

Sensor documentation

1. Introduction

1.1 Purpose

The purpose of this document is to introduce the performance of sensors, workflow LF data frame structure, RF/LF frequency characteristics, etc.

1.2 Performance

1.2.1 Service life

The lifespan of the sensor is 10 years or 240000 kilometers (whichever comes first)

1.2.2 Pressure Sensor

RF data frame structure,

Measurement range: 100Kpa~900Kpa

Measurement error: +/-7KPa in the range of 0 degrees to 50 degrees, +/-9KPa in the range of 50 degrees to 70 degrees, +/-17.5KPa in the range of -40 degrees to 0 degrees and 70 degrees to 125 degrees

1.2.3 Temperature Sensor

Measurement range: -40 degrees to 125 degrees

Measurement error: The error between -20 degrees and 70 degrees is +/-3 degrees, and the error between -40 degrees to -20 degrees and 70 degrees to 125 degrees is +/-5 degrees

1.3 Sensor operating temperature

Working temperature -40 ° C to 125 ° C

1.4 Sensor Storage Temperature

Storage temperature -40 ° C to 125 ° C

1.5 Sensor weight

Weight 30g

2 Sensor workflow

The sensor has 4 working modes in total

Manufacturing Mode

Sleep Mode

Drive Mode

Park Mode

2.1 Manufacturing Mode

Manufacturing Mode is its default mode, which is in this state when production from the factory is completed. Power consumption is in minimum mode.

In this mode, the pressure is detected every 60 seconds.

In this mode, acceleration is not detected

In this mode, LF signals need to be received

In this mode, when the pressure is detected to be greater than 50% of the tire pressure setting value, enter Sleep Mode.

In this mode, there are no overvoltage/undervoltage alarms

In this mode, there is no air leakage alarm

In this mode, when LF detects the LF signal of Force Frame, it emits an RF signal once.

In this mode, when LF detects the LF signal of Enter Sleep Mode, it enters Sleep Mode.

2.2 Sleep Mode

In this mode, the pressure is checked every 15 seconds

In this mode, acceleration is detected every 15 seconds

In this mode, LF signals need to be received

In this mode, RF data is sent every 60 minutes

In this mode, when the acceleration value is greater than 15G, enter Drive Mode

In this mode, there is an overvoltage/undervoltage alarm

In this mode, there is a leakage alarm

In this mode, there is a high temperature alarm

In this mode, when LF detects the LF signal of Force Frame, it emits an RF signal once

In this mode, when LF detects the LF signal of Enter Manufacturing Mode, it enters Manufacturing Mode.

2.3 Drive Mode

In this mode, the pressure is checked every 5 seconds

In this mode, acceleration is detected every 15 seconds

In this mode, LF signals need to be received

When entering Sleep Mode, data is sent every 15 seconds for the first 3 minutes and every 1.5 minutes thereafter.

When entering this mode from Park Mode, if the 3-minute fast send is not completed, continue to complete the fast send mode. If it is completed, send data every 1.5 minutes.

In this mode, when the acceleration value is less than 5G, enter Park Mode

In this mode, there is an overvoltage/undervoltage alarm

In this mode, there is a leakage alarm

In this mode, there is a high temperature alarm

In this mode, when LF detects the LF signal of Force Frame, it emits an RF signal once

2.4 Park Mode

In this mode, the pressure is checked every 5 seconds

In this mode, acceleration is detected every 15 seconds

In this mode, LF signals need to be received

In this mode, RF signals are sent every 3 minutes

In this mode, if the duration reaches 15 minutes, enter Sleep mode

In this mode, if the acceleration is greater than 15G, enter Drive Mode

In this mode, there is an overvoltage/undervoltage alarm

In this mode, there is a leakage alarm

In this mode, there is a high temperature alarm

In this mode, when LF detects the LF signal of Force Frame, it emits an RF signal once.

In this mode, when LF detects the LF signal of Enter Sleep Mode, it enters Sleep Mode.

2.5 Alarm detection

The sensor alarm has the following situations:

Leakage alarm

over voltage alarm

Undervoltage alarm

High temperature alarm

2.5.1 Leakage alarm

When the tire pressure decreases by 20kPa (30kPa/Min) at a rate greater than 20kPa/Min, the sensor triggers a leak alarm

When a leak alarm occurs, RF data is sent every 5 seconds until the alarm is resolved.

The detection method is as follows:

After completing the pressure detection, if the pressure drops by more than 20kPa (30kPa) compared to the previous detection, a leakage alarm will occur. If it is not greater than, compare it with the pressure value detected 1 minute ago. If the pressure drops by more than 20kPa (30kPa), a leak alarm will occur.

