

# Dynamic Measurement of Tyre air Pressure in Vehicle



## Engineering

**KEYWORDS :** Tyre Pressure Monitoring System, switch, signal conditioning unit, microcontroller, RF

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### ABSTRACT

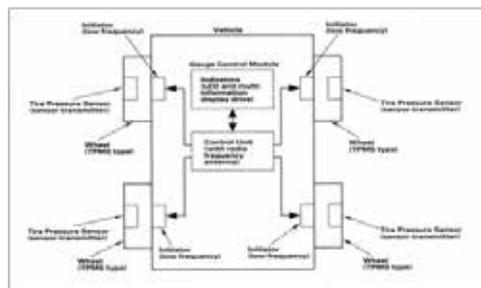
*This paper proposes a method to implement Tyre Pressure Monitoring System (TPMS) in vehicles. TPMS measures the air pressure inside pneumatic tyre of automobiles. The proposed TPMS has an electronic unit that directly screws onto the stem of tyre. The unit includes a pressure sensor and switch, signal conditioning unit, microcontroller, RF (radio frequency) transmitter and battery. An on-board RF receiver communicates with the TPMS unit and displays real-time tyre pressure of all tyres. The unit can be easily detached and re-attached to the tyre. Modification to the tyre is not required. The system and each TPMS unit have unique to prevent false data reception from neighboring vehicles. Tyre replacement or maintenance will not affect the system's working. Warning is generated whenever tyre pressure crosses the maximum or minimum safe pressure level, or when it changes abruptly. This lower level and upper limit of tyre pressure or safe range of abrupt change can be modified by user through the user interface. The system can be implemented on any vehicle. It has given accurate results while proving to be user friendly.*

### INTRODUCTION

A Tyre Pressure Monitoring System is a safety device that measures, identifies and warns the driver when one or more tires is significantly under-inflated.

Tyres are one of the most critical safety features on a vehicle and most people ignore them. There is a flat tire for every 46,000 miles (74,029 kilometer) driven with more than half due to under-inflation and three-fourths of all tire problems are due to a slow loss of pressure by way of a slow leak or under inflation. A loss of 3 PSI relates to an increase of tire wear by 1.5 percent and the life of the tire is reduced by 10 percent.

- 33,000 crashes are a result of under-inflated tires
- 75% of roadside flats are caused by a slow leak or under inflation
- 35% of drivers admit to never checking tire pressure



### TPMS TYPES AND SYSTEMS TESTED

There are three types of tire pressure measurement and/or control systems that are currently available for use on heavy vehicles over 10,000 pounds GVWR (heavy weight). Each is described below, in order of increasing functionality and control.

**Tyre Pressure Monitoring System** – senses tire pressures and alerts driver if pressures are outside of safety setpoints or pressure leakage rates. The “Monitor” systems may either read the actual pressure in each tire (direct TPMS) or estimate the relative pressure in a group of tires comparing the rotational speed of the tires using the antilock brake system (ABS) wheel speed sensors (indirect TPMS).

**Tyre Pressure Maintenance System** – adds automatic tire inflation capability, without driver intervention. Some of these “Maintenance” systems do NOT measure the actual tire pressure in individual tires, but provide only a central pressure monitor, which regulates the pressure in a series of tires that are attached to this control unit. For example, one maintenance controller may maintain the pressure in eight tires of a tandem-drive-axle Class 8 truck with only one centrally located pressure sensor. In this type of system, individual tires would have check valves installed on them so pressure could be increased only, not reduced.

**Tyre Pressure Management System** – allows the driver to raise and lower tire pressures on demand (e.g., logging trucks that go on and off-road). Similar to some maintenance systems, many pressure “Management” systems do NOT use pressure sensors in individual tires, but depend upon a single pressure sensor or monitor to control a group of tires.

**Smart Wave System** Following are a series of copies of photographs showing Smart Wave system components and mounting locations. The Smart Wave rim-mount installation kit included ten sensing transmitters, receiving antenna and mount, a receiver (Wireless Gateway), a driver's display, ten rim-mounting bands, and several interface cables to connect the receiving end components together



