CS-iTWM-05D Manhole Cover Monitoring Sensor

# Users Manual

（CS-iTWM-05D-SS）

（REV:B）



Xi'an Chinastar M & C Ltd.

# Contents

# CS-iTWM-05D Manhole Cover Monitoring Sensor

# User Manual

## 1 Overview

### 1.1 Introduction

- Product functions: Manhole cover abnormal movement alarm (tilt, movement, damage, fall), heartbeat self - inspection, low - power alarm, magnetic steel activation, automatic sleep, remote management and maintenance (manhole cover equipment monitoring and management, parameter configuration, alarm statistics, work order dispatch management, map display, permission hierarchical management, large - screen display).
- Easy to install, high protection level, long battery life, high detection accuracy, and stable operation.
- Monitor the status of manhole covers in real - time with low power consumption. When the tilt angle exceeds the threshold, an alarm message will be sent to the platform immediately.
- Information indicator light prompts for product startup, alarm, daily reporting, etc.
- Small size, with a diameter of 104mm and a height of 38mm, making it easy to install.
- Suitable for monitoring the status of various manhole covers such as power wells, water supply wells, and rainwater wells.
- Wireless communication methods include NBIOT and CAT1.

Figure 1 Manhole cover monitoring Sensor

### 1.2 Working principle


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The manhole cover monitoring sensor is installed on the back of the manhole cover. It measures the current inclination angle of the manhole cover through the acceleration sensor. The alarm condition is trigerred when the manhole cover is tilted and the inclination angle is over 10° (configurable). The alarm signal is sent to the monitoring center through wireless transmission.

The device supports setting the timing reporting interval, and alarm angle threshold（default 10°）. In the normal condition, the device sends the report message at the time interval of the periodic report. The status flag in the message can be used to determine whether it's the alarm or normal status. When the device detects that the battery voltage is low, the device reports a low voltage warning message. The device sends the status information according to the set timing interval.

The conditions of abnormal movement are: ABS(current angle - initial angle) ＞ alarm angle threshold. When the condition is met, an alarm message is sent.


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# 2 Technical indicators

## 2.1 Main technical parameters

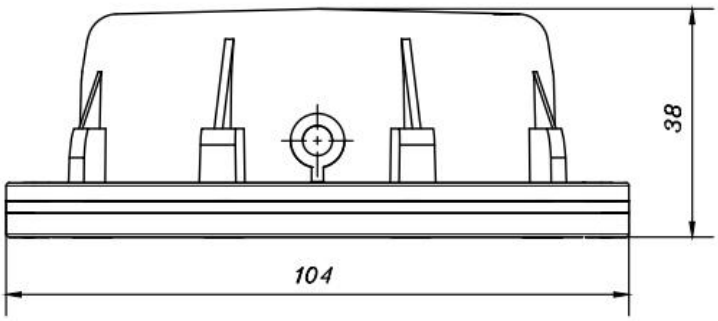
The main technical indicators of the manhole cover monitoring sensor are shown in Table 1.

Table 1 Main technical parameters

| Name | Technical parameters | Remarks |
|---|---|---|
| Working frequency | B1/3/5/7/8/20/28 | CAT1 |
| | B3/B5/B8 | NB-IoT |
| Operating Voltage | ER1450*3+SPC1520 | non - rechargeable |
| Battery Life | ≥ 3years(No less than 3,000 items) | |
| Maximum working current | ＜350mA | |
| Sleeping current | ＜25.0uA | |
| Protection level | IP68 | |
| Shell material | PC+ABS | Anti-aging, anti-corrosion, anti-collision materials |
| Operating temperature | (-40～+85)℃ | |
| Storage temperature | (-40～+85)℃ | |
| Measuring range | 0° ～ 180° | |
| Alarm delay | <30s | The signal environment is good, with RSRP≥ - 105 dBm |

## 2.2 Dimensions

The shape and size of the manhole cover monitoring sensor are shown in Figure 2.





