TBS-223 Wireless Vehicle Detector

User Manual

V1.0

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WUHAN TURBO TECHNOLOGIES CORPORATION

Content

REV	DESCRIPTION	Written by	DATE	APPROVED
0.9	Initial Release	Melvin Chow	24/10/2020	
0.91	Changed the Android app description in Section 10.5	Melvin Chow	27/10/2020	
0.92	Add the GPS turn on requirement for the WeChat apps and Android App on Section 10 and FAQ section	Melvin Chow	09/12/2020	
1.0	Add system time stamp and low battery alarm in the FAQ section and disclaimer.	Melvin Chow	08/03/2021	
1.01	Correct the Android App language issue and created a new Link and QR code for download the fixed version	Melvin Chow	19/04/2021	

1. Overview

TBS-223 Dual mode wireless vehicle detector is a wireless sensor using LoRaWan long-distance wireless standard, it integrated with geomagnetic detection and microwave technology. Using effective dual-mode joint algorithm, the detector delivers precise parking spot detecting function and can be widely used in intelligent traffic, smart community, smart parking and other applications.

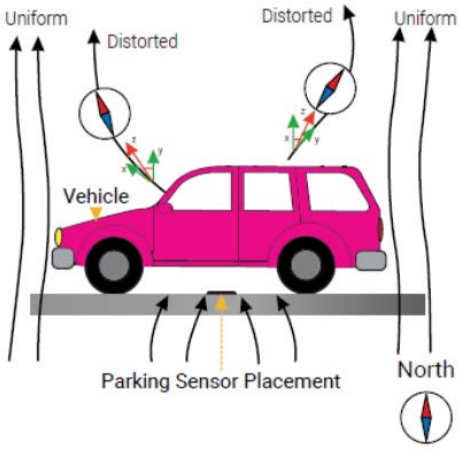
TBS-223 is the essential elements for the latest IoT Smart parking solution, which integrate with LoRaWan gateway and smart parking application management platform provided a smart parking management monitoring solution. TBS-223 is compatible with LoRaWAN protocol, can communicate with gateway which compatible with LoRaWAN protocol.

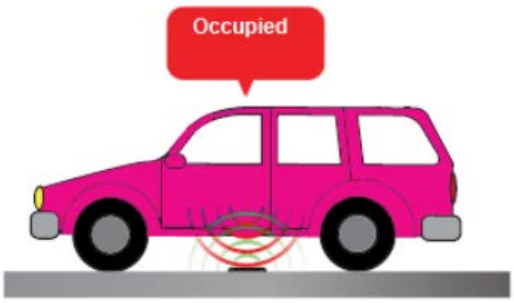
2. Working Principle

Traditional magnetometer type Smart Parking sensor is using the characteristic of ferromagnetic material in the vehicle frame, which make disturbance to surrounding magnetic field while moving.

The movement of the vehicle creates a short-range distortion of this field which is measured by the smart parking sensor with a complicated calculation to determine where there is vehicle parked or left. The magnitude of this distortion depends on the type of the ferrous alloy, the size of the object and the distance to the sensor.

Compared with traditional magnetometer measurement and the Radar technology, TBS-223 improve the detection accuracy and reduce the uncertain situation happen.





Below is the table showing the comparison between different types of smart parking sensor and the available feature of the TBS-223 Dual mode parking sensor.

	Supported by TBS-223 Dual mode Parking Sensor				
	True Radar & Magnetometer mode Parking Sensor	Radar Parking Sensor	Magnetometer Parking Sensor	Infra-red Parking Sensor	Ultrasonic Parking Sensor
Potential affected by nearby vehicle movement	NO	NO	YES (required very good calculation to compensate)	NO	NO
Potential affected by electromagnetic interferences (underground powerline)	NO	NO	YES (required very good calculation to compensate)	NO	NO
Potential affected by Dirt or dust	NO	NO	NO	YES (Can't be improved)	YES (Can't be improved)
Current consumption rating	slightly higher than magnetometer sensor	Mid power consumption	LOW	High power consumption	Super high-power consumption
Potential mechanical damage or required aperture design	NO	NO	NO	YES (It required aperture design and can't be covered)	YES (it required ultrasonic sensor expose to open air)
Sensing Gap / interval	NO or short	YES (20sec-1mins delay sensing)	NO	NO	NO
Potential detection problem with Electric vehicles	NO	NO	YES (usually Electric Vehicles change less magnetic field)	NO	NO

Remark:

Red colour above stated the critical potential problem which is not recoverable and causing a critical issue on site.

3. Key Features

- Supported 3 different operation modes to adapt different environment requirement.
    - Magnetometer only
    - Radar only
    - Joint mode with Radar and Magnetometer activated **(recommended)**
- High accuracy detection, up to 99%
- The detector has extremely low power consumption able to work for 5 years under the *normal application. (Based on 5 vehicles IN and OUT per day)
- High battery capacity 20AH provided enough power for sensor to work in different situation.
- Supported battery replacement to extend the life of the sensor.
- 100 Internal data logs for debugging
- 10 sensor status buffer logs prevent data lost while LoRaWan network has issue due to public internet problem in Packet forwarder mode.
- Supported Bluetooth wireless remote upgrade and calibration.
- Supported one click installation from the WeChat, Android apps to avoid the complicated setup process.
- Supported security passcode to avoid unauthorised user access the device.
- Supported downlink command remote calibration and configuration.
- Strong magnetic field interference alert together with auto mode switching to prevent sensor function impact by incident
- Support instant (nominal 2-3sec delay) Parking status report, high efficiency response compared to many other sensors in the market
- In built Temperature and Humidity sensor to measure the environmental information.
- Optional - External mounting cradle for using Epoxy to mounting the device on the Road or building to avoid drilling hole.
- Optional - Reflective warning stickers available in order to increase the visibility of the sensor to avoid any inattention accident.

4. Application

- For Smart parking to locate the empty parking spot
- Time management to reduce the Street parking searching time
- Intelligently assign the Commercial parking spot to guest
- Reduce air pollution by guiding the target vehicle to target Parking spot
- Avoid car park in the restricted zone.
- Suitable for pre-alert when vehicle park in Click and collection application zone

Note: All applications based on the local onsite testing result. We strongly recommend customers to order sample unit for testing before go for mass application.

