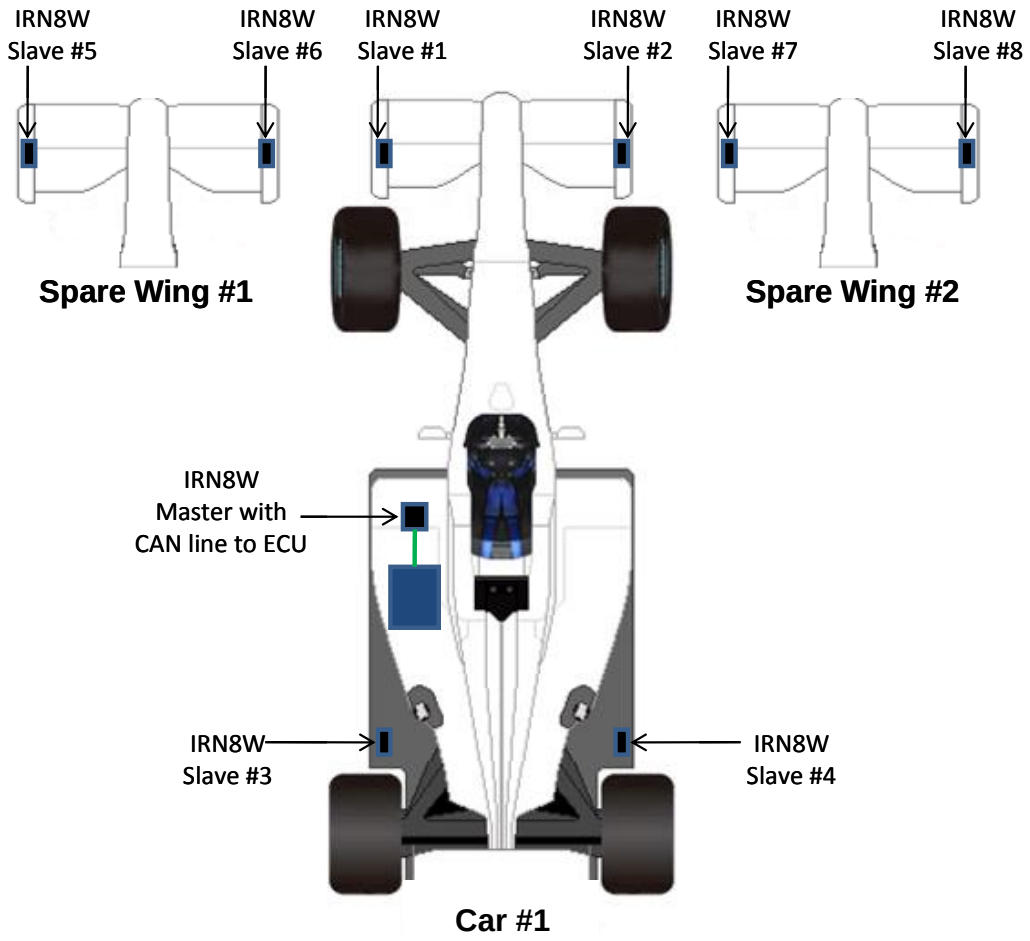
IRN8WS4 User Guide

1. System contents

IRN8WS4 wireless system includes the following components:

- 1 x Master box GenWM.
- Up to 22 slave sensors.

The system is designed in order to get a car full equipped for tires temperature measurement, including spare wings:



2. Installation recommendation

In order to reach the best performances for radiofrequency communication, we do recommend taking into account the following recommendations:

- Both master box and slave sensors should be attached in a place where there is as less as possible shield between antennas and air.
- Both master box and slave sensors should not be attached above a metal plate.
- If possible, it is recommended to not have any metallic parts closer than 20cm from both master box and slave sensors.

The recommended torque for the fixation holes is 1N.m.

