YourDyno ULTIMATE Data Acquisition system
Installation and capabilities

1   Introduction

Congratulations on your purchase or consideration of a Dynamometer Data Acquisition system from YourDyno.com. This manual describes the installation and capabilities 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 ULTIMATE instrument kit hardware features

- 4 Load cell inputs. Unused load cell inputs can be used as 0-5V analog sensor channels

- 8 Analog sensors (0-5V). 2 of the analog inputs can be directly coupled to thermistors (water temp sensors etc)

- 8 K-type Thermocouple inputs

- 6 digital sensor inputs which can be used as RPM sensors, frequency-based sensors (like flow meters), or digital on/off sensors

- 1 VR RPM sensor input

- 1 inductive pickup sensor input (for ignition RPM pickup)

- 4 outputs (Analog or PWM) or 2 Stepper motor outputs (2 x DIR/PUL)

- Built in CAN bus support with data in and out (data can be read from CAN sensors or ECUs, and data channels can be sent to CAN devices like ECUs, dashboards, loggers etc)

- External weather station with 3m cable for use with automatic correction (SAE J1349, DIN70020, etc) for environmental factors (Temperature, humidity and air pressure)

- All connectors are included and are with screw type terminals

- Support for all YourDyno plugins including KMTronic relay unit and 3rd party plugins enables almost limitless possibilities

- 3m USB cable

- External power supply

- YourDyno Pro software, which supports all new features of YourDyno Ultimate in addition to YourDyno's standard features

