SPORTDYNO V4.1

USER'S MANUAL

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1. SportDevices End User Software License & Warranty Disclaimer

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SportDevices
Cami del Port 145, 46470 Catarroja, Spain

1.1 General Safety Instructions (SPx devices)

Use the following safety guidelines to help ensure your own personal safety and to help protect your equipment and working environment from potential damage.

SAFETY: General Safety

When setting up the equipment for use:

- Place the equipment on a hard, level surface. If the equipment is installed in a closed-in wall unit, ensure that there is enough ventilation.
- Avoid placing objects on top of this equipment to permit the airflow required for proper ventilation. Restricting airflow can damage the equipment.
- Keep your device away from radiators and heat sources.
- Keep your equipment away from extremely hot or cold temperatures to ensure that it is used within the specified operating range. (check technical parameters section at SPx manual)
- Keep your equipment away from Electromagnetic emitting devices like CDI ignition, or electric motors / VFD (Variable Frequency Drive)
- Do not push any objects into the air vents or openings of your equipment. Doing so can cause fire or electric shock by shorting out interior components.
- Ensure that nothing rests on your equipment's cables and that the cables are not located where they can be stepped on or tripped over.

When operating your equipment:

- Do not use your equipment in a wet environment, for example, in a wet basement.
- Do not use AC powered equipment during an electrical storm.
- Do not spill food or liquids on your equipment.
- Before you clean your equipment, disconnect it from the electrical outlet. Clean your device with a soft cloth dampened with water. Do not use liquids or aerosol cleaners, which may contain flammable substances.
- Clean the display with a soft, clean cloth and water. Apply the water to the cloth, then stroke the cloth across the display in one direction, moving from the top of the display to the bottom. Remove moisture from the display quickly and keep the display dry.
- Long-term exposure to moisture can damage the display. Do not use a commercial window cleaner to clean your display.

⚠ **CAUTION: Do not operate your equipment with any cover(s) removed.**

- If your equipment does not operate normally - in particular, if there are any unusual sounds or smells coming from it - unplug it immediately and contact an authorized dealer or service center.

⚠ **WARNING: To prevent the spread of fire, keep open flames away from this product at all times.**

1.2 SAFETY: When Working Inside Your Device

Do not attempt to service the equipment yourself, except as explained in your documentation or in instructions otherwise provided to you by SportDevices. Always follow installation and service instructions closely.

1.3 SAFETY: General Power Safety

 By default, if other values are not specified all SportDevices equipment are rated for **230 VAC / 50 Hz.** (115 VAC units will have a specific label for that)

Observe the following guidelines when connecting your equipment to a power source:

- Check the voltage rating before you connect the equipment to an electrical outlet to ensure that the required voltage and frequency match the available power source.
- Do not plug the equipment power cables into an electrical outlet if the power cable is damaged.
- To prevent electric shock, plug the equipment power cables into properly grounded electrical outlets. If the equipment is provided with a 3-prong power cable, do not use adapter plugs that bypass the grounding feature, or remove the grounding feature from the plug or adapter.
- If you use an extension power cable, ensure that the total ampere rating of the products plugged in to the extension power cable does not exceed the ampere rating of the extension cable.
- If you must use an extension cable or power strip, ensure the extension cable or power strip is connected to a wall power outlet and not to another extension cable or power strip. The extension cable or power strip must be designed for grounded plugs and plugged into a grounded wall outlet.
- If you are using a multiple-outlet power strip, use caution when plugging the power cable into the power strip. Some power strips may allow you to insert a plug incorrectly. Incorrect insertion of the power plug could result in permanent damage to your equipment, as well as risk of electric shock and/or fire. Ensure that the ground prong of the power plug is inserted into the mating ground contact of the power strip.
- Be sure to grasp the plug, not the cable, when disconnecting equipment from an electric socket.

1.4 SAFETY: If Your Device Gets Wet

⚠ **CAUTION: Before you begin any of the procedures in this section, see the SAFETY: General Safety section of this document.**

⚠ **CAUTION: Perform this procedure only after you are certain that it is safe to do so. If the device is connected to an electrical outlet, turn off the AC power at the circuit breaker, if possible, before attempting to remove the power cables from the electrical outlet. Use the utmost caution when removing wet cables from a live power source.**

1. Disconnect the AC cord from the electrical outlet, and then, if possible, disconnect the AC cord from the device.
2. Turn off any attached external devices, then disconnect them from their power sources, and then from the device.
3. Contact SportDevices support (info@sportdevices.com)

⚠ **Limited Warranties:** warranty is limited to normal usage of the device, any fault caused by inappropriate usage or accident will not be covered

1.5 SAFETY: If You Drop or Damage Your Equipment

⚠ **CAUTION: Before you begin any of the procedures in this section, see the SAFETY: General Safety and Power Safety sections of this document.**

4. **CAUTION: If any internal components can be seen through damaged portions, or if smoke or unusual odors are detected, disconnect the device from the electrical outlet and contact SportDevices support** (info@sportdevices.com)

1. Save and close any open files, exit any open programs, and shut down the computer.

2. Turn off the device and disconnect from the power source, and then disconnect from the computer.
3. Turn off any attached external devices, and disconnect them from their power sources and then from the computer.
4. Connect the device to the power source and turn on the device.
5. If the device does not start, or if and smoke or unusual odors are detected, or you cannot identify the damaged components, contact SportDevices support.

1.6 Protecting Against Electrostatic Discharge

⚠ **CAUTION: Disconnect product from mains power source in accordance with product specific safety information located on the "Safety Information" section of this website.**

Electrostatic discharge (ESD) events can harm electronic components inside your device. Under certain conditions, ESD may build up on your body or an object, such as a peripheral, and then discharge into another object, such as your device. To prevent ESD damage, you should discharge static electricity from your body before you interact with any of your device's internal electronic components, like the Bluetooth plug-in.

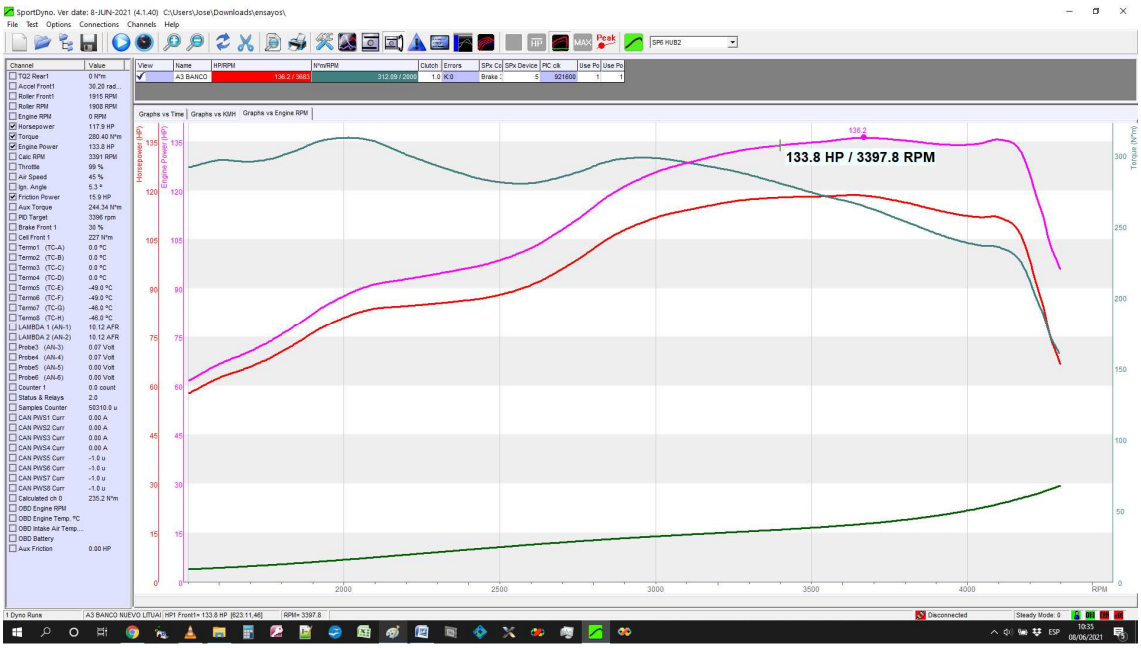
You can protect against ESD and discharge static electricity from your body by touching a metal grounded object (such as an unpainted metal surface on your device) before you interact with anything electronic.
You can also take the following steps to prevent damage from electrostatic discharge:

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component. Just before unwrapping the antistatic package, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all electrostatic sensitive components in a static-safe area. If possible, use antistatic floor pads and work bench pads.

1.7 Dynamometer Important Safety Tips

- Securely fasten test vehicle using all available restraining ratchet straps. The more straps the better. Secure both front to back and side to side. Never move the steering wheel for front wheel drive vehicles while under test.
- Always inspect vehicles for fuel or oil leaks before testing as dyno electrical system can ignite fuel
- Always perform low speed test run to confirm vehicle is adequately secured and operational before doing extensive testing.
- Keep people away from the dyno test area and NEVER have people stand behind the rear of the vehicle. Debris may be stuck in the tires tread and may become projectiles during testing.
- When operating around rotating parts do not wear loose fitting clothing as they may get caught up in rotating pulleys or mechanical components
- Keep dyno area clean from all loose objects
- Keep all hands, feet, and other objects away from moving rolls during tests
- Always wear approved safety equipment such as eye protection and steel tow boots around dyno area
- The dynamometer rollers and power absorption units can become very hot during testing. Avoid contact with them as serious burns or injury can occur.
- The dynamometer power absorption units require high voltage DC current to operate.
- Contact with the high power electrical wires and boxes may be fatal. Disconnect all power to the electrical system before inspecting or servicing.
- During extended testing vehicle cooling system and engine may become very hot.
- Extreme caution is necessary when working near these components.
- Always inspect vehicle tires for wear or damage before testing and only operate with tires that are in good condition and at the proper tire pressure. FOR ALL TIRES TIRE PRESSURE SHOULD BE BETWEEN 1.8 to 2.5 bar (25-35 PSI)
- Never let untrained personal operate the vehicle during dyno testing
- Exhaust gasses are poisonous and may be fatal.

2. MAIN SCREEN.



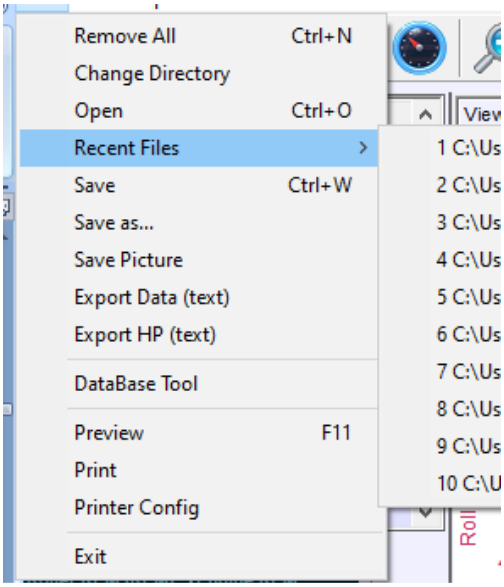
This screen is divided into several zones that are described below:

1. Menu
2. Button bar + other buttons.
3. Channel selector.
4. Options for X axis.
5. Tests list.
6. Graphs area.
7. Scroll bars
8. Status bar.

2.1 Main Menu

Below the program options are explained, there are six menus:

2.2 File Menu



2.2.1 Remove All.
It removes all tests from the memory, but not from the disk.

2.2.2 Open.
It shows a window to choose the tests to be loaded in memory. It is possible to load them one by one or several at once.

2.2.3 Recent Files
It stores a list with the 10 latest open files to ease opening them again

2.2.4 Change directory.
It allows changing the directory where tests are automatically saved.

Change Directory Window

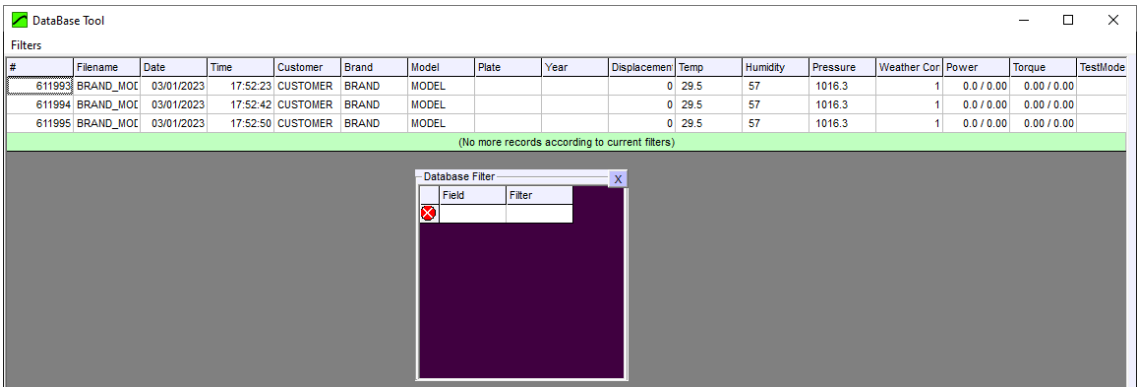
2.2.5 Save as.
It allows saving the dyno run with a different name or in a different place.

2.2.6 Save picture.
It saves a picture with the current graphs area in BMP format. If you want to send it by email, it is better if you change it to gif later.

2.2.7 Export Data (text / raw)
It exports all test RAW data in CSV format (Comma Separated Values), so the data can be used with other programs, for example Microsoft Excel.

2.2.8 Export HP data.
It writes a text file with data from HP and TQ in CSV format, so data can be used with other programs like Excel.

2.2.9 Database Tool
Sportdyno stores the results of all tests so a search across the different fields can be done. The user can add filters to several fields to complete the search. Using the field 'path' the user will be able to open the tests, but if the tests have been moved after they were stored, the SW will not open them.



2.2.10 Preview.

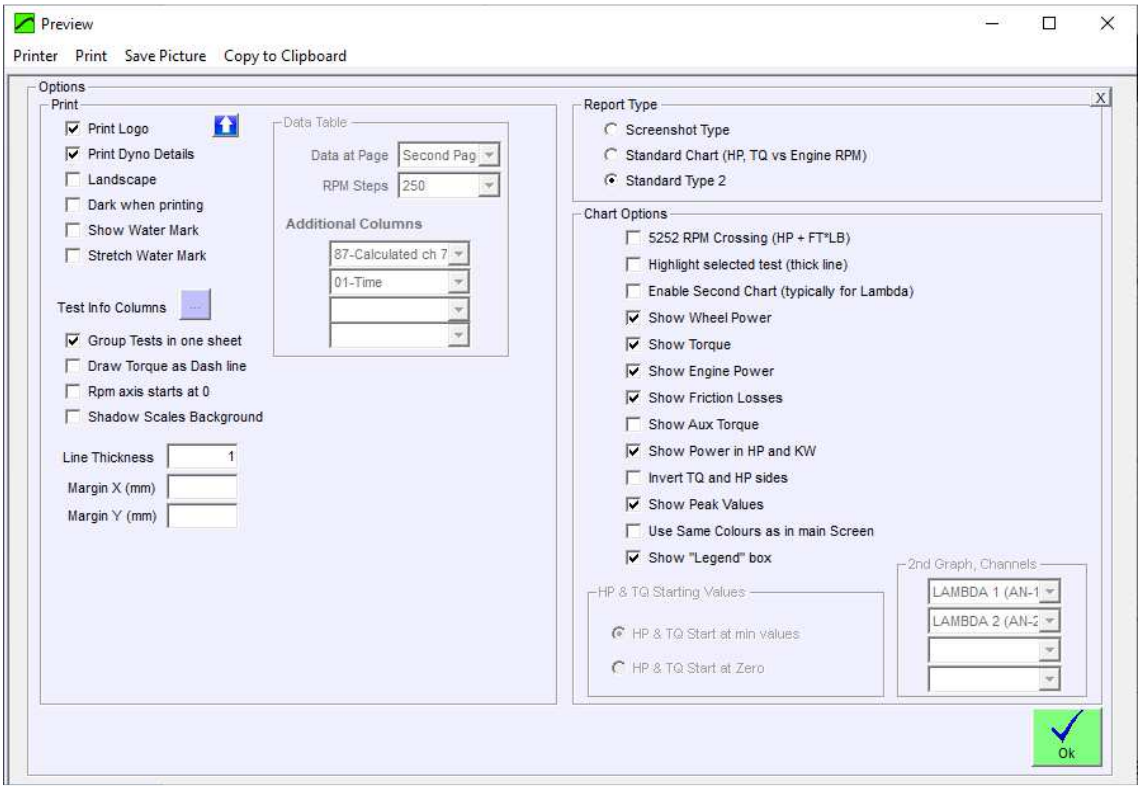
It shows a preview in the screen of the tests in the same way as they will appear in the printer. Note: in this version are **three** type of reports: “screenshot”, “standard chart” and “type 2 chart”

2.2.11 Print.

It prints the selected tests. It shows a window so you can first choose and configure the printer. Note: in this version are three type of reports as described above.

2.2.12 Printer Config

(Note that printer configuration has been moved from the Main Configuration to this specific window)



Print Logo: user can select whether he wants to print the logo or not. There is a file named “**logo.gif”** at installation folder (C:\Program Files (x86)\Sportdevices\Sportdyno41) that can be replaced to set your own business logo. Please use a similar size file.
There is also an “upload” button (the arrow up), to install your logo.

Up arrow: This button eases to upload the new logo, rather than having to manually copy it to the installation folder. A logo of a similar size and layout should be used.

Print Dyno Details: If active, the report will show Sportdyno SW date and version, Dyno name, and Roller inertia, and active options (displacement correction, correction factor, load cell active)

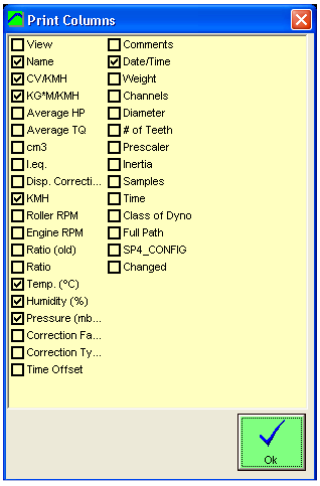
Landscape: With this option dyno runs will be printed horizontally instead of vertically. In this way a bit less numeric data will fit on the paper.

Dark when printing: when printing, pure colors (red, yellow, etc) are not clearly shown over white paper. Then this option is used to dark the graphs color over the paper.

Show Watermark, Stretch Watermark

Test Info Columns Button: program will show Test Info fields selected in this window at report’s header. By default: Name, Power, Torque, Temperature and a few more fields are shown per each test in the first table (on page header). User can choose which test data is to

be printed on the report's header for each test (do not confuse with the test channels shown at the right table).



2.2.13 Data table

Page: None, First Page or Second Page. By default graphs and numeric table are printed in a single page. Now the user can chose to not print the data table (option=none), to print it with the graph (option=First Page) or to print it in a second page (option=Second Page)

RPM steps, when printing a dyno run the default RPM step is 250 for the data table, you can change this value to 100, 250, 500 or 1000 rpm.

Columns 4 and 5, when printing a dyno run, the first three columns of data are: RPM (or time) HP, TQ. The next column(s) can be chosen from the rest of recorded channels of dyno run.

2.2.13.1 Report Type

- **Screenshot Type:** this is the mode used in previous versions. Sportdyno draws the same graph as in main screen for the printed report.
- **Standard Chart (HP, TQ vs Engine RPM):** this mode shows the new HP chart. There are two graphs: top graph shows HP and TQ, bottom graph shows extra channels as lambda or others.
- **Standard Chart "Type 2": (default)** this is a more formatted report focused for printing one run, or for comparing two runs. It includes a foot section with detailed data from the tests.

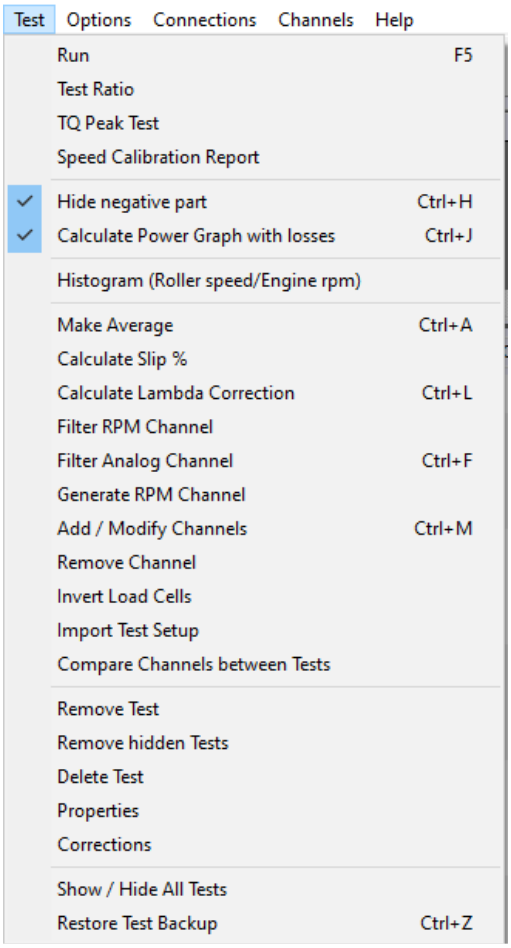
2.2.13.2 Chart Options (only at Chart mode)

- **5252 RPM crossing (HP + FT*LB),** it sets the HP and TQ units to the imperial units so the graphs cross at the known place: 5252 RPM
- **Highligh selected test (thick line):** by default the selected test will be drawn with a thicker line. This test is important because the numeric table is referred to it.
- **HP&TQ starting values:** graphs can start from 0, or from their minimum value so the curve is magnified to fit the whole graph area.
- **2nd graph channels:** In chart mode, the 2nd graph shown at bottom allows to show up to 4 channels. By default only lambda 1 is shown, but other channels can be set

2.2.14 Exit.

The program will be closed.

2.3 Test Menu.



2.3.1 **Run** (F5).

It opens the 'Gauges' Window. In this window you can input the data for the dyno run and the environmental conditions. Then, you can start the test by clicking over the 'Start' button in this window or the **start/stop button** on the dyno.

Note: in this version, test recording is guided by the software. In a typical run, SW will show:

- gauges window,
- then Ratio Window (it is not shown if fixed ratio, clamp or OBDII /xDS modes)
- then "semaphore" window (to find when the engine rpm matches the starting rpm),
- then it will record the test,
- and then if "stop when lower" option was selection it will show the "press clutch" warning

2.3.2 **Test ratio (F7).**

This option opens the "Ratio" Window which is used to calculate the Engine RPM / Roller RPM ratio using the vehicle's Engine RPM Gauge, when the engine RPM channel is not available.

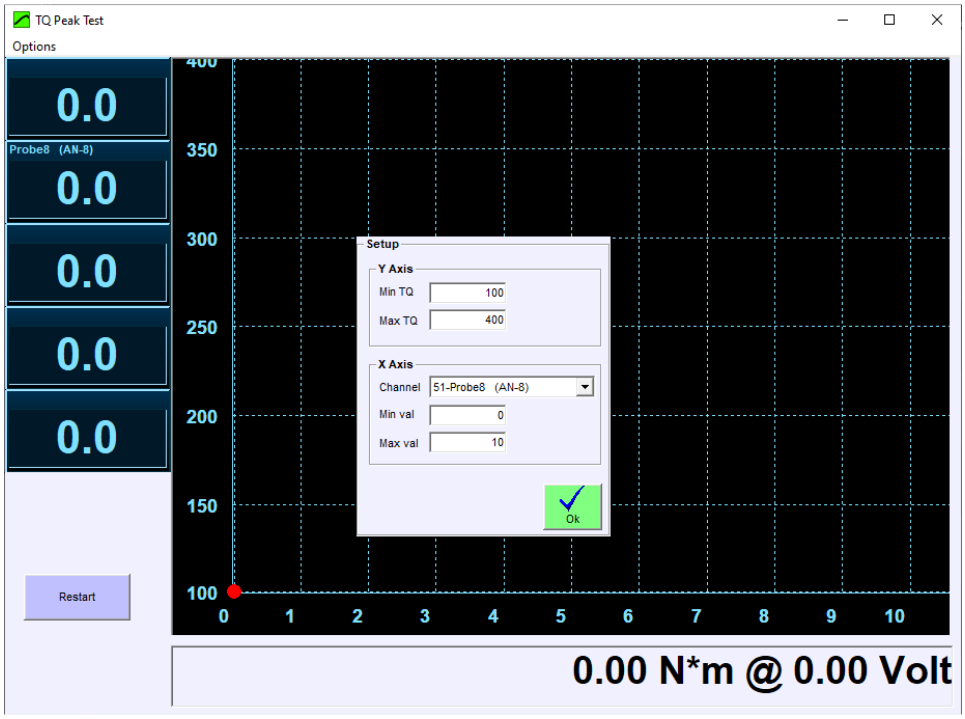
In this window the user can input the rpm value at which the calibration will be performed.

Normally this calibration is performed in the last gear (say 5^{th} or 6^{th}), although in some vehicles you may need the previous gear (4^{th} or 5^{th}). The procedure consists of accelerating the engine up to it reaches the selected RPM value, typically ½ of top engine speed (for example 6000) and then press Continue" Button (or the start/stop in the dyno).

2.3.3 TQ Peak Test

This window allows to perform a braked test to compare the Torque vs other channel (typically a channel from the ECU that shows the ignition advance) to find at which value the TQ peak is reached.

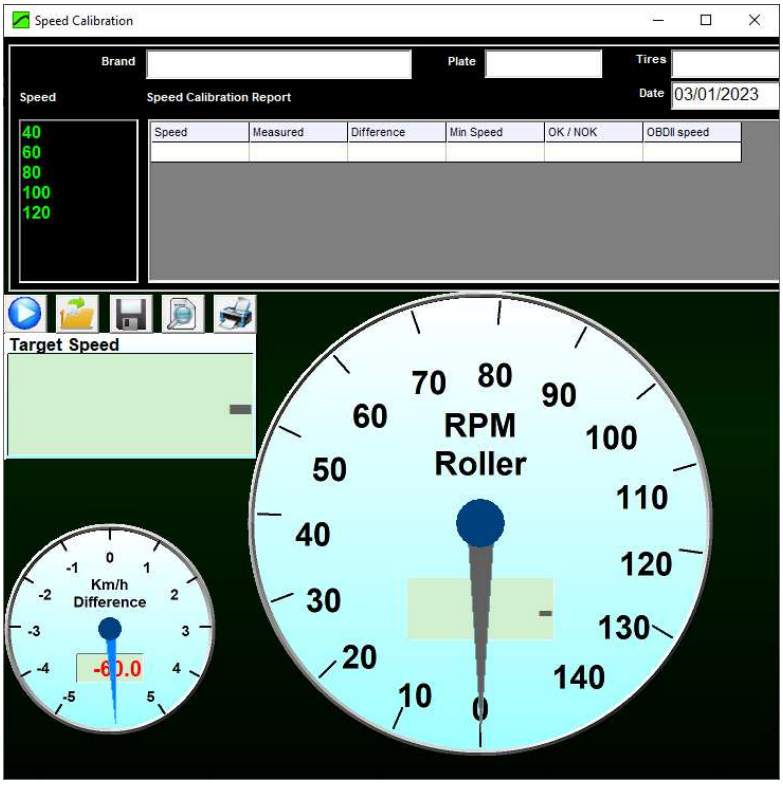
Use the Options/Setup Menu to configure the channel used for the reference (ignition advance)



2.3.4 Speed Calibration Report

This window is activated under a specific license

It is used to calibrate the vehicle speedometer (with the current status of the tires) with respect the dynamometer speed.



2.3.5 Hide Negative Part

It hides all channels during the coasting phase (ex. Lambda), in this way channels are only shown where the engine/vehicle is providing power and torque, and they are not “overwritten” when the engine RPM goes back (which normally is confusing).

2.3.6 Calculate Power Curve with Losses / Power at Engine

It calculates the addition of **wheel power** + **friction losses,** and displays the result instead of the real power curve. It is important to keep in mind that that calculation is only an estimation of the real power.

In Sportdyno 4.1 Engine Power is a different channel than Wheel / Raw power and both can be shown at same time (previous versions didn’t allow this)

When activating “Calculate Power Curve with Losses” will also activate “Hide Negative Part”, but not the opposite direction.

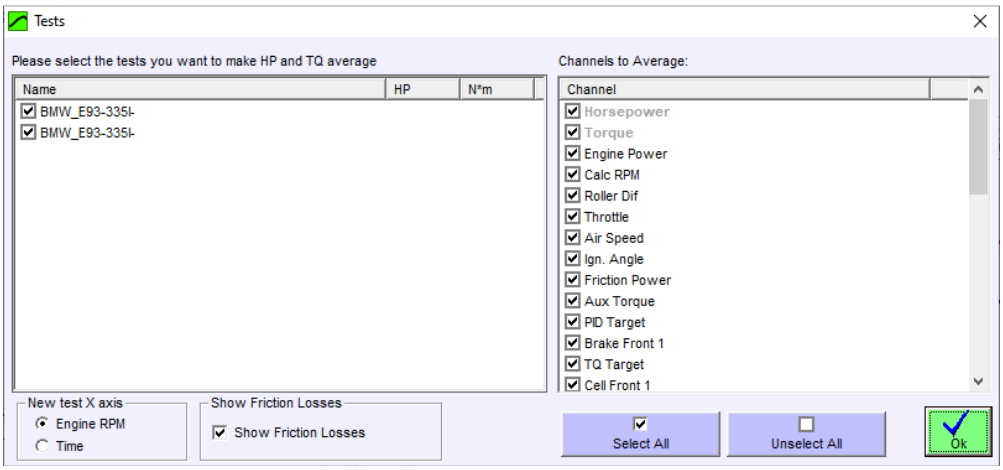
2.3.7 Histogram.

