

SERVICE MANUAL

SERVICE MANUAL SECTION

Tire Pressure Monitoring System (Feature Code 16VCM)

S17003

04/23/2008

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1. DESCRIPTION AND OPERATION



WARNING – To avoid personal injury or death, shift transmission to neutral or park, set parking brake, and block wheels before doing diagnostic or service procedures.

CAUTION – If you notice either a label located in the wheel hand hole area or what appears to be a stud mounted 180 degrees from the valve stem, you must follow the instructions on the attached bulletin from the manufacturer when removing and installing a tire. Failure to follow these instructions when removing or mounting a tire could cause the tire pressure monitor to break off inside the wheel resulting in a loose sensor inside of the tire and wheel assembly. This can eventually lead to tire damage or failure of the tire sensor.

The tire pressure monitoring system (TPMS) is an optional feature used to monitor and display tire pressure. The vehicle information display (VID), standard on vehicles equipped with TPMS, is used to display and program TPMS related information. Refer to the Vehicle Information Display Operator's Manual for detailed information on using the VID menus.

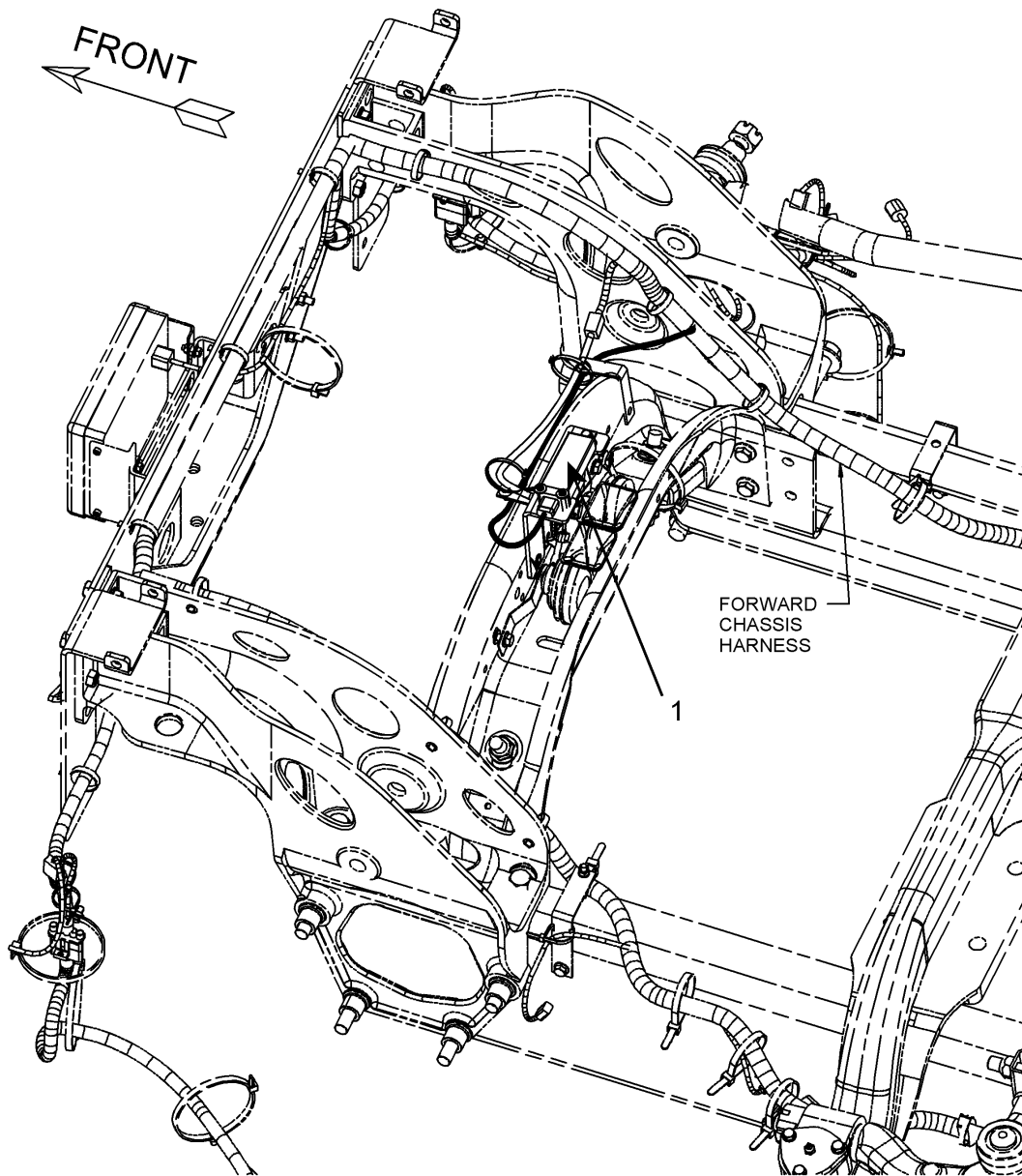


Figure 1 Front Tire Pressure Monitoring Antenna

1. Antenna Module

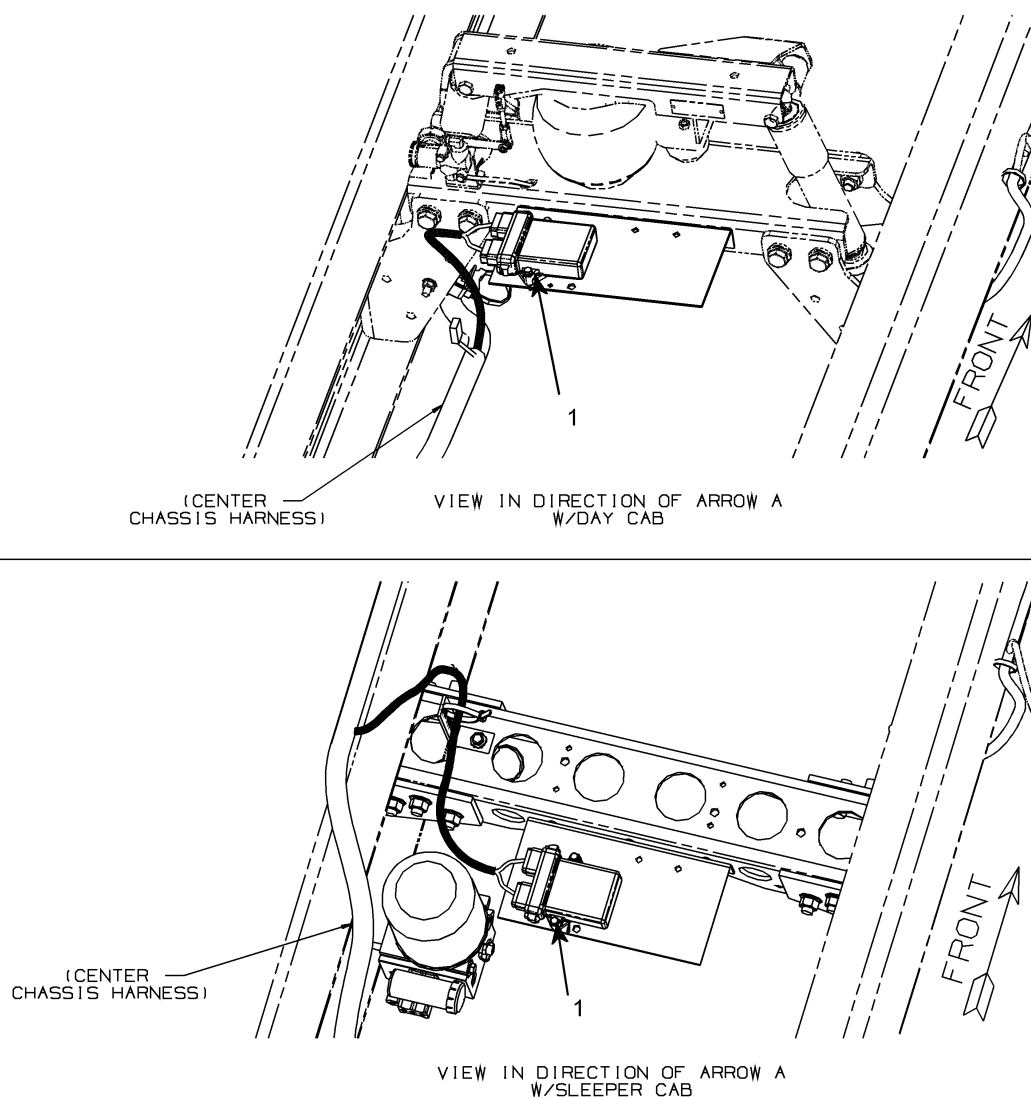


Figure 2 Rear Tire Pressure Monitoring Antennas

1. Antenna Module

Vehicles equipped with TPMS will be equipped with the following additional electrical components:

- **TPMS controller** located under the engine cover on the module plate next to the ICON module.
- **Up to 3 tire pressure antennas**
 - **Front tire pressure antenna** located below the cab and behind the front axle, near the horn.
 - **Left rear tire pressure antenna** located on the outer portion of the left rear frame rail.
 - **Right rear tire pressure antenna** located on the outer portion of the right rear frame rail.
- **10 tire pressure sensors** (1 sensor mounted in each wheel)
 - If equipped with super single wheels – located 180 degrees from the valve stem hole.
 - If equipped with dual wheels – located on the back of the valve stem.

1.1. TIRE PRESSURE MONITORING ELECTRICAL SYSTEM

The following section describes the wiring of the electrical components. Please refer to the circuit diagram manual for a complete illustration of the electrical system including specific connectors and pins.

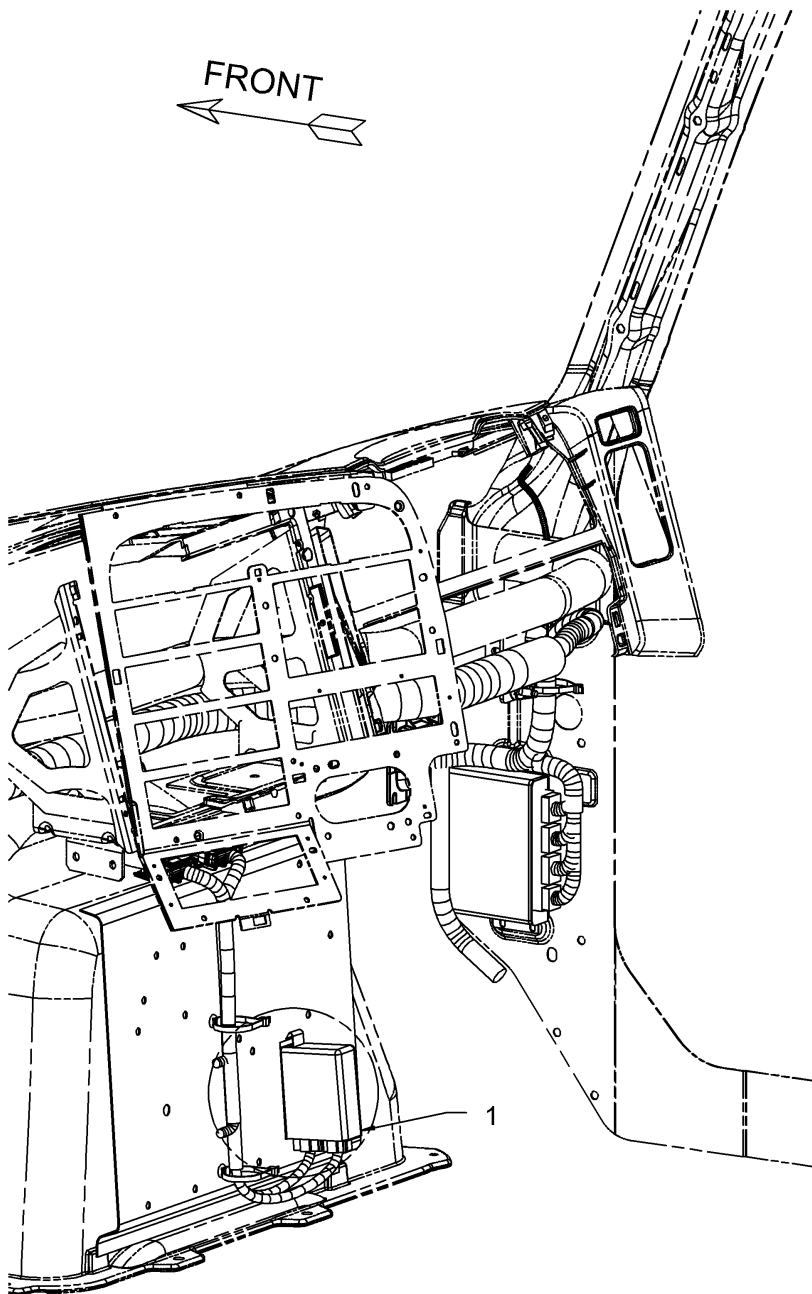


Figure 3 Tire Pressure Monitoring Controller

1. Tire Pressure Monitor Controller

The TPMS controller receives battery voltage from the interior power distribution center (PDC). The accessory relay provides voltage to the TPMS controller when the key switch is placed in the ACCESSORY or ON position. This 'wakes up' the TPMS controller. The TPMS controller is permanently grounded at the ground stud.

Each tire is monitored by a tire pressure sensor. These sensors are not hardwired. Instead, the tire pressure sensor transmits a radio frequency (RF) signal which is received by the tire pressure antenna. The tire pressure antennas have been located to optimize system performance. Reception of the front wheels is performed primarily by the front tire pressure antenna. Reception of the rear wheels is performed primarily by the left rear and right rear tire pressure antennas.

The antenna units are connected to the TPMS controller by LIN bus, which consists of three circuits per antenna. The TPMS controller provides a zero volt reference (ZVR) and 12V signal to each antenna. The antenna communicates information to the TPMS controller on the signal circuit. The TPMS controller processes the data received from the antennas and sends the information to the vehicle information display (VID) via the SAE J1939 data link.

SAE J1939 Communication

The tire pressure monitoring controller communicates with the vehicle information display (VID) by means of the SAE J1939 data link for various functions such as:

- TPMS related programming via the VID.
- TPMS related data for display on the VID.
- Communicating TPMS related DTC information.

'Lost' SAE J1939 Communication

Communication is considered 'lost' if the VID has not received a 'heartbeat' from the TPMS controller for 30 seconds.

The following will occur if communication is lost between the TPMS controller and the VID:

- The VID will display all tires in RED on the TPMS screen AND an N/A next to each tire (rather than temp/pressure).

The actions above will occur until the communication has been restored. This normally takes approximately 30 seconds.

LIN Bus Communication

The TPMS controller communicates with the 3 tire pressure antennas via LIN bus communication for various functions such as:

- Receiving tire pressure/temperature information from the tire pressure sensors.
- Receiving tire transmitter ID information from the tire pressure sensors.
- Receiving fault code information from the tire pressure sensors.

'Lost' LIN Bus Communication

Each tire pressure antenna communicates with the TPMS controller via the LIN bus. If the TPMS controller does not receive a transmission from the antenna upon initial key cycle or during normal operation the TPMS controller will attempt to communicate by transmitting to the antenna every 30 seconds on the LIN bus.

The following will occur if the TPMS controller is unable to communicate with the antenna (LIN bus communication is 'lost') for 2.5 minutes:

- **"TPMS Antenna Lost Communication"** popup message will be displayed in the VID.
- **AND** the VID will display all tires in BLACK on the TPMS screen AND an N/A next to each tire (rather than a temp/pressure value).
- **AND** the TPMS controller will set a 'defective antenna' DTC for the appropriate antenna.
- **AND** the TPMS controller will set a 'LIN bus communication' DTC for the appropriate antenna.

