YourDyno Data Acquisition system

Installation and capabilities

1 Introduction

Congratulations on your purchase or consideration of the Dynamometer Data Acquisition system from YourDyno.com. This manual describes the installation of the acquisition system.

2 Contents

2.1 YourDyno general warranty disclaimer

YourDyno is a generic dyno data acquisition system, made to support many different types and brands of dynos. It is impossible to test all combinations of settings and setups, so each install must be verified by a qualified dyno operator/installer.

New software is released regularly, both beta versions and released versions. Although the goal is continuous improvements, you must always make sure the new version works in your setup as intended. Software bugs can be introduced, and hardware errors can also occur.

All risk of damage and accidents in all aspects is assumed by you as the end user, even if the cause of the problem can be deemed to be a software or hardware issue in the YourDyno system.

3 General safety risks

Dyno systems come with many inherent risks. It is your responsibility to understand the applicable safety concerns in your setup, be it electrical shocks, cars coming off the dyno, tires exploding, engine catastrophic failure, etc.

Take safety seriously, always expect that something can happen during a run.

4 YourDyno instrument kit features

- Data acquisition electronics box with USB-C interface
- Supports inertia dynos, roller-based dynos with 1 brake or 2 brakes (4WD or dual brake on one axel), and hub dynos with 2 brakes (2WD), engine dynos
- 4WD hub dynos is supported using 2 YourDyno boxes in tandem
- Brake type support includes Eddy current brakes, water brakes, hydraulic pump brakes, and others
- All brake outputs use individual brake controllers (i.e. supports setups with different brakes and different load on front and rear axle)
- 2 analog load cell inputs
- 2 RPM inputs for Roller/Hub RPM or Engine RPM
- 1 k-type thermocouple input (for engine or exhaust temperature). Can add up to 8 more thermocouples using the CAN Tool plugin
- 3 analog (0V-5V) inputs, for example for Lambda sensors, MAP, boost, etc. Can add more analog channels using the VM167 plugin
- 2 Brake control outputs, each supporting either Pulse width modulation (PWM) and analog (0-5V) signals. 1 output supporting Stepper motor
- Self-powered from the USB cable, no external power supply
- Supports any analog load cell for brake/absorption dynos
- Easy to use FREE PC software with setup wizards, calibration options and plugin system for integrating other sensors or data

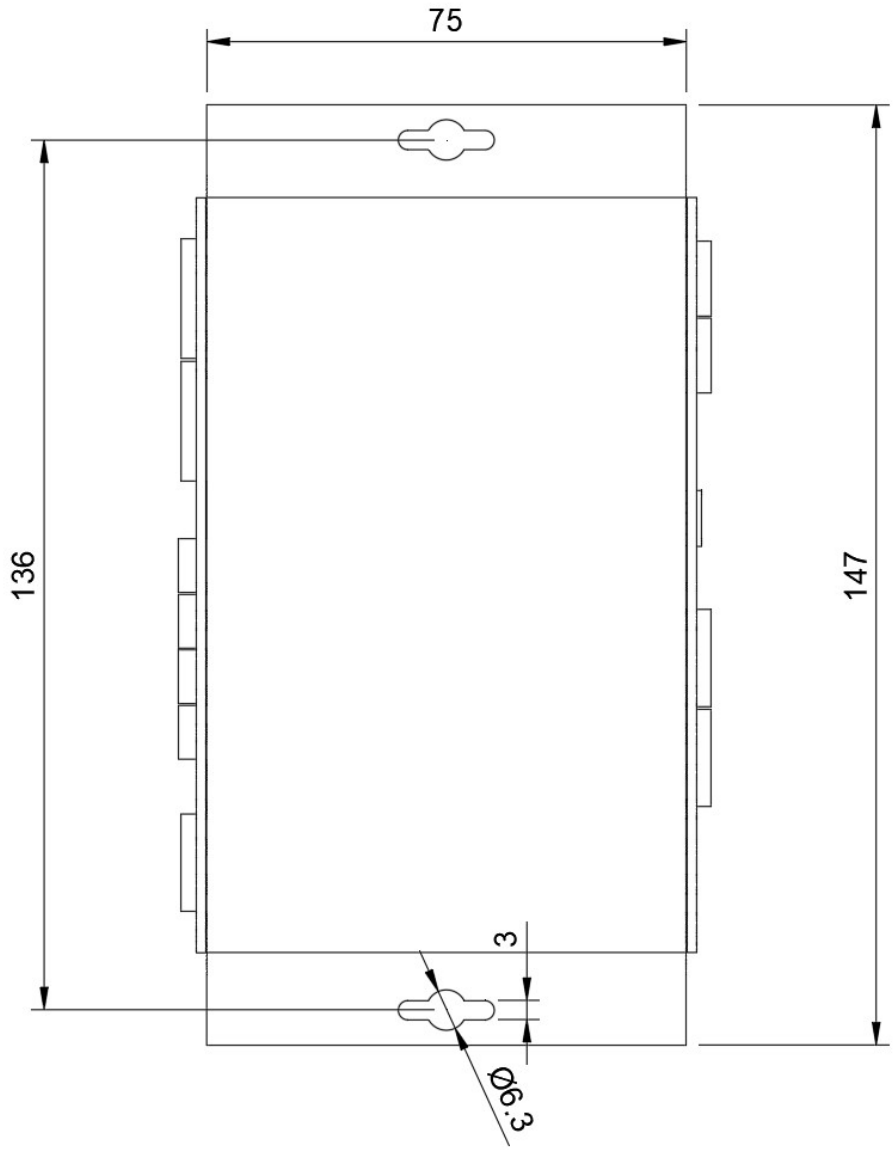
5 Included in the instrument kit

- Instrument box
- All connectors, screw type
- Built in Environmental sensors (humidity, temperature and pressure)
- 3m USB-C cable

6 Dimensions

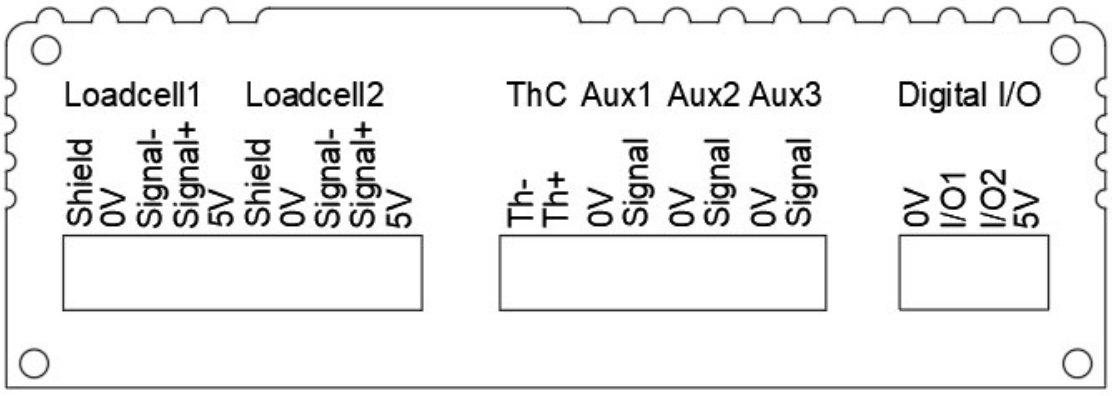
All numbers in mm.