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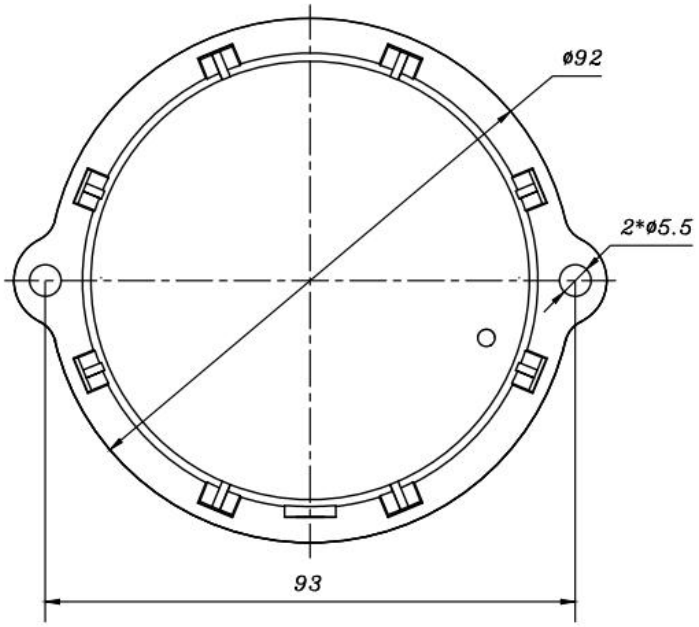


Figure 2 Dimensional drawing


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# 3 Instructions for use

## 3.1 Installing the SIM Card and the Battery

The SIM card and battery used in the product are installed before the factory to ensure that the product has a reliable seal.

## 3.2 Network Description

The IMEI number is printed on the product casing and can be used directly when accessing certain platforms. The device supports TCP,UDP ,LWM2M and COAP communication protocols.

Products are compatible with China Telecom Internet of Things open platform, China Mobile OneNET Internet of Things open platform, if necessary, can provide codec plug-in for platform docking.

## 3.3 Communication Protocol

Product communication protocol related documents are available from the manufacturer.

## 3.4 Fault Retransmission Mechanism

If the terminal fails to access the network, the terminal attempts to access the network again at a random interval of several seconds (less than 10 seconds). After three failed attempts, the terminal sleeps and tries to access the network again after the next message is sent.

If the terminal succeeds in connecting to the network but fails to send data and receives no response, the terminal sends data again at an interval of 10 seconds. If no response is received, restart the module, try to connect to the network again, and send data again. If the message still fails to be sent, the terminal sleeps and tries to access the network again after the next message is sent.

## 3.5 Collect terminal activation and background Angle

The battery is connected before delivery. By default, the battery is in hibernation state and does not detect alarms or send packets. When the terminal installation is complete, you need to use the magnetic steel to activate the terminal to enter the normal working mode.



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Activation method of magnetic steel: Place the marking surface of the terminal up, and place the magnetic steel on the activation mark of the terminal shell for 3-5 seconds, as shown in the figure. If the indicator lights up and starts to blink at 1Hz, immediately remove the magnetic steel and close the manhole cover to make it normal (Note: If the magnetic steel is not removed or the activation operation is repeated, the terminal will work abnormally); If the magnetic steel is placed at the activation mark of the terminal shell for 5 seconds and the indicator does not blink, it indicates that the magnetic steel has not been triggered successfully. You can remove the magnetic steel for 5 seconds and then re-activate the operation.

If the activation is successful, the preset installation time will be delayed (factory default: 10min, configurable range: 1min~10min) and then the background Angle (that is, the initial Angle value placed at the wellhead in the normal closed state of the well cover) will be automatically collected, which will be used as the reference Angle value to determine whether the well cover is changed. After the collection is completed, the current status information of the manhole cover will be reported to the cloud platform immediately. Before the platform receives the reported information, ensure that the manhole cover is not disturbed by external vibration and avoid repeated activation operations. If the activation fails, the platform does not receive a status message after the reserved installation time. If the platform does not receive a status message after the installation time has expired for 5 minutes, it can activate the platform again.

