Timewise Model 825
Analog Reading Electronic Speedometer

General Information & Terms and Conditions

1. While every reasonable effort has been made to produce a reliable and repeatable device, this is new technology and as such, results cannot be guaranteed. The creators, manufacturers, contributing parties, and the Great Race Rally Partners, Inc. cannot be held responsible for any negative results that might occur due to any malfunction or failure of the speedometer. If you choose to run with the speedometer, you are accepting any possible adverse side effects of this emerging technology.
2. If the speedometer malfunctions due to a factory defect within one year, we will replace it for free. Although we do not expect to see any failures, as a precaution we will have a limited number of spares units available during the race. Barring any catastrophic number of failures, we will be able to service any warranty issues that might arise each night after the day's competition is over.
3. Should the speedometer not work to your satisfaction prior to its use in competition, return it for a refund *, less shipping and the cost of the magnetic pickup unit (assuming this was installed). Shipping and the magnetic pickup unit costs are $70.
4. Once the speedometer has been used in competition (Great Race or otherwise), it cannot be returned.
5. If you do not agree with these conditions, return the unit for a refund* (less $15 for shipping) before you begin installation.
6. Should you wish to have your speedometer's calibration checked, contact Timewise. There is a fee of $50 to have the speedometer calibration re-confirmed.

*The actual amount of the refund is contingent on the physical and electrical condition of the returned speedometer and sensor. We must be able to sell the speedometer and transducer as new in order to provide a full refund.

User’s Manual
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General Information

The Timewise Model 825 analog reading electronic speedometer eliminates the traditional problems associated with mechanical speedometers used in perfect time rallies such as the Great Race. The Model 825 speedometer has no variation with temperature, no accuracy degradation over time, and no repeatability issues.

Dimensions:

- Bezel diameter: 4.187"
- Bezel thickness: 0.75"
- Barrel diameter: 4.00"
- Total depth: 3.50" (including bezel thickness, but not including rear surface screw heads or grounding lug). The rear surface screw heads add 0.1", and the grounding lug extends about 0.75"
- Once plugged in, the magnet sensor cable requires a minimum bend radius of about 1.00"
- The power cord requires a minimum bend radius of about 0.375"

Accuracy: (Variation from the speedometer reading compared to actual speed)

- +/– .0125 mph

Repeatability: (Variation between readings at the same speed, made at different times)

- +/– .0125 mph

Resolution: (Speed variation needed to cause the needle to move)

- +/– .0125 mph

Variation with temperature:

- 0 mph

Aging (Lifetime Degradation):

- 0 mph

Factor adjustment sensitivity (factor resolution):

- +/– 1 sec/hr

Minimum reading with accuracy

- 5 mph

Maximum speed with accuracy

- 150 mph

The speedometer dial is marked in one mile per hour speed increments. The inherent linearity of the mechanism eliminates the need to re-calibrate and re-mark the dial for any installation. The one-mile per hour tick marks are approximately 1/4 inch apart, allowing easy interpolation for the driver when fractional speeds are targeted.

NOTE: Each Timewise Model 825 speedometer is supplied with a calibration certificate developed specifically for that speedometer. This calibration certificate is a chart identifying the inaccuracy of displayed speeds due to mechanical tolerances within the speedometer, and subtle variations between each printed dial faceplate. The errors due to these physical differences are so minor that most rallyists simply disregard the information presented in the chart. Even so, many rallyists attach this adhesive backed label to the cylindrical body of the speedometer.

Electrical Connections

The speedometer operates from a nominal 12-volt, negative ground, vehicle supply.

The Timewise 825 speedometer will not operate off of a 6-volt power supply. If you have a 6-volt vehicle, power the speedometer directly off a separate 12-volt motorcycle or garden tractor battery. When using a separate 12-volt battery, you may want to connect the negative side of the battery to the chassis of the vehicle (even if the vehicle uses a “positive ground” system).

Current consumption for the speedometer is about 330 milliamps while the car is moving, and about 40 milliamps while stopped. You will need a battery with a minimum capacity of 5 AHrs (amp-hours) to ensure that the speedometer operates throughout the day without recharging the battery. Most garden tractor batteries have much more than 5 AHrs capacity.

There are three electrical connections that you must make to assure correct operation of the speedometer. In addition to the standard positive and negative electrical connections, the speedometer case should be grounded to the chassis of the vehicle.

Positive and Negative Power Connections

The power connections for the speedometer must be made with the utmost of care. The black wire must connect to the negative (–) potential of the battery and the red wire must connect to the positive (+) potential of the battery. Attaching both leads securely is mandatory, as just a momentary loss of electrical contact by either wire while the car is moving will cause a malfunction. Such an intermittent power connection while the car is moving will cause a loss of the true zero point on the speedometer. Should this happen, the needle will not return to zero when you stop. We describe how to fix this later, but you are much better off preventing such a problem in the first place. The only way the speedometer can lose its zero point is when a power interruption occurs while the needle is not pointing at “0”.

The red wire must make continuous contact to a circuit that will never lose power while driving, rolling, or starting the vehicle. A good attachment point for the red wire is at the fuse box. Here, the positive potential cable from the battery brings uninterrupted power to all circuits in the vehicle. The red wire is supplied with a slip-in connector that may fit between a fuse and its holder. Several other attachment methods include: attaching to the power distribution panel screw terminals provided in some vehicles, removing the fuse box and attaching to a terminal on its underside, soldering (or crimping) directly to the 12 volt cable connector at the battery terminal, or tapping a circuit that always powers an electrical accessory.

If you attach the positive (red) wire to a circuit already protected by a fuse, keep in mind that a problem elsewhere in the vehicle may blow that fuse and disable the speedometer. Make certain that the vehicle fuse is free of corrosion and makes continuous contact with its holder.

Connection of the negative (black) wire can be to a screw or bolt on the chassis that is near the point of attachment for the red wire. The connection must be free of dirt, oil, grease, and paint. Do not over tighten the connection, as you may weaken the wire by breaking some of its fine strands.

Important! The red and black wires must be attached to points that are as close to each other as reasonably possible. In addition, the two wires must be twisted around each other approximately one turn for every inch of travel. Do not attach the black wire to some point on the chassis directly behind the speedometer and run the red lead a long distance to the fuse box or battery. By doing so, you create a huge antenna that can pick up all manner of radiated energy. Such energy cannot be filtered out of the power line without prohibitively expensive electronics. The connection for the black wire must be near the attachment point for the red power lead.

Important! When routing the red wire, make certain that the in-line fuse holder has some freedom of movement. If the wires at either end of the fuse holder are pulled, a spring inside the fuse holder can be compressed. The fuse will then lose electrical contact within the fuse holder. This may occur only when the vehicle is jarred by a bump in the road.

Grounding the Speedometer Case

Traditionally, a good case ground connection shields sensitive electrical components from radiated electrical noise. Unfortunately, on old cars the chassis and engine grounding interconnection are often very poor. When the speedometer case is attached to a poorly grounded chassis, the connection simply acts as a path for noise to enter the speedometer.

As a result, there are two recommendations for grounding the speedometer case.

Recommendation 1

Don't ground the case. On old cars with poor grounding between the engine, chassis and battery, isolating the speedometer case seems to be the preferred configuration. The speedometer case needs to be completely isolated from the car ground. This includes your mounting bracket/mechanism. Wrap insulating tape around the bracket connections or use some other non-conductive material to keep the case isolated.

Recommendation 2

Grounding the case is beneficial if the car has a good solid ground.

When the speedometer case is connected to a properly grounded chassis, electrical noise and static discharges are dissipated along a path that doesn't interfere with the power supplied to the instrument. Grounding the speedometer is accomplished in a similar manner to grounding a radio.

On early style (silver body) speedometers, a very good ground can be made by mounting the speedometer with metal hose clamps that connect to the chassis. The black anodized body of the later style speedometer is an insulator so a metal hose clamp cannot make a good ground connection. To ground these speedometers, you'll need to attach a heavy gauge ground wire to the threaded grounding stud on the back of the unit. Simply run a length of heavy gauge wire from the grounding stud to a nearby screw or bolt on the chassis. The thicker the wire, the better. You can't get too thick. Also, the shorter the run of wire, the better. A foot is long, here.

See the discussion later on **Electrical Noise Problems** for more information.

Speed Range

Although the speedometer appears to only read up to 50 mph full scale, it is usable to 150 mph. To read speeds greater than 50 mph, simply add 50 (or 100) to the indicated faceplate value when the needle is on its second (or third) time around. For example, a speed of 70 mph is indicated as 20 mph after the needle rotates past the 50 mph mark. There is no loss of accuracy when the needle circles the dial multiple times.

The speedometer will read down to 4.5 mph. Speeds lower than 4.5 mph will be displayed as 0 mph. The 4.5 mph minimum limit is a calculated speed using an anticipated worst case factor of 5900. (See information later regarding setting the factor switches.) For installations that use a factor lower than 5900, the speedometer may read lower than 4.5 mph before dropping to zero.

When running at speeds between zero and 4.5 mph, the needle may bounce between zero and five. This is not indicative of a problem. It is simply the result of a microprocessor inside the speedometer alternately evaluating vehicle speed as zero and some other speed.

The Transducer (Pulse Sensor or Pick-up)

The Model 825 speedometer uses a special "transducer" that converts vehicle motion into electrical pulses. As the vehicle moves, the electronics inside the speedometer measure the time between the pulses generated by the transducer. Using this time measurement and information about the distance traveled between the pulses, a microprocessor inside the speedometer calculates your speed.

The transducer, or pulse pick-up unit, must be mounted to your car. There are two types of transducers that can be used for generating pulses.

The most common type of transducer is a "two-piece" pick-up. This type of transducer consists of a magnet sensor and separate magnets. (Both of these items are supplied when the Model 825 speedometer is ordered at the Great Race package price.) The magnets are to be attached to the driveshaft or a wheel. The sensor is carefully positioned (using a mounting bracket you must fashion on your own) so that the magnets repeatedly pass by the end of the sensor as the vehicle moves. A signal is generated when either the North or South pole of the magnet passes about 3/8 to 5/8 inch from the end of the sensor. (Actually, you can have the magnet pass as close as you wish to the sensor, but you risk having the two pieces hit if the sensor moves slightly, or the wheel or driveshaft wobbles.) The non-pole sides, or edges, of the magnet will not cause a pulse to be generated.

A second choice of transducer style is a "one-piece" or "speedometer cable" transducer. (The speedometer cable transducer is optional, and is not supplied automatically with the Model 825 speedometer.) The speedometer cable transducer installs on the end of the speedometer cable in place of original speedometer, or, alternatively, to the transmission or overdrive in place of the speedometer cable itself. The self-contained mechanism produces electrical pulses as the vehicle moves. Two pulses are generated for each revolution of the speedometer cable. Speedometer cable transducers can be installed on most vehicles, providing the speedometer cable connection method is one available from Timewise. If you wish to use this option, contact Timewise at 847-550-5052. The cost for this type of transducer ranges from $85 to $100, depending on the requirements of your vehicle. (The standard pick-up supplied with Model 825 speedometer can be returned for a credit of $50.)

Installing the Transducer and Magnets

The following paragraphs describe installation of the two-piece transducer system supplied with the speedometer. If you are using a speedometer cable transducer, installation simply consists of connecting the transducer to the transmission or to the end of the speedometer cable.

The sensor and magnets of the two-piece transducer system may be installed on the drivetrain or on a wheel. Regardless of the chosen location, rule number one is to make the installation rugged and secure.

If the rotation of a wheel is used as the source of vehicle movement, two magnets must be used. The magnets must pass 3/8 to 5/8 inch from the end of the sensor. You must use two, and only two, magnets. If more than two magnets were to be used, any unequal rotational distance between the magnets will cause a wavering speedometer needle. Extra magnets are provided, but only two are required.

If driveshaft rotation is used as the source of vehicle movement, you must only use one magnet.

Important! Be careful when handling magnets near ferrous metals or other magnets. If a magnet slips from your fingers, it may shatter on impact. Even if it doesn’t break, the physical shock will weaken its magnetic field.

When mounting the magnets, do not recess them in a hole drilled in a metal surface, or locate them within a depression in metal. Doing so will change the shape of the magnetic field, drawing it closer to the surrounding surface. When the magnetic field does not extend far away from the magnet, you may not be able trigger the transducer.

Also, do not machine a magnet to fit a particular location! Cutting, drilling, or grinding a magnet will reduce its magnetic field strength by both material loss and stress induced demagnetization. The magnetic field of the remaining material may not be sufficient to stimulate the sensor. If you need magnets of a different shape, size, or magnetic orientation, please contact Timewise.

We do not generally recommend that you attach magnets to the brake drum. The high amount of heat generated during hard braking can bring the magnet to its "Curie temperature". When a magnet reaches its Curie temperature, it will completely lose its magnetism. Such extreme heat can also weaken its attachment method.

If you must mount the magnets to the brake drum, use a small bracket to raise the magnets off the drum. We have seen successful installations which used a bracket formed somewhat in the shape of the Greek letter omega (Ω). The "feet" of the bracket were threaded into tapped holes drilled into the outer perimeter of the brake drum. Very small screws were used...probably 4-40 screws. The magnet was inserted into the center of the bracket. This installation held the magnets away from the hot brake drum.

When magnets are installed on the driveshaft, you may see occasional needle bounce (once every 10 minutes or so) caused by backlash in the drive train. We have noticed that upon a sudden speed change, the driveshaft of an old car may actually pause or even spin backwards for a moment. If the magnet is exciting the sensor when this occurs, an extra pulse can be seen. As mentioned, use only one magnet when sensing the rotation of a driveshaft.

When sensing rotation of a wheel, it’s not always obvious which wheel to use. Front wheels are generally non-driven and experience less wheel slippage. However, the front suspension experiences more weight reduction due to aerodynamic lift. With front end lift, the rolling circumference of the front tires grows. On light automobiles with large exposed flare fenders, the change in lift between 20 mph and 50 mph can produce up to a 5% error in the perfect driving time. Therefore, on light vehicles a rear wheel installation is often a better choice.

Regardless of whether you use a front or rear wheel, use the wheel closer to the center of the road.

When attaching the magnets, use a good, strong epoxy. The best readily available epoxy we've found is "JB Weld". Most hardware stores carry this two-part epoxy. JB Weld has a coefficient of expansion close to that of the magnets and metals on the car. Super-glues and brittle adhesives will not accommodate expansion of the metals. RTV silicone adhesives remain flexible when cured, so they may also work well.

Locate two magnets 180 degrees apart on the rotating member. Exact spacing between the magnets is not critical. (The speedometer averages the time that elapses between sequences of three pulses. Note that whether one or two magnets are used, any sequence of three pulses starts and stops at the same magnet. Were you to use more than two magnets, the angular spacing between each magnet would have to be precisely the same, otherwise the "3 pulse sequence" time would change depending on which magnet started the measurement. This is why we stipulate that you should not use more than two magnets.)

Thoroughly clean the intended location for each magnet to remove all dirt, rust, grease, oil, and paint. You can use navel jelly or a little vinegar to remove small amounts of surface rust. Use emery paper or a wire brush to remove paint and heavy deposits of rust. Following this, clean the surface with alcohol to remove all residues. Clean the magnet as well, removing anything that has accumulated during handling.

Prepare the epoxy according to the directions on the package. Now carefully coat the surface of the magnet that will lie against the mounting surface. Use just enough to fill small gaps. Too much epoxy and the magnet may not lie flat. Place the magnet in position and use additional epoxy to fill-in along the sides of the magnet. Apply a liberal amount here, but do not cover the upper surface of the magnet. And don’t form a ridge around the magnet that will interfere with the sensor. Some people use JB Weld only to attach the magnet and, once the epoxy has cured, fill in the sides of the magnet with silicon adhesive.

When mounting the magnet to a driveshaft or rotating flange, you may wish to wrap nylon-reinforced tape around the rotating member to hold the magnet in place while the epoxy is curing. Keeping this tape in place after the epoxy cures provides additional holding power should the epoxy bond fail. Always wrap the tape in the direction opposite the normal turning motion of rotating member. **Caution!** Improperly applied adhesive tape may begin to unravel and get caught between the sensor and rotating member, possibly damaging the transducer and/or magnet.

When mounting magnets on a wheel, locate them so there is some support in the direction of the centrifugal force they will experience. **Caution!** An improperly epoxied magnet could come off while spin balancing the wheel. Also, if you are attaching magnets to a wheel that is removed from the vehicle, replace the wheel only after the epoxy has cured. This will prevent accidental movement of the magnets.

After the magnets have been installed, locate the sensor as necessary using your custom designed bracket and mounting method. Position the sensor to achieve the required 3/8 to 5/8 inch gap as the magnets pass 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. Avoid routing the cable near electrical noise generators such as the distributor coil, spark plug wires, horn, electrical wiper motors, etc.

Once everything is in place, the magnet sensing transducer will provide years of reliable service. The sensor is not affected by water, dust, or extreme temperature

Note: If a magnet does get dislodged while using the speedometer, the displayed speed will be exactly 1/2 your actual speed. Drive at precisely half the given speed and your score will not be affected.

Setting the Factor Switches

Prior to setting the factor switches, disconnect power to prevent damage to the speedometer. Also, inflate the vehicle tires to an optimal value. Tire pressure typically ranges from 30 psi (pounds per square inch) to 50 psi. Set your tire pressure to a value midway in this range.

On the back of the speedometer, there are four holes that allow access to the factor switches. **When setting or reading the factor selection switches, orient the speedometer so that the switches are toward the bottom, or six o'clock position.** The factor number is read from left to right when viewing the speedometer from the back. A default value of 3000 is set on all new units. Adjustments to the switch positions are performed using a small flat-blade screwdriver. Turn the small arrow on each switch to point to the desired value, 0 through 9. If you set the factor value backwards, or with the speedometer oriented "upside down", you'll never be able to determine a correct factor...this is the single most common cause for confusion when setting a factor.

The factor value is the distance in inches that the car travels when the sensor produces exactly ten pulses. The factor has a resolution of xxx.x inches. As an example, if the distance the vehicle travels for every ten pulses is 531.4 inches, the factor is set to 5314. Note that the factor switches do not show a decimal point.

When using two magnets on a wheel, ten pulses are produced when the wheel turns five revolutions. Here's a simple way to determine the distance traveled for ten pulses. First, make a caulk line on the tire and slowly roll the vehicle forward until the caulk mark is against the road. Then make a mark on the road where the tire's caulk mark touches the road. Now roll the car forward five revolutions of the wheel. When the tire's caulk mark touches the road on the fifth revolution, make another mark at that point on the road. Then measure the distance between the two caulk marks on the road. Measure to a resolution of a tenth of an inch. This is the factor.

Alternatively, you can measure the distance traveled in one revolution. In this case, there will be two pulses, not ten. The factor is five times the distance measured. We suggest five revolutions simply to be more precise.

<u>Install only one magnet on the driveshaft when it is used as the indicator of movement</u>. The factor will then be the distance the car travels in exactly ten revolutions of the driveshaft. Note that you can also measure the distance the car travels during only one revolution of the driveshaft. The factor would then be ten times that distance. Or you can just "move the decimal point" one place to the left. You'll have to be a bit more precise in the distance measurement when doing things this way...that's why we suggest 10 revolutions of the driveshaft. In either case, we recognize it is difficult to measure the distance the vehicle travels while watching the driveshaft turn. Don't worry...you'll have many opportunities to "tweak" the factor later. For now, just measure as close as you can.

