

# Suspension Analyzer

## Full Vehicle Version

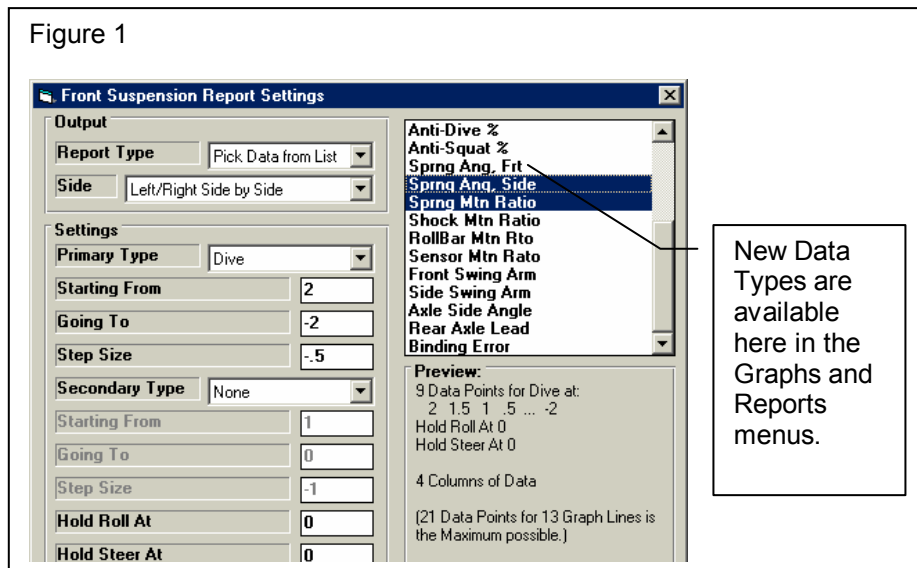
### Overview of Features

The Full Vehicle version of Suspension Analyzer has several enhancements over the standard version, the most significant is analyzing various types of rear suspensions and combining front and rear suspensions together for full vehicle analysis. A list of the Full Vehicle version's features includes:

The Full Vehicle Version lets you graph or report these additional types of data.

Anti-Squat %	Sprng Ang, Frt	Sprng Ang, Side
Sprng Mtn Ratio	Shock Mtn Ratio	RollBar Mtn Rto
Sensor Mtn Ratio	Front Swing Arm	Side Swing Arm
Axle Side Angle	Rear Axle Lead	Binding Error

These data types are added to the bottom of the Data List in the Graph and Report menu.



These data are displayed on the Main Screen in the Data Grid. For a complete listing of these inputs and calculated outputs, click on Help at the top of the Main Screen, then List Definitions for Main Screen Input/Output.

The Full Vehicle Version lets you specify Push Rod w Rocker Arm and Pull Rod w Rocker Arm springs for Double A Arm suspensions. In Vehicle Specs, choose these types for the "Springs" spec.

Figure 2 Example of Pushrod Spring Layout

**Front Suspension**

Toe-In Gain: .19" Roll Center Ht: .89 Turn Radius: None Roll Center Right: .00 Toe-In Gain: .19"  
 Camber Gain: -.49 Caster Gain: .49 Caster Gain: .49 Camber Gain: -.34

Location	Type	Lt Out (X)	Lt Height (Y)	Lt Depth (Z)	Rt Out (X)	Rt Height (Y)	Rt Depth (Z)
Spring Mount on Frame	Input	6	7	0	6	7	0
Push Rod Mount on Lower Arm	Input	18	8	0	18	8	0
Bellcrank Axis Front	Input	12	14	-10	12	18	-10
Bellcrank Axis Rear	Input	12	14	10	12	10	10
Spring Mount on Bellcrank	Input	9	18	3	9	18	3
Pushrod Mount on Bellcrank	Input	14	16	0	14	16	0
Spring Length	Output				11.79		
Spring Angle from Front	Output				-15.25		
Spring Angle from Side	Output				15.25		
Spring Rate/Wheel Rate	Input (clc)	400	180.1		400	244.8	

Full Vehicle Version lets you analyze these ends of the car.

Front Suspension Only	Rear Suspension Only
Front and Rear Suspension together	

Click on Vehicle Specs for the Menu Shown Here

Click these tabs to view specs (like Suspension Type) for Front or Rear of car.

Choose Which End to Analyzer here: Front only, Rear Only, or Front and Rear.

Click these buttons to work on, view and analyze the different ends of the car.

To graph or report data for a particular end of the car, you must have chosen to view that end of the car on the main screen by clicking on the appropriate button at the lower right of the layout screen.

The Rear Suspension Types supported at this time include are given below.