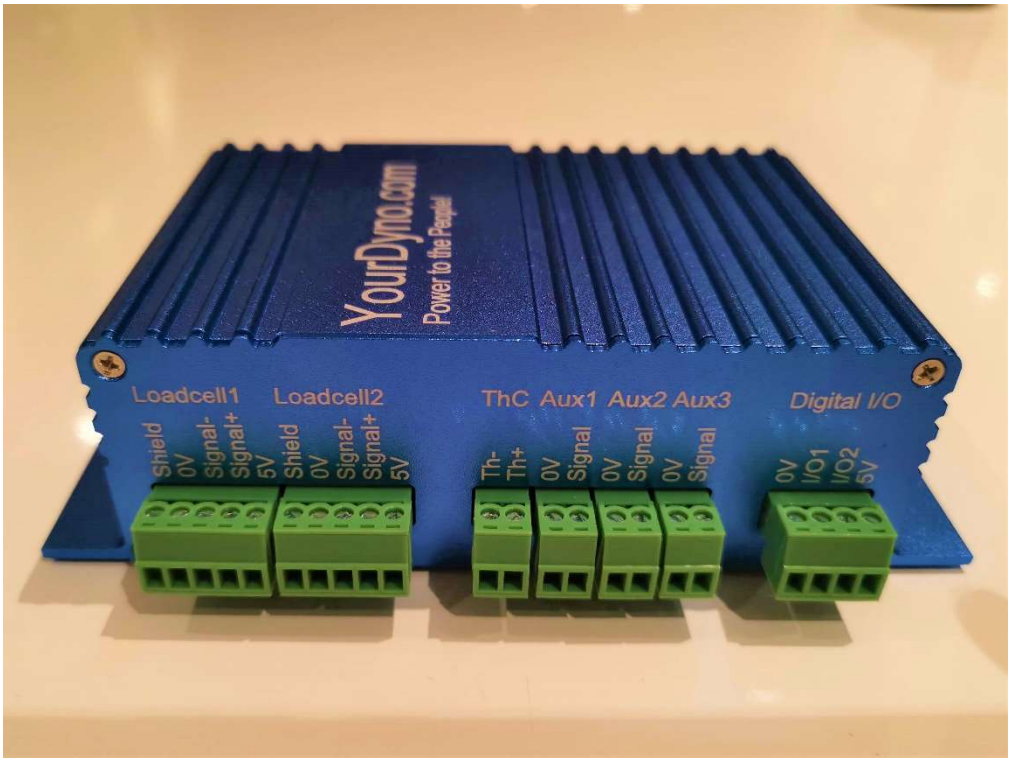
Weight: ca 0.5kg



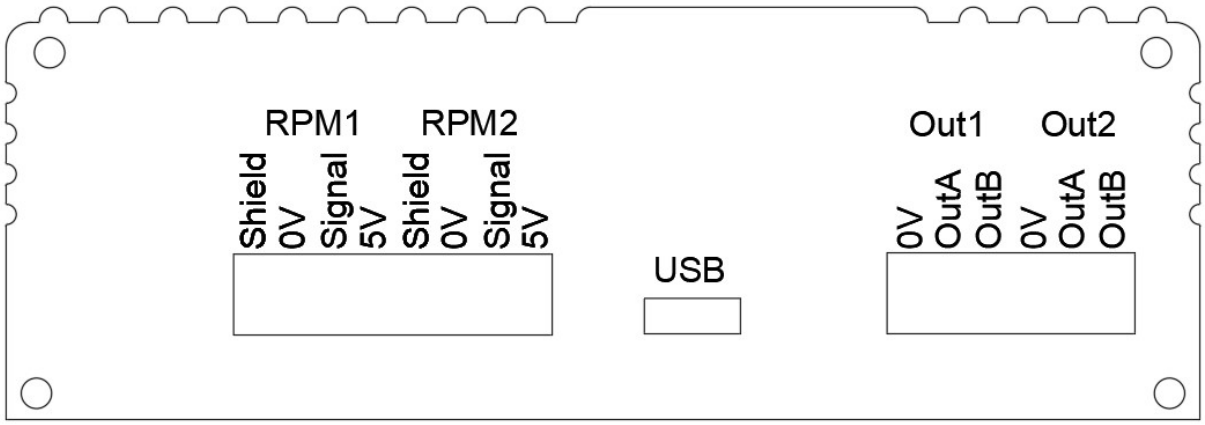
Dimensions

7 Connections





Connections to the box are clearly marked



Connections to the box are clearly marked

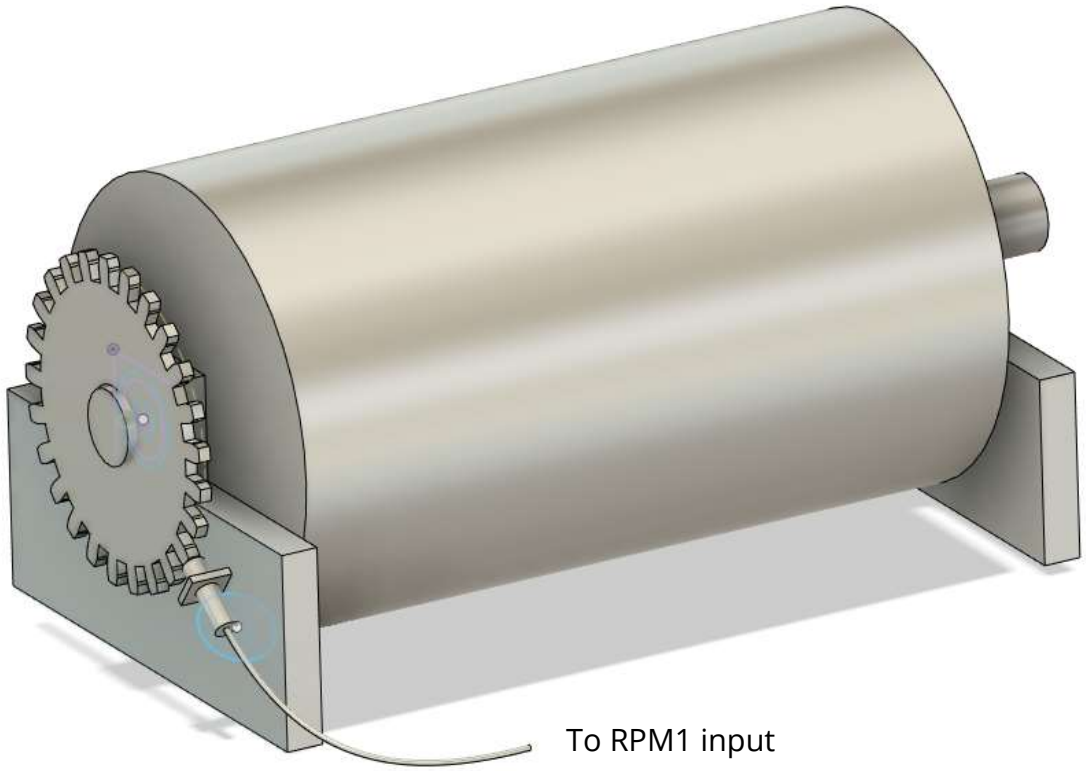
8 Types of dynos supported

YourDyno supports the following dyno types

8.1 Inertia dyno

This dyno uses a heavy wheel that is accelerated, and power is calculated from the time it takes to accelerate the wheel.