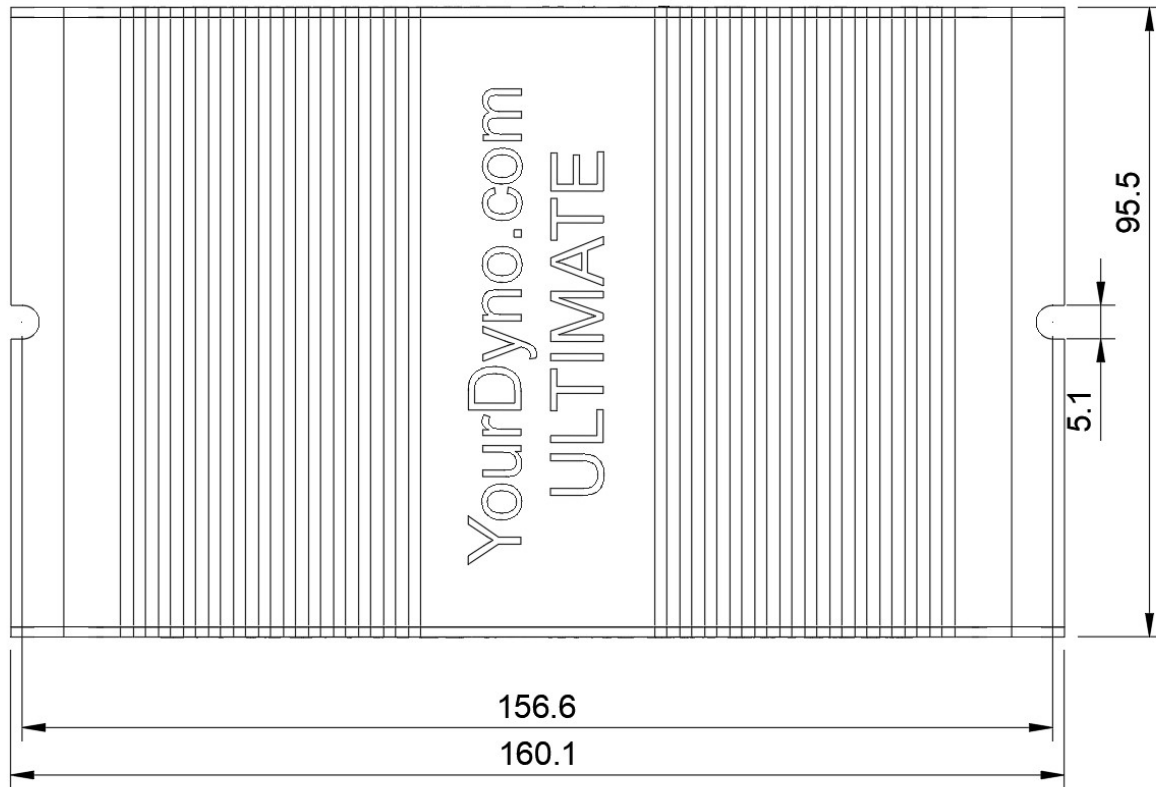## 5   Included in the instrument kit

- Instrument box
- All connectors, screw type

- External Environmental/Weather station (humidity, temperature and pressure) with 3m cable
- Power supply
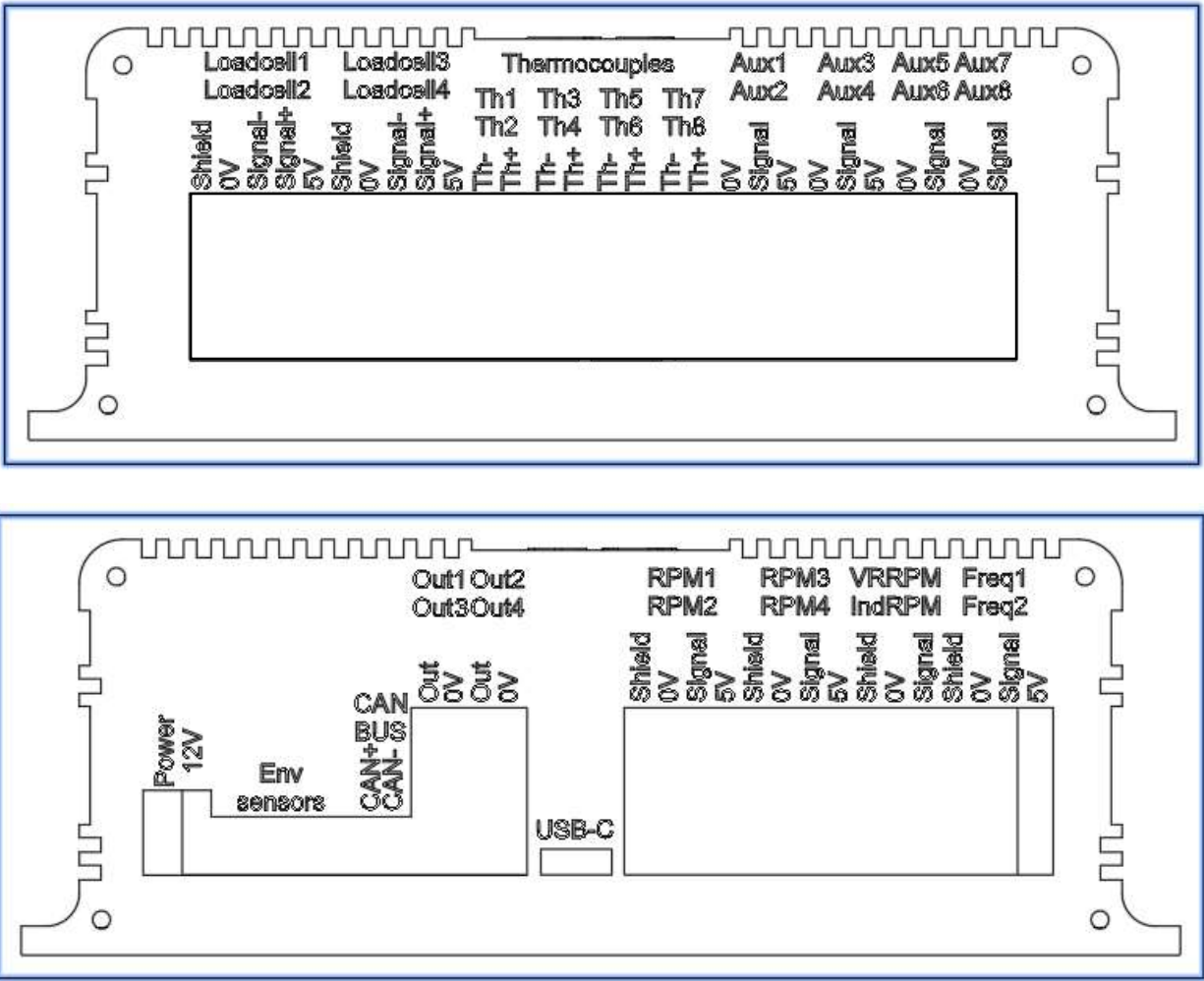- 3m USB-C cable

6 Dimensions

All numbers in mm.

Weight: ca 0.5kg

Dimensions (mm)

7 Connections

Connections to the box are clearly marked

8 Types of dynos supported

YourDyno supports the following dyno types

8.1 Water brakes

Water brakes are the most common use for YourDyno ULTIMATE. Water brake setups usually require many channels, which the ULTIMATE offers. There is a special water brake control mode called Load control in the software.

A Stuska 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.

The YourDyno water brake valve is a stainless-steel valve with a very fast and precise servo/gearbox setup. It comes in 3 sizes, 1", 1.5" and 2" and is plug and play with the YourDyno Instrument box.

YourDyno ULTIMATE supports both 1 water brake valve setup (inlet or outlet control) and 2 water brake valves (inlet and outlet control).

Figure 1 The YourDyno water brake valve is plug and play with YourDyno Ultimate

8.2 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.

To RPM1 input
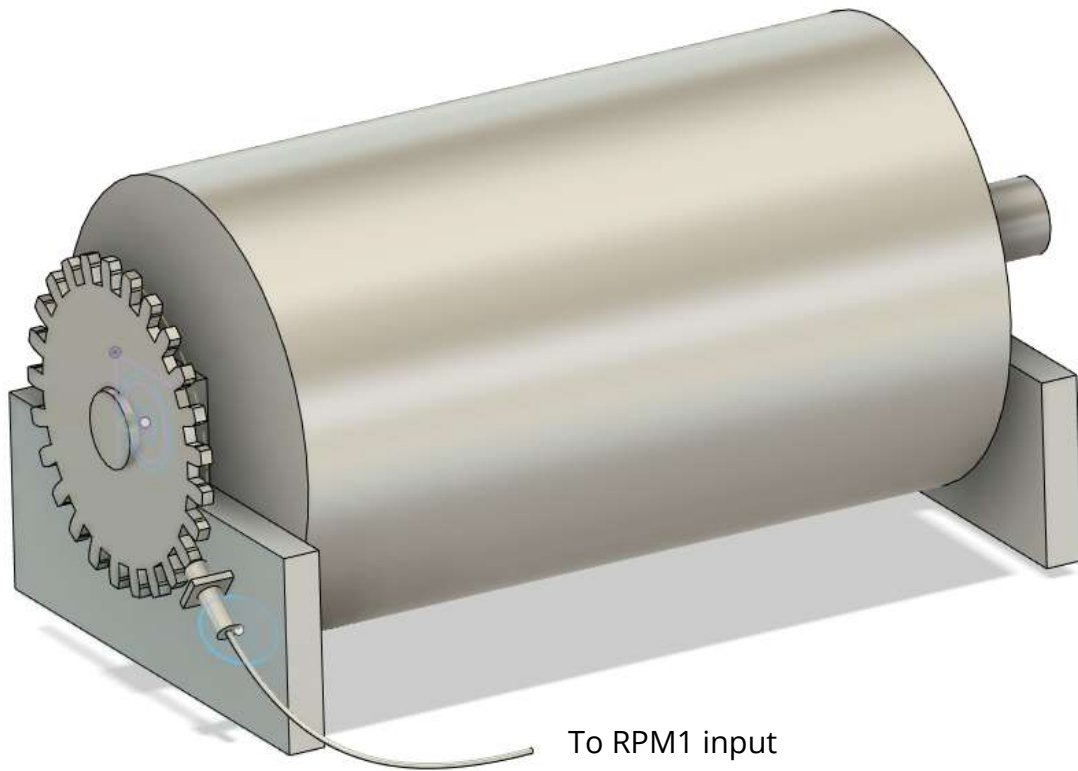
Inertia dynos only requires an RPM sensor

8.3 Roller dyno with 1, 2 or 4 independently controlled brakes

These dynos are typically using Eddy brakes.
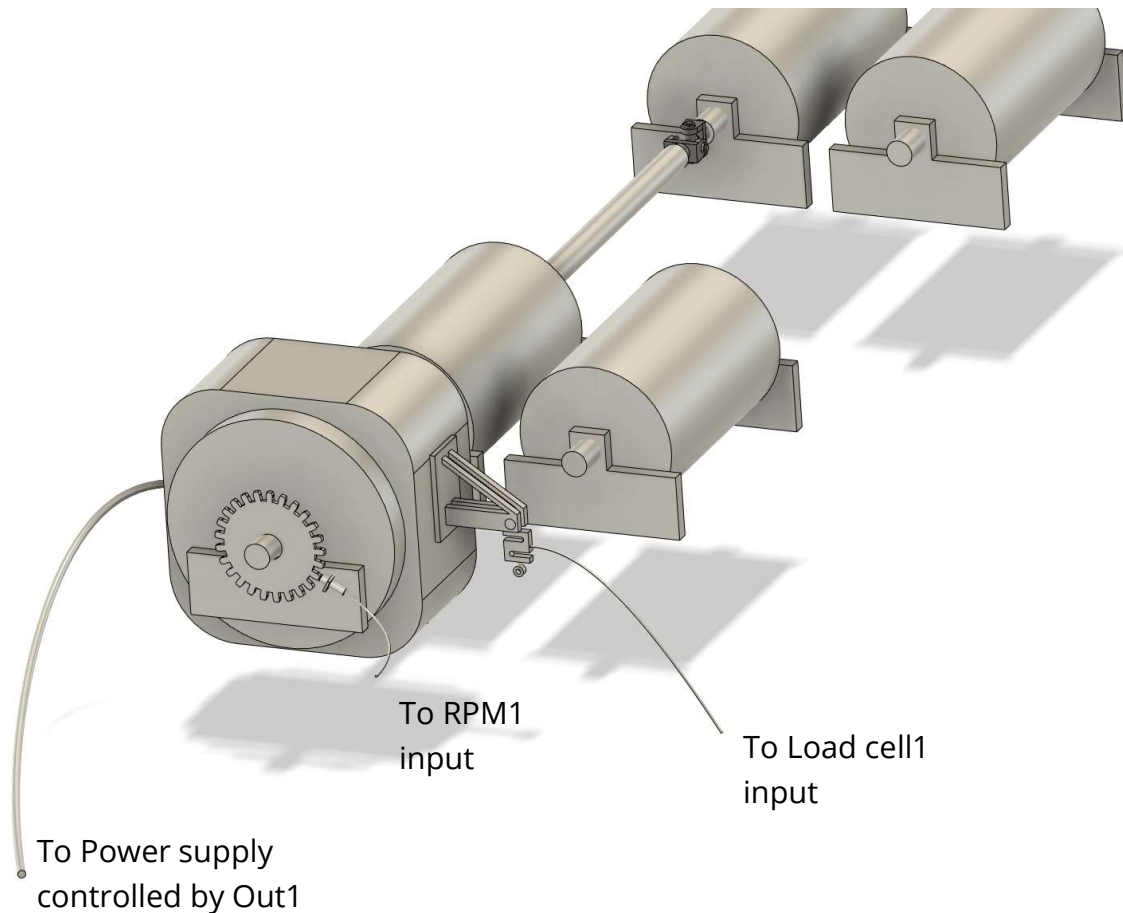
Example of single axis roller based eddy braked dyno. Newer dynos typically have a single roller per axle

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.

