The Low Tire Pressure Warning System

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Version 2. 8-Mar-20

It's easy to love or hate this feature of our ZR-1's. Love would be for the uniqueness and its place in history. Hate would be for its limited reporting.

In preparation for the introduction of the LT5 engine, GM was working with Goodyear on leading edge tire technology. The tire was designed for sustained use at over 150 mph. An under inflated tire generates more heat from internal friction. It's easy to see that a tire with low inflation pressure could run too hot if the car was run at it top speed for an extended time. In 1989, the year that the ZR-1 was planned for introduction, GM released their first tire pressure monitoring system on the Corvette. It was production option UJ6 and sold for $325. [1] All ZR-1's received the option. About 20 to 40% of the base '89 to '96 cars ordered the option. The most unique aspect of the system was the sensor's self-contained power generator, thus it did not need a battery. The Epic Corporation manufactured the sensor. A piezo electric generator was used to generate electricity.

The piezo electric effect has been known to science for over 100 years. Certain crystal materials will generate piezoelectricity when a force is applied to the material. The Corvette sensors use a sheet of piezo electric material. One end is fixed on the sensor circuit board and the other end has a weight that is free to move due to inertia if motion is imparted to the sensor case. The generator in the sensor develops one volt AC. The same principle generates thousands of volts in the application that lights a gas grill.

System Operation

The sensor has a pressure switch that closes when the tire pressure is less than 26 psi. The sensor sends a signal to the receiver module in the dash to indicate that it is operational. There is no speedometer input to the control module so it can't sense that the car is in motion. When the ignition key is turned on, both the Low Tire Pressure and the Service LTPWS lamps blink on for a lamp test and successful self-test of the receiver module.

'89 to '90 Cars.

The receiver uses the appearance of the signal from the first sensor to wake-up and determine that the car is in motion. The system then expects the signals from the other three sensors. It checks for the receipt of all four wheel sensor signals. If one or more of the sensors does not activate, the receiver will illuminate the Service LTPWS lamp. The early system does not provide diagnostic error codes. This is the procedure to identify a failed sensor. Set 35 psi in three of the tires. In one tire set 20 psi. Lift the tire off the ground. Vibrate the tire in the area opposite from the wheel stem with a large rubber mallet while observing the Low Tire Pressure lamp. While vibrating the tire at one stroke per second, the light should illuminate within one minute. A sensor that is in excellent condition will activate the light in as little as 20 seconds.

[1] Corvette Black Book 2005 issue.

Since the system relies on at least one sensor to check-in. It can't detect if all of the sensors are defective or not present.

The system shares power with the cruise system. Removing the fuse will turn off the cruise system. The only other way to extinguish the lamps is to remove them.

'91 to '95 Cars.
The operation is the same except for two things. One, the system runs a timer to detect the presence of the sensors. An error will set if the ignition key is on for 30 minutes or more in three consecutive key-on cycles and a sensor is not detected. This allows the detection of a situation where all of the sensors are defective or not present. Second, the system has an error code reporting system. It can report which sensor caused the service light to turn on. For '91 – '93 cars, the error codes are flashed with the Service LTPWS light when the A and B pins are connected on the ALDL port. For '94 – '95 cars connect pins 5 and 6.

To clear an error code, connect the ALDL pins together for one second three times within 10 seconds. Both lamps will turn on to confirm a successful clear operation.

Part Numbers

The original style parts have not been available from GM since about 2006.
'89 – '92 cars.

Production sensor PNs.		Service PNs. Supplied through the GM parts system.
RF Blue	10098494	14104393
LF Green	10098495	14104396
RR Orange	10098496	14104394
LR Yellow	10098497	14104395

The early sensors operate on a radio frequency of 245 mHz. The Canadian government had a problem with the use of that frequency. The frequency was changed to 355 mHz. for the '93 model year.
'93 – '95 cars.
Production and Service Sensor Part Numbers.

LR Yellow	10161854
RF Blue	10161855
LF Green	10161856
RR Orange	10161857

About 2008 GM parts distributed service sensors for the '93 – '95 cars that have a completely new design. The sensors are easy to identify because instead of the little curved sensor case, the new sensors have a larger black rectangular case. These sensors use a lithium battery for power. The sensors were discontinued in 2010.

LR	88959444
RF	88959445
LF	88959446
RR	88959447

Good used sensors are somewhat easy to find because some people removed them from wheels when installing upgrade wheels. Others removed them due to fear of the sensor breaking loose in the wheel. I believe that is a problem only if sensor is damaged by improper tire service.