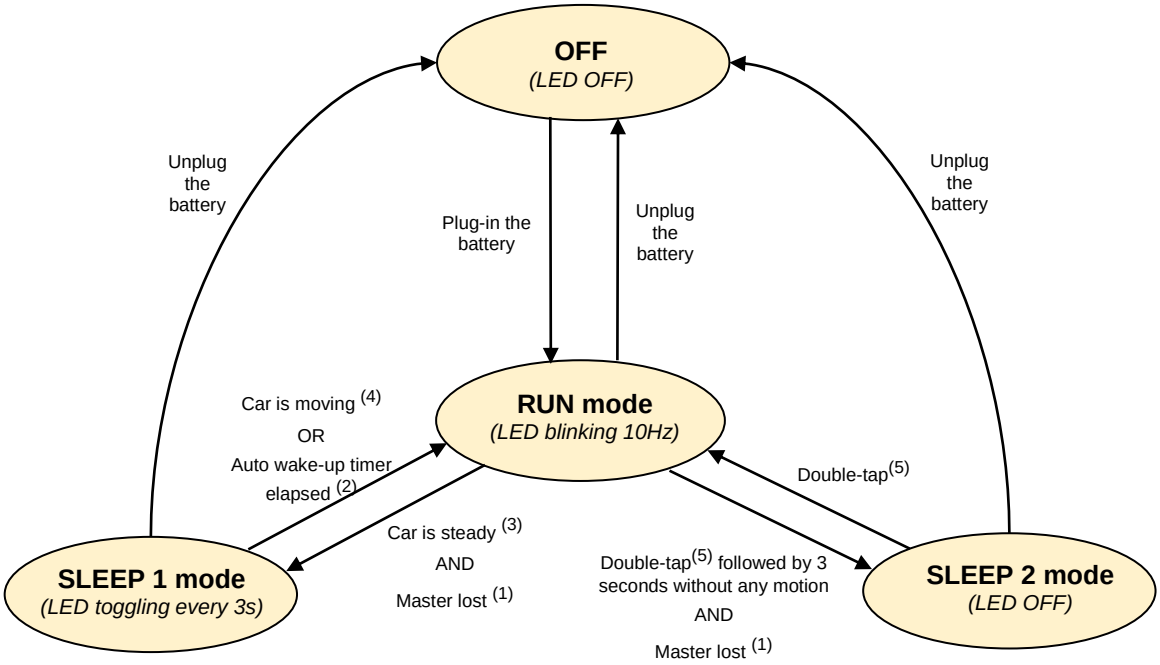
3. Running the system

- Master box has to be connected and powered (see also specification sheet for pinout and operating voltage).
- When switching ON the master box, CAN data should be received (see also CAN communication chapter).
- For a slave sensor, switching ON and OFF is performed thanks to a power management algorithm that includes radiofrequency and accelerometer information (please refer to power management chapter for further details).
- When one or more slave sensors are switched ON from a sleep mode, RF connection should occur in less than 1 minute and the system should run providing data on CAN bus.
- When switching ON a Slave sensor, a red LED should blink. Blinking frequency is :
    - 1Hz when the sensor is woken-up without RF communication.
    - 10Hz when RF communication is active.
- In addition, each slave sensor uses a 3-axis accelerometer for detecting the car state (steady or moving) and the double-tap request.

4. Power management

- Slave sensors are provided with a 400mAh primary battery.
- Batteries should be replaced when voltage drops below **3V.**
- Power saving is performed by using different sleep modes.

4.1 General state machine



(1) Master lost : No master was found for more than 40 seconds

(2) Auto wake-up timer: xx minutes elapsed, with xx selectable between 2 and 60 minutes.

(3) Car is steady: 40 seconds elapsed with accelerometer's 3 axis slopes lower than 0.5G (default value).

(4) Car is moving: At least one accelerometer axis is higher than 0.75G (default value).

(5) Double-tap: Double shock on any axis (default threshold/time: 1G/250ms).

General current consumptions:

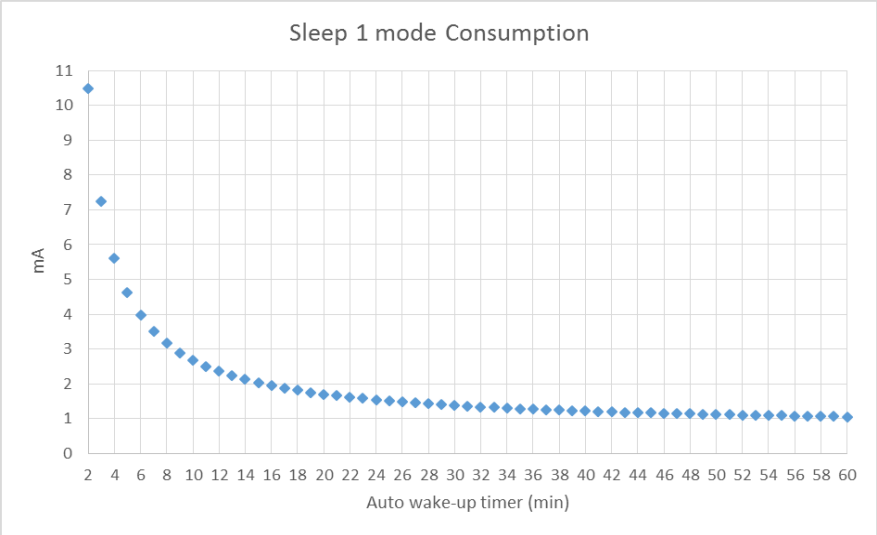
State	Led pattern	Consumption
OFF	OFF	No consumption
SLEEP 2 mode	OFF	600 µA
SLEEP 1 mode (including auto wake-up phases)	Toggling every 3 sec	Please see Sleep 1 mode explanation
RUN mode (emission 10Hz) :	Blinking at 10Hz	9 mA
RUN mode (waiting for RF connection) :	Blinking at 1Hz	30 mA

Auto wake-up timer:

Every 5 minutes (default value selectable from 2 to 60), the system wakes up to see if a master is available in the RF field. If yes, it considers that the master is found and enters Run mode.

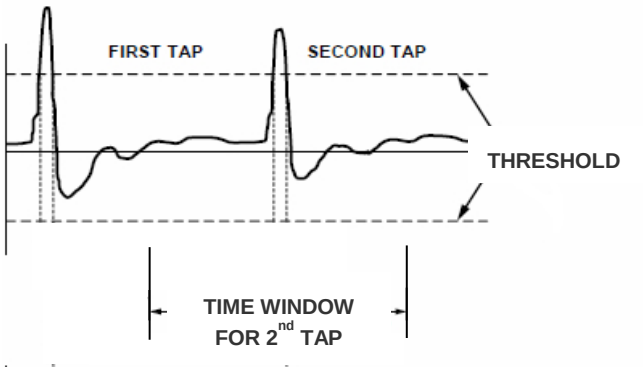
Sleep 1 mode consumptions:

Sleep 1 mode consumption is highly dependent on selected auto wake-up timer. The law between average consumption and the timer is:



Double-tap definition:

Double-tap detection takes into account a threshold AND a time window. The acceleration must comply with the following specific shape:



Note: For all parameters, please refer to IRN8WS4 specification to know which values are set on your device and which parameter number is concerned. Please refer to §9.2 to know how to modify the default values of threshold and time.

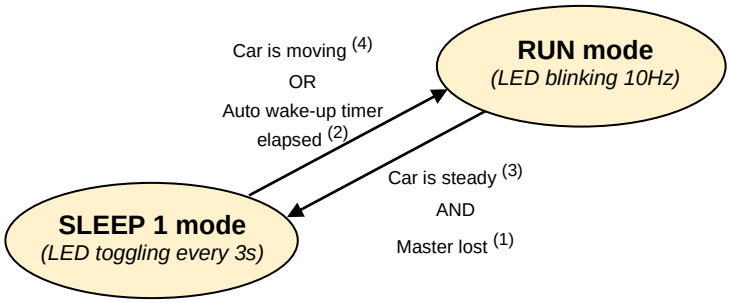
4.2 Particular state machines

It is possible to force to true or wrong some transition conditions by using extremum values:

- Setting the **Accelerometer double-tap threshold** set to maximum (**7750 mG**) will force the double-tap condition to false.
- Setting the **Accelerometer idle threshold** set to maximum (**3985 mG**) **AND Accelerometer wake-up threshold** set to minimum (**0 mG**) will force the condition "Car is steady" to false and "Car is moving" to true.
- Setting the **Accelerometer idle threshold** set to maximum (**3985 mG**) **AND Accelerometer wake-up threshold** set to maximum (**3985 mG**) will force the condition "Car is steady" to true and "Car is moving" to false.

Using these particular transition conditions, we can generate 5 particular state machines:

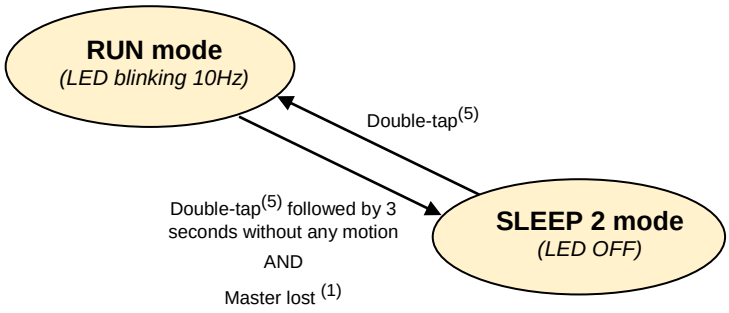
1. Particular state machine n°1:
    - **Accelerometer double-tap threshold** set to maximum (**7750mG**).



Noticeable behaviour:

- While the master stays powered, the slave never enters Sleep 1 mode. This is a good security mechanism to avoid unintentional sleeping.
- But you need to power down the master when not using the slave, otherwise the battery will be drained uselessly.
- The sleep 2 mode is not available.

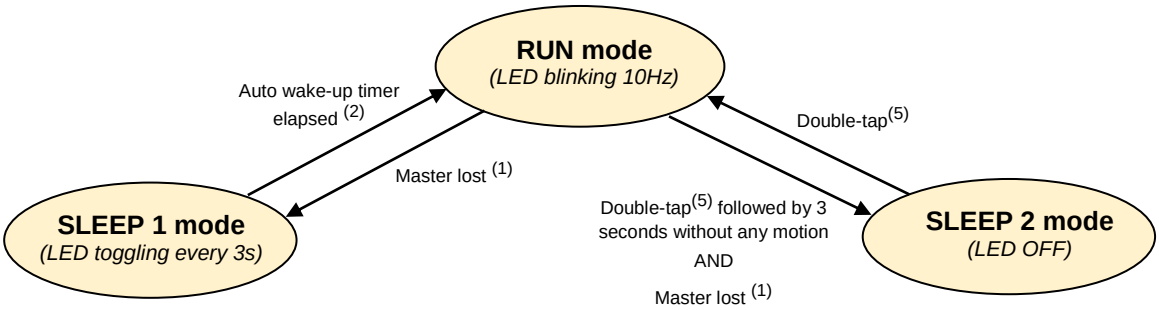
2. Particular state machine n°2:
    - **Accelerometer idle threshold** set to maximum (**3985 mG**)
    - **AND Accelerometer wake-up threshold** set to minimum (**0 mG**).



Noticeable behaviour: The sleep 1 mode is not available.

3. Particular state machine n°3:

   - **Accelerometer idle threshold** set to maximum (**3985 mG**)
   - **AND Accelerometer wake-up threshold** set to maximum (**3985 mG**)

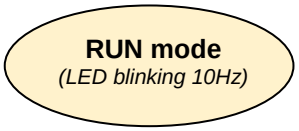


Noticeable behaviour:

- While the master stays powered, the slave never enters Sleep 1 mode. This is a good security mechanism to avoid unintentional sleeping.
- But you need to power down the master when not using the slave, otherwise the battery will be drained uselessly.
- No move conditions are used for entering and leaving sleep 1 mode (only master presence condition).

4. Particular state machine n°4:

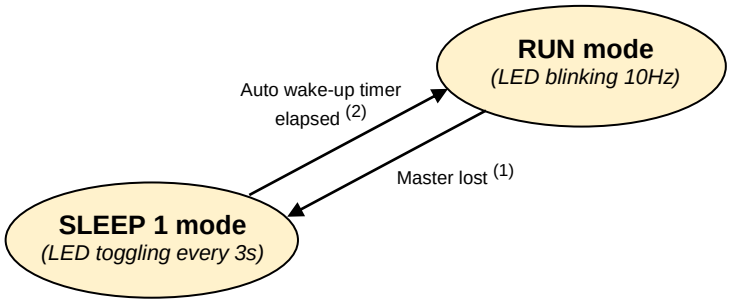
   - **Accelerometer double-tap threshold** set to maximum (**7750mG**)
   - **AND Accelerometer idle threshold** set to maximum (**3985 mG**)
   - **AND Accelerometer wake-up threshold** set to minimum (**0 mG**).



Noticeable behaviour: The system always runs.

5. Particular state machine n°5:

   - **Accelerometer double-tap threshold** set to maximum (**7750mG**)
   - **AND Accelerometer idle threshold** set to maximum (**3985 mG**)
   - **AND Accelerometer wake-up threshold** set to maximum (**3985 mG**)



Noticeable behaviour:

- While the master stays powered, the slave never enters Sleep 1 mode. This is a good security mechanism to avoid unintentional sleeping.
- But you need to power down the master when not using the slave, otherwise the battery will be drained uselessly.
- The sleep 2 mode is not available.
- No move conditions are used for entering and leaving sleep 1 mode (only master presence condition).