If the background Angle value is wrong in the data information reported by the product, it may cause false alarms. For this problem, refer to the background Angle collection instruction in the terminal communication protocol and send it through the cloud to collect and update the background Angle value again to ensure the accuracy and reliability of the background Angle value.

### 3.6 Deep sleep of the terminal

When the terminal is not installed or does not need to monitor the status of the manhole cover, in order to reduce battery consumption, the terminal can enter the deep sleep mode, as follows:

In normal working mode, the terminal is placed vertically, the Angle range is [85° ,95° ], and the vertical direction is the reserved hole position facing upward. After the terminal reports an alarm message, it will continuously monitor whether it is always in the vertical state and meets the above Angle range. If the terminal remains in the vertical state more than three minutes later, it will enter deep sleep. Otherwise, it fails to enter hibernation if it is not within the above Angle range, and it can continue to be placed vertically for at least 3 minutes for re-detection. Note: After the terminal enters the deep sleep mode, the alarm response and status data are no longer reported.


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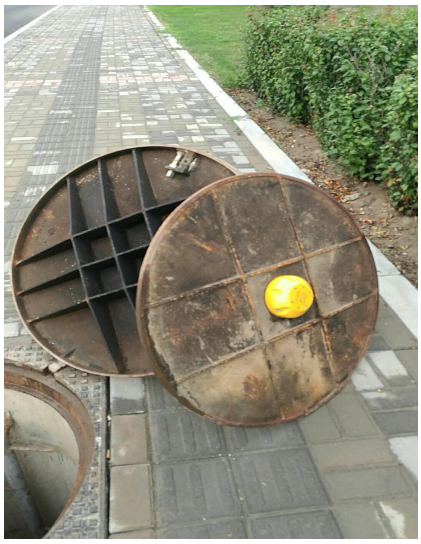
# 4 Installation method

## 4.1 Installation of double-layer manhole cover

The double-layer cover is consisted of upper bearing layer, and the lower protective layer. The device can only be installed on protective layer.



The construction steps and technical requirements are as follows:

Installation accessories: CS-iTWM-05D-A02

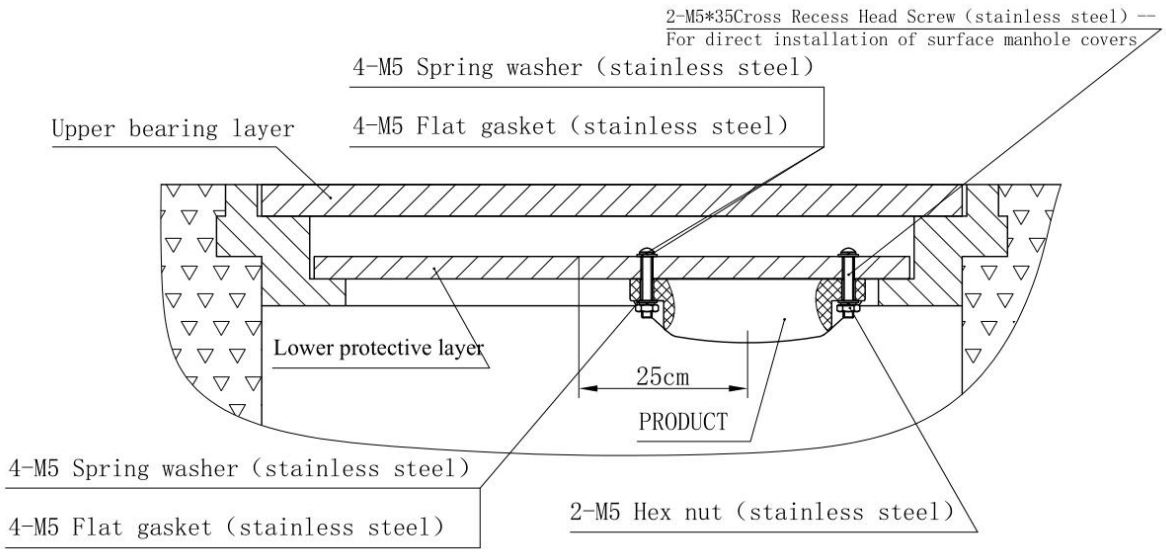



Figure 4 Installation instruction with CS-iTWM-05D-A03

1) Open the lock of the upper manhole cover, removes the upper manhole cover.

2) Pull up the lower protective cover, place it on the road.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3）Place the monitoring device flat on the pre-installation position of the lower protective cover, use the pencil to align the 2-Φ5.5mm holes centers to describe the pre-punching position on the lower protective cover;

4）Remove the monitoring device, install the Φ6 drill with the hand-held electric drill, and drill on the lower cover, make sure the drill right at the center of drawing hole;

5）Open the battery cover, protect the cover from being stained with dirt, install the battery, put on the battery cover, and tighten the screws;

6）Put the 2-M5*35mm hexagon socket bolts with spring washers and flat washers through the 2-Φ5.5mm holes, tighten the 2-M5 nut with the inner hexagonal wrench to fix the device onto the lower cover;

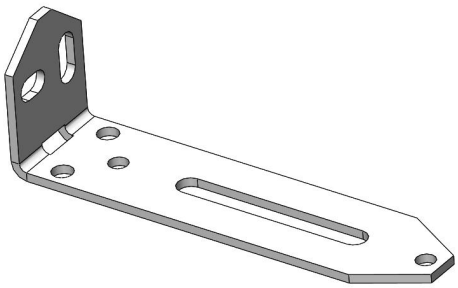
7）Place the lower cover equipped with the monitoring device back in the original position. The on-site engineer will arm the alarm state, and put the manhole cover back in the natural state, then take it out and place it on the road surface to observe the alarm state. After the operation is completed, place the manhole cover back in the original position, and record the current GPS latitude and longitude;

8）After the installation is completed, put the upper manhole cover back and lock it.

### 4.2 Installation of iron manhole cover

For iron manhole cover, as shown in the figure, the monitoring device is mounted on the bracket, which is installed on any side of the hexagonal rib at the center of the manhole cover.

Iron manhole cover



Mounting bracket

The construction steps and technical requirements are as follows: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Installation accessories：CS-iTWM-05D-A01

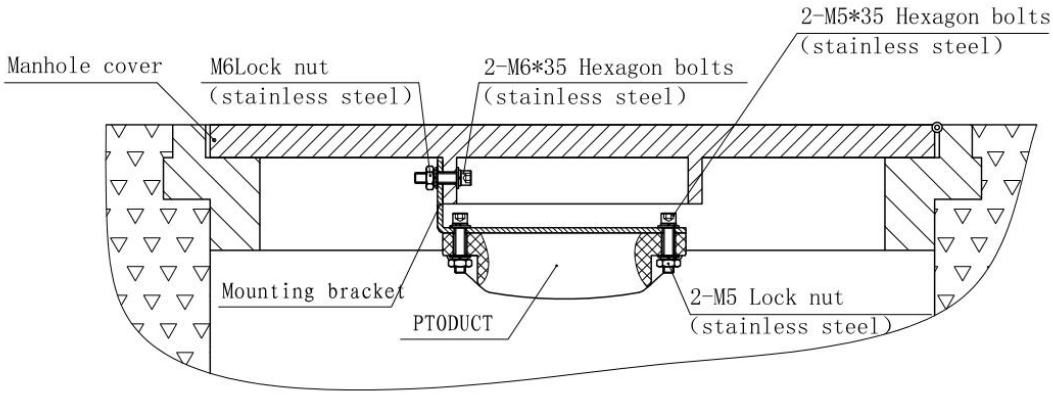


Figure 5 Installation Instruction with CS-iTWM-05D-A01

1）Open the manhole cover, make sure it being placed stably;