It performs a statistical analysis in which can be seen the predominating RPM/KMH ratio of the test. The program makes automatically a histogram after doing a dyno run when the “using rpm clamp” option has been chosen.

2.3.8 Make average.

This option is useful to make an average between tests of the same vehicle, typically consecutive tests, to get a new test with the averaged power and torque.

It shows a window to choose which tests to average, and it creates a new test from them. It is needed to have at least two tests loaded.

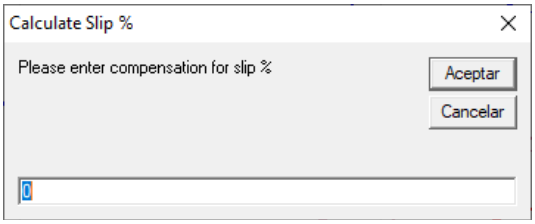


2.3.9 Calculate Slip %

As the wheel applies torque over the roller, certain slip percentage is produced (proportional to torque). This option creates a calculated channel from roller rpm channel and engine rpm channel to see the slip percentage at each point. Actual HP could be calculated by adding the slip percentage at the maximum HP point, but it is not a reliable process to be automated by the program.

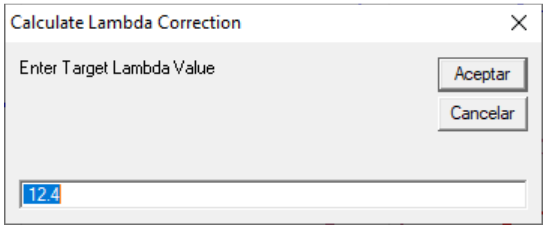
In order that the slip% calculation is accurate, the user must know the exact ratio without torque. Thus a no-acceleration test is strongly recommended in order to get the actual gearbox ratio, at steady rpm. Then, by using this ratio a normal dynorun will be performed. And slip% could be calculated from a consistent ratio that starts from slip%=0 when no torque is applied.

You can also try to compensate the current ratio with this window, but this is only an approximate way to do it:



2.3.10 Calculate Lambda Correction

For a given lambda target, the SW will create a compensation channel to show the percentage that fuel has to be corrected, either increasing current values at ECU or decreasing them.



2.3.11 Filter RPM Channel.

This option removes some "glitches" at RPM channel, but not always it can be done. Anyway, SportDyno software uses engine RPM channel in a statistic way to determine ratio between engine RPM and speed of Roller, so few glitches at the channel do not affect the Ratio, HP and TQ calculations. (Ratio is calculated only when Roller accelerates, so rpm channel is not used when the Engine decelerates)

2.3.12 Filter Analog Channel.

This option performs a low-pass filter to the selected channel to remove high-frequency noise. The size of the filter can be entered between 1 to 30.

This operation is not undo-able.

2.3.13 Generate RPM Channel.

This option recalculates the entire engine RPM channel overwriting the previous values with its calculated ones. This new values are the result of multiplying speed channel by Ratio value, thus if ratio value is wrong, resulting RPM channel will be wrong too.

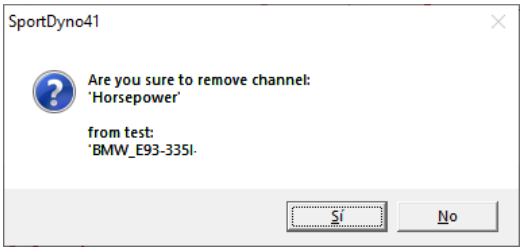
This option is only useful to generate a calculated rpm channel when it wasn't recorded, but keep in mind that this channel is fake, and could not match with the true one…

2.3.14 Add / Modify Channel.

This option adds or modifies a calculated channel to the current test. Calculated channels are selected from the total channel list, and a calculation formula is used to generate the channel. For more information please refer to section 13 (Calculated channels).

2.3.15 Remove Channel.

This option removes the current selected channel from the current test. It can be used for either removing normal channels or calculated channels. Please be careful, once a normal channel there is no "undo" option to recover it.



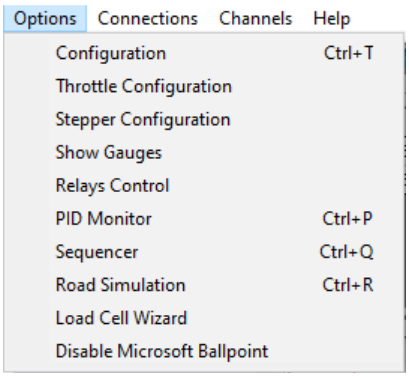
2.3.16 Remove Test.

It removes the selected dyno-run from memory (not from the disk).

2.3.17 Delete Test.
It deletes the dyno-run from memory **and from the DISK**. Be careful.

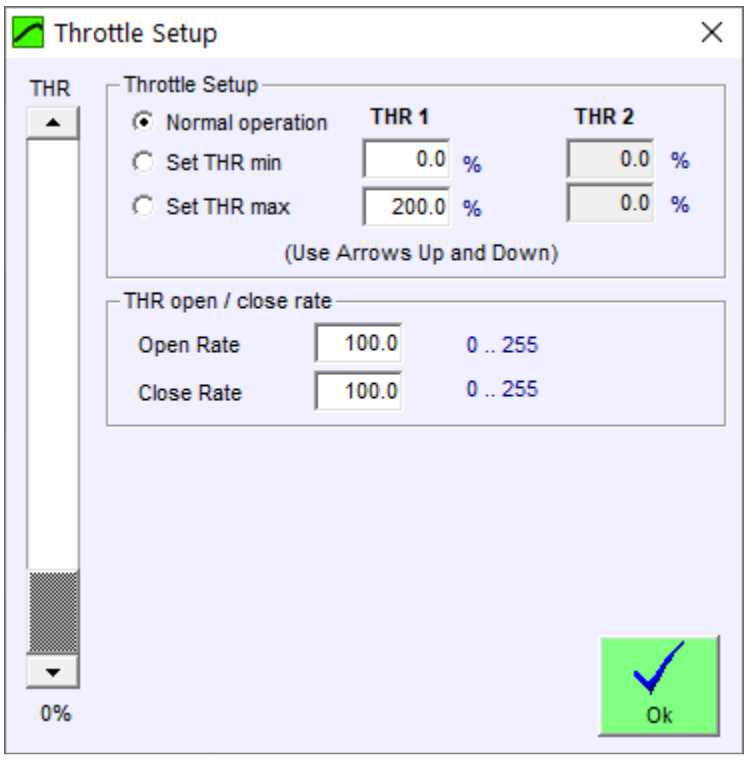
2.3.18 Properties.
It shows all data from the test in a new window (the same data as in the dyno runs list). This window allows the user to change certain values (such as ratio, temp, etc) after doing a dyno run.

2.4 Options Menu



2.4.1 Configuration.
This option opens the (main) Configuration Window, it is explained below.

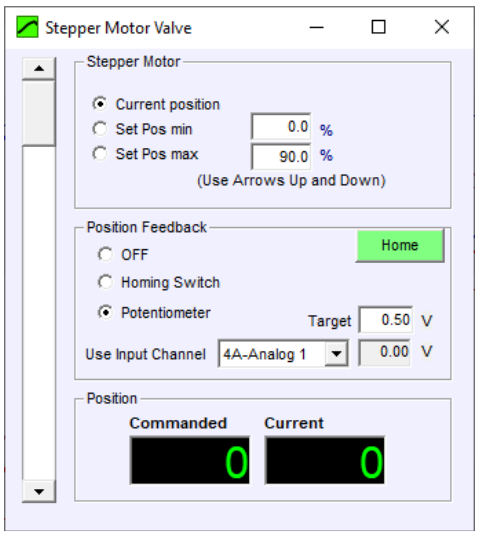
2.4.2 Throttle Configuration [NEW]
It opens the Throttle Configuration Window. Please refer section 10.



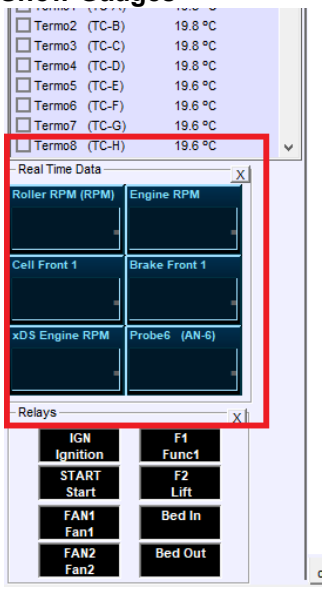
Note: **some options like this one are hidden in the initial configuration** for not creating more confusion to new users. For activating them, go to Configuration / Options / Advanced Options.

2.4.3 Stepper Configuration [NEW]

Braked DAQs (SP1+, SP5 and SP6) support controlling a stepper motor for driving a water brake valve (with a special Firmware)



2.4.4 Show Gauges

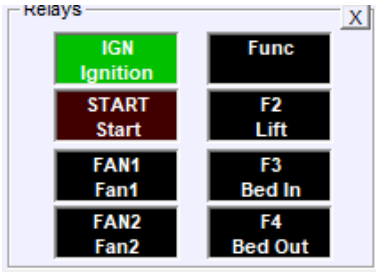


Sportdyno 4.0 and 4.1 can show 6 numeric boxes in the main window all the time, to help to supervise main channels as Roller RPM, Load Cell, Brake, Engine Temp (for instance from OBDII)

This option shows / hides these gauges

Boxes can be edited with the right mouse button.

2.4.5 Relays Control [NEW]



It shows the Relay Control panel at the Main Window. Each button can operate one relay. Button names can be changed by using the right-mouse button.

Note 1: 'Start' button is different: it only works while the mouse button is pressed. It is envisaged to use it for the starter motor.

Note 2: Relays can also be accessed using a shortcut: SHIFT + F1 to F8.

2.4.6 PID Monitor

It opens the PID monitor Window which is useful to configure and see the Speed Controller (PID) performance and to setup the PID value.

2.4.7 Sequencer.

Automated test mode, it provides a way do some automation on the test process with SP4 / SP5.

Ex: wait 2 seconds at 3000 rpm in stationary mode, and then start recording in ramp mode at 100 rpm/s rate. It is explained below.

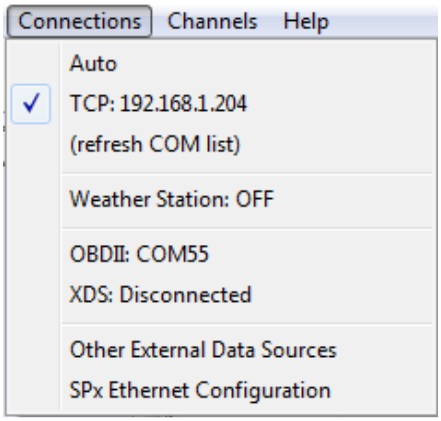
2.4.8 Load Cell Wizard.

It opens the Load Cell Wizard to ease the process of setting up the load cell.

2.4.9 Disable Ball Point Device

Windows can eventually detect the data stream from the DAQ or from the Weather Station and decide that it is a MOUSE, it will install their drivers and block the access from other applications. It is recommended to execute the Disable Serial Ballpoint procedure, **but it will only works if Sportdyno has been executed in Administrator Mode**

2.5 Connections



2.5.1 Auto Detect.

It shows the Auto-COM-search window. It is strongly recommended for USB adaptors where the COM*xxx* can be any number between COM1 and COM255.

2.5.2 COM1 - COM(n).

It selects the serial port in which the SPx module is connected. If a port fails, it will be shown grayed. If there is not any available port, it is recommended to close all programs and open SportDyno again.

Everytime the Auto Detect option is clicked, this COMs list is updated, this allows to display new COMs when a new USB adapter has been connected.

Please note that by default most FTDI adapters have a long latency that can make the realtime graphs and gauges to work "in steps" instead of having a fluid operation. To avoid this you can either configure the latency manually to 1 ms in the Hardware Manager, or using the FTDI type connection below.

2.5.3 FTDI (0xnnn) [NEW]

It performs the connection using the FTDI driver, which allows the software to configure the latency and other parameters necessary for a better performance of realtime graphs and gauges.

2.5.4 Reconnect

If this option is active, when the connection is lost, Sportdyno will re-try the connection every few seconds. This allows disconnecting and connecting USB adapters in case Windows removed the adapter driver, or in case of TCP connections, it allows to plug the Ethernet connector and Sportdyno will create the connection automatically.

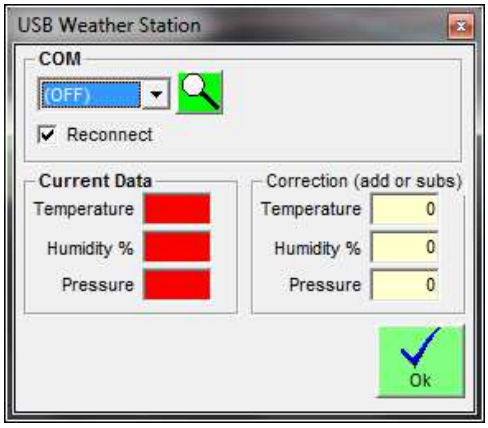
2.5.5 (Refresh COM list)

When connecting and disconnecting USB devices, the COMs list is updated automatically, but this option forces its updating in case the adapter is not shown.

2.5.6 USB Weather Station

This option opens the Weather Station window. This window allows choosing the COM port for the Weather Station, and also performing an automatic search for the W.S. (magnifying glass button).

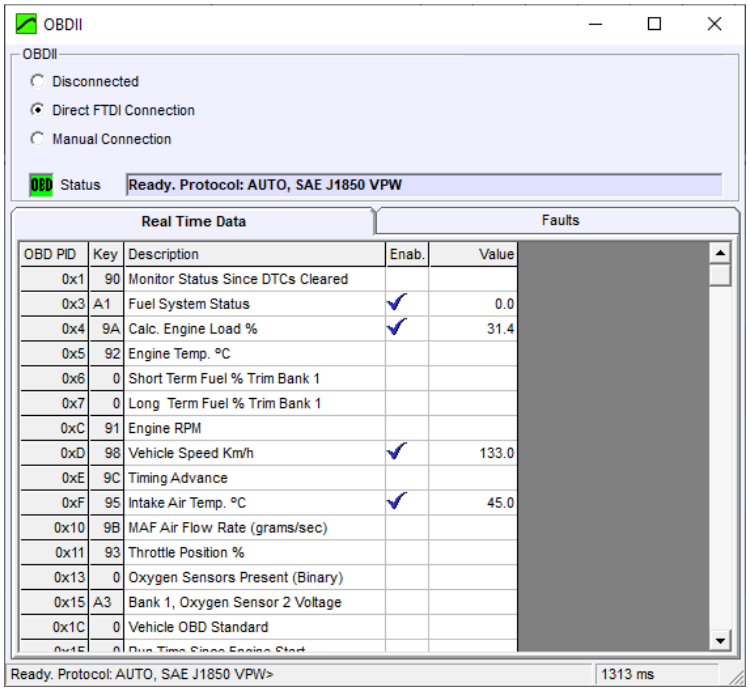
This window also allows adding correction offsets for temperature, humidity and pressure (adds or subtracts), although normally this is not necessary as Weather Station uses a high quality Bosch sensor for Temperature and Pressure.



2.5.7 OBDII

This option opens the OBDII window. This window allows connecting to the OBDII device and choosing the PID channels to be acquired (note that some cars have slow protocols and only a few channels can be acquired at a reasonable speed)

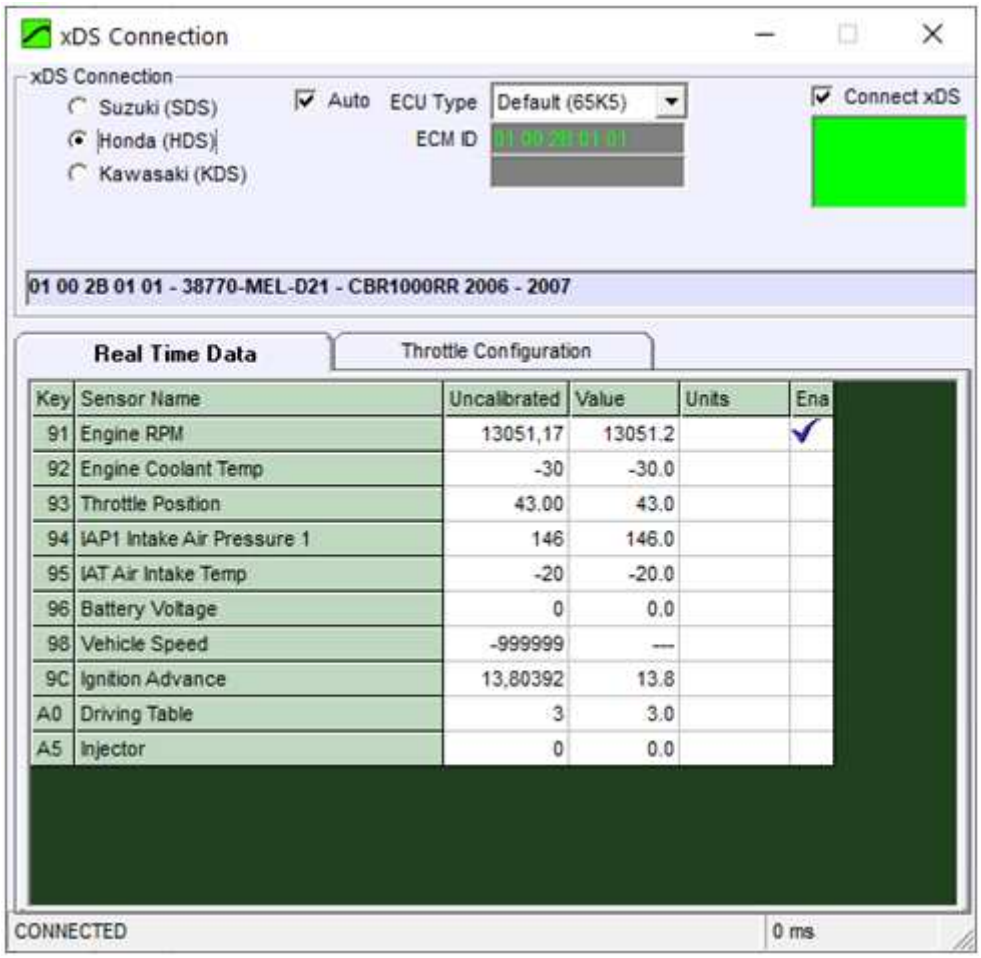
Please refer to section 14 (OBDII).



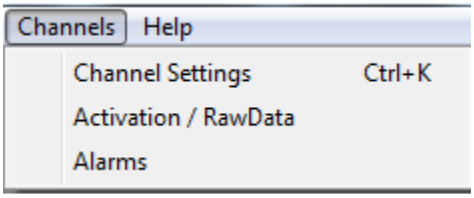
2.5.8 xDS Interface

This option opens the xDS window (Suzuki SDS, Honda HDS, Kawa KDS). This window allows connecting to the xDS link and choosing the ECU channels to be acquired (note that some protocols are slow like KDS, and only a few channels can be acquired at a reasonable speed)

Please refer to section 15 (xDS).


xDS Connection
xDS Connection
Suzuki (SDS)
Honda (HDS)
Kawasaki (KDS)
Auto
ECU Type
Default (65K5)
ECM ID
Connect xDS
01 00 2B 01 01 - 38770-MEL-D21 - CBR1000RR 2006 - 2007
Real Time Data
Throttle Configuration
Key
Sensor Name
Uncalibrated
Value
Units
Ena
91 Engine RPM 13051,17 13051.2
92 Engine Coolant Temp -30 -30.0
93 Throttle Position 43.00 43.0
94 IAP1 Intake Air Pressure 1 146 146.0
95 IAT Air Intake Temp -20 -20.0
96 Battery Voltage 0 0.0
98 Vehicle Speed -999999 ---
9C Ignition Advance 13,80392 13.8
A0 Driving Table 3 3.0
A5 Injector 0 0.0
CONNECTED
0 ms

2.6 Channels Menu.



2.6.1 Channel Settings.

It shows the channels configuration window. Channel name can be changed in this screen so the name matches to the function that channel performs in your dyno, for example: channel 0x4A (former 'J'): 'Sensor 1', could be named as 'Lambda 1'. Also, you can modify the scale data of the sensor, and decimal places.

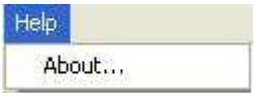
2.6.2 Activation / Raw data.

It shows a Channels Window useful to see the incoming data from the SPx box (to see if there is any fault)

2.6.3 Alarms.

It shows the Alarms configuration window. Alarms are useful to detect hazard situations especially on Engine test bed dynos that could be working for hours without the operator surveillance.

2.7 Help Menu



2.7.1 License Manager

Generally, most Sportdyno features are free, but certain very specific features, such as the external CAN, may require an associated license.

2.7.2 About.

It shows information about SportDevices, developer of the software and SPx module manufacturer.

2.8 Button Bar

By clicking over these buttons you can do more quickly the same actions that using the menu. Options are:

Paper sheet: New. File/new menu.

Opening folder: Open. File/open menu.

Folders tree: Change directory. File/change directory menu.

Disk: Save as. It saves the dyno run with another name or in another directory.

"Play" icon: Run. Test/run menu. (F5 key)

Gauge: Test Ratio. Test / ratio calculation menu.

Glass +: Zoom +. It magnifies the graphs area x 2.

Glass -: Zoom -. It reduces the graphs area / 2.

Round arrow: Redraw. Draws again the dyno runs, and also calculates again the scales (if not in manual mode)

Scissors: Cut-end-of-the-test. When using this option, the user will click over a certain part of the test (in graphs vs time mode) then the program will discard the final part of the test from the point where the user clicked to the end of the test.

Sheet and glass: Preview. File/preview menu (F11 key)

Print. File/print menu (F12 key)

Tools. It opens program configuration window.

Graphs: Channels. It opens channel configuration window.

Load Cell Wizard. It shows the Load Cell Wizard window.

Invert Load Cell.

Exclamation sign: It opens the Alarms window.

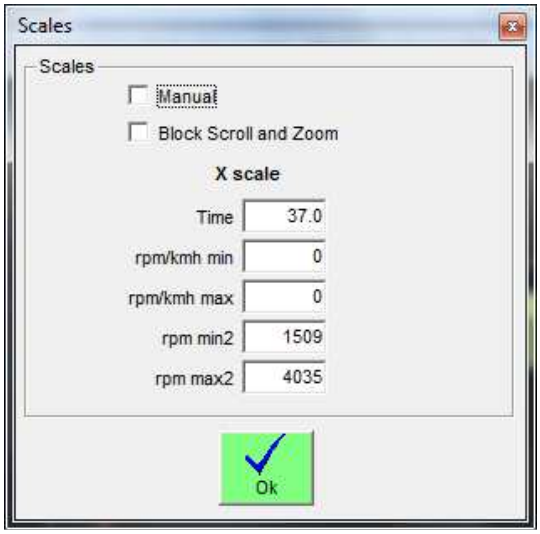
Blue Label. It shows/Hides data label. This label shows certain information from the chosen channel while the user moves the cursor across the tests.

Gray and Black blocks: It changes the window arrangement: In vertical arrangement, all small frames (channels, relay buttons) are displayed at left side. In horizontal arrangement all small frames are displayed on top to allow the graphs to take the whole Window width.

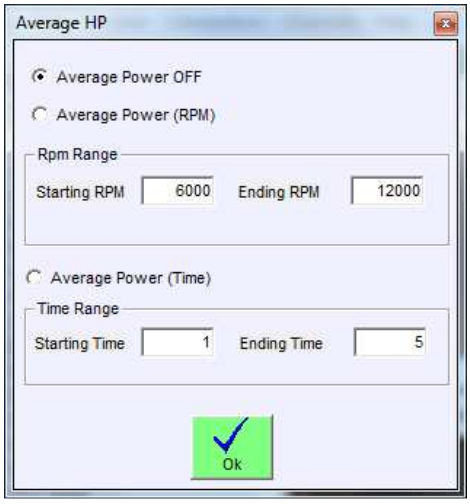
Red lines: It modifies the colour grouping. In one mode all tests use the same colour for the same channel (different colours per channel), and in the other mode each test uses a different colour for all its channels.

Manual. Manual mode is useful to set a fixed Time, speed (1) or Rpm (2) scales regardless of the test values. It could be useful if some strange data is present on the test and you want to force known limits. The rest of scales (HP, TQ, and the rest of channels) have been removed from this window and have been added on the channel configuration window, by using the upper bound and lower bound fields.

- **Manual** checkbox activates the manual mode. Once activated, the button on the main window changes its colour to show you manual mode is active.
- **Block Scroll and Zoom** checkbox disables the mouse tracking and moving over the graphs.



HP average. This option is used to calculate average power inside a rpm range or a time range. The option has been moved from main configuration to this independent window to ease its use. It has three modes: OFF, RPM range and time range.
When activated, two small vertical lines will be displayed showing the selected range and a doted horizontal line crossing at the HP power value. This calculated value is also available in the test data area. The column is hidden by default, but the user can enable it with the right button of mouse.

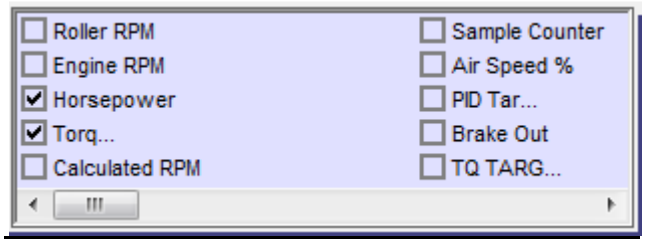


Peak dot: it will show a dot for the peak value at the current selected graph

SportDevices Icon: About. Help / About menu.

Dyno Profile Selector (combo box). Sportdyno allows to configure several dyno profiles for instance for using the same SPx DAQ box with two dynos, of for using either Front or Rear axle on an AWD dyno. Using this combo box the user can change from one configuration to another without having to enter into the Config Window.

2.9 Channel selector.

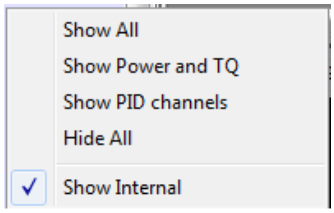


There are several channels at this box, if these channels are checked they will appear on graphs area (if they exist at the dyno run):

- **Roller RPM.** It displays roller rpm channel (when selected)
- **Engine RPM.** It displays engine RPM channel.
- **HorsePower.** It displays horsepower channel.
- **Torque.** It displays torque channel.
- **Calculated RPM.** With SP1 to SP4 Sportdyno generates a calculated RPM channel. With SP5 this channel is sent by the DAQ.
- **EXHAUST.** It displays thermocouple 1 channel (if available).
- **WATER.** It displays thermocouple 2 channel (if available).
- **Load cell.** It displays load cell channel (torque from brake in SP3).
- **Lambda1.** It displays lambda channel 1 (if available).
- **Lambda2.** It displays lambda channel 2 (if available).

This box dynamically loads depending on the channels available on the system. Right bar and bottom bar can be moved with the mouse to make the area bigger, if more channels are present.

With mouse right button it is shown the following window:



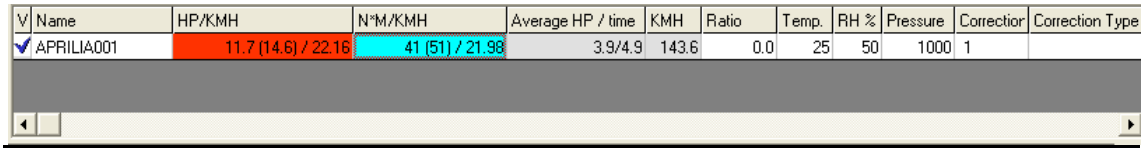
- Show All. Activates all available channels.
- Show Power And Torque. Activates only HP and TQ channels.
- Show PID Channels.
- Hide All. Hide all channels.
- Show Internal: this check box alternates between checked/unchecked. When active it will show all channels.

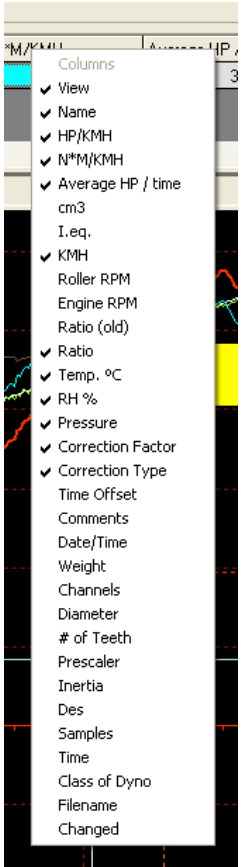
2.10 Options for X Axis.

Options in this box are:

"Graphs vs. time" It displays dyno run curves as a function of time (seconds).
"Graphs vs. KMH/MPH" (for vehicle dynos) or "Graphs vs. Roller RPM" (for engine dyno) It displays dyno run graphs as a function of roller RPM/Speed
"Graphs vs. Engine RPM" It displays test curves as a function of engine RPM. This **channel is always calculated** by using the ratio value (RPM/KMH) of dyno run, so this scale will be wrong if ratio is wrong.
Note: Automatic engines **should not be displayed Engine RPM mode**, because the gearbox ratio or CVT changes while the roller accelerates.