2.5.2 Overvoltage alarm

When the tire pressure is greater than 125% of the tire pressure setting value, the sensor has triggered an under alarm

When an overvoltage alarm occurs, RF data is sent every 5 seconds until the alarm is resolved.

The detection method is as follows:

After completing the pressure detection, compare it with 125% of the tire pressure setting value. If it is greater than, an overpressure alarm will occur.

2.5.3 Underpressure alarm will occur

When the tire pressure is less than 75% of the tire pressure setting value, the sensor triggers an undervoltage alarm

When an undervoltage alarm occurs, RF data is sent every 5 seconds until the alarm is resolved.

The detection method is as follows:

After completing the pressure detection, compare it with 75% of the tire pressure setting value. If it is less than, an underpressure alarm will occur

2.5.4 High temperature alarm

When the temperature of the tire exceeds 85 degrees, the sensor triggers a high temperature alarm

When a high temperature alarm occurs, RF data is sent every 5 seconds until the alarm is resolved.

The detection method is as follows:

After completing the temperature detection, if the temperature is greater than 85 degrees, a high temperature alarm will occur

Because each time pressure and acceleration are detected, temperature values must be measured first. The temperature detection cycle is based on the detection cycles of pressure and acceleration.

2.6 Battery Voltage Status

When the battery voltage is below 2.1V, the battery voltage status position 1 must be set when sending RF data

The detection method is as follows:

Perform battery voltage detection every time RF data is sent.

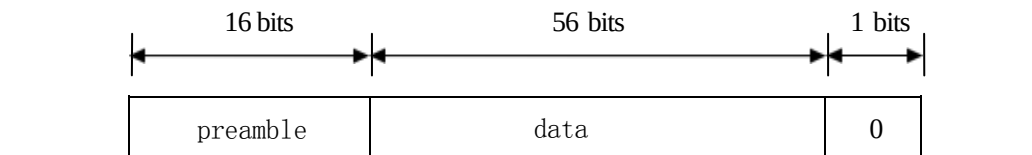
Before sending RF data, read the previous battery voltage detection value. If the voltage value after 20 contacts is lower than 2.1V, the battery voltage is low.

Once a low battery voltage is detected, the battery voltage status bit remains set to 1.

2.7 Sensor's own status

When the sensor cannot detect pressure, temperature, and acceleration normally, the abnormal position 1 of the sensor must be identified during RF data transmission

3 RF Data Frame Structure RF Data Structure



The length of the entire data frame is 73 bits,
consisting of a 16 bit preamble
56 data bits

3.1 Preambles:

The preamble consists of 16 bits, with values of 0x00 and 0x01

3.2 Data:

The data section consists of 56 bits, arranged in order as follows:

24 digit ID

8-bit pressure value

8-bit temperature value

8-digit function code

8-digit verification code

3.2.1 ID Byte

Each sensor has an independent 24 bit ID that does not conflict with other sensors.

A 24 bit ID value can have a maximum of 16.777 million IDs

3.2.2 Pressure Byte

The 8-bit pressure byte represents a pressure range of 100kPa~450kPa, with an accuracy of 1.373kPa per bit.

The output of pressure values is shown in the following table:

Absolute pressure value	8-bit pressure byte
<100kPa	0000 0000
100kPa – 101.372kPa	0000 0001
101.373kPa – 102.745kPa	0000 0010
102.746kPa – 104.118kPa	0000 0011
and the like	
899.369kPa – 899.742kPa	1111 1110
>= 899.742kPa	1111 1111

Table 2

3.2.3 Temperature Byte

The 8-bit temperature byte represents a range of -50 degrees to 204 degrees, with each bit having an accuracy of 1 degree. The output of temperature values is shown in the table below:

Temperature value	8-bit temperature byte
<-50 degrees	0000 0000
-50 degrees -49.1 degrees	0000 0001
-49 degrees -48.1 degrees	0000 0010
-48 degrees -47.1 degrees	0000 0011
and the like	
203-203.9 degrees	1111 1110
>=204 degrees	1111 1111

Table 3

3.2.4 Function code bytes

The 8-bit function code byte represents the working status of the sensor. The meaning of each is shown in the table below:

digit	describe
Bit 7	Abnormal sensor operation position
Bit 6	Battery voltage status bit
Bit 5	Temperature alarm position

Bit 4	Overvoltage/undervoltage alarm position
Bit 3	Leakage alarm position
Bit 2	LF incentive sending position
Bit 1: 0	Sensor working mode

Table 4

3.2.4.1 Abnormal sensor operation position

This position indicates the abnormality of the sensor itself, such as abnormal detection of pressure sensors, acceleration sensors, etc.

