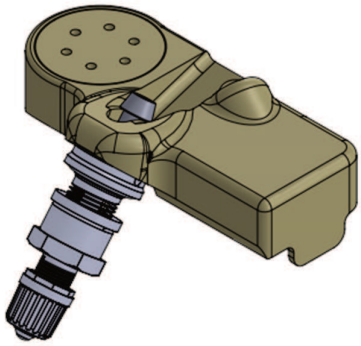
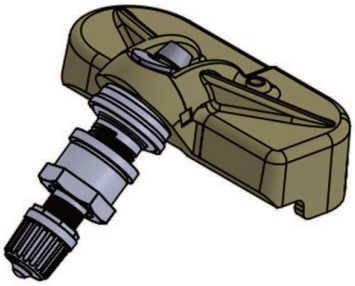
Texense TPMS-A system user guide





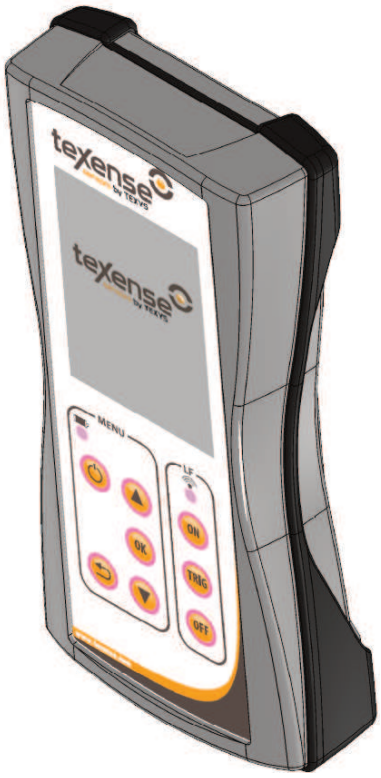


Table of contents

1. Introduction 3
System description 4
   A. TPMS-RH <-> TPMS-S or TPMS-RS 4
   B. TPMS-CR <-> TPMS-S or TPMS-RS 4
   C. Corner recognition on TPMS-CR 4
2. TPMS sensor 5
   A. Phase diagram 5
   B. Transition definitions 6
   C. Pressure thresholds 7
   D. Temperature thresholds 7
   E. Acceleration thresholds 8
   F. Transient mode thresholds 9
   G. Maximum stationary time 9
   H. Diagnostics 10
3. TPMS-RH remote controller 10
   A. Scanning page 11
   B. Data page 13
   C. Configuration page 15
   D. Configuration of TPMS-RH parameters 16
   E. Charging 18

Warning: all sensors provided by Texys are paired with a unique customer ID ensuring that data are not readable by other customers. Only Texys is able to change pairing of sensors.

1. Introduction

Texense provides TPMS system kits including TPMS-S or TPMS-RS sensor, car receiver and the remote handheld unit. This document presents information about TPMS behaviour and how to use the remote controller.

System description

A. TPMS-RH <-> TPMS-S or TPMS-RS

After unpacking, you should test each TPMS (S or RS) with the TPMS-RH controller. To do so, power the TPMS-RH and click on "ON" button with the remote controller close to (less than 60 cm) one or several sensors. Reachable sensors will wake up and display data. Four last digits of their serial number is displayed among data and permits identification of sensors.

B. TPMS-CR <-> TPMS-S or TPMS-RS

The TPMS-CR is the car receiver, its role is to forward data collected wirelessly to the CAN bus of the car. Each TPMS-CR has a ***Car ID***. This parameter should be unique per vehicle. It ensures that 2 different cars won't receive data of TPMS mounted on another car. ***Car ID*** can be set at the factory on customer's request or directly by the customer thanks to the Texense tSIB. To know the address of ***Car ID*** parameter, please refer to the Specification sheet delivered with the TPMS-CR.

After you chose and set up your ***Car ID*** on the TPMS-CR side, you should modify the ***CAR ID*** on the TPMS-S or TPMS-RS side. TPMS-RH must be used to modify a sensor's parameter. Please consult TPMS-RH remote controller scope for further help.

C. Corner recognition on TPMS-CR

TPMS-CR does not know which sensor will be mounted on which corner. For example, if you decided to mount the sensor with serial number SN20062020 on front left position, it will not be aware of it.
The corner setup is written on the sensors (TPMS-S or TPMS-RS) parameters. It is very important to modify ***Corner*** parameter of each TPMS-S or TPMS-RS to have consistent data on the CAN bus. The corner setup is done with TPMS-RH, with the same procedure as the ***Car ID***.

If the wheel has been fitted with a TPMS-S or TPMS-RS and you decided to change corner afterward, there is no problem, you can change corner parameter on fitted wheel with the TPMS-RH.

When the parameters ***Car ID*** and ***Corner*** is set up on all your TPMS-S or TPMS-RS. The TPMS-CR is ready to receive data. To test your setup with TPMS-CR, ensure the TPMS sensors are awake by pressing "ON" button of the TPMS-RH. You should see the same sensors on the TPMS-RH and the TPMS-CR except the TPMS-CR filters out TPMS with a different ***Car ID***.

