SpeedChanger ã QUICK INSTALLATION REFERENCE

REVISION 2 October 23, 2002

NOTE: For much more **detailed descriptions** of this installation & advanced trouble shooting techniques refer to the full **SpeedChanger ã Installation Manual** included or located on line at www.terf.com. If **after reading** this information you still have questions or concerns then contact us. We will be glad to help.

1. Determine where in the system SpeedChanger© is to make the electronic ratio modification. See the back of this sheet for **common system diagrams.** Advanced vehicle specific information located at www.terf.com.

2. **Locate the vehicle speed signal, power & ground** wire connections corresponding to the system components to be modified (Speedometer, Engine Computer, Transmission Computer etc.)

3. Determine a convenient & **suitable location to mount** the SpeedChanger© that corresponds to the system components to be modified.

4. Try to keep the wiring reasonably short to **prevent problems. Solder all wiring** connections to prevent problems in this frequency based signal system. Thoroughly insulate all connections with electrical tape or shrink tube.

5. Attach the SpeedChanger© **Red Positive Wire** to a Positive Power Source that is "ON" in the Ignition key on condition(s) "Run" and "Start".

6. Attach the SpeedChanger© **Black Negative Wire** to a Negative Power Source or "Ground" that is Close To the system components to be modified.

7. Cut the **Vehicle Speed Signal Wire(s)** in the appropriate location(s) to achieve the desired system configuration based upon the diagrams on the back of this sheet.

8. Connect the wire generated by cutting the Vehicle Speed Signal Wire from the speed signal sensor side to the SpeedChanger© **Orange Signal In Wire**.

9. Connect the other wire generated by cutting the Vehicle Speed Signal Wire (supplying signal to the Speedometer or other components) to the **White Signal Out Wire.**

CALIBRATE & ACTIVATE THE SYSTEM

10. Set the SpeedChanger© **"HI / LO" switch** in the proper position (*suggested* on the back of this sheet…See the SpeedChanger© Installation Manual for more details).

11. Move the SpeedChanger© **"TEST / RUN" switch** to the "RUN" position (slide it right).

12. Dial the **desired calibration ratio** into the SpeedChanger©. The dial descriptions are indicated on the back of this sheet and inside the lid of the SpeedChanger©.

13. Turn on the vehicle ignition switch. Look for the SpeedChanger© **Green Power On Light.**

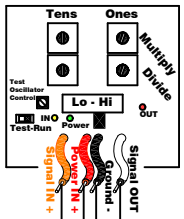
14. When the vehicle is moved or driven the SpeedChanger© **Yellow Input Light** indicates a good input signal & the **Red Output Light** indicates a good output signal.

15. If any problems occur or more detail is required **refer to the SpeedChanger Installation Manual indexed by topic** to aid in detailed and variation of installations as well as detailed debugging.

Note the first section in the Installation Manual for important safety issues!!

SpeedChanger© INSTALLATION SYSTEM REFERENCE

REVISION 2
OCTOBER 23, 2002



BASIC POWER CONNECTION

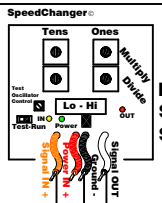
ORANGE SIGNAL INPUT FROM SPEED SENSOR

WHITE SIGNAL OUTPUT TO SPEEDOMETER OR CONTROL MODULE

IGNITION KEY SWITCH
START
RUN
OFF
POSITIVE +
NEGATIVE --
VEHICLE BATTERY

VEHICLE BODY GROUND

THIS CONFIGURATION USED TO EFFECT COMPUTER RELATED FUNCITONS SUCH AS SHIFT POINTS AND MAX VEHICLE SPEED. DO NOT CONNECT HERE IF ANTILOCK BRAKE SYSTEM OR AIRBAG IS CONTROLLED BY THE COMPUTER!!

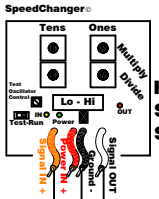


HI LO SWITCH SET "HI"

PICK ONLY ONE CONFIGURATION

BEST CONFIGURATION

THIS CONFIGURATION USED TO EFFECT ONLY THE SPEEDOMETER AND IS SUGGESTED ... ESPECIALLY IN SYSTEMS WITH MANUAL TRANSMISSIONS.



HI LO SWITCH SET "LO"

SPEEDOMETER

SPEED SENSOR AT TRANSMISSION OR AXLE

ANTILOCK BRAKE SYSTEM IF EQUIPPED (OPTIONAL)

POSITIVE POWER CONNECTION (OPTION ON 3 WIRE SENSORS)

VEHICLE SPEED SIGNAL POSITIVE (VSS+)

ENGINE, TRANSMISSION AND OR VEHICLE COMPUTER

VEHICLE SPEED SIGNAL POSITIVE (VSS+)

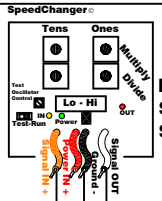
CUT VEHICLE SPEED SIGNAL POSITIVE (VSS+)

VEHICLE SPEED SIGNAL NEGATIVE (VSS-) OR BATTERY NEGATIVE

VEHICLE BODY GROUND

CUT VEHICLE SPEED SIGNAL POSITIVE (VSS+)

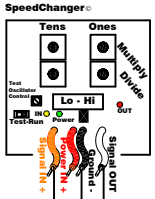
THIS CONFIGURATION USED TO EFFECT COMPUTER RELATED FUNCITONS SUCH AS SHIFT POINTS AND MAX VEHICLE SPEED. THIS IS COMMONLY USED TO AVOID NOISY ABS SIGNALS CAUSING SPEEDO JUMPING.



HI LO SWITCH SET "HI"

PICK ONLY ONE CONFIGURATION

THIS CONFIGURATION USED TO EFFECT ONLY THE SPEEDOMETER AND IS SUGGESTED ... ESPECIALLY IN SYSTEMS WITH MANUAL TRANSMISSIONS.



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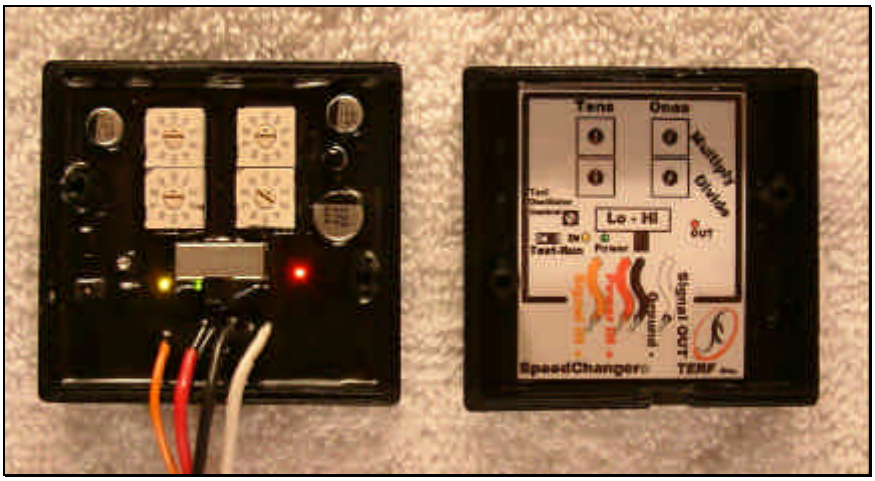
VEHICLE BODY GROUND

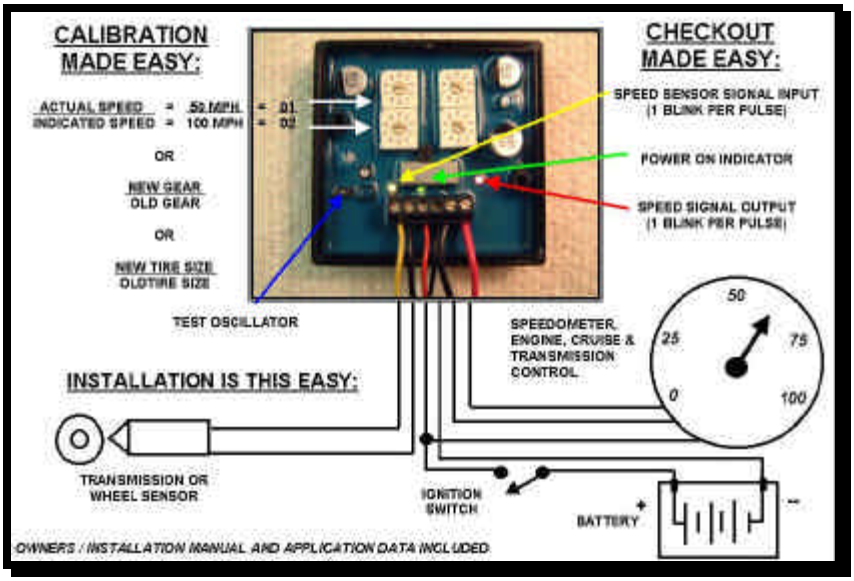
CUT VEHICLE SPEED SIGNAL POSITIVE (VSS+)

SPEEDCHANGER© INSTALLATION, OPERATION & CALIBRATION MANUAL

Revision 3 – August 28, 2002



SpeedChanger© Assembly



SpeedChanger© Controls

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IMPORTANT SAFETY NOTICES

This device, or any other similar device, should **NEVER to be used in the Antilock Brake System or Airbag System circuits.** These systems are specifically designed to operate only in the configuration supplied by the Original Equipment Manufacturer. **Ignoring this warning will result in a rather nasty death. NO KIDDING!** This unit CAN be used in vehicles with Antilock Brake Systems and Airbags. Care should be taken to make sure that the unit only effects systems like the speedometer, engine controller, transmission controller, and cruise control.