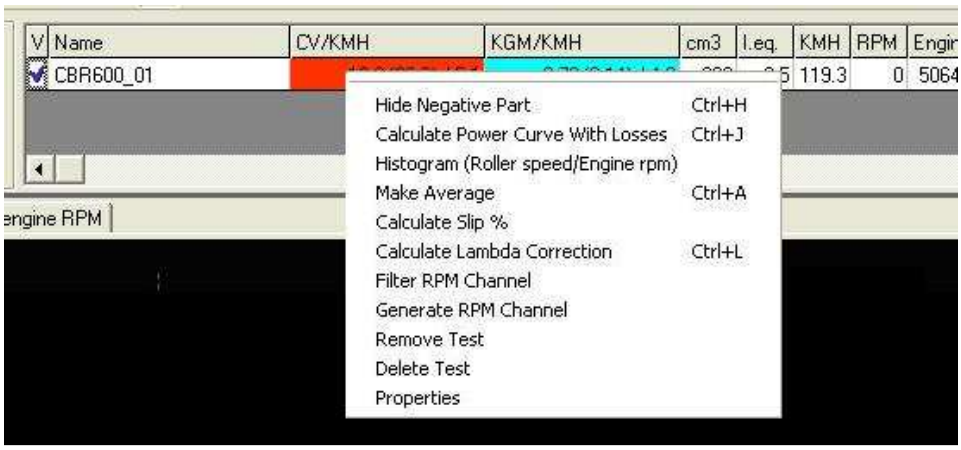
2.11 Dyno run List





This list contains tests loaded from the disk or tests done with the dyno.

By **right-clicking** over the test list, a popup window will be displayed to ease certain functions related with the test. Behaviour of these functions is the same as on the Test Menu.



The user can change directly most data over the list, to do this you can press key F2 or click twice over the desired cell. Note: **gray cells** cannot be edited.

If you right-click over the Titles row then a popup menu will be displayed. This menu contains all **available columns**. Here you can check / uncheck over them in order the columns will be displayed on the list or not.

Test Grid Columns:

View. By clicking over this column a check mark will appear/disappear, making the test being displayed / hidden on the main window.

Name. Name of dyno run, if name is changed and then ENTER is **pressed the file on the disk will change its name** too.

HP and TQ. These are the maximum values of power and torque, and RPM or KMH or MPH at which values was done (depending on the configuration)
If HP at engine is selected (on configuration window) it will be displayed in this way:

HP=90 (105) / 9000:
90 HP at wheel, (without losses),
105 HP at engine, (with friction losses), read at 9000 rpm

TQ=50 (65) / 7000:
50 N*m torque (without losses),
65 N*m torque (with friction losses), read at 7000 rpm

Average HP. If average option used (starting rpm and ending rpm have value) the program will show the average HP value in the selected area.
For example, if an engine has 50 HP at 5000 rpm, and 60 HP at 6000 rpm (making a straight line), the average power will be 55 HP between 5000 and 6000 rpm.

Average TQ. Same as average HP applied to TQ.

Cm3 (displacement). This field is used in “displacement correction” option (roller inertia + rolling parts of the vehicle). It can be changed after the dyno run is done (key F2 or double click)

I.eq. (Equivalent Inertia). This value is added to the inertia of roller when “displacement correction” option is checked).
There is a file: “inertia.ini” that stores all displacement and inertia values used in this option. The user can modify this file.
It can be edited.

KMH. Maximum speed of roller during the test. It can be changed to MPH in configuration window.

Roller RPM. Maximum roller speed during the test in RPM.

Engine RPM. Maximum engine speed during the test in RPM. It may be wrong if some spikes has been read from the ignition.

Ratio (RPM/KMH) (old). This field is used in the program to draw the horsepower vs. engine RPM. Its only recommended for vehicles with manual gearbox. The formula is: “engine rpm / km/h”, i.e.: if vehicle with the last gear set is running at 200 km/h and its engine is at 12000 RPM, it will have a ratio of 60.
Also, ratio value can be calculated if ratio between gears and wheel are known. Usually ratio value is calculated by the program automatically, when ignition pickup is used. The program does a histogram from engine rpm/speed values and takes the most important value for the ratio.

Ratio. In current version, ratio formula is always “engine rpm / roller rpm”, but the old value is maintained for compatibility.

Ratio button, when you edit the ratio value, this button is shown. By pressing it automatically does a histogram between “engine rpm / roller rpm” and it puts the calculated ratio into the ratio box. It can be used if was input a fixed value when doing the dyno run, but you are not sure about the value is right.

Temperature, Humidity, Pressure. Weather conditions are stored with the dyno run when is done. They are important because “temperature correction” option uses them. If changed after doing test, HP and TQ values will change too.

Correction factor. Depending on the chosen correction type, the program will calculate automatically this value. This value can be edited, and once you have changed it, the program won’t recalculate it again. But if you want the program recalculates it, you only have to delete the number and press enter, then the program will calculate it again as a function of temperature, humidity, air pressure and correction type.

Correction Type. There are several correction formulas available:

- Blank (none)
- ISO 1585
- SAE J1349
- DIN 70020
- JIS D1001
- EC95-1
- *EWG 80/ 1269*
- FIXED

The program will use the correction type of the configuration window as default, but you can change it after the test is done

Time offset. This value has been added to the dyno run to enable comparison between tests when graphs are displayed vs. time, because the starting point of each test is not always the same. By changing this value all the test will be displaced later in time (positive values) or displaced before in time (negative values)

Comments. Comments are stored with the test. If editing the comment there will be displayed a button at the right of the box of the comment (...). By clicking the button it will show a window in which comments can be written in several lines.

Date / Time when the test was done.

Weight of vehicle. This field is only informative, but could be used for acceleration calculation purposes in future.

Channels recorded in the test. For example: 01AJ: 0-roller, 1-engine RPM, A-thermocouple, J-lambda.

Diameter (front) of the roller used on the test. The program uses it when calculating HP and TQ. It cannot be edited.

Diameter 2 (rear) of the roller used on the test. The program uses it when calculating HP and TQ. It cannot be edited.

Number of teeth (front) used on the test. The program will not use it after the test is saved. It cannot be edited.

Teeth (rear) used on the test. The program will not use it after the test is saved. It cannot be edited.

Prescaler used on the test. The program will not use it once the test is saved. It cannot be edited. For SP5 prescaler is always 1.

Inertia (front) of the roller / flywheel. The program uses it when calculating HP and TQ. It can be edited if you have entered it wrong.

Inertia 2 (rear) of the roller / flywheel. The program uses it when calculating HP and TQ. It can be edited if you have entered it wrong.

Recording (samples) taken by the SPx unit for the main channel.

Time spent on the dyno run. This **value has no relationship with the engine acceleration.** You can do a test of 5 seconds and then wait 30 seconds during coasting phase before stopping the test, and then the test will be 35 seconds long.

Full Path. Full file name and path of the test.

SW Date. Date of the software version used for recording the test.

FW Version (SP5) Firmware version number of the device used for recording the test (SP5 only)

SPx Config. Summary of all SP4 or SP5 specific configuration, including load cell, PID settings, ramp rate, etc.

SPx device. DAQ type (number) used for recording the test (1, 3, 4, 5)

Test Mode. 0 = inertial, 1 = steady, 2 = ramp, 3 = fixed brake, 4 = sequencer

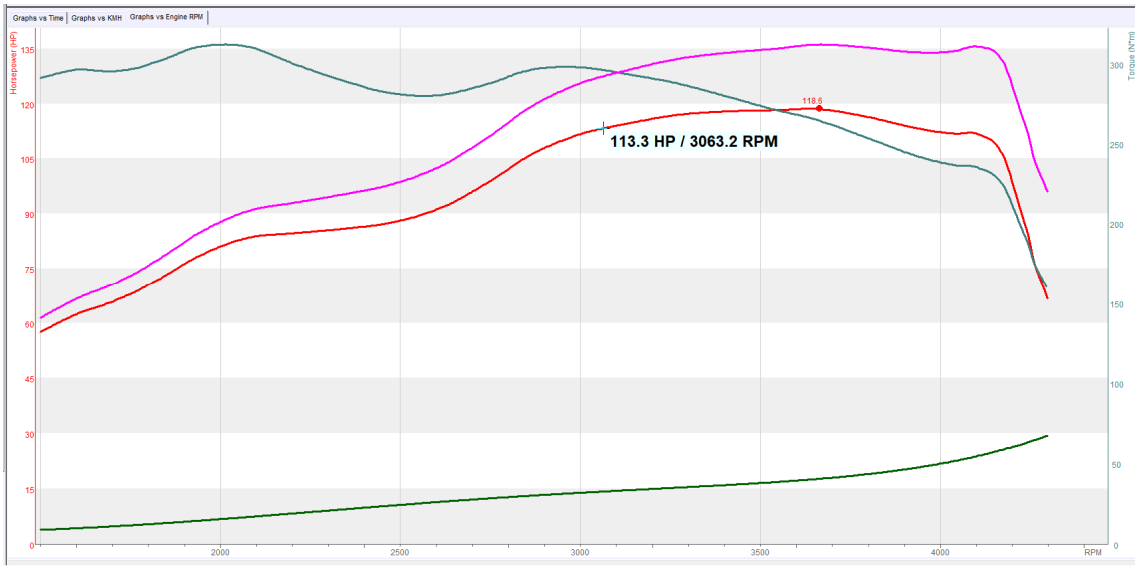
WD mode (wheel drive mode): 0 = front, 1 = rear, 2 = AWD

~~**Class of dyno** where the test was done (vehicle or engine).~~

Changed. It will be '*' if the test was changed. If using "automatic saving" the test will be saved and this filed will be blank again.

2.12 Graphs Area

In this area are shown the curves from the channels of the different tests loaded in memory (power, torque and rpm).

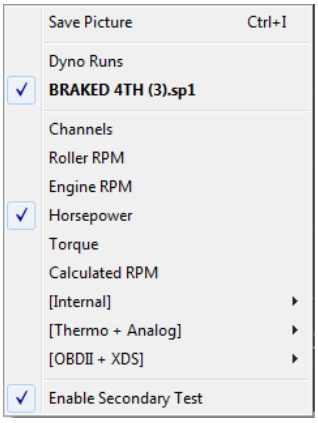


Most scales are shown at the left side graph area, but a few of them such as torque or load cell are shown at the right side. The scale showing side can be configured at channels configuration window.

X axis at the bottom shows the selected scale (time, roller RPM, km/h or engine RPM)

The scale from the **selected channel** (torque at the example) is displayed to the right side, close the graph area.
Channels colour could be grouped by test (all channels same colour for each test), or by channel (all tests have same colour for each specific channel)

To show/hide any test only it is needed to click over the first column on the list of tests at the desired test.



By **right-clicking** over the **graphs area**, a list with the loaded tests is shown, this list also includes the channels from the active test. Note that in this version some special groups have been defined to hide the high amount of channels available.

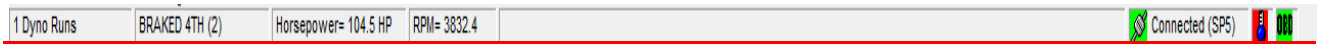
You click over a test or a channel to change the selected test or selected channel.

save picture option has been added. The same as on file menu.
Enable Secondary Test, option has been replicated (same as on configuration / options)

2.13 Graph movig / zooming

Zoom can be controlled by using the mouse wheel, or the + and – lens in the tool bar.
The user can also change graph position by dragging the graphs area with left mouse button.

2.14 Status Bar

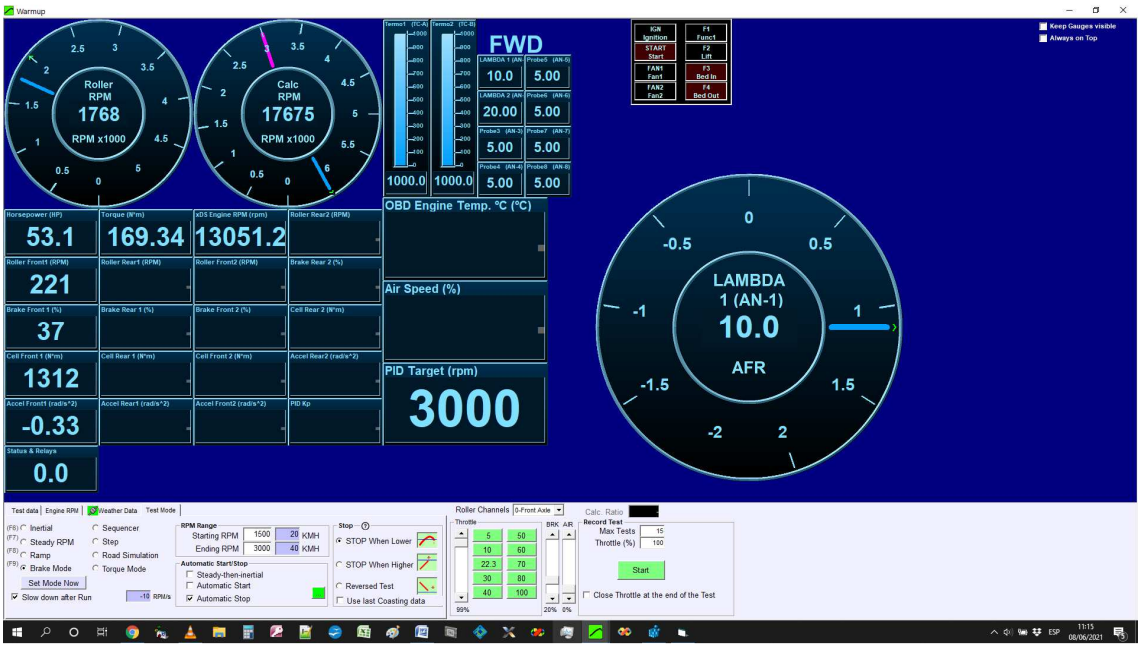


This area shows:

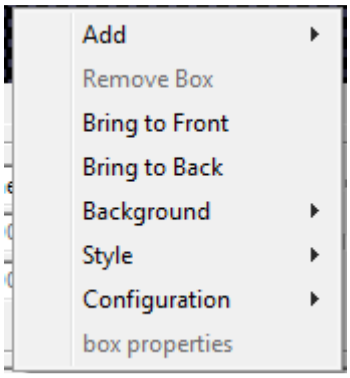
- Number of loaded tests
- Name of selected test
- Name of selected channel,
- Values from selected channel, while the mouse moves over the graphs area,
- Status messages,
- Whether SPx module is connected or not.
- Weather Station Status
- OBDII Interface Status
- xDS Interface Status

3. GAUGES WINDOW

3.1 Gauges' area.



This window is user configurable. The user can add new controls: Gauges, Thermometers, Numeric boxes or Scroller type windows. If you right click over any control a popup menu will appear.



Options are:

- **Add new Control:**
  - Gauge,
  - Temp,
  - Box,
  - Scroller

  Once the control is on the screen, the user can move it to the desired position, and change its properties, and assigned channel.

- **Remove Box:** user can remove any of the current controls on the screen.
- **Bring to Front:** user can move a control over all others on the screen.
- **Bring to Back:** user can move a control behind all others on the screen.

- **Background [NEW]:**
  - **Default** (carbon fiber effect)
  - **Plain colour:** will show a colour selection window
  - **Bitmap:** allows to load a BMP file for the background

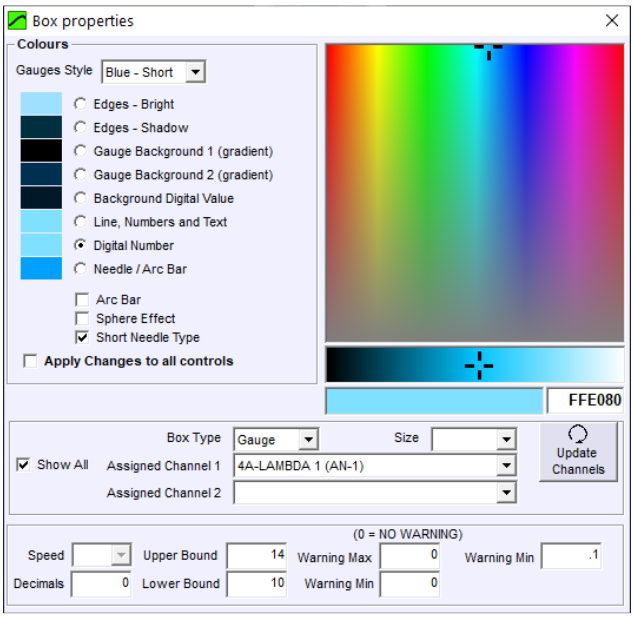
- **Style:** It changes the default colours for all controls
  - **Cyan**
  - **Yellow**
  - **Blue**

- **Configuration: Open / Save.** It allows to save the current layout of Gauges window, and load it from a file

- **Show Peak.** This option will show permanently the peak values for all controls. Clicking it again will go back to the current values.

- **Reset Peak.** The peak value mark will start decay automatically after 30 seconds (configured in advanced options), but this option allows to reset the peak manually, for instance when the time is set very long.

- **Box properties:** with this option a properties window will be shown. This window lets you to change certain data from the control.



In this window user can change the control type (gauge, box, thermometer, scroller), the size of the control, the colour used for numbers, the assigned channel (1), the second channel (only for gauges and scroller), the upper lower bounds (special for gauges and scroller), decimals places.

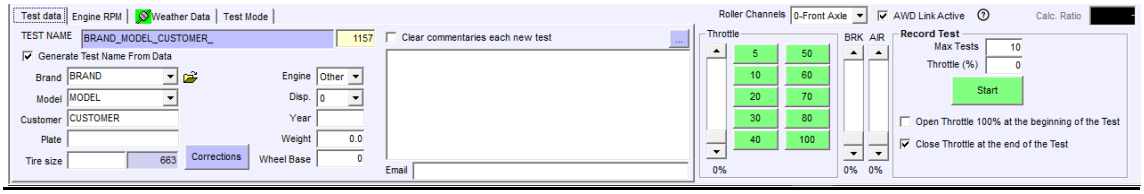
In addition controls implement a warning mechanism, if “warning max” and “warning min” fields are filled, they will detect when its channels it is out of limits and will blink in red for “warning max” and in blue for “warning min”

Note that not only SPx unit channels can be also added to Gauges Window, but also channels from: **Calculated channels, Weather Station, OBDII, xDS interface, CAN interface, etc.**

3.2 Test data area

This window is used to enter the test data and to setup the way the test will be done.
In the current version it has been splitted into four tabs to group the data by its function and to allow more data and options are available.

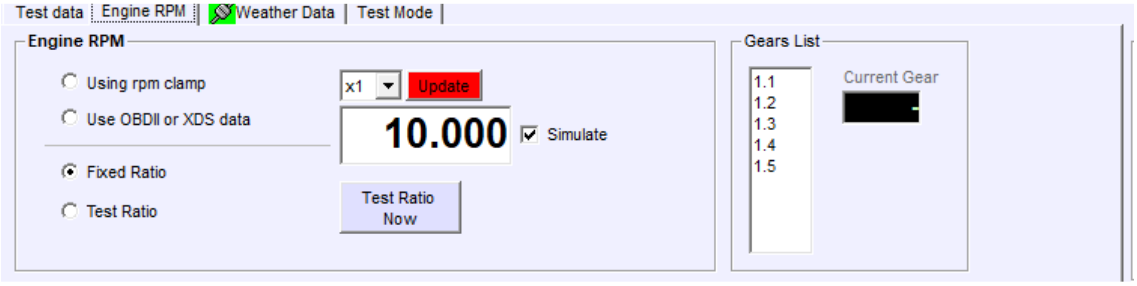
3.2.1 Test Data



- **Test Name,** this name will be the same that it will be saved to disk. Name will be “incremented” every new test (TEST_001, TEST_002 …)
- **Customer, Brand, Model, Plate, Year,** these are informative fields, but they can be used to **generate the filename automatically** from them, if the “**Generate Test Name From Vehicle Data**” option is active.
- **“Folder”.** This option can be used to create a folder tree structure automatically using the brand, model, customer, plate information. One folder for each field.
- **Tire Size Tool.** This field will use the tire description (for instance **“185/55/14”**) to calculate the tyre diameter (560 mm) which is used in HUB dynamometers to overwrite the “roller diameter” fields in the test, so the calculated speed is the actual speed of this car in the road (according to the tire size). Tire size can be used to calculate the actual **Wheel Torque,** using a calculated channel.
- **Tire Diameter.** It is provided by the Tire Size Description “185/55/14” format
- **Engine Type:** It is an informative field, may be used in the future for a default setup according to the engine type, but still are many variants (petrol car, motorcycles, kart engines…)
- **Engine Displacement,** the software can use an inertia table (engine displacement vs inertia) to add some inertia to the test if this compensation is enabled. **This method was used in light dynos, but it is no longer recommended.** It is better to use the Engine Inertia field instead.
- **Equivalent Inertia,** this inertia value is added to the dyno’s inertia in order to compensate the inertia from wheels, gearbox, etc.
- **Engine Inertia.** As engine has some inertia and normally runs at higher speeds than the rollers / brakes, its effect can be noticeable in some cases, especially in lightweight inertial dynos and when using short gears. For instance a motorcycle engine can have 0.05 – 0.1 kg*m2 (aprox), while a car engine can have 0.15 – 0.25 kg*m2 (or more). This is especially noticeable when comparing gears.
- **Weight,** is an informative value, it is not used on calculations.
- **Comments box:** user can fill several comment lines on this box for each test
- **Clear commentaries each new test,** the program will keep the comments from the last test by default. With this option you can clear them automatically.

- **Email.** It is an informative field, but could be used by an external tool to send each test to its customer.

3.2.2 Engine RPM



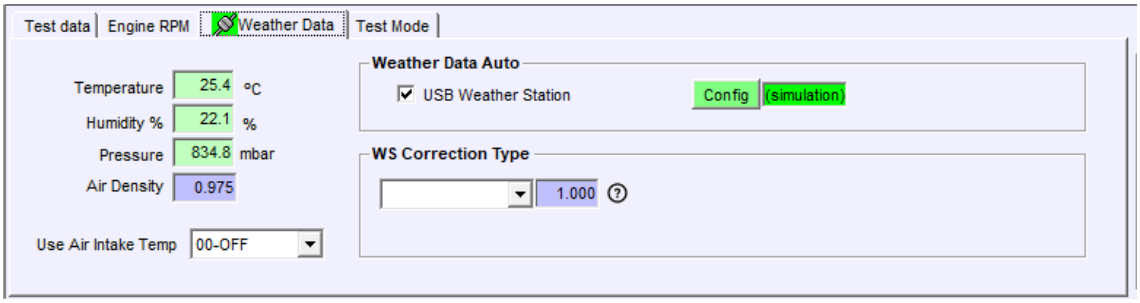
Sportdyno and SPx use the **ratio** value for the following functions:

- Estimation of engine RPM in SP1+, SP4, SP5, SP6 for speed control
- X-axis when drawing graphs vs engine RPM
- Torque at engine calculation since torque is measured at roller but normally it is higher than at engine due to the effect of gearbox and transmission

Sportdyno provides the following methods to find out the ratio value:

- **Using RPM Clamp**: This is the most automatic way to get the ratio, but it is not recommended for braked modes. When accelerating, Sportdyno will use the Engine RPM channel to calculate automatically the Ratio value while the “update” button is enabled. With braked modes it can have potentially unexpected results, then it is better to click on the “update” button, perform a light acceleration so the ratio value and then **disable the “update” button,** so the ratio is no longer recalculated during braking.
- **Use OBDII or xDS data.** Both car ECUs through OBDII or motorcycle ECUs through xDS links (Suzuki, Honda, Kawasaki) provide accurate engine RPM data. Sportdyno can use this data to find out the ratio value. The ratio will be updated only if the **“update” button** is enabled.
- **Fixed Ratio:** Use this mode if the Ratio value is known (for instance on engine dynos using sprockets), or after determining Ratio using the Ratio calibration Window.
  - **Simulate RPM:** as most times that Fixed Ratio is used, Engine RPM channel is not available, then this option is used to display the calculated RPM, which are the same that SP1+, SP4, SP5 and SP6 use for the speed control (speed control is not performed using Engine RPM)
- **Test Ratio:** it opens the Ratio Window to determine Ratio value, and then it comes back to Gauges Window.

3.2.3 Weather Data



- **Weather conditions:** Air Temperature, Humidity and Pressure. These values are used to correct horsepower and torque.

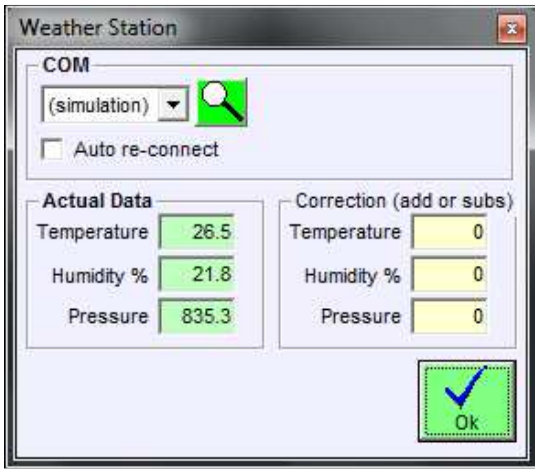
- **Air Density.** It is calculated by Sportdyno, just for information purposes.
- **Air Temp from OBDII (air intake).** If air intake PID (95h) is **available and selected** in the OBDII window, the SW will take this value to overwrite the Weather Station temperature, as normally the engine intake is at a higher temperature than the room. It also allows to choose any DAQ's analog channel (41h – 4Dh)
- **Correction type.** There are several compensation methods available:
    - Blank (none)
    - ISO 1585
    - SAE J1349
    - DIN 70020
    - JIS D1001
    - EC95-1
    - *EWG 80/ 1269 (not fully implemented)*
    - *FOS (2 stroke engines)*
    - FIXED (here the user can set the fixed correction factor)

  By default the software will take the correction type from the configuration, after that, the user can change it for each individual test. The program shows in the grey box the current correction factor for the current weather conditions.

- **Weather Data Auto / External USB Weather Station.** This option allows automating the weather data acquisition. By default data has to be entered by hand, but by using our USB Weather Station the weather data can be acquired automatically. Data is shown in real time (if enabled)

  When using USB Weather Station press Config button to open the Weather Station window and perform n automatic search for its virtual COM port.

- **Config button → Weather Station Window**



  - **COM:** Virtual COM port used by the USB Weather Station, it is normally selected automatically using the **"magnifying glass" button**, but it can be changed by hand.
  - **Auto Re-Connect**: The default option is that the program will reconnect automatically if the weather station is disconnected from USB port and then connected again. For compatibility reasons with old devices it may be necessary to disable it.
  - **Actual data:** real time data from the Weather Station
  - **Correction:** value to be add (or subtracted) to Temperature, Humidity and Pressure readings. **Keep to zero for normal operation**

3.2.4 Test Mode

3.2.4.1 Inertial (brake off)

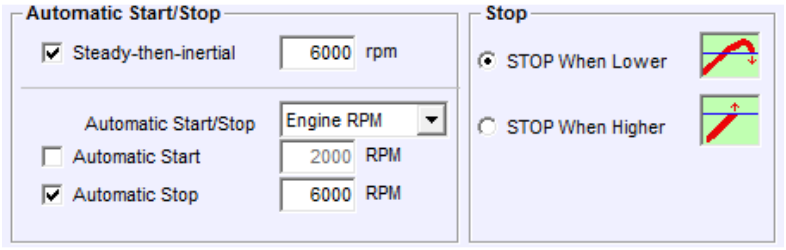
With SP1 only inertial mode will be available (inertial mode is also available on SP4 / SP5), Inertial mode corresponds to the **Idle** mode of SP4 / SP5 (brake OFF).

3.2.4.1.1 Steady-then-inertial. [NEW]

In some cases user needs to have the engine steady and full loaded before starting an INERTIAL test, then enable this option. The SP4 / SP5 will remain in steady mode before starting the test (for instance to load the turbocharger), and when the recording is started it will perform an inertial test.
Note: as the brake is still braking for the first few instants test (or more) due to its remaining magnetic field, the test is computed as a Steady Test, and Load Cell is considered as if it was a braked test.

3.2.4.1.2 Automatic Start / Stop Mode

When doing inertial tests, certain automatic Start / Stop functions are available:

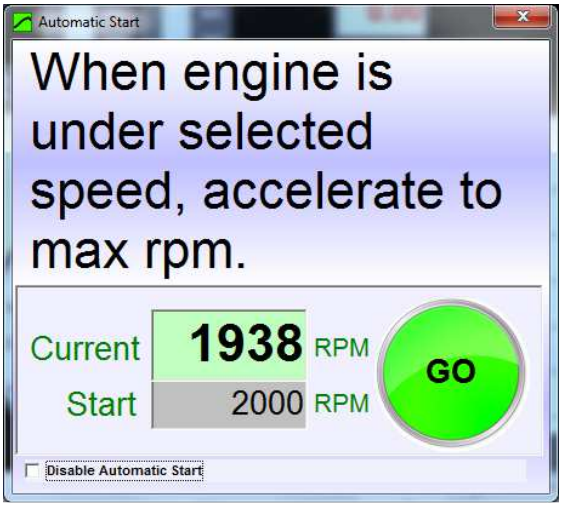


Speed, Engine RPM: User can enter the automatic Start value and **automatic Stop value** in **Speed units or in Engine RPM** units. But always the data is calculated from the roller rpm channel with ratio (if needed) because it is a much more accurate channel than Engine RPM channel. Thus ratio MUST be a valid value (you can use the RPM clamp or the fixed ratio modes)

3.2.4.1.3 Automatic start

If this option is selected, the dyno run will start when Engine RPM is greater than the value set at the right (ex. 2000 rpm)

Mode of operation: when button is pressed, "gauges" window will appear as usually. If you press again the button the “semaphore” window will appear (with automatic start activated). This frame give the following direction: "accelerate to max rpm".