0 indicates no abnormality, 1 indicates abnormality

3.2.4.2 Battery Voltage Status Bit

This position indicates that the battery voltage is below 2.3V, which means the battery voltage is low.

A value of 0 indicates normal battery voltage, while a value of 1 indicates low battery voltage

3.2.4.3 Temperature alarm position

This is an alarm for high tire temperature. When the tire temperature is detected to be greater than 85 degrees, an alarm is triggered.

A value of 0 indicates normal tire temperature, while a value of 1 indicates high tire temperature

3.2.4.4 Overvoltage/undervoltage alarm position

When under pressure (tire pressure less than 75% of the tire pressure setting) or over pressure (tire pressure greater than 125% of the tire pressure setting) occurs, the sensor emits an over/under pressure alarm.

0 indicates normal, 1 indicates overvoltage/undervoltage alarm

3.2.4.5 Leakage alarm position

This position indicates that the sensor has detected a leak alarm.

0 indicates no air leakage alarm, 1 indicates air leakage alarm

3.2.4.6 LF incentive sending position

This bit indicates that this frame of data is caused by LF excitation.

0 indicates no LF motivation, 1 indicates LF motivation

3.2.4.7 Sensor working mode position

These two digits represent the working mode of the sensor, as shown in the table below:

Bit1: Bit0 value	Working mode
00	Manufacturing Mode
01	Sleep Mode
10	Drive Mode
11	Park Mode

Table 5

3.2.5 Verification code byte

The verification algorithm adopts CRC8 algorithm, which starts from the ID byte and ends at the function byte, totaling 6 bytes. The initial value of CRC8 is 0x00, and the polynomial is 0x07

3.3 End position

End bit counter 1 bit, with a fixed value of '0'.

4 RF characteristics

Carrier frequency: 433.92MHz (+/-50KHz)

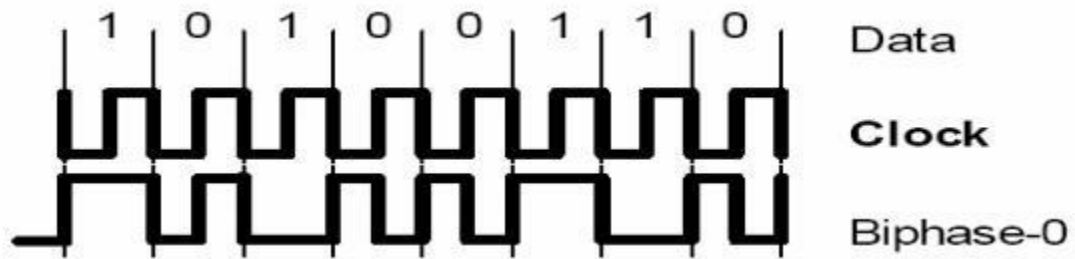
Carrier frequency: 315MHz (+/-50KHz)

Modulation method: FSK/ASK

Baud rate: 9918 bps (+/-5%)

Data frame length: 7.36ms

Encoding method: Manchester Bi-phase 0



Manchester Bi-phase 0 Encoding method

Send 3 data frames each time

Transmission power: less than or equal to 80dB uV/m at 3 meters and less than or equal to 70 dB uV/m at 10 meters

The LF data frame structure is as follows:

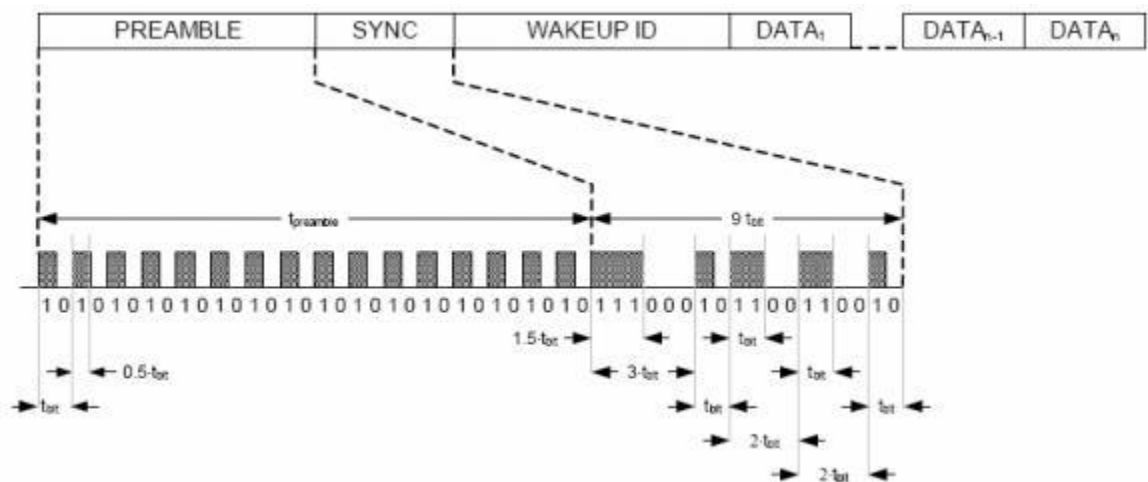


Figure 1 LF Data Frame Structure

5.1 Preliminary section

The preamble section consists of a series of '0's'. Its number is not less than 16 bits, 5.2 SYNC part

The SYNC section has a total length of 9Tbit.