When using a speedometer cable transducer, the factor is the distance the vehicle travels every five speedometer cable revolutions. This is because there are two pulses produced per cable revolution. If you know the exact number of speedometer cable revolutions per mile for your vehicle, you can simply calculate the factor. For example, if the speedometer cable rotates 1200 times per mile, there would be 2400 pulses produced by the speedometer cable transducer for each mile traveled. Since there are 63360 inches in one mile, 10 pulses would have occurred in a distance of 264.0 inches (63360/2400 ∗ 10). A factor of 2640 would be used.

Another way to determine a factor involves timing yourself as you travel through a fixed distance. That is, you can drive a measured distance at a predetermined speed and note your error in the ideal travel time through the course. The error in your driving time will be due to the error in your factor. From this information, you can correct the factor.

For example, set the factor to our default value of 3000. Then drive a 1/10th mile course at exactly 30 mph, as indicated on the speedometer. Precisely measure the time it takes to complete the run, from start to finish. If the factor of 3000 had been perfect, and therefore the speedometer would have been reading perfectly, the 1/10th mile run should have taken exactly 12 seconds (or 0.20 minutes). Any error from this perfect time is due to the error in the default factor (3000). To determine a corrected factor, divide 12 seconds by the measured time. Then multiply that result by 3000. The final number is the corrected factor for your installation.

Note that when setting up a rally course, the rallymaster does not always use perfect statute "miles". This is because the rallymaster expects you to adapt to his distance measurement "standard", even if it's not the same as the national standard. This is the typical scenario in every rally...the rallymaster set the standard, not the public governing body. As a result, you will have to "adjust" your factor at every rally. And on the Great Race, you'll probably have to adjust your factor every day. As such, the setting of your factor, and therefore the speed you see on the speedometer, must be corrected as needed.

To change your speedometer so it exactly matches the rallymaster's, simply correct your factor. The correction is a percentage change. The percentage change is the percentage error between your time to run a speedometer calibration run and the ideal time indicated by the rallymaster. That is:

Change in Factor value = Percentage Error in the speedometer calibration run ∗ Old Factor.

To help you determine whether you increase or decrease the factor, use this rule: "Too slow on the course, reduce the factor"; "Too fast on the course, increase the factor". We also say, "Smaller factors make you arrive Sooner"; and, "Larger factors make you arrive Later". Or, "SS" and "LL".

For example: If you are 9 seconds late in a one hour speedometer run, your error is 9/3600 (remember, one hour is 3600 seconds). This is a 0.25% error (9/3600 x 100 = 0.25%). This percentage, times your original factor, gives the adjustment. You had arrived late…you want to arrive sooner. Make the factor smaller by 0.25% because you need to arrive sooner. After the adjustment, your speedometer will exactly match the rallymaster's.

Another example: If a speedometer calibration run is supposed to take exactly 15 minutes, and you arrive 1 second too soon, the error is 4 seconds/hour…or 4/3600, or 0.11%. Make the factor 0.11% larger to arrive later.

Here's another way you can correct for small differences between your speedometer's "indicated" speed and the rallymaster's "official" speed. Since a change in tire pressure alters the rolling circumference of a tire, a tire pressure adjustment can be used to correct your actual speed. Our experience indicates that a 1 psi change in tire pressure typically results in a 1 to 2 second/hour driving time change (regardless of the distance).

In fact, small tire pressure adjustments can be used to accommodate differences between your speedometer and the rallymaster's. A 10 psi pressure adjustment range allows for a 10 to 20 sec/hour correction. This is generally enough to align your speedometer to the rallymaster's. There will be no need to change the factor. (Until recently, Great Race rules did not allow changes in the factor during the day's event, so this method was often used following the daily calibration run.)