As with any distraction while driving, working on this device and concentrating on the speedometer, tuning dials and performing calculations will result in your attention being pulled away from the road. GET HELP! **Do not attempt to calibrate and drive at the same time.** This procedure will very quickly mesmerize you into paying attention to everything but the road.

Watch your speed. We have experienced the urge to "chase the speedometer" to see if the calibration holds through the whole range. It does. This distraction has the added hazard of watching the speedometer instead of the road AND adding unusually high speeds that may catch you off guard.

If you are testing on a hoist or jack make sure that the vehicle is secure! Very secure! A car running on a jack or hoist will tend to vibrate. This may result in the vehicle moving around. Point the vehicle in a safe direction. In the event that something does go wrong you will have a better chance of reacting. Keep children, pets, loose clothes, hoses, cables, tools or anything else that may interfere with moving parts well away.

Watch your speed on the jacks or hoist. **Speeds above 20 MPH on a tire that is not in full contact with the road may come apart.** They are not designed for this operation and great care should be taken not to let this over speed condition occur. There is a high probability that you speedometer may not be working or reading correctly. The vehicle will not be moving and giving you the usual sensation of speed. Tires accelerate very quickly with the load off. In short a lot of restraint is required here.

USE THE 30 SECOND RULE. BEFORE YOU START THE ENGINE OR TURN THE POWER ON IN ANY SITUATION FORCE YOURSELF TO STOP AND LOOK AT EVERYTHING YOU ARE DOING FOR 30 SECONDS. You will be surprised how many little details you will discover are amiss. I assure you the 30 seconds will not be missed… Body parts and people will!

CAUTIONS WIRING THE SYSTEM

 **CAUTION: NEVER CONNECT THE BATTERY OR POWER SUPPLY POSITIVE (+) POWER TO THE NEGATIVE (-) BLACK WIRE CONNECTION of SpeedChanger and THE NEGATIVE (-) POWER TO THE SIGNAL OUTPUT, WHITE WIRE, of the SpeedChanger ã.** The device will immediately begin to overheat and will burn out. This condition could not be avoided, as GM speedometers require a near absolute 0 volt signal at the output and a protection diode could not be employed.

Making these connections causes an obvious failure of the unit and voids our warranty. The unit is protected against all other miss connections. However, make every attempt not to test this principle.

Care should be taken when installing this device not to allow the wiring from your vehicle to be shorted to ground or any other miss connection. Great care has been taken to design this unit so that it is difficult to damage and will not damage associated circuitry. In general these same precautions have been designed into the components of your vehicle. It is impossible to cover the infinite variety of miss connection, however, (i.e. connections to the spark coil). Take care in what you are doing.

REMEMBER THE 30 SECOND RULE. We cannot send you a new unit in 30 seconds. Take your time and confirm your connections.

PRINCIPLE OF OPERATION

Remember grade school math class and fractions? Most people figured that they "would never use that stuff". Well here is a case where you will. I will explain this in the simplest terms possible. If you have a PHD in math, bear with the rest of us.

SpeedChanger© is simply the electronic equivalent of a fraction. You give it a number of pulses (frequency) by feeding it a signal from the wheels or transmission sensor, on board computer or whatever. You can then multiply and divide that frequency signal to make it correct for what your speedometer or on board computer requires. Sound simple enough?

MAKING THE CONNECTIONS

POWER CONNECTIONS:

NEGATIVE POWER CONNECTION – Connect the Negative (-) Power, BLACK wire, of the SpeedChanger© to a Negative power point on the vehicle. This point should be connected to the ground near or on the on-board computer if you have one in this part of the system. The next best choice would be on the instrument cluster ground. Do not ground to the engine. Attaching to a grounding point too far away may introduce "noise" (stray signals) into the system. Noisy connections will result in unwanted "bouncing" or "thumping" of the speedometer. In other words don't ground this thing to the trailer hitch and expect to pick up one (1) volt signals under the hood. Keep your wires short and neatness definitely counts.

DO NOT LET STRAY STRANDS OF WIRE REMAIN OUTSIDE OF THE CONNECTION AS THEY MAY SHORT OUT THE MATERIALS. NEATNESS DEFINITLY COUNTS! REMEMBER THE 30 SECOND RULE.

POSITIVE POWER CONNECTION – Connect the Positive (+) Power, RED wire, of the SpeedChanger© to a FUSED power source that is only active when the ignition switch is in the "RUN" or "RUN & START" condition. SpeedChanger© only requires a few milliamps and will not require a different (larger) fuse to be used if SpeedChanger© is connected to an existing circuit such as the engine computer or instrument cluster circuits.

GETTING A GREEN LIGHT – When the Negative and Positive have been connected correctly and power (key) is turned on, the GREEN PILOT LIGHT, located in the middle of SpeedChanger©, will light indicating that SpeedChanger© is on. At this point it is safe to turn on the power and check your connections. If everything is OK and you have a green light switch the power off and continue with these directions. If you don't get a green light check your connections especially the polarity and retry. You may need to use a voltmeter to determine why the power is not getting to SpeedChanger©.

FINDING THE SPEED SIGNAL WIRE IN YOUR VEHICLE:

The **SPEED SIGNAL WIRE** on the vehicle will need to be located at this point. The easiest way to locate this wire is to look it up in the electrical repair manual for your particular vehicle. This can be gotten from most auto parts stores and dealerships. We are continually adding diagrams for vehicles to our web page vehicle applications section on www.terf.com or www.speedchanger.com.

For vehicles with simpler electrical systems like racecars or older vehicles you may be able to identify the wire simply by looking at the system components like the back of the speedometer.

It is better to keep the SpeedChanger© unit mounted inside of the vehicle to protect it from the elements, especially in harsher climates. SpeedChanger© should NEVER be mounted next to exhaust

components or turbo chargers or any other component that produces extreme heat as this could damage SpeedChanger© and void the warranty.

The easiest way to find the SPEED SIGNAL WIRE on the vehicle is to look for the SPEED SIGNAL SENSOR. This sensor is typically located on the tail end of the transmission. If this is the case follow the wire into the vehicle or bring a pair of wires from the inside of the vehicle where the SpeedChanger© is to be mounted out to the SPEED SIGNAL SENSOR outside of the vehicle.

BEFORE YOU CUT ANY WIRES take a stickpin and poke it through the insulation, or in some other manner, connect the wire you have determined to be the SPEED SIGNAL WIRE on the vehicle to the SIGNAL INPUT, Orange wire on the SpeedChanger© unit. (See SIGNAL INPUT connections below.) Rotate the wheels on the vehicle and determine if the input YELLOW light on the SpeedChanger© flashes in time with this movement. This will determine if in fact you have the right wire and save you from making wire patches for cutting the wrong wires. Remember to turn on the Ignition and confirm that you have a GREEN light on the SpeedChanger© unit.

Be sure that the TEST Oscillator switch is moved toward the right, center of the box, or "RUN" position. The engine need not be running for this operation. If you connect the SpeedChanger© unit to the wrong wire, no damage will result to either the SpeedChanger© unit or the other components in your vehicle. Included in the Appendix of this document are some more advanced wiring diagrams of how vehicle systems are constructed. This may help in finding the proper wire for your application.

