SPEEDOM8R instruction manual

Built under U.S. Patent # 7,392,145

Overview

The device you are about to install is intended for use with a cable driven mechanical speedometer. Installation on newer electronic speedometers will simply not work. The idea here is to use a small electric motor to drive the speedometer in place of the speedometer cable. With this device, you can always and easily maintain the accuracy of your vintage speedometer instrument. Changes in wheel size or tire size can be easily and accurately compensated for in minutes, without ever having to move the vehicle and without ever having to spend money on gearboxes, drive gears or cables. The SpeedoM8R brings you the magic of having your vintage instruments run with the accuracy and convenience of state of the art computer technology.

We love old cars and custom cars and we love to see them on the road and up to par. We also know it can be difficult keeping them that way. The device you are about to install should make your old speedometer work like new again. So, Have at it! Feel free to email us with any questions or concerns you might have while installing or using this product. But before you start, we thought you might enjoy seeing the test bed that started it all.

1960 Fiat Abarth Zagato 750 Gran Tourismo

Installation and operating instructions

This is, in great part, a do-it-yourself project and one that is well worth the effort. Please read through these pages at least once before installing and using this device. Much of the content will be obvious

to most of you, but there are some interesting and unusual features that you should be aware of.
Contents

Unpacking.

Take a few moments to familiarize yourself with the individual parts that come with the SpeedoM8R. We will describe them in detail as we progress through the installation instructions. You should find the following items included in your package:
Controller assembly
Wheel sensor assembly and magnet
Drive motor assembly

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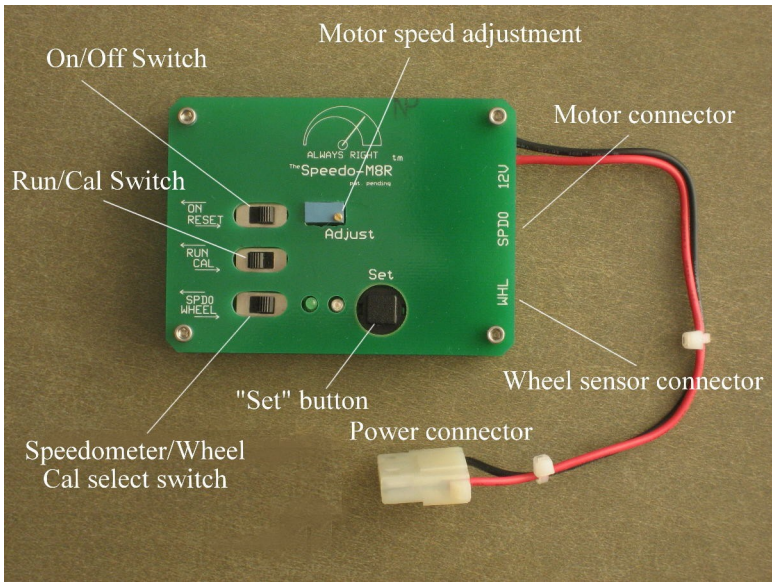
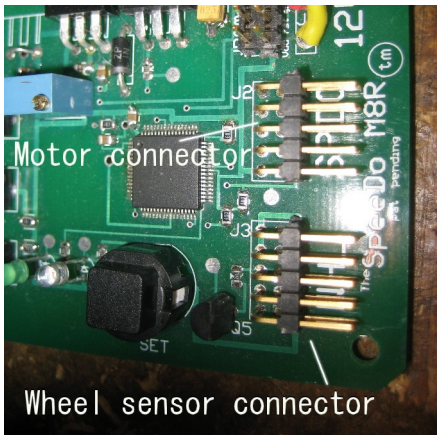
Let's start with the controller.





Power connector

Two wire connector for Power and Ground provides power for the entire device. Although it is preferable to connect the Red wire to 12 volts and the Black wire to ground. These wires can be reversed with no ill effect. In any event, the power wire should be connected to a 12 volt source that is switched off with the ignition key.

On/Off Switch

Should be ON for normal operation. The OFF position is provided as a means of rebooting (resetting) the on-board computer. The unit is disabled in the OFF position.

