represents the all test dividing the values by bands (Figure 3b).

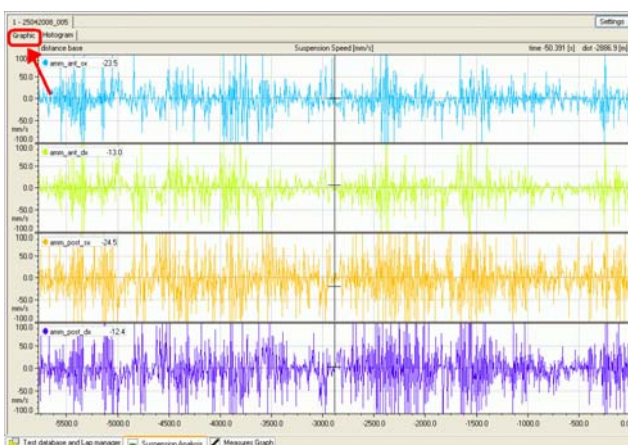


Figure 3a – Graph window.

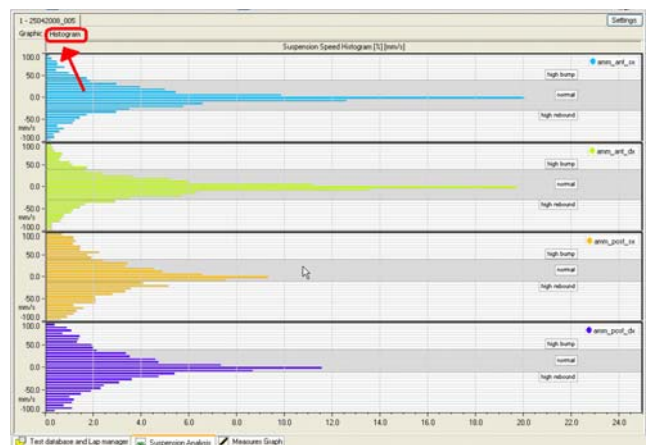


Figure 3b – Histogram window.

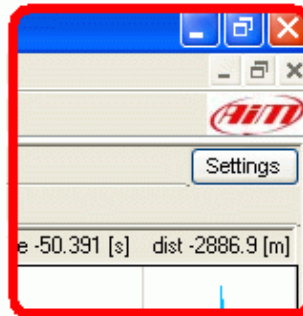
To switch from one layer to the other click on its label (highlighted in red in Figures 3a and 3b).

## 2 – How to set data visualization

For a correct data visualization it is necessary to previously set graph channels and scales through setting window. It also allows to set general options useful to create the graphs.

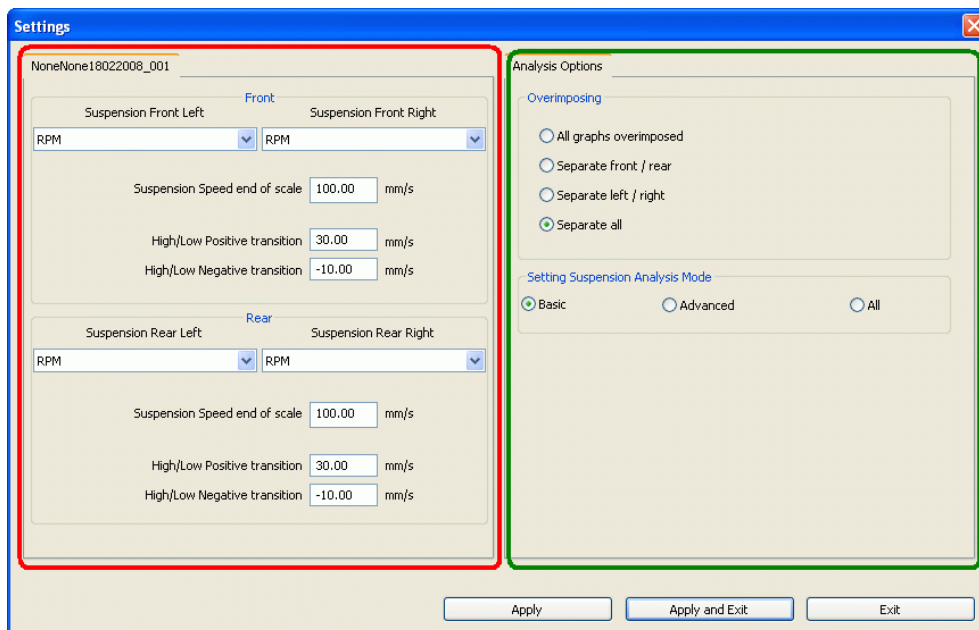
Setting window can be reached in three ways:

1. using “Settings” button, top right of suspension analysis window (**Figure 4**);



**Figure 4** – Settings button – (particular of the main window).

2. right clicking into suspension analysis window;
  1. through “Options/settings” button in **menu bar** of “Suspension analysis” window;



**Figure 5** – Settings window.

The window is divided in two panels (red and green circled in **Figure 4**). Graph parameters are set through the right panel (green circled) while single test parameters are set through the left one (red circled).

## 2.1 – Setting test parameters

**Warning: setting window needs to be set BEFORE looking at the graphs**

To set the left panel follow these instructions:



**Figure 6** – Setting test parameters.

1. Set channels associated with the suspensions (necessary to have a coherent graph), selecting channels corresponding to the four suspensions from the drop down menus red circled in **Figure 6**. In the example above, for instance, the left rear suspension corresponds to the channel labelled: amm\_ant\_sx.
2. Set “Suspension speed end of scale” box (green box in **Figure 6**) that corresponds to the graph end of scale (vertical axis of Graphic window – **Figure 3a**). It is a modular value (to say that it works both as a positive and as a negative max value). In **Figure 6**, for example, max suspension speed value is  $\pm 100$  mm/s.
3. Set “Negative Transition” and “Positive Transition” cases corresponding to rebound (negative transition) and bound (positive transition) speed threshold over which tunings for high speed come into play – assuming vehicle dampers allow them. In order to correctly interpret data it is necessary to set threshold values that are coherent with suspension constructive/hydraulic characteristics. These information, not easy to find, are usually included in the suspensions users manuals.

## 2.2 – Setting Analysis options

In “Analysis options” panel it is possible to set different graph and data visualization modes (red and green boxes in **Figure 7b**, that corresponds to the bleu box of **Figure 7a**). These sections are explained in the following paragraphs.

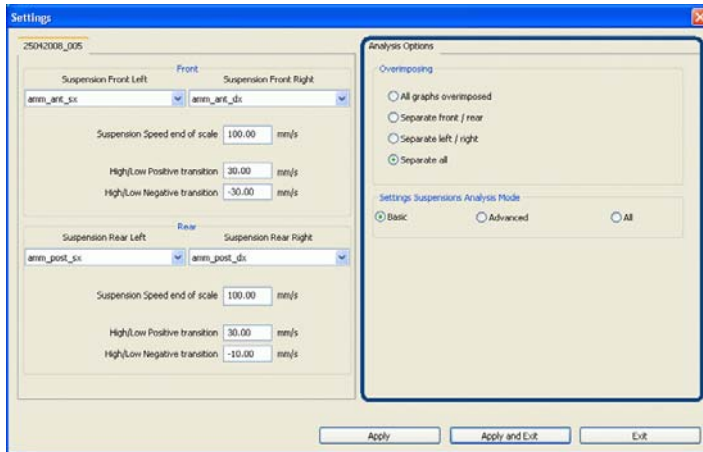


Figure 7a – Setting analysis options.