2. TPMS sensor

In order to optimize the battery lifetime, a power management strategy is used that takes into account the environment of the sensor (acceleration, pressure, temperature).

A. Phase diagram

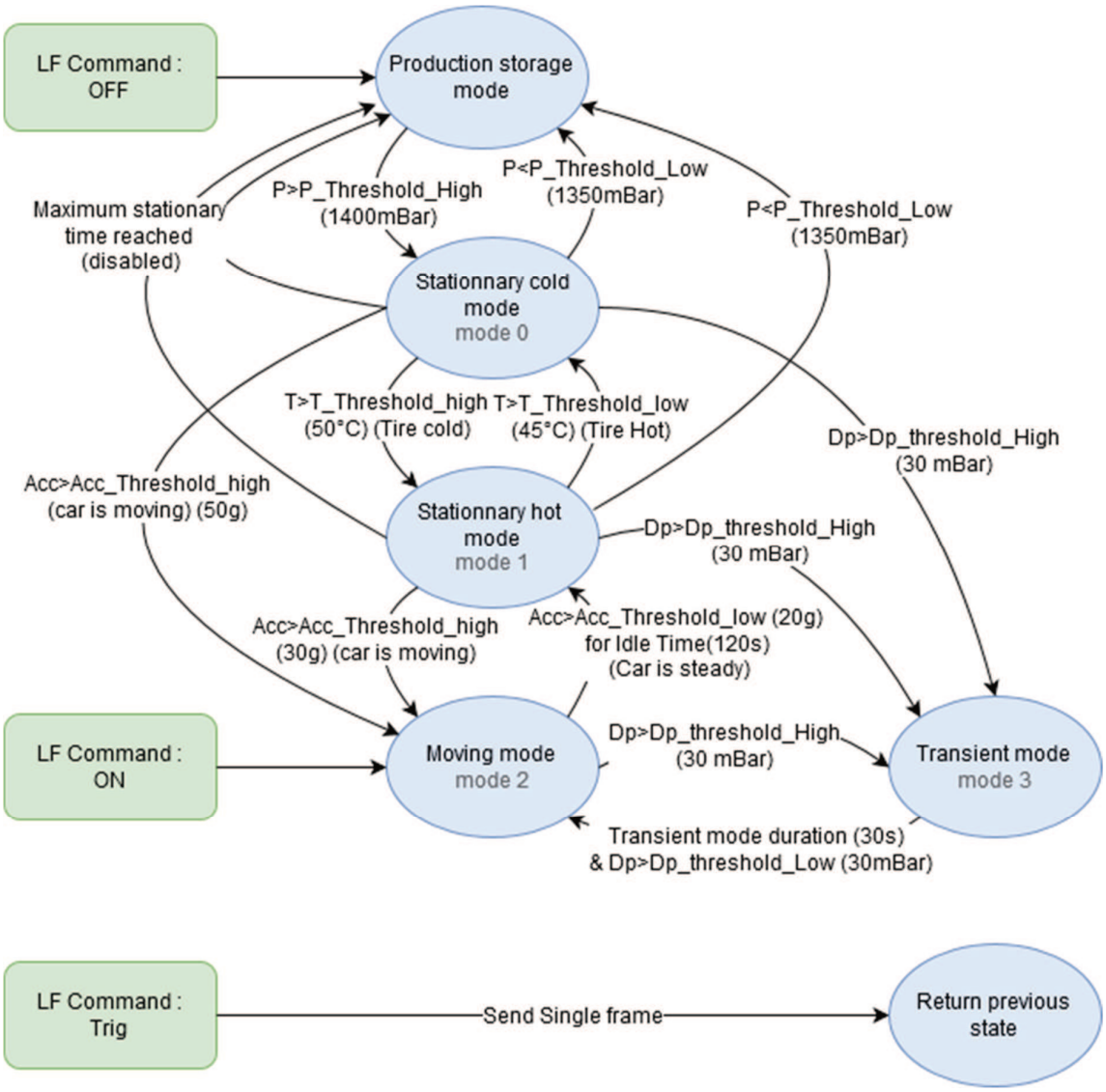


Figure 1: Power modes transitions, phase diagram

Power mode	Condition	Data sent (TPMS-RS)	Data sent (TPMS-S)
Storage	Deflated tyre	No Transmission	No Transmission
Stationary, cold wheel	Inflated tyre, no movement, Temperature <= 50°C	Every 10 seconds: P, BT	Every 60 seconds: P, BT, AT, RH
Stationary, hot wheel	Inflated tyre, no movement, Temperature > 50°C	Every 10 seconds: P, BT	Every 60 seconds: P, BT, AT, RH, RT, TT
Moving	Inflated tyre, movement, Temperature > 50°C	Every 1 second: P, BT	Every 1 second: P, BT, AT, RH, RT, TT
Transient	Puncture detected	Every 0.5 second: P, BT	Every 0.5 second: P, BT, AT, RH, RT, TT