Double A Arm	McPhearson Strut
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Three Link w panhard bar	Four Link (angled links like Chevelle or 5.0L Mustang)
Four Link w panhard bar	Ladder Bars (trailing arms)
NASCAR Truck Arms	C3 Corvette (63-82) coming soon

**Figure 4**

Click on the Rear Suspension tab to be able to choose the Rear Suspension Type from this list

Note that springs can be attached either to the lower arms or the axle housing itself. This can have a large affect on Spring Motion Ratio, Roll Stiffness and Front to Rear Roll Couple.

Layout view of 4 Link Rear Suspension with Panhard Bar

Total Vehicle results.

Slide slide bar button to bottom to view Total Vehicle results shown here.

**Suspension Analyzer v1.1 Performance Trends [ 4 Link + Panhard Bar ]**

File Edit Graphs Reports Vehicle Specs Adjust Optimize Zoom Animate Preferences Help

Front View Side View Top View No View Dynamic Squat 1 Roll 1.5

This is a view from the rear of car (right side of screen is actually right side of car).  
Gain based on 1" Dive.

Toe-In Gain: .01" Roll Center Ht: 7.50 Turn Radius: 7469 ft Lt Roll Center Left: .56 Toe-In Gain: -.01"  
Anti-Squat, Static 181.8% Dyn 181.0% Turn Toe In: .00" Anti-Squat, Static 156.0% Dyn 141.7%

Front Suspension  
Rear Suspension  
Refresh

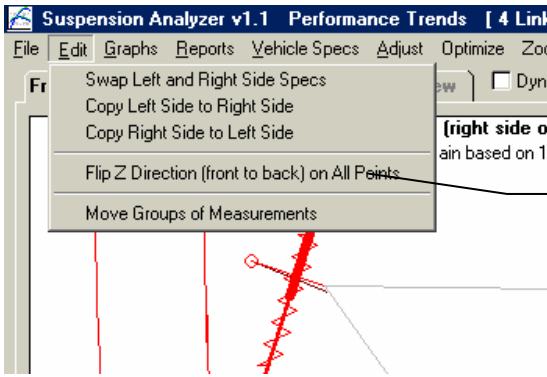
Location	Type	Lt Static	Lt Dynamic	Lt Change	Rt Static	Rt Dynamic	Rt Change
Lower Link Length	Output	21.19			20.69		
Panhard Bar Length	Output	35.01					
Binding Error, in	Output	.00	.06	.06			
Side View Swing Arm Length	Output	27.4	25.3	-2.1	29.2	25.6	-3.6
Total Roll Stiffness, ft-lbs/deg	Output	1609.0					
Front Roll Couple, %	Output	80.90					
Rear Roll Couple, %	Output	19.10					
Roll Axis to CG Moment Arm	Output	11.38					
Level Ground Roll Rate, deg/G	Output	1.28					
Front Natural Freq, cps	Output	2.18			2.46		
Rear Natural Freq, cps	Output	1.22			1.74		

If you analyze Front and Rear Suspension together, the program also calculates and displays these Full Vehicle results. These results are listed at the bottom of the Data Table on the main screen.

Total Roll Stiffness, ft-lbs/deg	Front Roll Couple, %
Rear Roll Couple, %	Roll Axis to CG Moment Arm
Level Ground Roll Rate, deg/G	Front Natural Freq, cps
Rear Natural Freq, cps	

The Depth (Z) measurements for Rear Suspensions are positive if they are in front of the axle, toward the front of the car. Depth (Z) for both the front and rear mean "in towards the center of the car". See Figure 5 if you've made a mistake entering Z measurements.

Figure 5

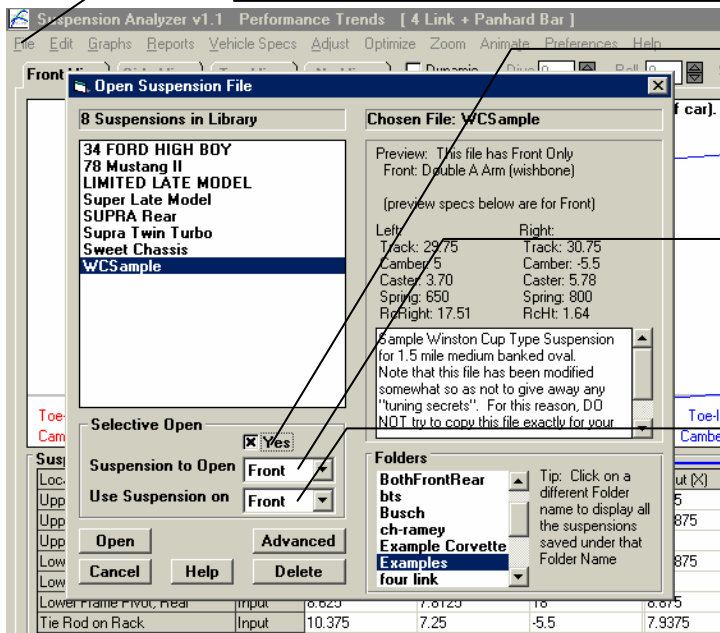


Should you make a mistake on the Z direction measurements, this command will swap the Z measurements from front to back, or switch the + and - signs on all Z measurements.