To RPM1
input

To Load cell1
input

To Power supply
controlled by Out1

To RPM2
input

To Load cell2
input

To Power supply
controlled by Out2
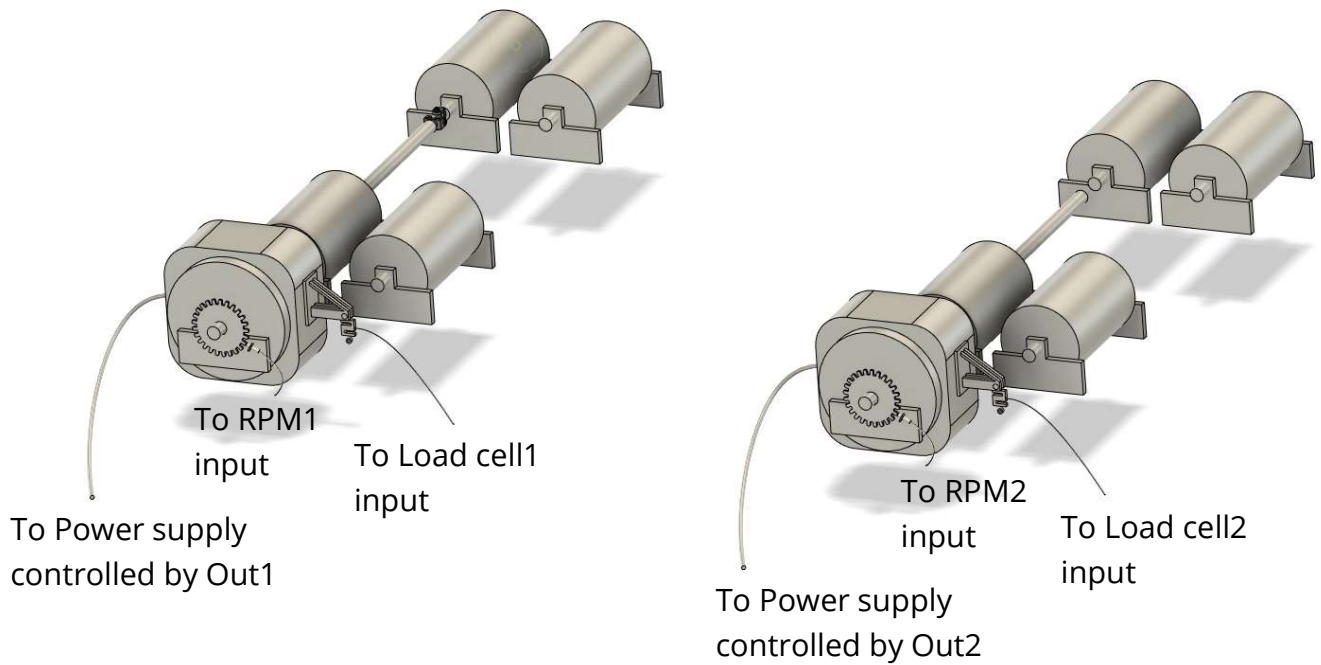
Example drawing of a 4WD roller based eddy braked dyno

8.4 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, with RPM1-4, Load Cell 1-2 and Out 1-4 being used.

A hub dyno from JDM Dyno using YourDyno

8.5 Eddy current brake 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.

8.6 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 sensor station (weather station) that are used for horsepower corrections come with a is easy to install somewhere close to the engine's intake.

9.2 USB cable considerations

- The YourDyno box is connected to the PC with a USB cable. Max length without a repeater is 3m.

- Repeaters need to be capable of USB 2.0 Full speed (12 MBits/s)

- If you have any connection issues or issues suspected to be from electromagnetic interference a USB isolator is recommended. 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:

  - Load cell: 3.5m
  - RPM sensors: 4m
  - Pressure sensors and Temperature sensors: 3m

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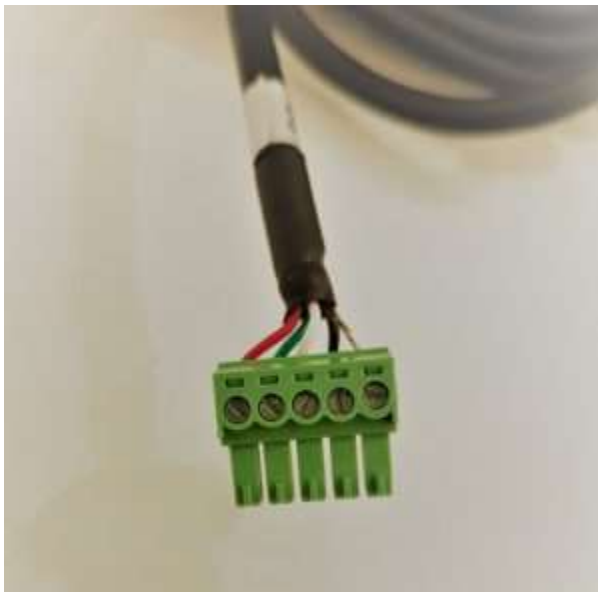
If you have your own load cell, make sure it does not have any amplifier built in, it should be completely analog. The plug is clearly marked with 5V, 0V, Signal + and -. In case you mess up the + and -, then calibration will fix that. In general, you will not