5. RF Communication.

5.1 Overview.

5.1.1 RF Frequency

The system is configurable for being used in 868MHz, 902MHz or 920MHz frequency bands. As a general guideline, 868MHz is dedicated to Europe when 902 and 920MHz are dedicated to Americas and Asia-Pacific. Both master box and slave sensor uses RF transceivers that are suited for systems targeting compliance with EN 300 220 (Europe) and FCC CFR Part 15 (US). Nevertheless, approval for the finished product is not yet performed. Therefore, prior to use the system in any country, we do recommend checking for local regulation.

RF Frequency can be set by end user on master side (please refer to master specification sheet). Whatever the RF frequency is, any slave will be able to synchronize by scanning automatically all bands without any configuration change.

5.1.2 RF pairing

When delivering a system, we provide a master box paired with up to 22 slave sensors. The pairing mechanism is based on 3 parameters:

- **Customer ID:** this ID is factory set and cannot be changed by the end user. This prevents from any interference between end users.
- **System ID**: this is the ID of a whole system including one master and up to 22 slaves. The system ID must be the same for the master and all its slaves. So special care must be taken regarding this parameters. In fact, using a same system ID for 2 different systems will result in interferences between the 2 systems. The end user can use simultaneously up to 16 different systems.
- **Slave ID**: This ID is dedicated to discriminate and identify the slaves. The end user can use simultaneously up to 22 slaves. Depending on CAN data frequency used, this number can be reduced (please refer to configuration section).

5.1.3 RF anti-collision mechanism

In order to deal with several systems in the same area, the system uses a channel jump mechanism. There are 5 channels shared with 3 different channel jump sequences.

The channel jump sequence can be configured by the end user (please refer to configuration section). In order for a team to get several cars communicating easily in the same box, we recommend:

- to have a different channel jump sequence for each car.
- to have the same channel jump sequence for a whole system (a master and its paired slaves would have the same channel jump sequence).

Note: About channel jump sequence, we can advise customer regarding the best option to choose when ordering the system, depending on its application.

6. CAN communication

- CAN bus can run according to Bosch's CAN 2.0A or 2.0B specification. The CAN type A or B is configurable (please refer to GenWM datasheet).
- Data is available on the CAN bus according to 2 mechanism :
    - Standard mechanism: each data is classically defined by the CAN frame ID.
    - Multiplexed mechanism. In this case, one single CAN frame ID is used for up to 22 slaves. The frame itself contains other IDs to discriminate the data and the slave.

  The mechanism is configurable, please refer to GenWM datasheet for more information.
- Data received by RF from any slave sensor, is converted to CAN frames and provided to ECU by master box. The frames contain temperature measurements, battery voltage, sensors internal temperature and a free running counter (please refer to master specification sheet for CAN IDs and data formatting).
- If there is no slave sensor running around, master box will only provide the CAN frame dedicated to free running counter.
- Even if the system is sized for up to 22 slave sensors, CAN frames dedicated to pressure measurement are sent only if data are received by RF. So the bus will be loaded only with consistent data.

7. Data rate

The end user can select between 2 data rate modes: the mono-frequency and the multi-frequency modes. This feature can be changed on master side (please refer to master specification sheet). The term “frequency” here defines the measurement refresh rate as it will appear on the CAN bus.

7.1 General information

The master GenWM is a generic master and can work with multiple slave sensors. Moreover, it is possible to mix the slave types (pressure sensors, temperature sensors, torque sensors…). As all slave types don’t work at the same frequency, it is important to understand the behaviour of the whole RF system.

7.1.1 Mono-frequency mode

In this mode, all the slave measurements are triggered with the configured frequency but the number of possible slaves to use is limited and depends on the chosen frequency:

- If configured to 100Hz, only 3 slaves can be used (slave IDs 1 to 3). All other slave IDs will be ignored.
- If configured to 50Hz, only 6 slaves can be used (slave IDs 1 to 6). All other slave IDs will be ignored.
- If configured to 10Hz, all the 22 slaves can be used (slave IDs 1 to 22)
- If configured to 1Hz, all the 22 slaves can be used (slave IDs 1 to 22)

7.1.2 Multi-frequency mode

In this mode, all the slave measurements are not triggered with the configured base frequency. The system will work as follow:

- If configured to 100Hz :
  - 2 slaves will work at 100Hz (IDs 1 and 2).
  - 10 slaves will work at 10Hz (IDs 3 to 12).
- If configured to 50Hz :
  - 4 slaves will work at 50Hz (IDs 1 to 4).
  - 10 slaves will work at 10Hz (IDs 5 to 14).