5. Specification

Working Frequency	470/868/915/923MHz (based on order) Fulfilled CN470, EU868, NA915, AU915, AS923 etc standard. (order by requested)
Communication Standard	LoRaWAN™, Class A
Transmitting Power	Maximum 19dBm (Depends on frequency plan for regulation)
Receiving Sensitivity	-135 dBm (SF12,125KHz)
Detection Rate	>99%
Bluetooth Calibration	Auto calibration after device wake-up via Bluetooth
Downlink Configuration	Calibration, detection threshold, heartbeat interval
Uplink Alarm	Low battery alarm, failure alarm
Software Upgrade	Wireless upgrade
Power Supply	Built-in battery, 3.6V, 20000mAh
Power Switch	Strong magnetic switch
Battery Life	>5 yrs, in typical working state [1]

Bearing Weight	>10 tons
IP Grade	IP67
Working Temperature	-40°C ~85 °C
Storage Temperature	-50°C ~85°C
Working Humidity	10%~95%
Environment Requirement	There are no ferromagnetic materials, No strong magnetic field nearby. No Metal shield covers the detector.
Size	Unit dimension Φ: 200mm, H: 29mm Cradle base dimension Φ: 216mm, H: 10mm (optional)
Weight	Unit: 650 g, Cradle base: 435g

Note [1]：Typical working state means the device report information every 12 hours, there are 5 vehicles come in and out to a parking space a day.

Microwave Antenna Specification

Item	Receiving antenna	Transmitting antenna
Vertical 3dB main lobe width	38°	38°
Horizontal 3dB main lobe width	38°	38°
Minor lobe level	≥15dB	≥15dB

6. Size and dimension

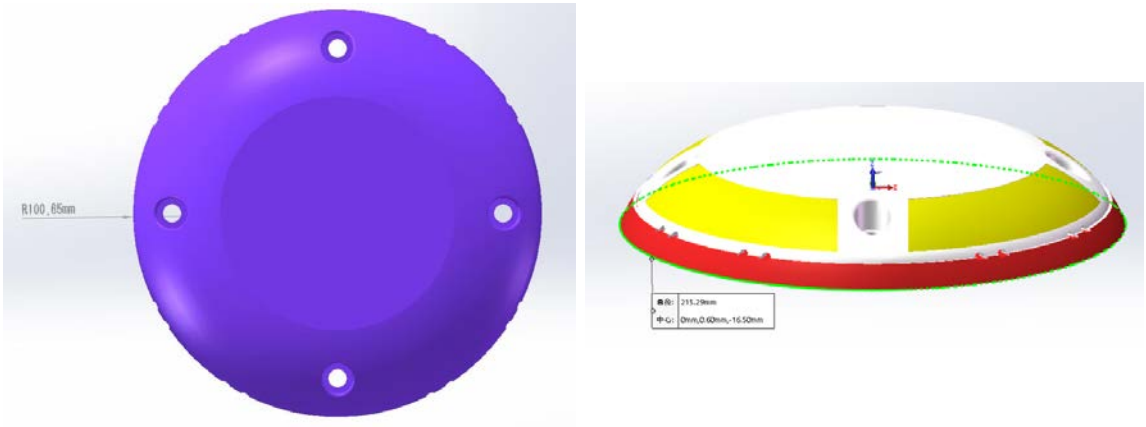


Figure 1. TBS-223 3D drawing

7. LoRaWan Parking system structure

TBS-223 build in with the LoRaWan communicate module, it works with LoRaWAN gateway and smart parking application server located in cloud or local.

Below is a diagram showing TBS-223 Parking sensor, LoRaWAN gateway, application server and smart parking application (APP) composite of Smart parking system.

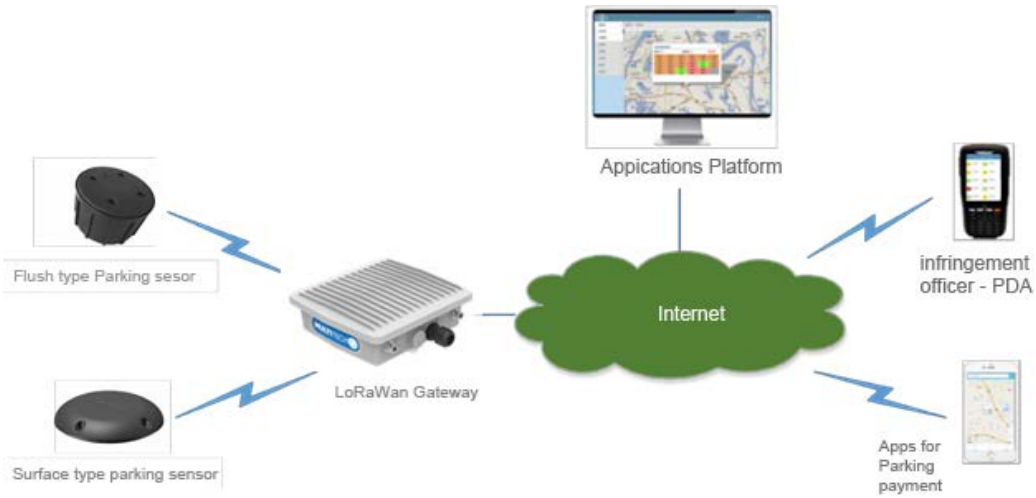
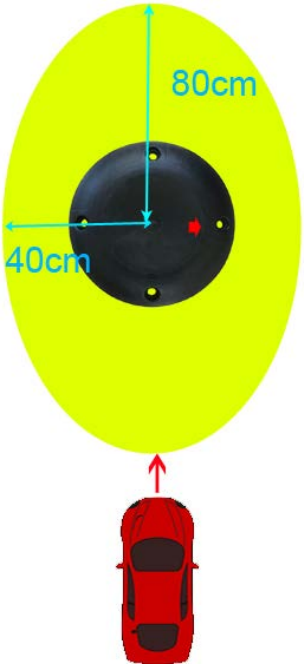


Figure 2. Smart Parking System

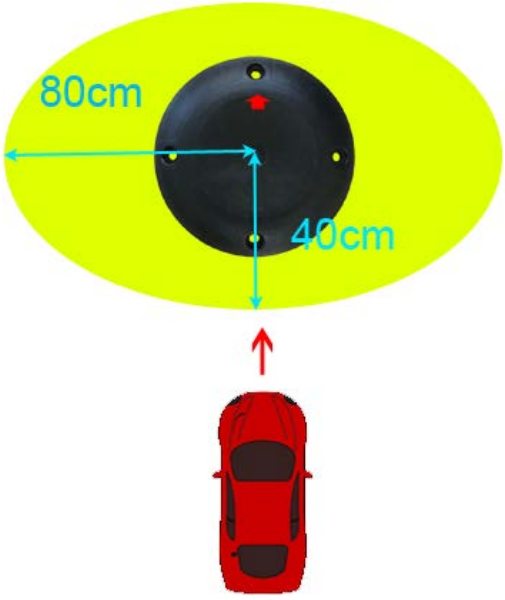
8. Active zone

TBS-223 is a sensitive sensor and based on different installation method, the active zone will be changed. The below yellow zone is the suggested vehicle keep away distance, when Vehicle drive into or left the zone, the sensor will be activated.

The parallel to vehicle installation is much more sensitive than 90-degree installation. Generally, if using 90-degree installation, it is suggested to change the sensitivity to 7; however, based on different situation, customer may need to fine tune the sensitivity and position to avoid error.



90 degree to the vehicle installation



parallel to Vehicle installation

9. Installation

a. Installation Steps

i. Product Check

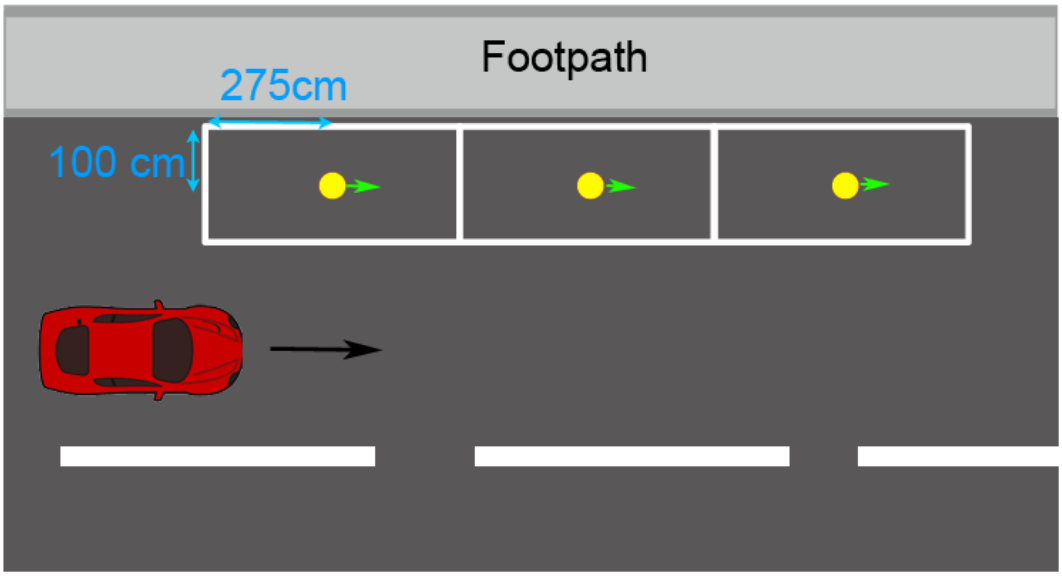
Check the sensor to make sure there do not has physical damaged.

Figure 3. Product appearance

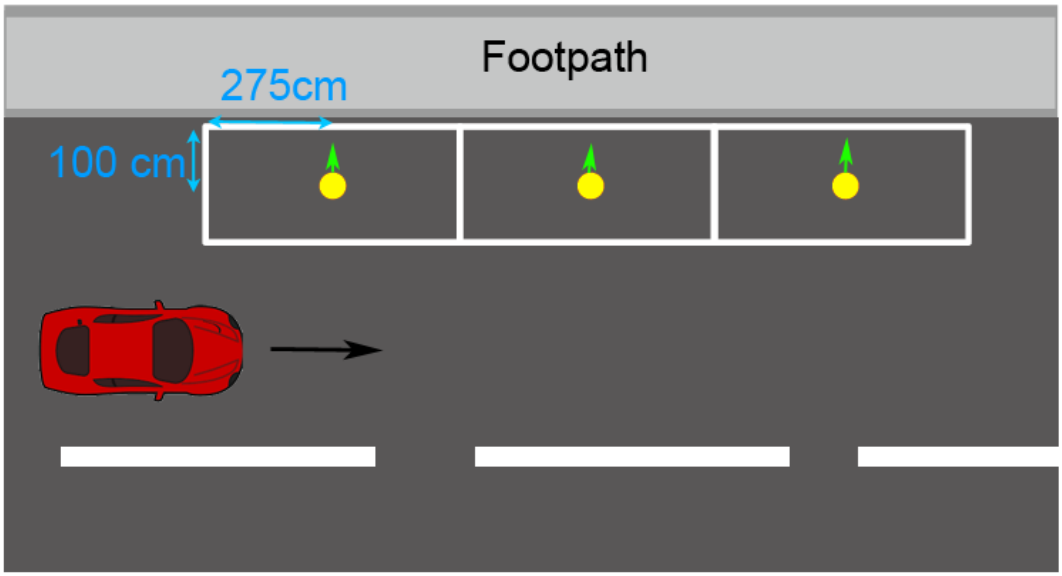
ii. Mount the device on the Car spot

It is suggested to use the below positions, parallel or 90 degree, to mount the sensor on the Car spot. The design is based on the standard Car spot size at 5.5m x 2.5m.

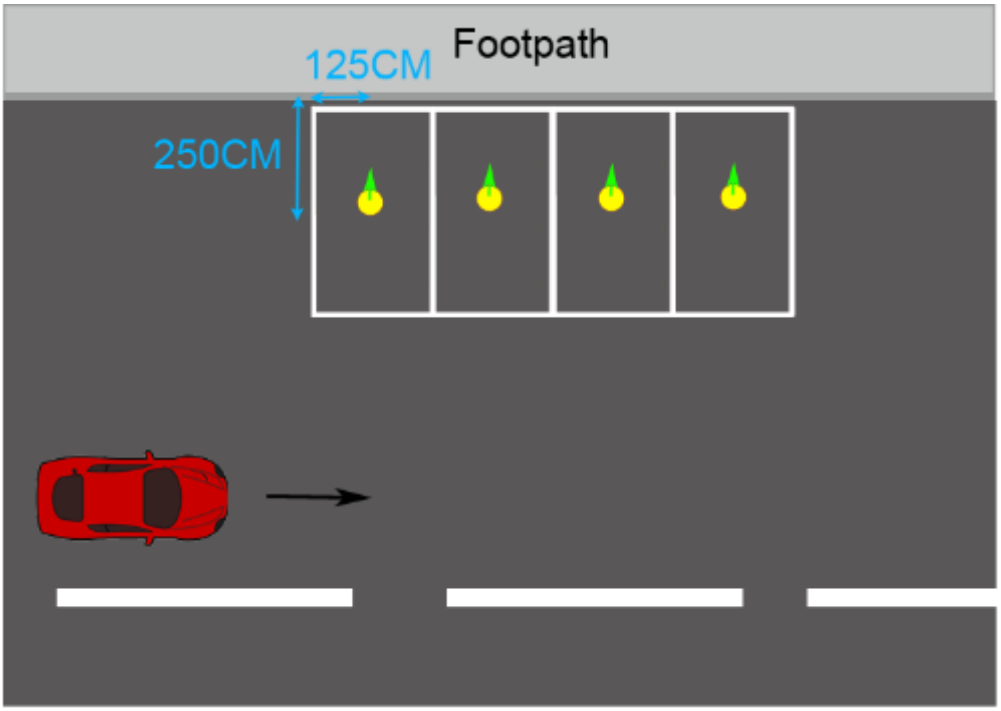
For parallel parking the Car spot size may be varied from 5.5m x 2m to 5.5m x 2.5m