The actions above will occur until the communication has been restored. This normally takes 2.5 minutes.

1.2. TIRE PRESSURE MONITORING CONTROLLER DIAGNOSTICS

Battery Voltage Circuit Diagnostics

The TPMS controller performs a diagnostic test on the battery voltage circuit at the TPMS controller connector. The voltage provided on this circuit must be within the range of 9.5 -17.0 volts, or the TPMS controller will detect the fault.

The following will occur if the battery voltage is below 9.5 volts:

- The TPMS controller will set a "below normal level" voltage DTC.
- **AND** the VID will not receive data from the TPMS controller on the SAE J1939 data link.
- **AND** the TPMS screen in the VID will display all tires in RED.
- **AND** all TPMS related functions are inoperative.

NOTE – The TPMS controller will shut down if the voltage is below 6.5 volts.

The TPMS controller takes the actions above until it is brought up above 11.8 volts.

The following will occur if the battery voltage is above 17 volts:

- The TPMS controller will set an "above normal level" voltage DTC.

NOTE – The TPMS controller will shut down if the voltage is greater than 18.0 volts.

The controller takes the action above until it is brought down below 15.0 volts.

1.3. TIRE PRESSURE SENSORS

Tire pressure and temperature are measured periodically by an intelligent tire pressure sensor located inside each wheel. The sensor uses sensitive silicon microelectronics to detect changes in tire pressure (similar to a diaphragm being pushed). Each sensor is powered by a lithium battery and contains a radio frequency (RF) transmitter.

The tire pressure sensor sends tire pressure/temperature information along with the unique identification number (ID) of the current tire via 433 MHz RF signal to the tire pressure antenna. The tire pressure antenna processes the RF signals received from the tire pressure sensors and transfers the data via TPMS LIN-bus to the TPMS controller. The tire transmitter ID allows the TPMS controller to determine the wheel location.

The tire pressure sensor also provides status information such as remaining life of sensor battery, sensor battery under voltage, fast pressure loss, and over temperature information. Sensor battery life is typically 5 years, however, life will be reduced under critical system conditions in which fast data transmission is required.

Under normal operating conditions, the tire pressure sensors transmit data to the tire pressure monitoring controller once every minute.

Sensor Diagnostics

If any tire sensor is moved out of the range of the antenna, fails to transmit, has a low sensor battery, or is unable to measure tire information correctly, the TPMS controller will detect the condition and set a corresponding DTC. Refer to the Diagnostic Trouble Codes section for more information about the DTC associated with the tire pressure sensor.

Fast Transmit Mode

The sensor will be placed in 'fast transmit mode' (transmits data once every second) if:

- The sensor is replaced **AND** the tire has been newly pressurized (**See Note 1**).
- **OR** if a 'fast leak' condition occurs (**See Note 1**).

Note 1: 2 - 3 PSI air pressure must be added or removed from the tire within 1 second for 'fast transmit' mode to occur. The sensor will remain in fast transmit mode for approximately 3 minutes after the above conditions are true.

Note 2: Placing the tire sensor in 'fast transmit' mode by releasing air from the appropriate tire can be useful in locating tires on the VID screen.

The following will occur if the sensor is placed into 'fast transmit mode':

- The VID will display "**WARNING: Fast Tire Pressure Loss**" as a popup message (**See Note 3**) if air has been removed.
- **AND** a corresponding 'fast leak' DTC will be set by the TPMS controller (**See Note 3**) if air has been removed.
- **AND** any sensor in 'fast transmit' mode will appear first in the list of detected sensors on the vehicle information display (VID).
- **AND** any sensor in 'fast transmit' mode will have an asterisk next to that tire transmitter ID on the VID.
- **AND** sensor battery life will be reduced while in 'fast transmit' mode.

Note 3: Warnings and diagnostic trouble codes will only be generated for sensors that have been programmed into the system. Sensors can be programmed only after they have been initialized. Refer to the *Sensor Initialization* section for more information.

Sensor Initialization

To preserve sensor battery life, tire sensors are in 'sleep mode' while in storage and will not transmit data. When a tire sensor is installed (must be pressurized) for the first time, the sensor will be placed into 'fast transmit mode' for 3 minutes, but no warnings will be generated by the TPMS controller.

During this first pressurization, if the pressure is reduced to less than 22 PSI within 3 minutes, the tire sensor goes back into 'sleep mode'. After the first pressurization, 'sleep mode' is no longer available. After the tire sensor has been programmed into the system, YELLOW or RED tire pressure warnings may be displayed in the VID depending on the programmed value in the VID "Pressure Setup" screen.

1.4. TIRE PRESSURE ANTENNAS

The tire pressure antenna processes the RF signals received from the tire pressure sensors into digital information. An antenna unit is equipped with a RF receiver and a microcontroller which performs the following:

- Decodes the received RF signals.
- Converts the RF signals into serial data.
- Transfers the data via LIN bus to the TPMS controller.

Antenna Diagnostics

The TPMS controller monitors the voltage on each of the tire pressure antenna 12V circuits. If any of the 3 antenna 12V circuits is outside the range of 6.5 to 17.0 volts then the TPMS controller will immediately shut down the power supply to the respective antenna.

Short Circuit Diagnostics

If either of the LIN bus data circuits is shorted to ground then TPMS controller will detect the condition and set a corresponding “grounded circuit on LIN bus” DTC. In addition, the antenna will no longer communicate with the TPMS controller on the LIN bus. Refer to the ‘Lost’ LIN Bus Communication section for more information.

Open Circuit Diagnostics

If any of the antenna circuits (12V, ZVR, or signal) are open, the TPMS controller will detect the condition, and the antenna will no longer communicate with the TPMS controller on the LIN bus. Refer to the ‘Lost’ LIN Bus Communication section for more information.

2. FEATURE FUNCTIONS

The following functions are performed by the system.

2.1. MONITORING TIRE PRESSURE AND TIRE TEMPERATURE

The TPMS controller monitors pressure in conjunction with temperature to detect system faults. For example, if a low tire pressure condition exists while the temperature is increased it is likely that the condition is due to low tire pressure, since low tire pressure causes excess friction/heat. Likewise, if a temperature related condition exists in the absence of a low pressure condition it is likely that the condition is due to friction from a faulty wheel bearing or dragging brake. The tire pressure displayed in the VID, however, reflects the actual tire pressure gauge reading and is not temperature compensated.

The TPMS system knows what the corresponding pressure should be at any given temperature, and therefore will not set erroneous faults based on normal pressure changes in proportion to temperature. The system generates warnings based on the difference between the target tire pressure, programmed into the VID “Pressure Setup” parameter, and the expected pressure for a particular tire temperature.

Refer to the Tire Pressure Diagnostics section to understand the thresholds at which tire pressure diagnostics are performed and warnings are displayed.

The feature will monitor tire information if all of the following conditions are true:

- The key switch is placed in the ACCESSORY position (See Note 1).
- No active ‘loss of communication’ errors are present.

- No active TPMS antenna related diagnostic trouble codes are present.

Note 1: The voltage received by the TPMS controller via the ACCESSORY relay must be greater than 3.5 volts for the controller to 'wake up'. Otherwise, the controller will remain 'asleep' in which the following conditions will be true:

- All TPMS related functions are inoperative.
- **AND** the VID cannot receive data from the TPMS controller on the SAE J1939 data link.
- **AND** the TPMS screens will be accessible, but the VID will display all tires in RED.

Because the tire sensors normally transmit data only once every minute, it may be necessary to wait up to 2 minutes for the feature to receive data from all of the sensors. The wheel may appear BLACK on the VID TPMS screen before the data is received from the tire sensor.

2.2. TIRE PRESSURE WARNINGS

Tire pressure warnings will be displayed in the VID if:

- The tire pressure reaches a predetermined threshold preset by the vehicle manufacturer (**See Note 1**).
- The respective tire sensor has been programmed into the system (**See Note 2**).
- The "WE sensor" error is not present for the wheel location in which the tire warnings are desired.

Note 1: Refer to the "Tire Pressure Warnings" diagram in this section to understand the point at which the warnings will be displayed based on the programmed "Pressure Setup" value and the expected tire pressure for a particular tire temperature.

Note 2: The VID can be used to program tire sensors that have not been associated to a particular wheel location. Refer to *Tire Transmitter ID Programming* for more information.

The following graph illustrates the point at which the YELLOW and the RED warnings appear in the VID based on a programmed "Pressure Setup" value of 102 PSI.

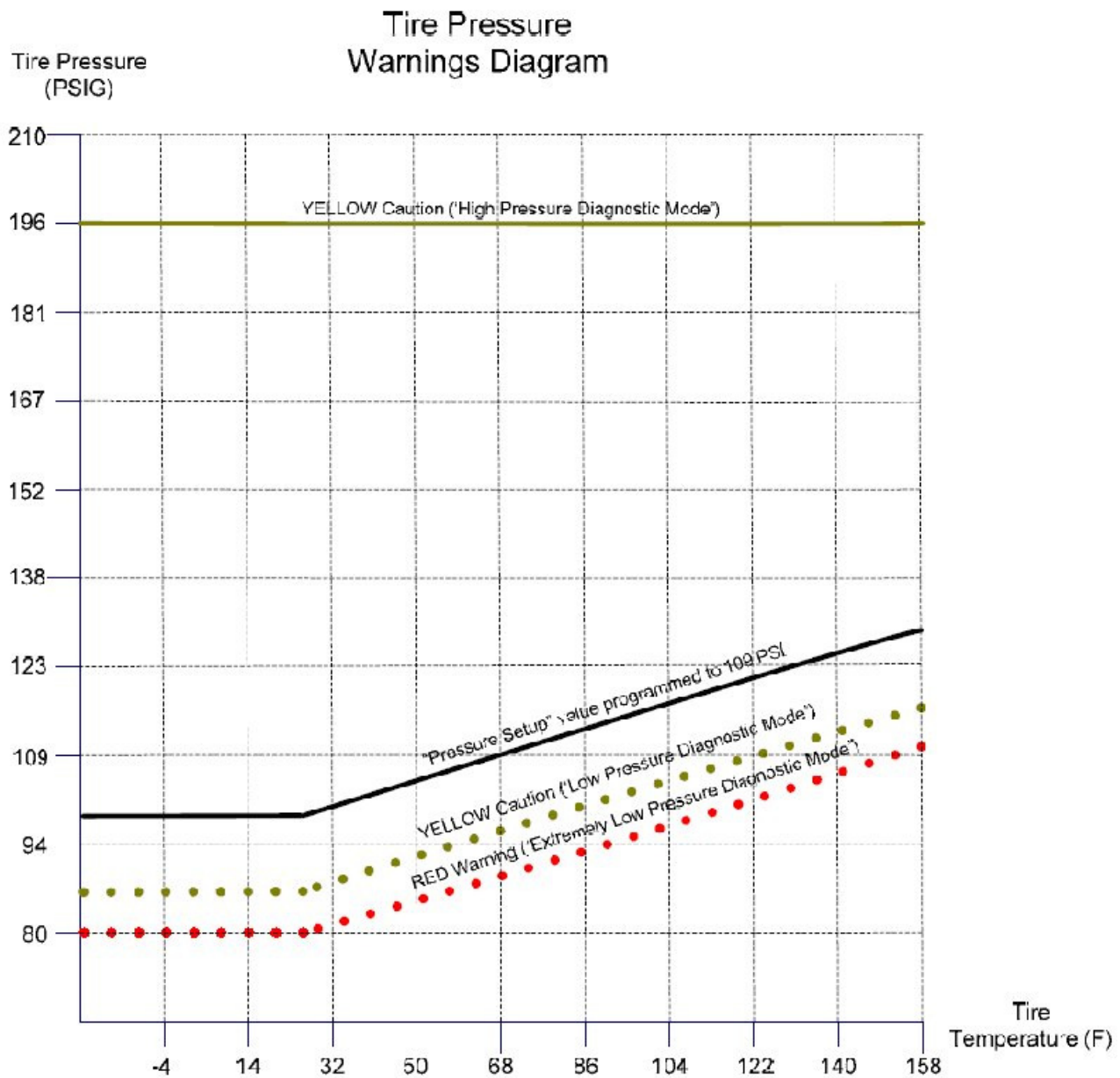


Figure 4

The next graph is based on a programmed "Pressure Setup" value of 109 PSI. Notice how the pressure at which the YELLOW and RED warnings appear is increased.

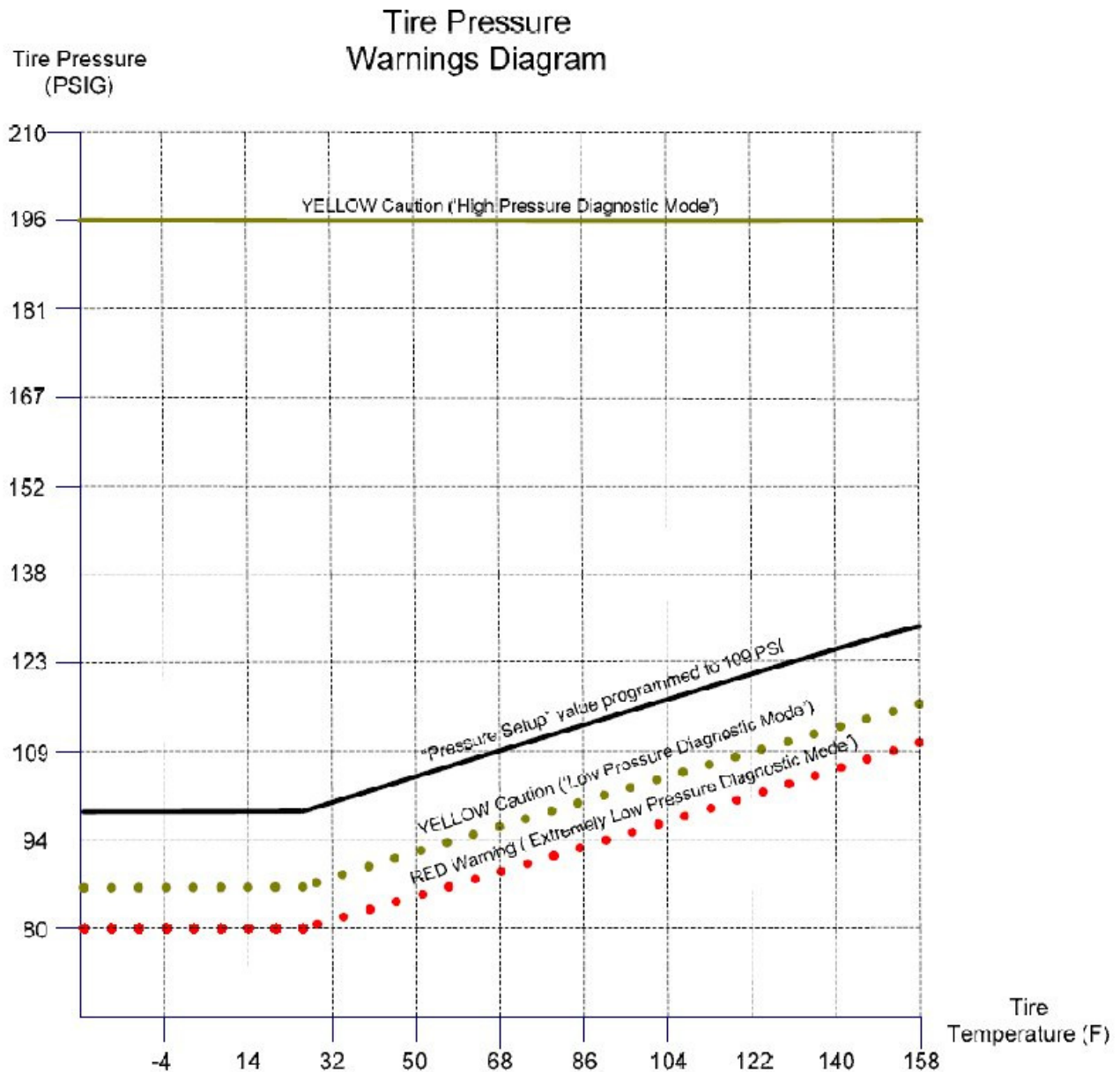


Figure 5

2.3. TIRE PRESSURE DIAGNOSTICS

The system alerts the operator on the VID and sets a corresponding DTC if a fast leak, low pressure, extremely low pressure, or excess pressure condition exists.