The basic concept is to find the SPEED SIGNAL WIRE, positive or active, on the vehicle and **CUT** the wire so that the SpeedChanger© unit can modify the signal as it passes from the speed sensor (or source such as the computer) to the speedometer (or computer). If you are working with a system with more than one wire, cut the "HOT" or active side. Connect the Sensor or Input side of the cut wire from the vehicle to the SIGNAL INPUT, Orange wire, of the SpeedChanger©. Connect the other wire you have created in the **CUT** to the SIGNAL OUTPUT, White wire, of the SpeedChanger©. Leave the SPEED SENSOR NEGATIVE wire or groundside wire (VSS negative) on the vehicle factory connected unless you find that the use of the SPEED SIGNAL WIRE, positive or active, on the vehicle alone will not work. Typically the ground for the speed sensor and the ground for the vehicle are common and the SpeedChanger© will get this information from the POWER GROUND, Black wire, connection.

For late model vehicles with advanced electronic computer controls, you have an option here. The SPEED SIGNAL WIRE actually passes from the speed sensor to (a speed modifier box (in the case of GM pickups for example)) the engine computer then to the speedometer. If you place SpeedChanger© between the computer and the speedometer all you change is the speedometer reading. If you place SpeedChanger© between the speed sensor and the engine computer you modify everything the engine computer uses the speed signal for. This may include transmission shift points, engine operation limits, vehicle maximum speed limits (for tire overrev safety), cruise control, active steering, etc. This may be advantageous if you find these systems are not reacting correctly due to the inaccuracy in your current configuration. **BE SURE THAT THE ENGINE COMPUTER DOES NOT FEED SPEED INFORMATION TO AIRBAG OR ANTILOCK BRAKE CONTROLS IF YOU CHOOSE TO MODIFY THE SIGNAL BEFORE THE ENGINE COMPUTER. Ask your dealer for more information and/or look for alternative input sensors at each wheel for the antilock brake system. This is important.** If this is the case you must modify the speed signal after the engine computer, affecting only the safe systems indicated.

SIGNAL INPUT CONNECTIONS:

SIGNAL INPUT POSITIVE CONNECTION – Connect the Signal Input Positive, ORANGE wire, to the signal source, such as the speed sensor or computer.

SpeedChanger© was designed with a very special input circuit that automatically adjusts itself to virtually any input signal. SpeedChanger© will read VR Magnetic Sensors, Hall Effect Digital Sensors, computer generated signals all without making any adjustments to the unit. You may need to determine which wire is the "HOT" or positive signal wire of a system, such as a VR Sensor. The best way to determine the correct connection is to simply connect the Signal Input Positive, ORANGE wire, to one of the two speed sensor wires on the vehicle. If the YELLOW light on the SpeedChanger© flashes when the

wheels are moved you are done. If not, connect the Signal Input Positive, ORANGE wire, to the other speed sensor wire on the vehicle. And repeat the test by spinning the wheels. You will generate a signal that will be read and result in a flashing YELLOW light on the SpeedChanger© unit. Often times this wire is labeled in vehicle technical manuals as VSS positive for Vehicle Speed Signal Positive if you have such a manual at your disposal. This device is designed not to damage any of the vehicle components if you do not make the correct connection. This input is a very "high impedance" or looks nearly invisible to the vehicle systems.

If you are adding this unit to a "stock system" the VSS negative (Vehicle Speed Signal negative) connection will already be made. If you have a new installation as with a racecar or the like you may need to make this connection. If you have a simple VR Sensor simply connect the "other sensor wire" to negative or ground. See the diagrams in the Appendix for other installations and techniques.

GETTING A YELLOW LIGHT – When the Signal Input Positive is received correctly the YELLOW SIGNAL INPUT LIGHT (on the left side above the wires) on the SpeedChanger© will flash once with every input pulse that is received.

SpeedChanger© can also be tested independently of an input signal by moving the "TEST OSCILLATOR" switch to the TEST INPUT position. This places an internal 50 Hz oscillator to the input and stimulates the system. **OBVIOUSLY, THE SWITCH MUST BE PLACED IN THE "RUN" POSITION FOR THE UNIT TO FUNCTION IN YOUR SYSTEM.** It will not be necessary for the engine to be running at this point.

SIGNAL OUTPUT CONNECTIONS:

SIGNAL OUTPUT CONNECTION – The Signal Output, WHITE wire, provides a square wave output voltage that varies from near the Positive Power Input to the Negative Power Ground value. (For you technical types the output is shown in the figure attached.)

This SIGNAL OUTPUT has several advanced features unique to this product:

First, the output is protected against being connected directly to the Positive Power Input. Normally this would instantly "roast" SpeedChanger©. SpeedChanger© has been equipped with an AUTOMATIC RESETTING CIRCUIT BREAKER. This circuit breaker turns off the Signal Output from the SpeedChanger© in the event that too much current is being drawn. Keep this in mind if you try to overload the maximum instantaneous output rating of SpeedChanger©. No damage will occur, however no signal will be provided either. The circuit breaker resets itself several times every second so there is no delay in operation once the problem is rectified.

Secondly, this unit has a feature that stops the Signal Output when no Signal Input is received. This has no effect on the speedometer reading. The minimum speedometer reading is typically >5MPH. SpeedChanger© is designed to give an output minimum ~4MPH. This feature is activated at a frequency typically below 2MPH.

This feature DOES stop the Odometer from logging miles while the vehicle is not moving. Otherwise SpeedChanger© would output the ~4MPH while setting at lights or any time the ignition is in the "RUN" position. These miles can add up over time so we have added this advantage.

GETTING A RED LIGHT – A RED Light (on the left side of SpeedChanger© above the wires) indicates an Output Signal. When the Output Signal is "pulled low" or connected to NEGATIVE GROUND by SpeedChanger© (or externally by connecting the output to NEGATIVE GROUND) the RED Light is activated. This RED Light will blink at low frequencies. As the frequency increases the light will APPEAR to be on constantly.

IN SUMMATION OF CONNECTIONS

GREEN LIGHT – On when power is connected

YELLOW LIGHT – Blinks ON once with each Input Pulse. Can be tested with "TEST OSCILLATOR" by moving "TEST OSCILLATOR SWITCH" to "TEST" position.

RED LIGHT – Blinks ON once with each Output Pulse. If "stuck" ON the Output is shorted to ground. If "stuck" OFF the Output is shorted to positive.

DESCRIPTION OF UNIT FUNCTIONS	WIRE COLOR	CONNECT TO
SIGNAL INPUT POSITIVE	ORANGE	SENSOR POSITIVE or COMPUTER VSS+
POSITIVE POWER (BATTERY +)	RED	IGNITION POWER (ACTIVE IN "RUN" CONDITION)
NEGATIVE POWER (BATTERY -)	BLACK	SYSTEM NEGATIVE, COMPUTER GROUND
SIGNAL OUTPUT FREQUENCY	WHITE	SPEEDOMETER OR SYSTEM SIGNAL INPUT

TABLE #1: System wiring connections and functions.

SETTING THE SPEEDCHANGER©

Entering the fraction into this unit is specifically designed to be absolutely as easy as possible.

There are four (4) dials. The two (2) dials on top are for the Numerator (Multiply by). The two (2) dials on the bottom are for the Denominator (Divide by). The wires and lights are at the very bottom. Each dial has a setting from 0-9. This allows a mathematical entry of 00 to 99 / 00 to 99. Start with a setting of 01 / 01. This is the same as not having installed SpeedChanger©. This will allow you to make sure that your vehicle is working the way it did before you started. This is a good test of the installation.

This feature is significant and unique to this product! Notice that there are no banks of switches, wires to cut and reconnect, look up tables and associated chaos. A lot of time and effort was spent making this is the easiest ever speed calibration device…. Basically because we hate calls in the middle of the night when things don't work properly.

THE "HI LO" SWITCH SETTINGS

The "HI LO" switch is there to prevent the system from "clipping." If you have an incoming signal that is very fast (typically from the sensor at the transmission to the engine computer) set the SpeedChanger© to divide first or in the "HI" position. If you have an incoming signal that is very slow (typically after the engine computer) set the SpeedChanger© to multiply first or in the "LO" position. If the speedometer reads correctly at slow speeds and stops abruptly at a speed (typically about 30-50 MPH) move the switch from "LO" to "HI". If the speedometer jumps violently or "thumps" move the switch from "HI" to "LO". This switch may be moved at any time without damage to any components. In the event that your speedometer "Pegs" you may need to knock on the lens or restart the ignition switch to get it to read "0" again.

BASIC TERMINOLOGY AND MATH

NUMERATOR – The "top part " of the fraction, also known as the "Multiplier" (multiply by).

DENOMINATOR – The "bottom part" of the fraction, also known as the "Divisor" (divide by).

RATIO – The Numerator / Denominator or fraction.