Changing tire pressure can also accommodate long-term tire wear.

Note to rallyists who have a Timewise rally computer: The factor in the Model 825 speedometer uses “inches” as its unit of measure, whereas Timewise rally computers use factor units of "miles". There are 63360 inches in a mile. To convert a Model 825 speedometer factor to a Timewise rally computer factor, divide the speedometer factor by 0.06336 (Neither instrument identifies the factor’s decimal point location, so the conversion figure shifts the decimal point as needed.) Rather than dividing, you can multiply by 15.7828 (the reciprocal of 0.06336):

Speedometer Factor * 15.7828 = Rally Computer Factor

If you are converting the rally computer’s factor to one appropriate for the speedometer, just do the inverse.

Rally Computer Factor * 0.06336 = Speedometer Factor

Calibration

Each speedometer is provided with a calibration chart that is printed on an adhesive backed label. This chart is supplied so you can adjust your driving to account for subtle printing offsets on the dial faceplate, as well as small unit to unit mechanical variations. Some rallyists attach this label to the cylindrical body of the speedometer. On the calibration chart, a driving time error at each speed is listed. While traveling exactly at a specific indicated speed, you will accumulate the error shown on the chart during each hour of driving. The typical error will be 0.0 second per hour to 0.1 second per hour. Yes, the speedometer is that accurate!

Should you wish to have your speedometer’s calibration re-confirmed, contact Timewise. There is a fee of $50 for this service.

Re-Zeroing the Needle

You must be absolutely certain that power connections to the speedometer are proper and uninterrupted whenever your vehicle is moving. Here's why:

When power is initially applied to the speedometer, a microprocessor inside the speedometer assumes the initial needle position is 0 mph. As your speed changes, the microprocessor directs a stepper-motor to move the needle a calculated deflection from the previous reading. If power to the speedometer is interrupted when the needle is not at 0 mph, the needle will not automatically return to the original starting point. When power is then re-applied, the initial starting point for the needle will be wrong.

Therefore, never allow power to the speedometer to be interrupted while the needle is indicating a vehicle speed other than 0 mph!

Nevertheless… If power had been interrupted when the speedometer was not indicating zero speed, you must manually re-zero the speedometer. The procedure is very simple.

To manually reposition the needle to the true zero point, you'll need to remove the protective glass cover on the front of the speedometer. On early models of the speedometer (silver body units), a chrome plated locking ring held the glass in place. Use a small flat blade screwdriver to carefully flex the chrome locking ring inward so that it can be removed. With the ring removed, you can lift the glass off. A small suction cup helps.

The second generation of the speedometer – the black body model - has the cover glass held in place with a screwed-on bezel. Simply unscrew the bezel ring to gain access to the needle.

With power applied to the speedometer, carefully rotate the needle toward zero. Grasp the needle close to its center post. You will feel considerable resistance to the rotation as you overcome strong magnetic fields generated by the internal stepper-motor. When you are satisfied that the needle is re-aligned to zero, replace the glass and the bezel (or locking ring). You can also re-position the needle to zero when power is not applied to the speedometer, but generally the power connection is already present.

NOTE! On some speedometers, there is small adjustment screw on the needle near its pivot point. This adjustment screw is only used to calibrate the speedometer during manufacturing. Do not turn this screw. Also, note that the speedometer faceplate (the printed dial) is held in place with two screws. These screws allow the faceplate to be precisely oriented during the calibration process. Never loosen these screws! If you do, you will most certainly need to have the speedometer re-calibrated.

Electrical Noise Problems

Electrical noise is a problem for electronic devices in any car. This is particularly true in old cars.

A symptom of electrical noise is a speedometer needle that does not hold steady while you drive at a constant speed. In fact, under severe electrical noise situations, the needle will spin wildly around the dial.

Noise suppression hardware and a software “filter” have been designed into the speedometer. These features eliminate many erroneous readings caused by random low levels of noise. Unfortunately, the noise generated by solid ignition wires is so great that it cannot be rejected completely. **If you have solid ignition wires installed in your vehicle, you will be plagued with electrical noise trouble. You absolutely must change old "non-resistive" solid ignition wires or copper straps to modern "resistive" wires**. You may also need to install resistive spark plugs.

If you are using resistive ignition wires and continue to have noise problems, improve the ground connections between the chassis, engine, and battery. A good electrical path between these vehicle components is critical. We cannot over-emphasize the importance of heavy gauge ground straps and strong, clean ground connections. Everything in your car will run better.

Adding a noise filter to the power leads can help reduce electrical noise. Try Radio Shack p/n 270-051B.

Problem Solving

The following is a list of reported problems and solutions:

1. Speed readings bounce higher than the actual speed.
   - In speedometer cable transducer installations, or two-piece transducer installations with the magnet attached to a wheel, random high speed readings can occur when electrical noise is excessive. Review the electrical noise section of the manual.
   - In two-piece transducer installations with the magnet attached to a driveshaft, random high speed readings can be caused by either electrical noise or driveshaft backlash. First, make certain that you are using only one magnet on the driveshaft. Second, eliminate electrical noise possibilities. If the problem continues, you may have to change the installation to sense the rotation of a wheel.

2. Speed readings bounce both ways:
   - This can occur in speedometer cable transducer installations if the threaded connection is loose or not perfectly straight. Recheck the threaded connections. If the problem continues, the problem may be occurring because the gears in the transmission are exhibiting backlash. In this situation, you may have to utilize the two-piece magnetic transducer.

3. Speedometer no longer returns to zero when stopped.
   - This can only be caused by a power interruption. Check both power connections and review the power connections section of this document. You’ll need to manually re-zero the speedometer needle.

4. Speed readings bounce lower than actual values and then recover.
   - This is probably caused by the sensor missing a pulse periodically. A weak or improperly oriented magnet, or a misaligned sensor, can cause occasional missed pulses. There could also be excessive tension on the

transducer cable connection at the back of the speedometer. On rough roads the connection might temporarily open, causing missed pulses.

5. The indicated speed suddenly drops to half its correct value. (magnets on a wheel)
   - One of the two magnets has probably fallen off the wheel.

6. The indicated speed drops to zero and stays there (magnets on a wheel or driveshaft).
   - The magnet has probably fallen off the driveshaft, or both magnets have fallen off the wheel. Or the transducer connection to the speedometer is loose. Or the transducer cable is damaged.

7. Speed drops to zero or close to zero and stays there until you slow to nearly a stop. The speedometer then recovers and operates normally. The zero speed point is maintained.
   - This is a combined problem and design feature of the speedometer. If your speed is greater than 40 mph when pulses become erratic, the microprocessor interprets a sudden change in pulse rate as electrical noise. The microprocessor then directs the needle toward zero until your speed can be properly calculated. When you slow down or stop, the microprocessor will lock into the new speed and allow the speedometer to function normally again. To prevent this scenario, find out why there are missing or erratic pulses.
   - This problem also shows up when two magnets are used on a driveshaft. Remove one of the magnets and double the factor.

8. The speedometer needle is not precisely in the middle of the “zero” mark when the vehicle is not moving.
   - This is due to a power savings mode of the speedometer’s firmware. When vehicle speed is determined to be zero, the microprocessor removes all power from the stepper motor drive circuitry, and lets the stepper motor rest in an energy efficient position. This sometimes results in an extremely small visible offset – up to half the width of the dial tick mark. Do not be concerned, the speedometer is still perfectly calibrated at speeds other than zero. We believe most people can sense when the vehicle is not moving..

9. After calculating a new factor, that value does not make the speedometer measure properly.
   - This is likely due to observing or setting the four factor selection switches in reverse order. When adjusting the factor switches, rotate the speedometer so that the four switches are oriented toward the “six o’clock” position. Then, when viewing the speedometer from the rear, the factor is set from left to right.