If Engine RPM is higher than the starting rpm value the “semaphore" will be red, and dyno run won’t start. When engine downs to a lower rpm, the "semaphore" will be green. Then, when you give full throttle and RPM are higher than the starting rpm value, dyno run will begin.

3.2.4.1.4 Automatic stop

Here the stop rpm value is entered. There are two possibilities to determine when to stop:

- when engine has reached the stop value, or
- when the test is in the losses / coasting stage and engine reaches down the stop value.

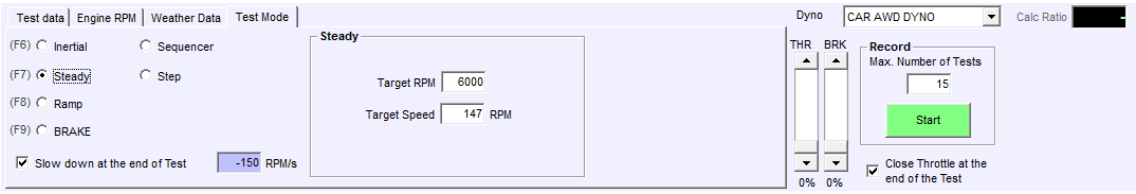
3.2.4.1.5 Stop Mode

In vehicle dynamometers, when doing a dyno run, user has to accelerate the engine near its maximum rpm, then clutch is pressed to leave the roller decelerate slowly (coasting phase), and when roller speed is lower than the “ending rpm” value (applying ratio) the test will stop automatically. Here user will use “stop when lower” stop mode.
In engine dynamometers (if no clutch is available), when accelerating the engine near its maximum rpm, user will finish the test as soon as the selected max rpm value is reached. Here user will use “Stop When Higher” stop mode.

These modes are provided here regardless the type of dynamometer so you can choose the mode you need for the tests you are doing.

3.2.4.2 Steady

This mode is only available with SP4/SP5 units.



When starting the test, it will enter automatically the SP4 / SP5 in Steady mode (not when choosing the option), and will update the RPM Target when changing the “Target RPM” box, or when using the page up and page down keys.
When a test is recorded in this mode, target rpm remains constant for the whole test.

Manual Step Test: It is possible to use keys PG DN and PG UP to change target RPM during the recording of a steady test, but (automatic) Step Test is recommended over this manual way.

3.2.4.3 Ramp

This mode is only available with SP4 / SP5 unit.

When test is started, it will enter automatically the SP4 / SP5 in **Steady Mode**, and will update the RPM Target when changing the "Min RPM" box, or when using the Page Up and Page Down keys. This lets you to get the engine steady and full loaded **before** starting the recording.
The user should set the Ending RPM and Test Time before starting the test (Accel Slope is calculated from these 3 values).

Do not hold at Max RPM. For most cases, the ending RPM only tells the software where the ramp ends, but it is preferable not to hold the engine at that value to avoid strange measurements when load changes from partial torque (during ramp) to full torque (during holding). Only for certain engines in which exceeding the max rpm can cause a damage it can be interesting to hold the engine at the max value.

Time / Acceleration setting. Ramp mode is based in an acceleration slope, this slope can be defined as a time (from starting rpm to ending rpm), or as a slope rpm / sec.

Slow Down at the End of the Test. This option uses some braking action (percentage) to decrease the roller speed until it reaches the starting Min RPM. It is useful on Engine Test bed specially when there is a clutch between engine and brake (typically with 2 strokes), but also on heavy car dynos, because braking the car (with the car's brakes) can make it move backwards due to the inertia of the rollers.

"Stop when lower" and "Stop when higher" work in the same way as on inertial mode.
After the test starts, the program will enter automatically the braked DAQs (SP1+ to SP6) in **Ramp** (Sweep) Mode in order to start to increase the Target RPM as the engine accelerates.

Use Last Coasting Data [NEW]. Specially in hub dynos, in which the coasting phase is difficult to get correctly (due to the parasitistic torque when the brakes disconnect after the clutch disengagement, and also due to the low inertia which cause a sudden loss of speed, and thus the coasting graph is often half of the whole range), this option allows to perform an initial "inertial" test (brakes OFF) with a clean coasting graph (even if the power section is not useful due to the lack of load), and then the data obtained from the **Coasting Polynom** can be used in the consecutive tests even if they have no coasting phase.
In the rest of the cases (rolling road dynos, or engine dynos) it is not recommended to use this option.
The way to use is is as follows:

1. **Enable "Coasting Polynom" filter**
2. **Disable** "keep last coasting data"
3. Do a normal "inertial" test: acceleration + coasting (even if the power graph is not useful due to the lack of load)
4. **Enable** "keep last coasting data"
5. Do ramp tests as usual, even if they have coasting, the SW will use the coasting formula from the first test ("3.596254; 3.200022E-03 format")

3.2.5 Common area

Throttle slide bar [NEW], this allows to control the throttle while preparing the test (envisaged for Engine Test bed dynos)

Brake slide bar [NEW], this allows to control the brake either after a dyno run (to slow down the roller), before a new run, or just to test the brake.

Max number of tests, (in older versions: "remove last tests"), this box (at the bottom-right side), indicates to the program the maximum number of dyno runs loaded at memory each time a new dyno run is done, it will remove the older tests if there are more. It is useful

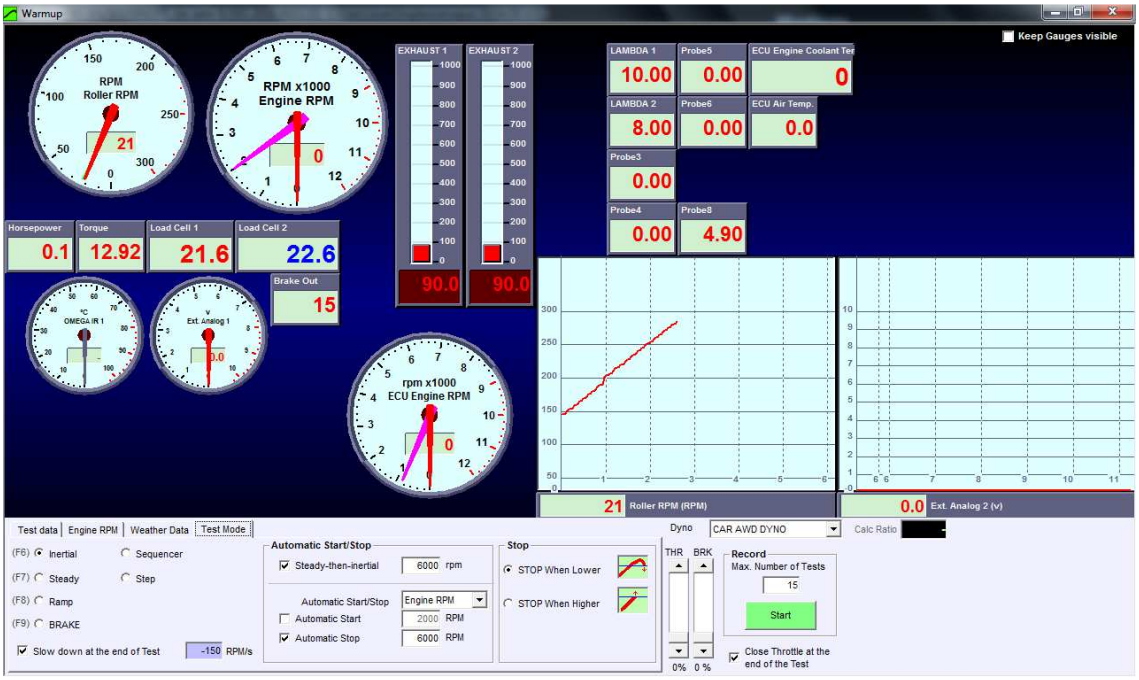
when a lot of test are being done, for example to allow one alone person to use the dyno. It prevents to accumulate a big quantity of curves at screen.

Start Button, it will start a new test (see next section 4 “How to do a dyno run”)

Close Throttle after the end of the Test bar [NEW]. This option automatically closes the throttle when the test recording ends. It is envisaged for Engine Test bed dynos.

Calc Ratio. For “using clamp” and “use OBDII / xDS” modes, this box will show the real time calculated ratio value.

4. HOW TO DO A DYNO RUN?



F5 key has the same effect as the start/stop switch provided with some kits

Test phases are as follows:

4.1 Gauges Window

By pressing F5 key or the Start/Stop switch, Sportdyno will show the Gauges Window. This window shows all channels in real time: roller speed, engine rpm, thermocouples, analog channels, and also all external data sources (OBDII, xDS, CAN, EGA, Infrared sensors, etc).

This window is used to enter:

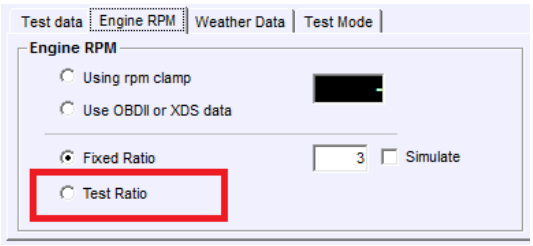
- Test name and vehicle data
- Engine RPM and engine capturing options (clamp, OBDII, etc)
- Weather conditions / Weather station
- Test mode: inertial, steady, ramp, fixed brake, step test, sequencer, etc

All these options have been described at section 3.2 (Test Data Area)

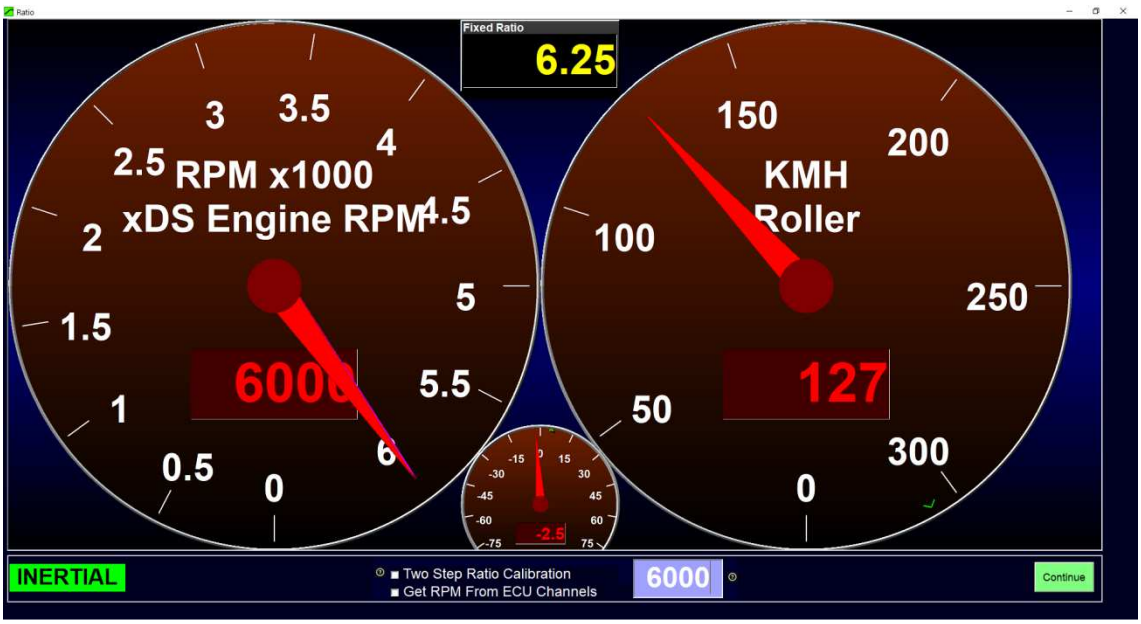
Once the user has filled all test data, F5 key or Start/Stop switch has to be pressed to go to the next phase, which depending on the ratio mode will be the Ratio Window, Semaphore Window or directly the test recording.

Note 1: activating the option **"Keep Gauges Visible"** will keep this window when the test is started
Note 2: In this version, for ramp mode, the user **does not have to accelerate** to keep the engine steady during Gauge Window stage (as for older versions)

4.2 Ratio Calibration Window



When “Test Ratio” is selected (or by pressing F7 key at Main Window) Sportdyno will show this window after the Gauges Window to start a process to determine the ratio value on a given vehicle when Engine RPM channel is not available.



Ratio is the relationship between Engine RPM / Roller RPM. This value is used for several functions in Sportdyno:

- Speed control (referenced to engine RPM)
- Graphs X-axis in “graphs vs Engine RPM” mode
- Torque at engine calculation (torque is actually measured at roller)

When ratio value is unknown for a vehicle, Engine RPM channel is not available or difficult to record (for example diesel engines), or it is noisy and inaccurate, or OBDII data is not available, then it is better to approximate ratio value with this method based on the observation of the vehicle’s tachometer.
Test Ratio Window can also use OBDII data (or xDS data) to determine the ratio at a certain RPM value, in a more deterministic way than if using OBDII or xDS in real time mode, but both ways are valid.

The procedure for determining the ratio consists on setting a certain reference RPM value on this window (say 2000 rpm for cars) and drive the engine to the same value using the tachometer as a reference.

> Note about gear selection: in general it is recommended to use last gear or last gear -1 for recording the test and thus for determining the ratio, but normally in car dynamometers it is recommended to use 4th gear for 5 and 6 gearboxes.

When vehicle tachometer matches the reference RPM, the roller will run at a certain speed (for example 600 rpm), and ratio value will be **= fixed rpm / roller rpm** (2000 / 600 = 3.33 on the example). Then, when pressing “continue” or “start/stop” button, this value will stored to be used for the test recording.

Get RPM from OBDII Channels. This option allows using the Engine RPM PID from **OBDII** or from xDS link (Suzuki, Honda, Kawasaki) to get the actual Engine RPM value, instead of using the Vehicle's Engine RPM gauge. This provides more accuracy in the ratio calculation, but it is still recommended to keep a steady speed on the vehicle, as OBDII has a small delay that can be translated to a small error in ratio if both speed and engine RPM are changing.

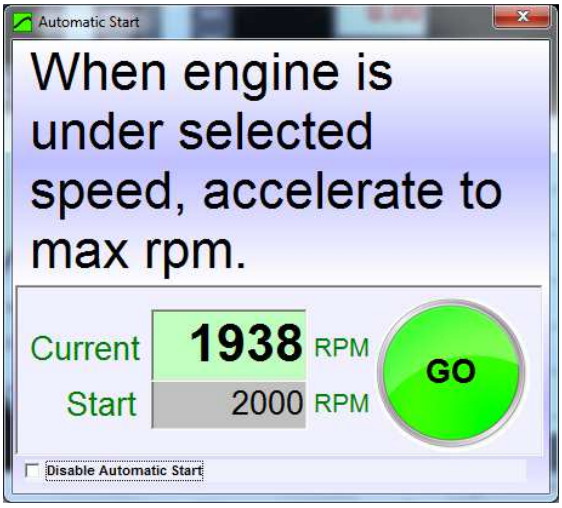
Two Step Ratio Calibration:

- **Step 1: calibration under no load.** It is performed as usual, the dyno will be in inertial mode (brakes OFF) and the ratio will correspond to the gearbox ratio * wheel vs roller diameter ratio. The software will give the suitable instructions when going to the step 2.
- **Step 2: Calibration under load.** The software will command the steady mode at the reference speed (say 3000 RPM), then the operator will accelerate. If the rollers cause some deformation in the tires, the apparent diameter will be lower and the wheels (and engine) will reach a higher speed than in no load condition. This new (higher) ratio value is useful to make the X-axle match the actual engine RPM channel. It is a common issue that twin roller dynos show less calculated engine speed than the actual value due to this tire deformation.

Finally the software will give instructions to **release the throttle before removing the steady mode** (to avoid an uncontrolled acceleration)

4.3 Semaphore Window

In both cases: when using automatic start in inertial mode or ramp mode Sportdyno will show the semaphore window. This window shows current calculated RPM and the starting RPM value.



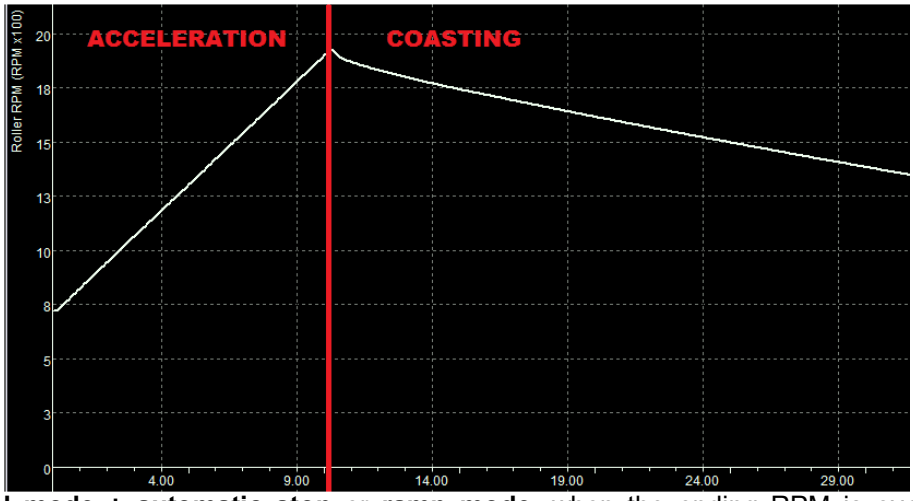
- In Inertial mode + automatic Start, the starting value determines when the test is going to start. Thus as soon as the engine RPM changes from "lower than starting value" to "higher than starting value" the test recording will start. Note that if the initial engine rpm is higher than the starting value the semaphore will be red.
- In ramp mode, the Semaphore Window also sets the steady mode to reach a steady condition in the engine at the starting RPM before starting the test recording. This was done in previous versions at Gauges Window, but now it has changed to this stage.

4.4 Test Recording

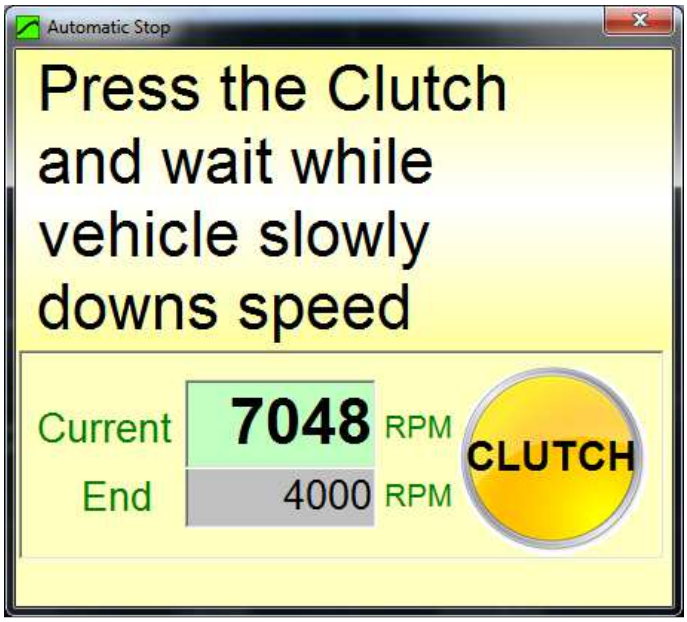
At this stage Sportdyno will start recording of test. Test normally consists of two phases controlled by the dyno operator:

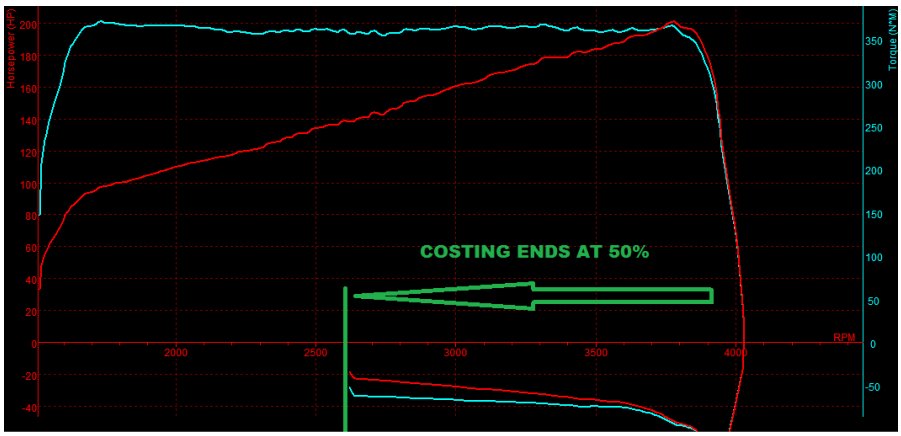
- **Acceleration**: recording the maximum performance of the vehicle until its maximum RPM (or close to max RPM) at full throttle

- **Coasting:** if clutch or N gear are available, when engine reaches its maximum speed (or close to it), dyno operator has to press the clutch and leave the vehicle run free while losses speed slowly.



In **inertial mode + automatic stop** or **ramp mode,** when the ending RPM is overpassed, Sportdyno will show a warning message to tell the operator to activate the clutch.
Test recording will automatically stop at the 50% value between starting speed and ending speed. This 50% value can be changed at configuration.





5. CONFIGURATION

At main menu options / configuration the program will show this window.
There are three sections (tabs):

5.1 Class of Dyno

5.1.1 Profiles / Dyno Name

This box allows setting the dynamometer name. It also enables using **several profiles** within the same program and electronic unit.
There are two buttons: **'+'** and **'-',** in order to add a new profile to the list, and to remove the current one.

5.1.2 Dyno Type

Current supported dynos are listed in this area. Some of them are equivalent (motorcycle = single axel car dyno), but are listed for coherence.
Vehicle dynos can use the "displacement correction". Also, losses on transmission are calculated.

5.1.3 SPx Device.

By default "**Auto Detect**" option is active, and then Sportdyno identifies the SPx device type. Nevertheless, user can select one specific SPx unit.

5.1.4 Roller Characteristics

Diameter and inertia, these data are fixed for each dyno, user normally sets it once, and does not change it afterwards. Roller diameter affects to speed measurement, and Inertia affects to Horsepower and Torque measurements (in a linear way).
For AWD operation two inertia values and two diameters have to be set. Current version needs that all rollers have the same diameter.

5.1.5 SPx Configuration

We recommend using a gear tooth between 8 and 150 teeth.
Number of teeth: number of teeth/pulses used on roller or flywheel. This gear could also be used for the starter motor.

Prescaler (SP1, SP3, SP4): this feature adapts the digital input (up to 15 KHz) to the capacity of **SP1 to SP4** units (up to 1 KHz). Depending on the number of teeth, gear tooth will generate a different frequency at the hall sensor, and then a different prescaler has to be configured (the program will chose on by default)

Configuration	Minimum teeth	Maximum teeth	Frequency range
Prescaler 1	1 teeth (60.000 RPM)	8 teeth (7.500 RPM)	0 to 1000 Hz
Prescaler 4	2 teeth (120.000 RPM)	60 teeth (4000 RPM)	0 to 4000 Hz
Prescaler 16	61 teeth (14.754 RPM)	160 teeth (5.625 RPM)	0 to 15000 Hz

SP1+, SP5 and SP6 have always Prescaler = 1.
From SP5 PCB v2.2, it includes a hardware prescaler to allow the usage of **Encoders** (up to 2000 pulses per rev). But then the number of pulses have to be divided, for instance for 500 PPR encoder, set prescaler 4:1 (at PCB), and pulses=125 (500/4) at Sportdyno.

5.1.6 Load Cell Zero and Scale fields.

These values are a copy from the ones at Load Cell Wizard. They are repeated here just to show how each Dyno Profile selector updates load cell data.

5.1.7 SP4 / SP5 Specific

Please refer to section 10.

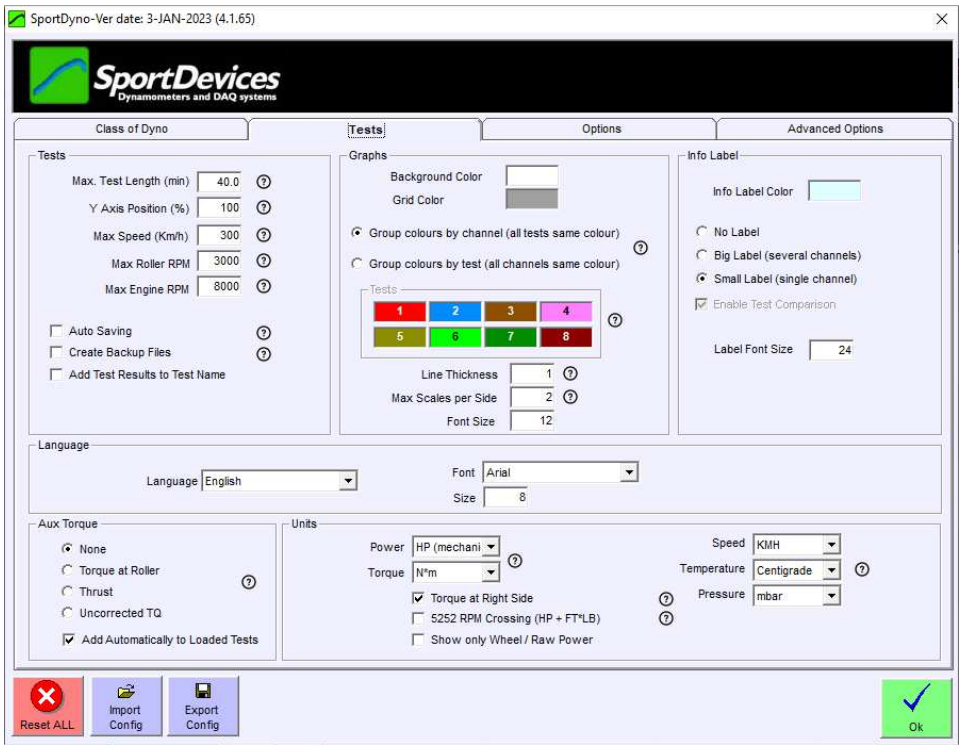
5.1.8 Lower Buttons

RESET ALL (button). This option will erase all program configuration. This is useful when there is something that does not work and the user wants to go back to a safe configuration. Keep in mind that all different versions (changes on major number: 3.5, 3.6, 3.7, 3.8) have a different set of configuration at Window Registry, but between intermediate versions (3.8.27.10, 3.8.28.3, etc) configuration is shared

Open. This option will load a text file with the program's configuration.

Save. This option will save a text file with current program's configuration.

5.2 Test Options.



5.2.1 Tests

Max. Length: maximum time for data recording, in minutes.

Y axis position: percentage of area used for the positive part of the graphs. If you are using an Engine Dyno without clutch you may find interesting to use 90 or 95% of the graph for positive area (because you will not record losses at negative area), but if you are using a vehicle dyno, it is better using 70% to allocate the losses graphs. Default value is 70%.

Max Speed: This value is used for Roller RPM gauges, when in Speed mode. The program will set the maximum for all Roller gauges to this value (if more than one)

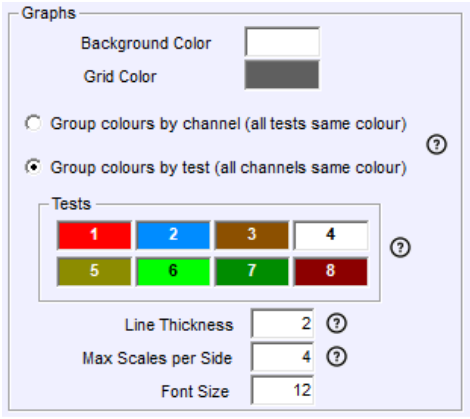
Max Roller RPM: This value is used for Roller RPM gauges, when in RPM mode. The program will set the maximum for all Roller gauges to this value (if more than one)

Max Engine RPM: This value is used for Engine RPM gauge. The program will set the maximum for all Engine and Calculated Engine gauges to this value (if more than one)

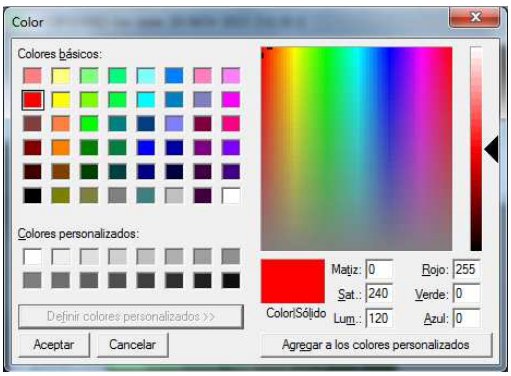
Auto saving: By default the program always save the dyno runs to the disk when a test is done. But it can be disabled. Later, the program will ask the user if he wants to save it to the disk (at program closing or when removing tests).

Create Backup Files: By default the program creates a backup file when a new file is being modified. It will rename the file to .spx_bak extension and will record the modified file with the modifications.

5.2.2 Graphs and Colors



Background Color, defines the background color in the main window. It can be edited by double-clicking over it and then a colour selection window will appear. Select a colour and press OK button.



Grid Color, defines the color used for the grid in the main window

Color Group Mode:

- **Group colors by channel:** Each channel has a different colour, defined at channels window. And all tests use the same colours for the same channel.
- **Group colors by test:** Each test has a different colour, but all channels of each test have the same color. This mode is normally used to compare tests, and when only a few channels are active.

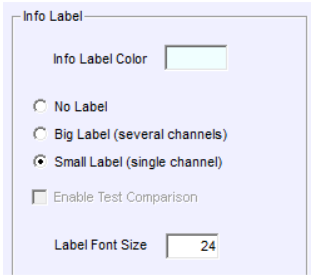
User can also modify the colors that will be used for each test.

Line Thickness. Thickness used for the graphs at main window

Max Scales per side. By default the SW will show only 2 scales at each side, but it can be increased (although it will make the graph more confusing)

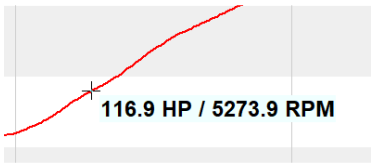
Font Size. Font used for the numbers and channel names in the main window.

5.2.3 Info label

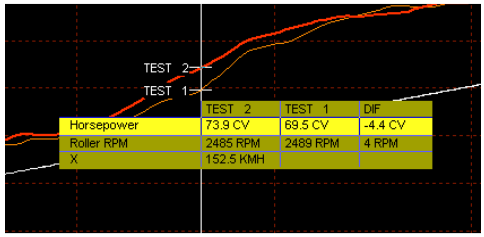


Info Label Color: color for the label background
Type: The software provides two types of "tracking" over the graphs when moving the mouse pointer over them.

- **None:** no label
- **Big Label:** it is the same label as in 3.x and 4.0 versions. It is big and full of numbers. It is useful to check several channels at a time or for comparing between two tests
- **Small Label:** this new label only shows the active channel's value. It is smaller and cleaner.



Enable Test Comparison. When using the "Big Label" it will show the values for the active channels from the latest tests at a time and the difference between them



Label Font Size. Font size used in the label

5.2.4 Language

Language: current available languages are: **English, Dutch, French, German, Italian, Russian, Polish, Russian and Spanish.** These languages are stored on text files (*.lan)

that can be edited by the user easily (with Notepad for instance). When language is changed, the changes will take effect when closing the configuration window.

Font: the user can change the Font used in the program, this is mainly interesting for languages that need a special charset as Russian Language.

Size: font size can be changed, but keep in mind that the space reserved for texts will be the same, so eventually the texts will not fit at their places.

5.2.5 Aux Torque. Torque Calculation

From this version, torque is always calculated at engine. The software calculates this channel from the torque measured at Roller, and uses the Ratio value to do this. Keep in mind that torque at engine **depends on the ratio value.** If Ratio is wrong for the dyno run, torque at Engine will be wrong too.

Torque at Engine normally is lower than torque at wheel due to gearbox, transmission and tire size, because torque is increased as RPM is decreased.
Torque at engine cannot be calculated on automatic transmissions using a FIXED ratio

Auxiliary torque channel:

- **None:** no aux channel is added
- **Torque at roller:** Sportdyno measures torque at roller (inertial and load cell). This mode is normally only useful to compare total torque with load cell torque.
- **Thrust:** It is a variant of torque at Roller; it provides the linear thrust or vehicle force over the roller. It could be used to calculate the capacity climbing capacity of the vehicle on a slope. It does not depend on ratio.
- **Uncorrected TQ.** As the default Torque is calculated at engine (ratio calculation and friction corrections), it cannot be compared with the Wheel Power anymore, then the uncorrected TQ (which only includes the ratio calculation, but not the friction) can be compared with WHP. This is typically used for the “magic” 5252 RPM crossing point.
- **Dynamic TQ.** The software will use the actual engine RPM channel to calculate the actual **uncorrected** Engine TQ as the CVT changes its ratio. Note: it is important that the Engine RPM Channel signal is the best quality as possible, as the calculation uses the Engine RPM in a raw way, without any previous processing.

5.2.6 Units

Power units. User can chose between

- HP mechanical (745 W),
- KW (1000 W)
- HP metric (736 W)

Torque:

- N*m,
- Ft*Lb (1 Ft*Lb = 1.355 N*m),
- Kg*m (1 Kg*m =9.8 N*m)

Speed:

- KMH,
- MPH (1 mile = 1.609 kilometers)

Temperature:

- Celsius,
- Fahrenheit (1 Fahrenheit degree= 1.8 celsius, Fahrenheit starts at 32º for Celsius=0º)

Pressure:

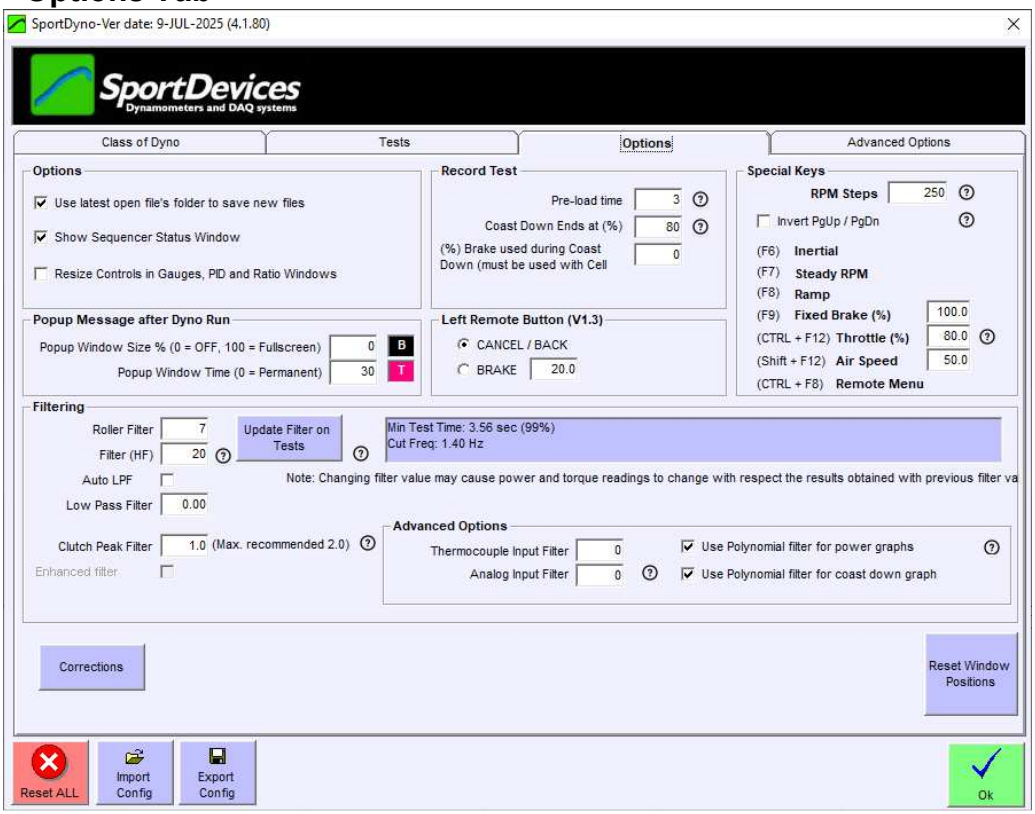
- Mbar
- inHg (1 mercury inch = 33.8638 mbar)

Torque at Right Side: By default, the SW will show HP at left side and TQ at right side

5252 RPM button: this option configures the following options to allow that HP and TQ cross at the "magic" point of 5252 RPM:

- **Units** are set as HP for power, and Ft*Lb for Torque. Keep in mind that 5252 RPM crossing only happens with imperial units, with other units the crossing point changes
- **HP and TQ channels** are set to use the "Group 1". Channels using the same group share the same scale instead of that each channel has its own scale (depending on the channels peak value). If Power has its peak at 100 HP, then Torque channel will also use 100 Ft*Lb as maximum for its scale.

5.3 Options Tab



5.3.1 Options

Show "Power at Engine", between brackets. If checked, the program will show the wheel power value, and power + losses between brackets. The same is applied to torque.
Example: HP = 55.4 (67.9) / 9000

Use "Sum" method for losses calculation. There are two methods to calculate power at engine:

- **Peak Method:** Calculating the Wheel's Power Peak value (for instance 100 HP at 5000 RPM), and then adding the losses for the same RPM point (for instance 20 HP at 5000 RPM)
- **Sum Method:** First adding power and losses sections, and then calculating the peak for the sum. For instance at some point wheels power is 99 HP, but losses is 22 HP, then peak for sum is 101 HP.

Both methods normally will **not** give the same result. This option is provided to use always the "sum" method, regardless of whether the graphs are displayed with the negative section, or are added in the screen.

Use latest open file's folder to save new tests. This option when active changes the internal file path to the latest folder in which the user open some file. If not active path is not changed, and can be kept the same during all program execution.

Show Sequencer Status Window. During a sequencer controlled test (SEQ files) and a race-track simulation test (CSV files) a status window is shown at bottom-right corner. This option allows disabling it.

Popup Window Size. After the dyno run a popup window will be shown. This field allows to change its size (% with respect the main screen)

5.3.2 Special Keys

RPM Step. In Gauges and PID monitor windows, when the cursor is at Target RPM, the user can use Page UP and Page DN keys to quickly make this value to go up and down. This field determines the amount to increase/decrease the Target Value.

Invert PgUp / PgDn. With some keyboards it may be more intuitive use these keys in the opposite way.

F6- Inertial, F7- Steady, F8- Ramp, F9- Brake key (Informative) These keys can be used as a shortcut to enter each control mode at in main window, at gauges window, at PID monitor and during test recording.

F12-Throttle%. Throttle can also be set to a predefined value (say 80%) and 0%.

Shift+F12, Air Speed. The PWM output/air speed voltage can be set to a specific value in this section. Pressing Shift+F12 will first go to 80% (for example), and pressing it again will go to 0%, and so on.

Advanced options. See section **5.4** (advanced options).

5.3.3 Filtering

Note: All filters used in the software are low-pass filters, which eliminate high frequencies (usually noise) and allow low frequencies to pass. The high/low distinction is made because some filters are more effective at higher frequencies (noise) and others at slightly lower frequencies (mechanical vibrations). However, the resulting information will always be very low frequencies.

Roller Filter. This filter can be used when the Roller signal is not stable and due to vibrations or imperfections in the gear tooth, then the speed signal has ups and downs. These oscillations will cause that in graph vs speed modes (Speed and Engine RPM) small loops will be shown in the graph caused by these changes on speed up and down.
This filter only affects to graphs and speed/RPM calculations, it is not used for power calculation.

Filter (HF). This filter is applied to Power and Torque graphs in order to remove high frequency noise and low frequency mechanical oscillations. On large dynos (car), or dynos with high vibrations it can be also necessary to use the "Low Pass Filter" option.
Note that the program shows an informative window that explains for each filter setting what is the minimum recommended test duration (acceleration phase) in order to not lose information about power and torque. For instance for a filter of 19 (and Low Pass = 0) minimum acceleration time should be 3.47 seconds. If acceleration duration is below this time, then accuracy is not warranted to have less than 1% error (nominal accuracy)

Filter (Low Pass). This option is used for large dynos (car) or with high vibrations. And normally it is not necessary to be used on inertial dynos (as tests are shorter). It applies a second filter stage after the HF filter. Low pass filter works better for low frequencies (mechanical) vibrations. It requires longer tests. This makes it recommended only on braked dynos, and makes that minimum recommended test time is 10 seconds (for Ramp mode).

As a general rule, the LPF filter shouldn't be higher than 1/10 of acceleration duration.

Update Filter on Tests. Tests hold the filter settings that were active when the test was recorded, these values should not be changed to preserve the original HP and TQ readings, but user can force the tests to be updated using this button.

Thermocouple input Filter. This value is used to filter the thermocouple inputs (8) with a low-pass filter at the input. Data will be recorded after the filter. The higher the value, the higher the filtering.

Analog input Filter. This value is used to filter the analog inputs (8) with a low-pass filter in the input. Data will be recorded after the filter. The higher the value, the higher the filtering.

Glitch Filter. This option will filter short glitches (spikes) in the **load cell channel.**

5.3.4 Corrections

Displacement correction. This is a correction based on the whole inertia of the vehicle and dyno (roller + wheel + transmission + gearbox) as a function of the engine displacement. If activated, this correction will be applied to all loaded tests. This option is not stored with the test, but with the program. There is a file **(inertia.ini)** that the user can edit to customize this assignation.

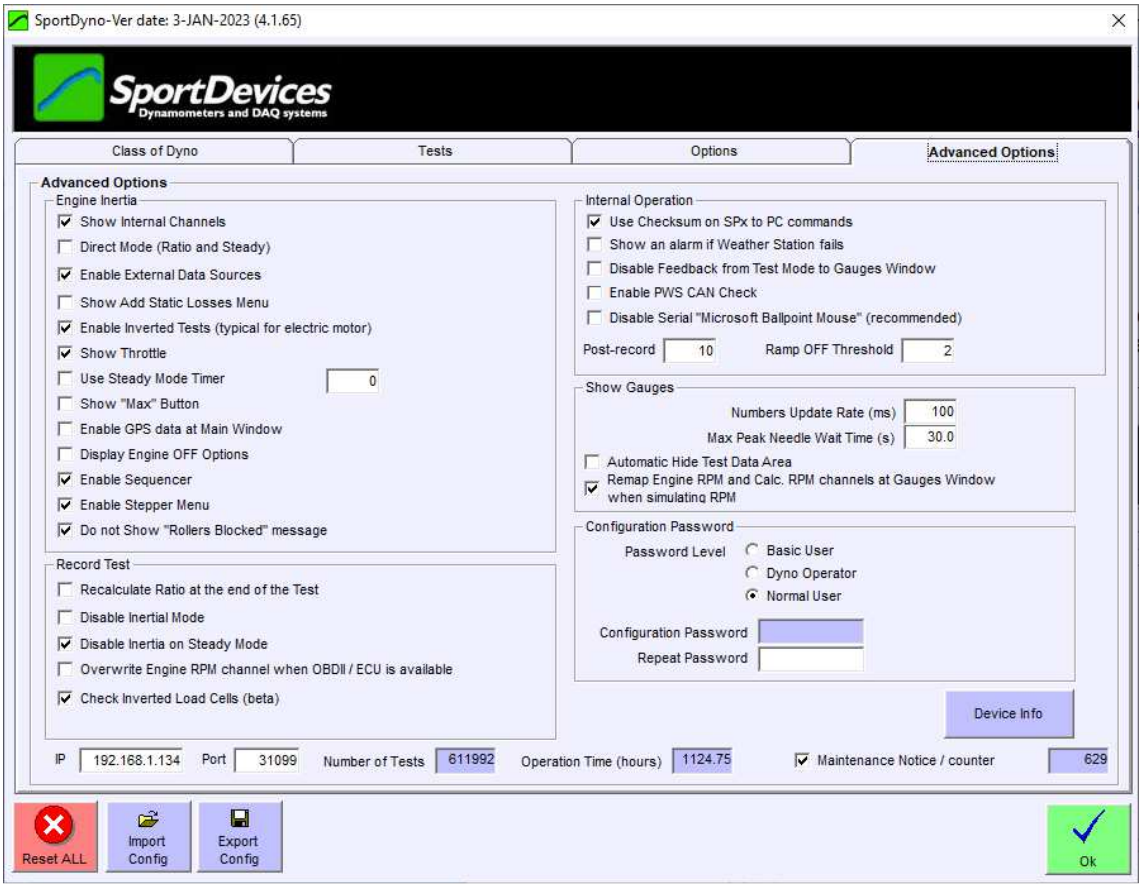
Correction type. There are several correction formulas available:

- Blank (none)
- ISO 1585
- SAE J1349
- DIN 70020
- JIS D1001
- EC95-1
- *EWG 80/ 1269 (not fully implemented)*
- *FOS (2 stroke engines)*
- FIXED (here the user can set the fixed correction factor)

If changed on the configuration, the program will ask you if you want to change to all loaded tests.

5.4 Advanced Options

Normally user does not need to modify these options. Nevertheless, they are provided in case of special needs, or systems that need to force special conditions on the software.



Menu enables:

Show Internal Channels. Some channels as brake output, PID target, etc, are disabled by default to not confuse new users. They can be enabled afterwards (they are always recorded)

Direct Mode (Ratio and Steady). From version 4.0 the guided mode is used to perform the tests, in which it is giving instructions to the user so each step is performed in the correct order. This guided mode can be disabled and return to the former direct mode (when this option is active) as in old versions.

Enable External Data Sources. Sportdyno 4.x implements many new digital data sources (data which is acquired directly to PC, not through the SPx unit): OBDII, xDS, CAN, EGA, Infrared sensors, etc.
These data sources are explained at section 16 (External Data Sources).

Show Add Static Losses Menu. "Add Static Losses Menu" is disabled by default to not add to simplify the program operation for new users.

Enable inverted tests (electric motor). This option is hidden by default to simplify the program operation for new users. Inverted tests are typical with electric motors which used to be tested from max RPM increasing brake load until the engine stalls.

Show Throttle Menu. This menu is disabled by default to not add to simplify the program operation for new users. Throttle menu allows calibrating throttle min position and throttle max position. See section 2.4.2. It also makes throttle slider visible at Gauges Window.

Use Steady Timer. This is an experimental feature to time the recording time during steady test. It is disabled by default.

Show Max Button.

Enable GPS data at main Window.

Display Engine OFF options

Enable Sequencer

Recording

Use interpolation of samples to increase accuracy. From version 3.0 of software, it was added an interpolation algorithm to increase accuracy when there are a few pulses per rev (for example one tooth per rev), and when acceleration is very fast. This option is enabled by default, but it can be disabled for test purposes.

Recalculate Ratio at the end of Test. By default Ratio is calculated while the program is at Gauges Window, and also after the dyno run has been performed. Normally Ratio value is not exactly the same during the dyno run, than before starting. This is caused by the little slippage caused by the wheel applying torque to the roller (vehicle dynos). This slippage is lower or does not exist before starting the test.

Record Weather Station data during the test. By default this option is enabled, and it causes that the program record the Weather Station data (temperature, humidity and pressure) within the test for later reference. Normally these values will not change during the test, but a high variation on one of them (for instance room temperature), may reveal a problem in the dyno room (insufficient ventilation, small room, etc)

Interpolate OBDII Data. OBDII channels, even with CAN protocols, are slower (2 to 10 samples per second) than SP1, SP3, SP4, SP5 channels (50 samples per second). This causes that OBDII channels generate step-like patterns. To improve this shape the program performs a 3rd grade interpolation to create a smooth shape.

Post-record. Filters generate delays depending on its size. This parameter is used to record a few samples more after the test is committed to stop to feed the filters provide accurate graphs at the latest samples.

Coasting ends at %. By default coasting will end at the 50% value between starting RPM value and ending RPM value. For instance for a test between 2000 and 6000 RPM, recording will stop when coasting reaches the speed equivalent to 4000 RPM. This percentage can be changed.

Pre-load time. In ramp test, at the semaphore window the engine has to last at least this time in the steady condition before the ramp and the recording start. By default it is set to two seconds, but it can be modified.

Internal Operation:

Use Checksum on SPx to PC commands. Depending on Firmware version, some SP4s send configuration data to PC without a checksum, and others do use checksum.
With SP1+, SP5 and SP6, all FW versions use checksum on both directions.
Actually this option is something that Sportdyno configures by its own.

Show an Alarm if Weather Station fails. By default the SW will show an alarm if the Weather Station has an assigned port and the communication is lost.

Disable Feedback from Test Mode on Gauges Window,
By default all changes on DAQ are sent to Sportdyno to update the status. Nevertheless, feedback for **Test Mode** status can have non deterministic effects at Gauges Window. For this reason feedback is disabled by default for this specific message.

Enable PWS CAN Check. When the power supplies are connected using CAN to SP5 or SP6, this option will perform a check before starting a test to ensure that the communication

works and there are no errors in the power supplies. This is especially useful in AWD, HUB-2 and HUB-4 dynamometers.

Disable Serial "Microsoft Ballpoint Mouse" Windows can eventually detect the data stream from the DAQ or from the Weather Station and decide that it is a MOUSE, it will install their drivers and block the access from other applications. It is recommended to execute the Disable Serial Ballpoint procedure, but it will only work if Sportdyno has been executed in **Administrator Mode**

Gauges

Numbers. Update Rate (ms) for all numbers present at gauges, update rate can be configured. By default it is set to 100 ms to allow enough time to read each change of numbers, but some users may prefer faster changes that look like more fast software operation (but make more difficult to read the values)
Please note that most times a slow updating frequency in both gauges and graphs can be caused by the latency setting in the FTDI-COM configuration (check section 2.5.2)

Max Peak Needle Wait Time (s) new gauges add a peak value needle, the value will be set to the maximum value reached by its assigned channel, and **after this wait time** it will start to decay slowly to zero, to be able to register other maximum values.

Automatic Hide Test Data Area. In the gauges Window, some users may prefer having the whole area available for gauges / numbers when they are not editing the test details. This option will hide the Test Details when the mouse is not over that area.

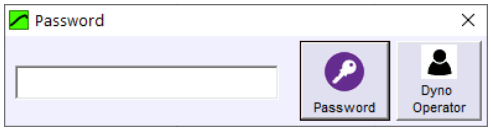
Remap Engine RPM and Calculated RPM channels at Gauges Window when simulating RPM. By default all gauges containing either “engine RPM” or “calc. RPM” will be remaped to “calc. RPM” when “simulate RPM” option is active, or to “engine RPM” when it is disabled. This automatic behaviour may cause a conflict if the user wants to have both channels available, then this option has to be disabled so the gauges are not reassigned automatically.

Configuration Password

By default the software will be run in the ‘Normal User’ level, nevertheless some dyno owners may need to have a “Basic User” or a “Dyno Operator” level to limit the functions that the software allow to do to 3rd users.

- **Basic User**: only has access to printer settings
- **Dyno Operator**: has access to all settings except the dyno configuration
- **Normal User**: has access to all configuration

When the access level is changed to Basic or Operator, the **software will request to fill both password fields** (with the same to ensure that the dyno owner will be able to go back to the Normal user mode)
When in Basic or Operator levels, the SW will ask for the password every time that the configuration is entered. Basic and Operator users will only be able to click in the right button to access their limited options.



Device Info

This box will show all available information about the SPx device (if available)

- Firmware version
- SPx DAQ type (SP1, SP1+, SP3, SP4, SP5, SP6)
- Firmware Subtype
- PID Type
- OV Type (overshoot control, classical derivative control)
- CMD Echo (commands are “echoed” from SP5 to PC to verify the communication)
- AWD Enable (SP5/6 allows AWD or not)

- MAC Address (SP5/6)
- Clock resolution

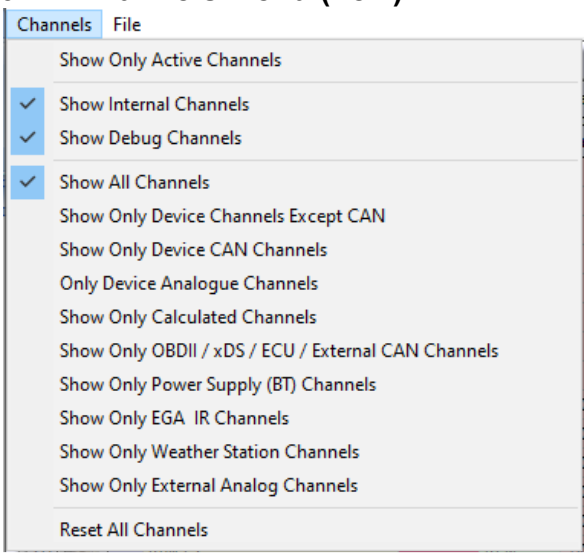
Bottom area

IP and port can be modified at this place. By default SP5/6 IP is assigned by the Discovery protocol when searching for a SP5/6, and port is fixed 31099, but they can be modified.

Number of Tests and Operation Time. These are informative fields about the usage of the dyno. They cannot be reseted with the “Reset All” button at Config Window. In addition they cannot be exported or imported from another computer, so new computer → count starts from zero. (They are not stored into the SPx unit)

6. CHANNEL SETTINGS.

6.1 Channels Menu (new)



This menu makes viewing channels easier, as in the latest versions there are so many channels that it's becoming increasingly difficult to identify one in the entire list.

6.1.1 Active channels only.

This option will only display channels on the connected SPx device and on enabled external interfaces (e.g., OBDII). You may want to disable it if the device is powered off.

6.1.2 Show internal channels and debug

This option will only be enabled when the channel filter is in "show all channels" or "show device channels only" mode. Its purpose is to display internal and debug channels that normal users typically won't need.

6.1.3 6.1.3 Filter by channel type

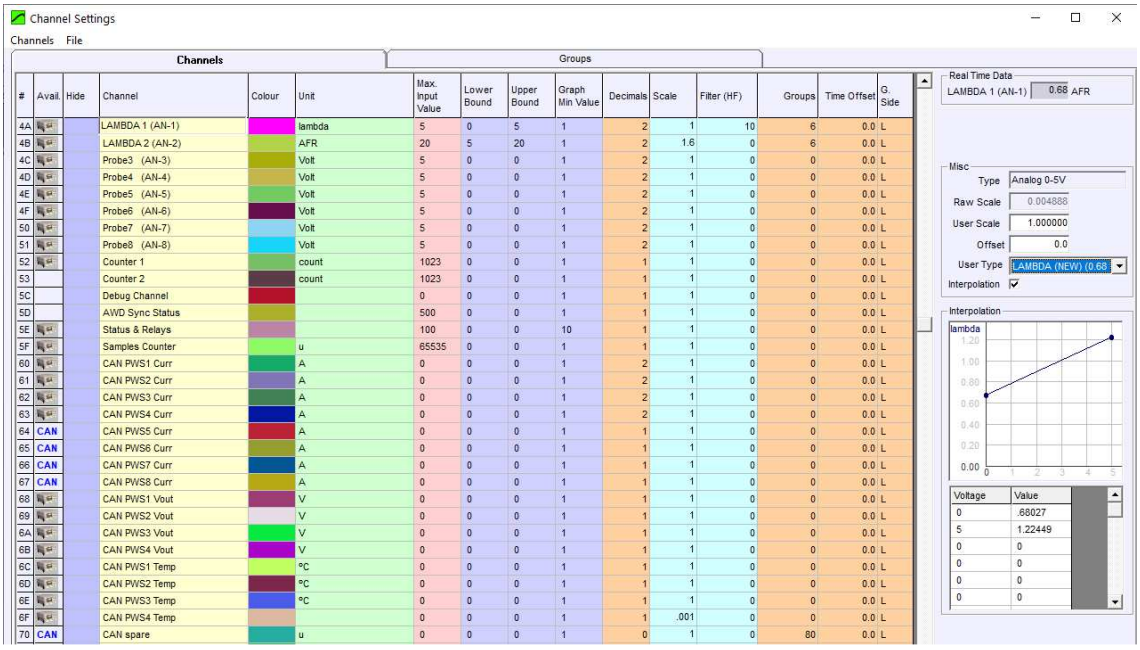
- Show all channels
- Only SPx channels except CAN
- Only CAN (SPx) channels
- Only Calculated channels
- Only OBDII, xDS, CAN/ECU channels
- Only PWS (Bluetooth) channels
- Only EGA and IR channels
- Only weather station channels
- Only external analog channels

Except for the first option which will show all channels, the following ones will show one or two groups to make it easier to find a channel and edit it.

6.1.4 Reset channels.

This option will return all channel settings to their default values, including any changed names. This can be useful for forcing channel names that have been translated to the name found in their corresponding language file.

6.2 Channel List



This window is used to display and modify the Channel Settings.

A list of all existing channels is shown at the left side. The box icon means that this channel is available on your system. The standard configuration includes:

- SP1: Roller RPM, Engine RPM, 2 thermocouples and 4 analog sensors (ex. Lambda1).
- SP3 units also include load cell channel.
- SP1+, SP4, SP5 and SP6 units include 8 thermocouples, 6 or 8 Analog channels, and several internal channels (brake output, PID Target, servo output, etc)

Note: f(x) channels are internal calculated channels (ex. HP and TQ), they are not transmitted by the SPx unit.

6.2.1 Channel key

It is the internal code to identify the channel. It cannot be changed.
Note that from version 3.8 it has been changed from ASCII (A, B, C.... I, J, K) to hex numbers (41, 42, 43...49, 4A, 4B) to allow the new channels to be used, as they use an eight bit encoding and are more difficult to be represented as ASCII characters. For instance OBDII Engine RPM is 90 which does not have an associated ASCII character in most charsets.

6.2.2 Hide

Channel will be hidden in the lists and graphs. This is useful to hide certain internal channels, and to have an easy access to the channels that are being used.

6.2.3 Channel Name

It is the visible name for the channel. Some channels have specific default texts in each language. All of them can be edited by the user. This will affect to new tests which will be recorded with the new texts.

6.2.4 Colour

Channel colour can be edited directly in this window by clicking over the color. After that, depending on the grouping mode graphs will use channel colours (for group by channel) or test colours (for group by test)

6.2.5 Unit

The measuring unit name for the channel (kilograms, degrees, rpm, Newtons, etc)

6.2.6 Maximum input value
It is the maximum value for the channel. It is used as “filter” on the input. Be careful because if input is sometimes higher than this value, the program will clamp the channel at this value to void the graph to be rescaled to extreme values.

6.2.7 Upper bound, Lower bound
Those values are used in gauges and graphs as upper limit and lower limit for displaying, but they do not modify the channel data. When any of them are set, the program understands that this channel no longer uses the auto-scale method, but it uses manual scalling.
Those values are used for HP and TQ instead the “manual window” as in previous versions.

6.2.8 Decimals
Decimal places to print the numbers for this channel.

6.2.9 Raw Scale (only at properties section)
It is the scaling factor applied to digital input from the SPx unit. As data received from SPx is 16 bits integer, data has to be converted to a meaningful value for each channel.
For example: general purpose input goes from 0 to 5 volt, and its read values can be between 0 and 1023, then a factor of 5/1023=0.00488 is applied so when received 1023 value, it will recorded as 5 volt.
Normally this setting is internal and cannot be changed

6.2.10 (User) Scale (at the table and properties section)
This is the scaling factor that the user can change to convert for instance a voltage into lambda or other value depending on the sensor. Some of the sensor types / presets set this value depending on the selected sensor type.