In other words:

If
Numerator = 1 & Denominator = 2

Then
The fraction (or the Ratio) is Numerator / Denominator or ½

Likewise:
If
Numerator = 4 & Denominator = 1

Then
The fraction is Numerator / Denominator or 4/1
And as you will recall any number divided by 1 is equal to that number
Or in this case 4

If
Numerator = 4 & Denominator = 8

Then
The fraction is Numerator / Denominator or 4/8
Remember if the Numerator will "go into" the denominator one or more times you can reduce the fraction to "the lowest common denominator" by doing so. In other words 4/8 = ½ Is this coming back to you yet?

IMPORTANT NOTE: For Ratios with long decimal places, some technique is necessary when determining the lowest common denominator. In the event that the speedometer "shakes" or "thumps" at low speeds near 10 MPH you have set a Numerator too high for the number of pulses that you are receiving from your input sensor. Simply there is not enough incoming information to do the mathematic calculation you are trying to perform.

Typically Numerators less than 13 are OK. You may need to round off your fraction to something reasonable. For example a Ratio of 96/99 is not likely to work well on a system where the speedometer sees 10 Pulses per Mile at 10 MPH. It will "thump" pretty hard. **In all likelihood you may never use the "Numerator Tens" dial.**

A Table of Fractions will be a big help here. These are common to machine shops for choosing drill sizes and the like. We have included one in the Appendix.

One more thing:

If
Numerator = 0

Then
The answer is 0. In the case of the SpeedChanger© you will get an output equal to the fastest frequency it can generate. Most speedometers register this at about 950 MPH or Mach 1.2! This condition over rides the Denominator = 0 condition in the "HI" switch position.

If
Denominator = 0

Then
You have a “divide by 0 error” in math terms. In the case of the SpeedChanger© the signal from the input doesn’t reach the output. The answer is the slowest frequency it can generate. Most speedometers register this at about 4-5 MPH in the “HI” switch position and 0 in the “LO” switch position.

There is a special feature of SpeedChanger© that stops all frequency output if there is no signal in. This keeps your vehicle from logging odometer miles while you are sitting still and the device is turned on. To get the Min & Max signal outputs described by setting the Numerator or Denominator = 0 you may have to generate some input signal. This can be accomplished by setting the “TEST OSCILLATOR SWITCH” to the “TEST” position. Installing the device and moving the vehicle, thus generating an input signal, can also accomplish this.

So much for “Math Class 101”

CALIBRATION

NOTICE!!! WE NOW HAVE A SERIES OF CALIBRATION TOOLS, PRICED TO FIT YOUR NEEDS, TO MAKE EXACT CALIBRATION A SNAP.

MINI SPEED-CAL TOOL for an inexpensive calibration tool, accurate and affordable!

SPEED-CAL TOOL DELUX for a professional and complete speedometer system diagnostic shop in a single box! Great for the true automotive enthusiast!

Okay, this is where the rubber meets the road. The idea is actually quite simple. The input to the device is a frequency or series of pulses. The output from the device is a different frequency or series of pulses. The difference between them is simply the fraction entered into the Numerator and Denominator dials as described in the previous section.

The task at hand is to determine what the Numerator and Denominator settings should be. This can be accomplished in a number of different ways. I will describe many of these here. You may be able to come up with a few that works easier in your unique situation with a little ingenuity.

IMPORTANT NOTES: The most common mistake is to flip the fraction. Don’t be afraid to put the Denominator in the Numerator position and vice versa if your math doesn’t come out right. Just a hint. Remember if the original speedometer installation indicates too fast your ratio will be less than one. If the original speedometer installation indicates too slow the ratio setting will be greater than one.

STUCK SPEEDOMETER: You may enter a value that “pegs” the speedometer (runs the needle over the top.) Don’t panic. We have yet to find a speedometer that will actually be damaged by this. Simply turn off the power and the needle will return. Undo whatever you did that set it up this high. You probably entered a wrong Numerator or Denominator setting. Perhaps you spun the numerator dials past 00 causing that Mach 1 output we talked about in the math section. It is best not to set the Numerator to 00 during the calibration process. This saves some abuse on the speedometer.

If the speedometer is still “stuck” to the top with the power removed rap on the instrument with a very calibrated knuckle a few times until the needle un-sticks. Be careful not to scratch or break the lens. This was particularly useful on the Ford Thunderbird speedometer we tested. When it went off the top of the scale it stuck against the stop.

If this doesn't work try the following. Run the frequency speed up to near the top speed indicated on the speedometer by using the 50Hz TEST OSCILLATOR and the Numerator and Denominator. Then slowly step the speed down pulling the speedometer off of the top. This method worked particularly well on the late model Camaro and Mustang we tested on. Some speedometers apparently do not have a return spring and rely on the signal for their ultimate position. We have not found any speedometers that one of these techniques will not fix.

NEW vs. OLD RATIO METHOD:

If you know exactly what you changed from the stock "correct" calibration on your vehicle that is your ratio or your setting.

NEW / OLD = RATIO = NUMERATOR / DENOMONATOR

If you change more than one thing simply multiply them together.

(NEW 1 / OLD 1) X (NEW 2 / OLD 2) X …. (NEW n / OLD n) = RATIO

RATIO = NUMERATOR / DENOMINATOR

REMEMBER TO USE THE LOWEST COMMON DEMOMONATOR. Numerators in excess of 10 *may* become unstable on some systems causing the speedometer needle to "shake" or "thump" at low speeds around 10 MPH.

For example:

The Numerator / Denominator =
The New Tire Size / Old Tire Size *and or*
The New Tire Circumference / Old Tire Circumference *and or*
The New Gear / Old Gear *and or*
The New Speedometer Pulses Per Mile / Old Speedometer Pulses Per Mile
Etc.

33" New Tire / 30" Old Tire = Ratio = 1.1

1.1 = 11/10 If this doesn't work well due to thump the following may also be acceptable: 10/9 = 1.111 , 9/8 = 1.125, 8/7 = 1.142, 7/6 = 1.16…. You get the idea.

KNOWN ERROR METHOD:

If you know how far off your current system is you have the answer. The Actual Speed / The Speed Indicated on the Speedometer is the Ratio.

This may be the most common way to determine the proper setting, as most people will notice this error and this will be the reason to purchase SpeedChanger©. Perhaps you received one of those wonderful speeding tickets and you know how fast your speedometer indicated you were traveling at the time. Congratulations, your local law enforcement just determined your Ratio for you. You could also make friends with one of these local traffic officers and have them clock you. Perhaps they will be so impressed by your interest in your civic duty to avoid breaking the law they would help and clock you. Clocking below the legal speed limit, of course. This is more accurate the faster you go however.

Take the radar speed / indicated speed and you have the Ratio of the Numerator / Denominator.

The other ways to accomplish this is as follows:

Get 3 friends, 2 cell phones, a vehicle with a known good speedometer calibration, a piece of paper and a pencil. You can probably figure out the rest. One vehicle follows the other vehicle. Note the speed from the correct speedometer and the one you are trying to calibrate. Do this with a setting of 01/01 or before you install the device. The Ratio of 1 will look like the vehicle did before you started and make the math easier. Again the Correct Speed / The Indicated Speed is the Ratio.

This can be accomplished by using a closed track and a stopwatch to determine the actual speed. Remember to log the indicated speed.

This can be accomplished by using mile markers and highway signs but takes a pretty long trip. It has also been discovered that (believe it or not) there is sometimes a large discrepancy between the Odometer and the Speedometer reading over time… Go figure?

RATIO OF PULSES PER MILE METHOD:

The Pulses Per Mile is (as you might guess) the number of pulses that the sensor generates in one mile and or the number of pulses expected by the speedometer (computer or controller) in one mile. The Ratio is the Number of Pulses Per Mile at the Input Sensor / the Number of Input Pulses Per Mile expected at the Speedometer.

This information can be looked up in the technical and repair manuals for your vehicle. You may be able to get one or both of the answers from these manuals.

If you have a frequency meter great! This is a good way to determine what your speedometer requires in Pulses Per Mile.

1. Connect the frequency meter to the input or output (or the signal if you have yet to install the device.
2. Travel at a safe speed and read the frequency meter and the speedometer.
3. The number of Pulses Per Mile is as follows.

The math is as follows:

(Frequency from meter (Hz) Pulses/Second) X (3600 Seconds/Hour) / (Speed Mile/Hour) = Pulses/Mile or Pulses per Mile

Note: Yes “per” and “/” is the same thing

To determine the number of Pulses Per Mile produced by your sensor you might try this. Measure the distance around the circumference of the tire in feet. (Or in inches and divide by 12 inches per foot.) Carefully spin the tire by hand and count how many times the Yellow light blinks per revolution. You may want to spin the tire slowly several times and divide the Yellow blink count by that number to get a more accurate count.