Scroll to “TPMS Setup”, “Pressure Setup” menu on the VID to verify the current programmed pressure value.

If the tire pressure becomes less than the pressure expected at that particular temperature, the TPMS controller will set a DTC and the VID will display a YELLOW or RED warning depending on the pressure value below the pressure needed for that particular temperature.

Low Pressure Diagnostic Mode

The tire sensor goes into 'low pressure diagnostic mode' if the difference between the programmed "Pressure Setup" parameter, and the expected pressure for a particular tire temperature reaches a predetermined threshold.

For example, if the tire temperature is at approximately 70F (20C), a YELLOW caution appears if the tire pressure falls more than approximately 10 PSI below the programmed "Pressure Setup" value in the VID. This means the tire pressure must drop to 91 PSI for 'low pressure diagnostic mode' to occur if the programmed value is set to the default value of 102 PSI.

The following will occur while the tire sensor is in the 'low pressure diagnostic mode'.

- **"CAUTION Low Tire Pressure Detected"** popup message is displayed in the VID.
- **AND** the corresponding tire will be displayed in YELLOW on the VID.
- **AND** the tire pressure monitoring controller will set a DTC.

The low pressure DTC will remain active and the VID will display the appropriate tire in YELLOW until adequate pressure has been restored to the tire.

IMPORTANT! As tire temperatures increase, the expected tire pressure also increases. Both the tire temperature and the programmed "Pressure Setup" value change the point at which the warnings will be displayed. The Tire Pressure Warnings diagram illustrates this concept. Refer to the *Tire Pressure Warnings* section for more information.

Extremely Low Pressure Diagnostic Mode

The tire sensor goes into 'extremely low pressure diagnostic mode' if the difference between the programmed "Pressure Setup" parameter, and the expected pressure for a particular tire temperature reaches a predetermined threshold.

For example, if the tire temperature is at approximately 70F (20C), a RED warning appears if the tire pressure falls more than approximately 17 PSI below the programmed "Pressure Setup" value in the VID. This means the tire pressure must drop to 84 PSI for 'extremely low pressure diagnostic mode' to occur if the programmed value is set to the default value of 102 PSI.

The following will occur while the tire sensor is in the 'extremely low pressure' diagnostic mode:

- **"Warning Extremely Low Tire Pressure Detected"** popup message is displayed in the VID.
- **AND** the corresponding tire will be displayed in RED on the VID.
- **AND** the tire pressure monitoring controller will set a DTC.

The extremely low pressure DTC will remain active and the VID will display the appropriate tire in RED until adequate pressure has been restored to the tire.

IMPORTANT! As tire temperatures increase, the expected tire pressure also increases. Both the tire temperature and the programmed "Pressure Setup" value change the point at which the warnings will be displayed. The Tire Pressure Warnings diagram illustrates this concept. Refer to the Tire Pressure Warnings section for more information.

High Pressure Diagnostic Mode

The tire sensor goes into 'high pressure diagnostic mode' if the tire pressure reaches 196 PSI or higher.

The following will occur while the tire sensor is in the 'high pressure diagnostic mode':

- **"Caution High Tire Pressure Detected"** popup message is displayed in the VID.
- **AND** the corresponding tire will be displayed in YELLOW on the VID.
- **AND** the tire pressure monitoring controller will set a DTC.

The high pressure DTC will remain active and the VID will display the appropriate tire in RED until the proper pressure (default = 102 PSI) has been restored to the tire.

2.4. TIRE TEMPERATURE DIAGNOSTICS

The system also alerts the operator on the VID and sets a corresponding DTC if an over temperature condition exists, as described below.

High Temperature Diagnostic Mode

The tire sensor goes into 'over temperature mode' if the following conditions are true:

- The temperature measured by the tire sensor is greater than 248F (120C).

The following will occur while the tire sensor is in the 'over temperature mode':

- The tire sensor will stop transmitting data.
- **AND** the corresponding tire will be displayed in RED on the VID.
- **AND** the tire pressure monitoring controller will set a 'Temperature cut-out' DTC.

The tire sensor goes back to "normal mode" (transmitting data once every minute) after the temperature becomes less than or equal to 212F (100C).

3. CAUTION WHEN PERFORMING TPMS SERVICE



WARNING – Extreme care must be taken when servicing TPMS equipped wheels, tires and tire sensors. Refer to Section 10 of this manual prior to servicing any of these components.

4. GENERAL DIAGNOSTIC INFORMATION

It is strongly recommended that DLB is used along with this information to enhance diagnostic capabilities. See the diagnostic software manual for details on using the software.

4.1. DIAGNOSTIC TROUBLE CODES

NOTE – Passwords may be required to access any or all of these menu options or they may be permanently locked out.

Displaying Diagnostic Trouble Codes

Diagnostic trouble code (DTC) information can be displayed either on the gauge cluster or vehicle information display (VID) – if equipped and enabled. Refer to the Displaying Diagnostic Trouble Codes section of S08303 for more information. Diamond Logic Builder (DLB) software can also be used to read Tire Pressure Monitoring System diagnostic trouble codes.

If available, the Diagnostic Codes screen will display as shown in Figure 6.

The button functions, when the Diagnostics Menu screen is displayed, are as follows:

1. Pressing the UP and DOWN buttons will select either Active or Inactive Codes.
2. Pressing the SEL button will take the operator to the selected screen.
3. Pressing the HOME and BACK buttons will force the operator to exit this screen and return to the MAIN MENU screen.

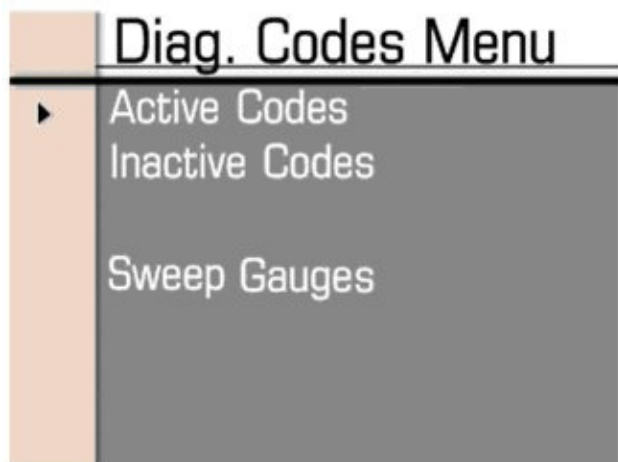


Figure 6 Diagnostics Menu

While the VID is retrieving diagnostic information, a PLEASE WAIT screen will be displayed.

The following diagnostic trouble codes are issued by the TPMS controller (Source Address = 51). The TPMS controller communicates DTC information to the vehicle information display (VID) on the SAE J1939 data link. TPMS DTCs can also be read with the Diamond Logic Builder software.

Definitions: Certain DTC are wheel specific. The information contained within the message displayed in the VID, for example, will specify a particular wheel location according to the SPN.

In the DTC List below, A1 = the front axle, A2 = the front rear axle, A3 = Axle 3 = the rear rear axle, LI = the left inner wheel, LO = the left outer wheel, RI = the right inner wheel, and RO = the right outer wheel.

Table 1

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521000	Operating voltage Analog Digital (AD) converter defective	4	N/A	N/A	ECU power supply Operating voltage AD converter defective	N/A	See Note 1 below for details.
521001	Memory check EEPROM category A	31	N/A	N/A	Memory EEPROM category A ECU Category A memory check error	N/A	See Note 1 below for details
521002	Memory check EEPROM category B	31	N/A	N/A	Memory EEPROM category B ECU Category B memory check error	N/A	See Note 1 below for details
521003	Memory check EEPROM category C	31	N/A	N/A	Memory EEPROM category C ECU Category C memory check error	N/A	See Note 1 below for details
521004	Memory check EEPROM category E	31	N/A	N/A	Memory EEPROM category D ECU Category D memory check error	N/A	See Note 1 below for details
521005	RAM error	31	N/A	N/A	ECU RAM RAM error	N/A	See Note 1 below for details
521006	EEPROM checksum	31	N/A	N/A	ECU EEPROM EEPROM checksum write error	N/A	See Note 1 below for details
521007	ROM error	31	N/A	N/A	ECU ROM ROM error	N/A	See Note 1 below for details
521009	TSS defective	31	N/A	N/A	ECU Health ECU defective	N/A	See Note 1 below for details
<p>Note 1: All of the above listed diagnostic codes (521000, 521001, 521002, 521003, 521004, 521005, 521006, 521007, and 521009) are the result of a defective TPMS controller.</p> <p>Cycle the key switch. If this does not clear the DTC, then replace the TPMS controller.</p>							

Table 2

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521012	Implausible parameterization	11	N/A	N/A	ECU Parameter error Parameter out of range	N/A	See below for details

This Diagnostic code could be the result of any of the following conditions:

- 1 or more tire sensors have not been programmed into the system.
- **OR** the same tire sensor is programmed onto 2 different wheel locations.

If this diagnostic code is present, ensure that all of the tire pressure sensors are programmed properly into the system. Refer to Tire Transmitter ID Programming for more information.

Table 3

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521021	Interruption of Power supply	31	8952	3	Vehicle power supply interruption Interruption of power supply (terminal 30)	N/A	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when there is an interruption of power on the battery voltage circuit of the TPMS controller while the engine is running.

Conditions for Clearing the DTC: The active Diagnostic code is cleared if the ignition key is cycled from OFF to ON, but the DTC will remain in the history.

This Diagnostic code could be the result of any of the following conditions:

- There is an intermittent or poor connection on the battery voltage circuit of the TPMS controller.
- **OR** the TPMS controller is defective.

NOTE: Cycle the key switch after the repair is completed.

Table 4

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521032, 521038, 521044, 521050, 521056, 521062, 521068, 521074, 521080, 521086, NOTE: Includes SPN 1697 (FMI=12)	WE sensor error	31	N/A	N/A	Axle "X" Wheel "XX" sensor health 521032 (A1 LI), 521038 (A1 RI), 521044 (A2 LO), 521050 (A2 LI), 521056 (A2 RI), 521062 (A2 RO), 521068 (A3 LO), 521074 (A3 LI), 521080 (A3 RI), 521086 (A3 RO) Refer to the beginning of the Diagnostic Trouble Codes section for definitions.	Appropriate wheel is BLACK.	See below for details

Conditions for Setting the DTC: This Diagnostic code will be set if the tire sensor is not able to measure the tire pressure information properly. The TPMS controller sets the DTC after receiving 3 successive "error" messages from the tire sensor.

Conditions for Clearing the DTC: This Diagnostic code is cleared if the "error" message is no longer being received from the tire sensor.

This Diagnostic code could be the result of any of the following conditions:

- Defective tire pressure sensor.

Perform the following steps if this diagnostic code is present:

- Replace the appropriate tire pressure sensor.
- Perform the Tire Transmitter ID Programming procedure after the sensor is replaced.

Table 5

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521033, 521039, 521045, 521051, 521057, 521063, 521069, 521075, 521081, 521087 NOTE: Includes SPN 1697	WE no reception	11	N/A	N/A	Axle "X" Wheel "XX" sensor transmission 521033 (A1 LI), 521039 (A1 RI), 521045 (A2 LO), 521051 (A2 LI), 521057 (A2 RI), 521063 (A2 RO), 521069 (A3 LO), 521075 (A3 LI), 521081 (A3 RI), 521087 (A3 RO) Refer to the beginning of the Diagnostic Trouble Codes section for definitions.	Appropriate wheel is BLACK.	See below for details

Conditions for Setting the DTC: This DTC is set when a particular tire sensor's information is missed 10 times consecutively while the vehicle is moving (speed greater than 4.3 mph).

Conditions for Clearing the DTC: This Diagnostic code is cleared when the TPMS controller receives information again from the tire sensor for at least 1 occurrence (normally takes 1 minute).

This Diagnostic code could be the result of any of the following conditions:

- Defective tire pressure sensor (sensor not transmitting).
- **OR** the wheel/sensor was replaced, but the sensor was not programmed into the system using the VID.
- **OR** the wheel/sensor is out of the range of the system.
- **OR** the system is not receiving information from the tire sensor due to RF interference.

Perform the following steps if this diagnostic code is present:

1. Ensure that all TPMS equipped wheels are installed on the vehicle.
2. Pull the vehicle away from the garage (100 ft or more from other TPMS equipped vehicles).
3. Ensure that the key switch is placed in the IGNITION ON position.
4. Wait at least 2 minutes. This allows time for the wheel sensor's information to be received by the TPMS controller.
5. Ensure that the wheel sensor is programmed into the system using the VID (the appropriate wheel should be GREEN on the VID).
6. If the wheel is BLACK on the VID, program the tire sensor into the system using the VID. Refer to Tire Transmitter ID Programming for more information. The wheel should change from BLACK to GREEN on the VID TPMS screen after programming is complete.

7. Wait at least 2 minutes.
8. If the wheel changes to GREEN after programming, then the system is OK. (GREEN indicates that the tire information is being received correctly).
9. If the wheel is still BLACK on the VID, drive the vehicle (at least 4.3 mph) for at least 10 minutes (DTC should go away). This eliminates the chance of RF interference being the cause. Two (2) or more sensors not being received (BLACK on the VID) indicates a stronger likelihood that RF interference is present.
10. If the wheel is still BLACK on the VID, replace the appropriate tire sensor.
11. Perform the Tire Transmitter ID Programming procedure after the sensor is replaced. The wheel should change from BLACK to GREEN on the VID TPMS screen after programming is complete.

Table 6

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521029, 521035 521041, 521047 521053, 521059 521065, 521071 521077, 521083 NOTE: Includes SPN 241 (FMI=0)	Excess pressure	16	N/A	N/A	Axle "X" Wheel "XX" over pressure Excess pressure 521029 (A1 LI), 521035 (A1 RI), 521041 (A2 LO), 521047 (A2 LI), 521053 (A2 RI), 521059 (A2 RO), 521065 (A3 LO), 521071 (A3 LI), 521077 (A3 RI), 521083 (A3 RO) Refer to the beginning of the Diagnostic Trouble Codes section for definitions.	• "Caution High Tire Pressure Detected" is displayed Wheel is YELLOW on the TPMS screen.	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when the TPMS controller has received 60 successive 'excessive pressure' readings from the tire sensor (normally takes about an hour). The tire pressure is considered 'excessive' if the pressure reaches 196 PSI or higher. Refer to the *High Pressure Diagnostic Mode* section for more information.