5.3 Wakeup ID section

Wakeup ID is composed of 16 bits. Its values are: 0x87, 0x78

5.4 Data section

The data section consists of 16 bits, totaling 2 bytes.

The values are shown in the following table:

describe	data value
Force Frame	0x81,0x7E
Enter Sleep Mode	0x91,0x6E
Enter Manufacturing Mode	0xA1,0x5E

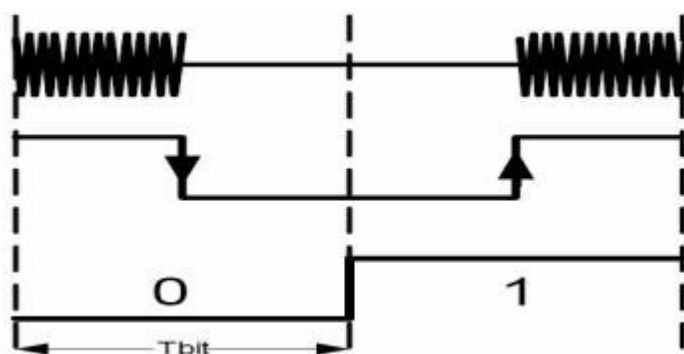
6 LF characteristics

Carrier frequency: 125KHz

Modulation method: ASK

Baud rate: 3.9k bps (+/-5%)

Encoding method: Invert Manchester



Invert Manchester Encoding method

7 Sensor Product Block Diagram

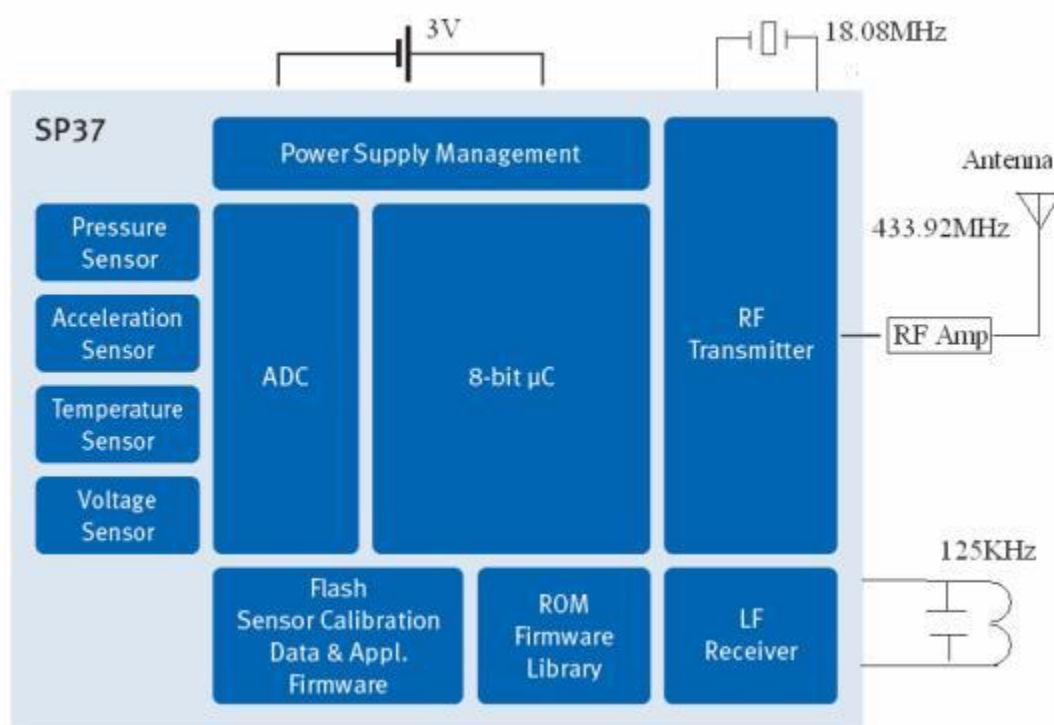


Figure 2

NOTE:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction