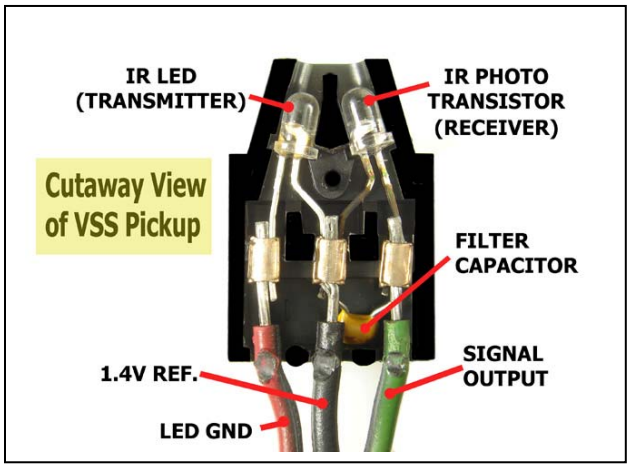
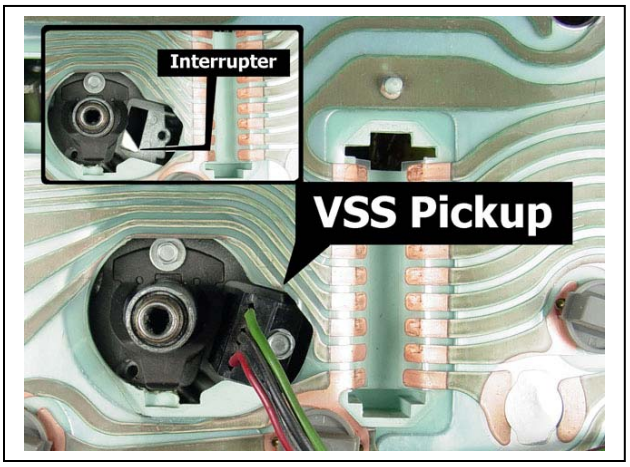
T E C H N I C A L I N F O R M A T I O N

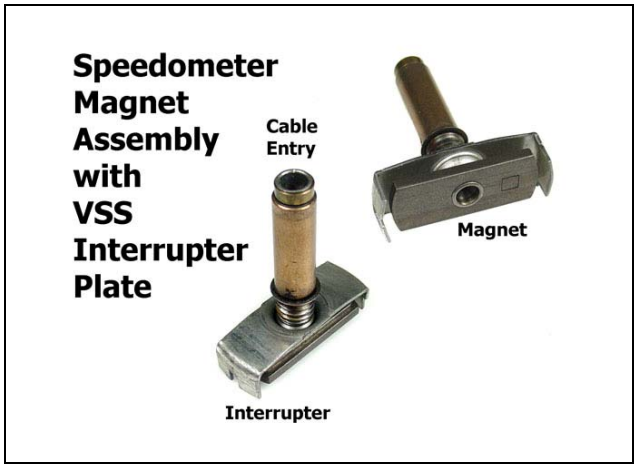
Vehicle Speed Sensor (VSS) and Speedometer Operation

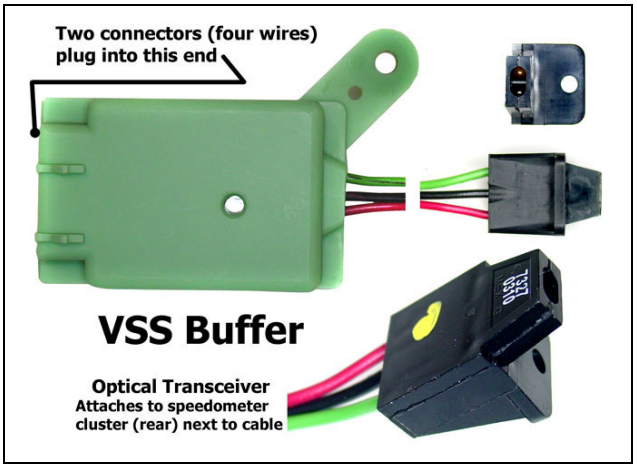
Road speed is a key factor in processing important functions in the GM vehicle, such as Torque Converter Lockup, Canister Purge events, Coolant Fan shut-off, speed governor, deceleration enleanment filtering, and a few other “housekeeping” chores. To maintain normal vehicle operation, it is important that the vehicle speed sensor functions properly. If the sensor should fail, a SES code 24 will be set and will cause improper operation of the vehicle.

The vehicle speed sensor in the 1984-1987 Regal is a sensor that registers a pulse train, relative to actual road speed, by monitoring the speedometer cable rotation. This is accomplished by a pickup transceiver which is mounted in the rear of the speedometer head. The pickup, secured by a single screw, incorporates an infrared light source (transmitter) and a focused IR phototransistor (receiver). When positioned in the speedometer head, the pickup focuses upon an interrupter which is a reflective steel plate. The plate is designed so that with each revolution of the speedometer cable, the reflective plate enters the field of view twice, resulting in two pulses for each full turn of the speedometer cable.