Run/Cal Switch

This switch should be in the RUN position for normal operation. It should be moved to the CAL position when doing a Calibration operation on either the Speedometer or the Wheel sensor.

Speedo/Wheel Switch

This switch should be in the SPEEDO position to calibrate the speedometer. It should be moved to the WHEEL position to calibrate the wheel sensor for various size wheels and tires. This switch is only used when the run/cal switch is in the CAL position. When in the RUN mode, the speedo/wheel switch can be left in either position.

Motor Speed Adjustment

This is a 25 turn adjustment used to change the speed of the drive motor during calibration. A convenient adjustment wand is included in the package. Turning the adjustment "knob"to the left, or counter clockwise, lowers the motor speed. Turning it to the right, or clockwise, increases the motor speed.

Set Button

This button is used during the calibration of both speedometer and wheel sensor. It is also used to enter the Measured Mile test.

LEDs

There are two. One green and one red. These are status indicators and serve several functions. These will be discussed later in these instructions.

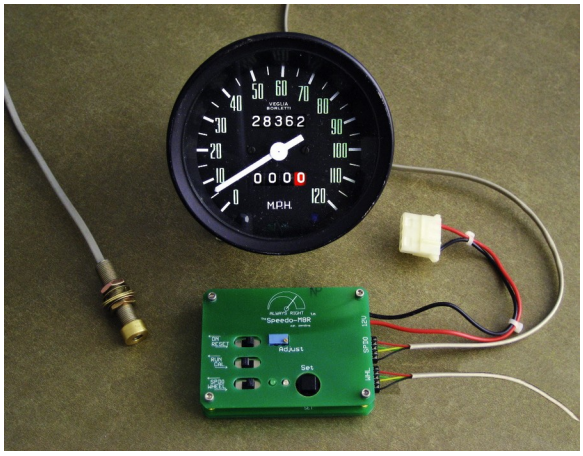
Motor Connector

This is a 10 pin male header connector. The drive motor is connected here.

Wheel sensor connector

This is a 10 pin male header connector. The wheel sensor is connected here.

WHEEL SENSOR ASSEMBLY



This assembly is housed in a 3/8" threaded steel cylinder. It's job is to detect a small magnet passing in front of it. The magnet is attached to one of your road wheels or to a component that rotates at the same rate as the road wheel being measured. You must provide a custom bracket or other means to hold the sensor. Further information is given in the Wheel sensor installation section of these instructions.

The neodymium (rare earth) magnet supplied is .375” in diameter (3/8”) or 9.52 mm. It is .125” thick (1/8”) or 3.125 mm. It is approximately half the size of a US penny, but a bit thicker.

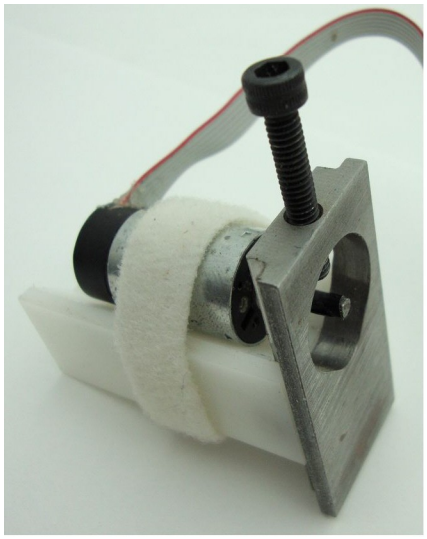
One word of caution before you begin. The neodymium rare earth magnet supplied with this kit is very strong for it's size. Mechanical watches and pacemakers can suffer ill effects if they come too close to strong magnets. Please be informed of such matters and take appropriate precautions before you begin .

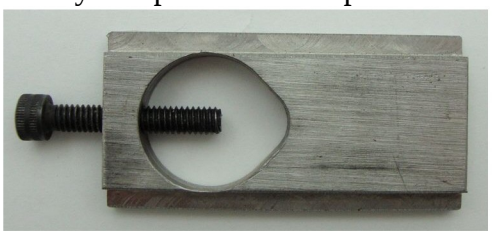
DRIVE MOTOR ASSEMBLY

This assembly consists of three parts.