Use Caution When Having the Tires Serviced

In 2007 tire pressure monitoring became required on all new cars. Tire technicians are learning all about the new sensors. Tire pressure monitoring is not new to ZR-1 owners, since all ZR-1s are equipped with it.

The automotive service industry, unfortunately, tries to make simple procedures with a one size fits all mentality. This can affect our tire pressure sensors. Most of the new tire pressure sensors are part of the valve stem assembly. Automotive trade publications are instructing technicians to break the tire bead on the side opposite of the valve stem to avoid damaging the sensor. On ZR-1 wheels, the sensor is attached by a band in the area opposite from the valve stem. If the simple advice that is popular today is followed, it will guarantee that the ZR-1 sensor will be destroyed.

On ZR-1 wheels, the bead should be pushed off the rim on the side of the wheel adjacent to the valve stem.

OE wheels were labeled with tire dismounting instructions. The factory assumed that a dual arm tire dismounting apparatus could be used, and the labels state that the bead should be pushed 90 degrees from the stem. This works with a single arm machine too. With a single arm machine, I recommend pushing on the area adjacent to the valve stem for maximum protection of the sensor.

Be alert when working with a service adviser and not the technician at a tire shop. When describing the ZR-1 sensor position, make sure that the advisor is listening to you. Be concerned if you are told that they know all about the sensors because they are used on all of the newer cars now. The advisor probably thinks that the technicians have been trained to handle all tire pressure sensors. Following the simple rule will destroy a ZR-1 sensor. I recommend asking to speak with the technician or the senior technician for the shop tire area and making sure that they know the location of the sensor in a ZR-1 wheel.

As a back-up plan, I like to leave an informational note on the dash that the technician will see when the car is moved into the service bay.

A Modern Tire Pressure Monitor System Upgrade

One system is the Omega Steelmate ET-780AE Tire Pressure Monitoring System. This simple system installs the sensors on the valve stems in place of the dust caps. It can be installed without dismounting the tires. This is a cheap Chinese product but it does get the job done. About $140 at Amazon.

Identifying Weak or Intermittent Sensors on ’89 and ’90 Cars

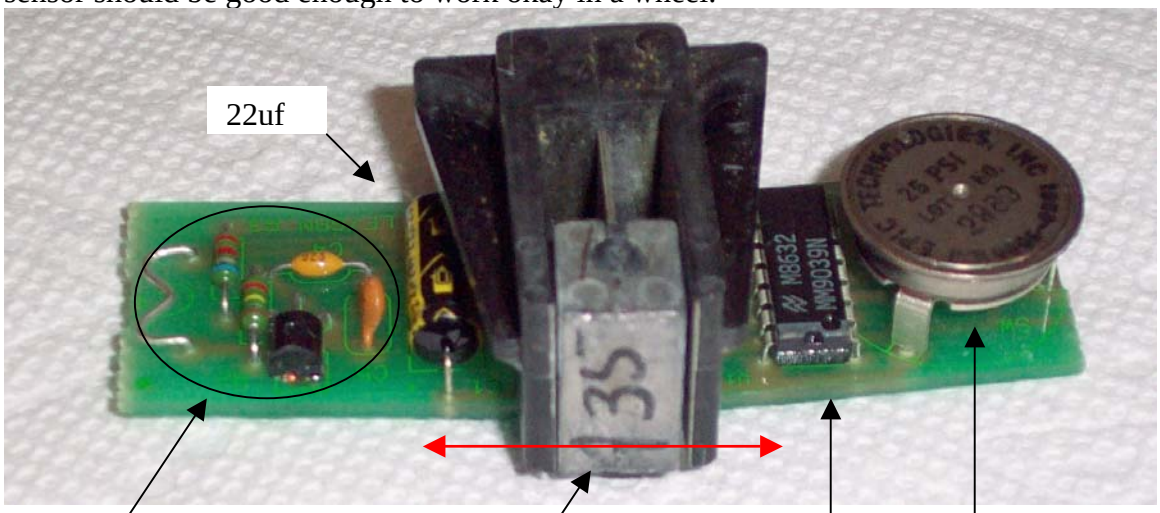
The method described above for identifying a defective sensor works well for a sensor that is not operational or very weak. It is possible to have a marginal sensor that tests well but fails only when the car is driven. A great way to take control of this situation is to install a ’91 or ’92 receiver module. With a ’91 –’92 receiver module a failing sensor will log an error code specific to the wheel location. The codes are 24 for the RR, 34 for the LR, 44 for the LF and 54 for the RF. The first code will always be a 12 to indicate that the diagnostic system is operational. The brown wire on pin C of the receiver module needs to be connected to the ALDL connector pin B, black wire with a white stripe, for the diagnostic control. Oddly, some early ’90 cars have this wire in the harness.