Conditions for Clearing the DTC: This Diagnostic code is cleared when the TPMS controller has received a pressure reading of 152 PSI or less from the tire sensor for 2 consecutive occurrences (normally takes about 2 minutes).

This Diagnostic code could be the result of any of the following conditions:

- The tire is over inflated.
- **OR** the tire sensor is defective (the tire sensor is not reporting pressure correctly).
- **OR** the TPMS controller is defective.

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
<p>Perform the following steps if this diagnostic code is present:</p> <ul style="list-style-type: none"> • Cycle the ignition key. • Diagnose any “WE Sensor Error” (if present) DTC prior to performing the remaining steps. • Check the tire for proper pressure. Refer to the Operator’s Manual for the recommended cold inflation pressure. 							

Table 7

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521030, 521036, 521042, 521048, 521054, 521060, 521066, 521072, 521078, 521084 NOTE: Includes SPN 242 (FMI=0)	Temperature cut-out	31	N/A	N/A	<p>Axle “X” Wheel “XX” temperature cut-out</p> <p>521030 (A1 LI), 521036 (A1 RI), 521042 (A2 LO), 521048 (A2 LI), 521054 (A2 RI), 521060 (A2 RO), 521066 (A3 LO), 521072 (A3 LI), 521078 (A3 RI), 521084 (A3 RO)</p> <p>Refer to the beginning of the Diagnostic Trouble Codes section for definitions.</p>	Wheel is RED on the TPMS screen.	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when the TPMS controller receives a temperature value greater than 248F (120C) from the tire sensor.

Conditions for Clearing the DTC: This Diagnostic code is cleared when the TPMS controller receives a temperature value less than or equal to 212F (100C) from the tire sensor.

This Diagnostic code could be the result of any of the following conditions:

- Faulty wheel bearing causing excess friction/heat in the wheel.
- **OR** a brake issue (hanging/dragging/misuse) causing excess friction/heat in the wheel.

Perform the following steps if this diagnostic code is present:

- Inspect the wheels/brakes, etc. for malfunctions.

Table 8

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521031, 521037, 521043, 521049, 521055, 521061, 521067, 521073, 521079, 521085 NOTE: Includes SPN 1697 (FMI=17)	WE low battery	31	N/A	N/A	Axle "X" Wheel "XX" Sensor low battery 521031 (A1 LI), 521037 (A1 RI), 521043 (A2 LO), 521049 (A2 LI), 521055 (A2 RI), 521061 (A2 RO), 521067 (A3 LO), 521073 (A3 LI), 521079 (A3 RI), 521085 (A3 RO) Refer to the beginning of the Diagnostic Trouble Codes section for definitions.	N/A	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when the TPMS controller receives information from the tire sensor that the sensor battery is low.

Conditions for Clearing the DTC: A new tire pressure sensor must be installed (**battery cannot be replaced separately**).

Perform the following steps if this diagnostic code is present:

- Replace the tire pressure sensor at the next tire service (battery cannot be replaced separately).
- Program the tire pressure sensor into the system using the VID. Refer to Tire Transmitter ID Programming for more information. The wheel should change from BLACK to GREEN on the VID TPMS screen after programming is complete.

Additional Information: The sensor battery may have up to 6 months left when the 'low battery' DTC is first set. The wheel will turn BLACK on the TPMS screen when the sensor battery goes completely dead, therefore, it may be helpful to keep track of the Tire Transmitter ID corresponding to the weak tire sensor when the DTC is first set.

Table 9

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521029, 521035 521041, 521047 521053, 521059 521065, 521071 521077, 521083 NOTE: Includes SPN 2586	Fast pressure loss	0	N/A	N/A	Axle "X" Wheel "XX" leakage, Fast pressure loss 521029 (A1 LI), 521035 (A1 RI), 521041 (A2 LO), 521047 (A2 LI), 521053 (A2 RI), 521059 (A2 RO), 521065 (A3 LO), 521071 (A3 LI), 521077 (A3 RI), 521083 (A3 RO) Refer to the beginning of the Diagnostic Trouble Codes section for definitions.	"WARNING Fast Tire Pressure Loss" popup displayed.	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when 2 - 3 PSI air pressure is removed from the tire within 1 second.

Conditions for Clearing the DTC: This Diagnostic code is cleared upon the next ignition cycle (if the condition is no longer present).

This Diagnostic code could be the result of any of the following conditions:

- The tire has a leak due to foreign object, faulty valve, etc.

Perform the following steps if this diagnostic code is present:

- Inspect the tire for leaks, and perform any necessary repairs.
- Check the tire for proper pressure. Refer to the Operator's Manual for the recommended cold inflation pressure.
- Cycle the ignition key.

Table 10

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521029, 521035 521041, 521047 521053, 521059 521065, 521071 521077, 521083 NOTE: Includes SPN 241	Dropped below warning limit	18	N/A	N/A	Axle "X" Wheel "XX" second pressure level Dropped below warning limit 521029 (A1 LI), 521035 (A1 RI), 521041 (A2 LO), 521047 (A2 LI), 521053 (A2 RI), 521059 (A2 RO), 521065 (A3 LO), 521071 (A3 LI), 521077 (A3 RI), 521083 (A3 RO) Refer to the beginning of the Diagnostic Trouble Codes section for definitions.	"Caution Low Tire Pressure Detected" popup displayed. Wheel is YELLOW on the TPMS screen.	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when the TPMS controller has received 10 successive 'low pressure' readings from the tire sensor (normally takes about 10 minutes). Refer to the Low Pressure Diagnostics section for more information.

Conditions for Clearing the DTC: This Diagnostic code is cleared when the TPMS controller receives information from the tire sensor that 'low pressure' condition is no longer present for 1 occurrence (takes about one minute).

This Diagnostic code could be the result of any of the following conditions:

- The tire has a leak due to foreign object, faulty valve, etc.
- **OR** the tire sensor is defective (the tire sensor is not reporting pressure correctly).
- **OR** the TPMS controller is defective.

Perform the following steps if this diagnostic code is present:

- Inspect the tire for leaks, and perform any necessary repairs.
- Check the tire for proper pressure. Refer to the Operator's Manual for the recommended cold inflation pressure.

NOTE: Ensure that the pressure value in the "Pressure Setup" screen on the VID is set to the proper pressure based on the current vehicle load.

Table 11

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521029, 521035 521041, 521047 521053, 521059 521065, 521071 521077, 521083 NOTE: Includes SPN 241	Dropped below minimum pressure	1	N/A	N/A	Axle "X" Wheel "XX" first pressure level Dropped below minimum pressure 521029 (A1 LI), 521035 (A1 RI), 521041 (A2 LO), 521047 (A2 LI), 521053 (A2 RI), 521059 (A2 RO), 521065 (A3 LO), 521071 (A3 LI), 521077 (A3 RI), 521083 (A3 RO) Refer to the beginning of the Diagnostic Trouble Codes section for definitions.	"Warning Extremely Low Tire Pressure Detected" popup displayed. Wheel is RED on the TPMS screen.	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when the TPMS controller has received 2 successive 'extremely low pressure' readings from the tire sensor (normally takes about 2 minutes). Refer to the Extremely Low Pressure Diagnostics section for more information.

Conditions for Clearing the DTC: This Diagnostic code is cleared when the TPMS controller receives information from the tire sensor that 'extremely low pressure' condition is no longer present for 1 occurrence (takes about one minute).

This Diagnostic code could be the result of any of the following conditions:

- The tire has a leak due to foreign object, faulty valve, etc.
- **OR** the tire sensor is defective (the tire sensor is not reporting pressure correctly).
- **OR** the TPMS controller is defective.

Perform the following steps if this diagnostic code is present:

- Inspect the tire for leaks, and perform any necessary repairs.
- Check the tire for proper pressure. Refer to the Operator's Manual for the recommended cold inflation pressure.

NOTE: Ensure that the pressure value in the "Pressure Setup" screen on the VID is set to the proper pressure based on the current vehicle load.

Table 12

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521168, 521178, 521188	Grounded circuit on LIN bus	31	N/A	4, 5, 6	Antenna "X" LIN bus short circuit Grounded circuit on LIN bus 521168 (Antenna1), 521178 (Antenna2), 521188 (Antenna3).	"TPMS Antenna Lost Communication" popup displayed. All wheels RED on the TPMS screen.	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when any of the antenna signal circuits is shorted to ground for 2.5 minutes. Refer to the Short Circuit Diagnostics section for more information.

Conditions for Clearing the DTC: Cycle the ignition key. If the communication is reestablished, then the DTC will be cleared.

This Diagnostic code could be the result of any of the following conditions:

- Short to ground on any of the antenna signal circuits.
- **OR** a defective tire pressure antenna.
- **OR** a defective TPMS controller.

Perform the following steps if this diagnostic code is present:

- Repair any faulty circuits, replace any faulty components.
- Cycle the key switch.

Table 13

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521167, 521177, 521187	Open on circuit LIN bus	31	N/A	4, 5, 6	Antenna "X" LIN bus open circuit Open circuit on LIN bus 521167 (Antenna1), 521177 (Antenna2), 521187 (Antenna3).	"TPMS Antenna Lost Communication" popup displayed. All wheels RED on the TPMS screen.	See below for details

Conditions for Setting the DTC: This Diagnostic code is set when any of the antenna signal circuits are open.

Conditions for Clearing the DTC: Cycle the ignition key if the active DTC does not clear automatically following the repair.

This Diagnostic code could be the result of any of the following conditions:

- Open or high resistance in any of the antenna signal circuits.
- **OR** a defective tire pressure antenna.
- **OR** a defective TPMS controller.

Perform the following steps if this diagnostic code is present:

- Repair any circuits, and then cycle the key switch.

Table 14

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521169, 521179, 521189	No communication on LIN bus	31	N/A	N/A	Antenna "X" LIN communication No communication on LIN bus 521169 (Antenna1), 521179 (Antenna2), 521189 (Antenna3).	"TPMS Antenna Lost Communication" popup displayed. All wheels RED on the TPMS screen.	See below for details

Conditions for Setting the DTC: The TPMS controller has not been able to communicate with one or more of the antennas for 2.5 minutes.

Conditions for Clearing the DTC: Cycle the ignition key, if the communication is reestablished, then the DTC will be cleared.

This Diagnostic code could be the result of any of the following conditions:

- Open, high resistance, short to ground, or short to battery on any of the antenna signal circuits.
- **OR** an open or high resistance on any of the antenna ZVR circuits.
- **OR** an open, high resistance or short to ground on any of the antenna 12V circuits.
- **OR** a defective antenna.
- **OR** a defective TPMS controller.

Perform the following steps if this diagnostic code is present:

- Repair any faulty circuits, and then cycle the key switch.

Table 15

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521172, 521182, 521192	Antenna power supply is below normal level	31	N/A	7, 8, 9	Antenna "X" power supply Antenna power supply is below normal level 521172 (Antenna1), 521182 (Antenna2), 521192 (Antenna3).	"TPMS Antenna Lost Communication" popup displayed. All wheels BLACK on the TPMS screen.	See below for details

Conditions for Setting the DTC: The TPMS controller receives information from the antenna that the voltage being received at the antenna power supply is below normal.

Conditions for Clearing the DTC: The condition for setting the DTC is no longer present, and the key switch is cycled.

This Diagnostic code could be the result of any of the following conditions:

- Open, high resistance, or short to ground on any of the antenna 12V circuits.
- **OR** a defective tire pressure antenna.
- **OR** a defective TPMS controller.

Perform the following steps if this diagnostic code is present:

- Repair any faulty circuits, and then cycle the key switch.

Table 16

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521175, 521185, 521195 NOTE: Includes SPN 1699	Antenna defective	11	N/A	N/A	Antenna "X" power supply Antenna power supply is below normal level 521175 (Antenna1), 521185 (Antenna2), 521195 (Antenna3).	"TPMS Antenna Lost Communication" popup displayed. All wheels RED on the TPMS screen.	See below for details
<p>Conditions for Setting the DTC: The TPMS controller sets this DTC (additionally) if any of the following DTC is present:</p> <ul style="list-style-type: none"> • 'No communication on LIN bus' (521169, 521179, 521189) • 'Grounded circuit on LIN bus' (521168, 521178, 521188) • 'Antenna power supply is below normal level' (521172, 521182, 521192) • 'RAM fault in antenna' (521170, 521180, 521190) • 'ROM fault in antenna' (521171, 521181, 521191) • 'Wrong frequency of antenna' (521174, 521184, 521194) • 'Antenna receiver offset too low' (521173, 521183, 521193) <p>Conditions for Clearing the DTC: The conditions for setting the DTC are no longer present.</p> <p>Perform the following steps if this diagnostic code is present:</p> <ul style="list-style-type: none"> • Resolve any of the above DTC conditions, and this DTC will be automatically cleared. 							

Table 17

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
521170, 521180, 521190	RAM fault in antenna	31	N/A	N/A	Antenna "X" RAM RAM fault in antenna 521170 (Antenna1), 521180 (Antenna2), 521190 (Antenna3).	N/A	See Note 1 below for details
521171, 521181, 521191	ROM fault in antenna	31	N/A	N/A	Antenna "X" ROM ROM fault in antenna 521171 (Antenna1), 521181 (Antenna2), 521191 (Antenna3).	N/A	See Note 1 below for details
521173, 521183, 521193	Antenna receiver offset too low	31	N/A	N/A	Antenna "X" receiver offset Antenna receiver offset too low 521173 (Antenna1), 521183 (Antenna2), 521193 (Antenna3).	N/A	See Note 1 below for details
521174, 521184, 521194	Wrong frequency of antenna	31	N/A	N/A	Antenna "X" frequency Wrong frequency of Antenna 521174 (Antenna1), 521184 (Antenna2), 521194 (Antenna3).	N/A	See Note 1 below for details
<p>Note 1: All of the above listed diagnostic codes (521170, 521180, 521190, 521171, 521181, 521191, 521173, 521183, 521193, 521174, 521184, and 521194) are the result of a defective tire pressure antenna.</p> <p>Cycle the key switch. If this does not clear the DTC, then replace the appropriate tire pressure antenna.</p>							

Table 18

SPN	Description	FMI	Conn.	Pin	VID Message Displayed	VID Symptom	Probably Cause
2051	TSS defective	11	N/A	N/A	Tire Pressure Monitor Controller is defective	N/A	See below for details
<p>Conditions for Setting the DTC: This DTC will be displayed (additionally) if any of the following DTC is present: 521001, 521002, 521003, 521004, 521005, 521006, 521007, or 521009.</p> <p>Conditions for Clearing the DTC: None of the DTC listed above are present.</p> <p>This Diagnostic code could be the result of a defective TPMS controller.</p> <p>Perform the following steps if this diagnostic code is present:</p> <ul style="list-style-type: none"> • Cycle the key switch. If this does not clear the DTC, then replace the TPMS controller. 							

5. FREQUENTLY ASKED QUESTIONS

1. **Question:** "Why do I keep getting low tire pressure warnings displayed on the VID?"

Answer: This is part of the normal operation of the system as described in the Tire Pressure Diagnostics section of this document.

NOTE – The threshold at which certain tire pressure warnings appear is adjustable on the VID "Pressure Setup" screen. However, the default value is preset by the vehicle manufacturer.

To ensure tire pressure warnings are displayed properly on the VID, set the current pressure value in the "Pressure Setup" screen to the recommended cold inflation pressure as specified in your Operator's Manual. This should include adjustments based on vehicle loading.

2. **Question:** "Why are the low tire pressure warnings being displayed in the VID when the tire pressure is at or above the recommended inflation?"

