Instructions to make an OnTrack Dyno Speed Sensor

The OnTrack Digital dyno software uses the soundcard in a PC or laptop to capture data signals from an inertia dyno speed sensor and convert the signals from analogue to digital data.

A soundcard can capture up to 48,000 data samples per second, so it can very accurately capture and process the signals from an inertia dyno speed sensor.

Data Input Ports on PCs and Laptops

OnTrack can use either a Line-In or Microphone (MIC) port on a PC soundcard for data input. The maximum voltage that these ports will accept is 5V for the Line-In and 0.5V for the Microphone port.

These Build Instructions are for a Dyno Speed Sensor that uses the PC Microphone port

Some PCs and laptops only have one sound input port, usually marked as Microphone. The single port in these PCs can sometimes be set in the Windows Sound Settings as either a Microphone or Line-In port. We use the Microphone setting.

The advantage of using the Microphone port for input is that one of the lines in the Microphone port has a voltage, in the range of 3 to 5 volts, that can be used to generate a data signal for the Speed Sensor.

Many new laptops do not have a Microphone port at all in which case you can use a Sound Port adapter, pictured below, that includes a Microphone input and plugs into a USB-B or USB-C port on the laptop. These adapters are small and inexpensive.

The following are examples of USB-B audio adapters for PCs and laptops.

Speed Sensor Circuit Diagram

The Speed Sensor uses a Reed Switch that is triggered by a passing magnet which turns the switch on or off, depending on the type of Reed Switch, and this generates the speed signal pulses that are captured at the Microphone port of the PC.

There are 2 types of Reed Switches. The Normally Closed (NC) type has the Reed Switch closed (on) when a magnet is close to the Switch and the Normally Open (NC) type has the Reed Switch Open (off) when a magnet is close to the Switch. You can use either a Normally Closed or Normally Open Reed Switch, but it is very important to choose the correct circuit below to match the type of Reed Switch that you are using.

Note: Most Reed Switches that you can purchase at an electrical or hardware store are of the Normally Closed (NC) type. We have also seen Reed Switches that are incorrectly labelled as Normally Closed or Open so you should test the Switch to check the type.

Speed Sensor Circuit Diagram for a Normally Closed (NC) Reed Switch

Normally Closed Reed Switch **Stereo Audio Jack**

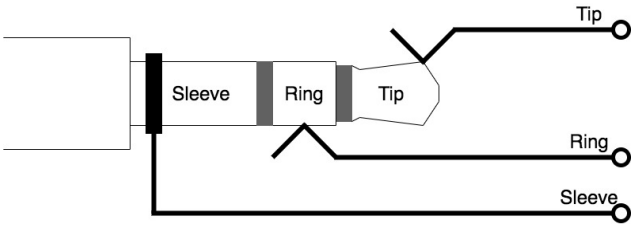
| A _____ Audio Jack Ring (5 volts)
|
|
/ Reed Switch
|
|
| B_____
|
330 ohm
|_____Audio Jack Tip (Speed Signal)
| | |
33 ohm Diode 1 Diode 2
|_____ |_____ |_____ Audio Jack Sleeve (Earth)

Speed Sensor Circuit Diagram for a Normally Open (NO) Reed Switch

Normally Open Reed Switch **Stereo Audio Jack**

| A _____ Audio Jack Ring (3-5 volts)
| |
| 330 ohm
/ Reed Switch |_____Audio Jack Tip (Speed Signal)
| | | |
| 33 ohm Diode 1 Diode 2
| B_____ |_____ |_____ |_____ Audio Jack Sleeve (Earth)

3.5mm Stereo Audio Jack



How the Speed Sensor works

The Speed Sensor uses a Proximity Reed Switch that is triggered by a passing magnet which turns the switch on and off which generates the speed signal pulses that are captured at the Microphone port of the PC or laptop and is processed by the OnTrack Dyno software.

The signal is filtered by the resistors (33 Ohm and 330 Ohm) that act as a voltage divider to reduce the 3-5 volts from the Audio Jack Ring down to 0.3-0.5 volts for the Speed Signal line on the Audio Jack Tip.

Diodes 1 and 2 are connected in opposite directions with the negative side of one Diode connected to the Earth line and the negative side of the other Diode connected to the Signal line. The diodes are used to limit the maximum voltage across the Signal and Earth lines and filter out any stray voltage peaks. PC Microphone and USB ports include their own voltage limiting protective circuits, but we have included these diodes just to be doubly safe. The maximum voltage allowed by the diodes across the Signal and Earth lines is 0.7 volts, with any higher voltages filtered out.

Parts required for the Speed Sensor

1 Magnet triggered Proximity Reed Switch. It can be a Normally Closed (NC) or Normally Open (NO) type.

Regarding the selection of a Reed Switch, we have tested many Reed Switches, including inexpensive types from a hardware store and more expensive “industrial” types and all perform well with clean switching up to the maximum trigger frequency that we tested of 14,000 switches per minute.

The following are examples of Reed Switches. Reed Switches are very reliable, but it’s a good idea to buy a second as a spare.

This type of Proximity Reed Switch and paired magnet is usually a Normally Closed (NC) type. They include a mounting flange and are often used as door sensors. They can be purchased from electronic stores and many hardware stores. These switches are inexpensive and work well as a dyno speed sensor. You can swap the magnet for a small Rare Earth magnet which may be easier to mount on a dyno shaft.

This type of Proximity Reed Switch has both Normally Open (NO) and Normally Closed (NC) circuits.

Proximity Reed Switches are available in many forms, this type has a threaded body and position adjusting nut.

This type of Reed Switch and magnet is often used in security applications and can be purchased at electronic and hardware stores.

1 Rare earth magnet: This is optional if the Proximity Reed Switch comes with a trigger magnet. Rare earth magnets are very strong magnets, and you can mount them further from the Proximity switch (5-10mm) if required.
For example: A small Rare Earth button magnet can be glued to the dyno shaft and works well. Also, a layer of glue over the magnet will not affect its ability to trigger the Reed Switch. Buy a couple as spares.

1 Stereo 3.5mm Audio Cable: A good quality, shielded audio cable that is long enough to run from the PC microphone port to the speed sensor on the dyno. It is important that it be shielded to prevent interference. If needed, you can use audio extension cables to get the length required. Note: Some stereo audio cables are made as a single cable with the shielding around 2 inner wires. Others are 2 cables joined together, each with shielding around one wire. Both types of cable will work fine.

Resistors: 1 x 33 Ohm, 1 x 330 Ohm. Note: The exact value of the resistors is not important, just that the ratio between the two resistor values is 1 to 10. For example: 1 x 100 Ohm and 1 x 1000 Ohm (1k Ohm).

Diodes: 2 Silicon Diodes. The exact diodes is not so important, just that they are Silicon Diodes, for example: type 1N4001, 1N4004, and 1N4007, and that they have a maximum voltage of 12V or greater.

Circuit Enclosure Box: This is optional. The resistors and diodes can be located at the Proximity Switch or at any point along the audio cable. To locate them along the audio cable you can cut the cable, feed the cable through a hole drilled in each end of the Circuit Enclosure Box and solder the resistors and diodes across the cable wires inside the box. Fasten or glue the cables so that they cannot be pulled out of the box.

Circuit Enclosure Boxes are available in a variety of sizes, plastic or metal, and some include mounting flanges. The box can be any size and as small as 50mm x 75mm (2in x 3in) which is large enough for the few components required.

1 Small Circuit Board. This is optional. For a neat job you can mount the resistors, diodes and cable ends on a small circuit board which fits inside a Circuit Enclosure Box.

Wiring up the Proximity Switch (Sensor)

Referring to the correct Speed Censor Circuit Diagram above for the type of Reed Switch that you are using.

Cut off the audio jack from one end of the audio cable, separate and bare the cable wires, then connect the cable wires from the audio jack to the Reed Switch and other components according to the wiring diagram. When you first cut the audio cable and bare the wires you should test which wires are connected to the audio jack Sleeve, Ring, and Tip. The Sleeve will be the shielding wire that wraps around the other 2 wires. Check which wire is which with a multimeter. If you don't have a multimeter then here is your chance to get one, every home should have one.

The diodes and resistors can be placed at the Proximity Switch or anywhere along the cable, optionally in a Circuit Enclosure Box above.

Mounting the Speed Sensor on the dyno

The trigger magnet can be mounted on any moving part that is rotating at the same speed as the dyno flywheel or rollers. A good place is on the main dyno shaft. You can glue the magnet to the shaft with epoxy or similar glue. It does not affect the signal if you cover the magnet with glue. The Proximity Switch needs to be mounted so that the magnet passes the switch with a 2-5mm gap. With a strong Rare Earth magnet, the gap can be up to 10mm.

Note: When routing the audio cable keep it away from engines, electric motors and other equipment that may course interference.

Testing the Speed Sensor

When testing the Speed Sensor, it helps to think of it as an external microphone on the PC or laptop.

PCs and laptops may also have an internal microphone or other external microphone, for example on a webcam.

It is important to check/select that the Microphone (MIC) Input that the Speed Sensor is plugged into is the active Input Device / Microphone in the **Windows Sound Settings**.

In Windows 10, this can be found at **Settings – System – Sound – Input, Chose Your Input Device** (drop down list).

After setting up the Speed Sensor as an external microphone in Windows you can test it using the standard **Voice Recorder** application in Windows.

To test using the Windows Voice Recorder:

- Open the Voice Recorder app from the Windows Start menu, or search for it in Windows Taskbar Search.
- Click on record and wave a magnet close to the Proximity Switch.
- Stop recording and play the recorded sound. You should hear a clear click – click – click sound from the magnet passing the Proximity Switch.

You can also do a test playback of the recorded data within the OnTrack Dyno software as follows:

- Start the OnTrack software and go to the Dyno Run screen
- Start a Sensor Data Input dyno run as normal, which processes and records data from the Proximity Switch.
- While the dyno run is inputting data, wave a magnet close to the Proximity Switch.
- Stop the dyno run and click on Playback data. You should hear a clear click – click – click sound through your PC speakers.

Any Questions?

Email us at: ontrackdigital@outlook.com

OnTrack Digital website: www.OnTrackDigital.com