Be very careful with your measurements and counting here as any error gets multiplied by ~1000 or so. Make sure that the “other” tire on the opposite side of the gearbox is not moving. This will seriously mess with your count. Most differentials will spin the opposite wheel the other direction effectively removing pulses from the count in most systems. Pin the opposite wheel before performing this test (assuming you are doing it on a jack & jack stands). Don’t forget to remove the “pin” when you put the vehicle back into service. If you have enough help you can do this on the ground. Just don’t run over or into anything or anybody. You will have to spin very slowly as not to miss count.

The math is as follows:

(5280 feet / mile) / (Circumference of the tire in feet) = Tire Rotations per Mile

(Number of Yellow Light blinks) / (The Number of tire rotations during the count) = The Number of Pulses per Rotation

(Tire Rotations per Mile) X (The Number of Pulses per Revolution) = The Number of Pulses per Mile.

The final Ratio is The Number of Pulses per Mile of the Input Sensor / The Number of Pulses per Mile of the Speedometer.

TRIAL & ERROR METHOD:

You guessed it. Not always very easy, but perfectly valid. Put in a ratio, guess how fast you are traveling by whatever magic suits you, change the ratio until you get the answer you are happy with.

Impress your girlfriends with the speed of your '74 Vega and set the speed twice as fast as the actual setting. Set your sports car to read faster than actual and keep your kids and wife from getting speeding tickets. This may be like setting your clock fast so that you are not late for work. It only works for some people.

INTERPOLATION METHOD FOR FINE TUNING:

When you have determined your ratio and the reading you are getting is still not exactly right do the following. Double the Numerator and the Denominator. Then set the Denominator up on or two or down one or two settings. If you set up or down too far you will simply have the next highest ratio at the original level. If this still doesn't give you exactly the right answer add the original Numerator and Denominator to the top and the bottom and Denominators slightly higher or lower (depending on if you are reading too high or too low) until you get the best answer. We effectively put a Ford Thunderbird Speedometer in a GMC ¾ ton pickup by this method. GM vehicles have 2 sets of Pulses per Mile. These are the high speed from the transmission and the low speed at the engine computer and the speedometer. The following was the list of settings used to set the output to match the low speed Thunderbird Speedometer with the high-speed transmission sensor signal.

The Pulses per Mile of the high speed transmission sensor on the GMC truck = 90,000 Pulses per Mile

The Pulses per Mile expected by the Ford Thunderbird speedometer = 7250 Pulses per Mile

The Ratio is 7250/90000 = 0.0805555555555

The "rounded" lowest fraction was 1/12
One answer was 2/24 plus 1 on the Denominator = .08000
The another answer was 3/36 plus 1 on the Denominator = .08108
Even better answer was 5/60 plus 2 on the Denominator = .0864
The best answer is 7/84 plus 3 on the Denominator = .08459

						1/11	1/12	1/13						
							.08333							
					2/22	2/23	2/24	***2/25***	2/26					
					.909			***.0800***	.07692					
				3/33	3/34	3/35	3/36	***3/37***	3/38	3/39				
								.08108	.0789					
			4/44	4/45	4/46	4/47	4/48	4/49	4/50	4/51	4/52			
								.08163	.0800	.0784				
		5/55	5/56	5/57	5/58	5/59	5/60	5/61	***5/62***	5/63	5/64	5/65		
								.08196	***.08064***	.0793				
	6/66	6/67	6/68	6/69	6/70	6/71	6/72	6/73	6/74	6/75	6/76	6/77	6/78	
									.08108	.0800				
7/77	7/78	7/79	7/80	7/81	7/82	7/83	7/84	7/85	7/86	***7/87***	7/88	7/89	7/90	7/91
									.08139	***.080459***	.0795			

Table #2 Interpolation Example

Do you see the pattern and how this interpolation method is accomplished?

PHYSICAL MOUNTING

Once you have made the required connections and settings, you are ready to close the unit. You will want to use some non-corrosive liquid gasket material to seal the box and around the wire-opening if you are mounting SpeedChanger© outside the vehicle or exposed to the elements.

DO NOT MOUNT THIS UNIT NEAR HEAT SOURCES. While the SpeedChanger© is designed to meet or exceed the best automotive design specifications it is NOT designed to be mounted next to components that generate extreme heat such as turbo chargers, exhaust manifolds or exhaust components.

SpeedChanger© may be mounted by using Velcro®, glue, zip tie or other method suitable to secure the box in a manner that will prevent it from moving around. It is important to prevent the wires from being pulled. Eventually this will cause your connections to fail and the system will cease to operate properly. Remember, you may need to reenter the box for future adjustments. Keep this in mind when mounting SpeedChanger©. Screws have been provided to hold the halves of the SpeedChanger© box together. Be thorough and neat about your installation.

APPENDIXES:

SPEEDCHANGER© SPECIFICATION DATA SHEET - APPENDIX 1:

SECTION	PARAMETER	MIN	TYP	MAX	UNIT
SUPPLY POWER	VOLTAGE INPUT	9.5	12	18	Volt
	VOLTAGE SPIKE	-100	-	100	Volt
	CURRENT INPUT	0.1	0.2	0.3	Amperes
	CURRENT SPIKE	0	-	8	Amperes
SIGNAL IN	LOGIC HIGH	0.2	*The Range*	8.35	Volt
	LOGIC LOW	-750	0	7.6	Volt
	VOLTAGE SPIKE	-750	-	750	Volt
	LOGIC HIGH	-0.000755	*The Range*	0	Amperes
	LOGIC LOW	-0.750	-0.000755	-0.000755	Amperes
	CURRENT SPIKE	-0.750	-	.0750	Amperes
	FREQUENCY MAX	2	*The Range*	2000000	Hz
	FREQUENCY MIN	0	0	0	Hz
SIGNAL OUT	LOGIC HIGH	*Note 1*	V IN – 0.7	VOLT IN	Volt
	LOGIC LOW	0	0.3	0.5	Volt
	VOLTAGE SPIKE	0	-	50	Volt
	LOGIC HIGH	0	*Note 2*	*Note 2*	Amperes
	LOGIC LOW	0	*The Range*	2.5	Amperes
	CURRENT SPIKE	-0.03	-	0	Amperes
	FREQUENCY MAX	600	700	1000	Hz
	FREQUENCY MIN	0	4	6	Hz
SETTINGS	NUMERATOR	1	<7	99	Dial Integer
	DENOMINATOR	1	1 TO 99	99	Dial Integer
TEST OSCILLATOR	FREQUENCY	40	50	60	Hz
PACKAGING	LENGTH	2.350	2.400	2.450	Inches
	WIDTH	2.295	2.300	2.350	Inches
	HEIGHT	0.950	1.000	1.050	Inches
	TEMP	-40	25	85	Deg C
	VIBRATION		100		G
	SHOCK		500		G
	WIRE CONNECTION	25	20	18	AWG

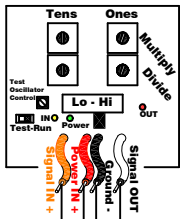
Note 1 **SIGNAL OUT LOGIC HIGH MIN VOLTS = Volt IN – 0.7 – (Ampere Load/ 1000)**
Note 2 **SIGNAL OUT LOGIC HIGH AMPERES = (Volt IN - 0.7)/1000**

WIRING DIAGRAMS – APPENDIX 2:

THESE 2 PAGES INTENTIONALLY LEFT BLANK
PLEASE SEE FOLLOWING 4 PAGES.

SpeedChanger© INSTALLATION SYSTEM REFERENCE

REVISION 2
OCTOBER 23, 2002



BASIC POWER CONNECTION

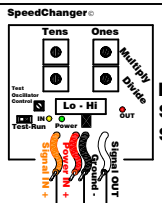
ORANGE SIGNAL INPUT FROM SPEED SENSOR

WHITE SIGNAL OUTPUT TO SPEEDOMETER OR CONTROL MODULE

IGNITION KEY SWITCH
START
RUN
OFF
POSITIVE +
NEGATIVE --
VEHICLE BATTERY

VEHICLE BODY GROUND

THIS CONFIGURATION USED TO EFFECT COMPUTER RELATED FUNCITONS SUCH AS SHIFT POINTS AND MAX VEHICLE SPEED. DO NOT CONNECT HERE IF ANTILOCK BRAKE SYSTEM OR AIRBAG IS CONTROLLED BY THE COMPUTER!!

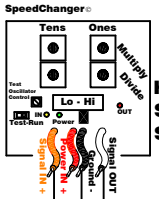


HI LO SWITCH SET "HI"

PICK ONLY ONE CONFIGURATION

BEST CONFIGURATION

THIS CONFIGURATION USED TO EFFECT ONLY THE SPEEDOMETER AND IS SUGGESTED ... ESPECIALLY IN SYSTEMS WITH MANUAL TRANSMISSIONS.