Another useful feature for working with front and/or rear suspensions is the ability to “selectively open” one end of a vehicle suspension file and use it on the same end of the current vehicle you are working with or building. For example, say you have built a vehicle file working with only the Front Suspension file. Now you want to put only that front suspension on an existing vehicle file which has both a front and rear, but you want to keep the rear. You would click on File, then Open, then choose the Selective Open option shown in Figure 6. This feature also lets you put a front suspension on the rear or rear suspension on the front (McPhearson Strut or Double A Arm only).

Figure 6

Click on File, then Open (from all saved suspensions)



Set this option to Yes for Selectively Opening just the front or rear suspension of a particular saved file.

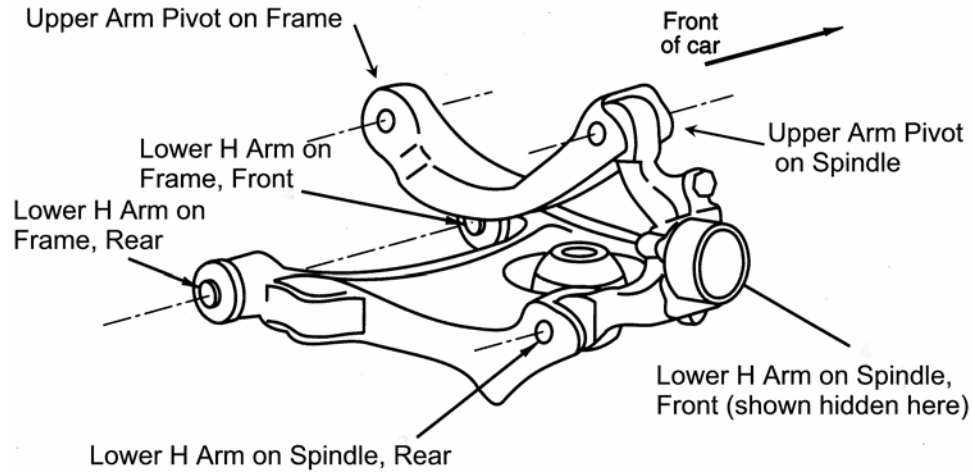
This combo box lets you choose which suspension to use from the file you are opening.

This combo box lets you choose where to put the suspension on the current file you are working with.

Lower frame pivot, rear	Input	8.625	7.8125	16	8.875
Tie Rod on Rack	Input	10.375	7.25	-5.5	7.9375

Version 1.1 C.017, Feb 4, 2002 added a new type of rear suspension type, the IRS with lower H arm, typical of that used in the IRS Ford Thunderbirds in 1987 and the Cobra Mustangs. See Figures 7 and 8 below.

Figure 7 Independent Rear Suspension (IRS) with Lower H Arm



Courtesy of Milliken & Milliken, Race Car Vehicle Dynamics (C) 1995

Figure 8 Data Input Screen for IRS Rear Suspension Type

**Suspension Analyzer v1.1 Performance Trends [ IRS Temp ]**

File Edit Graphs Reports Vehicle Specs Adjust Optimize Zoom Animate Preferences Help

Front View Side View Top View No View  Dynamic Squal 0  Roll 0

This is a view from the rear of car (right side of screen is actually right side of car).  
Gain based on 1" Dive.

Front Suspension  
**Rear Suspension**  
Refresh

Toe-In Gain: **-18"** Roll Center Ht: 6.78 Turn Radius: None Roll Center Right: .00 Toe-In Gain: **-18"**  
Camber Gain: **-1.47** Caster Gain: **-19** Caster Gain: **-19** Camber Gain: **-1.47**

Suspension Data							
Location	Type	Lt Out (X)	Lt Height (Y)	Lt Depth (Z)	Rt Out (X)	Rt Height (Y)	Rt Depth (Z)
Upper Arm Pivot on Spindle	Input	24	19.5	1	24	19.5	1
Upper Arm Pivot on Frame	Input	16	17.5	3	16	17.5	3
Lower H Arm on Spindle, Front	Input	25	6	-4	25	6	-4
Lower H Arm on Frame, Front	Input	13	7	-6	13	7	-6
Lower H Arm on Frame, Rear	Input	14	7.5	5	14	7.5	5
Lower H Arm on Spindle, Rear	Input	24	5.5	3	24	5.5	3