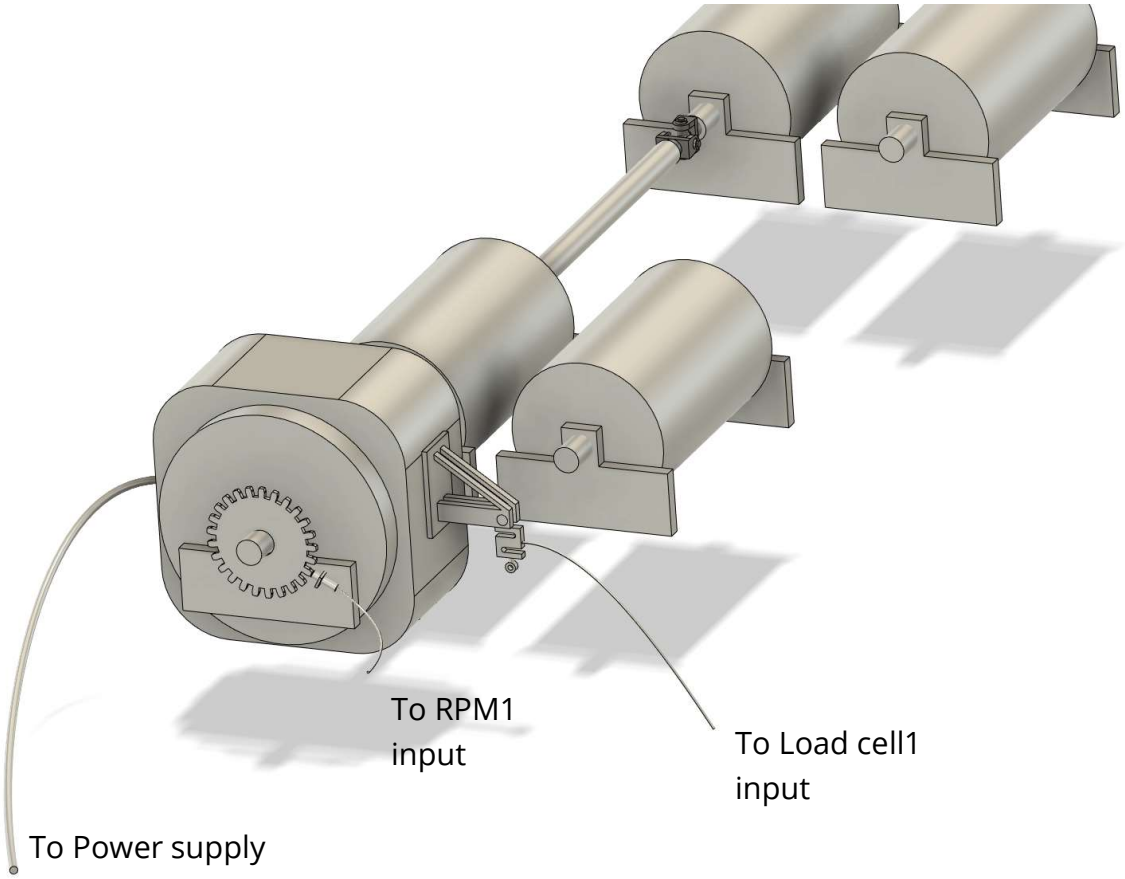
This dyno type only uses an RPM sensor for the power calculations.



Inertia dynos only requires an RPM sensor

8.2 Roller dyno with 1 or 2 independently controlled brakes

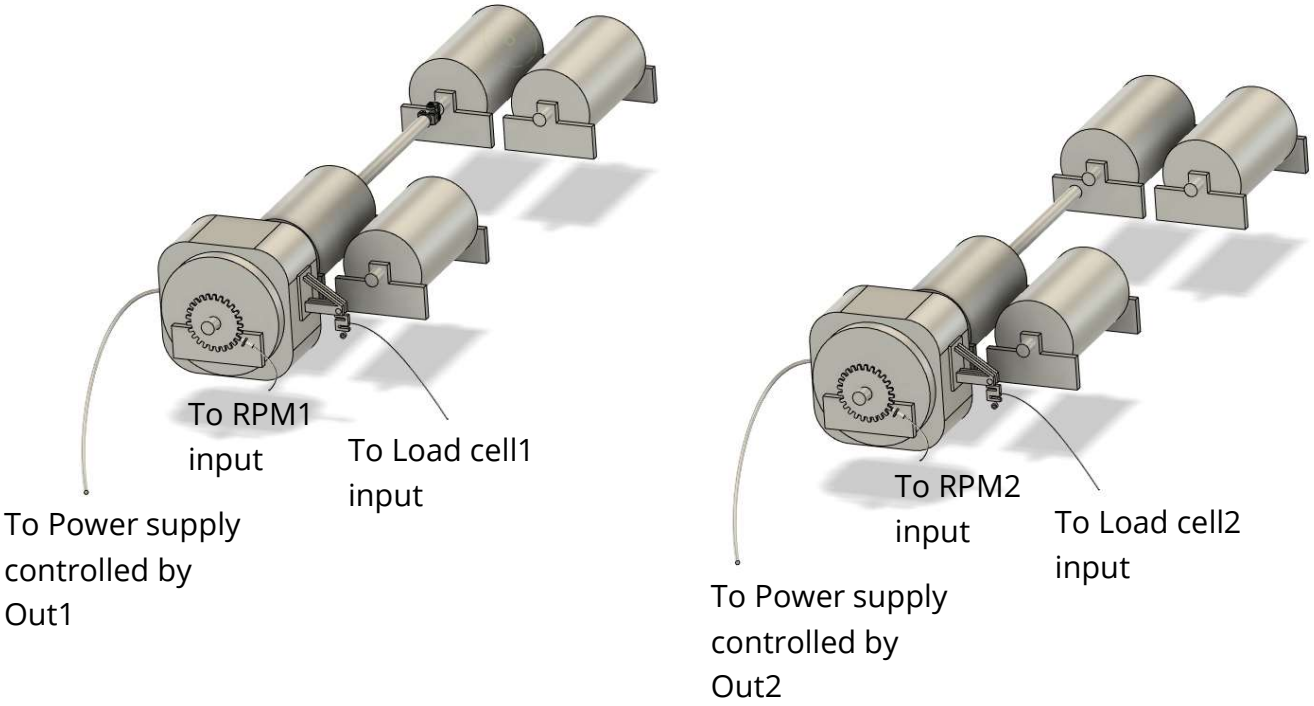
These dynos are typically using Eddy brakes.