Table 1: Power mode definition

Data acronym:

- **AT:** Air Temperature (TPMS-S only, with humidity option)
- **BT:** Board Temperature
- **P:** Pressure
- **RH:** Relative humidity (TPMS-S only, with humidity option)
- **RT:** Rim Temperature (TPMS-S only)
- **TT:** Tyre Temperature (TPMS-S only: 5 Infrared spots available amongst 14)

B. Transition definitions

(1) **Inflated tire:** Absolute pressure is higher than a ***High pressure threshold***. (default 1400mbarA (20.3PSI) ±100mbar for more than 6 minutes.)

(2) **Deflated tire:** Absolute pressure is less than a ***Low pressure threshold*** (default 1300mbarA (18.85PSI) ±100mbar for more than 1 minute.)

(3) **Car is moving:** At least one accelerometer axis is higher than ***High acceleration threshold***. (*default value= 50G).*

(4) **Car is steady:** accelerometer's 3 axis slopes lower than the ***Low acceleration threshold***. *(default value=25G)* for xx seconds where xx is the configurable ***inactivity timer*** *(default value=120s).*

(5) **Puncture detected:** the pressure variation is higher than ***Pressure variation threshold*** PSI/min *(default value=2.9PSI/min).*

(6) **Puncture timer elapsed:** a timer is launched when we enter the puncture mode. When the timer has elapsed after **Puncture timer** *(default value=30s)*, this condition becomes true.

All thresholds and parameters in bold are user-configurable thanks to the remote controller. They can also be set in factory upon customer request.

C. Pressure thresholds

Pressure thresholds are meant to switch sensors OFF, as soon as no pressure has been detected. This mode is intended to be used when the wheels are stacked and not used.
There are two thresholds:

- The ***pressure high threshold*** determines when a sensor will switch from Storage state to Stationary cold state.
- The ***pressure low threshold*** determines when a sensor will switch from Stationary cold state or Stationary hot state to Storage state.

User can modify the threshold values with the TPMS-RH to match with his inflation pressure. You must **always** have ***Pressure high threshold*** > ***Pressure low threshold***. Otherwise, the sensor will send a wrong parameter diagnostic bit and will stay on Moving mode to prevent data loss.

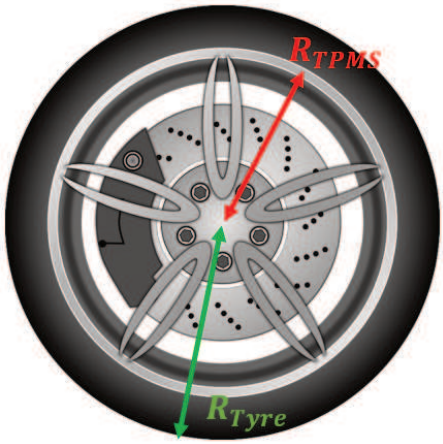
D. Temperature thresholds

Temperature thresholds are used to switch between Stationary cold and Stationary hot modes. There is no difference in behaviour between these two modes for TPMS-RS, but they are used to keep consistency with TPMS-S behaviour. For TPMS-S, the sensor will send only restricted data on Stationary cold mode, whereas it will send all data on Stationary hot mode. Please refer to Table 1: Power mode definition for further information.

Stationary hot mode is meant to be entered when the wheels are steady in the oven or under a blanket, ready to be mounted. Temperature thresholds should be modified to fit his pre-heating temperature.
You must **always** have ***Temperature high threshold*** > ***Temperature low threshold***. Otherwise, the sensor will send a wrong parameter diagnostic bit and will stay on Moving mode to prevent data loss.

E. Acceleration thresholds

Sensors monitor acceleration value to detect when the race starts. This is used to enter the higher consumption mode, which provides more data. The main acceleration the sensor endures is the centrifugal acceleration. It can be calculated depending on wheel radius and wheel speed:



$$Acceleration = \frac{Speed^2}{9.81} . \frac{R_{TPMS}}{{R_{Tyre}}^2}$$

With Speed in m/s, radius in m and acceleration in g.

Or:

$$Acceleration = \frac{Speed^2}{127.1} . \frac{R_{TPMS}}{{R_{Tyre}}^2}$$

With Speed in km/h, radius in m and acceleration in g.

Or:

$$Acceleration = \frac{Speed^2}{49} . \frac{R_{TPMS}}{{R_{Tyre}}^2}$$

With Speed in mph, radius in m and acceleration in g.

Example:

$R_{TPMS} = 0.21m \qquad R_{Tyre} = 0.28m$

Start speed: 30km/h

$$Acc\_high\_threshold = \frac{30^2}{127.1} . \frac{0.21}{0.28^2} = 19g$$

Stop speed: 15km/h

$$Acc\_low\_threshold = \frac{15^2}{127.1} . \frac{0.21}{0.28^2} = 5g$$

The sensor will quit moving state if measured acceleration is lower than ***Acceleration low threshold*** for ***Inactivity timer*** duration.