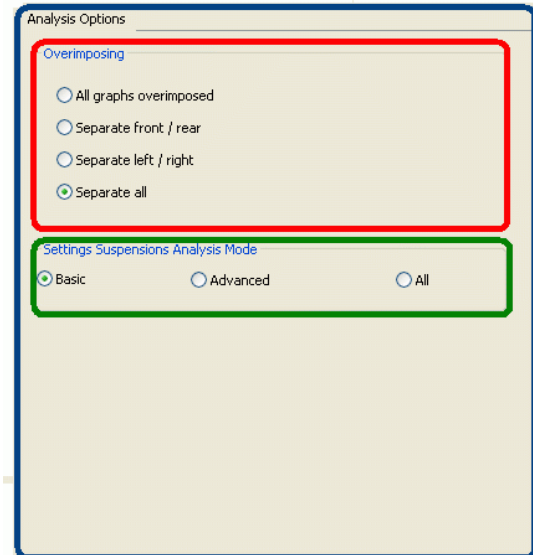


Figure 7b – Analysis options- particular.

### 2.2.1 – Over-imposing graphs

In “Over-imposing” panel are four available graphs visualization options (**Figure 7b** red box):

- **All graphs over-imposed:** over-imposes all graphs.
- **Separate front/rear:** shows two graphs: front (right and left) and rear (right and left) suspensions graph.
- **Separate left/right:** shows two graphs: right side (front and rear) and left side (front and rear) suspensions graphs.
- **Separate all:** allows to separate all graphs by channel.

### 2.2.2 – Setting suspensions analysis mode

This functions allows to set suspensions analysis mode to be used (**Figure 7b** green box):

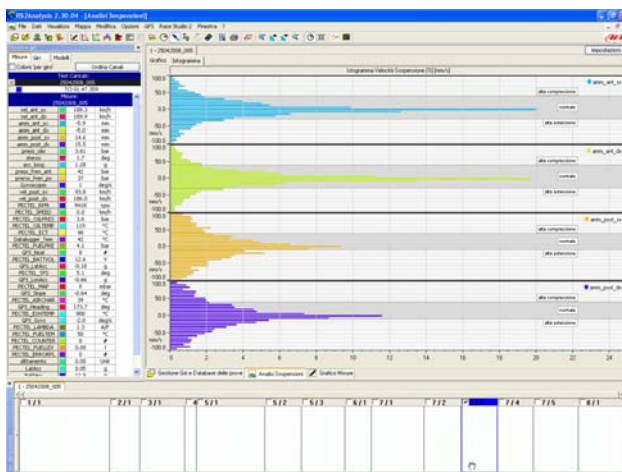
- **“Basic”** shows information concerning the four suspensions in one only layer.
- **“Advanced”** creates a layer for each suspension and different layers to set data visualization mode.
- 4. **“All”** enables a menu (Basic/advanced) that appears each time “Suspension Analysis” is opened.

The software stores setting mode.

### 3 – Functionalities and data analysis

This chapter is about the tools available in suspensions analysis **basic** mode.  
Reminder: click on layer labels to switch from one graph to the other (labels are red circled in **Figures 8** and **11**).

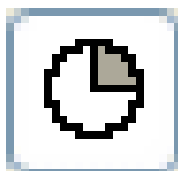
#### 3.1 – The main analysis tool of graphic layer



**Figure 8** – “Suspensions analysis” Graphic layer.

##### 3.1.1 – Time visualization mode

To enable this function press the button here below.

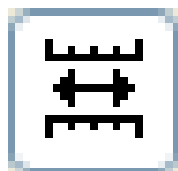


**Figure 9** – Time visualization mode icon

This function allows to switch from **distance mode** (visualization of punctual speed vs run distance) set by default to **time mode** (visualization of punctual speed vs elapsed time).

##### 3.1.2 – How to use Snap ON/OFF mode.

To enable this function press the button here below.



**Figure 10** – Snap ON/OFF visualization mode icon.

This function allows to show all test laps without showing the lap marker, to say allows to scroll the all test simply moving the cursor inside the window.  
To come back to lap visualization disable Snap button clicking again on it.

### 3.2 – The main analysis tool of histogram layer

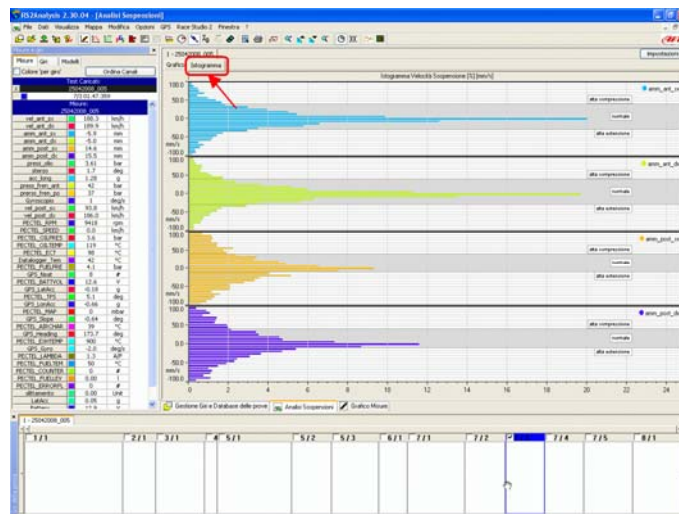


Figure 11 - "Suspensions analysis" window histogram layer.

#### 3.2.1 – Band visualization

This visualization mode allows to analyze suspensions travel at high and low speeds while bumping and rebounding. With reference to the following figures, please note that **Figure 9b** is an enlargement of red box of **Figure 9a**.

- Bump and rebound **Low speeds** are included in the grey band and are labelled "Normal" in **Figure 12a** (green box of **Figure 12b**).
- Bump and rebound **High/Low transition thresholds** are indicated by the yellow upper and lower limit of green box (**Figure 12b**).
- Bump and rebound **High speeds** are indicated by the red boxes in **Figure 12b**, labelled "high bump" and "high extension" in both figures.

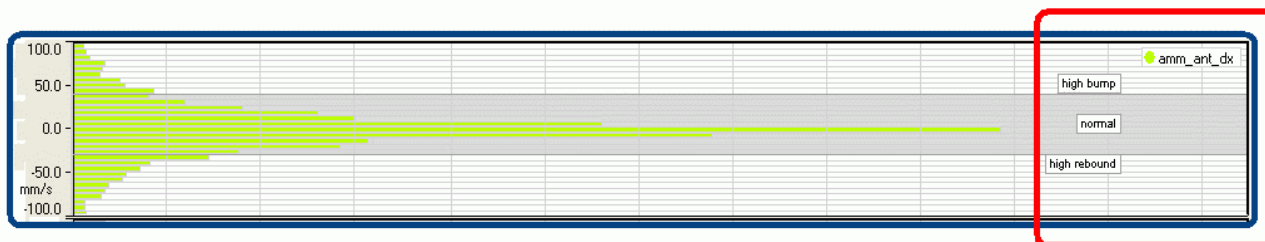


Figure 12a –Histogram.

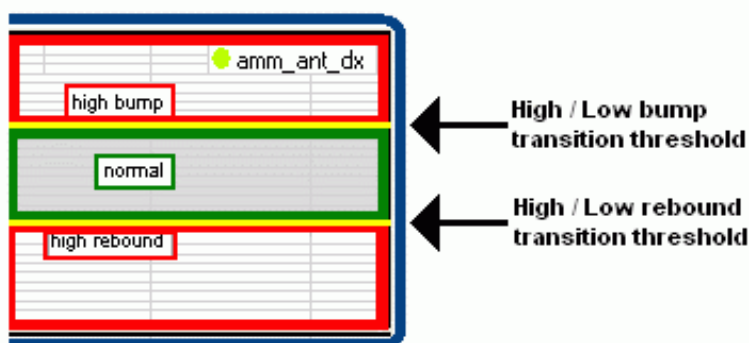
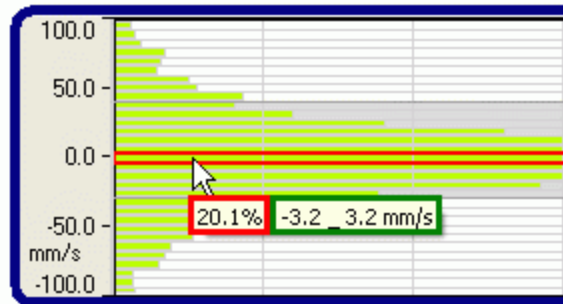


Figure 12b – Particular.



The histogram can show a complete lap or a split and clicking on it it is possible to show the percentage of time during which the shown range of values have been recorded. In the example below (**Figure 13**) values included between +3.2/-3.2 (green box) have been detected for 20.1% of time (red box) in the split shows by this histogram (external blue box).



**Figure 13** – Particular of histogram graph.

In the graph of **Figure 14** are represented shock absorber course curves with hard and soft tuning.

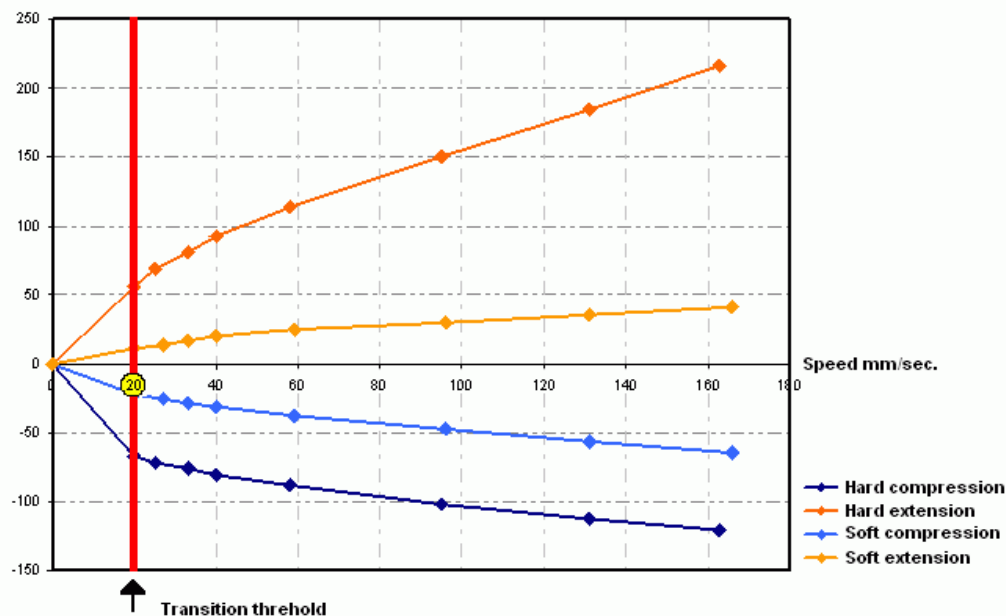
This graph has been obtained plotting the speed reached by the suspensions versus the various reaction strengths of the dampering stuff.

With reference to the graph of **Figure 14** transition threshold is around **20 mm/s** and is highlighted by the vertical red line.

This means that, using these experimental data, transition value between high and low speeds is not influenced by the shock absorbers tuning.

Left of transition threshold are positive/negative low bump/rebound values while right of threshold value are positive/negative high bump/rebound values.

Each shock absorber has its own characteristic curves, obtained experimentally at the test bench; it is suggested to insert the value in the dedicated setting box (see "Setting test parameters" paragraph).



**Figure 14** – Shock absorbers curve graph.