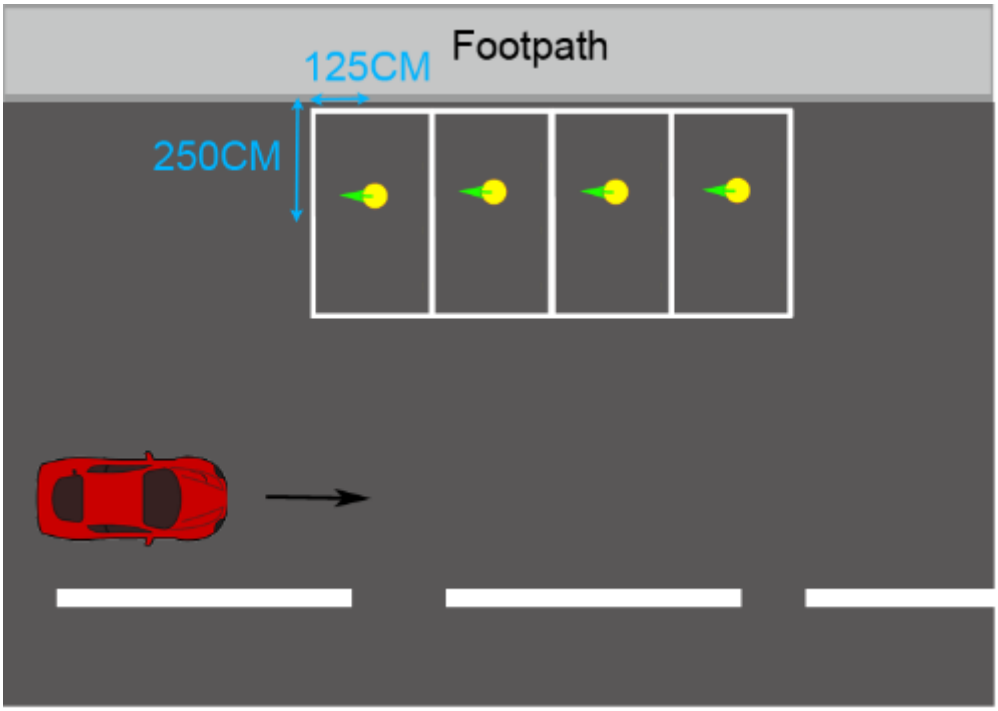
Parallel parking spot, parallel installation



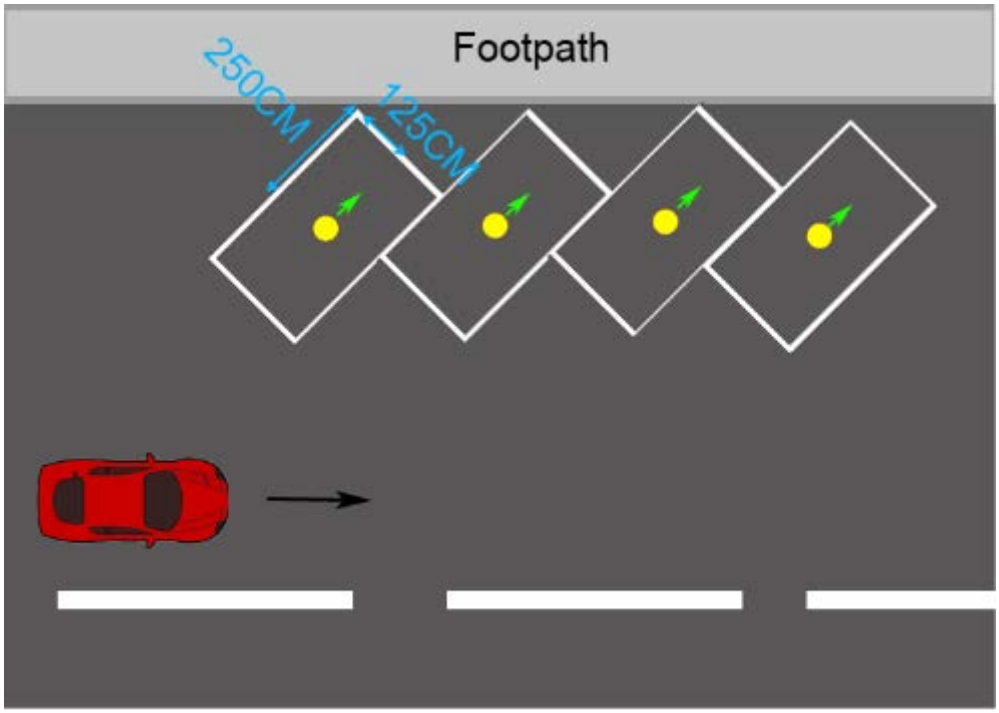
Parallel parking spot, 90 degree installation