You must **always** have ***Acceleration high threshold*** > ***Acceleration low threshold***. Otherwise, the sensor will send a wrong parameter diagnostic bit and will stay on Moving mode to prevent data loss. The ***Acceleration low threshold*** should not be lower than 5g to ensure that noise measurement will not prevent power mode transition.

F. Transient mode thresholds

Transient mode is intended to provide more data in case of puncture. To do so, TPMS monitor pressure variation between each sample. If pressure variation is higher than ***Dp threshold high***, the sensor will go to transient mode for the ***Transient mode duration***. If the pressure variation threshold is reached while in Transient mode, the time counter will restart from zero to maintain transient state longer.

G. Maximum stationary time

In some case, wheels are not deflated after a race and sensor will stay on Stationary state as long as they are not manually pulled off with TPMS-RH. User can define a maximum duration for the stationary state to preserve battery in case the TPMS are forgot on and pressured. This feature is disabled by default (***Maximum stationary timer*** is zero, meaning it is disabled).

If this feature is used and a sensor goes to storage state while inflated there are two means to wake up the sensor:

- **Send "ON" signal with TPMS-RH.**
- **Deflate tyre under *Pressure low threshold* for 10 minutes, inflate it back, higher than *Pressure high threshold*, and wait again 10 minutes.**

H. Diagnostics

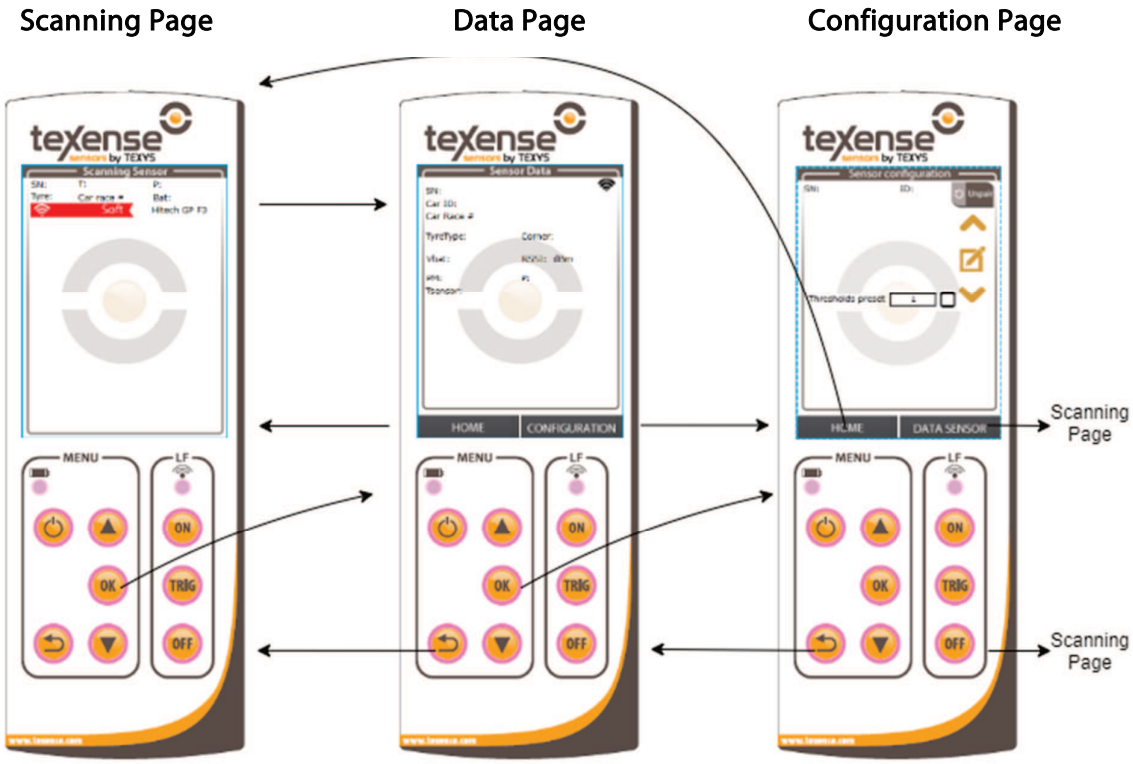
Two bytes are sent by TPMS-S and TPMS-RS to help troubleshooting. The **StartDiag** byte enables to know the reason why a sensor woke up. The description of this byte is available in TPMS-CR Specification sheet.

The **Diagnostic** Byte warns user of important error.