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 are also supported. VR sensors are generally not as consistent (jitter in time domain) as hall effect sensors, so for a new install, choose a hall effect sensor. In case of upgrade of an existing dyno, a VR sensor may already be installed. In that case, connect to the VR RPM input. There is a jumper inside the YourDyno box that selects between RPM1 and VR RPM that needs to be set in this case.
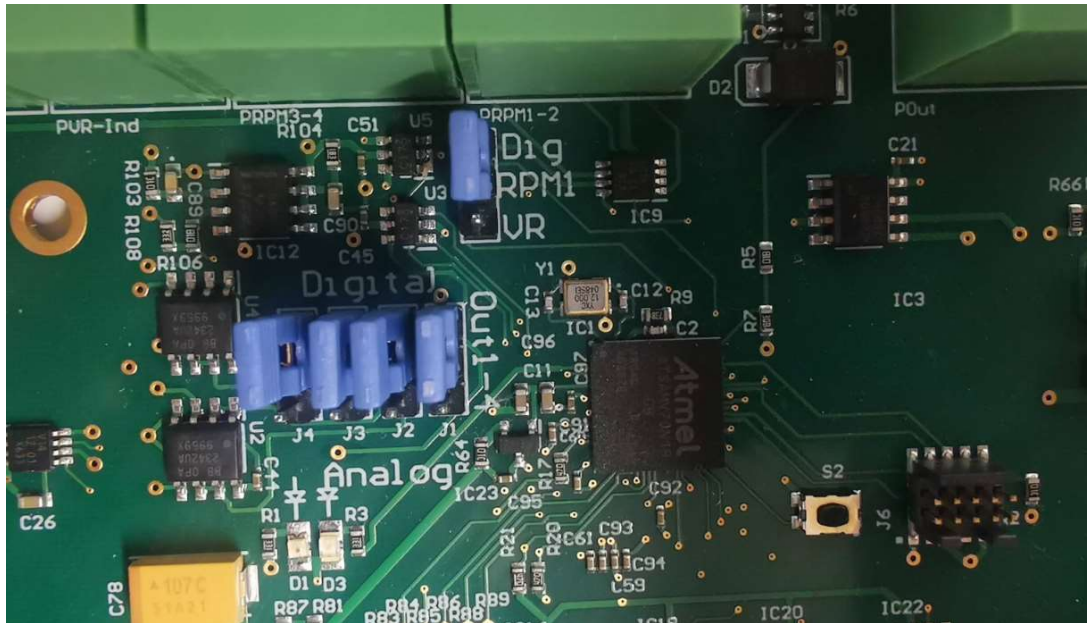
*Figure 2 Digital (default) or VR sensor selection jumper*

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 carbon steel).
2) Stainless steel does not work as a trigger wheel
3) 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]
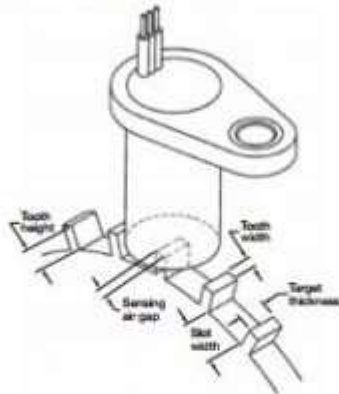
Characteristic	Parameter
Tooth height	5,06 mm [0.200 in] min.
Slot width	10,16 mm [0.400 in] min.
Tooth width	2,54 mm [0.100 in] min.
Target thickness	6,35 mm [0.250 in] min..

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

.4" Outer
20 Tooth
10mm Bore

Example of a trigger wheel. Note the sharp teeth. The YourDyno trigger wheel has 30 teeth and is made of 6mm thick carbon steel. Note that stainless steel or aluminium does not work for trigger wheels!

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 the accuracy of the power/torque from inertia 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 Enabling the prescaler

Max pulse frequency is 5000Hz. So, for example a 30 tooth wheel can max have 10.000 RPM. You can reduce the effective tooth count by enabling the prescaler. The prescaler effectively divides the pulse count frequency with the prescaler number. Using for example a prescaler of 3 with a 30 tooth wheel sets the minimum RPM to 1200 and max RPM to 30000.

10.6 Engine RPM sensors (hub/roller dynos)

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:

10.6.1 Spark plug wire/coil wire signal pickup

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

YourDyno Ultimate has an RPM pickup input (called IndRPM). It needs an inductive clamp such as the Innovate Motorsport clamp kit which connects to 0V and Signal (and shield if available).