6.2.11 Filter (HF)
This value applies a low pass filter to this channel. It is only for the graph displaying, it does not affect to internal calculationa. It is useful to display certain channels as load cell which normally have some noise.

6.2.12 Group
Normally channels are displayed using the auto-scale method, each channel has its own scaling according to the maximums and minimums detected. But sometimes it is better to group certain channels that have similar meaning using the same scale, to allow a direct comparison.
For instance when comparing the Engine RPM (or calculated Engine RPM) vs Target RPM, in order to analyze the Speed Control operation, it is strongly recommended to assign the same group to these 2 or 3 channels. For instance group “2”.
Group 0 means “no group”, use auto-scale for this channel.

6.2.13 Time Offset
In certain systems, for instance a Gas Analyzer, some channels could be received with certain delay with respect the other channels (as roller, power or torque), then the user set this field to correct the time offset of this channel with respect the others.

6.2.14 Graph Side
Most channels will be displayed at left side (L) of the graph area, except torque and load cells which will be displayed at right side (R). This side can be edited here.

6.2.15 Real Time
This box will show the realtime converted data for the current channel. This is useful when configuring an analog channel, or when configuring a CAN channel in order to see if the CAN ID, positions and scales are correct

6.3 Misc
This box displays additional parameters of the selected channel

6.3.1 Type. Channel types are defined by the DAQ and the software. They cannot be changed.

- **Digital Channel**: such as the RPM roller channels
- **Digital Calculated**: for example the intermediate power and torque channels (but not the main channels)
- **Power,Torque**: These are the main torque and power channels used in both the main window and the reports. For example, on an AWD bench, HP = HP1 + HP2
- **Internal,** internal channels such as brake output or target RPM,
- **Analog 0-5V**, standard analog channels such as lambda
- **Thermocouple (1000º),** thermocouple inputs
- **Digital CAN Channel,** channels 0x60 to 0x7F. The latest versions of SP5/SP6 allow the use of channels 0x60-0x63 to obtain information from CAN-controlled power supplies.
- **User Calc. Channel**, user calculated channels, from 0x80 to 0x8F
- **OBDII, xDS, CAN/ECU:** OBDII interface channels: 0x90 – 0xBF (48). From 0x90 to 0xB1 have reserved functions that are shared with other interfaces such as xDS, or CAN/ECU. For example 0x91 is always engine RPM. This is done because these three interfaces are never used simultaneously and share the same channel space.
- **Power Supply,** The Sportdyno can monitor a PWS3.x or HS source via a Bluetooth link. However, for AWD and HUB-4 (4 brake) applications, the CAN interface is recommended for full control of up to four PWSs.
- **Exhaust Gas Analyzer.** External analyzers, example EC997 dyno EGA
- **Omega Infra Red,** External USB sensor
- **Weather Station, T**he information from the weather station is not only stored at the test level but also at the channel level to see, for example, the evolution of the room temperature as the test progresses.
- **CIO External Channel,** Sportdyno allows control of up to four DEIF CIO modules, each with eight analog inputs. Alternatives to these modules will soon be available.

6.3.2 Raw Scale

It contains the internal scaling to convert the binary value received from the device to a value recognizable by the user.
For example, in the SP1, the analog channels are encoded from 0 to 1023 for 5V; this gives a scale of 5/1023 = 0.004887 to convert from binary to voltage.
However, in the latest data implementation (under test), the analog channels use 15 bits plus sign (5 / 32767).

This value does not need to be calculated by the user, nor can it be modified.

6.3.2.1 User Scale and offset

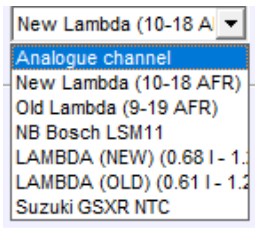
Channels can be configured either using the scale and offset, or using an interpolation table.

For instance for converting from 0-5V to 10 to 18 AFR, we need to multiply the voltage by a constant (18-10 = 8 -> 8 / 5 = 1.6) and add 10 AFR, then the user scale is 1.6 and the offset 10.

Do not use both methods: scale + offset and linearization at same time. The software would implement both.

6.3.2.2 User Type

Normally analog channels can be used for different functions. Those channels have to be configured or mapped to match the sensor or the function which is being used
The following list defines some pre-sets to configure an analog channel into some of the predefined functions. This configuration can be done also manually.



- Analogue Channel (0-5V)
- **New Band Lambda (0-5V) (10-18 AFR)**
- Old Band Lambda (0-5V) (9-19 **AFR)**
- NARROW Band Bosch LSM11 Lambda (0-2.5 V)
- **LAMBDA New (0.68 lambda to 1.22 lambda)**
- LAMBDA Old (0.61 lambda to 1.29 **lambda)**
- Suzuki GSXR Water NTC

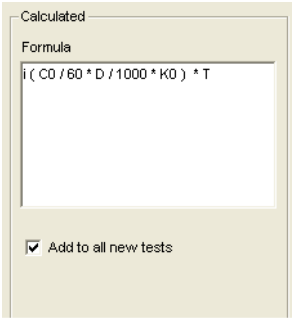
6.3.2.3 Interpolation

If checked the program will use the interpolation table instead of the scale value.
In this table you can configure any analog sensor even not lineal ones. Voltage values should be ordered from lower to higher. For each voltage it will be assigned a translated value, AFR (air fuel ratio) in the example.

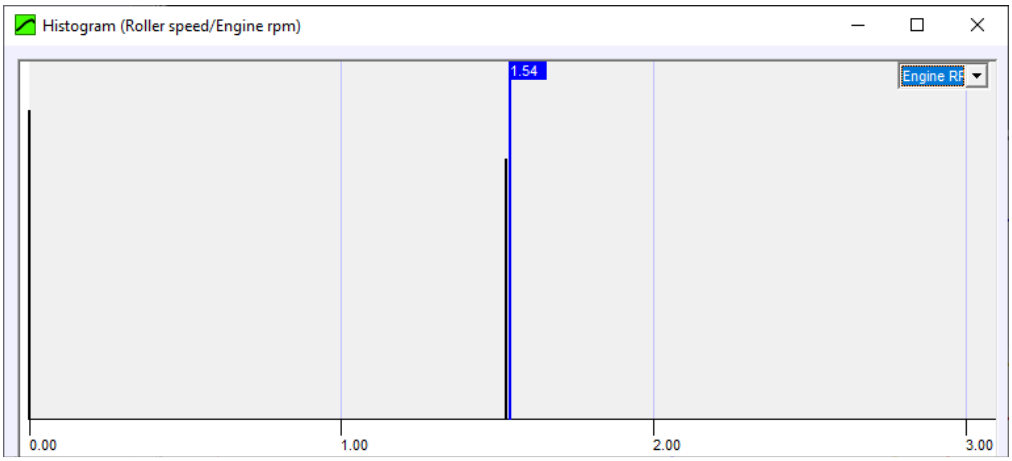
Interpolation also is possible with CAN channels

6.3.3 Default Calculated Channels

Calculated channels can be configured in this window to be added by default to all new tests. In addition its formula is entered here to be used on the new tests.



7. HISTOGRAM



After doing a dyno run (with “using rpm clamp” option activated) the program will calculate automatically the Ratio value by making a histogram of the “Engine RPM / Roller RPM” function,

to find out the value that is more common during the test (only for the sections where the engine accelerates)

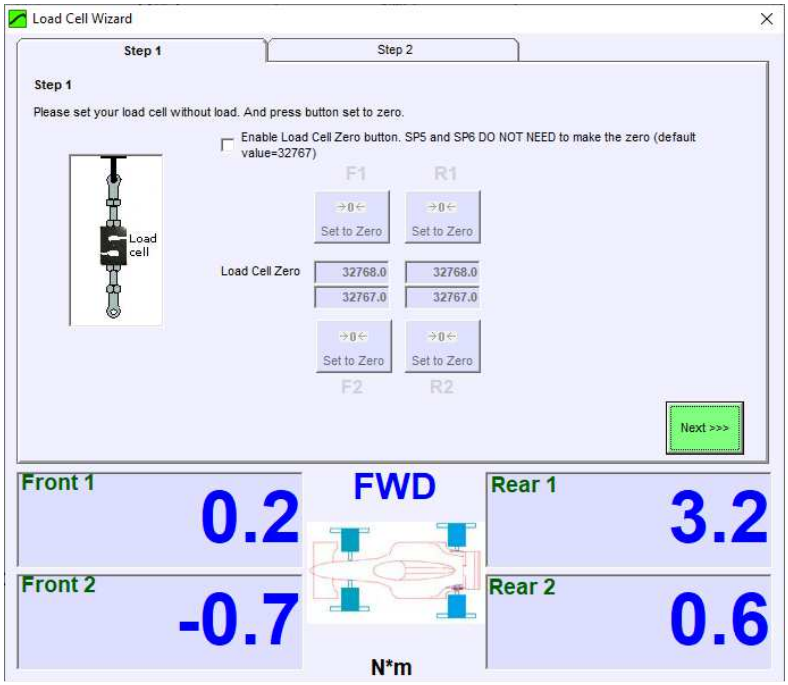
If user wants to see the histogram, it can be selected on the test menu, or by right-clicking over the desired test.

In this test all values from 0 to 3 for ratio are shown. And the amount of number of times this value was present when calculating the ratio function for each test sample. Finally the most repeated ratio value is shown with a label (1.54 in the example).

8. LOAD CELL WIZARD

This window eases the Load Cell calibration process. It is divided into two steps:

8.1 Load Cell Zeroing



Load Cell Zeroing is provided ONLY for compatibility with SP3 and SP4 which do not perform the initial zeroing process as SP1+, SP5 and SP6 do. In this case (SP3 and SP4), with the load cell free (no weight), press the “Set to Zero” button and check the “load cell zero” value is close to 32767, otherwise there may be some problem on the wiring or on the SPx unit.

For SP1+, SP5 and SP6 just restart the device and it will perform the internal self-zero calibration, and don’t use these settings.

8.2 Load Cell Scale

With the load cell mounted on the brake, and the calibration bar attached to the brake, and the calibration weight set at the end of calibration bar, enter the values on the white boxes and press the “Calibrate” button.
Check that the load cell reading (blue number, N*m) matches the “torque will read” number.

The DAQ should be restarted before applying the calibration weight so the calibration bar’s weight is not included within the calibration process.

Finally, press **OK** button to finish the calibration process and store the results.

9. PID Monitor (SP1+, SP4, SP5, SP6)

From Sportdyno Ver 4.0 SW combines PID monitor and PID configuration windows in a single window to ease the PID (speed control) setup process.

9.1 PID Mode

9.1.1 (F6) Idle

It sets the brake output to 0. It is useful to do inertial tests.

9.1.2 (F7) Steady

It enters SP4 / SP5 in the steady mode. A RPM Target is set to keep the Engine RPM fixed when Engine tries to overpass this Target point (it does not accelerate the Engine by itself).
SP4 and SP5 have a PID Controller that calculates the brake output as a function of Engine RPM input, RPM Target and PID coefficients.

9.1.3 (F8) Ramp (Sweep Test)

Once the Engine is steady, software can enter in the Ramp Mode, in which the SP4 / SP5 will increase the Target RPM at a fixed rate (Ramp Tate) until the “Max RPM” value is reached.

This mode only works when the user is accelerating, for RPM values near or higher than the current Target. If the user closes the throttle, when Engine RPM is lower than Target RPM, the SP4 / SP5 will detect that condition and will adjust the Target for the new speed in order to have a suitable starting RPM Target in case the user decides to accelerate again (although this is **not** the right way to use this mode).
Minimum RPM value that will be allowed for Ramp Mode is defined on the Ramp frame (below) in order to not stall the engine.

9.1.4 (F9) Brake

When entering this mode, a fixed value is applied to the brake. It is useful for test purposes and to stop the dyno when the test is finished (Pause key on gauges window).
Note: If the engine is not running, brake mode will disconnect the brake automatically after a few seconds in order to not overheat the coils.

9.2 Step

9.2.1 Fixed Value

This value will be used in the Target RPM box when you press the Page Down or Page Up keys to increase or decrease the target RPM (e.g., +500 RPM). The resulting value will also be rounded to the nearest zero.

9.2.2 Step List
This option will use the jump list in the Sequencer window for “Step Rehearsal” mode.

9.3 Ramp Limits (Sweep)
These two values set the starting and ending point for a Ramp Test.
Please refer to section 10.2

9.4 PID Settings
Kp, Ti and Overshoot values are used to control the Engine RPM when the PID is at Steady or Ramp modes. Please refer to section 10.1 below

9.4.1 Acceleration Filter
Acceleration is used to control overshoot, but it's a very noisy channel. Depending on the number of pulses, a filter between 1 and 3 can be applied for finer control.

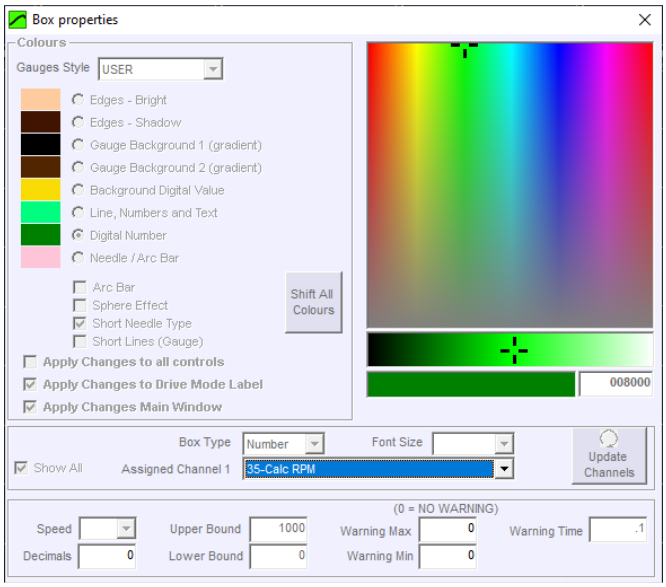
9.5 AWD

9.5.1 AWD mode
Select the type of drive in the DYNO (not the vehicle): front, rear or AWD

9.5.2 AWD Kp, Ti
These parameters control the synchronization between axles. It is recommended to use a Kp value lower than 1.0 or 1.5, and leave Ti at zero. For more information, contact us.

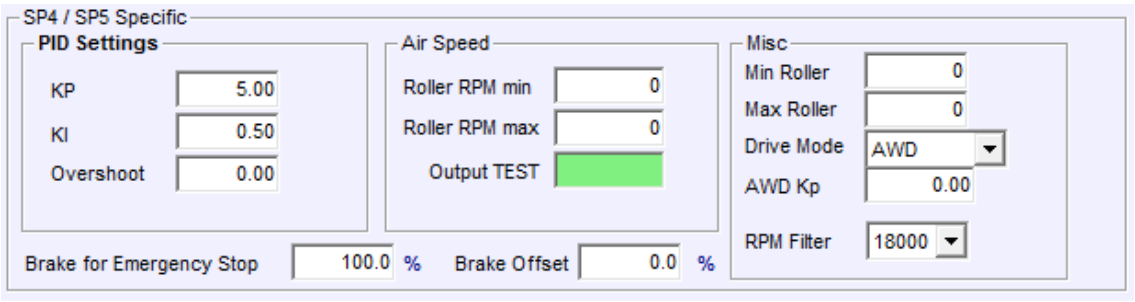
9.6 Misc
See section 10.4 below.

9.7 Numeric Boxes
PID Monitor Window allocates several numeric boxes that can be used to display any channel.
To edit the channel displayed just right-click over the box to be edited.
Only channel assignment, decimal places and colour can be edited for PID monitor.



10. SP1+, SP4, SP5, SP6 Specific Settings

This section mainly describes PID settings (speed control), and other settings which are specific for SP4 and SP5. Some of them can be found at both Config Window and PID monitor Window, and others only at Config Window.



Ramp settings at Configuration window, most settings are shared with PID monitor.

10.1 PID Settings

(Configuration and PID monitor) Kp, Ti and Overshoot values are used to control the Engine RPM when the PID is at Steady or Ramp modes.

- **Kp**: Proportional Gain Control, (the bigger Kp, the faster the control, but it will oscillate on excessive values)
- **Ti:** Integral Time Constant. For little Ti the faster the drift/approach, but they make the system slower to changes. Normally only values inside the range from 0.3 to 1.0 should be used.
- **Td.** Td implements a derivative control (it slows the acceleration to make the system easier to control). Normally for **chassis dynos and hub dynos it should be kept to** zero as it adds many "noise" to the brake signal.
  (Note: In earlier versions of SP5 a special **Overshoot** control algorithm was implemented, which was more efficient in steady tests that only the Td (derivative) control, but it performance was a bit worse in ramp than the classical Td control, so finally it was removed)

Please read the SP4 / SP5 / SP6 Setup documentation.

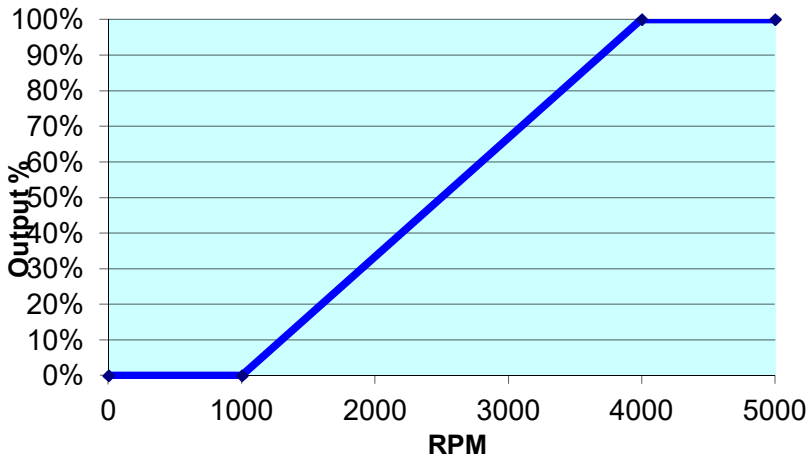
10.2 Ramp Limits (Sweep)

(Only PID Monitor) Min RPM and **Max RPM** values are used in the Ramp Mode as limits to the ramp sweep target generator (auto-increment). If the Engine decreases its speed (because throttle is closed) the system detects this condition and decreases automatically the Target RPM, this value is limited by the "Ramp MIN" value. When the Engine is accelerating, the Target value is increased automatically at the ramp rate until the "Ramp MAX" value is reached. If any of these values are set to zero, then it has no effect (PID will not force RPM to zero!)

10.3 Air Speed

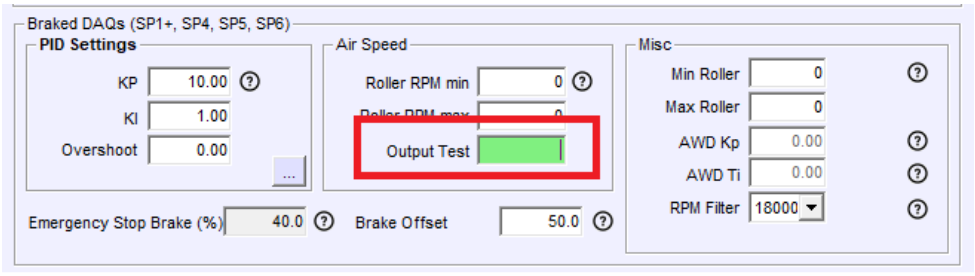
(Only PID Monitor) With certain SP4 units and all SP5 units, the servo2 output can be used to control the output signal to a VFD that powers a 3 phase motor connected to an air turbine.

- **Roller RPM min** is the speed value to start the operation for the air speed output. For instance if Roller RPM min = 1000 rpm, for all speed values between 0 and 1000 rpm, the output will be zero.
- **Roller RPM max** is the speed value in which the air speed output reaches 100%. For instance if Roller RPM max = 4000 rpm, for all speed values above 4000 rpm, the output will be 100% (5 volt)
- For all values of roller speed between **Roller RPM min** and **Roller RPM max**, the output will be a linear function proportional to the position between these two values.

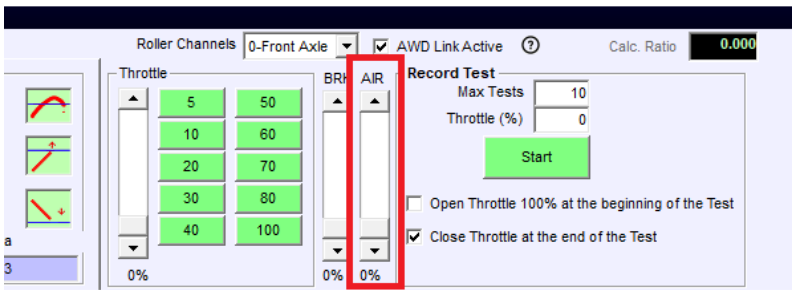


Air Speed Output Function
(min=1000, max=4000)

- **Output Test,** this field is used to perform a manual test of the air speed output when the roller is stopped.



Air speed output can also **be manually** operated from the Gauges Window. Manual control will override the roller speed command.



10.4 Misc Settings

10.4.1 Min Roller (SP1+,SP5/SP6).

(Config Window) When Roller speed is below this value, PID output is zero. This allows to prevent engine to stall, or if a centrifugal clutch is used it prevents it to get damaged. Note that the setting is for Roller RPM not Engine RPM

10.4.2 Max Roller (SP1+,SP5/SP6).

(Config Window) This setting fixes a maximum allowed speed for the system. If the system tries to go over this speed the brake will reach 100% its value. This may create oscillations but it is preferable this than overpassing the safety speed (if any). Note that if it is set to zero, then no max roller speed will be used.

10.4.3 Ratio.

(Config and PID monitor) This value is the relationship between Engine RPM and Roller RPM. All RPM values in the SP4 / SP5 are referred to the Engine RPM, but speed is measured at the Roller / Brake, thus Ratio value is very important as it used for the internal Calculated Engine RPM channel which is used for speed control.
On the gauges window, when using the RPM Clamp, the Ratio is calculated in real time and sent to SP4 / SP5.
Once the test is started the last Ratio value calculated is kept for the whole test.

10.4.4 (Config and PID monitor) Number of Teeth (geartooth).

For suitable PID operation it is recommended to use a gear tooth of minimum 8 teeth.

10.4.5 Prescaler (SP1, SP3 and SP4).

Depending on the number of teeth, prescaler has to be set among 1, 4 and 16. Usually prescaler=1 is used for number of teeth lower than 16. Prescaler=4 for 16 to 64, and prescaler=16 for higher number of teeth.
Note that **SP1+, SP5 and SP6** always use prescaler = 1.

10.4.6 AWD Mode (SP5 / SP6).

As SP5 / SP6 has dual Roller Channel set (roller speed, load cell and brake output), it allows 3 modes:

- **Only Front.** It uses the channels closer to the RS232 connector. This mode is used for engine test bed, single axle dynos, and for AWD dyno using Front axle.
- **Only Rear.** It uses the channels closer to the MAINs plug. This mode is only used for AWD dyno using Rear axle.
- **AWD.** It uses the both channels and enables the AWD synchronization.
  Note that AWD option is not free, not all SP5s have this option enabled.

10.5 Brake Configuration

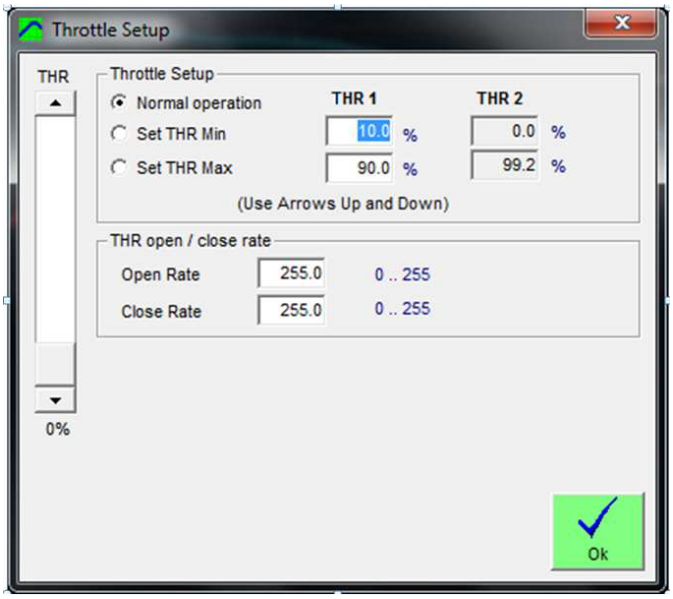
10.5.1 Brake for Emergency Stop (SP5 / SP6).

When Emergency Stop button is pressed (Panic Button), SP5 will go to Brake mode, and will apply this fixed value to the brake.

10.5.2 Brake offset.

Some Brake Power Supplies are not full linear (for instance **old Semikron PWS**). They start to provide current from brake values higher than 130 (13%). Note that this could change depending on the mains frequency on your country.
This offset is added to the brake action (when it is higher than 0) to get a suitable control signal over the power supply.

11. Throttle Configuration



11.1 Throttle Setup

Here servo start and ending positions are configured. It is important not to force the servo.
Min and max positions can be reversed in order the servo moves in the opposite direction.

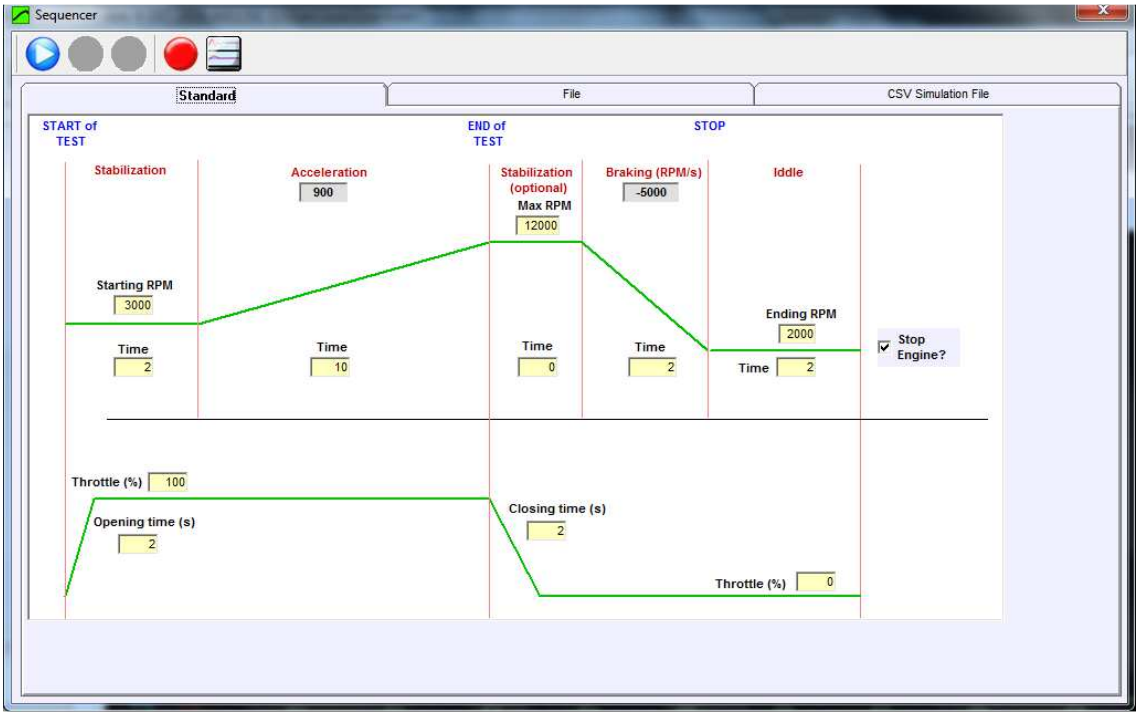
- Normal operation: the sliding bar to the left moves the servo.
- Set THR min: sets the minimum position for the servo
- Set THR max: sets the maximum position for the servo. Be careful to not force the servo against the Throttle body max allowed position.