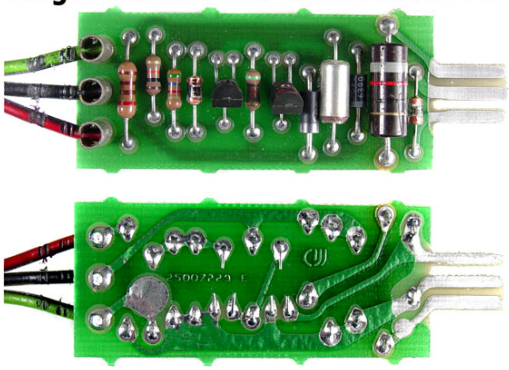


The pickup head is attached to the VSS Buffer Module which is a green plastic box located in the passenger compartment and attached near the base of the steering column. Note: Single Channel VSS Buffer is housed in a yellow plastic enclosure. Buick Regals have two types of VSS Buffer Modules, a “single channel” and a “dual channel”. The single channel module is used on vehicles which are not fitted with Cruise Control. However, most Regals are fitted with Cruise Control, so the dual channel modules are much more common. There are three colored wires in a harness connecting the Transceiver (pickup) head to the controller PC board: Green (signal) Black (1.4V LED power) and Red (LED Ground). The output of the VSS Buffer operates this way: When there is no reflection in the path of the pickup, the outputs go to ground, and when the pickup head “sees” the reflection, the output goes “open”. Since the ECM incorporates a “pull-up” resistor in its signal input pin, the ECM will then interpret logic “1” during interrupter signal and logic “0” with no interrupter signal. Cruise control signal input works in the same way.

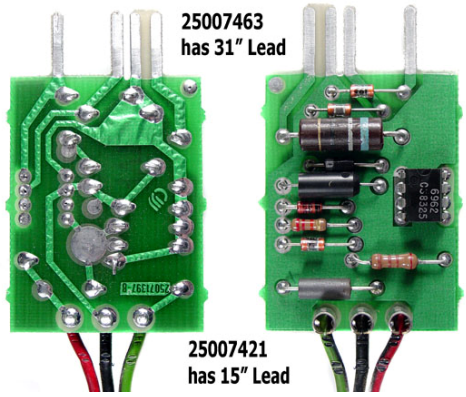
The harness length is either 15 or 31 inches long depending on the part number used in the specific application. Either part number can be used on the turbo Regals.

Shown below are the actual PC boards with the green or yellow housing removed. Note the extra connector pin on the dual channel design, which provides the VSS signal to the Cruise Control.

Single Channel VSS Buffer 25007227



Dual Channel VSS Buffer 25007421



The rate at which the mid-80's Buick ECM processes road speed is 2000 pulses per mile at 60MPH. Essentially, at 60MPH of road speed, the speedometer cable rotates at 1000RPM, and that signal is multiplied by two from the two reflective spots that the VSS pickup is focused on. The speed in RPM of the speedometer cable is calibrated at the factory based upon rear differential ratio and tire size. There are several combinations of driven and driving gears available from GM that can be interchanged at the transmission when modifying the factory components, to assure proper speedometer reading and correct ECM data.

While on the subject of road speed, it would be helpful to understand how the speedometer is able to display accurate road speed (MPH or KPH) relative to the rotational speed of the speedometer cable. For the sake of explanation, I will discuss miles per hour**.**

The mechanical speedometer was invented over a century ago and up until the point at which electronic speedometers were designed, was the product of choice by automakers. It should be noted that the digital-dash equipped Regals use the VSS signal (combination of mechanical and electronic technology) to display road speed where the analog-dash equipped cars use a mechanical-only display. How cutting-edge it must have been back in 1984! Still, both designs utilized a mechanical odometer for display of total vehicle mileage.

The speedometer uses a phenomenon called "eddy current" which uses a permanent magnet to generate electron flow within an air gap, ultimately causing the speedometer needle to deflect when the speedometer cable begins to rotate. Eddy current results in transfer of electrons from a moving magnetic field where the rotating member, basically a bar magnet, is positioned to pass thru and rotate around a "speedcup". This is a non-ferrous (aluminum) cup that is attached to the speedometer needle and suspended on a low friction bearing surface. The eddy current transfers electrons within the air gap that the speedcup passes thru, which causes the speedcup to generate and react to its own flow of electrons and rotate relative to the strength of the field. The bar magnet is precisely magnetized at a specific strength to cause just enough "pull" to rotate the speedcup at a certain rate. When the magnet is not rotating, the speedcup/needle assembly is forced to park at or around zero MPH on the display by the use of a very fine clock spring which keeps the needle parked until the speedcup starts to rotate, and also plays a role in full-scale calibration of the display.

To summarize: The eddy current generated in the rotating magnet forces the speedcup to rotate against the return spring at a specific rate, and the magnetic flux is applied in such a way as to cause pre-determined, calibrated movement, displaying accurate MPH on the speedometer face based upon a given rotational speed. By adding or subtracting magnetic density, one can accurately control the stalled position of the display needle vs. cable RPM. When replacing the 85 MPH display with an aftermarket silk-screened overlay (typically 145 MPH), a speedometer service shop can re-calibrate the magnet by reducing the magnetism in the bar appropriately to result in less deflection of the needle, thereby causing the speedometer to accurately display miles per hour (or Kilometers per hour if so equipped). Note that this has no effect on the VSS signal since the speedometer cable is still rotating at its normal speed. This is done using an accurate calibration rotating standard and a specially designed electromagnetic clamp-on device.

The odometer (which displays your total accumulated mileage driven) is mechanically linked to the speedometer cable thru a series of gears, and will accurately display mileage as long as the speedometer cable rotates at the proper speed. Larger diameter tires will affect the odometer accuracy and will reduce the rate at which mileage is accumulated. Also, lower rear end ratios will affect the odometer and speedometer readings.