Repairing a Sensor

The piezo generator is the number one cause of sensor failure. The piezo panel develops a crack and the voltage output drops off. A very good sensor develops 1 volt AC into the bridge rectifier and 3 volts DC across the 22 uf filter capacitor in the power supply.

Sometimes the pressure click switch fails and sets a false low tire pressure display. A switch from a sensor with a failed piezo generator can be harvested to repair the sensor.

After a repair the sensor can be tested by simply sitting in the car with the ignition key on and tapping the sensor gently with a screwdriver handle. A very good sensor will turn on the Low Tire Pressure light within 20 seconds. If the light goes on within 60 seconds the sensor should be good enough to work okay in a wheel.

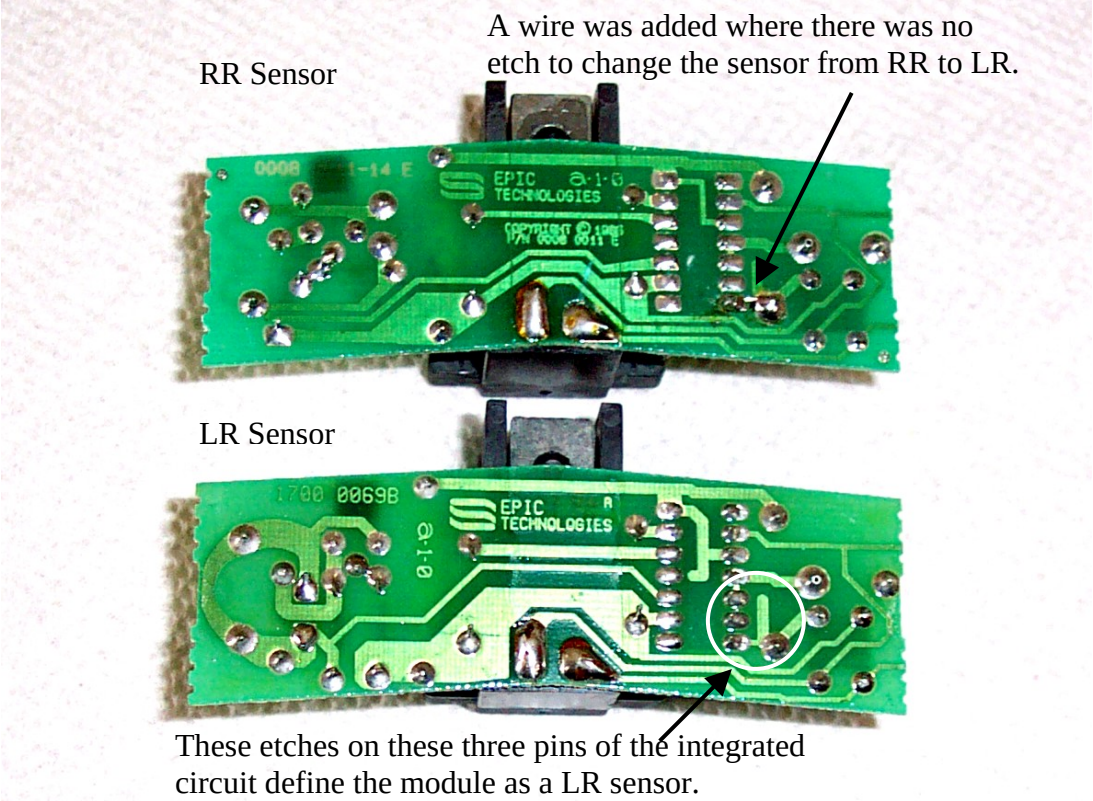


RF Transmitter. The piezo armature vibrates in the gap.
The M9039N chip is the same on all sensors.
The wheel selection is made by grounding select lines on the chip.
A bridge rectifier is located under the click switch.

25 psi click switch.

Converting a Sensor to Operate in a Different Wheel Location

The sensor's wiring defines its location. RR, LR, LF and RF. This is determined by the etched connections on the circuit board. A sensor can be modified to function in another sensor location. For example a RR sensor can be modified to function as a LR sensor if the circuit board etch is modified. Here is an example of a modification.



The receiver module on a '92 car can be used to verify that the modification was performed correctly. The '92 receiver can identify which module is signaling a low tire pressure condition. The codes are 23 for the RR, 33 for the LR, 43 for the LF and 53 for the RF. The '91 service manual lists these low tire pressure codes for the '91 cars. However they don't function on a '91.