11.2 Throttle Open / Close rate

By default, a value of 50 or higher at these values will make the servo open and close quickly, but by setting low values (1, 2, etc) it will move slowly. It is only available for servo 1 (throttle)

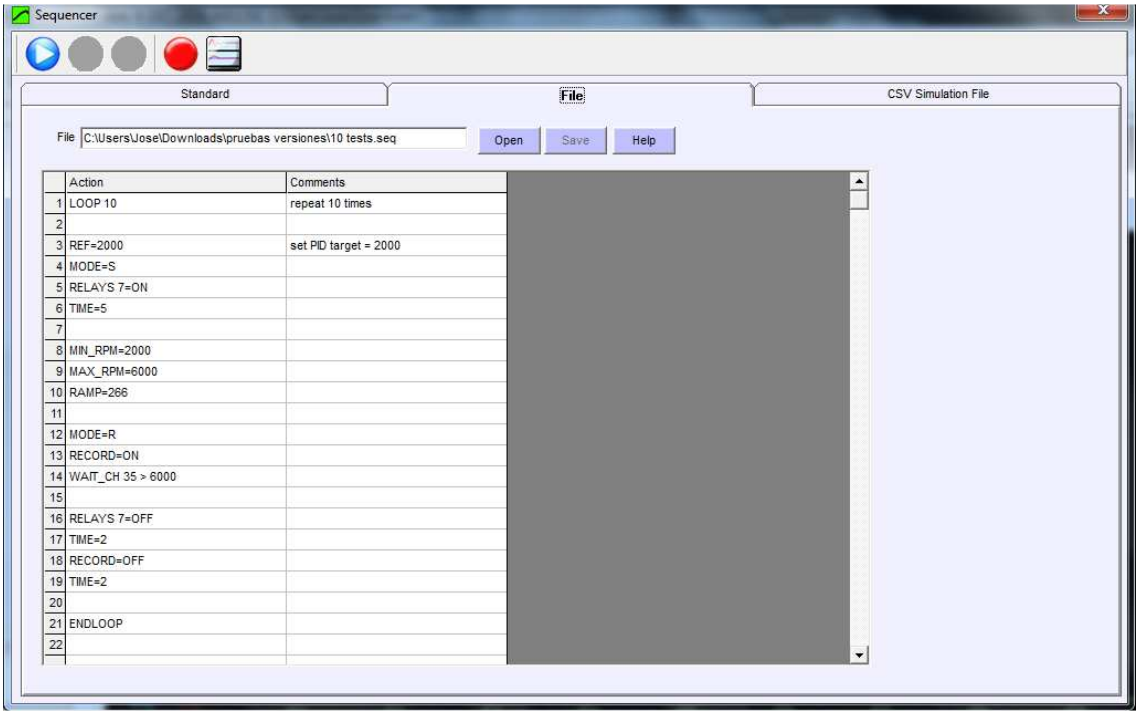
12. SEQUENCER (SP4 / SP5 / SP6)

12.1 “Standard” Sequence



This window is useful for simplified automated cycles.
The user can edit the duration of all stages and the parameters related to acceleration and starting / ending RPMs

12.2 Sequencer File



Sequencer File can be used to perform Engine Test Cycles. It can keep then engine running several hours to test its reliability. The programmed sequence is stored in a text file and automated by the program by using simple orders like THR=10, REF=3000, etc. One level loop is allowed to repeat certain program sequence a known number of times.
This version allows to edit the file directly in the grid list (older versions needed the usage of Notepad for editing the file)

Sequencer Commands [updated]

Command	Description
RELAY(n) = on | off	Turn Relay (n) ON or OFF. 7=IGNITION, 6-STARTER, 5 to 3: Fans or other user function, 2=Bed In, 1=Bed Out, 0=block/lift
MODE = I | S | R | B | T	I=IDDLE, S=STEADY, R=RAMP, B=BRAKE, T = Inertia Mult
THR = n%	Throttle 0..100%
REF = rpm	Set TARGET to rpm
RAMP = rpm / s	Set RAMP RATE to rpm/s
BRAKE = n	Set BRAKE TO n (%)
Variables	
START_PARAMS	Defines the Start of Parameters section
END_PARAMS	Defines the End of Parameters section
$Variable = nnnnn	Assigns a numeric constant to a variable. Normally at PARAM section
Key_word = $Variable	Assigns a variable to some key_word (for instance MIN_RPM = $Var1)
Test mode Control	
AUTO_START = ON | OFF	Sets auto Start mode ON or OFF
AUTO_STOP = ON | OFF	Sets auto Stop mode ON or OFF
STOP_MODE = L | H | R	Sets Stop mode to L = 'Stop when lower', H = 'Stop when higher', R = 'Reversed'
MIN_RPM = n	Sets starting value for ramp mode
MAX_RPM = n	Sets ending value for ramp mode
RATIO = n.nnn	Sets Ratio for current test
GEAR_LIST r1-r2-r3-r4	Defines the List of Gear Ratios for a specific vehicle

RAMP_CHANGE_RPM =	RPM value at which ramp slope will change
RAMP_CHANGE_SLOPE =	New Slope value when ramp changes
RAMP_TRANS_TIME =	Time to make the transition from steady to ramp smoother
Delays and Loops	
TIME= n.n Or Delay = n.n	WAITs n.n seconds
WAIT_END_OF_TEST	Returns when the recording finishes, for instance 'auto stop'
LOOP n . ENDLOOP	Repeat N times, loops cannot be nested
label:	label for GOTO
GOTO n | label	Go to line N, or go to LABEL
WAIT_CH n > val	Waits Channel N to be HIGHER than val, CH=@ is ESPACE (meters)
WAIT_CH n < val	Waits Channel N to be LOWER than val, CH=@ is ESPACE (meters)
START 0x31 > val	It activates the Starter Relay until the Engine (0x31) is higher than the value
RECORD= on | off	Start/Stop recording data

12.3 CSV Simulation File

From Version 3.8 Sportdyno can load a CSV file (Comma Separated Values) and use it for sending speed and throttle data to SP1+, SP4, SP5, SP6 and perform a simulation of a race track which was recorded with a Data Logger.

Mode of operation is simple: just load the CSV file and press “play” button.

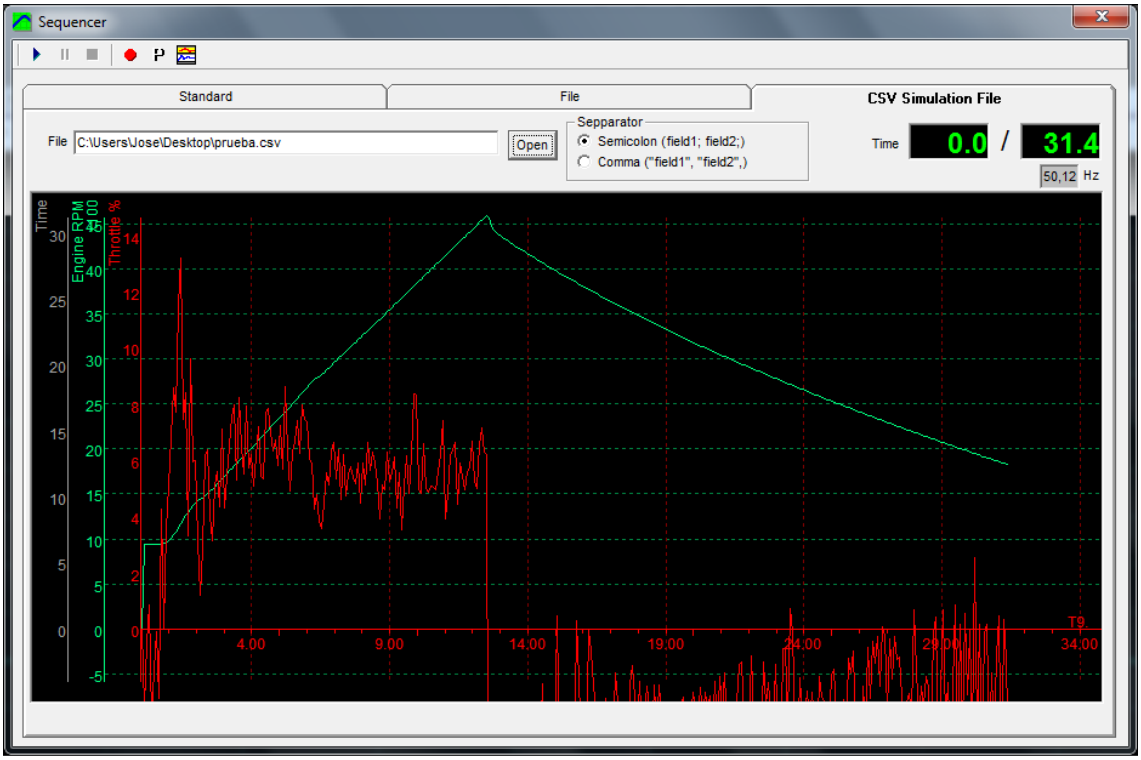
File format:

It admits two basic CSV formats, compatible with Excel (tm):

- Values separated by semicolons: 111; 222; 333....
- Values between quotation marks (“ “) and separated with commas: “111”, “222”, “333”

First line of the file (header) is ignored.
Only the first three columns of the CSV are used:

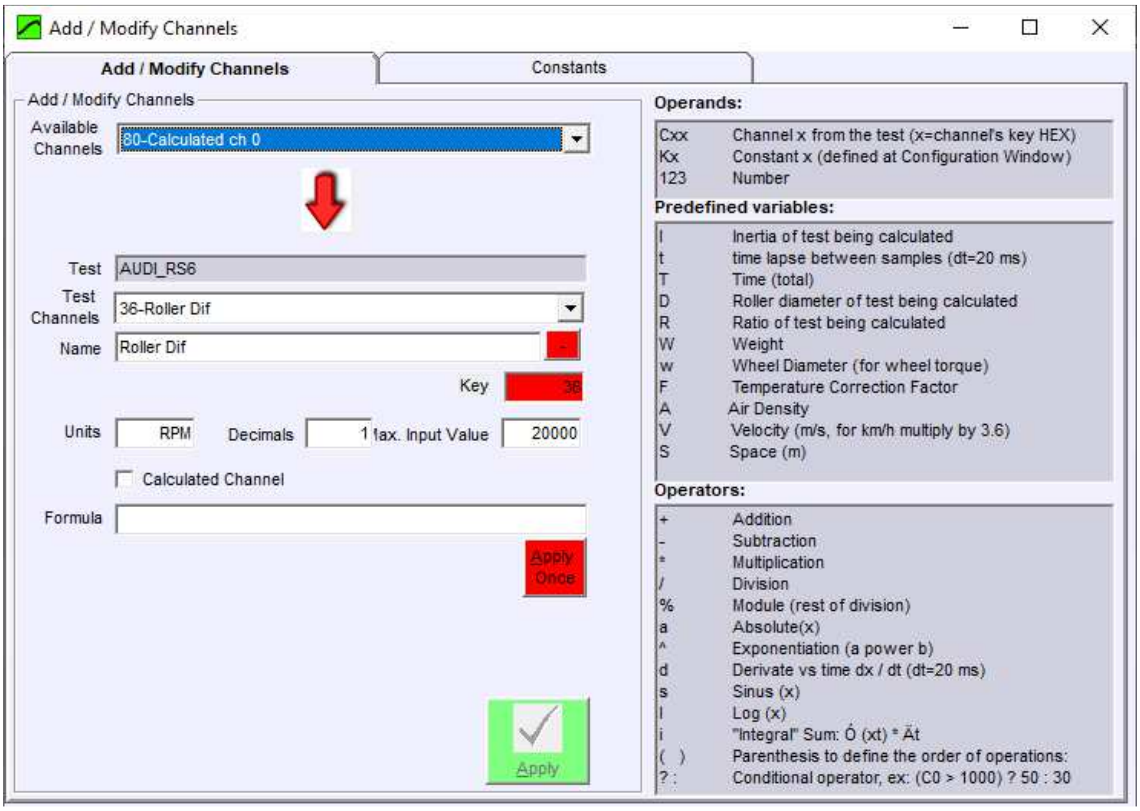
- First column is always Time (s)
- Second column is always Engine RPM
- Third column is always Throttle position (%)


Sequencer
Standard
File
CSV Simulation File
File
C:\Users\Jose\Desktop\prueba.csv
Open
Sepparator
Semicolon (field1; field2;)
Comma ("field1", "field2",)
Time
0.0
/
31.4
50,12
Hz
Time
Engine RPM x100
Throttle %
4.00
9.00
14.00
19.00
24.00
29.00
34.00
T9

13. Calculated Channels

Calculated Channels can be added to existing tests. They will take the Channel basic data (key and name) from an existing channel from the total channel list (not only SPx device channel list) and will use the specified formula to get data from other channels and perform the calculations that will provide the data for the new channel.

Calculated channels are recalculated every time that anything is changed in the test (ratio, inertia, etc)



Add / Modify Channels Window is used for adding channels to **existing** test

13.1 How to use it?

When the “Add Calculated Channel” option is selected from the main window the program will show the screen above.

Press the “+” button to automatically find the next free calculated channel, starting at 0x80. The user can also choose a different channel (including existing ones), and the program will show the default data for the channel (if it is new) or the current data for the channel (if it already exists) including the formula if it is an existing calculated channel.

Next step is giving the channel a meaning name, for instance: “calculated power”, and their corresponding units (HP), decimals (1) and formula.

Note: “-“ button has the same effect as “Remove Channel” in Test menu.

13.2 How to use the formula field?

Within the formula the user can combine Channels, Constant values (numbers), Constants and operators.

Prefixes to refer the items:
The formula consists of a series of 4 basic elements:

- Channels
- Program Constants

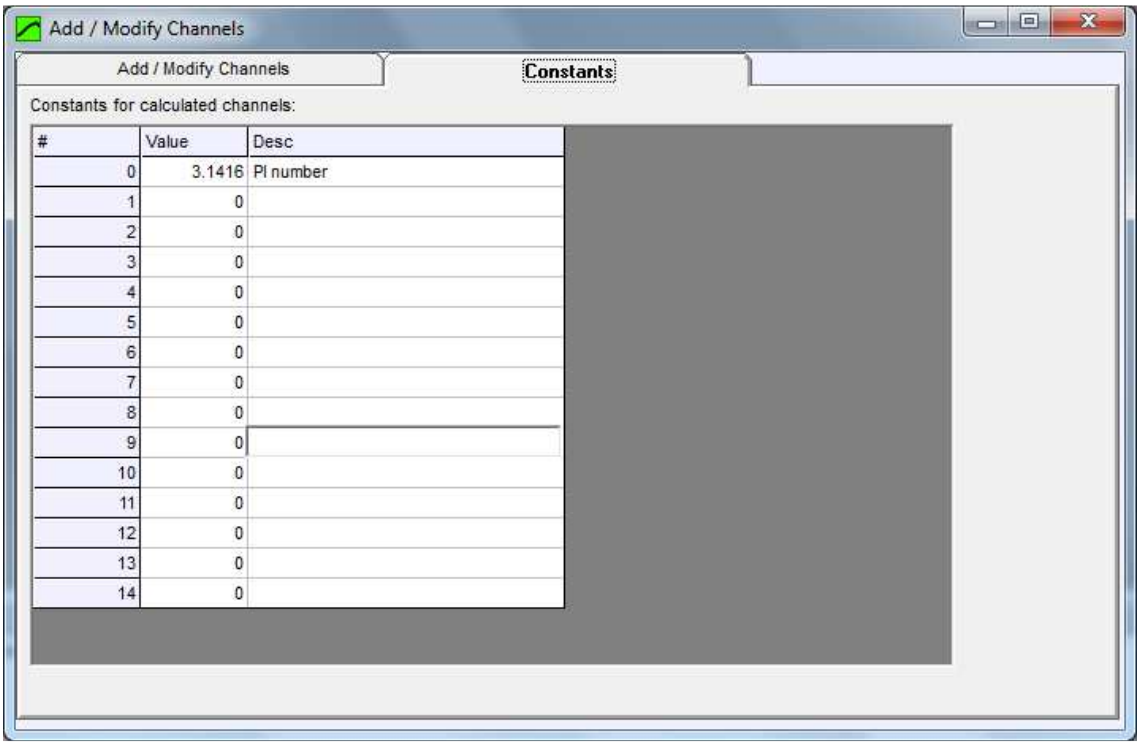
- Operators
- Test Constants

13.2.1 Channels

- To access to the data of an existing channel (for that test) write Ck (k is the channel's key), for instance roller channel is C30, engine channel C31, Lambda 1 channel C4A Note: old channels nomenclature was based on ASCII chars for Formulas, now also the Hexadecimal nomenclature is available.

13.2.2 Program Constants

- Constant (internal array of constants x = 0..15). Constants can be defined at "Configuration" Window.



Constants Tab

A typical constants is:
PI = 3.1416 (3.14159265358979323846264338327 95)

13.2.3 Operators

+	Addition
-	Subtraction
*****	Multiplication
/	Division
%	Module (division remainder)
a	Absolute value
^	Exponentiation (a power b)
d	Derivate vs time dx / dt (dt = 20 ms = 0.02 s)
s	Sinus (x)
l	Log (x)
i	Integral (x) (sum f(x) * dx)
( )	Parenthesis to define the order of operations
?	Conditional operator, example: (C0 > 1000) ? 50 : 30

13.2.4 Test constants

I	Inertia of current test
t	(dt) Time lapse between samples (20 ms)
T	Total test time
D	Roller diameter of test being calculated
R	Ratio of current test
W	Weight
w	Wheel Diameter (for wheel torque)
F	Weather Correction Factor
A	Air Density
V	Velocity (m/s, for km/h multiply by 3.6)
S	Space (meters)

13.3 Formula examples

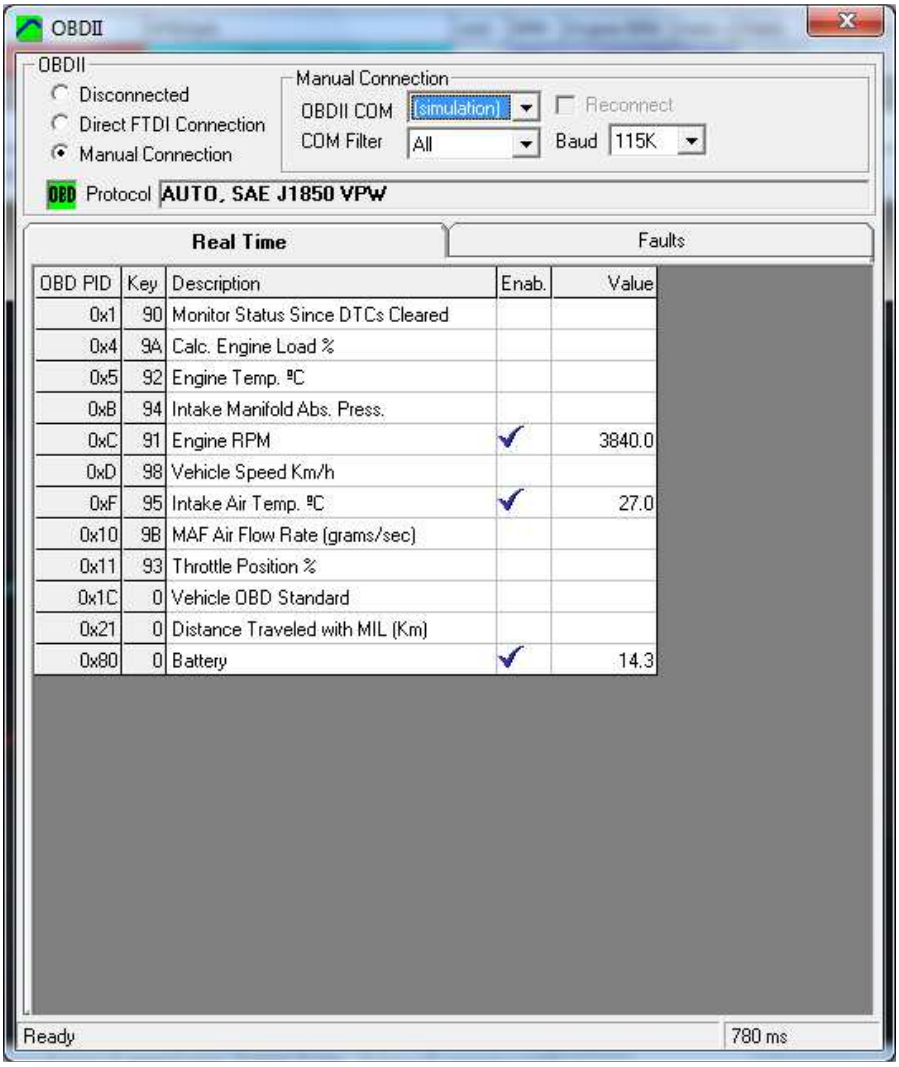
Torque (N*m): d (C30 / 60 * K0 * 2) * I * 50 + C39	Torque calculated from roller and load cell: d (“Roller rpm” / 60 * K0 * 2) * Inertia ---------- + “Load Cell“ dt *or* acceleration (Rad/s) * “Inertia” (kg/m^2) + ”Load Cell” (N*m)
Power (Watt) (d (C30 / 60 * K0 * 2) * I * 50 + C39) * C30 / 60 * K0 * 2 Is equivalent C33 * C30 / 60 * K0 * 2 Note: to convert to HP divide by 736	Torque (N * m) * Speed (Rad / s) or Torque channel (N * m) * Speed (Rad / s)
Speed (m/s) C30 / 60 * K0 * 2 * D / 1000 / 2 = C30 / 60 * K0 * D / 1000	(Roller / 60 * PI * 2) * (Diameter / 1000 / 2) or “Roller speed” (rad/s) * Diameter (m) / 2
Distance (m): i (C30 / 60 * K0 * 2 * D / 1000 / 2) * t = i (C30 / 60 * K0 * D / 1000) * t	Integral of (Roller / 60 * PI) * (Diameter / 1000) * dt or Integral of “Roller speed” (rad/s) * Diameter (m) * dt Or Integral Speed (m/s) * dt

K0 = 3.1416 (PI)

14. OBDII

Sportdyno provides support to Sportdevices OBDII interface from version 3.8. This interface is mainly provided for acquiring Engine RPM from the car (specially for diesel engines), although there are other interesting channels (PIDs) as Engine Coolant Temperature, Air Intake Temperature, Intake Manifold Abs. Pressure (turbo), Engine load, Throttle Position, etc that can be acquired.
OBDII is a set of standardized protocols. Each car normally will have only **one protocol.** Depending on the protocol the communications will be faster or slower. For instance K-Line protocols are quite slow, it is not recommended to acquire more than two channels (PIDs) per cycle. Nevertheless other protocols as CAN are faster and allow acquiring more channels per cycle.
Although OBDII is mainly used on cars, many motorcycles (for instance some Triumph) are using OBDII nowadays. Motorcycle manufacturers are committed to change to OBDII protocols to fulfill the testing requirements for official homologation process and periodic verifications.

14.1 OBDII Window / Real Time



OBDII Connection mode:

- **Disconnected.** Sportdyno will close the connection
- **Direct FTDI connection.** Most of our OBDII interfaces include a mechanism for detecting the OBDII automatically and provide authentification. Use this option by default.
- **Manual Connection.** For old OBDII devices or licenses acquired by separate user can configure a manual connection and a manual License authentication.

14.1.1 Manual Connection:

(This is not recommended connection method, try first Direct Connection)
OBDII COM: According to COM Filter, the program will load in this combo box those COMs of the specified type. Current Sportdevices OBDII uses a FTDI chip, thus Filter has to be set to "FTDI". As the connection procedure is a slow process, there is no an automated COM discovery process by now.
Note that default recommended connection is based on FTDI chip (automatic). No search is necessary.

COM Filter: As mentioned before, the filter allows loading certain COMs (as there can be several of them in the system). Current OBDII Interface is identified when setting filter="FTDI"
Note that first OBDII versions used a Bluetooth link (using Windows Pairing method) thus filter="Bluetooth". Other OBDII used a dedicated Bluetooth Hardware that was identified with filter="Silabs". Also some of the first cable units use "Prolific" or "Silabs" chips.

Baud: By default, current OBDII interface always use Baud=38K. Old versions may need Baud=115K setting (specially Bluetooth to COM USB card)

Status and Protocol: During the OBDII connection establishment, the driver will show the status of the connection (searching PIDs 00.. etc). After connection is complete, it will show the protocol name and details for that car. Normally each car has only one protocol, but there are cars with combinations of slow protocols and CAN.

PID list: Channel identifiers are called PIDs in the OBDII nomenclature.
Once the OBDII device has been identified, and the connection has been established with the car, the program will show the list of available PIDs. Each car has only some PIDs. Manufacturers are not obliged to implement all PIDs. Nevertheless most car have a fixed subset including: Engine RPM, Engine coolant Temp, Intake Air Temp, etc

Once the PIDs are listed, user should choose only a few PIDs (enable column) to be acquired, as OBDII is not very fast in general, and acquisition cycle should not be more than 500 ms (approx). On slow protocols as K-line, even only two PIDs can reach the 500 ms limit, but with CAN BUS time is about 100 ms for 3 PIDs.

These channels will be automatically acquired on both Gauges Window, and Test Recording.

14.1.2 Special connections

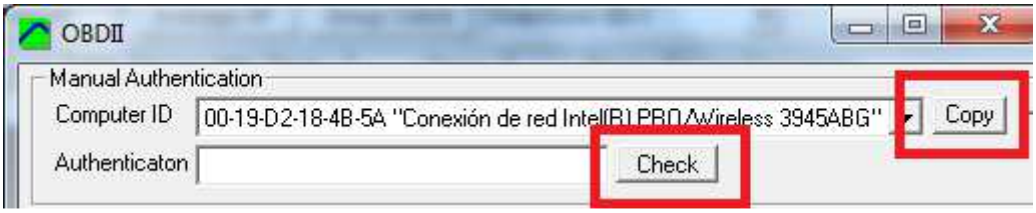
Sportdyno mainly use the OBDII protocols to connect most ECUs.

Recently **Motorcycle** manufacturers started to include OBDII protocols (normally based on CAN) in their ECUs. Sometimes using a special adapter, but the OBDII interface still is usable

For **Electric Vehicles** as there is not a standard yet (they seem not be committed to use OBDII) they use a special implementation normally based on CAN, but can be broadcast (like Zero Motorcycles) or based on a query-response protocol (like Nissan Leaf). If you are interested please contact us: info@sportdevices.com as we are adding some EV protocols to Sportdyno.

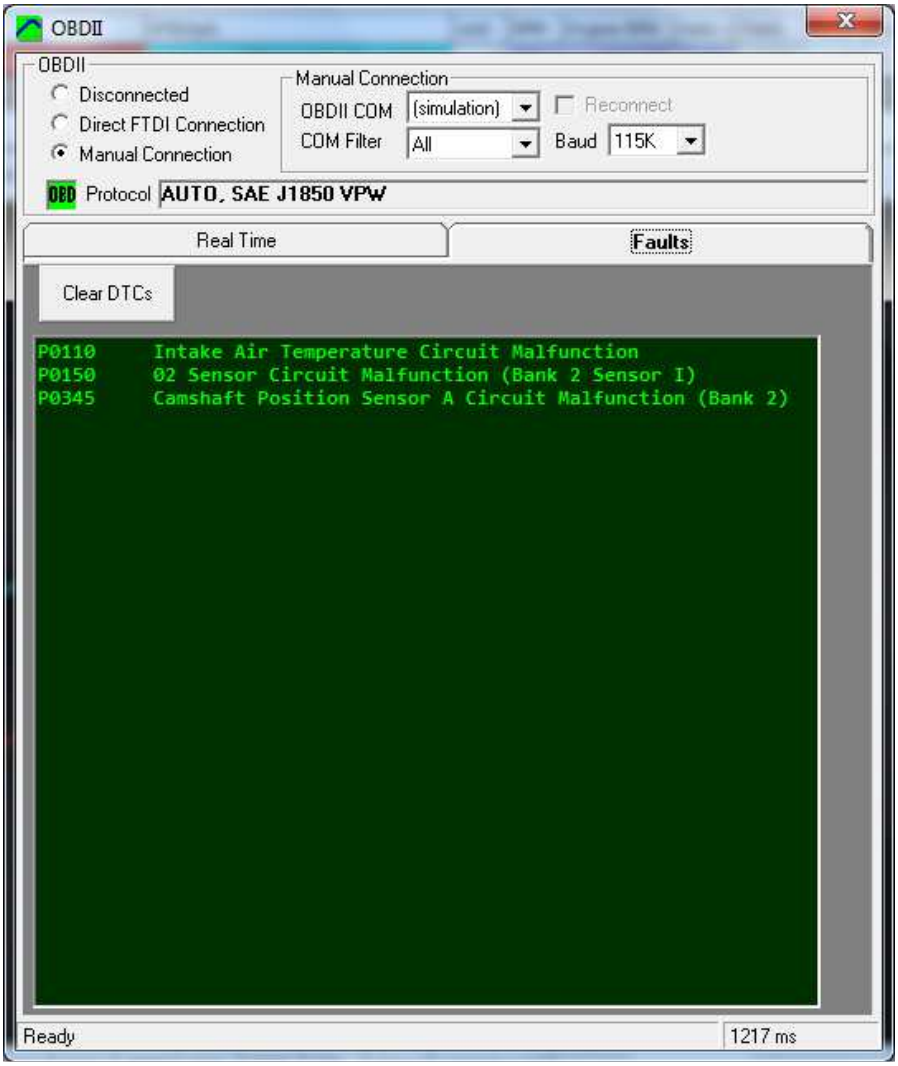
14.2 OBDII Authentication

(Only at manual connection) Sportdyno is designed to work with our OBDII interfaces. For 3rd party interfaces we can provide a license, but we cannot warranty that the performance is the same as with our units.
Some of the first OBDII units have special info recorded on them, and thus they do not need the manual authentication. Current version do not require manual authentication.
User has to send us an email with the Network info that the "**Copy**" button provides.
Then an authentication key is sent to the user, and the user enters it on the software, and press "**Check**" button.
This key can only be used in one computer



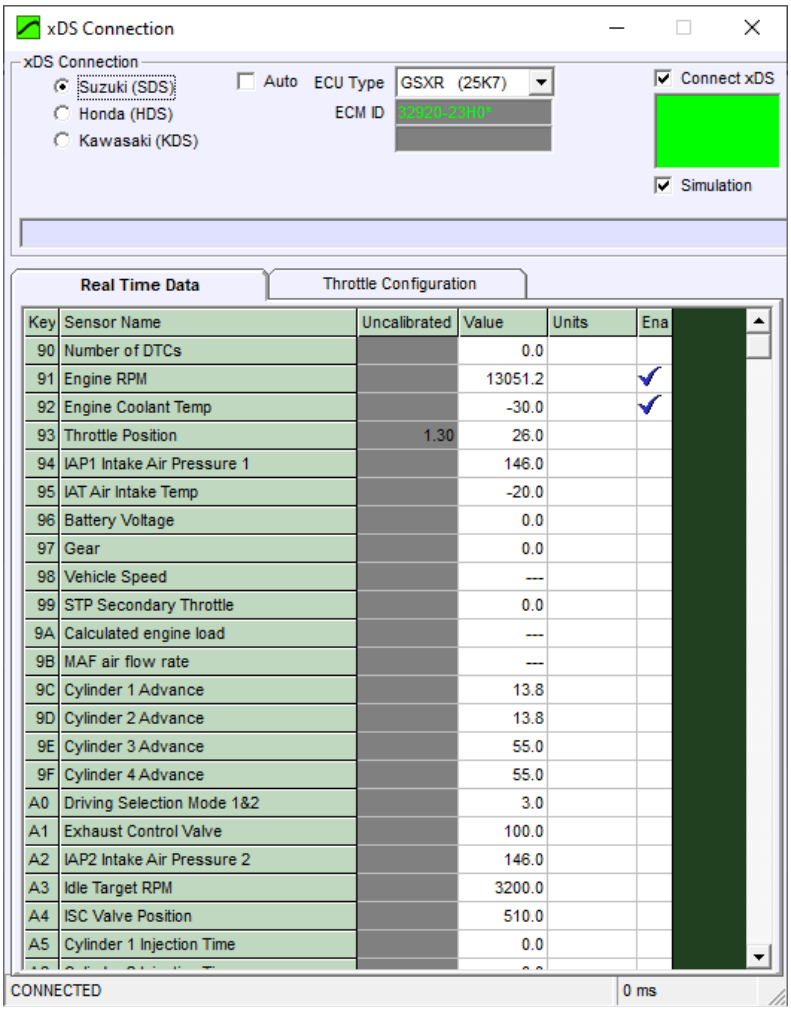
14.3 OBDII Window / Faults

OBDII interface can read ECU faults and list at the Faults Tab. There is a database of all public OBDII faults in the OBDII_DTCS.csv file.
Faults can be cleared at car ECU using the **Clear DTC** button.