2）Choose one side of the hexagonal rib that is convenient for operation, and place the gasket in the pre-installation position, and use a pencil to align the 2-Φ6.5mm hole centers on the gasket;

3）Use a hand-held electric drill with a Φ6.5 cobalt drill bit, and drill 2 holes at the fixed position, make sure the drill right at the center of drawing holes;

4）Thread the 2-M6 * 35 hexagon socket bolts, which are equipped with spring washers and flat washers, through the corresponding holes of the manhole cover and installation bracket in the order shown in Figure 5. Apply thread glue to the pre tightening positions of each bolt and nut, pre tighten the 2-M6 nut by hand, adjust the pre installed monitoring end face on the installation bracket to be basically parallel to the manhole cover surface, and then tighten the corresponding bolts and nuts with an Allen wrench and socket wrench to fix the installation bracket and manhole cover;

**（The monitoring terminal has already been pre-installed with an L-shaped bracket at the factory. Simply install the bracket and manhole cover according to the above steps on site.）**

5）After the installation and fixation are completed, align the magnetic steel with the activation point position of the shell and activate it close to the shell. At this time, the green LED light on the shell will flash;

7）The on-site engineer tests the alarm state of the monitoring device, puts the manhole cover to the horizontal position, and tests the automatic disarming state. After testing 2 times, place the manhole cover back in the original position, and record the current GPS latitude and longitude;


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8）After the installation is completed, reset the manhole cover, tidy tools & the site, make the mark, and remove the enclosure at last.

### 4.3 Installation of manhole cover monitoring terminal for other materials

Other materials manhole cover monitoring terminal installation method please contact us, we can provide customized installation solutions according to actual needs.


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## 5 Accessories

Customers can choose the attachment according to the selection table shown in Table 2.

Note: If you have questions about attachment selection, please contact your supplier.

Table 2 Annex selection table

| Annex | Description | Remarks |
|---|---|---|
| PL2303 | USB to UART-TTL adapter. It is used for customers to make their configuration. Otherwise it's not needed. | |
| CS-iTWM-05D-A01 | Mounting fittings for the manhole terminal on the back of the manhole cover | |
| CS-iTWM-05D-A02 | Mounting fittings for the installation on the lower layerdirect perforated manhole terminal | |

## 6 Precautions

1) Background Angle refers to the initial Angle of the wellhead after the installation is completed and the wellhead is closed. This is the standard for judging whether the alarm is generated. Generally not more than 10 degrees (except slope manhole cover);

2) After the manhole cover terminal is activated and turned on, the indicator end is placed horizontally downward to the normal state;

3) The installation of the terminal must be firm to ensure that the manhole cover monitoring data is reliable and stable;

4) When collecting and updating the background Angle of the product through commands, it must be ensured that the manhole cover is normally closed, otherwise the collection error will occur;

5) Battery power description:

a. Battery life is estimated under a typical environment (refer to remarks). Under the condition that a maximum of two messages are sent per day and the network environment is good, the manhole cover terminal strictly meets the technical requirements of product life;

NB-IoT typical working environment @25℃ : RSRP = -85dBm, SNR = 7


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b. When the device is installed in the poor NBIOT network (RSRP<-100,SINR<3) or the LORAWAN gateway performance is poor (the communication distance is short, can not cover the terminal node), will affect the normal operation of the product and shorten the battery life;

c. The remaining battery power information provided in the manhole cover monitoring terminal data message is for reference only and subject to actual use; Calculate from the product delivery date, when the use time exceeds 3 years or more than 3000 data sent, it is recommended to replace the battery.

## 7 statement

The company reserves the right to modify the specifications and contents of this manual, and is subject to change without prior notice. Due to product updates, some details of this document may not match the product, please refer to the actual product, the right to interpret this document belongs to the company.


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