Example of single axis roller based eddy braked dyno

The single axis roller based brake dyno may use one wide roller, two smaller interconnected rollers, or double rollers like in the drawing above, linked or unlinked. All modes are supported by YourDyno.

4WD roller based dynos are also supported, in this case there are 2 brakes, 2 RPM sensors, 2 load cells and 2 power supplies, and this second set of roller/brake uses RPM2, Load cell 2 and Out2.



Example drawing of a 4WD roller based eddy braked dyno

8.3 Hub dynos

Hub dynos are supported. The setup for a 2WD hub dyno is much the same as for a 4WD roller based dyno in terms of connections to the YourDyno box.

4WD hub dynos are supported as well, using 2 YourDyno control boxes. One box controls the rear wheel pair and one controls the front wheel pair.

A hub dyno from JDM Dyno using YourDyno

8.4 Engine dynos

Engine dynos are fully supported. In case of Eddy brake dyno, the setup is much the same as a single axle roller based brake dyno.

8.5 Water brakes

Water brakes are fully supported. There is a special water brake control mode called Load control.

A water brake

RPM and load cell connections are the same as for Eddy brakes. The brake is controlled via a manually controlled or electrically controlled flow valve. When electrically controlled The flow valve is controlled by a stepper motor or a servo.

A water brake valve from Land & Sea (stepper controlled)

8.6 Other brake types

Other brakes that can be controlled by YourDyno include hydraulic pump based brakes. The control setup is very similar to water brake; a load cell, an RPM sensor with trigger wheel and a stepper motor or servo controlling the flow control valve.

There is also a brake mode for hydraulic brakes, called Brake sweep.

9 General YourDyno instrument kit installation instructions

9.1 Box location

- Install the instrument box in a dry location, free from dirt and dust and condensing moisture. The location shall be free of strong vibrations and shock
- The box is not water splash proof
- The environmental sensors that are used for horsepower corrections are inside the box, behind a hole in the housing side. Mounting the box in a cabinet can distort these readings. If mounting inside a cabinet is preferred, then the PTH200 external environmental sensor can be used instead

9.2 USB cable considerations

- The YourDyno box is powered by the USB cable. It is important that it is connected either directly to the computer or to a powered USB hub such that stable and sufficient power is available
- If necessary, a USB isolator can be used. In this case, make sure to use a powered USB isolator such as this one: http://www.usconverters.com/usb-isolator with external power supply

9.3 Cables and cable routing

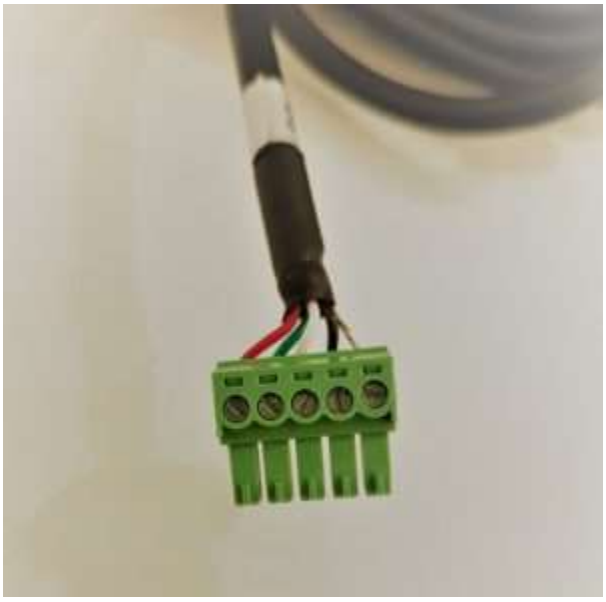
- Ensure to route high current carrying cables away from the USB cable and signal cables
- Cables can be extended if needed, but care must be taken to ensure the shielding is as intact as possible. Standard cable lengths are:
    - USB: 3 meter
    - Load cell: 3.5m
    - RPM sensors: 4m

10 Sensor connections

10.1 Load cells

YourDyno supports any Wheatstone bridge type load cell (which are almost all of them).

Here is how to connect a YourDyno standard load cell (color coding):



If you have your own load cell, make sure it does not have any amplifier built in, it should be completely analog. The plug is clearly marked with 5V, 0V, Signal + and -. In case you mess up the + and -, then calibration will fix that. In general, you will not

destroy anything by connecting the load cell wrongly but take care to understand what goes where to get the most accurate readings.

Some load cells have 6 wires, not 4. In that case there are 2 + wires and 2 – wires. Just connect them into 2 pairs.

10.2 Mounting the load cell

Load cells need to be mounted such that they get no bending moment. The way to do this is to use rod ends bearings, like this.

Rod end bearings are available in all threads and sizes suitable for the load cells.

Also ensure 90 degrees between the load cell and the load arm, and the load arm shall be horizontal.

10.3 RPM sensors

YourDyno needs as a minimum one brake RPM sensor per independent brake. So, if you have 1 brake you need 1 RPM sensor that measures the speed of that brake. If you have two brakes that are physically interlinked, you need only 1 RPM brake sensor and if you have 2 independent brakes you need 2 brake RPM sensors. For an inertia dyno you need 1 roller RPM sensor.

In addition (but not instead) the Engine RPM can be read. This will provide automatic calculation of gear ratio. Options for Engine RPM are described in the next chapter.

10.3.1 Brake/roller RPM sensor considerations

YourDyno RPM sensor is recommended as a low cost, proven sensor with shielded cable.

But any sensor that provides a 0-5V square wave signal will work. VR sensors do not work directly but can be used with an interface board that converts the signal to 0-5V. For example, http://www.jbperf.com/dual_VR/v2_1.html (select the 5V version).

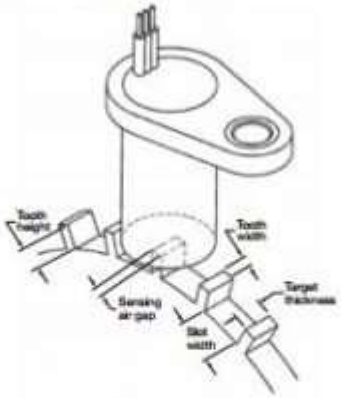
10.3.2 Trigger wheel

YourDyno needs **200 trigger pulses per second** as a minimum to work optimally. This means a trigger wheel is necessary. The RPM sensor senses the teeth on the trigger wheel and produces one pulse per tooth. There are a few rules for the trigger wheel.

1) The trigger wheel must be of a ferrous metal (iron or steel).
2) The distance between the teeth on your trigger wheel must be perfectly regular, otherwise you will have noise. You must also avoid eccentricity in the trigger wheel, as it will cause the sensor to trigger at slightly different times as the wheel spins. Use a trigger wheel with sharp teeth (i.e. not a sprocket for a chain for example)

Here are the specs for the mechanical dimensions of the wheel.