15. xDS (Suzuki, Honda, Kawa)

Clicking at Connections/xDS menu or at lower-right corner on the xDS icon SportdDyno will open the xDS window (Suzuki SDS, Honda HDS, Kawa KDS). This window allows connecting Sportdyno to the xDS link and choosing the ECU channels to be acquired (note that some protocols are slow like KDS, and only a few channels can be acquired at a reasonable speed)



15.1 XDS Connection:

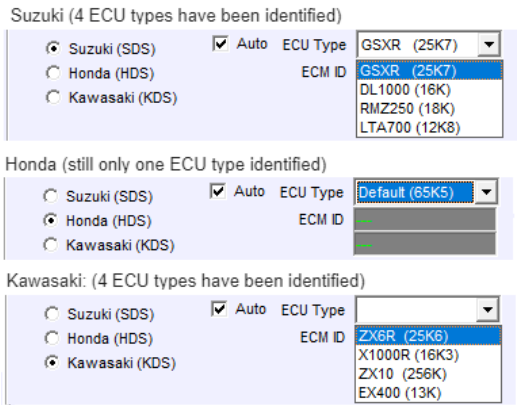
Select one of the three available protocols and enable the **Connect XDS checkbox**, and Sportdyno will enter the connection loop until it detects a valid connection.

- Suzuki SDS
- Honda HDS
- Kawasaki

Auto: After the ECM IDs are read from the ECU, the software will use them to search the ECU in a database. If not found, the user can choose one of the ECU types implemented for the selected brand.

The ECM ID, ECU type and Motorcycle model (and years) will be shown in the status box.

ECU Type. Each brand can have several ECU types with different scales for some channels like Engine RPM or Coolant temperature.
The name given in the software is only informative, there are many models that share the same type. The number close to the type name is the top RPM read when the input for RPM is 0xFFFF, for instance the “GSXR” type would read 25700 RPM if the ECU sends the 0xFFFF value. In this case the “GSXR” type is the most common in this database. Only 6 other models use the other 3 types.

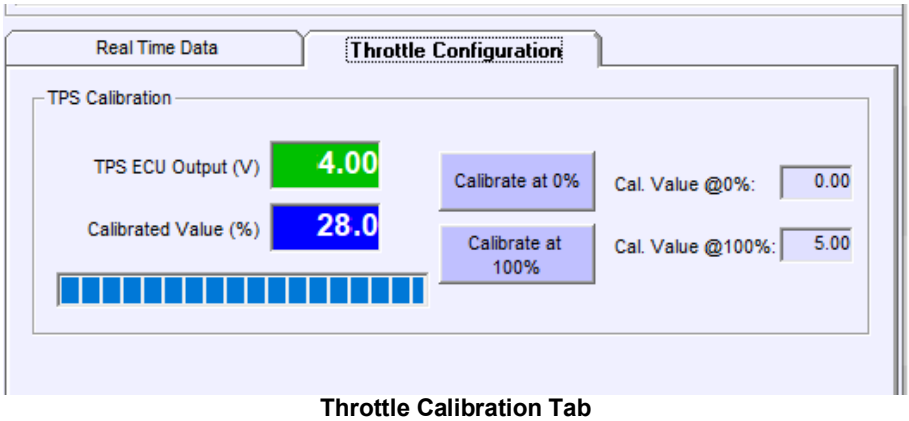


ECM IDs: Some protocols can read the ECU identifiers. If the ECM ID is in the database the software will use to choose the suitable ECU type to make RPM and Temperature show its right values.

Live Data: Sportdyno will show all available channels. User can enable or disable them by clicking over the “enable” cells, for optimizing the data transfer (for KDS protocol) and test channels usage.

15.2 Throttle Calibration:

Most ECUs send the throttle value uncalibrated (say from 23% to 106%). If the user needs that a calibrated value in the test, this window has to be used.

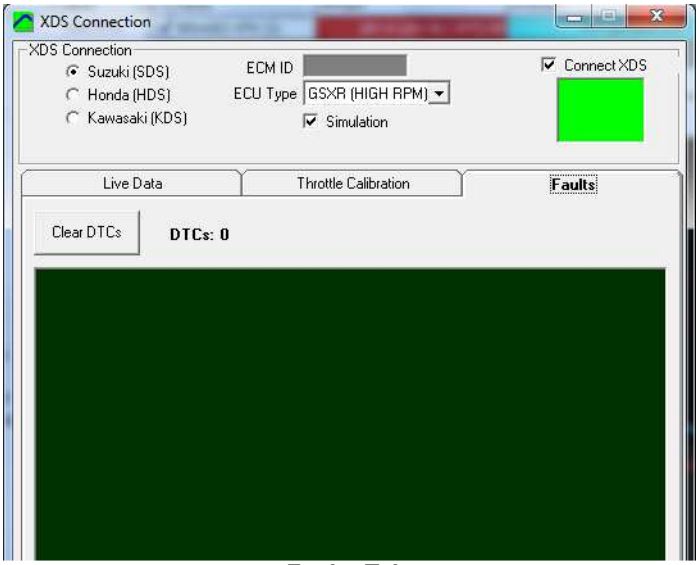


Throttle Calibration Tab

- **Green box** shows the raw value from ECU in volts (uncalibrated)
- **Blue box** shows the **value after calibration** (when it is complete)
- **Calibrate at 0**%: with throttle full closed, press this button to store the voltage for “cal value at 0%”
- **Calibrate at 100**%: with throttle full open, press this button to store the voltage “cal value at 100%”. Then calibration is ready. Realtime tab will show **the calibrated value.**

15.3 Faults Tab

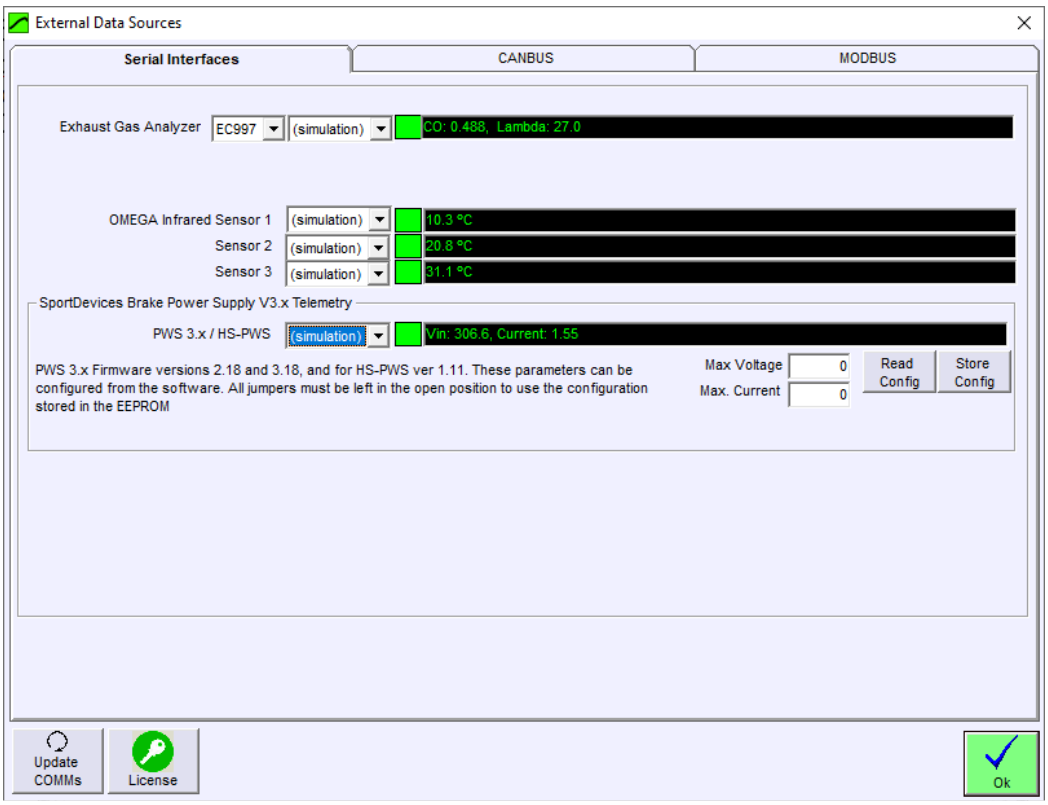
Current version of Sportdyno can read DTCs (faults) from **Suzuki SDS protocol**, and also can clear them at the ECU


XDS Connection
XDS Connection
Suzuki (SDS)
Honda (HDS)
Kawasaki (KDS)
ECM ID
ECU Type
GSXR (HIGH RPM)
Simulation
Connect XDS
Live Data
Throttle Calibration
Faults
Clear DTCs
DTCs: 0

Faults Tab

16. External Data Sources

Sportdyno 4.1 implements many new digital data links (data which is acquired directly to PC, not through the SPx unit): OBDII, xDS, CAN, EGA (Exhaust Gas Analyzer, compatible with EC997), OMEGA Infrared sensors, Power Supply Telemetry, MODBUS analog cards.



16.1 Serial interfaces

EGA (Exhaust Gas Analyzer), OMEGA Infrared sensors and Power Supply Telemetry are included in the basic Sportdyno License (they are free when purchasing the SPx unit). But CAN and MODBUS channels are not free, you have to use the License button to get your computer data and request a License to Sportdevices

16.2 CAN / MODBUS License

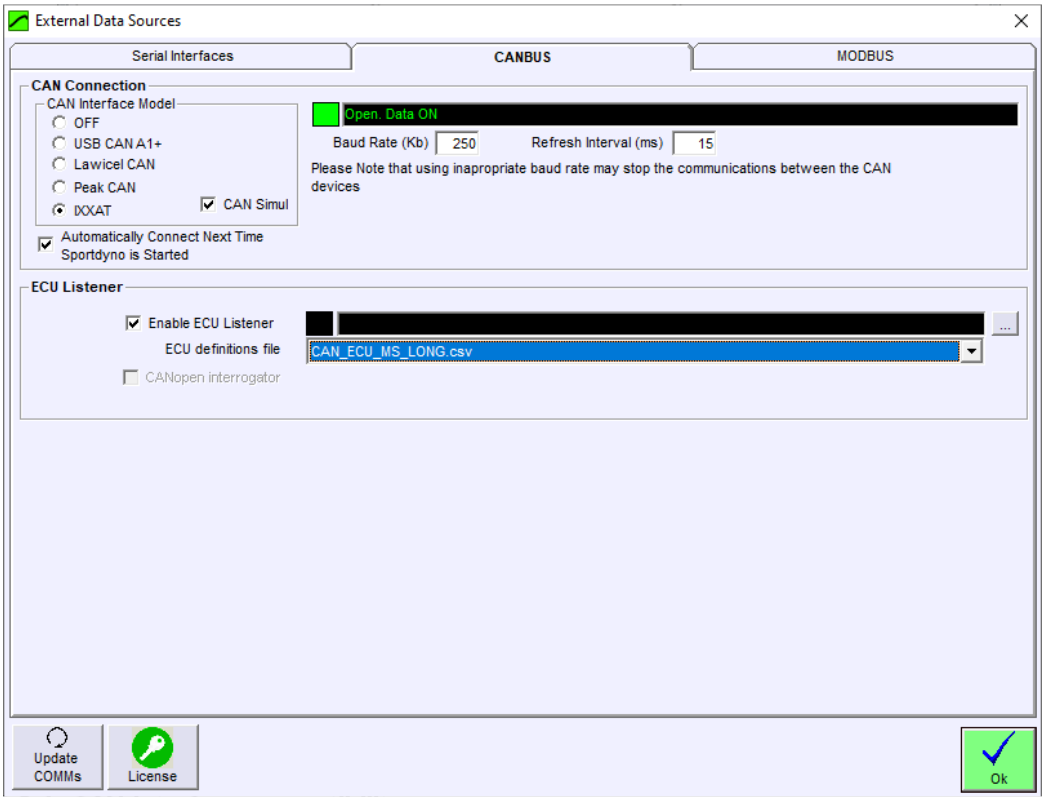
Press **copy button** to get your computer data at clipboard and send an email to info@sportdevices.com

License Key will activate both: CAN BUS and MODBUS connectivity.

CAN BUS and MODBUS open a **big range of channels expansion** for Sportdyno data acquisition capability:

- 48 channels for ECU listener
- and 32 channels for extra analog channels.

16.3 CAN BUS



16.3.1 CAN Interface compatibility

Sportdyno is compatible with 4 commercial USB-CAN interfaces:

- ~~**USB CAN A1+** (cheap interface, NO LONGER RECOMMENDED)~~
- **LAWICEL CAN** (intermediate price)
- **PEAK CAN** (most popular, less cheap)
- **IXXAT** (quite common for electric motor controller, specially with SEVCON)

Note that USB-CAN interface is not included with the CAN License (Licenses are free at the moment)

Once the CAN Interface type is selected, user can configure:

- **CAN Baudrate** (250 Kb or 500 Kb are the most common baudrates), check the device documentation
- **Refresh rate:** it depends on the device being acquired. Most devices will work fine with a refresh date of 100 ms. Allowed range is 10 ms to 100 ms

16.3.2 CAN Listeners

Sportydno CAN operation is based on that **broadcast function is active** in the device to be acquired. This is valid for CIO308 modules (analog inputs) and most ECUs, but not for OBDII CAN which has its own adapter.

16.3.2.1 CIO308 Modules Listener.

Note: DEIF CIO308 is no longer directly supported, but you can include a CSV file to read the information just like any other device.

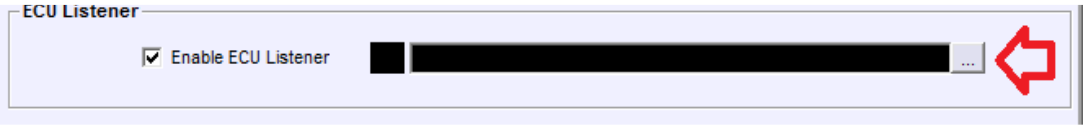
16.3.2.2 CAN ECU Listener.

The ECU must have the broadcast function enabled. Several definition files can be supplied for different ECUs:

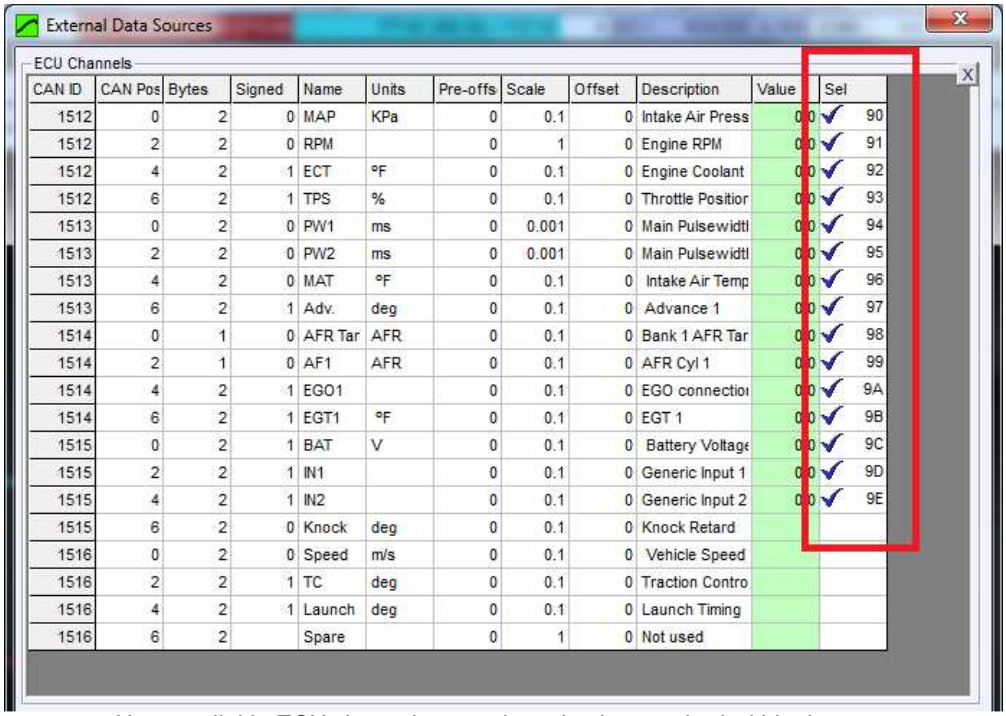
- Megasquirt short datagram (7 datagrams, ID=1512 to 1516)
- Megasquirt long datagram (64 datagrams, ID=1520 to 1563)

Other definition files are available.

Sportdyno allows you to enable and disable ECU listener reception. This module will use the channels reserved for OBDII or xDS. Channels 0x90 to 0xBF, for a total of 48 channels.



Since the channels available in an ECU can be many times larger (about 300 in the 'Megasquirt Long Datagram' file), while the reserved space in Sportdyno is 48, the user can modify the file to assign certain channels in the Sportdyno map. Note that some channels have a fixed assignment, such as Engine RPM, which is always channel 0x91.



CAN ID	CAN Pos	Bytes	Signed	Name	Units	Pre-offs	Scale	Offset	Description	Value	Sel	
1512	0	2	0	MAP	KPa	0	0.1	0	Intake Air Press	0.0	✓	90
1512	2	2	0	RPM		0	1	0	Engine RPM	0.0	✓	91
1512	4	2	1	ECT	°F	0	0.1	0	Engine Coolant	0.0	✓	92
1512	6	2	1	TPS	%	0	0.1	0	Throttle Positior	0.0	✓	93
1513	0	2	0	PW1	ms	0	0.001	0	Main Pulsewidtl	0.0	✓	94
1513	2	2	0	PW2	ms	0	0.001	0	Main Pulsewidtl	0.0	✓	95
1513	4	2	0	MAT	°F	0	0.1	0	Intake Air Temp	0.0	✓	96
1513	6	2	1	Adv.	deg	0	0.1	0	Advance 1	0.0	✓	97
1514	0	1	0	AFR Tar	AFR	0	0.1	0	Bank 1 AFR Tar	0.0	✓	98
1514	2	1	0	AF1	AFR	0	0.1	0	AFR Cyl 1	0.0	✓	99
1514	4	2	1	EGO1		0	0.1	0	EGO connectior	0.0	✓	9A
1514	6	2	1	EGT1	°F	0	0.1	0	EGT 1	0.0	✓	9B
1515	0	2	1	BAT	V	0	0.1	0	Battery Voltage	0.0	✓	9C
1515	2	2	1	IN1		0	0.1	0	Generic Input 1	0.0	✓	9D
1515	4	2	1	IN2		0	0.1	0	Generic Input 2	0.0	✓	9E
1515	6	2	0	Knock	deg	0	0.1	0	Knock Retard			
1516	0	2	0	Speed	m/s	0	0.1	0	Vehicle Speed			
1516	2	2	1	TC	deg	0	0.1	0	Traction Contro			
1516	4	2	1	Launch	deg	0	0.1	0	Launch Timing			
1516	6	2		Spare		0	1	0	Not used			

Here available ECU channels are selected to be acquired within the test.

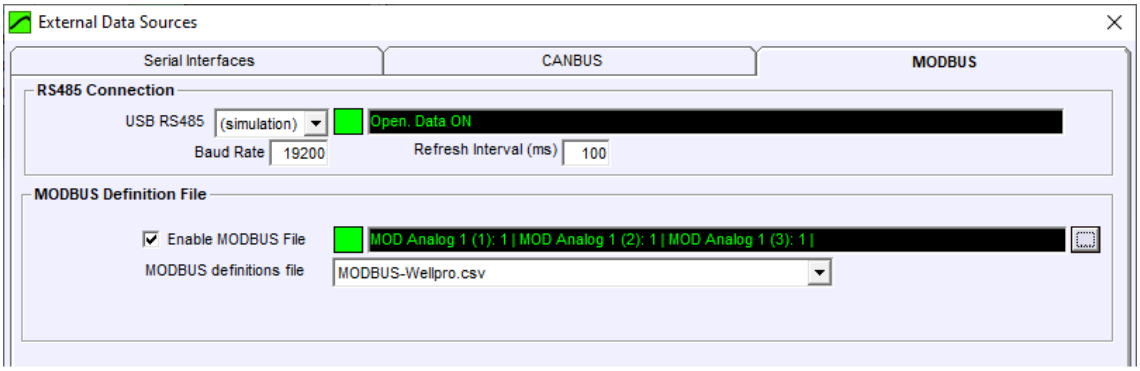
16.3.2.3 Enable CANopen Interrogator

CANopen is typically used for Electric Motor Controllers. This checkbox enables the interrogator loop.
CANopen protocol is based in a query-reply schema (instead of using a listener), this may cause some overhead in the bus and cause some collisions with other devices like the DVT Software used for SEVCON controllers. When it is possible, listener is preferred over CANopen (for instance SEVCON offers both methods for the telemetry)

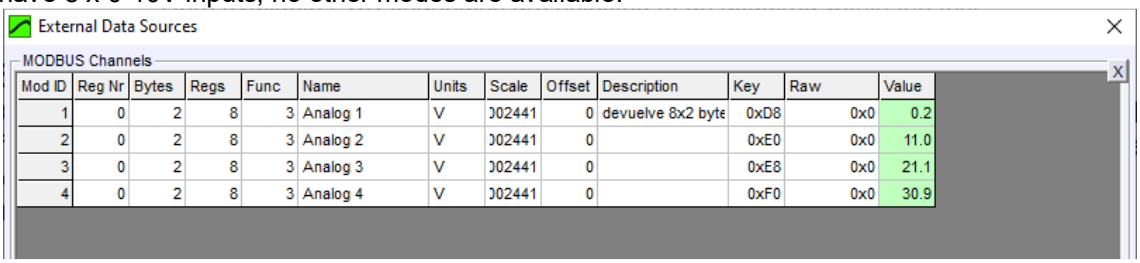
16.4 MODBUS

MODBUS is a classical bus in industrial automatization. It is based on a single link with RS485 differential lines (2 wires + GND optional). Thus an USB-RS485 adapter has to be used. There are lots of adapters compatible with Sportdyno, as long as they provide a virtual COM (same as for RS232 USB-serial adapters)

MODBUS is a protocol based on enquiry-response, not broadcast. We have implemented a full MODBUS interface based in a definition file similar to the CAN definition files.



For instance WELLPRO MODBUS devices are a cheap solution for analog acquisition, they have 8 x 0-10V inputs, no other modes are available.



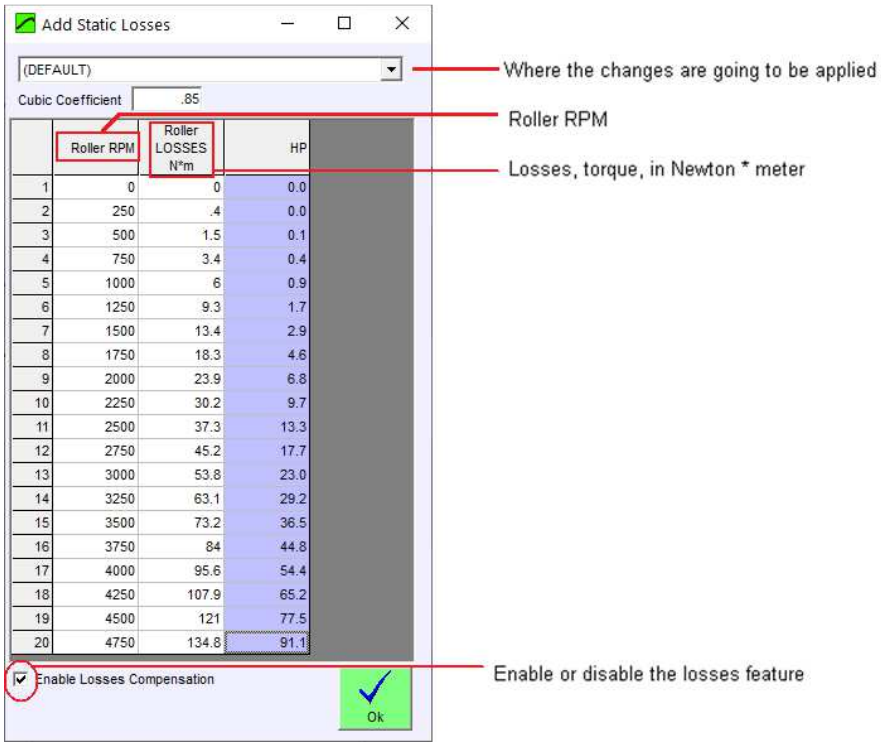
Other definition files can be provided under request. Please send an email to info@sportdevices.com to get more information about the compatible devices.

For configuring the RS485 connection, you have to find out:

- **RS485 COM**. It is assigned by Windows during the installation of the USB-RS485 adapter.
- **Device Baud Rate.** Common baud rates for MODBUS devices are 9600 and 19200 baud, but most of them can be configured with an external tool to a higher speed.
- **Refresh Interval.** Each device has a maximum allowed enquiry rate. A recommended value is 100 ms or slower.

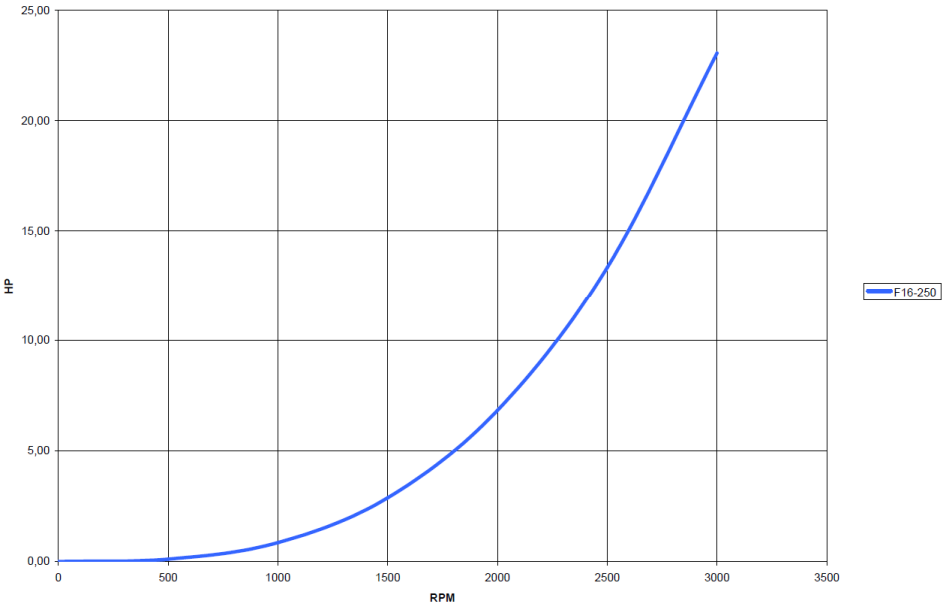
16.4.1 Add Static Brake Losses.

This option is useful for dynamometers with brake, in which the brake has losses (air friction) which cannot be measured with the load cell, and the user want to compensate these losses by using the retarder's manufacturer data, especially if the dyno has no clutch to measure the friction losses by the usual coast down method.



	Roller RPM	Roller LOSSES N*m	HP
1	0	0	0.0
2	250	.4	0.0
3	500	1.5	0.1
4	750	3.4	0.4
5	1000	6	0.9
6	1250	9.3	1.7
7	1500	13.4	2.9
8	1750	18.3	4.6
9	2000	23.9	6.8
10	2250	30.2	9.7
11	2500	37.3	13.3
12	2750	45.2	17.7
13	3000	53.8	23.0
14	3250	63.1	29.2
15	3500	73.2	36.5
16	3750	84	44.8
17	4000	95.6	54.4
18	4250	107.9	65.2
19	4500	121	77.5
20	4750	134.8	91.1

Example, Frenelsa F16-250 brake



We model the air pump losses as: **HP = ct * (rpm / 1000) ^3**

(Other losses sources may exist: bearings, belts, etc, but normally the brake is the biggest one)

In this case **HP = 23** for **RPM = 3000**, then 23 = ct * (3000 / 1000) ^3 = ct * 3^3

→ ct= 23 / 27 **= 0.85** (used in the table above)

Appendix I. What is new in 4.1 version? (Main topics)

- New Gauges interface
- New channels arrangement (Engine HP, Wheel HP, friction HP are always available at same time)
- New Report “Type 2”
- New filters: polynomial filters
- New test modes. (braked coasting)
- New PID / Brake Maps