Answer: By the laws of physics, pressure increases with increasing temperature. Tire temperature is increased as a result of friction from normal driving and braking. Therefore, although the tire pressure displayed in the VID may be close to the recommended cold inflated tire pressure; due to increased tire temperature while driving, tire pressure should have also increased.

If the system detects that the tire pressure has not increased with the rise in temperature, it assumes that the air volume has changed (air has leaked from the tire); hence the YELLOW (or RED) warning appears in the VID. This loss of air needs to be replaced until the YELLOW (or RED) warning in the VID goes out (the wheel turns GREEN on the VID TPMS screen).

As a standard practice, tire inflation should be done only when tires are cold, or incorrect air pressures will result.

3. **Question:** "Why is the tire information not being displayed on the VID when I turn the key switch to the IGNITION ON position OR when I start the vehicle? Several wheels are BLACK (empty) on the TPMS screen for almost a full minute."

Answer: It may take up to 2 minutes before the TPMS controller receives all of the sensor's information, due to the rate at which they transmit (once per minute). Therefore, the sensor's information may not be received by the TPMS controller immediately following an ignition key cycle.

4. **Question:** "Why are the low tire pressure warnings being displayed in the VID? Although the VID indicates that the air pressure for the tire is low on the TPMS screen, the tire pressure gauge reading indicates that the tire pressure is sufficient when I checked it."

Answer: Ensure all of the Tire Transmitter IDs have been programmed to the correct wheel location. The VID does not actually know the location of the tire sensors. Each tire sensor has been programmed to a wheel location, and these locations can be changed manually using the VID.

If a Tire Transmitter has been programmed into the wrong wheel location, the wheel location corresponding to the YELLOW or RED wheel on the TPMS screen will be incorrect. The fact that one of the wheels has lost air will be true, however.

6. TIRE PRESSURE MONITORING SYSTEM SETUP

INTERNATIONAL VEHICLE INFORMATION DISPLAY (VID)

THE INFORMATION ON YOUR VEHICLE DISPLAY SCREEN MAY LOOK DIFFERENT THAN THE FOLLOWING EXAMPLES, DEPENDING ON THE SYSTEM YOUR VEHICLE IS EQUIPPED WITH.

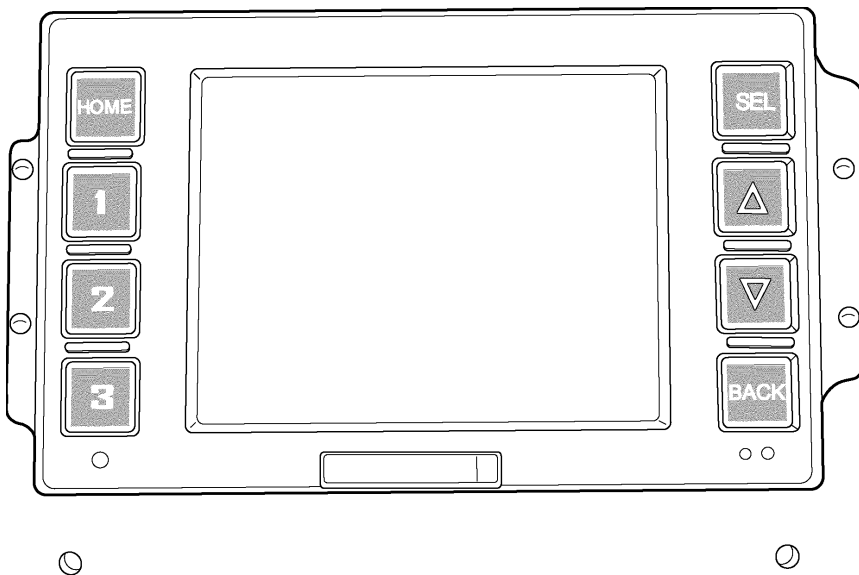


Figure 7

The VID is a user interface that provides visual information helpful to the driver, video views to aid in the safe operation of the vehicle, and diagnostic messages. In this manual we will only address the VID interaction with the TPMS.



WARNING – Do not use the VID while driving. Driving while distracted may result in an accident causing property damage, personal injury, or death.

NOTE – Be sure to read and understand this manual completely before attempting to operate the VID.

Power-Up/Down Conditions

This condition is triggered when the VID receives power from the ignition or ACC key positions. While powering up, a logo screen will be displayed. The VID will power-up and be fully operational within approximately 10 seconds. During power-down, the VID will save the current data and settings.

Warnings

Startup Warning Messages

When the power-up sequence is completed, the system may display warning messages indicating that maintenance is required. The operator is required to acknowledge these conditions (by pressing the SEL button) before the VID will continue to the Main Menu.

Pop-Up Warning Messages

Pop-up warnings may occur at any time during normal operation of the VID. These messages are the result of the VID receiving a new diagnostic message from the various electronic modules on the vehicle. It is important to pay particular attention to these messages as some may indicate a severe problem while others may indicate that some form of maintenance needs to be performed in the near future. These warning messages must be acknowledged by the operator in the same manner as startup warnings (there is a 2 second time out period during which acknowledgement cannot be performed to ensure the message is read).

Power LED

The Power LED is located under the BACK button in the lower right-hand corner of the VID and is illuminated constantly while power is supplied to the VID.

Standby LED

The standby LED is an amber light located under the BACK button in the lower right-hand corner of the VID. The VID will turn off backlighting after no button presses and no unacknowledged alerts are present for approximately 20 minutes. When this occurs, the standby LED will flash.

Pressing any key will revive the unit from standby mode, returning it to the previous screen selected.

LCD Screen

The LCD Screen is enabled or disabled based on operating conditions and power-up/down conditions. The backlighting is controlled by a photocell located under button number 3, at the lower left-hand corner of the VID. When enabled, the photocell measures the amount of light and adjusts the backlighting as needed.

Keypad Functionality

Located on the face of the VID are eight keypad buttons that are used to operate and toggle through the many screens of information available on the VID. The backlighting for the keypad is provided and controlled by the dash dimmer switch.

HOME Button

Pressing the HOME button takes the operator to the MAIN MENU screen immediately.



Figure 8

SELECT Button

Pressing the SELECT button allows the operator to select an option that is highlighted. In addition, it will allow the operator to acknowledge any diagnostic warnings.



Figure 9

UP and DOWN Button

Pressing the UP or DOWN button allows the operator to scroll through the items listed on the screen to select individual items.

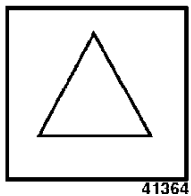


Figure 10

When entering numerical data is required, the UP and DOWN buttons will increment and decrement the value displayed.

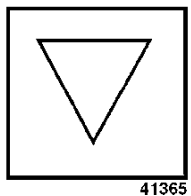


Figure 11

BACK Button

Pressing the BACK button will immediately take the operator to the previous screen, data field, or up one level in the menu hierarchy.



Figure 12

Hot Buttons: 1, 2 and 3

The operator has the ability to program each of these Hot Buttons by moving the cursor to the desired menu item and holding the selected Hot Button down for three seconds. Upon updating the Hot Button setting, a screen will be provided to indicate to the user his command was fulfilled. Once programmed, the Hot Button will allow direct selection of the programmed screen from any other screen.

Hot Buttons will not permit the operator to switch to a screen that is restricted while moving. Likewise, Hot Buttons will not permit the operator to circumvent password entry to secured screens.

These are also used for entering passwords.

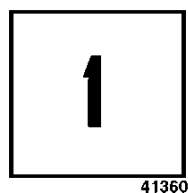


Figure 13

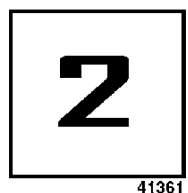


Figure 14

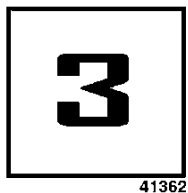


Figure 15

Password Security

Certain functions/screens may be set up to require a password in order to be accessed. When this is required, the VID will display the Enter Password screen.

The operator will be required to enter the correct password using the 1, 2, 3 keys, followed by the SEL key.

NOTE: The BACK key can be used as a delete/backspace in the event an incorrect digit is entered.

Once password access is granted for a screen, access will bypass password requests on other screens. This access will persist until the ignition is cycled to the OFF position.

In the event the wrong password is entered, the Incorrect Password Entered screen will be displayed.

NOTE – A maximum of three failed attempts will be allowed. When this limit is reached, a special screen will be displayed indicating no more attempts allowed.

7. TIRE TRANSMITTER ID PROGRAMMING

This document provides vehicle information display (VID) related programming information supplemental to the tire pressure monitoring system (TPMS).

7.1. REPLACING A WHEEL/RIM

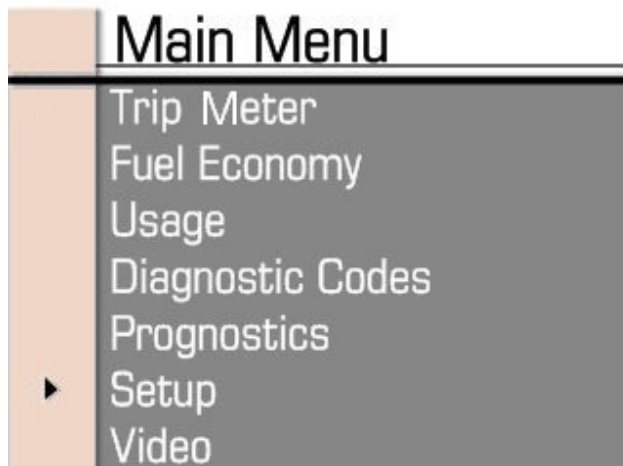
Initial tire transmitter ID programming is necessary under any of the following conditions:

- The “Tire Type” is changed on the VID “TPMS Setup” screen, such as from dual wheels to super single wheels or vice versa (**See Note 1**).
- **OR** the TPMS controller has been replaced (**See Note 1**).
- **OR** [either the wheel **OR** tire sensor has been replaced].

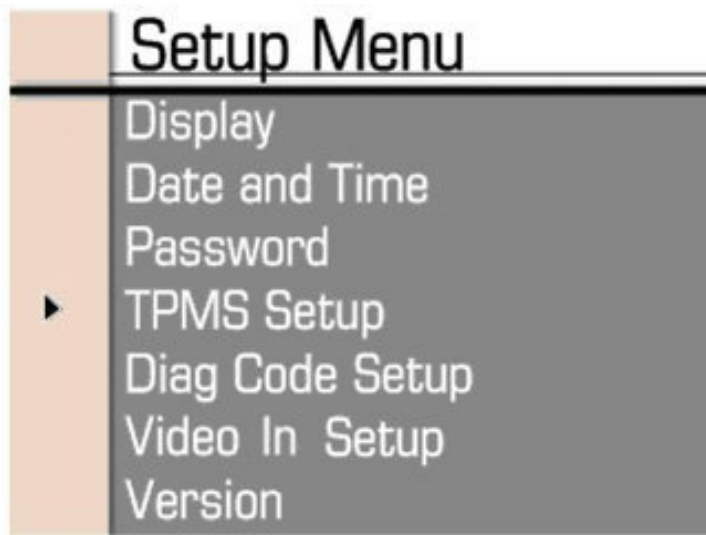
Note 1: All wheel associations will be cleared on the VID if the “Tire Type” is changed or the TPMS controller is replaced.

Note 2: It is recommended that the vehicle being serviced is moved more than 100 feet from other TPMS equipped vehicles and/or wheels. If it is not feasible to move the vehicle away from other TPMS equipped vehicles and/or wheels, remove 2-3 PSI air pressure from the tire within one second. This will place the tire sensor in fast transmit mode for approximately 2 minutes. That sensor will then appear 1st in the list of detected sensors on the Tire Transmitter ID screen (and with an asterisk), which helps to identify the particular wheel.

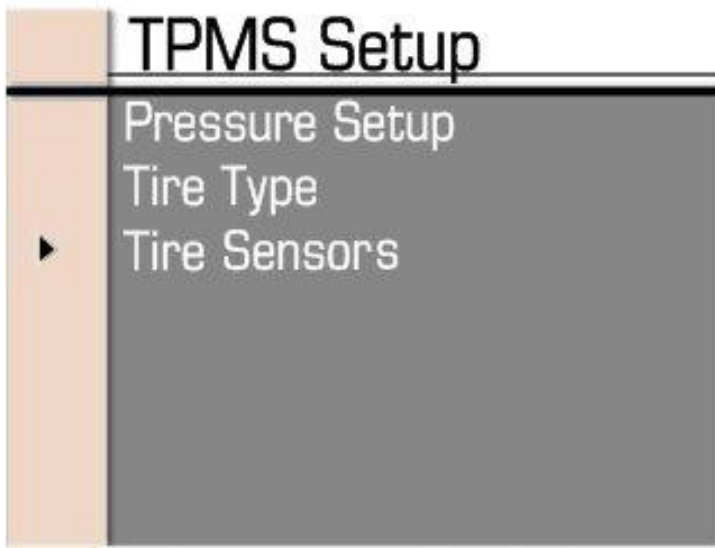
1. From the Main Menu, choose “Setup”.

**Figure 16**

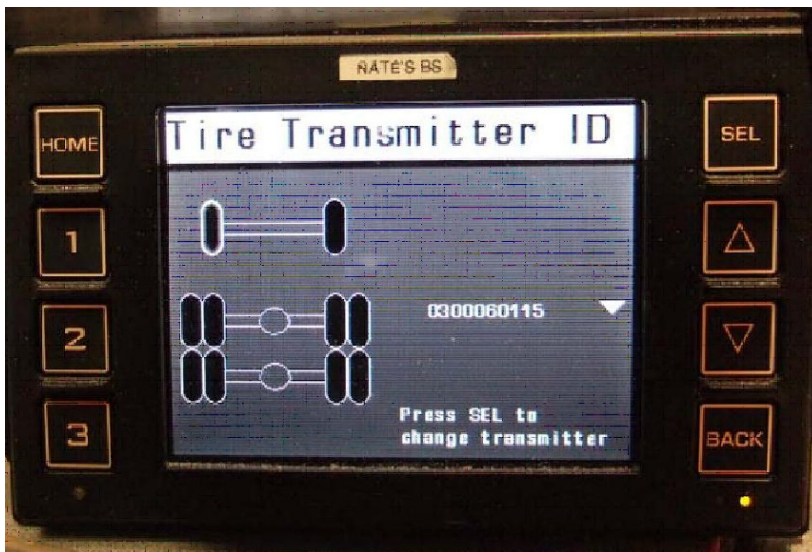
2. From the Setup Menu, choose "TPMS Setup". Note: This screen will be grayed out if the vehicle is not stationary.

**Figure 17**

3. From the TPMS Setup screen, choose "Tire Sensors".

**Figure 18**

The arrow keys can be used to highlight the appropriate wheel. We'll assume that the technician would like to replace the left front wheel (highlighted below) in this example.