7.2 Specific case of the IRN8WS4

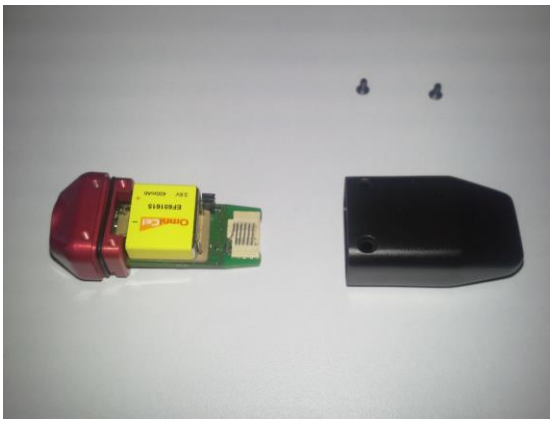
As the IRN8WS4 maximum frequency is 10Hz, the GenWM master configuration must be one of the following:

- Master mode “Mono-frequency mode”: in this case the master must be configured at 10Hz maximum. The IRN8WS4 must have a slave ID between 1 and 22
- Master mode “Multi-frequency mode”: in this case, there are 2 sub-cases :
  - If configured at 100Hz, the IRN8WS4 must have a slave ID between 3 and 12
  - If configured at 50Hz, the IRN8WS4 must have a slave ID between 5 and 14

8. Replacing batteries on sensors.

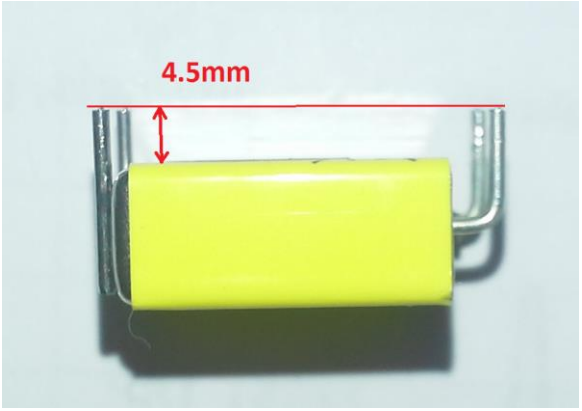
1. Remove the 2 hexagonal screws:

2. Remove the cover:



3. Remove the battery:

4. Modify the pins of the new battery (reference EF651615). Cut the pins to leave only 4.5mm pin length:



5. Plug the new battery and do the opposite step. The recommended torque for the 2 screws is 1N.m.

Note: After plugging the new battery, the system will automatically start and the led will blink showing the system is running. To avoid useless consumption, please enter the desired sleep mode.

9. Changing parameters.

Many parameters can be configured by the end user. A CAN protocol is available for the end user to modify the parameters: the "Texense's CAN protocol". Texense can provide this protocol on request.

9.1 Master GenWM configuration

The master parameters are basically:

- System ID
- CAN type
- data frequency
- RF band
- ...

Please refer to GenWM datasheet to see all available master parameters.

To modify a parameter, simply use the Texense's CAN protocol.

9.2 Slave IRN8WS4 configuration

The slave parameters are basically:

- Slave ID
- System ID
- wake-up and sleep acceleration thresholds
- …

Please refer to IRN8WS4 datasheet to see all available slave parameters.

To modify a parameter, you must first establish a "configuration" RF connection between the slave and the master then you can use the Texense's CAN protocol. To do this:

- **Step 1:** Power on only one master.
- **Step 2:** Execute the first 2 commands of Texense's CAN protocol:
  - "ID request" command (0x10). At this step, the master will stop to send CAN data.
  - "setup mode" command (0x20).
- **Step 3:** Power on or wake up the slave to configure. It doesn't matter whether the slave was previously paired with the master, the RF connection will be forced. Do not power on any other slave on the field. The led will blink fast indicating that the RF communication is OK. At this step, you have direct access to the slave through the CAN.
- **Step 4:** simply use the basic commands of Texense's CAN protocol to configure the slave parameters.