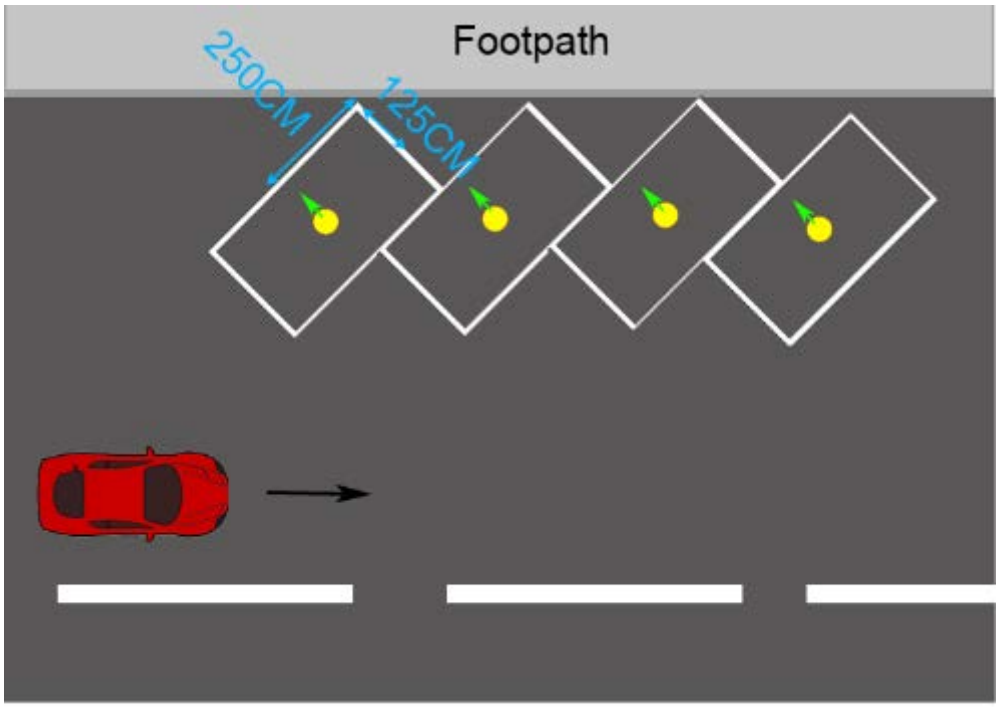
Right angle parking spot, parallel installation



Right angle parking spot, 90 degree installation



Different Angle parking spot, parallel installation



Different Angle parking spot, 90 degree installation

TBS-223 supported Epoxy mount via Cradle base or drill hole screw mounting

A. Drill hole screw mounting

1. Find the Parking space for install the parking sensor.
2. Mark the sensor hole on the ground and drill 4 holes

a) Find and mark the centre of the desired detector location. Shown as figure 7:

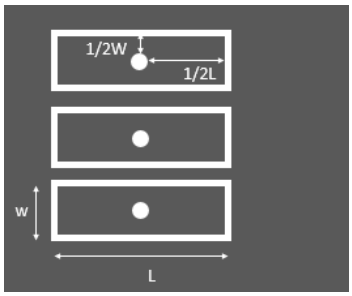


Figure 7, the desired location

b) Core 4 holes (approximately 8 mm in diameter, and 60mm deep) into the road.

Figure 8. Drill 4 hole

3. Install 4 expansion crews

Install four expansion crews on the TBS-223, as shown in figure 6.

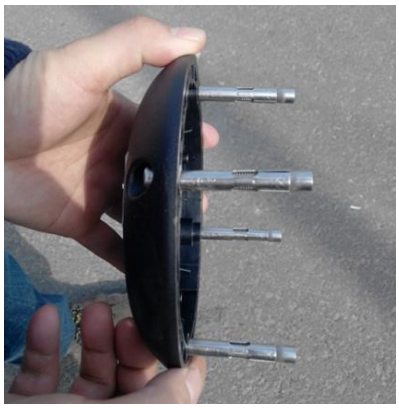


Figure 9 install 4 expansion screws

4. Place the vehicle detector

Place the vehicle detector into the surface, make sure 4 expansion screws direct to 4 holes and keep the TBS-223 bottom is closed to the road surface, using hexagonal screwdriver to tighten the screws and fix the TBS-223. Place the sensor Arrow Label in parallel with the Car spot and follow the above recommend installation position.

Figure 10 : triangle shaped label

B. <u>Epoxy mounting using the Cradle holder</u> (optional Cradle ordered separately)

1. Find the Parking space for install the cradle
2. Clean the ground with the Wire Brush to avoid any dust.
3. Place the Epoxy on the middle of the cradle, see below picture for the cradle back

4. Place the Arrow mark on the cradle parallel with the parking spot or follow the above recommended installation position.

5. Push the cradle evenly on the ground
6. Allow the adhesive > 12 hr to cure before screw the sensor on the cradle
7. After the adhesive cure, screw in the TBS-223 on the cradle follow with the same Arrow direction.

10. Start up and connect with the LoRaWan server.

TBS-223 sensor could be setup by using Bluetooth connection via the WeChat App and Android App

10.1 WeChat Applet Introduction

The Applet is designed to register the device to LoRaWAN network and wake up the device via Bluetooth.

a. Add WeChat Applet

There are two ways to add Wechat Applet.

1. Scan QR code.

Open Wechat, scan following QR code, then enter the applet. The code is shown as figure 8. then select ”Geomagnetic vehicle detector".

Figure 8. QR code

2. Search in WeChat

- Search “ 快捷设备安装” in WeChat.

b. Connect the device with the App and Start the join process

1) Turn on Bluetooth connection in mobile

2) Turn on the GPS location services and allow the APP to use the GPS location

3) Turn on the WeChat apps, go to Discover > Mini Programs > 快捷设备安装 > select “Geomagnetic vehicle detector”

4) Place the magnet stripe in the groove at the top of the device and stay for 5 seconds, then move away. The groove is shown as figure 9.

Figure 9. groove in the device surface

5) Click “Connected device” in applet. If success, the device basic information will be displayed in applet. As shown in figure 10.

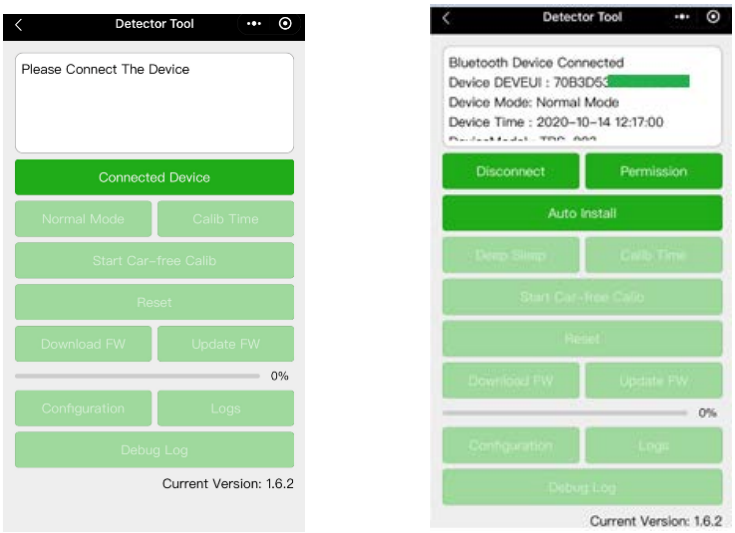


Figure 10. WeChat applet configuration page

6) Click “Auto Install”, to wake up the device and join requested will be sent. The sensor will also run the startup calibration in the meantime.

7) The installation process is done and the server should receive the 1st device parameter message and also 2nd sensor status message

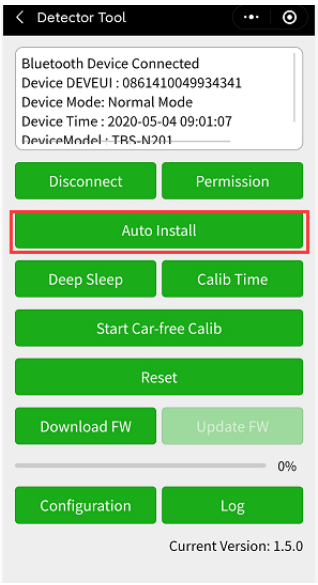


Figure 11. Auto install

c. Turn the device into Deep Sleep mode

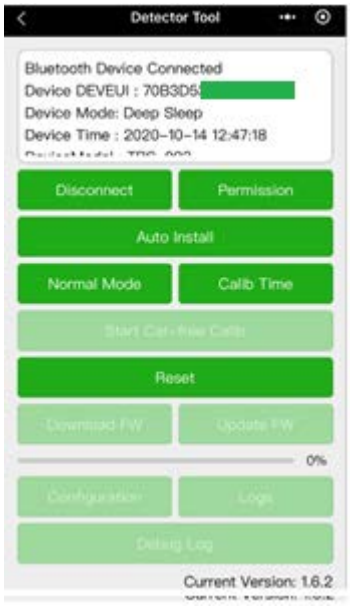
Once the device installed and activated, it does not require to turn into Deep sleep mode unless there is requirement for relocation. The device could be set into Deep Sleep mode by using the above App; however, passcode is required.

1) Click “Permission” and key in the 4-digitals password

2) The “Deep Sleep” is enabled now, click “Deep Sleep” button, and wait for 1-2

sec.

3) To reinstall the unit in the new location, please follow the above installation procedure, after new location fix, click “Auto Install” and step 7 and 8 will be repeated



10.2 Android App Introduction

The Android app is designed to register the device to LoRaWAN network and wake up the device via Bluetooth.

a. Install Android App

Please download the Android APK file in the below QR code

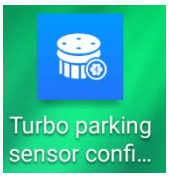
https://cdn.shopify.com/s/files/1/0067/0249/7890/files/tbs_ble_app_v2.0.0_Full_en.apk?v=1618800903

1) Use USB cable to connect with the Android mobile and computer, and download the apk into the Android mobile.
2) Install the apk into the Android mobile.

P.S: Android mobile may be warning for install the apps due to coming from unknown sources. Customer could disable the security in the Android phone by click the box in the **Settings > Security > Unknown sources**

3) Install the Utility program and there will be a new icon display in the mobile.

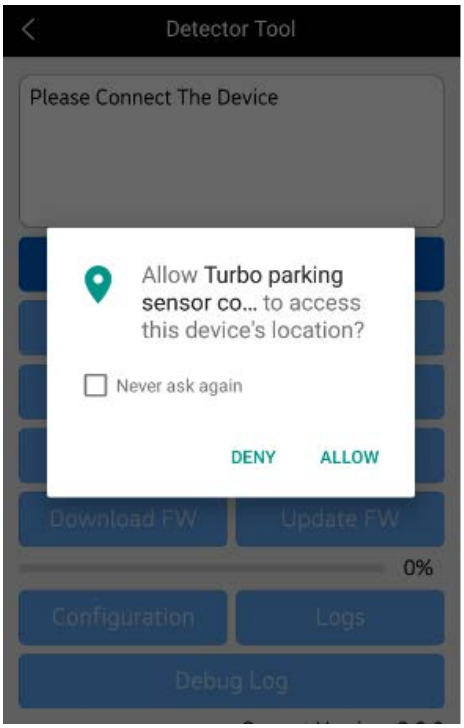
Click the below icon to start the configuration/ registration program.



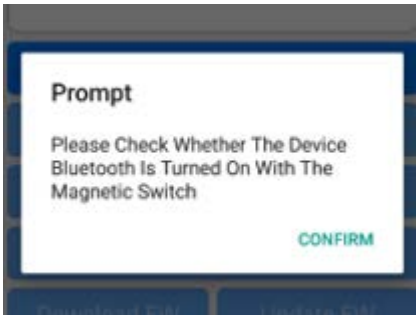
4) Turn on the GPS and allow the App to use the GPS location

i) Setting > Apps > Turbo Parking sensor configure tools > Permission > click and enable the location

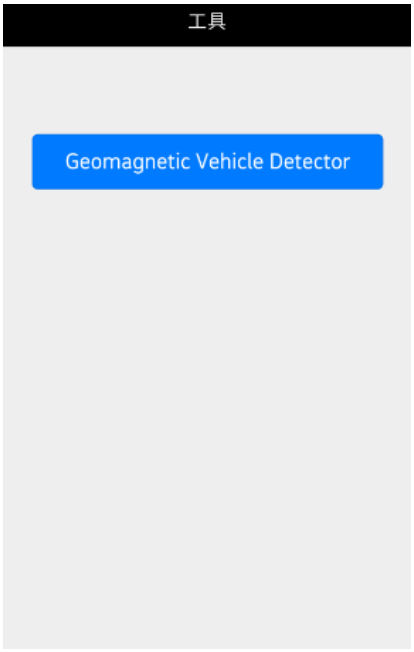
ii) If you didn't turn on the location services, when you switch on the APP, it will have the below message.