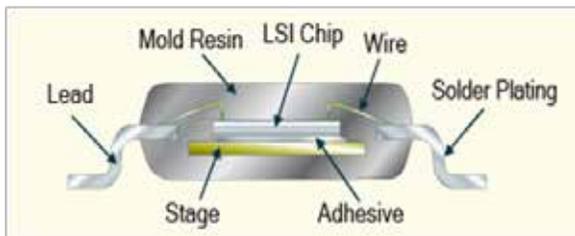


Fig. 2.7 INTEGRATED SILICON SENSOR

**WORKING PRINCIPLE**

**3.1 BLOCK DIAGRAM**

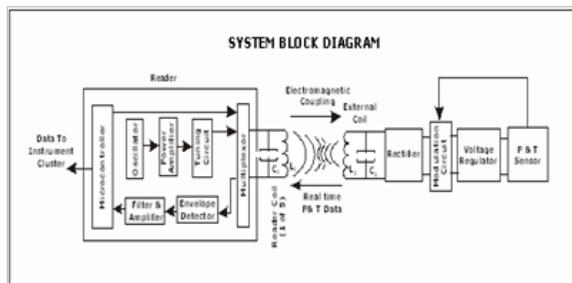


fig. 3.1 Block Diagram

**WORKING PRINCIPLE**

Direct TPMS employ pressure sensors on each tire, either internal or external. The sensors physically measure the tire pressure in each tire and report it to the vehicle's instrument cluster or a corresponding monitor. Some units also measure and alert temperatures of the tire as well. Although the systems vary in transmitting option scan display real time tire pressures at each location monitored whether the vehicle is moving or parked. There are many different solutions but all of them have to face the problems of exposure to tough environments and the powered by batteries which limit their useful life. Some sensors utilize a wireless power system similar to that used in RFID tag reading which solves the problem of limited battery life by electromagnetic induction. This also increases the frequency of data transmission up to 40hz and reduces the sensor weight which can be important in motorsport applications. If the sensors are mounted on the outside of the wheel, which is the case for some aftermarket systems, they are in danger of mechanical damage, aggressive fluids and other substances as well as theft. If they are mounted on the inside of the rim, they are no longer easily accessible for service like battery change and additionally, the RF communication has to overcome the damping effects of the tire which additionally increases the need for energy.

A direct TPMS sensor consists of following main functions requiring only a few external components — e.g., battery, housing, PCB — to get the sensor module that is mounted to the valve stem inside the tire:

- pressure sensor;
- analog-digital converter;
- microcontroller;
- system controller;
- oscillator;
- radio frequency transmitter;
- low frequency receiver, and
- voltage regulator (battery management).

Most originally fitted dTPMS have the sensors mounted on the inside of the rims and the batteries are not exchangeable. With

a battery change then meaning that the whole sensor will have to be replaced and the exchange being possible only with the tires dismantled, the lifetime of the battery becomes a crucial parameter. To save energy and prolong battery life, many dTPMS sensors hence do not transmit information when not rotating (which also keeps the spare tire from being monitored) or apply a complex and expensive two-way communication which enables an active wake-up of the sensor by the vehicle. they need to recognize the sensor positions and have to ignore the signals from other vehicles' sensors. some of them can be carried out by the driver, others need to be done by the workshops or even require special electronic tools. The cost and variety of spare parts, procedures and tools has led to much trouble and confusion both for customers and workshop

**TRANSMITTER:**



**RECEIVER:**



**ADVANTAGES, LIMITATIONS AND APPLICATIONS**

**ADVANTAGES**

- Improved vehicle, passenger & driver safety.
- Improved tyre life & tread life.
- Improved fuel economy.
- Improved dual wheel assembly performance.

**LIMITATIONS**

- This sensor requires the installation of tyre pressure monitoring systems that will warn you when your tire becomes significantly under-inflated.

**APPLICATIONS**

- ✓ Used in two wheelers, four wheelers, heavy load carrying vehicle

**CONCLUSION**

One TPMS is tested during this research project was successful at identifying at least one preset level of low tyre pressure, signaling low tire pressure to a driver display, and clearing the low-pressure warning from the display after the tyre was re-inflated.

Identification of sensor pressure sensitivity needs to be isolated from raw pressure detection as identified by the low pressure detection test procedures used in this report. A second test may need to be run using either fixed pressures.

Some of the tested TPMS provided system malfunction warnings on the display screens. These warnings are beneficial in tracking symptoms of faulty sensors, missing or damaged receiving antennas, and related component malfunctions.

#### **FUTURE SCOPE**

Identification of sensor temperature sensitivity needs to be isolated from raw pressure detection as identified by the low pressure detection test procedures used in this report. A second test may need to be run using either fixed pressures or the tires run through a heating and cooling cycle. To fabricate the adopter for joining TPMS circuit in rim .

#### **REFERENCE**

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