HI LO SWITCH SET "LO"

SPEEDOMETER

SPEED SENSOR AT TRANSMISSION OR AXLE

ANTILOCK BRAKE SYSTEM IF EQUIPPED (OPTIONAL)

POSITIVE POWER CONNECTION (OPTION ON 3 WIRE SENSORS)

VEHICLE SPEED SIGNAL POSITIVE (VSS+)

ENGINE, TRANSMISSION AND OR VEHICLE COMPUTER

VEHICLE SPEED SIGNAL POSITIVE (VSS+)

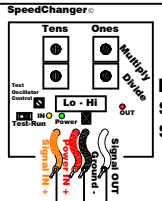
CUT VEHICLE SPEED SIGNAL POSITIVE (VSS+)

VEHICLE SPEED SIGNAL NEGATIVE (VSS-) OR BATTERY NEGATIVE

VEHICLE BODY GROUND

CUT VEHICLE SPEED SIGNAL POSITIVE (VSS+)

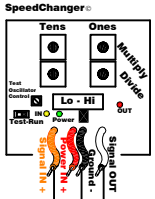
THIS CONFIGURATION USED TO EFFECT COMPUTER RELATED FUNCITONS SUCH AS SHIFT POINTS AND MAX VEHICLE SPEED. THIS IS COMMONLY USED TO AVOID NOISY ABS SIGNALS CAUSING SPEEDO JUMPING.



HI LO SWITCH SET "HI"

PICK ONLY ONE CONFIGURATION

THIS CONFIGURATION USED TO EFFECT ONLY THE SPEEDOMETER AND IS SUGGESTED ... ESPECIALLY IN SYSTEMS WITH MANUAL TRANSMISSIONS.



HI LO SWITCH SET "HI"

SPEEDOMETER

SPEED SENSOR AT TRANSMISSION OR AXLE

ANTILOCK BRAKE SYSTEM IF EQUIPPED (OPTIONAL)

POSITIVE POWER CONNECTION (OPTION ON 3 WIRE SENSORS)

VEHICLE SPEED SIGNAL POSITIVE (VSS+)

ENGINE, TRANSMISSION AND OR VEHICLE COMPUTER

VEHICLE SPEED SIGNAL POSITIVE (VSS+)

CUT VEHICLE SPEED SIGNAL POSITIVE (VSS+)

VEHICLE SPEED SIGNAL NEGATIVE (VSS-) OR BATTERY NEGATIVE

VEHICLE BODY GROUND

CUT VEHICLE SPEED SIGNAL POSITIVE (VSS+)

TROUBLESHOOTING – APPENDIX 3:

SPEEDCHANGER© OPERATING LIGHTS:

If the YELLOW Light on the SpeedChanger© is NOT blinking for an extended period of time and the RED Light on the SpeedChanger© is ON this indicates that the Output Signal is shorted directly to NEGATIVE GROUND. This is NOT a correct connection.

If the YELLOW Light on the SpeedChanger© IS blinking and the RED Light on the SpeedChanger© is OFF or very dim, then the Output Signal is shorted to the POSITIVE POWER SOURCE and denominator is set to something other then zero. This is NOT a correct connection.

The RED Light may glow slightly between full ON "blinking". This is OK. It simply means that the device you have connected to the Output Signal has a "small path to ground" or a natural voltage state below the POSITIVE POWER SOURCE. If the device you have connected to the Output Signal, Orange Wire, is removed the RED Light should return to full ON and OFF states during the blinking cycle. Remember the Output Signal, Orange Wire, and the RED Light will not "blink" unless there is an Input Signal. Also remember you can easily generate an Input Signal by moving the "TEST OSCILLATOR SWITCH" to the "TEST Position".

Did you know that there is a quick way to determine if the RED or YELLOW Lights are blinking after the flash rate is too high for your eye to tell (persistence of vision happens when an event occurs more than ~24 times a second (24Hz) making the light look like it is fully on.) Simply shake or slide the device back and forth quickly in front of your eye while looking at a fixed stationary point. Blinking will show up as a series of lighted dashes and dark dots in space. The length of witch will be determined by how fast the blink rate occurs and how fast you move the device in front of your eye. Remember don't focus on the light. Focus past it. This effect will not work if you follow the light with your eye.

STUCK SPEEDOMETER:

You may enter a value that "pegs" the speedometer (runs the needle over the top.) Don't panic. We have yet to find a speedometer that will actually be damaged by this. Simply turn off the power and the needle will return. Undo whatever you did that set it up this high. You probably entered a wrong Numerator or Denominator setting. Perhaps you spun the numerator dials past 00 causing that Mach 1 output we talked about in the math section. It is best not to set the Numerator to 00 during the calibration process. This saves some abuse on the speedometer.

If the speedometer is still "stuck" to the top with the power removed rap on the instrument with a very calibrated knuckle a few times until the needle un-sticks. Be careful not to scratch or break the lens. This was particularly useful on the Ford Thunderbird speedometer we tested. When it went off the top of the scale it stuck against the stop.

If this doesn't work try the following. Run the frequency speed up to near the top speed indicated on the speedometer by using the 50Hz TEST OSCILLATOR and the Numerator and Denominator. Then slowly step the speed down pulling the speedometer off of the top. This method worked particularly well on the late model Camaro and Mustang we tested on. Some speedometers apparently do not have a return spring and rely on the signal for their ultimate position. We have not found any speedometers that one of these techniques will not fix.

DECIMAL TO FRACTION CONVERSION TABLE – APPENDIX 4:

Important Note: any span of numbers that is underlined signifies that those numbers are repeated. For example, 0.09 signifies 0.090909....

Only fractions in lowest terms are listed. For instance, to find 2/8, first simplify it to 1/4 then search for it in the table below.

Fraction = Decimal			
1/1 = 1			
1/2 = 0.5			
1/3 = 0.3	2/3 = 0.6		
1/4 = 0.25	3/4 = 0.75		
1/5 = 0.2	2/5 = 0.4	3/5 = 0.6	4/5 = 0.8
1/6 = 0.16	5/6 = 0.83		
1/7 = 0.142857	2/7 = 0.285714	3/7 = 0.428571	4/7 = 0.571428
	5/7 = 0.714285	6/7 = 0.857142	
1/8 = 0.125	3/8 = 0.375	5/8 = 0.625	7/8 = 0.875
1/9 = 0.1	2/9 = 0.2	4/9 = 0.4	5/9 = 0.5
	7/9 = 0.7	8/9 = 0.8	
1/10 = 0.1	3/10 = 0.3	7/10 = 0.7	9/10 = 0.9
1/11 = 0.09	2/11 = 0.18	3/11 = 0.27	4/11 = 0.36
	5/11 = 0.45	6/11 = 0.54	7/11 = 0.63
	8/11 = 0.72	9/11 = 0.81	10/11 = 0.90
1/12 = 0.083	5/12 = 0.416	7/12 = 0.583	11/12 = 0.916
1/16 = 0.0625	3/16 = 0.1875	5/16 = 0.3125	7/16 = 0.4375
	11/16 = 0.6875	13/16 = 0.8125	15/16 = 0.9375
1/32 = 0.03125	3/32 = 0.09375	5/32 = 0.15625	7/32 = 0.21875
	9/32 = 0.28125	11/32 = 0.34375	13/32 = 0.40625
	15/32 = 0.46875	17/32 = 0.53125	19/32 = 0.59375
	21/32 = 0.65625	23/32 = 0.71875	25/32 = 0.78125
	27/32 = 0.84375	29/32 = 0.90625	31/32 = 0.96875

Need to convert a repeating decimal to a fraction? Follow these examples:

Note the following pattern for repeating decimals:
0.2222222... = 2/9
0.54545454... = 54/99
0.298298298... = 298/999
Division by 9's causes the repeating pattern.

Note the pattern if zeros precede the repeating decimal:
0.022222222... = 2/90
0.0005454545454... = 54/99000
0.00298298298298... = 298/99900
Adding zero's to the denominator adds zero's before the repeating decimal.

To convert a decimal that begins with a non-repeating part, such as 0.21456456456456456..., to a fraction, write it as the sum of the non-repeating part and the repeating part.
0.21 + 0.00456456456456456...
Next, convert each of these decimals to fractions. The first decimal has a divisor of power ten. The second decimal (which repeats) is converted according to the pattern given above.
21/100 + 456/99900
Now add these fraction by expressing both with a common divisor
20979/99900 + 456/99900
and add.
21435/99900
Finally simplify it to lowest terms
1429/6660
and check on your calculator or with long division.
= 0.2145645645...

ENGLISH (MPH) ←→ METRIC (KPH) CONVERSION – APPENDIX 5:

The SpeedChanger© unit can be effectively used to modify an existing speedometer to read in a different system of measurement (i.e. metric KPH). For example if you find yourself crossing over into Canada from the United States on a regular basis and would like to know how fast you are traveling without guessing or performing annoying calculations in your head every time you look at the speedometer, perform the following installation.

The SpeedChanger© unit can be installed with a simple Single Pole, Double Throw switch, easily accessible by the driver that will enable and disable SpeedChanger's© operation. Simply by entering a ratio value of 09/05 into the SpeedChanger© dials and enabling the unit you will convert the speedometer reading from English (MPH) to Metric (KPH).

If you have a vehicle that has a speedometer that reads in Metric (KPH) and would like it to read English (MPH) enter a ratio of 05/09 to make the conversion.

If you have a vehicle that requires both calibration and conversion you will need two (2) SpeedChanger© units to perform the necessary operations. As you can imagine, if the SpeedChanger© is not enabled it will not be possible to make the required calibration & conversion.

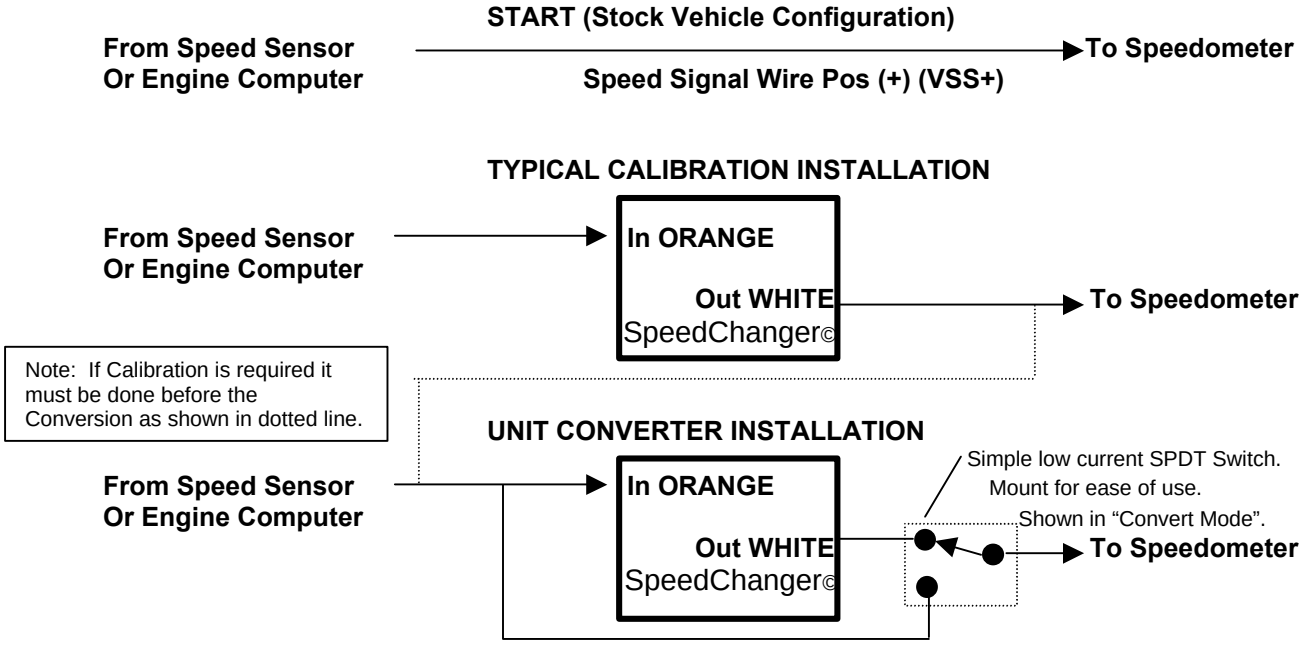
If your speedometer only reads 85 MPH and you convert to Metric (KPH) you may find that at highway speeds you "run out" of range on your dial. You may decide to divide your (KPH) reading by two (2), this will allow your speedometer to remain in range. A simple multiplication by two (2) is fairly easy to perform in your head when reading the dial.

FOR EXAMPLE:

Speed		**SpeedChanger© Setting**		**Speedometer Reading**
55 MPH	x	09/05	=	99 KPH (> 85 top of your speedometer dial)
55 MPH	x	09/10	=	49.5 KPH (multiply by 2 in you head =~100 KPH**)**

INSTALLATION MODIFICATION FOR UNIT CONVERSION:

Install the SpeedChanger© as described in this manual with the following modification to the circuit for an English to Metric conversion switch.



2 SPEED GEARBOX ADAPTER CONVERSION – APPENDIX 6:

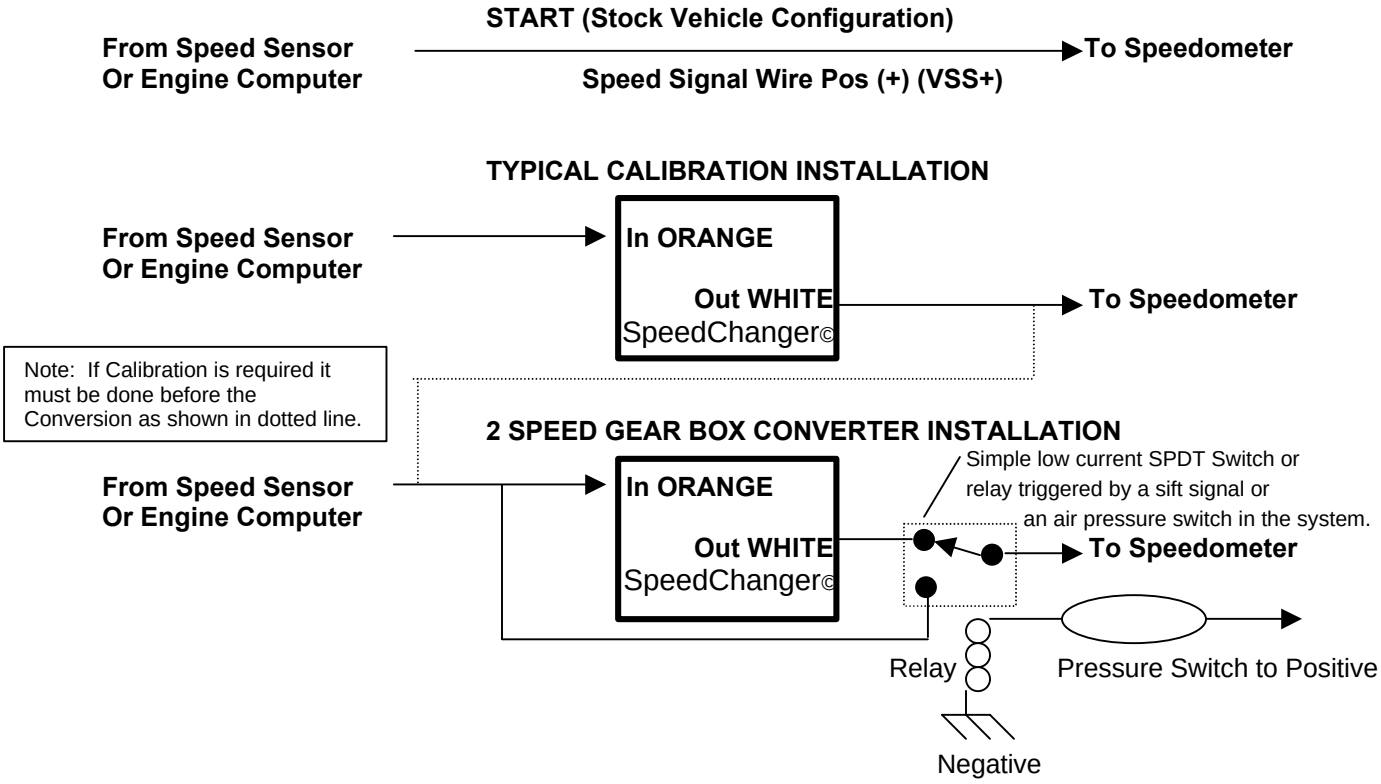
The SpeedChanger© unit can be effectively used to modify an existing speedometer to read correctly in a system with two different gear ratios. This is common in large trucks. Especially having 2 speed differential gear sets. To accomplish this perform the following installation.

The SpeedChanger© unit can be installed with a simple Single Pole, Double Throw switch, easily triggered by the shift selector that will enable and disable SpeedChanger's© operation. Simply by entering a ratio value of the alternate gearbox into the SpeedChanger© dials and enabling the unit you will convert the speedometer reading from the original operation to the alternate gear ratio.

If you have a vehicle that requires both calibration and conversion you will need two (2) SpeedChanger© units to perform the necessary operations. As you can imagine, if the SpeedChanger© is not enabled it will not be possible to make the required calibration & conversion.

INSTALLATION MODIFICATION FOR 2 SPEED GEAR BOX CONVERSION:

Install the SpeedChanger© as described in this manual with the following modification to the circuit for a 2 Speed Gear Box conversion switch.



WARRANTY POLICY – APPENDIX 7:

TERF Inc. warrants to the original purchaser of TERF Inc. manufactured products against defects in materials and workmanship for a period of 90 days from the date of original purchase. Products from other sources will carry their respective warranties provided by their manufacturers only, but will be warranted by TERF Inc. for a period of 30 days. If a product should fail to conform to this contract or to any warranty outlined herein, buyer's remedy shall be limited to repair or replacement of the nonconforming product or part(s), at TERF Inc.'s discretion. The warranty does not cover damages caused by physical abuse, misuse, unauthorized repair or modification, improper installation, inadequate maintenance, excessive or inadequate electrical power, surges, or other irregularities or operation outside of the environmental specification for the product. TERF Inc. offers no software or information warranty, expressed or implied. TERF Inc. accepts no software or information exchange or return. This warranty shall be in lieu of any other warranties, including but not limited to any warranty injury of any nature, whether direct, indirect, incidental, consequential, or special in connection with or resulting from the use of the product. This includes any losses caused due to default in manufacturing workmanship. The products we sell are not authorized for use as critical components in human implantable devices, or life support devices or systems involving safety (including, but not limited to, Antilock Brake Systems), human or otherwise. A critical component is any component of a human implantable device, a life support device or system, whose failure to perform can be reasonably expected to cause the failure of the implant, life support device or system, or to affect its safety or effectiveness.

TERMS OF SALE – APPENDIX 8:

Payment:

We accept Visa, MasterCard, American Express, Discover, and Money Orders. A third-party professional financial institution (Professional Merchant Services, certified by Visa, MasterCard, American Express, Discover and FMBS) receives credit card orders, on our behalf. This is done over a secure web site and a copy of your order form will be forwarded to you by email, fax or regular mail. Due to a large volume of credit card fraud, your billing address and name is required exactly as it is indicated on your credit card account and will be checked thoroughly, with the issuing bank. TERF Inc. has made every reasonable effort to protect your credit information and assumes no liability, expressed or implied, regarding the protection or unauthorized release of this information.

Shipping:

Products are generally shipped via UPS or US Mail. Priority deliveries are usually handled by UPS. All Shipping and Handling fees are non-refundable.

Foreign Orders:

All foreign orders over $100.00(except Canada) must be mailed with an International Money Order or arrangements for a bank wire must be made. They are shipped via U.S. Airmail. You are wholly responsible for any custom duties, import restrictions, etc. For wire/funds transfer, please contact our office by fax or E-mail for our banking information. No Letters of Credit will be accepted.

Legal Status of Products:

It is the responsibility of the Buyer (not TERF Inc.) to ascertain and obey all applicable local, state and federal laws in regard to possession and use of any item in this catalog/web site. Consult your attorney regarding local, state and federal laws before ordering. By placing an order, the buyer represents that he/she is of legal age and that the products will be used only in a lawful manner.

Miscellaneous:

Prices are subject to change. Product styles may vary. Michigan orders must add 6.25% sales tax. If tax exempt, please include a resale certificate. We assume no liability associated with product usage. The buyer is liable and responsible for any loss, damage or expenses of any kind, arising out of the use or misuse of the products. By placing an order, the buyer signifies agreement to these Terms of Sale and all other terms presented herein.

RETURN POLICY- APPENDIX 9:

Exceptions can be made for any of these policies; you just need to talk to us first.

Basic:

1. CONTACT US – LET US SEE IF WE CAN RECTIFY THE SITUATION. IF A RETURN IS NECESSARY YOU MUST OBTAIN A RMA (Return Materials Authorization) NUMBER
(This keeps us from confusing outbound product and inbound product. Part of our strict quality assurance program you see.)

2. INCLUDE A COPY OF YOUR RECEIPT!
(So we know who it's from, what was paid, the receipt number etc)

3. LET US KNOW IF YOU ARE RETURNING FOR AN EXCHANGE OR REFUND and WHY!
(So we know what to do and why we are doing it!)

4. SEND VIA INSURED MAIL OR UPS/FEDEX ETC!
(So if the post office or carrier loses it- You'll be able to get your money back from them!)

5. KEEP A COPY OF THE SALES RECEIPT, RETURN POSTAGE RECEIPT AND RMA NUMBER FOR YOUR RECORDS.
(So if the post office or carrier loses it- You'll be able to get your money back from them! AND this will make communicating with us regarding the exchange much easier.)

If you do not follow the instruction above, we will not know from whom the return package was sent or what to do with it. We'll take our best guess, and you know how that works out, or we'll have to wait till you call to let us know this information. We cannot accept collect or postage-due return shipments, and are not responsible for uninsured packages that are lost in transit. We strongly suggest that you insure you package.

Return Policy Details:

TERF Inc. reserves the right to issue an authorization number. Returns within 30 days, and for non-defect, non-compatible or technical difficulties are subject to a restocking fee. Absolutely no refunds after 30 days. No return will be permitted on any product that has been abused or modified in any way (except by our technical department). Modifications include the removal of, or attempted modification to identification labels attached to the product at the time of purchase. No returns, or refunds on Special Orders Items, software or information based items that can be easily copied and some test equipment.
An authorization (RMA) number must be obtained from TERF Inc. in order for the return to be accepted. The authorization number must be clearly marked on the shipping container and the returned receipt otherwise the returned shipment is subject to refusal by TERF Inc. All replacements are subject to stock availability. If a product has been discontinued, a replacement item of equal value or a credit for current value will be issued at TERF Inc.'s discretion. No liability is recognized for a waiting period or for a discontinued item. TERF Inc. reserves the right to refuse acceptance of any item that is returned incomplete. Please note that we can only process returns and refunds for items purchased from TERF Inc. or www.terfinc.com.

No Refunds On:

Any item that has been used or opened, lights, tools, semiconductors or "raw" circuit level devices (unless package is unopened), batteries, special orders, information based items that can be easily copied and some testing equipment. If a return on these is needed, just email us first and explain the situation.
Please inquire on specific items first if you have any questions.
A restocking charge may apply on merchandise returned that does not comply with the return policy. We really want to fair about any returns, so talk to us if you have any questions.

Canceling an Order:

In the event that you need to cancel an order placed online, please call 1-800-975-1445. If we are unable to stop your order from being shipped, you may return it using the procedures listed.

Credit Payment:

Refunds for credit card or commercial account purchases will be credited to the original credit account number used at the time of purchase. Allow time for the credit to appear in your second billing cycle after the return. Refunds of purchases made by personal or business check or money order will be made by check usually within 14 days after the return.

Shipping Damages or Shortages:

Have the carrier note any damages upon arrival. Inspect all packages and check the packing list to determine whether or not there are any shortages. If so, let us know **immediately!** If you receive cartons that are visibly damaged, please note the damage on the carrier's freight bill or receipt. Be sure to obtain a copy. Once received, keep the original carton, all packing materials and parts intact. Please contact our Customer Service Department at 1-800-975-1445 within 10 calendar days after receiving a damaged shipment, or as soon as you determine that a shipment is lost.

How To Return Items:

Simply indicate the reason for your return and if you want an exchange or a refund.
Include the packing slip or receipt or copy of receipt with your return AND THE RMA NUMBER.
Wrap and package the item securely. Preferably in the original packaging and in the same configuration.
For your protection, we recommend that you use *UPS, FedEx, Insured Parcel Post with delivery confirmation* or another courier that offers tracking and insurance for shipment because we cannot be responsible for lost shipments. Claims for lost shipments must be made with the courier you used.
All returns must be freight prepaid back to TERF Inc. We cannot accept collect or postage-due return shipments, and are not responsible for uninsured packages that are lost in transit. We strongly suggest that you insure you package.
Please note that we can refund shipping costs only if the return is a result of **our** error.

Return Address:

TERF Inc.
Attn: Returns Department
3588 Plymouth Rd. #232
Ann Arbor, MI 48105-2603

Problems, Questions, or Suggestions?

If you have any problems with your order, please don't hesitate to contact us.
E-mail: sales@terfinc.com
Telephone: 1-800-975-1445 or (248) 210-8009