Table 5. Reference Target Dimensions[1]



Characteristic	Parameter
Tooth height	5,06 mm [0.200 in] min.
Slot width	10,16 mm [0.400 in] min.
Tooth width	2,54 mm [0.100 in] min.
Target thickness	6,35 mm [0.250 in] min..

[1]Based on a target diameter of 101,6 mm [4 in] at a rotation of 10 RPM to 3600 RPM.

Example of a trigger wheel. Note the sharp teeth

How many teeth do you need

Choose a trigger wheel with enough teeth to give at least 200 pulses per second at the RPM you care about. This is because YourDyno needs 2 pulses to produce 1 result, so unless you have at least 200 pulses per second you will not get 100 updates per second. More importantly brake performance and inertia accuracy will be reduced.

NOTE: A typical crankshaft ignition/ECU timing wheel does not work! They are made with one or more gaps in the teeth for the ECU to know the absolute position of rotation of the crankshaft. YourDyno expects no gaps, and such a wheel will cause a large noise in the RPM readings.

10.4 Using an Encoder as RPM sensor

Using an encoder for the brake RPM is also possible if you do not want to use the standard YourDyno RPM sensor. Keep the pulses per revolution below 150 or so and choose an open collector type encoder (i.e. an encoder that needs a pull-up resistor to work). YourDyno has a built in pull-up resistor to 5V.

10.5 Engine RPM sensors

The system MUST have a brake/roller RPM sensor, but it is completely ok to not have an engine RPM measurement. In this case you use the brake RPM sensor + gear ratio to know the Engine RPM. Gear ratio can either be entered directly if you know it, or you can use the engine's tacho and hold the RPM at a set point (for example 4000RPM) then press a button. YourDyno will calculate the gear ratio.

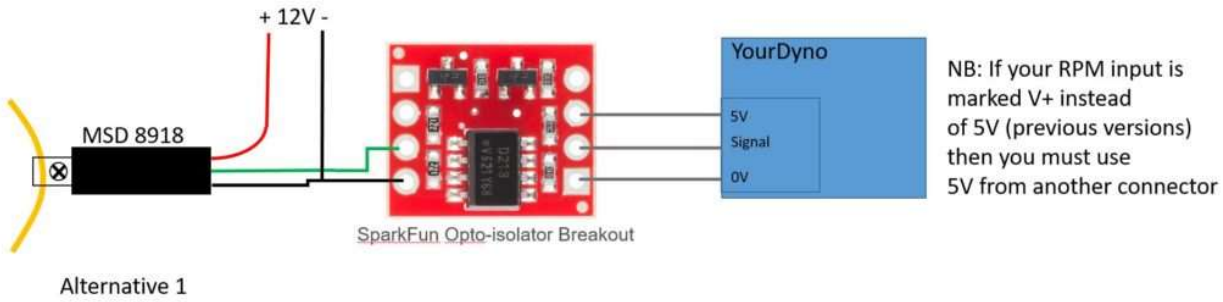
Alternatively, you can add a direct Engine RPM reading in one of the following ways:

10.5.1 Spark plug wire/coil wire signal pickup

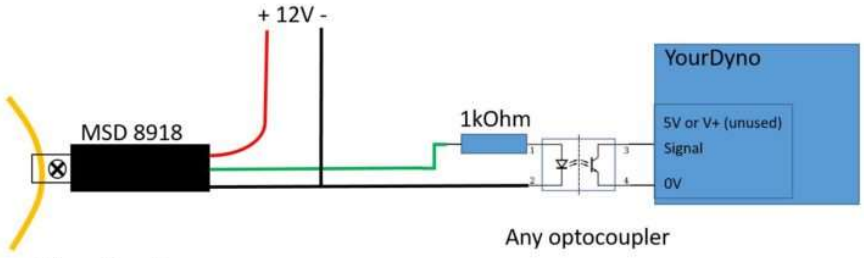
If the engine you test do not have OBD2 support (see below), then you can use a signal pickup.

The MSD 8918 Tach Signal Pickup is suitable for picking up the RPM signal from the coil primary wire. It senses current passing through a cable, so it works on the primary where the current is high and the voltage is low (this is opposite for the secondary that goes to the spark plug).

It needs 12V supply. Its output is also 0-12V, so you need an interface between the MSD and YourDyno. **If you try to connect the output directly to YourDyno then something will smoke**, so do not do that. Here is the connection diagram (two alternatives):



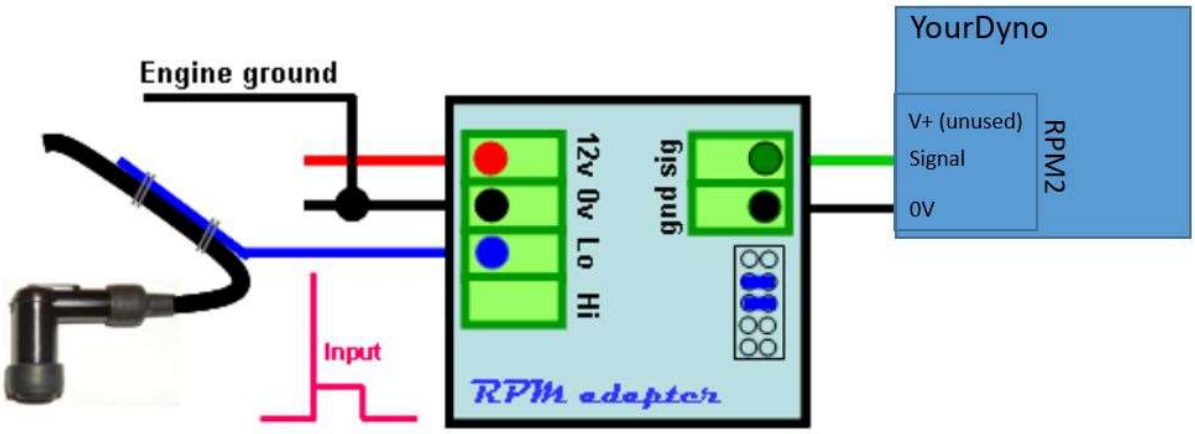
Alternative 1



Alternative 2

The 12V power supply (or battery) shall not be connected to YourDyno at all.