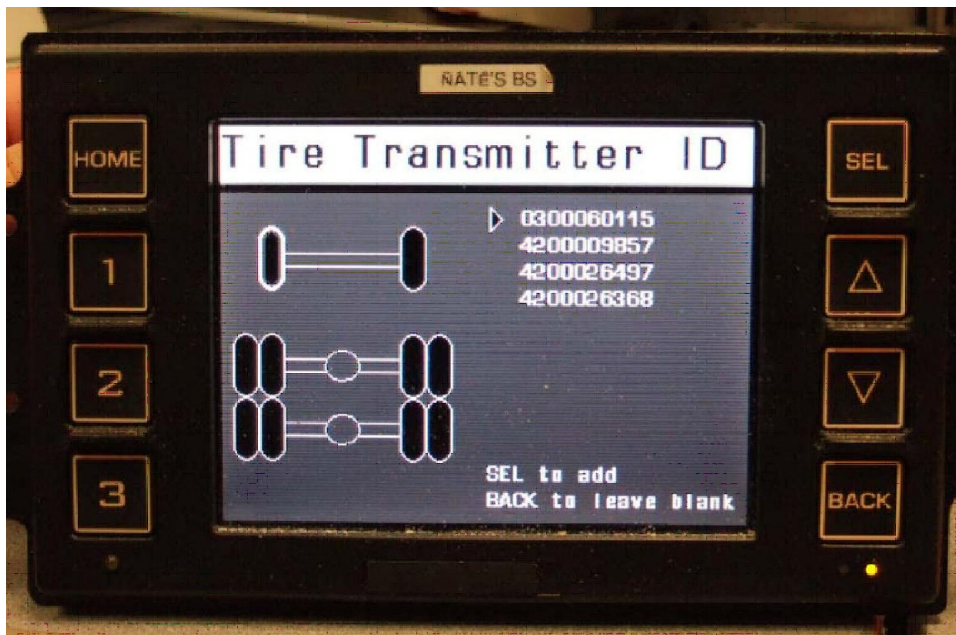
**Figure 19**

The 0300060115 indicates the Tire Transmitter ID currently programmed into that wheel location (LF). Different IDs will be displayed for different wheel selections using the arrow keys, if desired.

4. Press SEL while LF wheel is highlighted. The VID should prompt the question: "Remove this sensor from the system?"

**Figure 20**

5. Press SEL again while LF wheel is highlighted.

**Figure 21**

The VID will display all detected sensors. In the example above, there are 4 Tire Transmitter IDs detected. The first ID in the list (0300060115) is the sensor which was removed. This allows the user a chance to add the sensor back if it was mistakenly removed (this is also useful when rotating wheels, since the other wheel will be displayed 1st). The other 3 IDs are sensors which the TPMS antenna detects, but are not associated with that particular wheel location.

6. Select the appropriate Tire Transmitter ID from the list by pressing SEL. In this example, we will select the second Tire Transmitter ID (4200009857) from the list.

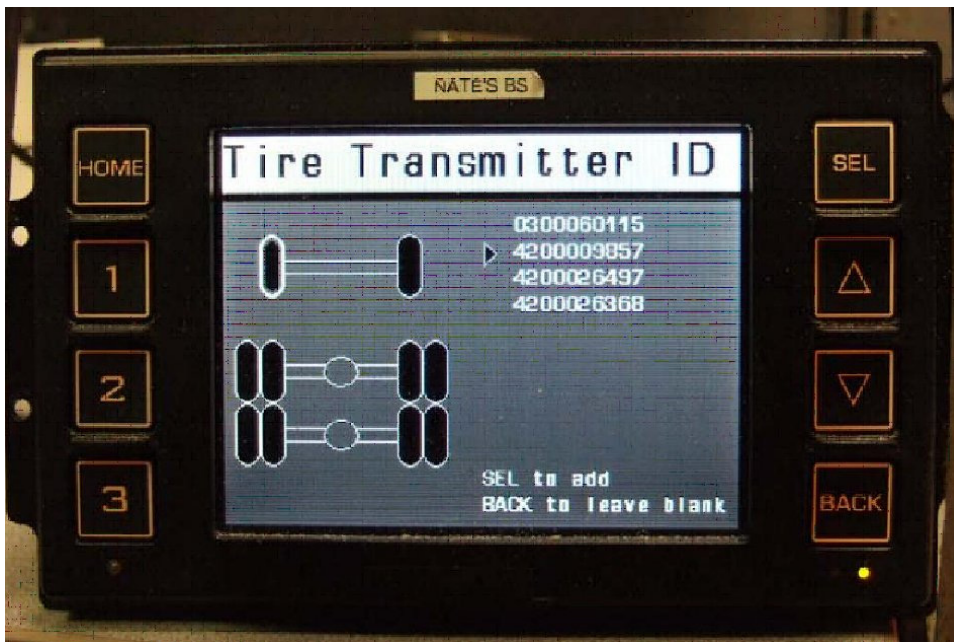


Figure 22

7. Press SEL again while the arrow is next to Tire Transmitter ID (4200009857). That sensor is now programmed into the LF wheel location, and the ID appears while the LF wheel is highlighted.

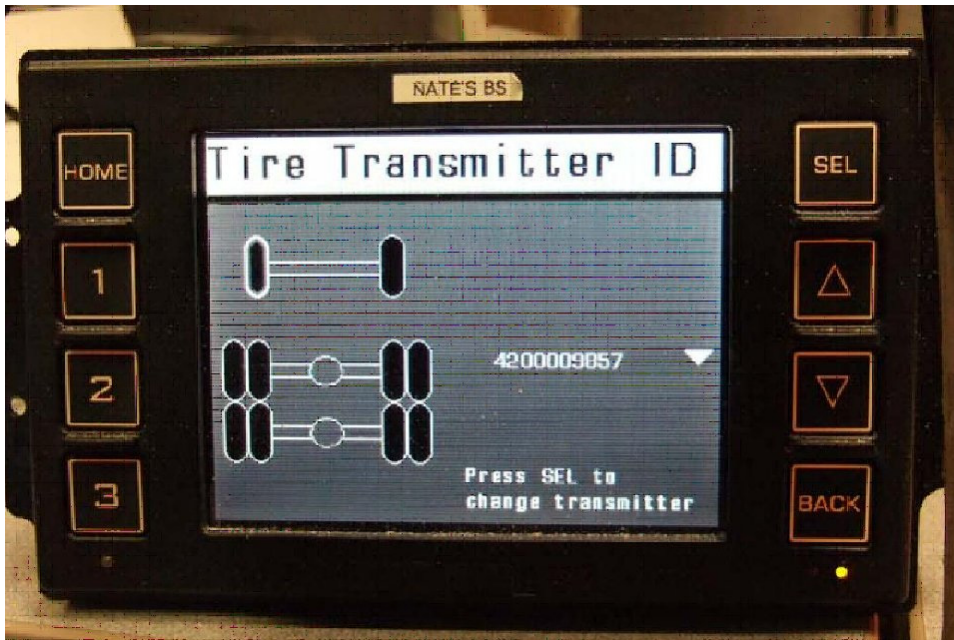


Figure 23

8. Refill any deflated tires to the recommended cold inflation pressure. Refer to the Operator's Manual for more information.
9. Wait at least 2 minutes for the TPMS system to update its tire pressure data.

10. Ensure that the tire pressure measured by the tire pressure gauge matches the tire pressure displayed on the TPMS screen in the VID for the newly associated wheel.

7.2. ROTATING THE WHEELS

If rotating tires (such as LF with RF), Tire Transmitters must be disassociated with both wheels and then both Transmitter IDs must be reprogrammed to their new wheel locations. Actual tires may be rotated before or after programming.

Keeping Track of Wheel Locations

It's important to ensure that tire sensors are not being reprogrammed back into the same location.

IMPORTANT! Prior to servicing a particular TPMS equipped wheel, keep track of its location with respect to the vehicle. Each wheel indicates the respective Tire Transmitter ID on a sticker in case wheels are moved from their original orientation.

If the TPMS sensor ID sticker on the wheel has been removed:

- **Either**, write the Tire Transmitter ID being received for that wheel location (displayed on the VID) by placing a sticker with that ID on the appropriate wheel before removing the wheel from the vehicle.
- **Or**, write the wheel's location (left front, for example) using a sticker on the wheel being serviced before removing the wheel from the vehicle.

If the Tire Transmitter ID is unknown AND the wheel was moved from its original orientation:

- **Either**, remove 2-3 PSI air pressure from the tire with the unknown Tire Transmitter ID within one second. This will place the tire sensor in fast transmit mode for approximately 2 minutes. That Tire Transmitter ID will then appear 1st in the list of detected sensors on the Tire Transmitter ID screen (and with an asterisk).
- **Or**, retrieve the Tire Transmitter ID (sensor serial #) from the tire sensor by removing the tire.

Procedure

1. With the starting wheel highlighted as shown (LF in this case), press SEL 2 times.

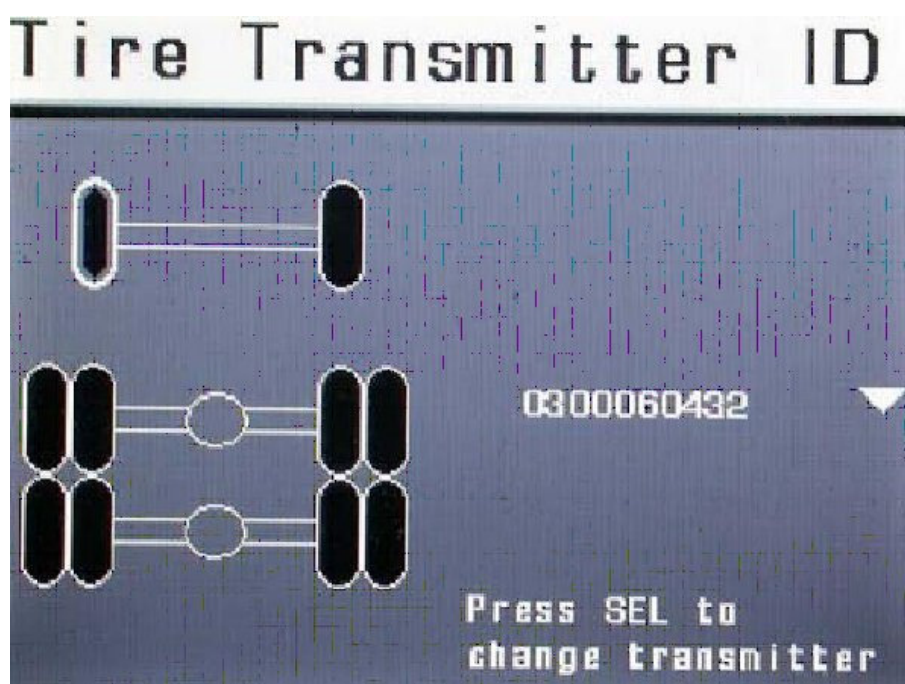


Figure 24

2. The screen below will then be displayed on the VID.

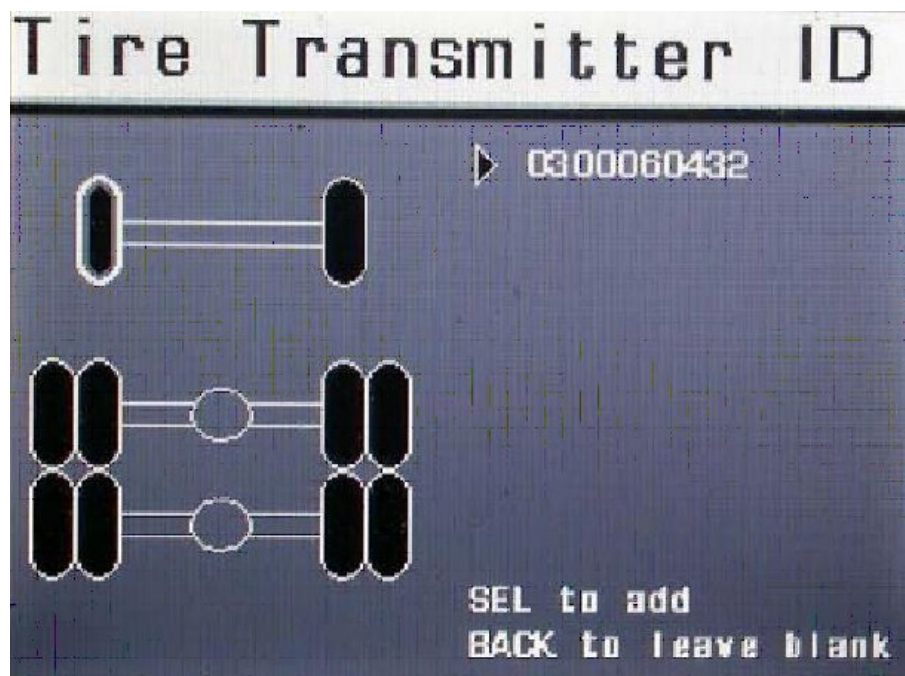


Figure 25

At this point (screen above) the tire sensor (0300060432) has been disassociated from the LF location and either a Tire Transmitter ID must now be added or the tire location must be “blanked” (no IDs will be associated with the location). Since we don’t want to reprogram the LF tire back to that location, we’ll leave it blank as instructed in the next step.

Note: In this case, the sensor removed is the only one in the list. In a shop environment, however, other IDs may be present due to the system receiving other TPMS equipped vehicles/wheels. If other sensors are detected, the first Transmitter ID in the list will be the one which was removed (LF).

3. Press BACK to leave the current wheel location blank. All sensors will remain disassociated with this location and 0000000000 will be displayed (as shown below) for this location when the wheel is selected.

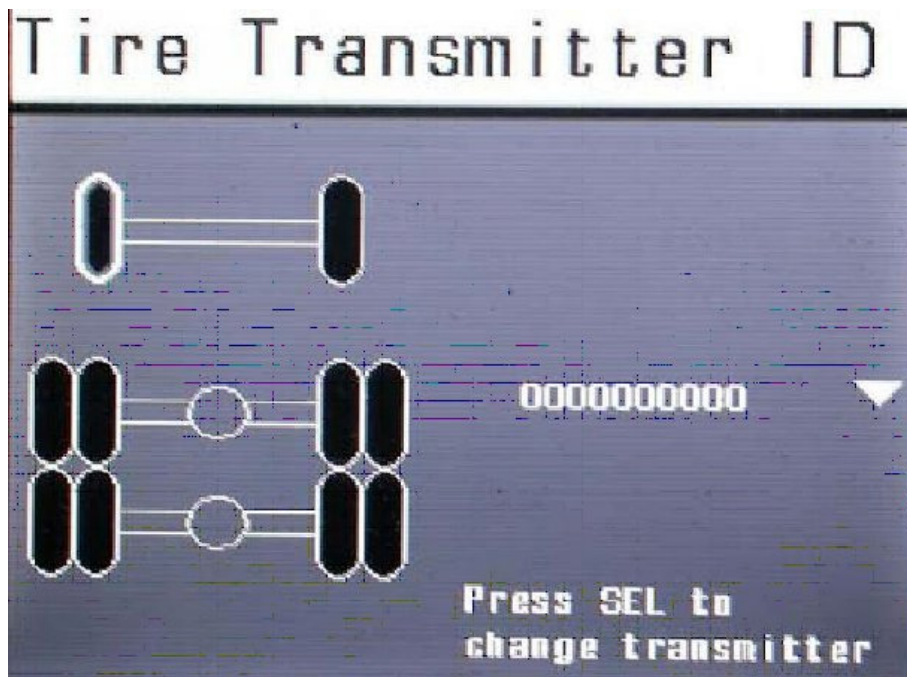


Figure 26

- Press the down arrow until the RF wheel location is highlighted (as shown below).