Figure 3 An inductive clamp for use to pickup RPM from the primary of the coil

10.6.2 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.

The OBDLink LX from obdlink.com is a good OBD2 adapter.

*Figure 4 OBDLink LX is recommended*

10.6.3 CAN Bus

Most vehicles have CAN Bus, even off the shelf ECUs provide this. Engine RPM, along with many other parameters can be logged via a CAN bus interface. YourDyno Ultimate has built in CAN bus support.

10.7 Aux channel setup

YourDyno supports 8 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. Unused Loadcell channels can also be used as 0-5V aux channels (software does not support this yet).

The aux channels are clearly marked with 0V and Signal, and connecting the sensor is straight forward. 0V is common for all sensor inputs.
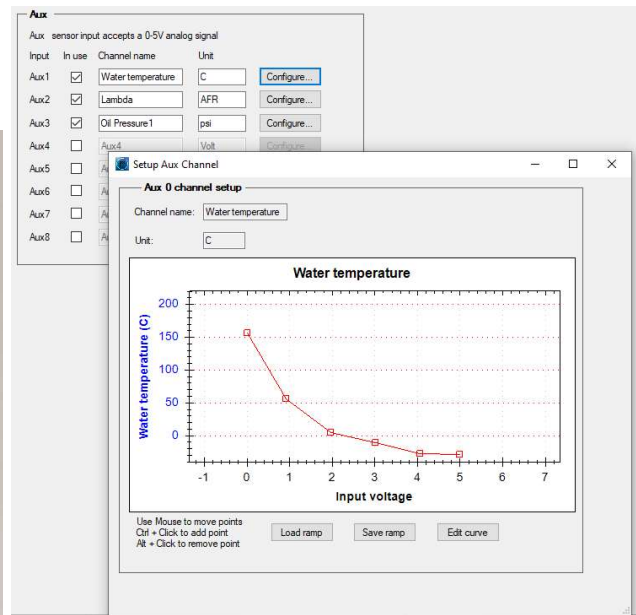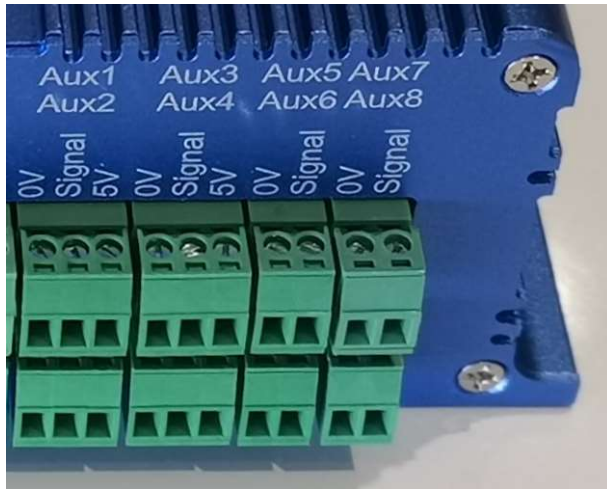
The Aux channels and how it is setup in the software

For YourDyno sensors (pressure and temperature sensors) the channel config file (which sets the reading vs input voltage can be chosen directly with Load ramp.

10.7.1 Aux pullup resistors

Aux 1 and Aux 2 have pullup resistors that can be enabled with jumpers. These are typically used for thermistors.
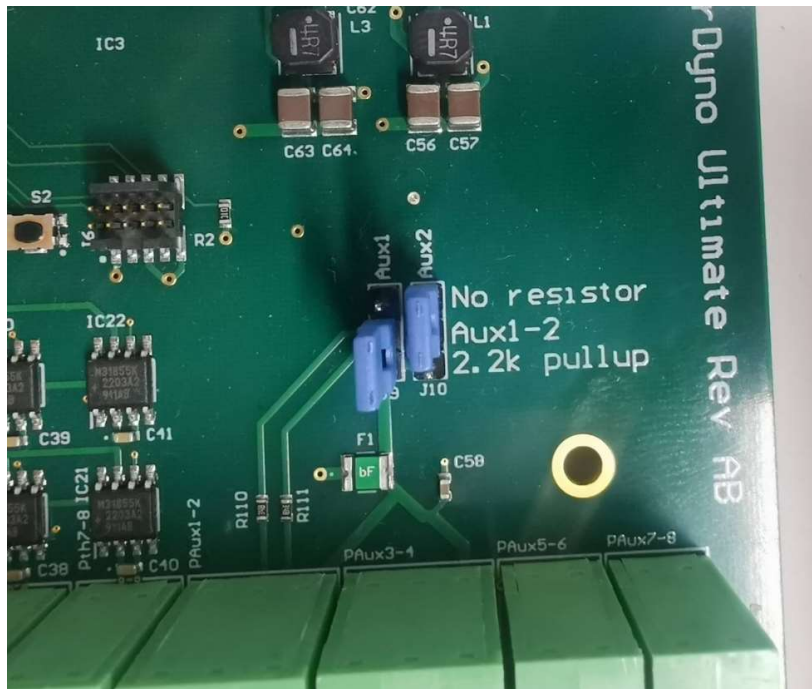
Figure 5 Internal pullup resistors for Aux1-2

10.7.2 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.