DTec also sells a suitable RPM adaptor. It can pick up the signal from the spark plug wires, from the coil or a VR sensor. Here is how to connect it:

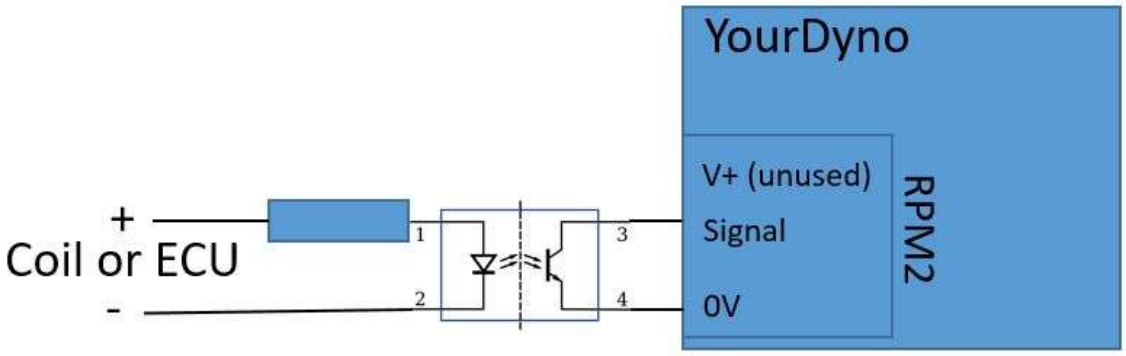


DO NOT ADD A PULLUP ON THE "SIG" SIGNAL like the DTec documentation says. YourDyno has an internal pullup. If you attempt to add a pullup to V+ you may damage the YourDyno box. Also, use a separate 12V power supply to this box, not connected to YourDyno at all. The only connection between YourDyno and the RPM box shall be the two signals as in the figure above.

You need to program "Pulses per revolution" to either 1 or 0.5, depending on your engine (1 for 2 stroke or 4 stroke with wasted spark, 0.5 otherwise).

10.5.2 RPM signal from ECU or coil

If you go this route, make sure to let the signal from the ECU or the coil trigger an optocoupler. No pullup is necessary, this is included inside the YourDyno box.



10.5.3 OBD2

This is a preferred solution for regular cars. RPM reading from OBD2 is supported via Bluetooth or USB using an ELM327 unit. These units are available many places and work well with YourDyno. WiFi version is not supported.

10.5.4 CAN Bus adapter

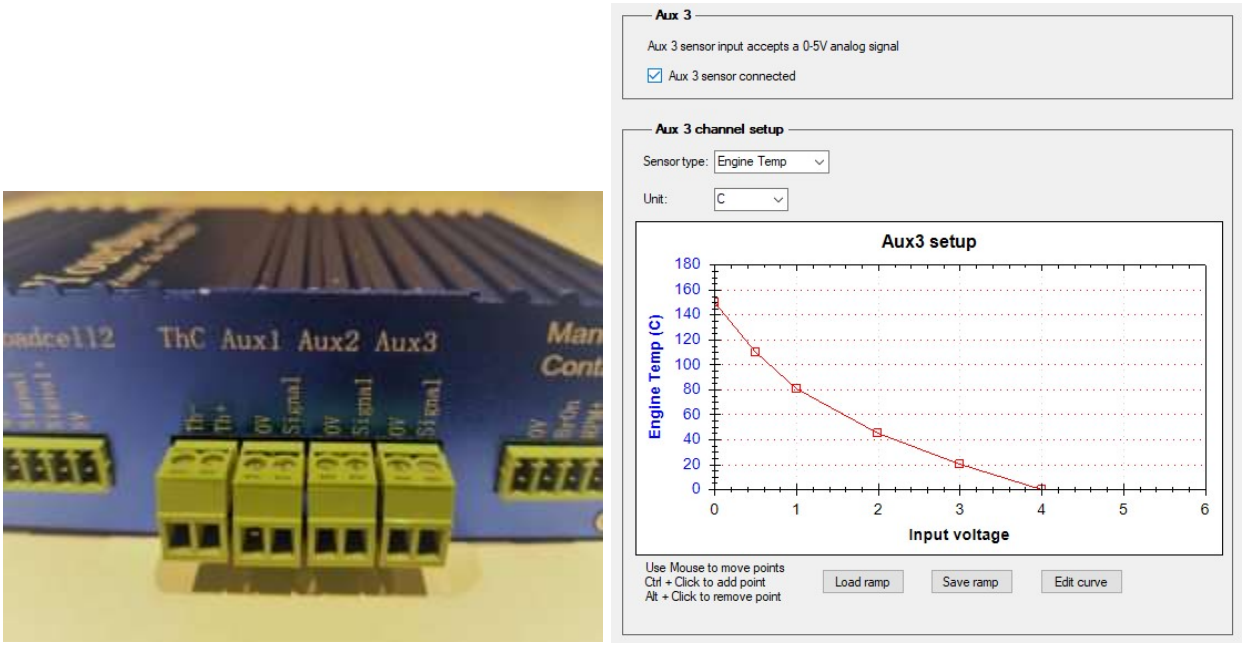
Most vehicles have CAN Bus, even off the shelf ECUs provide this. Engine RPM, along with many other parameters can be logged via the CANTool plugin and a CAN-to-USB adapter.

Supported CAN bus USB adapters

10.6 Aux channel setup

YourDyno supports 3 auxiliary channels. They can record any analog signal between 0V and 5V, for example recording of a wide band lambda sensor or a Boost pressure sensor or engine temperature. Read on to see how to connect it. Note that you can have many more channels with the use of plugins.

The aux channels are clearly marked with 0V and Signal, and connecting the sensor is straight forward. 0V is common for all sensor inputs.



The Aux channels and how it is setup in the software

Note that your sensor may very well need a separate power supply. Since the YourDyno box is powered by the USB cable, power is limited. You can connect up to 100mA to the 5V output on YourDyno in total in addition to RPM sensors and load cells. Anything more and you need a separate power supply. Make sure to connect the power supply's 0V (ground) to YourDyno 0V.

10.6.1 Lambda setup

YourDyno can read a wide band lambda sensor in one of the Aux channels. In addition to the wide band lambda sensor itself you need a wide band lambda controller that outputs an analog 0V-5V signal. There are several to choose from. 14point7.com has a good wide band lambda controller, called Spartan Lambda Controller 2.

The Spartan Lambda controller from 14point7.com

The LC-2 controller from Innovate Motorsports is also a good alternative.

The connections are as follows:

- 12V external power is connected to the heater 12V and heater ground
- 0V signal output (electronics ground) is connected to YourDyno 0V
- Linear output is connected to YourDyno Signal on Aux1, 2 or 3

10.7 Thermocouple channel setup

YourDyno has 1 k-type thermocouple channel. More can be added with plugins. Make sure to use a k-type thermocouple intended for motorsport/vehicles with shielded cable. Connect the positive terminal to Th+ and the negative to Th-. The cold junction is included inside the YourDyno box, so the thermocouple can be connected directly.

The shield of the thermocouple must only be grounded at one point. If the shield is connected to the sensor side, then make sure shield is not connected at the YourDyno side. If the shield is floating, then connect the shield to the shield of Load Cell 2 for example.

11 Brake control

YourDyno can control the dyno brake electronically. You can program RPM sweeps or steps or any RPM sequence, plus you can control brake RPM manually all through YourDyno. There is also a plugin option that allows any brake control.

