SYSTEM DESCRIPTION TPM KOMFORT ECU

1.1 TPM FUNCTIONALITY

The main function of the TPM system is to monitor all four tyre pressures during driving operation and at standstill.

LF trigger transmitters request periodically the wheel electronics to send datagrams containing information about tyre pressure and temperature. The system is able to detect the wheels fitted to the vehicle and their relative installation positions. This is achieved by analysing the triggering position and by performing a statistical analysis of the received information.

1.1.1 TPM System Interfaces

The trigger transmitter interfaces with the TPM Komfort ECU by means of a dedicated & proprietary LIN bus. The TPM control unit diagnoses the individual system components.

The TPM control module interfaces with the Driver Information Panel (DIP) and the Infotainment Unit (ZAB) by means of the Komfort CAN network.

1.1.2 TPM User Interface

The interface with the user is made via the ZAB and the DIP. The DIP shows to the driver any warnings in the form of TPM specific symbols and text. The ZAB presents information regarding the state and condition of each tyre pressure. The driver requests a system calibration (system learning) through the ZAB (shown below).

1.1.3 TPM System Configuration

There are two possible system configurations, dependent on radio frequency (RF) used:

- 315 MHz configuration for some Asian and African markets
- 433 MHz configuration for ROW (including NAR & Europe).

1.2 WHEEL MANAGEMENT

1.2.1 Overview

The TPM system detects automatically the wheels fitted into the vehicle. The system performs a statistical analysis of the received data in order to recognize which wheel electronics and in which position are the wheels installed in the vehicle.

In order to prevent other vehicles with TPM systems from causing interference at standstill, the "learning" or calibration is performed only when the vehicle is in motion.

The TPM system achieves wheel management by performing the following actions:

1) Wheel Detection	During this phase the system wheels are learned. If all wheel electronics respond with at least 2 datagrams to a trigger request, then all wheel electronics are marked as system wheels
2) Wheel Position Detection	The wheel position detection is done by using the response to the trigger signal. Once the positions of the wheel electronics have been clearly identified, the positions are stored in a non-volatile memory (EEPROM)

3) Running Wheel Detection	In order to support the wheel position detection a distinction is made between the spare wheel and the running wheels. This is achieved by using the information from the roll switch in the wheel electronics.
4) Confirmation	The confirmation phase enables the system to learn automatically any change of the wheel positions. This check is performed while the vehicle is in motion in order to avoid potential timeout because of non-reception while the vehicle is at standstill.

1.2.2   Wheel Detection

With the aim to perform wheel detection the system counts the number of responses to a trigger request. The system detects that a wheel is a system wheel when a wheel electronic (with its unique ID) has given at least two positive responses (2 or more) to trigger events at the same position and when the control unit has analyzed the result.

The system shall detect the wheels fitted within 3 minutes from the moment the vehicle is set in motion. If at least one of four wheels are not detected within three minutes then a DTC is recorded in memory and "System Fault" message is issued to the kombi.

1.2.3   Wheel Position Detection

An association matrix (ZOM), relating wheel electronics position and ID, is used to count the number of immediate responses that a wheel electronic (with unique ID) gives to the request of a trigger device. The counting is done in increments of 1.

Since the effective low frequency radio transmission sphere of a trigger device is limited, only one wheel electronic will normally respond to the request signal.

The wheel position detection is completed when:

-   There is exactly one wheel ID with maximum counter value for each of the trigger positions, and if this counter value is higher or equal than a preset limit (parameter)

-   The four running wheels have been clearly identified, i.e. no counter value for a certain trigger position will be higher than a preset value in the init- phase after the TSS sees first power supply.

The status "Assigned" is then reached.

The management of a spare wheel is not implemented.

1.2.4   Running Wheel Detection

The information of the roll switch contained in the wheel electronics is used to identify the running wheels.

The roll switch is designed in a way so that the wheel rotation will be detected above a tangential speed of typically approx. 20 to 30 km/h. This causes the corresponding bit in the wheel electronics datagram to be set to 1. The running wheel bit is used to distinguish between running wheel and spare wheel (wheel at rest).

1.2.5 Confirmation

After the status "Assigned" is reached a trigger request is issued. If there is a positive reply to this request then the status "Confirmed" is reached.

If the status "Confirmed" is not reached after the maximum admissible learning period has elapsed, a "System Fault" message is issued to the kombi. At the same time, a DTC is stored in memory. The aim of the confirmation phase is to ensure that the 4 assigned wheel electronics are in AutoTransmitOff-Mode[1].

1.3 TPM ELECTRONIC CONTROL UNIT

1.3.1 Overview and Installation

The TPM ECU is the "heart" of the TPM system. Ultimately, the ECU is responsible for requesting the trigger devices to issue a trigger event, to receive and decode the datagrams sent by the Wheel Electronic, to compute the hard and soft warnings, to interface with the DIP and ZAB, and to provide diagnostics to the required tools (E.g. VAS Tester).

The ECU will be installed outside the passenger compartment.

Requirements

Section 15.19: Labelling requirements
This device complies with Part15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Section 15.21: Information to the user
The user manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

IC statement according to RSS210
5.11 User Manual
Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device