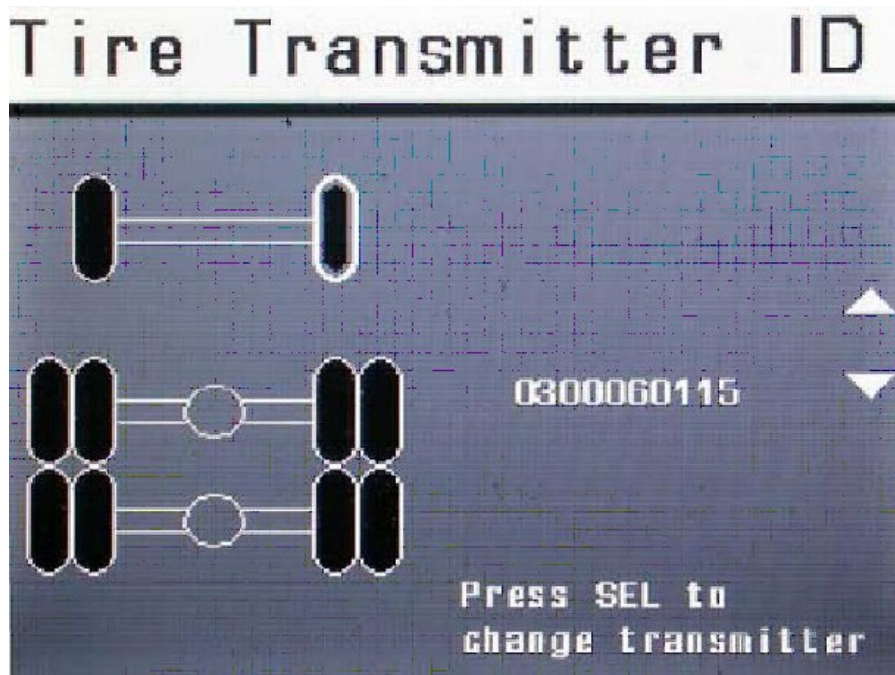


Figure 27

- Press SEL 2 times while the RF wheel location is highlighted.

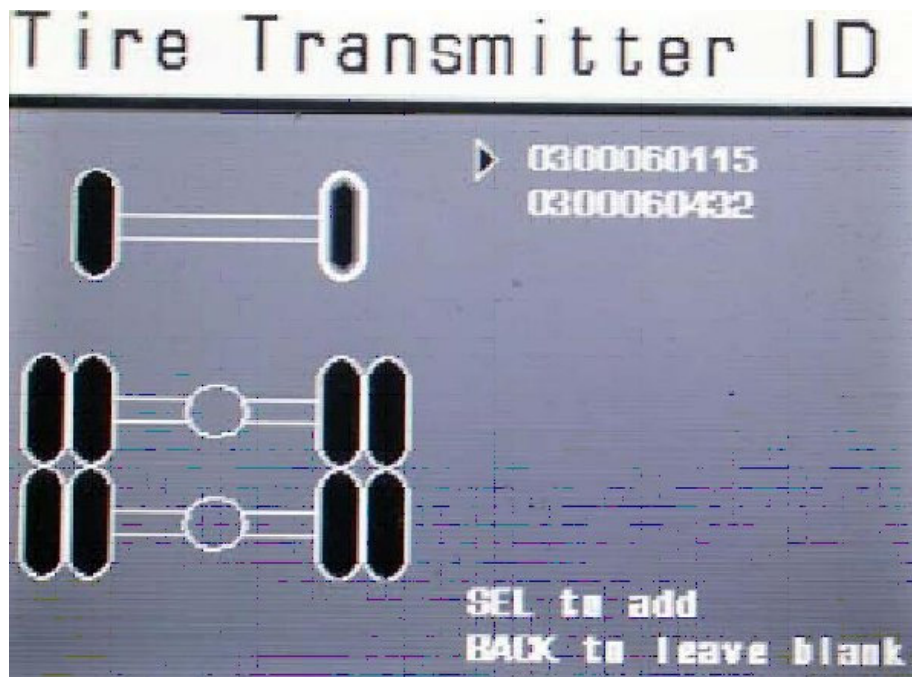


Figure 28

6. At this point (screen above) the previously programmed RF sensor (0300060115) has been disassociated from the RF location (shown first in the list). The only other sensor in the vicinity is the LF wheel (0300060432). That is the wheel which needs to be programmed into the RF location, so we'll select and add that wheel to the RF location by using the down arrow followed by pressing SEL. The screen below illustrates the results of the newly programmed RF sensor.

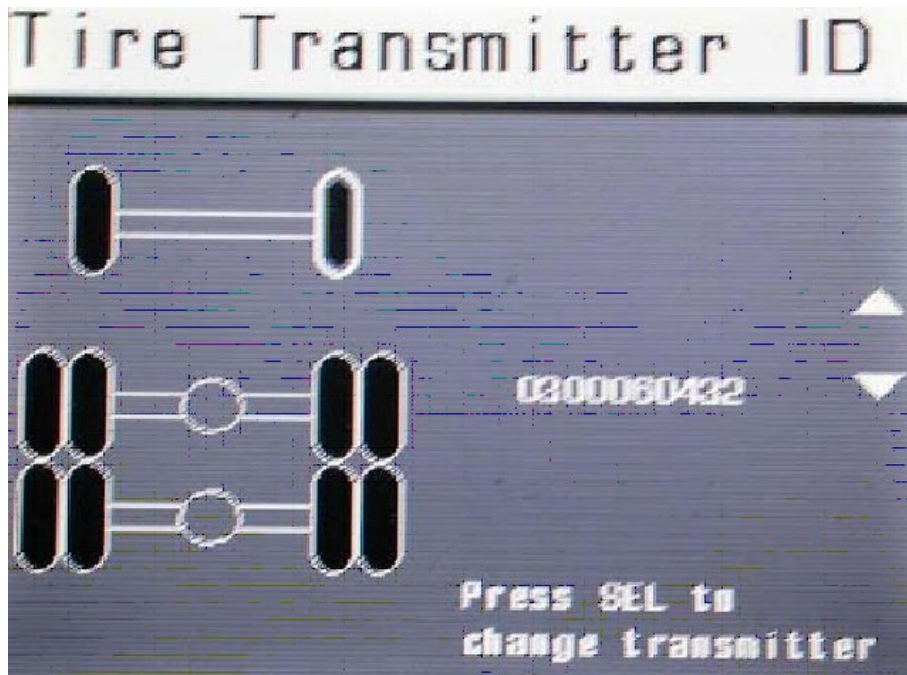


Figure 29

7. Press the up arrow to go back to the LF wheel location, then press SEL 2 times.

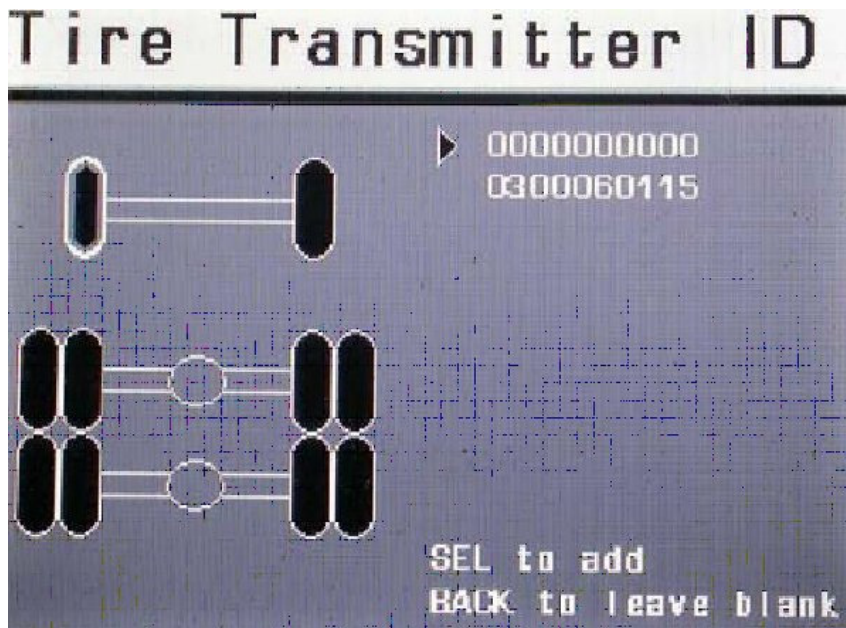


Figure 30

0000000000 will be the first Transmitter ID in the list (shown above). The second Transmitter ID (0300060115) is the one that was previously associated with RF location.

8. Press down to select the sensor that was previously associated with the RF location (0300060115) and press SEL to associate that sensor with the LF location. The association is shown in the example below.

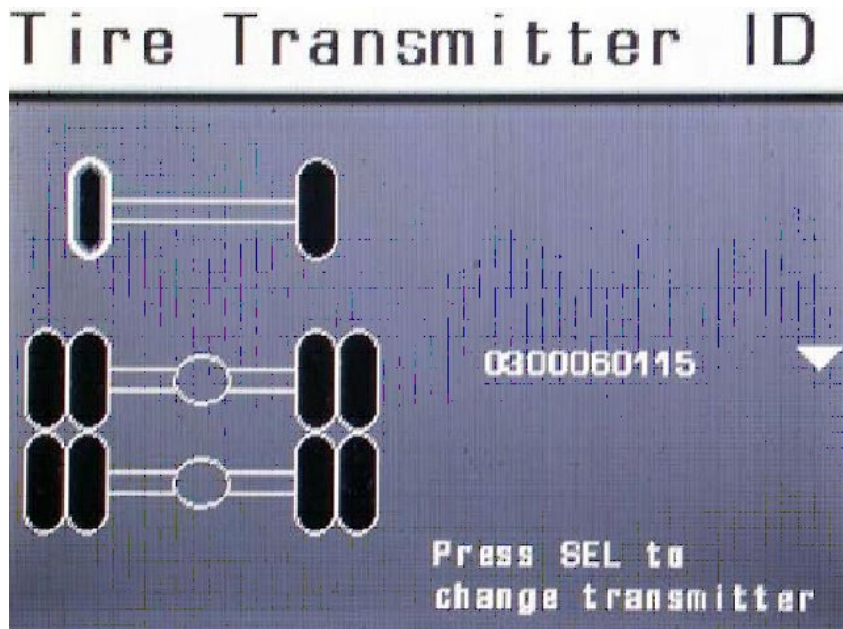


Figure 31

9. Procedure completed.

8. TIRE PRESSURE SETUP

Menu Descriptions

The following sections describe the functions available on the VID through the various menu screens.

Main Menu Screen

The MAIN MENU screen will display as shown in Figure 32.

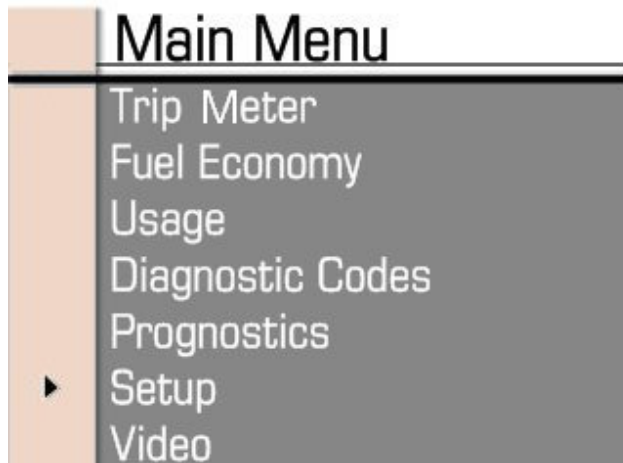


Figure 32

The Setup Menu will display as shown in Figure 33.

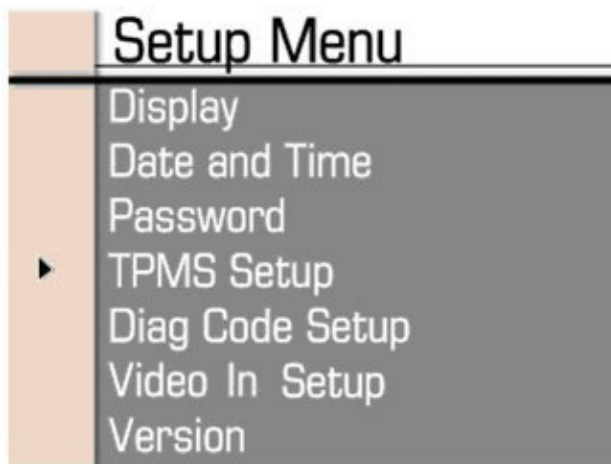


Figure 33 Setup Menu

The TPMS Setup screen will display as shown in Figure 34.

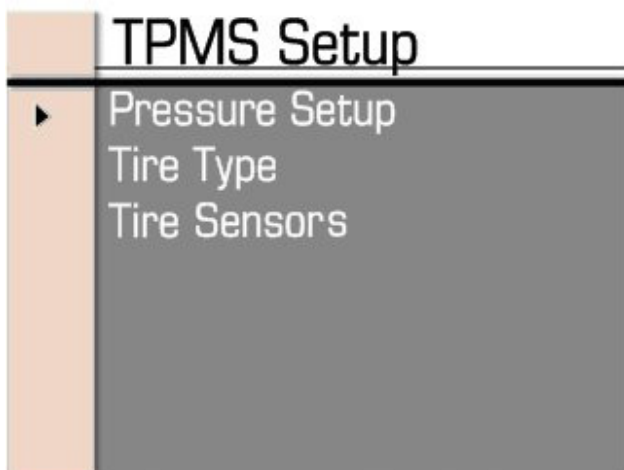


Figure 34 TPMS Setup

If no password is assigned, the VID will skip over password protection screens and all screens will be available. This is the default configuration from the factory, however, this screen can be set as password protected.

Pressure Setup

Selecting Pressure Setup will display a screen indicating tire locations and current value of the desired pressure setting, as shown in Figure 35.

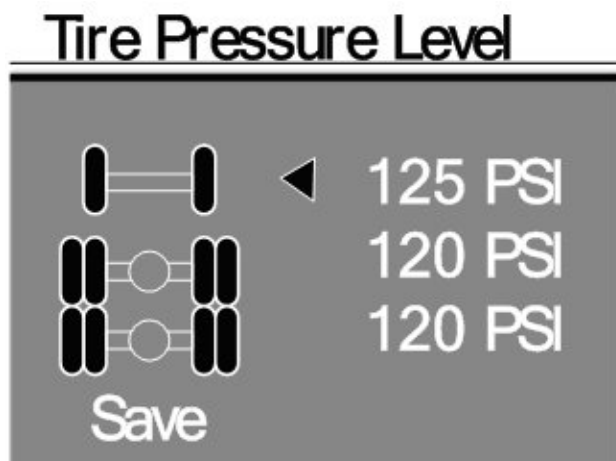


Figure 35 Pressure Setup

An on-screen arrow will indicate the tire location. To change the pressure setting, press the SEL button. The on-screen arrow will then point to the pressure setting and allow it to be changed. Pressing the UP or DOWN buttons will increase or decrease the pressure setting in 1 PSI increments (pressure settings are limited to 88 PSI minimum and 117 PSI maximum). When the desired pressure is entered, press the SEL button to return to selecting tire location.

Select the next tire location by pressing the UP or DOWN buttons and repeat the process.

When the desired pressure for all tires is correct, move the on-screen arrow to Save and press the SEL button.

Tire Type

Selecting Tire Type allows selection of the type of rear axle tires, dual or single (see Figure 36). Select the proper type by pressing either the UP or DOWN button and then the SEL button.

If the Tire Type is changed, a screen will appear warning that the TPMS sensor assignments must also be changed. On this screen, press SEL to continue with the change or BACK / HOME to cancel the change.