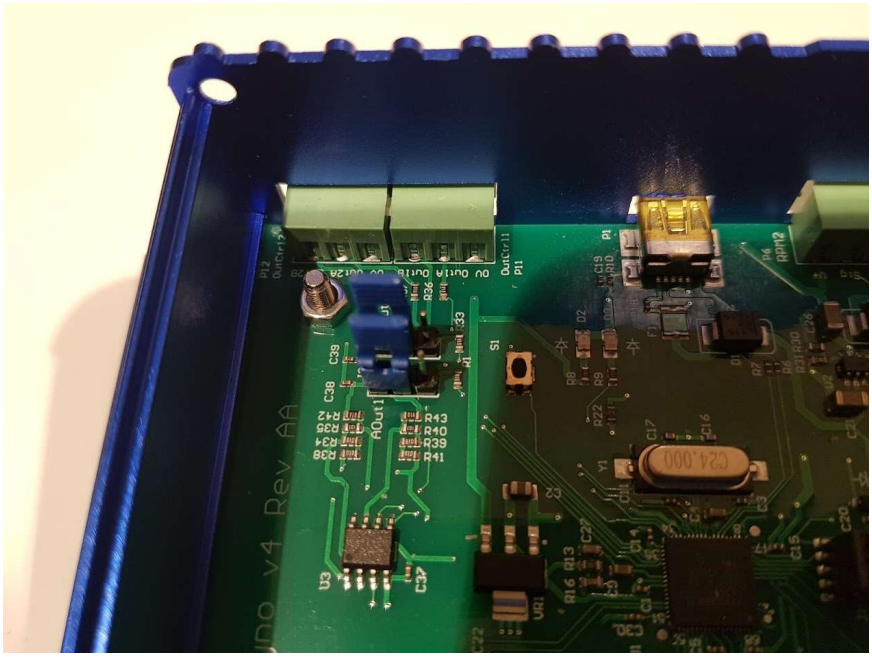
Electrically, the brake control is done using an analog 0-5V signal, a PWM (Pulse Width Modulation) signal or a stepper motor DIR/STEP or STEP+/STEP- setup.

This can be used in the following ways:

- Control an Eddy Current power supply
- Drive an RC servo, typically for water brakes or hydraulic brakes
- Drive a servo motor using a motor controller
- Drive a Stepper motor controller

11.1 Selecting Analog control signal or PWM/Stepper

In order to select the analog output, move the jumpers to the position as shown below (marked AOut1 and AOut2). The other position is used for PWM and stepper motors.



Jumper selection (here shown in analog position)

11.2 Eddy current brake control

YourDyno can perform Eddy current brake control.

11.2.1 The Eddy current power supply

CAUTION! When working with Eddy current brake control, be aware that high voltages are generated. Ensure all high voltage installations are done by a professional.

Make sure you know the power requirements for your brake. Dyno brakes are already wired with all coils in series, so the voltage and current requirements are specified from the brake supplier. Brakes from trucks and buses are wired for either 12V or 24V and will need to be rewired so all coils are in series. This will equate to either 96V or 192V for most brakes (each coil is 12V normally). Check the spec to also find the current rating.

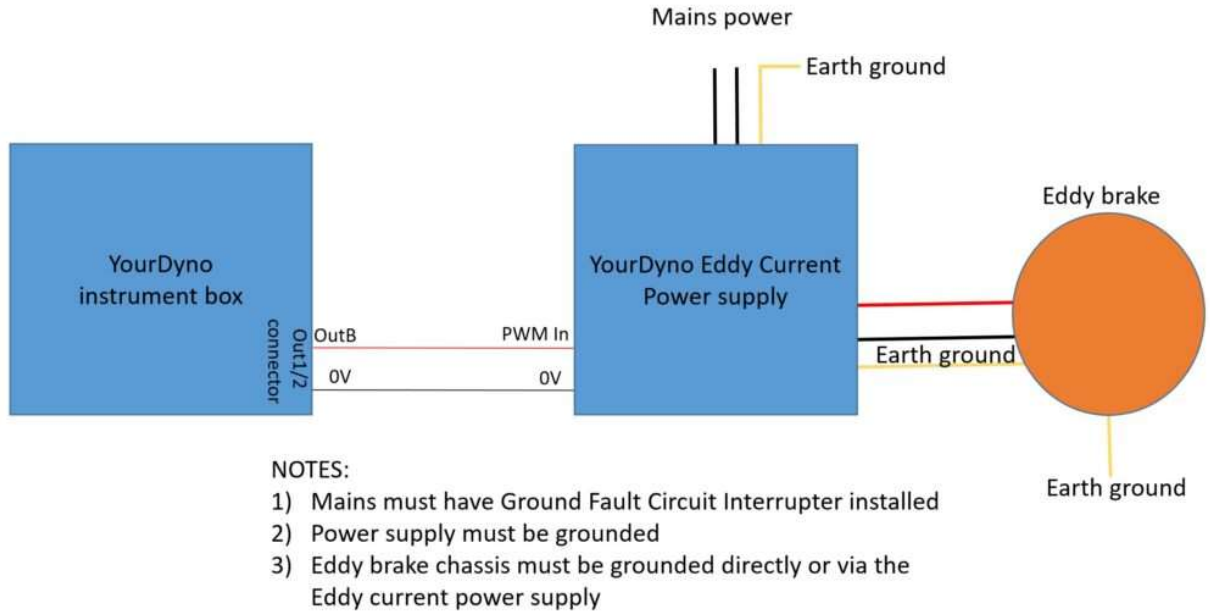
By far the easiest and most straight forward is to use the YourDyno power supply. It is made specifically for YourDyno, has electrical noise filters and is rated for 30 Amps. It includes a Bluetooth module with support for status.

11.2.2 Connecting the power supply to YourDyno

Here is how to connect YourDyno instrument box to the YourDyno power supply. Similar connections apply for other brake supplies. The jumper inside the YourDyno box should be in the default position which is PWM.

The power supply is made to run from 220-240VAC and will deliver 0-192V DC.

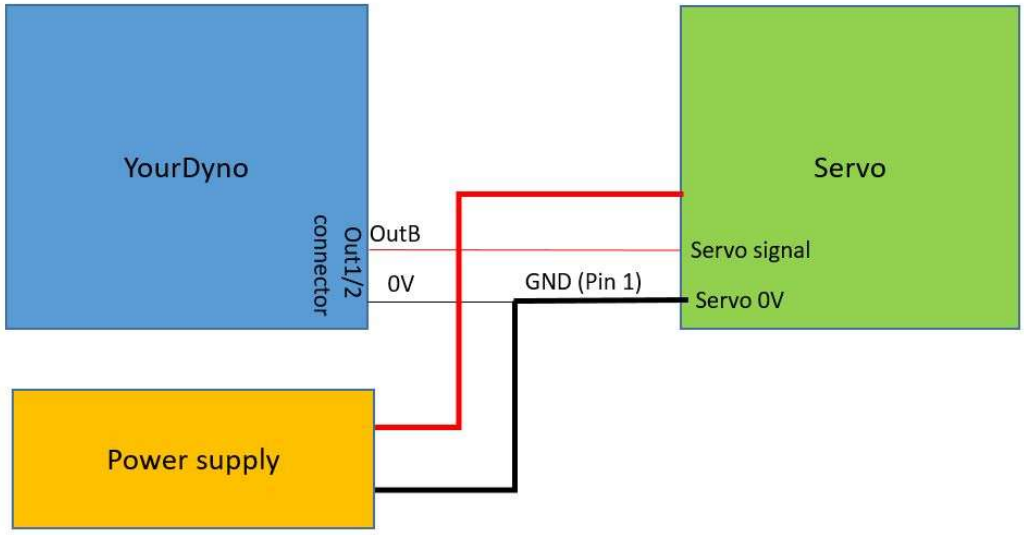
See https://yourdyno.com/yourdyno-eddy-brake-power-supply/ for more details.