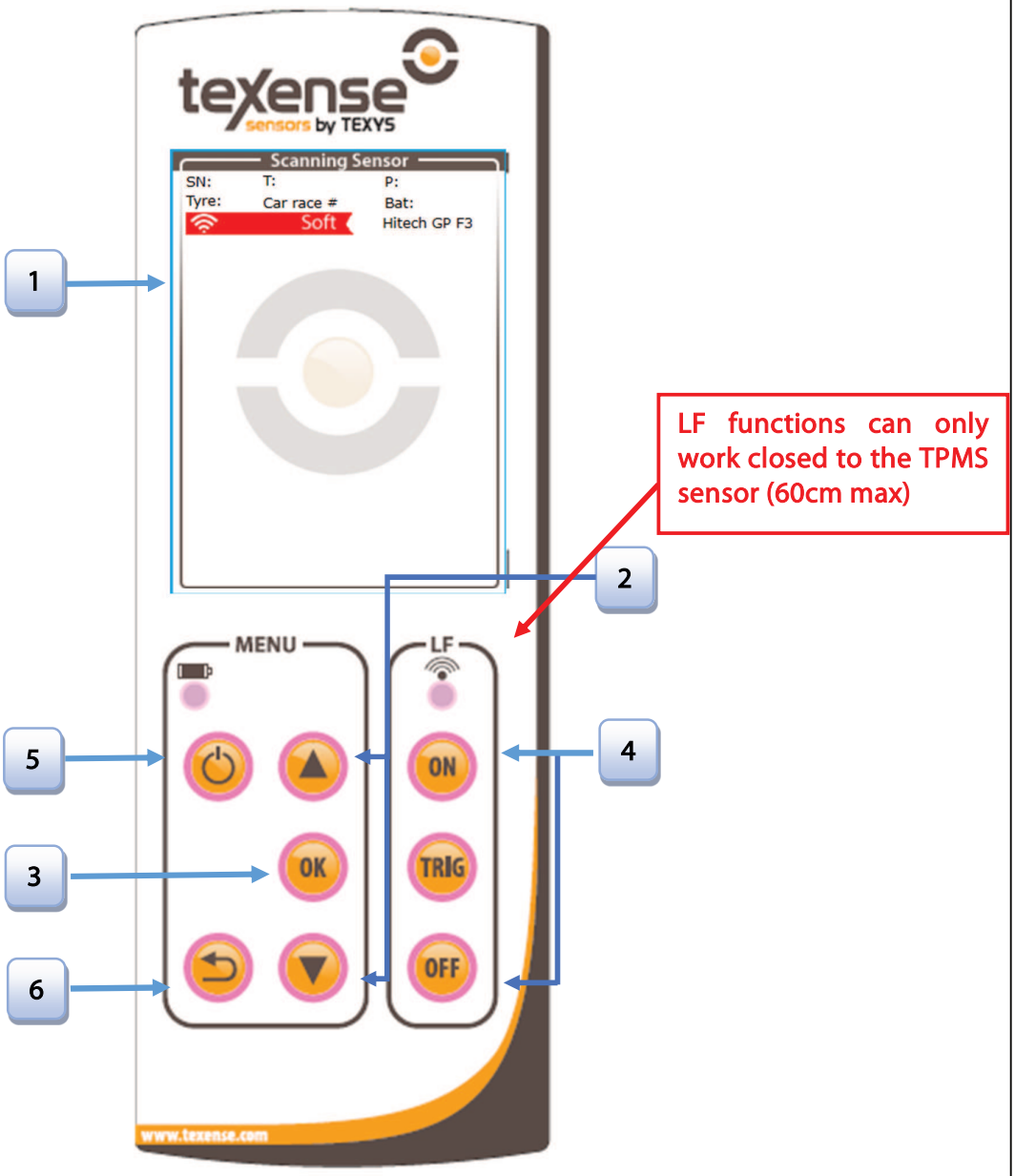
- ***Invalid parameters*** bit is set if the parameters set by the user is not consistent. The user must check that each high threshold value is higher than corresponding lower value with the TPMS-RH.
- Other failure code means there is a hardware failure on the TPMS. User can try to restart the sensor with the TPMS-RH to remove the error.

If one bit of ***Diagnostic*** Byte is set, the sensor will stay in moving mode to prevent data loss.

3. TPMS-RH remote controller



A. Scanning page



Two methods are available to access the data mode of a sensor:

1. Either with the touch screen:

1 Clicking on a "sensor" line in the drop-down list allows access to the sensor data mode.

2. Or with the buttons:

2 These buttons allow to go up and down in the drop-down list.

3 This button validates the choice of sensor in the drop-down list and allows to access to the data sensor page.

4 These buttons turn the team sensors ON and OFF. The "ON" button turns on all the sensors present around the remote control and belonging to the team. The OFF button turns off the sensor highlighted in the list.

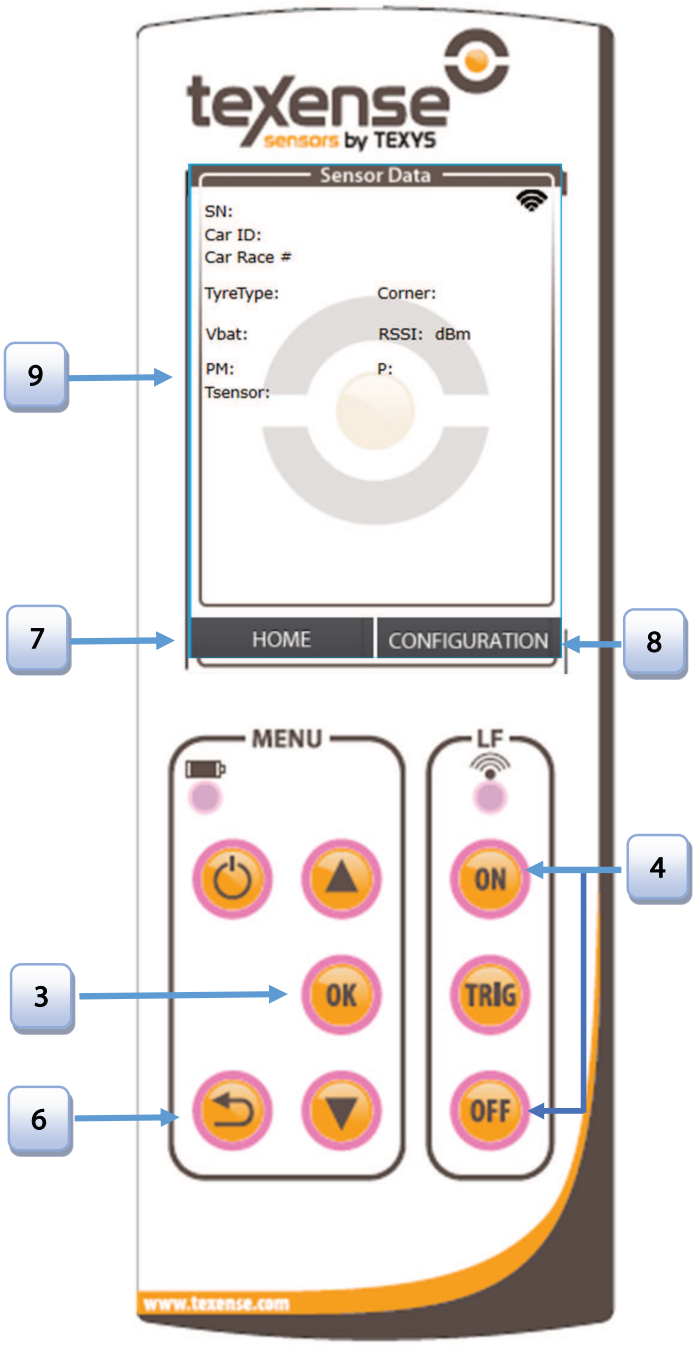
5 This button turns the remote control on or off. A short press turns off the remote controller. It is possible to force a hardware shutdown by pressing a long OFF.

6 This button clears and refreshes all the data in the sensor list.

** Each line displays five parameters regarding the sensors:*

- *The corner: corresponding to the position of the sensor.*
- *The serial number of the sensor.*
- *Team ID of the sensor.*
- *Tire pressure in absolute mBar by default.*
- *The remaining battery of the sensors (in % for TPMS-S and in V for TPMS-RS).*

B. Data page


teXense
sensors by TEXYS
Sensor Data
SN:
Car ID:
Car Race #
TyreType:
Corner:
Vbat:
RSSI: dBm
PM:
P:
Tsensor:
HOME
CONFIGURATION
MENU
LF
ON
TRIG
OFF
OK
9
7
8
4
3
6
www.texense.com

The sensor displays:

- The serial number.
- CarID.
- The temperature of the sensor (in ° C).
- VBat (in % and V for TPMS-S and in V for TPMS-RS).
- The absolute pressure (in mBar).
- The power mode.

Many functions are available:

1. Either with the touch screen:

7 This button allows to go back in Scanning Mode menu.

8 This button allows to go to the sensor configuration menu.

9 This area displays the sensor data.

2. Or with the buttons:

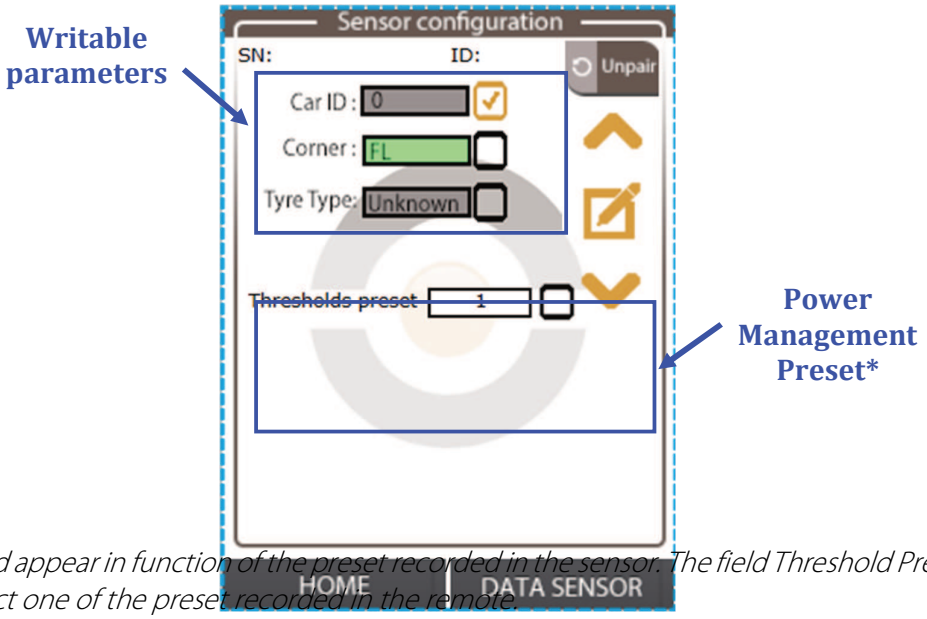
4 These buttons allow to wake up or turn off only the current sensor.
if the sensor successfully falls asleep, then the remote control returns to the main menu

6 This button allows to go back in Scanning Mode menu.

3 This button allows to get the data of the current sensor selected.

C. Configuration page

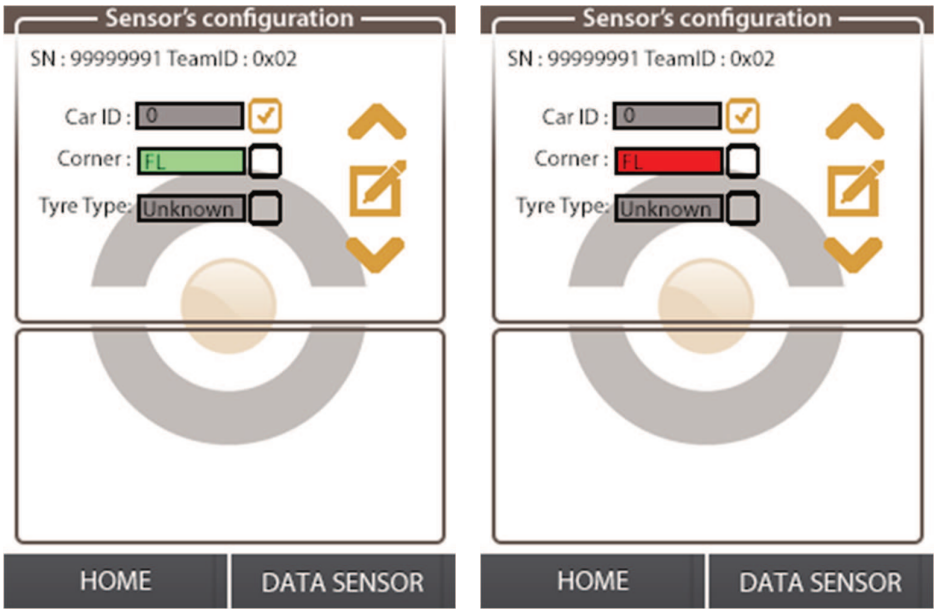
This page is intended to read and write TPMS sensor parameters.



* *A field appear in function of the preset recorded in the sensor. The field Threshold Preset allows to select one of the preset recorded in the remote.*

More parameters will be available in the final version. Acceleration, pressure and temperature thresholds will be fully configurable in this screen in addition to parameters already available. In this menu, you will also be able to configure which infrared spots you want amongst the 14 available.

The field appear in green if the writing procedure is successful or red if it failed.



