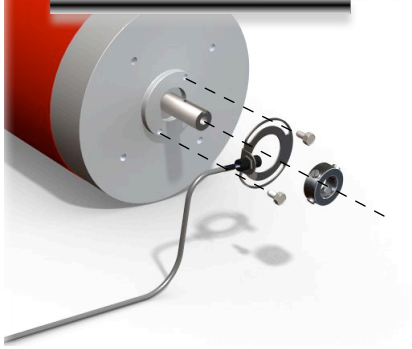
WarP™ Speed Sensor

Made in the USA by **RechargeCar Inc.**

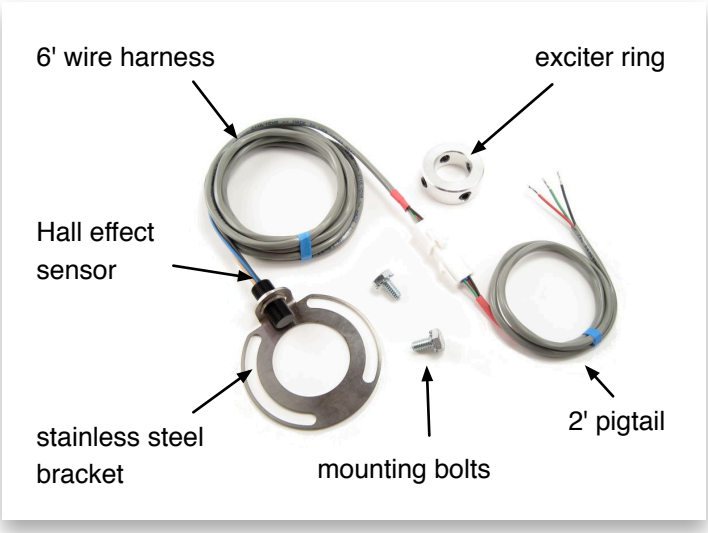


Thank you for purchasing the *WarP™ Speed Sensor* kit. This kit is designed by *RechargeCar Inc*. specifically for motors made by *NetGain Motors, Inc.* to provide RPM measurement. The sensor mounts to the tail shaft of many motors to measure RPM through a variety of possible display options. By knowing your motor's speed, you will have more control of your motor's efficiency and ability to ensure a safe operating RPM range.

What's included?

We have included everything needed to capture the speed of your motor and connect to your system to display your RPM.

The stainless steel bracket attaches to the tail-end of your motor using the included bolts to hold a Hall effect sensor. The exciter ring mounts to the motor tail-shaft with up to 4 set-screws acting as targets for the sensor. The 6' wire harness and 2' pigtail provide the electrical connection to your system.



Compatibility:

Our *WarP™ Speed Sensor* is designed to be compatible with the motors made by *NetGain Motors, Inc*. including most WarP™, ImPulse™, and TransWarP™ motors. Check for the two 1/4"-20 tapped holes near the tail end of your motor. This is where the sensor bracket mounts. Since the shaft diameter is different among the motors, when ordering choose:

7/8" (0.875") exciter ring for: WarP™ 8, WarP™ 9, WarP™ 11, and ImPulse™ 9 motors

1 1/8" (1.125") exciter ring for: WarP™ 13, TransWarP™ 7, TransWarP™ 9, and TransWarP™ 11 motors

Using accessories on tail-shaft of your motor:

Depending on your setup, you may be able to mount accessories on the tail-shaft while this kit is installed, including pulleys for turning pumps or compressors. The final, overall height of this setup is 0.925 inches (23.5mm) with a diameter of 2.9 inches (73.7mm).