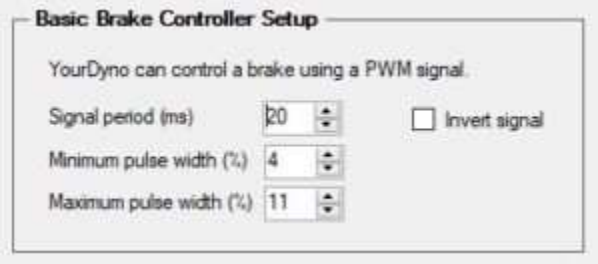
11.2.3 Servo control

For dynos requiring the control of a valve, for example Water Brake dynos, you can use an RC servo or Servo motor or a stepper motor, see further down.

Here is how to connect a servo to YourDyno:



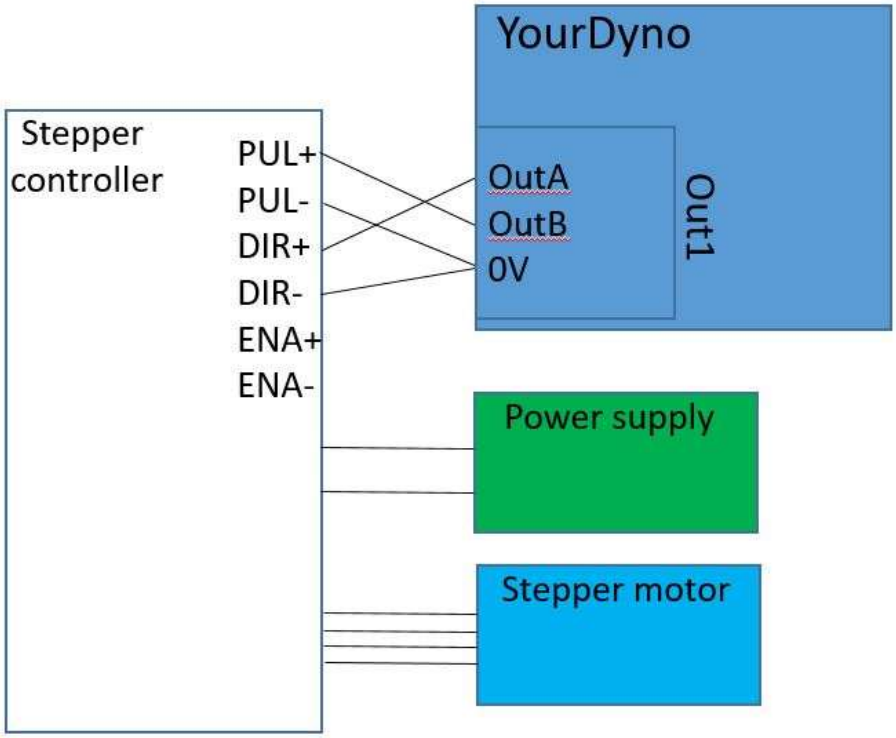
For an RC servo, set up the PWM parameters like this:



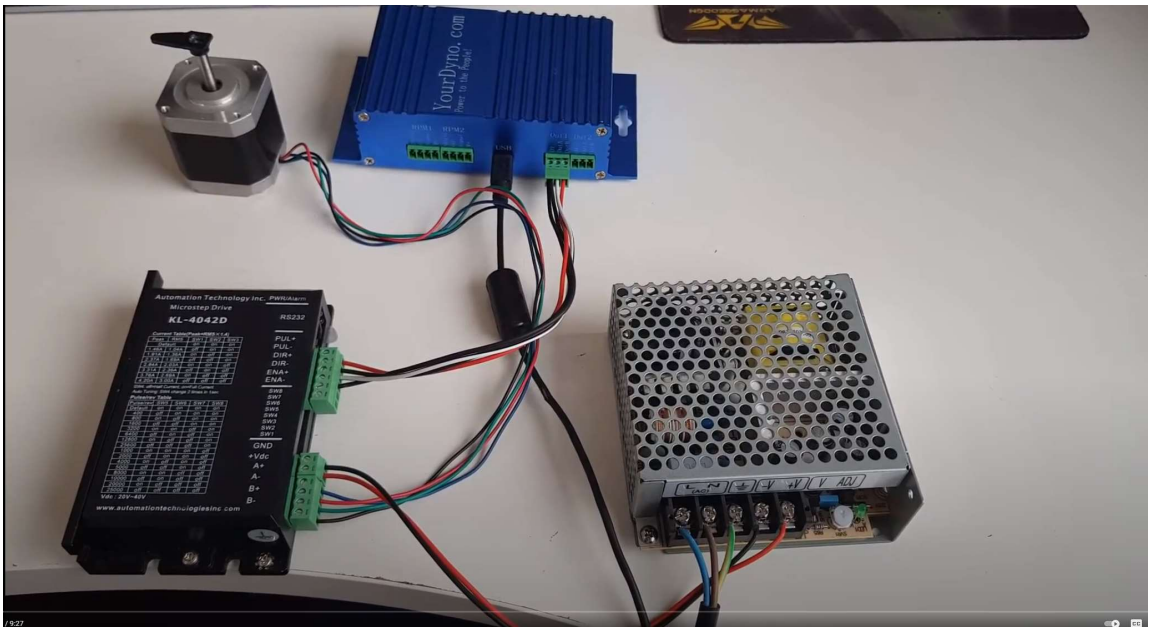
With these parameters, YourDyno can directly control the servo.

11.2.4 Stepper motor control

YourDyno can also control a stepper motor. You need a stepper motor controller in addition to the stepper motor. There are many to choose from. You choose mostly based on the current you need. Here is how to connect the stepper controller.



Connections to a stepper motor and stepper motor driver/controller



An example of a small stepper and a controller KL-4042D connected to YourDyno

Closed loop stepper motor has feedback, so they work much like a servo, always returning to the correct position. An open loop stepper needs to be tuned with correct max speed and acceleration settings. This can be done in YourDyno, but closed loop steppers are easier to work with.

A closed loop stepper/controller combo like in this picture is recommended

12 The YourDyno Dyno control software

See http://yourdyno.com/software-user-manual