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## Kia Soul: TPMS Sensor Mode of Operation



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### ASIC Mode

#### 1. Factory Mode

The factory mode is the mode that allows the TPM sensor to transmit RF Frames and sample LF more often in the HKMC factory. The TPM sensor will send normal RF frames in factory mode. LF sampling will occur every 1 second, to ensure a rapid response on the production line.

Figure 5 shows the state flow of the ASIC from Off mode through Factory mode to Non-Factory mode.

Factory mode is not a normal mode; it operates over the other customer visible modes to increase the LF sampling rates while the factory counter is not Zero.

On leaving Off mode the factory counter will be set to 15, each time the sensor moves from Service mode to stationary mode, the counter will be decremented.

After Factory mode has expired, the Factory\_LF command can be used to re-enter Factory mode, in which case the factory counter will be reset to 15.

If Factory mode is no longer required, it is possible to reset the factory counter, and therefore exit Factory mode by using the Exit\_Factory\_LF command.

During 10.8s mode, the sensor will transmit normal RF data frames every 10.8s. In case of high line sensor, the function code will indicate rotational direction.

Mode	Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
Factory	10.8	10.8	10.8	10.8

#### 2. Stationary Mode

In normal operation and while the vehicle is not moving the TPM Sensor will be in STATIONARY mode. In this mode sample and transmission rates are described below.

Mode	Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
Non-factory	60	60	15	-

Factory	60	60	15	-
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STATIONARY mode is excited when the vehicle begins to move and shock sensor input is verified by the ASIC.

### 3. AL/ALO Mode

Upon detection of motion, an Unknown / Normal function code is transmitted, then the sensor enters AL Mode (Auto Learn Mode) or ALO Mode (Auto Location Mode), depending on TPM sensor type (Lowline or Highline).

During AL mode, the sensor will continue to transmit Unknown/Normal function codes every 33 seconds for a duration of 16 RF Blocks ( 1 RF block = 4 RF frames).

During ALO mode the TPM sensor begins to determine which direction the sensor is rotating – clockwise or anticlockwise. For the first transmission after the Unknown / Normal function code, the data block will contain one of three function codes for ALO Mode. If the ASIC is unable to make a decision concerning rotational direction, then the sensor shall transmit an Unknown / Normal function code.

During AL/ALO Mode the shock sensors are sampled for motion, every 10.8 seconds. The pressure and temperature samples also occur every 10.8 seconds. The transmission rate and duration of AL/ALO Mode is set to a one block transmission (4 frames) rate every 33 seconds for a duration of 16 blocks. In ALO Mode rotational direction is acquired every 10.8 seconds. The transmitted function code is based on all ALO data since its last transmission.

The AL/ALO mode function flag will be set for the transmission of all valid AL/ALO frames.

If the speed of the vehicle drops below the stationary threshold and the sensor detects that there is no motion present, then AL/ALO Mode will be exited and Service Mode will be entered. If Service Mode exits due to detection of motion and AL/ALO Mode is re-entered then the AL/ALO Mode continues where it left off i.e. the total AL/ALO duration of 16 blocks is achieved regardless if Service Mode or Alert Mode has been entered during that AL/ALO Mode.

If a pressure change (Alert Mode) is detected in AL/ALO Mode and DP transmissions occur, AL/ALO Mode is suspended until the DP transmissions finish.

Sensors with ALO mode have 4 configurable options to optimize the WAL performance based on evaluation with the customer. Sensors supplied to Hyundai/Kia will have option 2 configured.

Mode	Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
Non-factory	10.8	10.8	10.8	33
Factory	10.8	10.8	10.8	33

### 4. Service Mode

Service Mode is the period when the TPM sensor has detected that the vehicle speed has dropped below the stationary threshold. During this period the pressure and temperature and motion samples occur every 15 seconds but there are no transmissions, the TPM sensor will only transmit on a pressure change, DP. The DP transmission will consist of two blocks (Total of 8 frames) of pressure information transmitted over a two second period. The duration of Service Mode is 15 minutes from when the TPM sensor has detected that there is no rolling detection. If during Service Mode rolling detection is detected again, the sensor will exit Service Mode and re-enter the mode it was previously in before it entered Service Mode, AL Mode or Normal Mode. Every time Service Mode is entered the 15-minute timer is reset. If Service Mode is exited before the Service Mode timer expires then the AL Mode counter will not be reset. Upon expiration of Service Mode the AL Mode counter is reset.

Mode	Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
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Non-factory	15	15	15	-
Factory	15	15	15	-

## 5. Rolling Mode

When AL Mode expires the TPM sensor enters Rolling Mode. In Rolling Mode the rate of transmissions and rolling detection sampling are decreased to once every 60s and the rate of pressure and temperature sampling occur every 15 seconds. For the first 16 blocks of transmissions after a drive begins the TPM sensor transmits the AL Mode function codes Clockwise, Anticlockwise or Normal/Unknown. After the 16 blocks of AL information have been transmitted, the TPM sensor will transmit the Normal/Unknown function code. If the speed of the vehicle drops below the stationary threshold and the TPM sensor detects that there is no rolling detection present, then Rolling Mode will be suspended and Service Mode will be entered.

On entry to Rolling mode the TPM sensor will sample pressure and do a normal RF transmission with a NORMAL/UNKOWN function code (see 4.1.1.5: Status Byte).

Mode	Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
Non-factory	15	15	60	60
Factory	15	15	60	60

When vehicle speed has dropped below minimum vehicle speed threshold, the sensor will remain in Rolling mode until the next scheduled rolling detection sample occurs. Once the rolling detection sample has confirmed the vehicle speed is below the threshold, the TPM sensor will enter Service Mode. After the Service Mode period has elapsed the TPM sensor will exit to STATIONARY Mode.

## 6. Alert Mode

In Stationary mode, Service Mode or Rolling mode, pressure is measured at intervals as described above. During the measurement routine the current pressure value is compared to the previous transmitted pressure value. If the current pressure sample differs by greater than 8 counts (>2 psi ) or more from the previous transmitted pressure value, a RE-MEASURE will occur immediately to ensure the sample is correct. If a delta P is confirmed the TPM Sensor will transmit immediately with an Alert status code. If the RE-MEASURE transmission occurs coincident with a regular transmission, the RE-MEASURE takes precedence and the regular transmission will be replaced by the RE-MEASURE transmission.

### (1) Stationary Alert Mode

While the sensor is in Stationary Mode, it shall transmit an instantaneous measured data frame, as defined in Section 4.1 of this document, if a pressure change of 2.0 psi from the last transmission or greater has occurred. All transmissions occurred due to a pressure change event shall have the Alert status code as specified in Section 4.1.1.5.6.

Stationary Alert mode will be exited if a change in pressure of 2.0p.s.i. or greater is not detected after 2 consecutive pressure samples.

Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
2 (max)	2 (max)	N/A	$\Delta P$

(2) While the sensor is in Rolling Mode, it shall transmit an instantaneous measured data frame, as defined in Section 4.1 of this document, if a pressure change of 2.0p.s.i. or greater from the last transmission or greater has occurred All transmissions occurred due to a pressure change event

shall have the Alert status code as specified in Section 4.1.1.5.6.

Rolling Alert mode will be exited if a change in pressure of 2.0p.s.i. or greater is not detected after 2 consecutive pressure samples.

Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
2 (max)	2 (max)	N/A	$\Delta P$

## 7. OFF Mode

This is a mode primarily used for shipping and storage of the TPM sensor units. When the sensor is de-energized (using the Enter\_Off LF command), it shall transmit one last transmission with the Off Mode function code then enter the Off Mode immediately. When the TPM sensor is in Off Mode, it shall continue sampling pressure and temperature at the rate specified in Table 13 of this document but it shall not transmit any transmission until the TPM sensor is re-energized again. The TPM sensor can be re-energized using the Normal LF command or when it detects a change in pressure of 19p.s.i. or greater.

Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
60(max)	60 (max)	-	-

## 8. RF Test Mode

The sensor must enter the RF Test Mode and provide the state code specified in 4.1.1.5.6 of this document upon the presence of an LF signal with the LF data command "Test\_LF" specified in Table 16 below.

The sensor must react (Transmit and provide data) no later than 700.0 ms after the LF data code has been detected. As soon as the sensor enters this mode it shall comply with all the sampling and transmission requirements specified in Table 14 of this document, regarding this specific mode independent of rotating, stationary, or service mode.

The sensor shall count the number of frames (each transmission contains four frames as shown in Table 15 of this document) it has transmitted since it entered this Mode, and this number shall be transmitted within the data in each frame as shown in Table 15 below.

The Data transmitted shall be in the format shown in Table 15 below. When the counter for the number of frames reach the value 255 (All of the 8 bits are used), the counter shall reset and restart again until the sensor exits this mode.

When the sensor exits this mode it shall clear the number of frames counter. The sensor shall exit this mode upon the presence of a Normal\_LF command as specified in Section 3.3.2 of this document.

The sensor shall start an eight hours timer from the moment it enters this mode and then shall exit this Mode immediately after the eight (8.0) hours' timer expires

Pressure Sample Rate (seconds)	Temperature Sample Rate (seconds)	Rolling detection Sample Rate (seconds)	Normal Tx Rate (Seconds)
15(max)	15(max)	15(max)	15(max)

RF Test Mode Data Structure = Fram 1 = Fram 2 = Fram 3 = Fram 4						
Preamble	H/L Bit	ID	Pressure	No. of Frames	Status	CRC
16 bits	1 bit	31 bits	8 bits	8 bits	8 bits	8 bits

## 9. Continuous Wave (CW) Mode

The TPM sensor must enter the specified CW Mode when it receives the appropriate LF data command ( CW\_Low\_LF or CW\_High\_LF ).

The TPM sensor must react (Transmit) no later than 200.0 ms after the LF data code has been detected. As soon as the sensor enters this mode it shall start transmitting the specified CW frequency (Carrier Wave Frequency) of the TPM sensor.

There are 2 CW modes available:

A. CW Low will transmit continuously at the lower FSK frequency.

B. CW High will transmit continuously at the upper FSK frequency.

The sensor shall exit this mode upon the presence of a Normal\_LF command.

The sensor shall start a four minutes timer from the moment it enters this mode and then shall exit this Mode immediately after the four (4.0) minutes timer expires.

## « [TPMS Sensor Description](#)

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## [TPMS Sensor Removal](#)

1. Remove the tire. (Refer to Tires/Wheels - "Tire") 2. Remove the screw with torx driver (A). ... »

See also:

### [Removal](#)

1. Remove the air cleaner assembly. G 1.6 GDI (Refer to Engine Mechanical System - "Air Cleaner")  
G 2.0 GDI (Refer to Engine Mechanical System - " ...

### [License Lamps Removal](#)

1. Disconnect the negative (-) battery terminal. 2. Remove the license lamp assembly (A) after loosening the mounting scre ...

### [CVVT & Camshaft Inspection](#)

Camshaft 1. Measure the height of the cam lobe using a micrometer and check the surface of the cam lob for wear and tear. If necessary, replace the camshaft. ...

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