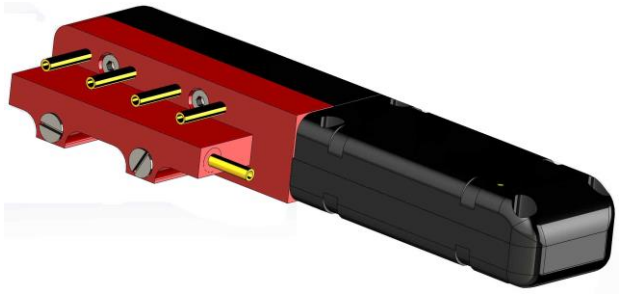
4xPDIFFW Quick Start Guide



1. System contents.

4xPdif wireless system includes the following components:

- 1 x Master box GenWM.
- Up to 22 slave sensors with primary batteries already plugged-in.

The system is designed in order to equip a car with pressure measurement.

2. Installation recommendations.

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

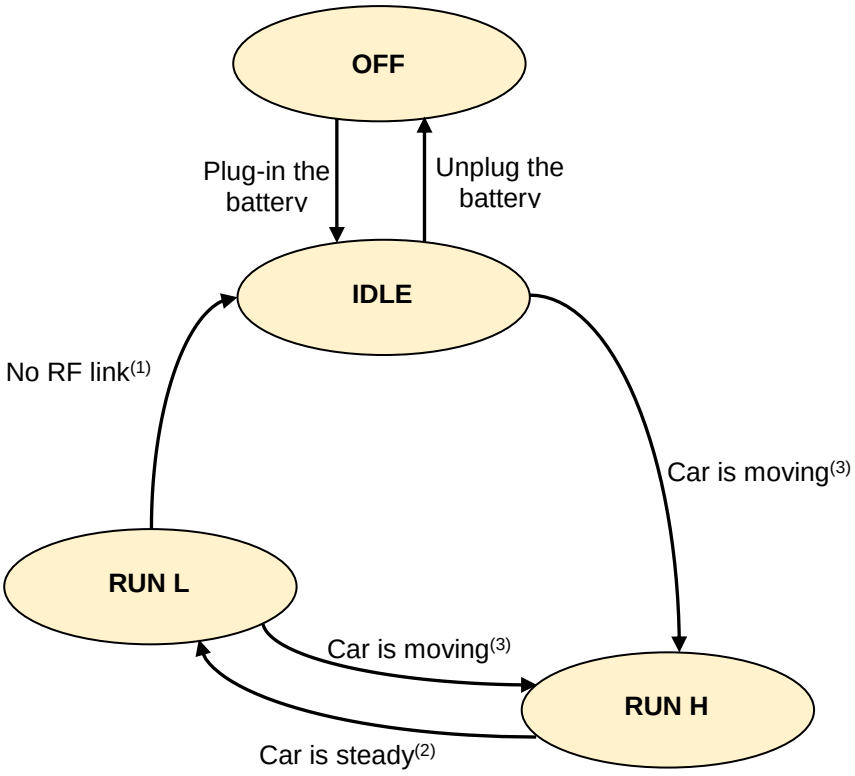
- Both master box and slave sensors should be attached in a place where there is as less as possible shield between antennas and air.
- Both master box and slave sensors should not be attached above a metal plate.
- If possible, it is recommended to not have any metallic parts closer than 20cm from both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

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 automatically 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 sleep mode, RF connection should occur in less than 1 minute and 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 if car is moving. Depending of car motion, data will be provided at 10Hz or at the configured frequency (see also power management chapter).

4. Power management.

- Slave sensors are provided with a 750mAh primary battery.
- Batteries should be replaced when voltage drops below **3V.**
- Power saving is performed by using different running modes (see also Figure 1 for fully detailed state machine).
- Current consumptions:
  - Off — No consumption
  - Idle mode (sensor asleep): — 600 µA
  - Run low speed (car steady or emission 10Hz): — 12 mA
  - Run high speed (car running, emission 10Hz): — 12 mA
  - Run high speed (car running, emission 50Hz): — 17 mA
  - Run high speed (car running, emission 100Hz): — 22 mA



(1) No RF link : RF communication is lost for more than 30 seconds

(2) Car is steady: 1 minute elapsed with accelerometer's 3 axis lower than 500mG (default value).

(3) Car is moving: At least one accelerometer axis is higher than 750mG (default value).

Fig 1: State machine for power management

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.

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 that is factory set and cannot be changed by the end user. This prevent 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 received by RF from any slave sensor, is converted to CAN frames and provided to ECU by master box. The frames contain pressure 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 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)

7.2 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).

8. Replacing batteries on sensors.

1. Remove the 4 hexagonal screws and the cover :

2. Remove the battery and place the new one instead :

3. Simply do the opposite step: put back the cover and screw it.

Note: After plugging the new battery, the system will automatically start and the led will blink slowly showing the system is searching for master. If a paired master is on the RF field, the slave will connect to it and the led will blink fast. If no master is on the RF field and if the slave is not moved for 1 minute, the slave will enter idle mode. The led will stop blinking and stays ON.

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 4XPDIFFW configuration

The slave parameters are basically:

- Slave ID
- System ID
- acceleration wake-up threshold
- …

Please refer to 4XPDIFFW datasheet to see all available slave parameters.

To modify a parameter, you must first establish a “configuration” 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 connexion 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.