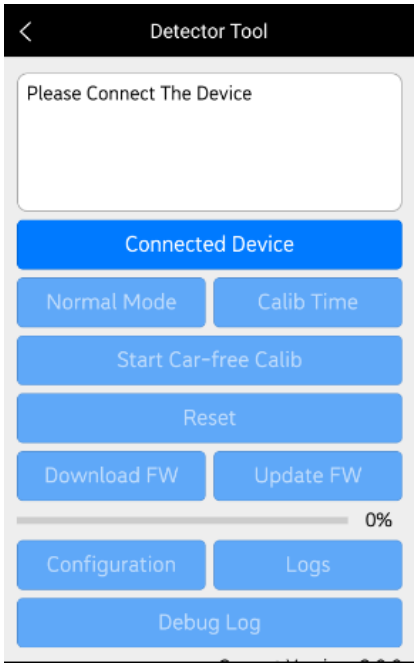
iii) If you didn't skip (ii), when you search the devices, it will prompt the below message



5) After the program running, Select the “Geomagnetic Vehicle Detector” to start the tools.



6) The configuration / registration pages will be shown as below



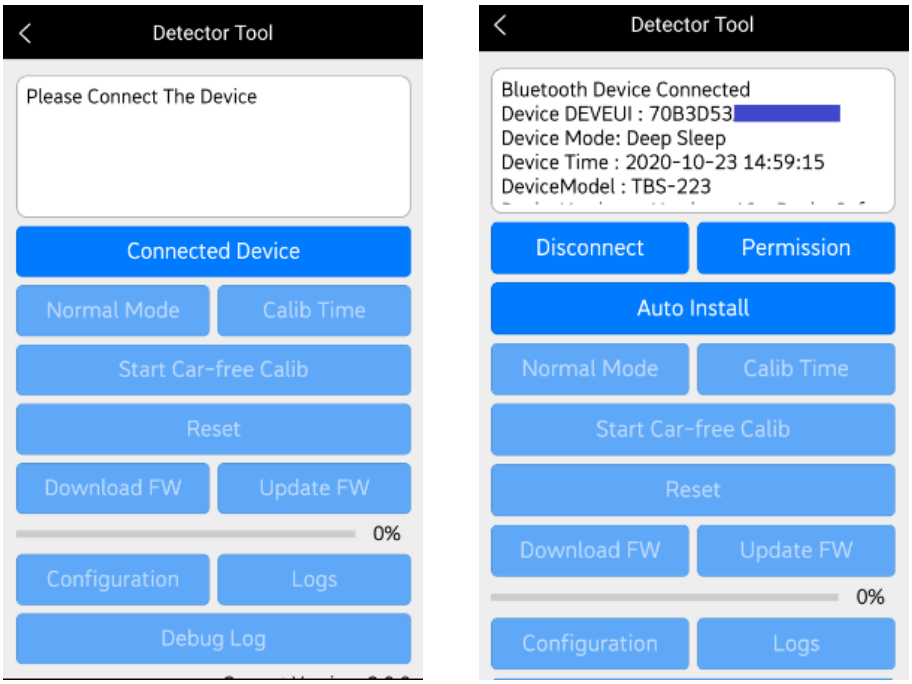
b. Connect the device with the App and Start the join process

a) Turn on Bluetooth connection in mobile

b) Place the magnet stripe in the groove at the top of the device and stay for 5 seconds, then move away. The groove is shown as below

groove in the device surface

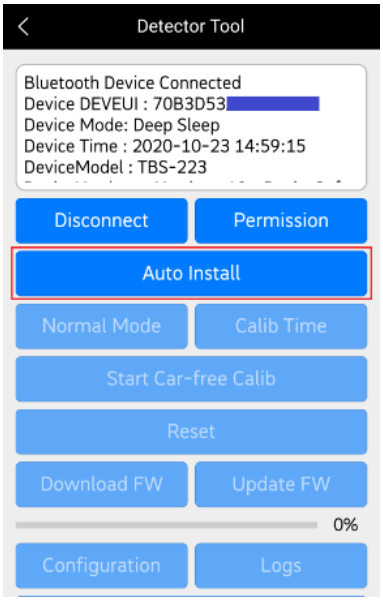
7) Click “Connected device” in app. If success, the device basic information will be displayed in applet.



Android app configuration page

8) Click “Auto Install”, to wake up the device and join requested will be sent. The sensor will also run the startup calibration in the meantime.

9) The installation process is done and the server should receive the 1st device parameter message and also 2nd sensor status message



Auto install button

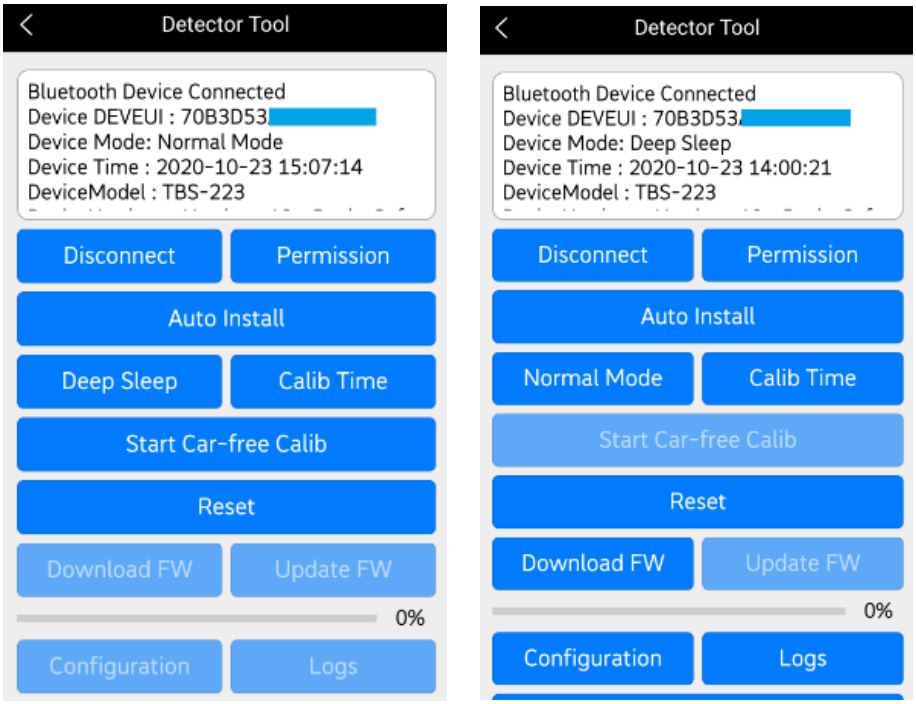
c. Turn the device into Deep Sleep mode

Once the device installed and activated, it does not require to turn into Deep sleep mode unless there is requirement for relocation. The device could be set into Deep Sleep mode by using the above App; however, passcode is required.

a) Click “Permission” and key in the 4-digitals password

b) The “Deep Sleep” is enabled now, click “Deep Sleep” button, and wait for 1-2 sec.

c) To reinstall the unit in the new location, please follow the above installation procedure, after new location fix, click “Auto Install” and step 7 and 8 will be repeated.



10.3 Recommendation during installation

1. During the calibration and installation, make sure there are no vehicle and other metal material within 1 meter around the device or calibration will make mistake.

2. If there is any abnormal running in the sensor, it could be reset through calibration command. However, if this method doesn't work, please try to perform manual calibration.

3. For manual calibration, if device cannot connect by Bluetooth, please try to change a magnetic stripe.

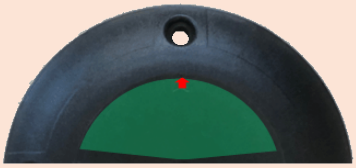
4. Re-calibration is needed once the device is moved from different locations.

5. Make sure the Arrow mark on the device is point to the direction stated in the above installation method.

6. Make sure the sensor top surfaces are clean without any object, especially using in the outdoor environment.

11. Frequency Asked Questions

No.	Question:	Reply
1	**Why we receive couple of payload data sometimes?**	Please check the Payload data Frame rate to ensure it is not resent data.
2	**The server received couple of payloads with different Frame count in the same time.**	Please check the LoRaWan Network Signal. TBS-223 could store 10 status logs in the buffer, if the sensor does not send the last status message due to network issue, it will store in the buffer and send out in the next available session. Once the network back to normal and followed an event trigger to send, the stored buffer message will be sent out, and maximum 10 data received in the same time with different Frame count and time stamp (UTC time) to identify the sequence
3	**The sensor reported "20010D" in the 13-15 byte during the status message**	"20010D" mean strong magnetic disturbance occurred, it may due to a high current power line on the ground or other unexpected event. TBS-223 will auto switch into Radar mode once receive this report to ensure the parking event is functioning and it will resume to normal joint mode operation when the event is clear. However, it is recommended to check the site to avoid the problem happen again.
4	**Why other sensors in the market take 20-40sec to report but TBS-223 only need 2-3 second?**	TBS-223 is a thoughtful design to tackle the standard parking event. The 20-40sec sensing gap is not being accepted as driver could park or leave the car spot in around 5 seconds and the longer sensing gap caused more potential issue like long stay parking causing by other vehicle, flip case...etc
5	**Can someone turn off the TBS-223 by using the magnet or other means?**	TBS-223 is passcode protected product. People cannot power off the sensor without the proper software tools and passcode.
6	**What is the IP rating in the TBS-223**	TBS-223 is IP67 rated.

7	**Can we install TBS-223 in the ground**	TBS-223 is designed for surface mount device. We recommend customer to use the same feature TBS-201 devices for in ground applications.
8	**We have received some IN and OUT message in very short time like 1-10sec.Why it happens, is it normal?**	TBS-223 is a very sensitive sensor. Especially under Parallel installation. If there is a vehicle drive on top of the sensor and stay like 0.5 sec or pass-through speed in less than 10km etc, the sensor may be activated and checked the status 2 times for IN and OUT In this case, it will report IN when the vehicle drives IN and then report OUT when the vehicle left the sensor, it could take only 1-2 second to report between 2 sessions where depends on network status
9	**The Vehicle is Not parked on top of the sensor but it still shows the parking spot is occupied**	Please double check if there is any vehicle or metal object in the Active zone mentioned in the Section 8 Active zone above.
10	**Parking Sensor is not working while there is a vehicle on top of it.**	Please double check if there is any object on top of the sensor, it will be best to have no other object or sticker on the top surface of the sensor
11	**Can I put a sticker on the sensor?**	Yes, please put the required sticker to the side of the sensor which already have the engraved marking for customer putting reflective sticker
12	**Can I put sticker on the top surface of the sensor?**	It is not recommended to put any sticker on top of the surface; however, if customer want to put the sticker on the top surfaces, we will highly recommend the sticker only put-on top of the surfaces closed to the Arrow marking only 
13	**Sensor can't connect to WeChat App or Android App**	Please check whether the GPS is turn on and allow the APP to access the GPS location

14	**Is there any low battery alarm**	Yes, the sensor has a low battery alarm set at 3V which is 10% left, when battery output voltage is lower than 3V, the alarm will turn on which listed in the payload, and please arrange battery change or sensor changed ASAP. You may see the alarm turn on and off during the time in around 3V, since the battery voltage is not constant falling in the real case.
15	**Why the timestamp in the payload is different to the timestamp in the server received time**	The timestamp in the payload is the UTC time in the clock at the sensor, which is time synchronized during installation with the mobile app, and there is potential shifting due to no repeat synchronised with the system. Thus, it is only being used as reference only.

12. Disclaimer

1. **Battery life:** The battery life refers to the service life under normal conditions. When the device under a poor LoRa network (SNR≤-12), the battery life will be affected and shortened. The above estimated battery life is based on our calculation for the Joint Mode at sensitivity level 4 assuming 5 vehicles IN and OUT per day and 2 heart beat per day where normal conditions mean the device work normally in stable network condition.

2. **Accuracy:** Turbo run an intensive testing with different vehicles to ensure the testing accuracy is corrected. However, there are too many vehicle types and different material to build the vehicle. Thus, the sensor accuracy is only being used as a reference ONLY. Customer need to test the sensor on their own experience before the site deployment.

3. **Standard parking event:** TBS-223 is a thoughtful designed Parking sensor, it is designed to tackle a standard parking event. Only the vehicle is driven on top of the sensor and stayed for around 1 second, the sensor will response. It is designed to avoid the long stay session caused by a long delay in reporting when vehicle left the car spot. However, there are too many parking situations in the real life which is not under covered by TBS-223. And there may have chance to have error reporting.

3. **Network Coverage:** TBS-223 required a good signal coverage for operation, even the design is fine tuned to the best RF performance. Since Vehicle is driven on top of the sensor where the RF signal was blocked by the vehicle, there will be around 10-15 dB signal dropped once vehicle on top of sensor. It is recommended to keep the RSSI > -90 and SNR >5 in no vehicle status.

4. **System Time Stamp:** The payload included the system timestamp (UTC) which is the time in the sensor which was synchronised with the mobile App during installation. Due to there is potential time shifting in the system clock, the time stamp in the payload is used as a reference only and provided a reference information for the payload event for the stored buffer data when there is LoRa network issue.