1. motor and associated cable
2. motor carrier
3. speedometer mount clamp

The unit mounts on the back of your speedometer in place of the existing speedometer cable.





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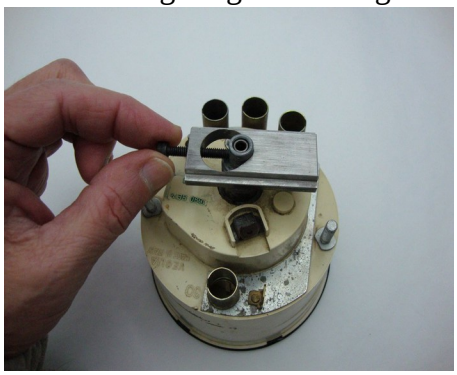
Installing the drive motor

The motor assembly replaces your speedometer cable. Disconnect the speedometer cable at the rear of the instrument and tie it off neatly out of the way. The next time you might need it will be when you sell your vehicle and move the SpeedoM8R to your new one. Leave the cable connected at the transmission or wheel end. Because the cable may still rotate as your vehicle moves, you will want to cover the open end of the cable so grease and oil can't spray around under the dash. A small plastic bag and a twist tie or plastic tie wrap will do here. The mounting system is designed to make it reasonably easy to get things lined up properly. The closer you can line up the motor with the center of the speedometer, the smoother things will run. Some guidelines below may help. Here is what you will need to do.

1. Remove the cable from the back of the instrument. Cover the end and tie off the cable in a convenient location.

2. Install the clamp onto the back of the speedometer. Do NOT over tighten as this can damage the speedometer. Finger tight to a snug fit is best. Wiggle and retighten.

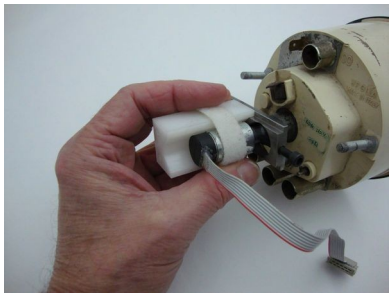


3. Insert the motor into the back of your speedometer instrument.

4. Attach the carrier to the clamp below the motor.
(Careful not to pinch your fingers !!)

5. Slide the carrier up until the motor rests in the groove.

6. Fasten the motor tightly to the carrier using the velcro strap



7. Connect the flat cable to the controller.

We'll get into specifics in a moment, but after the initial installation and jut before the first time calibration exercise, it is useful to readjust the mechanical position of the motor/carrier while the motor is running. You can begin by turning the adjustment knob to a convenient speed. Adjusting the position of the motor by sliding the carrier up or down will either cause or relieve a certain amount of mechanical misalignment. This will raise or lower the motor speed, hence raising or lowering the speedometer reading. The best motor alignment will be when the speedometer needle has the highest reading. The motor will also sound the smoothest at this position. This will be quite intuitive as you're doing it.

The motor mount components automatically allow for alignment in the horizontal axis. The motor mount will need to be adjusted in the vertical axis to compensate for differences in the diameter of the clamp surface of your speedometer instrument. Further, the motor can be moved up or down to allow the drive end to be optimally seated into the speedometer. Often, the space behind the speedometer is difficult to get to and tools are difficult to use. We have provided a knurled thumb screw for tightening and loosening the mounting clamp. As you get into the installation , you will find that the entire job can be quite nicely done by touch alone. It will be obvious when the motor is aligned, as it will run smoothly and make little clattering or vibrating. Small, sometime very small changes in position will make big changes in performance. Get it close first, then fine tune. Once the mount clamp is firmly attached to the speedometer, and the motor inserted into the speedometer, final

positioning should be done with the motor running. Make small adjustments until the motor runs smoothly and quietly, then do your final tightening. Again, no tools for tightening as this can deform the speedometer and cause binding.

Most speedometer cable core ends are square. Some are a little larger than others, but not by much. The plastic part on the end of the motor (the drive shaft) is the same size and shape as the end of your speedometer cable core. This is what goes into, and drives your speedometer. If your cable core has a different shaped end, email us with specifics and we'll try to provide what you need. If you find that the part on the end of the motor is the correct shape but just a bit too small in diameter, you can wrap a small piece of masking tape tightly around the part to build up the diameter until it fits snugly into the instrument. This approach has proved to be quite adequate when a larger diameter drive shaft was needed.

Installing the controller

The controller should be mounted within 18 inches of the drive motor, since that is how long the standard flat cable from the motor is. The controller can be attached to any convenient surface with the Velcro pad included in the kit. The choice is yours, but a few suggestions may help.

1. Try to allow for air flow above and below the unit to help cool the heat sink.
2. If possible, you may want to locate the controller in a place where you can see the LEDs.
3. Try to keep the controller from becoming wet for any reason.
4. Although it is rarely needed, it is possible to add extra length to the motor drive cable but this cable should never exceed six feet in length. If you need extra length, please contact us. We would be pleased to discuss the pros and cons and could possibly provide you with the exact additional length cable you need.
5. Finally, take extra care to make sure the connectors from the motor and the wheel sensor are squarely inserted into their respective mating connectors.

Installing the Wheel sensor (general guidelines)

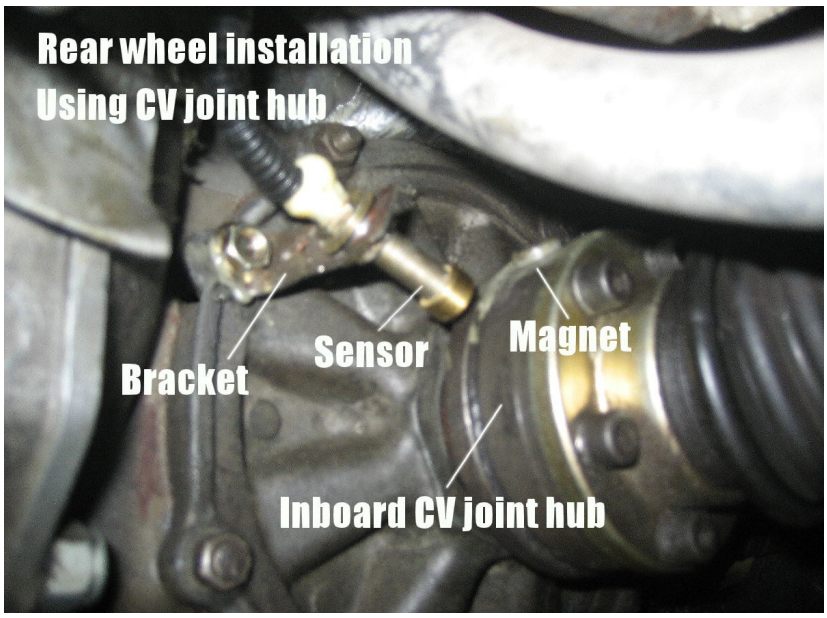
The wheel rotation sensor consists of two parts. The first is is a hall effect sensor which detects the presence or absence of a magnet passing in front of it. The second is the magnet which it detects. The sensor is housed in a threaded cylinder and has a cable of sufficient length to reach from the wheel to wherever the controller board is mounted. The end of the cable has a connector which plugs into the controller. The placement of the sensor and associated magnet is left to you to determine. However a few general rules and guidelines are offered here to make the installation easier.

Your first task is to find a place on your vehicle that rotates at the same rate as one of your road wheels. You can install the sensor and magnet on either a front or rear wheel. The location could be a rim, an axle, or any other rotating part to which a magnet can be glued. An inner or outer CV joint body is a good location if one is available. A rotating brake drum, although convenient, most often will require a bracket to hold the magnet away from the drum surface because of the high heat generated when stopping. Excessive heat can ruin the magnet causing poor performance or no performance at all.

The second task is to attach the magnet. Make sure it can't bump into anything on the way around. The magnet weighs XX grams. If balance is an issue in your installation, you can place a counter weight on the opposite side. Often it is not needed. Do NOT use more than ONE magnet as this will cause improper operation. Once the magnet is glued to the rotating member, the sensor must be mounted on a bracket of your choosing, such that the magnet passes directly in front of the sensor at no more than a 5/8 of an inch away. (closer if possible as long as it does not bump into the magnet) once per revolution of the wheel being measured. This is by far, the most difficult part of the installation. The bracket should be strong and stable and not allow the sensor to wander around. Once the magnet and sensor are in place, the sensor cable must be run to wherever the controller is located

and the end of the sensor cable should be plugged into the “wheel” connector on the controller board. Care should be taken to ensure that the cable does not drag on the ground, lay against any moving parts, or lay against any potentially hot surfaces. In short, try to protect the cable from any possible damage. If the sensor is mounted on a steerable wheel, make sure there is sufficient slack in the cable (or a small loop) to allow for a full left or right turn of the wheel without stretching or snapping the cable.

Installing the Sensor and Magnet



Regardless of the chosen location, rule number one is to make the installation rugged and secure. Only ***one magnet*** must be used. The magnet must pass closer than 5/8 inch from the end of the sensor. Important! Neodymium (rare earth) magnets are brittle and could shatter on impact. Excessive physical shock will weaken its magnetic field. Also beware of pinched fingers. These little magnets are very strong for their size. When mounting the magnet, do not recess it in a hole drilled in a metal surface, or locate it in a depression in the metal. If you do, the sensor may not be able to see it. Also, do not machine a magnet to fit a particular location! Cutting, drilling, or grinding a magnet will almost certainly ruin it. If the magnet appears cracked or broken, do not use it. Use the spare, or email us and we'll send you a new one at no cost. If the shape or size of the magnet doesn't lend itself to your particular installation, we have several different options to choose from. Email us with particulars. We'll send you something you can use at no additional cost to you.

If you must attach the magnet to a brake drum, make a bracket that holds the magnet away from the potentially hot brake drum surface. See our website (www.speedom8r.com) for some suggestions and sketches. Brackets should be attached to the drum using small screws rather than adhesives. Most adhesives don't like the extreme heat. Any bracket should provide an air space between the magnet and the surface of the drum. Just make sure the bracket can't bump into anything on the way around. When attaching the magnet to the bracket, use a good, strong epoxy. We like "JB Weld". Most hardware stores carry it.
JB Weld in the black and red tubes has a coefficient of expansion close to that of the magnets and metals on the car, so it's bond is not likely to loosen due to changes in metal temperature. They make some fast cure products as well, but the one shown above seems to do a great job. RTV silicone adhesives remain flexible when cured, so they may also work well.

Most of the following is just common sense, but here it is anyway: No matter what adhesive you choose to use, thoroughly clean the intended location for the magnet to remove all dirt, rust, grease, oil, and paint so the adhesive can stick to the metal. To remove surface rust, use sandpaper or a wire brush. Then clean the surface thoroughly with alcohol to remove all residues. Clean the magnet as well. Prepare the epoxy according to the directions on the package. Now carefully coat the bottom surface of the magnet that will lie against the mounting surface. Make sure the RED end is UP. Use a small amount to begin. Place the magnet in position and press until flat against the metal surface. Use additional epoxy if necessary to fill-in along the sides of the magnet. Apply a liberal amount here, but do not cover the upper surface of the magnet. Make sure added epoxy will not interfere with the sensor. Here is another approach. You can use JB Weld just to attach the magnet and, once the epoxy has cured, fill in the sides of the magnet with silicon adhesive. A small skim coat over the top of the magnet will actually help preserve the magnet. When mounting the magnet to a drive shaft or rotating flange, you can keep the magnet in place with a piece of duct tape or masking tape while the epoxy is curing. Caution! Remove the tape after the epoxy thoroughly cures. Tape will eventually come loose and likely get caught between the sensor and rotating member, possibly damaging your installation.

After the magnet has been installed, locate and install the sensor. Position the sensor to achieve the required 1/8 to 5/8 inch gap as the magnet passes by. The body of the sensor is threaded along its entire length to aid in the adjustment. Route the transducer cable such that it will not be snagged by the suspension's movement or by road debris. If you're mounting it on a front (steering) wheel, leave a small loop in the cable to allow for turns. Avoid routing the cable near electrical noise generators such as the distributor coil, spark plug wires, horn, electrical wiper motors, etc. Finally, connect the plug end of the cable into the “Wheel” connector on the controller.

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CALIBRATING THE SPEEDOMETER

Once the installation is complete, Calibrating your speedometer is a very quick and simple task. You can do it anytime and as many times as you wish. Here is the procedure.

1. Make sure the on/off switch is ON
2. Set the SPEEDO/WHEEL switch to SPEEDO
3. Set the RUN/CAL switch to CAL (the motor will start)
4. Adjust the needle on your speedometer to 60 MPH (take your time and be as accurate as possible.)
5. When you are satisfied that the needle is exactly at 60 mph, press and release the SET button. The motor will stop running and the speedometer pointer will return to zero
6. The red & green LEDs will alternate while the computer is calculating the settings for your particular speedometer. When it is finished, the motor will automatically start again and return to your 60MPH setting. On some older speedometers, this may not happen on the first try. If it does not return to where you set it, you may want to do another adjustment and re-press the SET button. (In other words, try again). Some older speedometers may have weak springs, weak magnets, sticky or dirty internal parts or some other issue that needs to be compensated for. There is a “measured mile” test that you can perform that will verify the accuracy of your 60mph setting. This will be discussed in the Measured Mile test section later in these instructions. It is important to note that the accuracy of your 60mph setting is the key to accurately setting your speedometer.
7. When you are finished with the Speedometer Calibration, you can begin adjusting for wheel size. If you are doing a speedometer RE-calibration and do not need to do a wheel adjustment, please remember to set your speedometer for maximum deflection before changing the Run/Cal switch back to Run.

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ADJUSTING FOR WHEEL SIZE

Once you have calibrated your speedometer, you can then compensate for whatever wheel/tire size you are using. As you will see, you must know the effective diameter of the tire that has the wheel sensor magnet attached to it. There are several good places to find this information. These are shown later on in this section. When you are sure of your tire diameter, you can begin to adjust your speedometer accordingly. (NOTE: you must have (at some point in time) previously performed a calibration on the speedometer instrument you are using. If you have not done so, please do it before continuing with the wheel adjustment.

With tire diameter information in hand, do the following:

1. Make sure the ON/OFF switch is in the ON position
2. Make sure the RUN/CAL switch is in the CAL position (the motor will start)
3. Put the SPEEDO/WHEEL switch in the WHEEL position (Not necessarily in that order)
4. Adjust the needle on your speedometer to the speed shown next to your tire diameter on the wheel chart below. (take your time and be as accurate as possible.)
5. When you are satisfied that the needle is exactly where you want it, press and release the SET button. The motor will stop running and the speedometer pointer will return to zero.
6. The red & green LEDs will alternate while the computer is calculating the settings for your particular tire size. Please note: The LEDs will blink slowly at first but will speed up quickly after some initial calculations. This part of the operation may take up to a minute to complete, but will usually be much quicker.
7. When the calculations are finished, the motor will automatically start again and the speedometer needle will return to where you set it.
8. ***VERY IMPORTANT PLEASE REMEMBER*** -- You must now adjust the speedometer needle for maximum deflection. For example; if your speedometer goes to 120 mph, turn the adjustment “knob” until the speedometer reads 120 or a little bit beyond. This is the limit you set for maximum speedometer needle deflection. This is done so that your speedometer can not be damaged by over driving it. You can set this wherever you want. Whatever maximum setting you choose will not affect the accuracy of the speedometer readings.
9. Move the RUN/CAL switch back to RUN. The motor will stop.
10. SpeedoM8R is ready for operation.