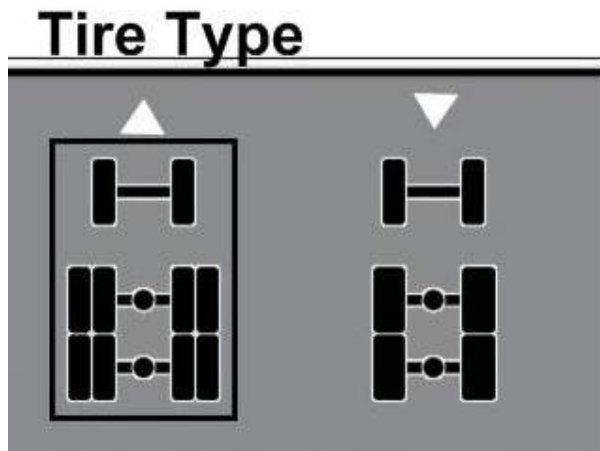


Figure 36 Tire Type

9. OPERATION

9.1. MONITORING DISPLAY



Figure 37 Prognostic Menu

The button functions when the Prognostics Menu screen is displayed are as follows:

1. Pressing the UP and DOWN buttons will cycle through the list of options.
2. Pressing the SEL button will take the operator to the screen of the indicated choice.

3. Pressing the HOME and BACK buttons will force the operator to exit this screen and return to the MAIN MENU screen.

Tire Pressure

Selecting Tire Pressure will display the TPMS (Tire Pressure Monitoring System) screen as shown in Figure 38.

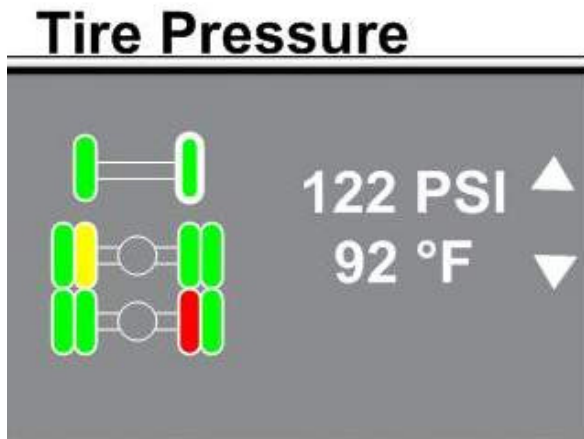


Figure 38 TPMS

Each tire's pressure and temperature are available on this screen. Up and down arrows on the edge of the screen indicate which button (UP or DOWN) to press to cycle through all tires.

In addition to the numerical readout of pressure, individual tires will show yellow if marginally inflated or red if dangerously under inflated.

Press the BACK button to return to the Prognostic Menu screen.

The button functions when the Prognostics Menu screen is displayed are as follows:

1. Pressing the Up and Down buttons will cycle through the list of options.
2. Pressing the SEL button will take the operator to the screen of the indicated choice.
3. Pressing the Home and Back buttons will force the operator to exit this screen and return to the MAIN MENU screen.

TIRE PRESSURE

Selecting Tire Pressure will display the TPMS (Tire Pressure Monitoring System) screen as shown in Figure 38.

Each tire's pressure and temperature are available on this screen. Up and down arrows on the edge of the screen indicate which button (UP or DOWN) to press to cycle through all tires.

In addition to the numerical readout of pressure, individual tires will show yellow if marginally inflated or red if dangerously under inflated.

Press the BACK button to return to the Prognostic Menu screen.

10. WHEEL SENSOR SERVICE PROCEDURE

! WARNING – To avoid personal injury or death, shift transmission to neutral or park, set parking brake, and block wheels before doing diagnostic or service procedures.

CAUTION – If you notice either a label located in the wheel hand hole area or what appears to be a stud mounted 180 degrees from the valve stem, you must follow the instructions on the attached bulletin from the manufacturer when removing and installing the tire. Failure to follow these instructions when removing or mounting a tire could cause the tire pressure monitor to break off inside the wheel resulting in a loose sensor inside of the tire and wheel assembly. This can eventually lead to tire damage or failure of the tire pressure sensor.

Mounting Locations: On Super Singles, the wheel sensor is mounted to a stud and nut (Figure 39 and 40). On regular tires, the sensor is mounted inside the rim on a special valve stem (Figures 41 and 42). Follow the procedures below.



Figure 39 Super Single Wheel Sensor



Figure 40 Super Single Wheel Sensor with Exploded View of Mounting Hardware



Figure 41 Standard Rim Wheel Sensor Mounting Hardware



Figure 42 Standard Rim Wheel Sensor Assembly

NOTICE:

The information supplied herein has been furnished by the manufacturer and/or the supplier for use with its product. International Truck and Engine Corporation reprints this information based on representations made to the company. While users are urged to carefully follow the instructions accompanying the product, International cannot accept any responsibility for user errors, or mishaps resulting from such errors, or from any misuse of the product.

11. RECOMMENDATION FOR MOUNTING AND DEMOUNTING TIRES

The following pages show the recommendation for mounting and demounting tires, including rim mounted wheel sensors. These recommendations should provide the basic information on how to handle tires with rim mounted wheel sensors. In general there are 3 different situations:

- (1) Demounting Tire (Service)
- (2) Manually Mounting Process (Service)
- (3) Mounting process using automated assembly machine

11.1. (1) DEMOUNTING TIRE PROCESS (DEMOUNT WHEEL SENSOR BEFORE REMOVING THE TIRE):

NOTE – Wheel sensor must be removed before tire is disassembled.

If the wheel sensor is not removed before demounting the tire, the sensor will be destroyed as shown in the pictures below.

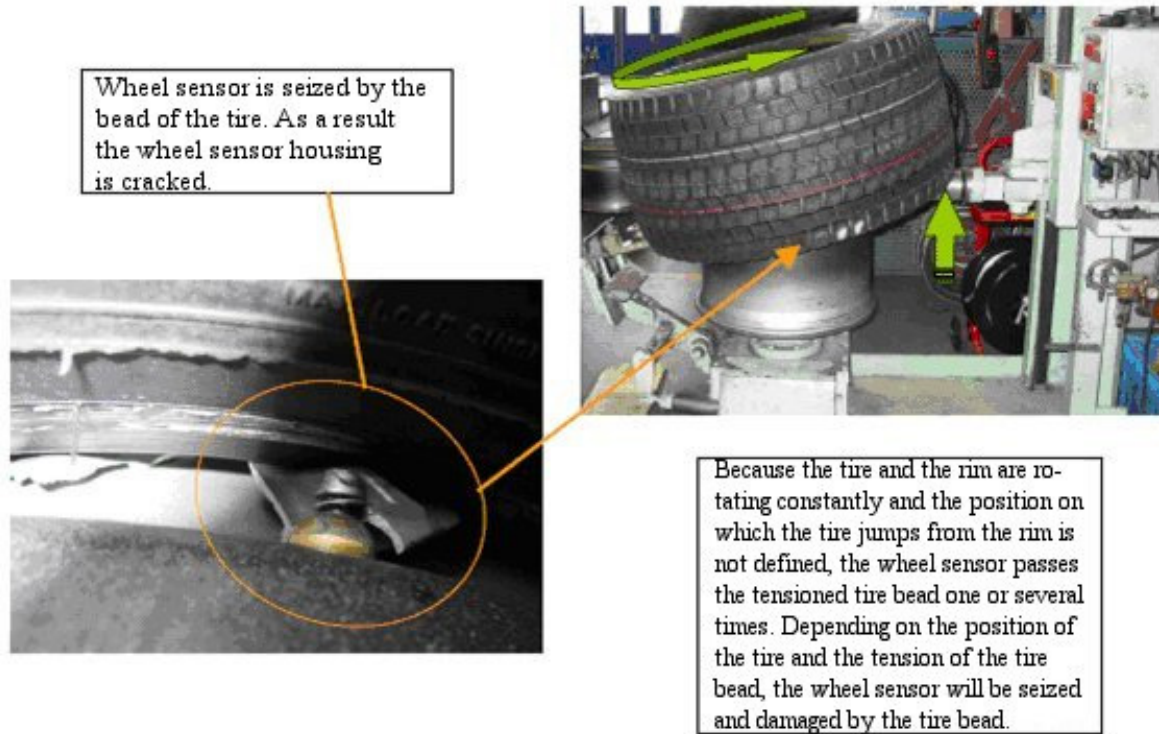


Figure 43

The wheel sensor has to be removed before demounting the tire. The easiest way to remove the wheel sensor is to push the tires sidewall away from the rim using the assembly machines shovel, until the wheel sensor is easily accessible. Then the wheel sensor attaching screw can be removed along with the wheel sensor. The mounting stud is not removed.

When the tire is removed, the wheel sensor can be mounted on the rim. A new attaching screw must be used!

If replacing the tire pressure sensor, it will come with a label imprinted with a bar code and a serial number. Remove the label and retain it so the serial number can be manually entered into the control unit via the display unit installed on the vehicle (Follow prompts from setup menu in the second section of this manual). If a bar code label is not included, record the serial number from the sensor.

Mount the threaded bolt on the rim and tighten the mounting nut with a tightening torque of 10 Nm (7.35 lbf-ft). The threaded bolt is mounted on the rim with the help of a **mounting nut which is to be torqued to 10 Nm**.

Mount the tire pressure sensor to the back of the threaded bolt. Torque the screw to 4 Nm (3 lbf-ft) . Please be advised that the tire pressure sensor is mounted to a threaded mounting bolt with a **screw which is to be torqued to 4 Nm** (Figure 39 and 40). If the screw is torqued to 10 Nm , the housing will break.

NOTE – Use a new screw for attaching the wheel sensor to the mounting stud. The attaching screw can only be used once. Never reuse an attaching screw .

11.2. (2) STANDARD MOUNTING PROCESS (INSTALLED WHEEL SENSOR):

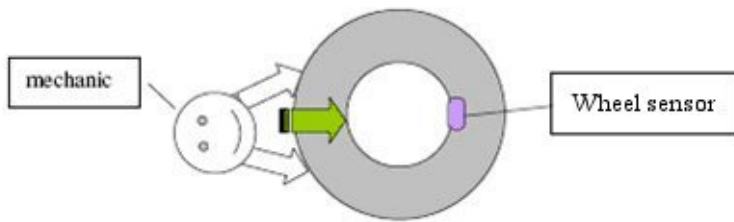


Figure 44

Figure 44 shows the principle of mounting the tire under service conditions without using an assembly machine. In this case mounting should be started with wheel sensor position opposite to the mechanic. The pictures in Figure 45 show the 3 steps of mounting the tire.



Step 1:
Wheel sensor positioned opposite to mechanic. Tire is applied to the rim from the wheel sensor opposite side.

Step 2:
1st tire bead is also pulled into the drop center of the rim opposite side of the wheel sensor first.
1st tire bead finally slips over the upper wheel run flange on the wheel sensor side. Alternatively an assembly iron is used forcing the bead to slip over the wheel run flange.



Step 3:
2nd tire bead one brings over the upper wheel run flange by alternatively using an assembly iron.
Starting position for 2nd tire bead → wheel sensor opposite.



Figure 45

11.3. (3) MOUNTING TIRE PROCESS USING AUTOMATED EQUIPMENT (INSTALLED WHEEL SENSOR):

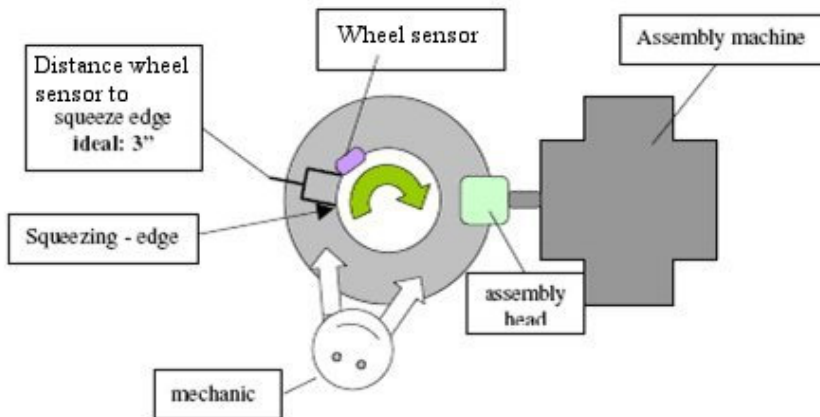


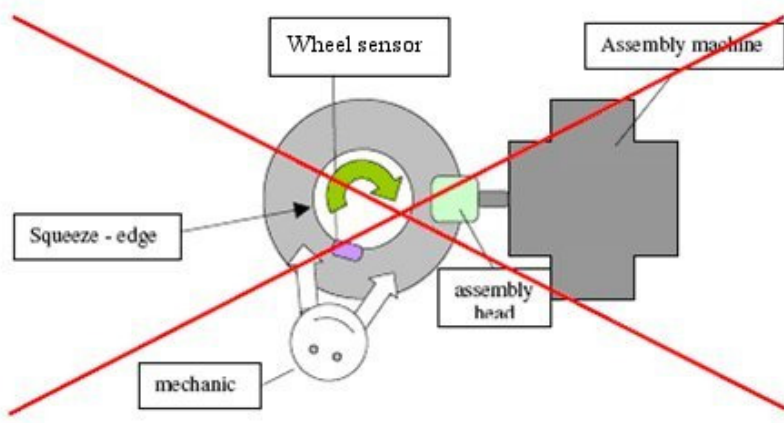
Figure 46

Figure 46 shows the top view of a typical assembly machine arrangement used for mounting tires. It is very important to prevent the wheel sensor from being stressed during the mounting process. Therefore, positioning the wheel sensor and performing the assembly routine has to be done in a way that the tire bead does not stress the wheel sensor.

In the configuration shown in Figure 46, the wheel sensor starting position is 10 o'clock. The assembly head is at the 3 o'clock position. The tire is applied to the rim by the mechanic in a way that the squeezing edge is 3" counter-clockwise away from the wheel sensor and the 1st tire bead is put into the drop center of the rim at the position where the mechanic is standing.

The assembly head is pulled downwards so the 1st tire bead is also pulled into the drop center of the rim in the assembly head region. Additional assembly aids may have to be used to prevent the squeezing edge from moving counter clockwise. The assembly machines turntable is now moved in a clockwise direction until the 1st tire bead is slipped fully over the wheel run flange. The region where the tire bead finally slips over the wheel run flange should be in the wheel sensor position area. This insures that there will be no tension on the tire bead when the tire bead passes the wheel sensor.

The 2nd tire bead should be mounted in the same as the 1st tire bead. With the wheel sensor starting position at 10 o'clock, mounting head at 3 o'clock – mechanic puts the 2nd tire bead into the drop center of the rim – then the assembly head is used to put the 2nd tire bead into the drop center at the assembly head region (additional assembly aids may have to be used to prevent the squeezing edge from moving counter clockwise) - the assembly machines turntable is now moved in a clockwise direction until the 2nd tire bead is slipped fully over the wheel run flange. For high volume fully automated in line production, the mechanic should be replaced by an automatic supply and positioning device.

**Figure 47**

As shown in Figure 47, the wheel sensor will be damaged. Starting the mounting process while putting the tire bead into the drop center at the wheel sensor mounting position will destroy the wheel sensor because the tension on the tire bead increases when finally slipping the tire over the wheel run flange. The beads high tension will apply a high amount of force to the wheel sensor housing. The housing of the wheel sensor will crack and the tire bead may be damaged.

**Figure 48 Possible Wheel Sensor Damage When Mounted as Shown in Figure 47**