Figure 6 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 Aux1-8

10.8 Thermocouple channel setup

YourDyno Ultimate has 8 k-type thermocouple channels. More can be added with plugins. Make sure to use a an isolated 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. The shield is normally connected to the sensor side, not the YourDyno side.

11 Brake control

YourDyno can control the dyno brakes 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/servo 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.
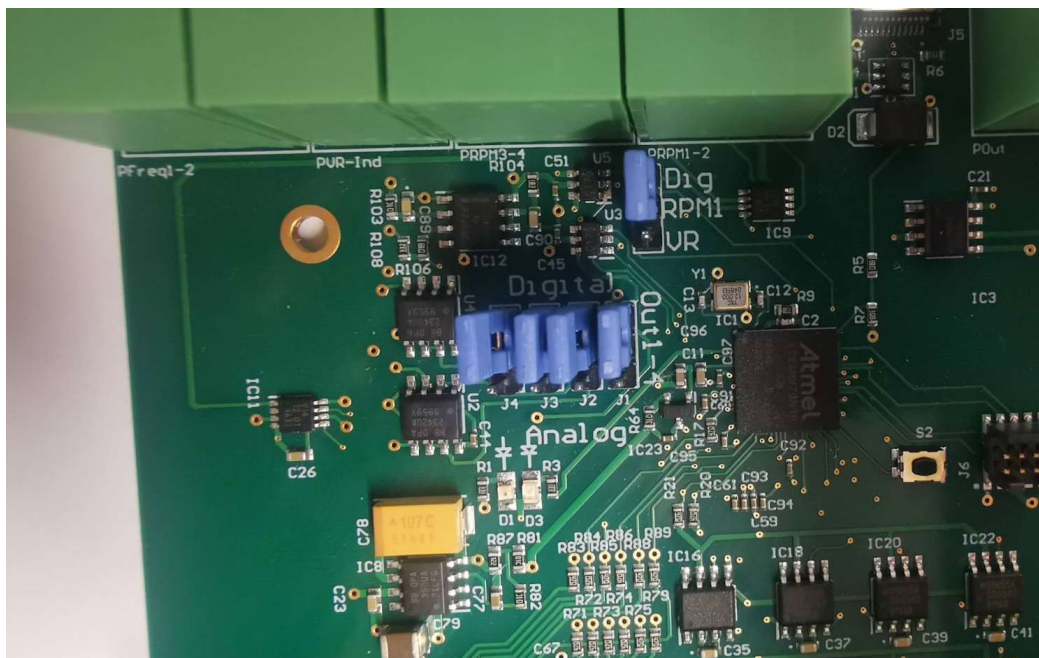
Out 1-4 jumper selection (here shown in digital position)

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.
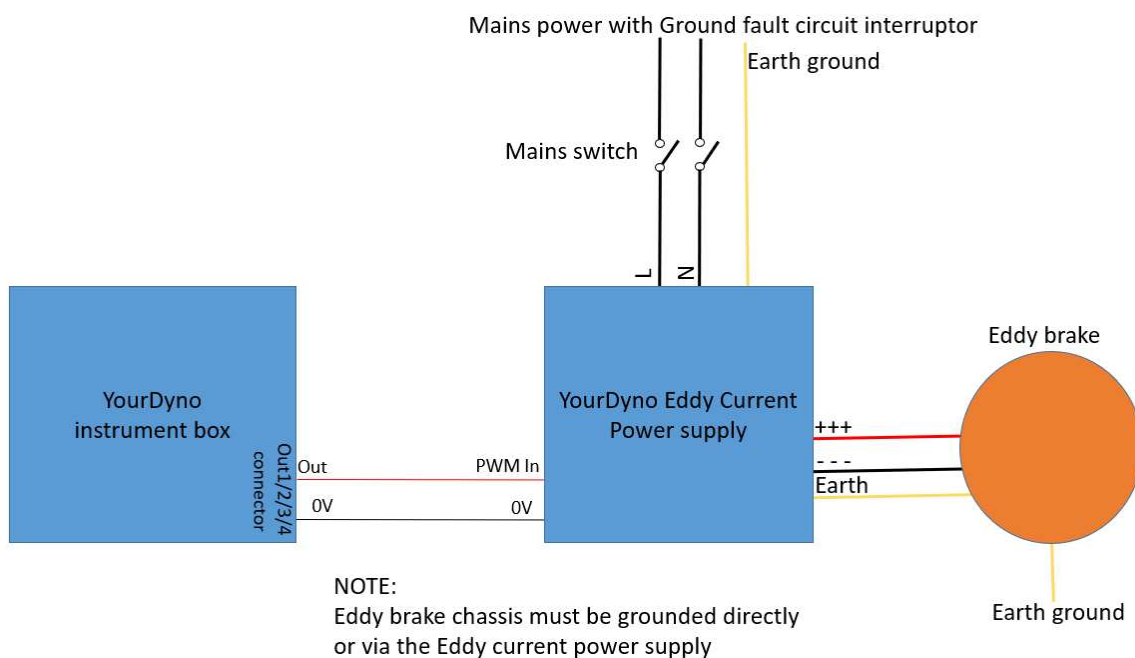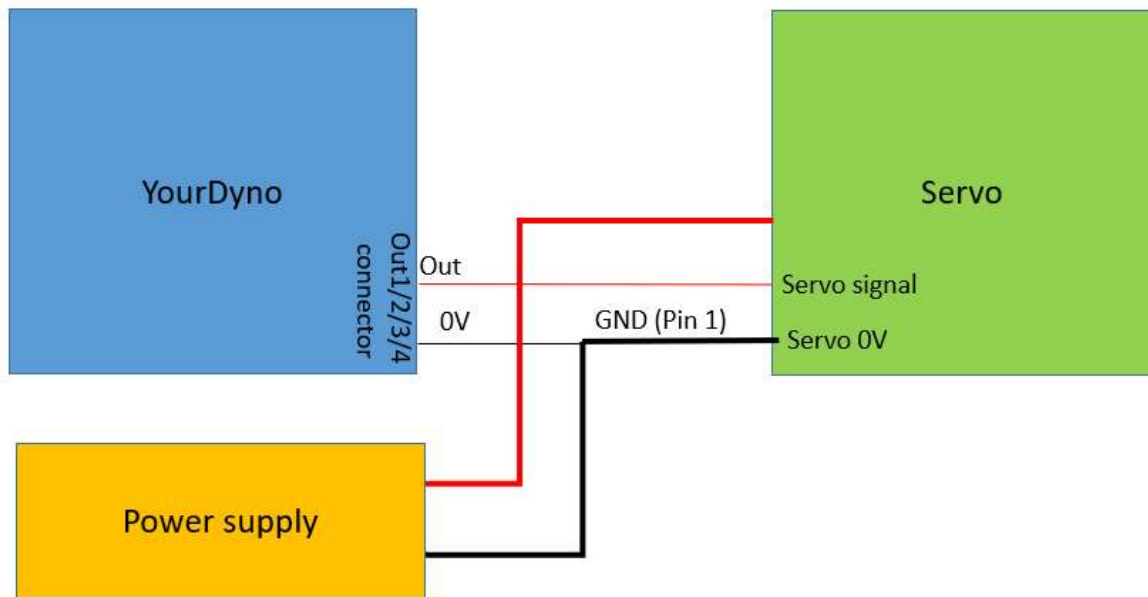