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NORMAL OPERATION

Since the unit should be powered from a switched 12 volt source, the power to the unit is off when the key is off. Normally, you can leave the ON/OFF switch on the controller board in the ON position so it will be ready for operation whenever the ignition key is turned on. Whenever the SpeedoM8R is powered up, it goes through a short diagnostic test routine. Part of this routine tries to determine how much force it will take to begin moving the speedometer needle. You may notice a 2 or 3 second starting delay while this diagnostic is being run. This starting point may be different each time you start based on factors such as temperature of the lubricants inside the speedometer. They may be a bit stiff when cold. Generally however, this delay is unnoticeable. Upon startup you will see the LEDs doing a little dance, indicating everything is OK. You'll soon come to recognize this blink pattern. Once the road wheels begin to turn, SpeedoM8R will indicate true road speed.

The red and green LEDs also play a part in normal operation. The red led will blink each time the wheel magnet crosses the sensor. At faster speeds, the red led will look as if it is ON steadily, but it is not. If the red led is blinking, the wheel sensor is working properly. The Green led will indicate the operating condition of the encoder in the drive motor. It will blink dimly at slow speeds and change to a more steady glow at 20 mph. At 80 mph and above it will be on continuously. These LEDs are intended to be a first order diagnostic tool. In the unlikely event something malfunctions,

you can use the ON/OFF switch to turn the unit off. Turning it back on acts as a reset (or reboot if you prefer) for the processor.

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MAKING A MEASURED MILE TEST

Your speedometer most likely contains two instruments which , under ideal conditions, work together. These are the Speedometer, which measures speed, and the Odometer, which measures distance. SpeedoM8R is concerned exclusively with making the Speedometer portion of the instrument indicate true road speed. In a healthy speedometer, both speedometer and odometer will track nicely. In an unhealthy speedometer the two most likely will not track. We can make the speedometer portion accurate again, but the odometer is on it's own.

A very accurate measured mile test can be conducted without ever having to move your vehicle, or even start the engine for that matter. A measured mile test can be useful in two ways.

1. It can be used to verify your 60MPH speedometer calibration setting (Where does the computer think 60 mph is?) (or where does the computer think you pushed the SET button during speedometer calibration?)
2. It can also be used to verify the ODOMETER operation. A measured mile test should move the odometer exactly ONE mile. This test can give an indication of the overall health of the speedometer. Why this is true and what information a measured mile test can provide is a bit tricky to explain but quite interesting. For further information, please visit www.speedom8r.com or email to SpeedoM8r@gmail.com with questions.

To make a measured mile test, do the following:

1. Make sure the ignition switch in ON , providing a source of 12 volts to the system.
2. Move ON/OFF switch on the controller to the OFF position
3. Press and HOLD the SET BUTTON
4. With the SET button pressed, move the ON/OFF switch to ON (both RED and GREEN leds will light)
5. Release the SET button. Green led goes on, Red led off. Speedometer will now go to where it thinks 60 mph is. If the speedometer does not read 60 mph, you should do another Speedometer Calibration procedure until it does. You have now verified where 60 mph is. You can stop here by turning the unit OFF, or you can continue with the measured mile test.
6. With the unit running at 60 mph (that is 1 mile per minute) watch the odometer and pick a convenient place to start such as when the 1/10 mile wheel goes to zero (or some other convenient number). At that point, press the SET button one more time. The red led will go ON and the computer will begin a timer for exactly one minute. At the end of one minute, the motor will stop and the needle will return to zero. The odometer should have traveled exactly ONE mile. The unit will then begin normal operation. Please note that SpeedoM8R allows you to see true road speed by compensating for any internal shortcomings of your speedometer. It cannot nor is it intended to compensate for internal errors affecting the odometer. Most odometers are built with a 2-3% tolerance. Errors of this magnitude are (unfortunately) normal. If your speedometer reads 60 mph during the measured mile test, but the odometer is off by 5% or more, then this is an indication that your instrument has some internal issues. NOTE: under these conditions, even if your odometer is off, your speedometer reading will be correct.

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WHEEL SETUP SPEED CHART.... During the calibration, when adjusting for wheel/tire size, find your tire diameter in the left hand column and adjust your speedometer to the speed shown next to it. If your tire diameter is larger or smaller than what is shown in the charts, send us an email with specifics. We may be able to suggest an appropriate setting or possibly provide you with other options.

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