Installation:

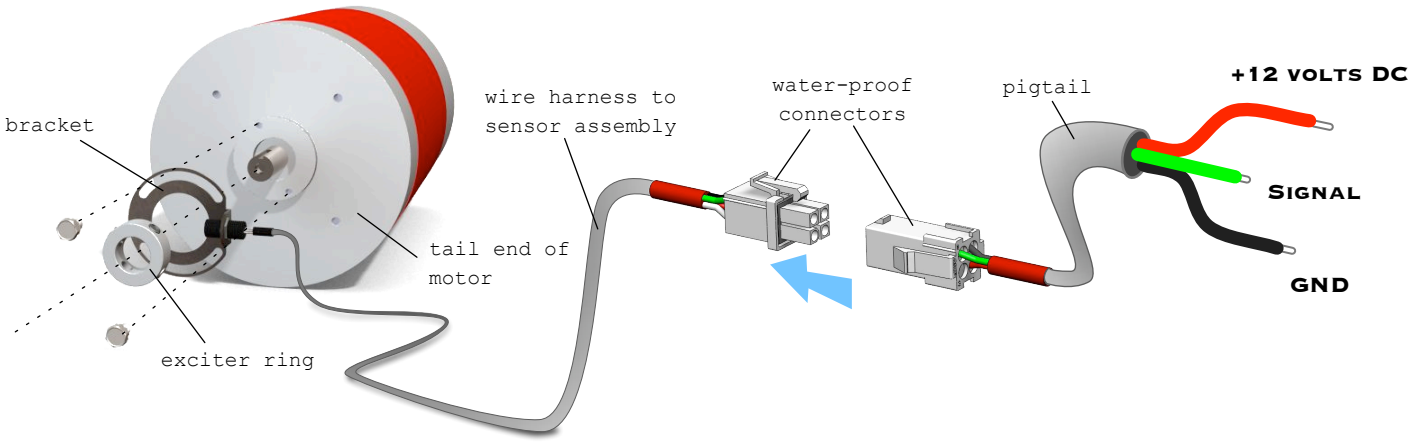
Installation of this kit requires only basic tools: a 7/16" socket wrench to mount the bracket, a standard screwdriver to secure the set-screws, and a two 9/16" open-ended or crescent wrenches to adjust the sensor position. Follow these steps for easy installation:

Step 1: Attach bracket and sensor assembly onto the tail (commutator) end of your motor using the two included bolts/lock washers. The angle of the bracket is adjustable.

Step 2: Slide the exciter ring over the shaft until the sensor points directly at the ring.

Step 3: Tighten each set-screw firmly, avoiding the keyway. Ensure that each set screw is at an equal depth. **Note:** Use 1, 2 or 4 set screws depending on how many pulses per revolution your system requires. If using 2 targets, make sure set screws are at 180 degrees from one another.

Step 4: Although we have pre-positioned the sensor in the bracket, you may need to adjust the distance between the sensor and the targets to about 1/16".



Hook-up instructions:

We have designed this sensor to be as compatible with as many systems as possible. The sensor simply provides "pulses" every time a piece of iron-based metal passes. As a result, it can be used for many applications, including driving after-market tachometer gauges and meters, interfacing to a computer via our *AutoBlock RPM*, or providing a sensor input to some motor controllers. We provide a pigtail to allow you to connect your gauge to the sensor module. There are 3 wires in the pigtail: **Red = +12volts, Black = GND, Green = Signal.**

When connecting your wires to the wires in the pigtail, ensure that you are making a good electrical connection and insulating that connection from the elements and other conductors. We suggest soldering and heatshrink.

Before making your solder connection, slide some heat-shrink tubing over the wire, solder the 2 wires together and shrink the tubing over your new connection. Do this for each of the 3 wires, and follow up by wrapping all three connections in electrical tape or wire loom. Lastly, plug your pigtail into the wire harness that connects to the sensor assembly.

Using the *WarP™ Speed Sensor* with an after-market tachometer gauge:

You can use our *WarP™ Speed Sensor* with an after-market tachometer gauge to monitor the RPM of your electric motor. These gauges are available at your local auto-parts store and are designed to be be compatible with various internal combustion engine types. The gauge expects to see a pulse from the vehicle's ignition system to determine the RPM of the engine. The number of pulses per revolution depends on the number of cylinders in the engine.

The *WarP™ Speed Sensor* can be used to simulate these pulses and drive the after-market tachometer gauge by using our optional exciter ring. This ring is made from aluminum with steel set screws acting as targets for the sensor. By adding or removing some set screws, you can produce 1, 2 or 4 pulses per revolution (3 even pulses can be achieved with some user modification of the exciter ring), depending on what your system requires. Set your gauges to monitor the number of cylinders equal to twice the number of pulses per revolution. For example, use 8 cylinders if you have 4 set screws (4 pulses) on your exciter ring.

Using the *WarP™ Speed Sensor* with the *AutoBlock RPM*:

Just plug it in. We have wired up the cable harness to be fully compatible with the *AutoBlock RPM*. The *AutoBlock RPM* provides the power to the sensor, and the keyway on the motor shaft can be used as a target for the sensor. Of course the exciter ring can also be used, but is not necessary.

Check out our *AutoBlock RPM* page for more information: http://www.rechargecar.com/product/autoblock-rpm

About the sensor module:

Our sensor module is a solid-state, open-collector sinking type sensor consisting of a Hall effect element, magnet and amplifier. As a ferrous object passes by the front of the sensor, the magnetic field changes and the output signal changes accordingly. The output signal is pulled up to the source voltage via a 2.2K ohm resistor.

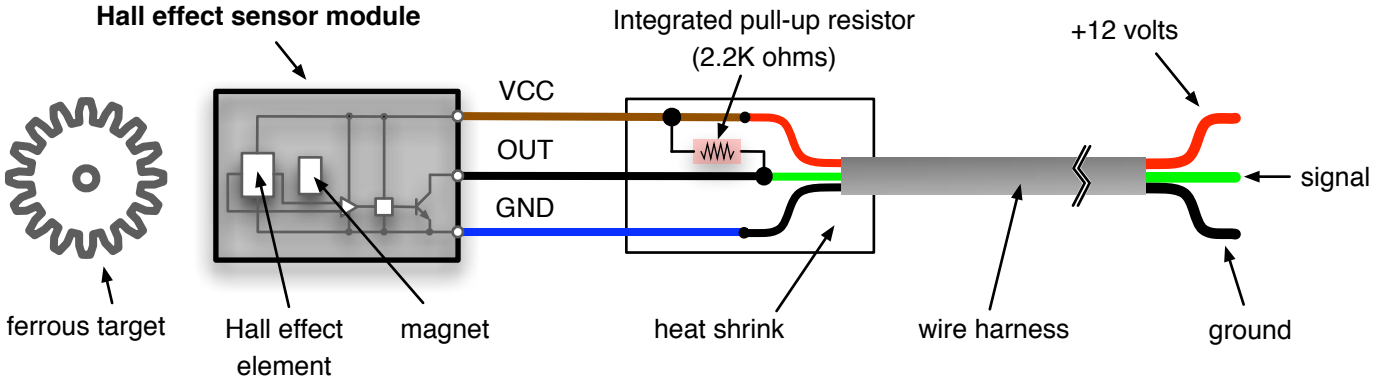
The housing is made from anodized aluminum and meets IP67 standards for dust and water protection. It mounts to the sensor bracket using 2 nuts and a lock-washer.

The sensor is capable of near-zero speed sensing. The dynamic nature of the internal circuitry allows for automatic threshold detection which self-compensates to target geometry. In other words, it is very forgiving in many setups and does not require precise alignment.

The sensor is compatible with unregulated power supply, is reverse battery protected to 24VDC and has the following technical specifications:

Supply Voltage =	4.5 - 24 volts	**Length** =	1.0 in (25.4mm)
Supply Current =	6 mA (max)	**Diameter** =	15/32" - 32 threaded
Output Voltage =	400mV (max)	**Temp Range** =	-40 to 125ºC or (-40 to 257ºF)
Output Current =	25 mA (max)		

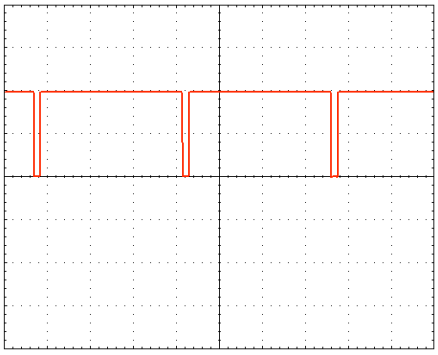
To simplify installation, we have included an integrated 2.2K Ω pull-up resistor near the sensor module sealed inside heat shrink tubing. If your application requires a smaller value pull-up resistor, place the appropriate value resistor between +12 volts and signal (in parallel with the integrated resistor), thereby reducing the final pull-up resistor value.



Sensor output:

The sensor output signal is perfect for driving gauges and meters, some motor controllers, etc. Many display options are possible as long as the signals are appropriate for the application. In order to describe the actual sensor output, typical oscilloscope waveforms of the sensor output are shown below. The test motor has a constant, known speed of 3500 RPM and has a 0.875" exciter ring attached. Each test shows the result of using 1, 2, or 4 set screw targets on the exciter ring.

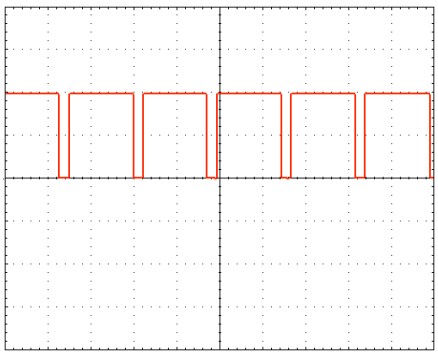
Test 1:
1 target = 1 pulse per rev



Period = 17.3ms
Freq = 1/Period = 57.8 Hz
Pos. Duty Cycle = 83%

RPM = (57.80 Hz x 60 sec/Min)/
(1 pulse/rev) = **3468 RPM**

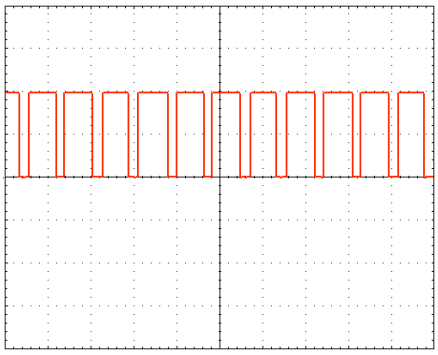
Test 2:
2 target = 2 pulses per rev



Period = 8.6ms
Freq = 1/Period = 116 Hz
Pos. Duty Cycle = 85%

RPM = (116 Hz x 60 sec/Min)/
(2 pulse/rev) = **3480 RPM**

Test 3:
4 target = 4 pulses per rev



Period = 4.3ms
Freq = 1/Period = 233 Hz
Pos. Duty Cycle = 82%

RPM = (233 Hz x 60 sec/Min)/
(4 pulse/rev) = **3495 RPM**

The horizontal grid is 5 ms, the vertical grid is 5 volts. The period (time between pulses), calculated frequency, and duty cycle are shown in for each test case.

The 80-85% positive duty cycle is approximately the same for each case. This corresponds to the geometry of the targets and distance between targets. The positive duty cycle will be greater in the 1.125" exciter ring due to the increased distance between targets.

As seen in these examples, the waveform provided by this sensor is very 'digital' in nature, where the signal is either low (near GND) when the sensor sees the target or high (near VCC) when the target is away from the target. Since most gauges look for a 'rising edge' in a waveform, this sensor is well suited for that application.

Accuracy of the final RPM value depends on the accuracy of the measurement setup. For basic displays and in-dash analog displays, small period differences will be unnoticeable. If more accurate measurements are required, high sampling rates are needed. Some products, such as the *AutoBlock RPM* can provide these high-speed digital sampling rates.

Caution:

While this product uses low-voltage to operate, the electric motor it mounts to may not. Remember, high voltage is dangerous. Use proper safety practices and equipment, read the manuals and ask questions if you are not sure about something. Never work alone.

CAUTION - high voltage electricity is dangerous. Use proper safety equipment and practices, and never work alone.

Ordering:

The *WarP™ Speed Sensor* is available from authorized *NetGain Controls* distributors and *RechargeCar Inc.*

http://www.ngcontrols.com/

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