Write OK **Write failed**

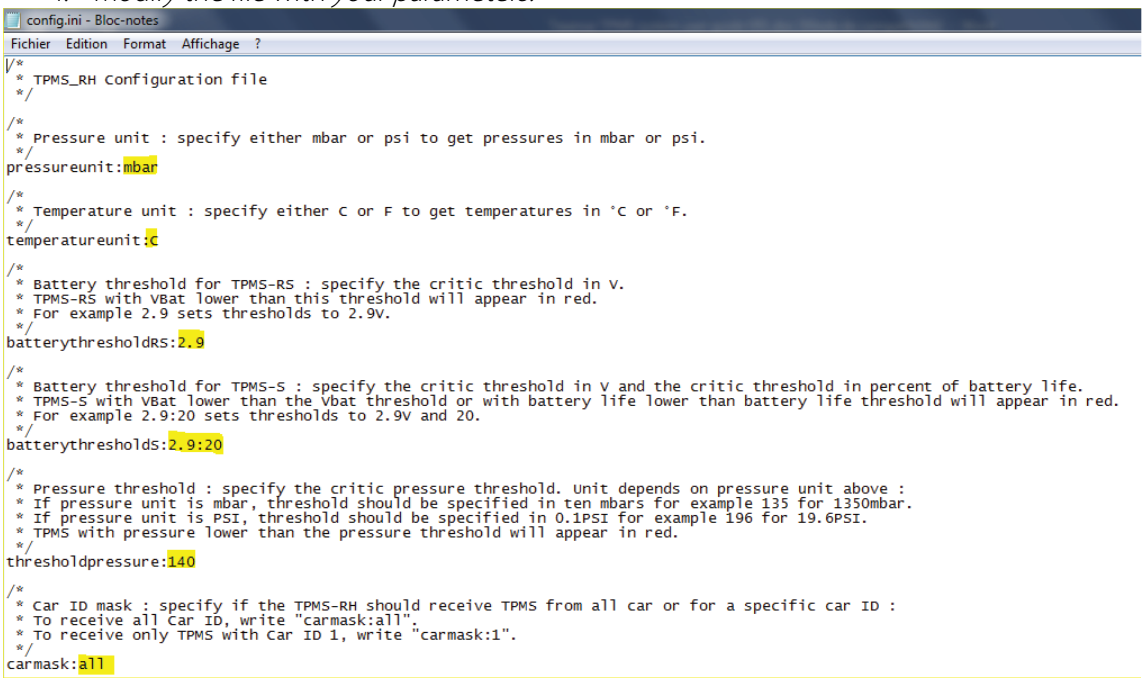
Warning: The writing operation uses LF functions so it is necessary to be close to the tyre (60cm max) to have this functionality working.

D. Configuration of TPMS-RH parameters

The remote controller can be configured through USB. It is seen as a USB storage device when you connect it through the USB port. In this USB storage device, an editable file called "config.ini" allows to change the configuration of the remote control.

Warning: *It is highly important to follow the following procedure to connect through USB:*

1. *Turn OFF the remote controller.*
2. *Connect it to a computer through USB.*
3. *Open the config.ini file*
4. *Modify the file with your parameters:*



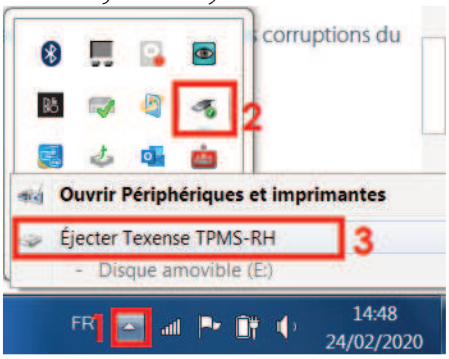
```
/* Power Mode Threshold :
 *              Preset #1 */
PWR_Mode_Preset_1.Pressure:1400,1350
PWR_Mode_Preset_1.Acceleration:50,25
PWR_Mode_Preset_1.Temperature:50,45
PWR_Mode_Preset_1.Puncture_threshold:30
PWR_Mode_Preset_1.Transient_mode_duration:30
PWR_Mode_Preset_1.Auto_sleep_time:0
PWR_Mode_Preset_1.Idle_timeout:120


/* Power Mode Threshold :
 *              Preset #2 */
PWR_Mode_Preset_2.Pressure:1400,1350
PWR_Mode_Preset_2.Acceleration:50,25
PWR_Mode_Preset_2.Temperature:50,45
PWR_Mode_Preset_2.Puncture_threshold:30
PWR_Mode_Preset_2.Transient_mode_duration:30
PWR_Mode_Preset_2.Auto_sleep_time:0
PWR_Mode_Preset_2.Idle_timeout:120


/* Power Mode Threshold :
 *              Preset #3 */
PWR_Mode_Preset_3.Pressure:1400,1350
PWR_Mode_Preset_3.Acceleration:50,25
PWR_Mode_Preset_3.Temperature:50,45
PWR_Mode_Preset_3.Puncture_threshold:30
PWR_Mode_Preset_3.Transient_mode_duration:30
PWR_Mode_Preset_3.Auto_sleep_time:0
PWR_Mode_Preset_3.Idle_timeout:120


/* Power Mode Threshold :
 *              Preset #4 */
PWR_Mode_Preset_4.Pressure:1400,1300
PWR_Mode_Preset_4.Acceleration:25,12
PWR_Mode_Preset_4.Temperature:50,45
PWR_Mode_Preset_4.Puncture_threshold:30
PWR_Mode_Preset_4.Transient_mode_duration:30
PWR_Mode_Preset_4.Auto_sleep_time:0
PWR_Mode_Preset_4.Idle_timeout:120
```

5. *Save the file*
6. *Close the file*
7. *Please eject safely the device:*



8. *Turn OFF the remote controller*
9. *Disconnect physically the remote controller*
10. *Turn ON the controller **without** the USB connection.*

When under the thresholds, the values are displayed in red characters on the screen.

E. Charging

It is possible to charge the remote control by plugging the provided USB type B cable. The full charge time is around 4 hours. Battery lifetime in nominal condition is around 5 hours.