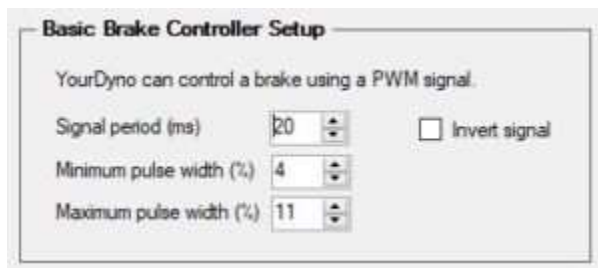*Figure 7 Connection to the YourDyno power supply*

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. Here is how to connect the stepper controller.
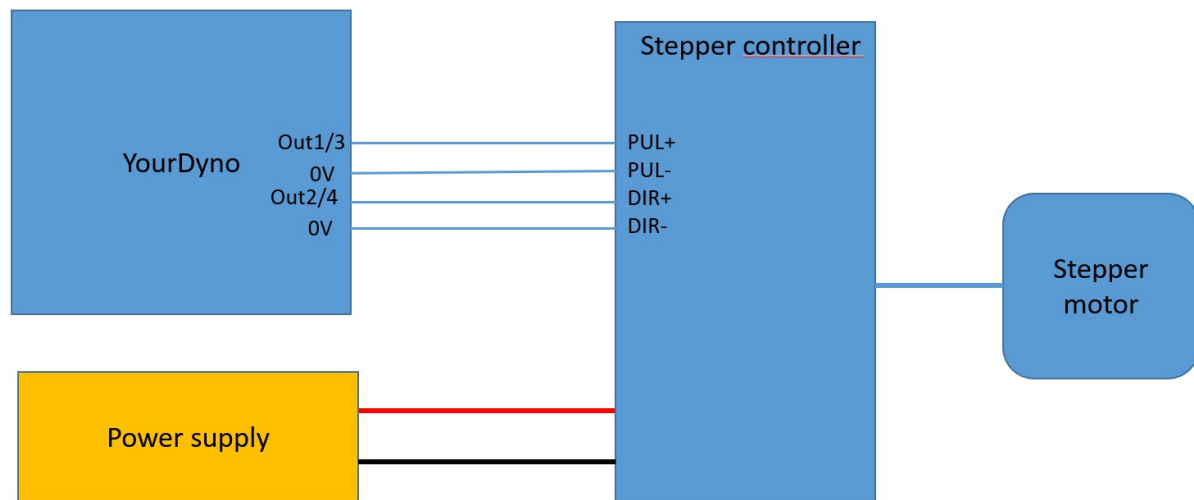
Figure 8 Stepper motor connection

Connections to a stepper motor and stepper motor driver/controller. For Standard v5, use PUL+ to Out1 and DIR+ to Out2.

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.

12 The YourDyno Dyno control software

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