



CS-iTWLM-05 Manhole Cover & Water level Monitor

# User Manual

(CS-iTWLM-05-SS)

(REV:A)

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# CS-iTWLM-05 Manhole Cover & Water level Monitor

## User Manual

### 1 Overview

#### 1.1 Introduction

The manhole cover & water level monitoring sensor is installed on the back of the manhole cover, which is placed horizontally as a normal state. The alarm condition is triggered when the manhole cover is tilted and the inclination angle is over  $10^{\circ}$  (configurable) or the water level exceeding the limit. The alarm signal is sent to the monitoring center through wireless transmission. Then, the monitoring center analyzes the data and judges the alarm.

The device, shown in Figure 1, can provide three wireless communication modes: LoRaWAN, NB-IoT and GPRS. It is powered by battery, and features easy mounting, long battery life, high detection accuracy and stable operation.



Figure 1 Manhole cover & Water level monitor

#### 1.2 Working principle

The manhole cover & water level 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. And It detects whether the water level exceeds the limit by water level float. The alarm condition is triggered when the manhole cover is tilted and the inclination angle is over  $10^{\circ}$  (configurable) or the water level exceeding the limit. 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  $10^{\circ}$ ). 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:  $ABS(\text{current angle} - \text{initial angle}) > \text{alarm angle threshold}$  or the water level is raising until the float floats upward (shown in Figure 2). When the condition is met, an alarm message is sent.

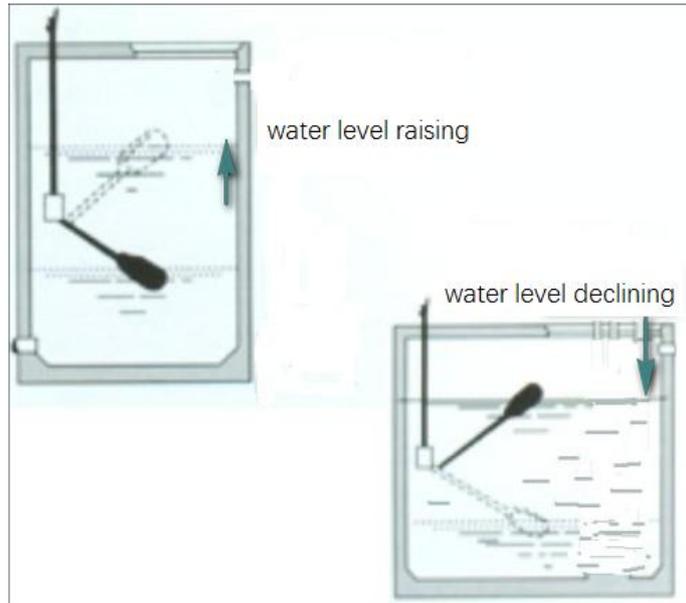


Figure 2 water level state

## 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	433MHz/470MHz/868MHz/915MHz	LoRaWAN
	B1/B3/B5/B8/B20	NB-IoT
	850/900/1800/1900MHz	GPRS
Equipment type	Class A	LoRaWAN
Antenna interface	FPC 天线	
Operating Voltage	Lithium batteryER26500+SPC1550 (3.6V)	ER26500+SPC1550 Not rechargeable
Battery Life	3-5years	Test condition: Work normally and report data up to twice a day
Maximum working current	<200mA	LoRaWAN
	<350mA	NB-IoT
	<2000mA	GPRS
Sleeping current	<25.0uA	
Protection level	IP68	
Shell material	PC+ABS Anti-aging, anti-corrosion, anti-collision materials	
Operating temperature	(-25~+85)°C	Consumer SIM Card
	(-40~+85)°C	Industrial SIM Card/LoRaWAN
Storage temperature	(-40~+85)°C	
Measuring range	0°~ 180°	
Measurement accuracy	±2°	

### 2.2 Dimensions

The shape and size of the manhole cover & water level monitoring sensor are shown in Figure 3.

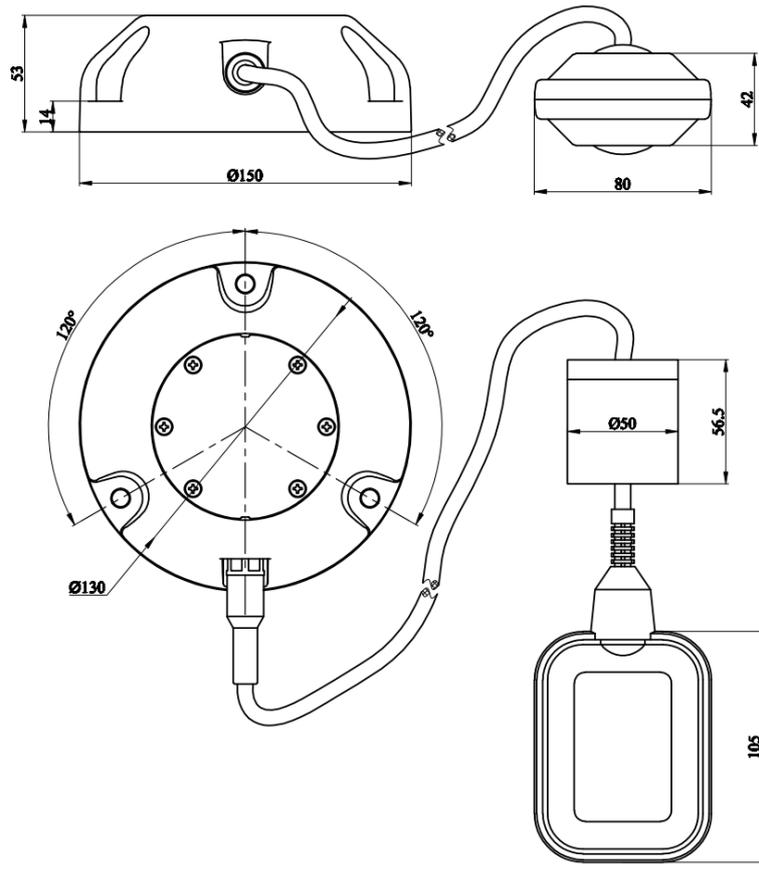


Figure 3 Dimensional drawing

### 3 Instructions for use

#### 3.1 Installing the SIM Card

For NB-IOT and GPRS communication devices, users can open the device's cover and install SIM cards themselves. After the installation is complete, put the cover on and tighten the screws to ensure waterproof performance.

It is recommended to use the SIM card provided by the manufacturer for the best protection. The user can also provide the SIM card and the manufacturer install it before leaving the factory.

#### 3.2 Powering on the product and replacing the battery

The sensor is powered by a disposable lithium battery(optional accessories). If it is equipped with a battery by factory, the product is not powered when it leaves the factory. When the battery is low and the device reports the low voltage alarm message, please replace the battery of same type (model: ER26500+SPC1550 battery pack, consulting the manufacturer for other equivalent battery type).

The steps to install or replace the battery are shown in Figure 4:

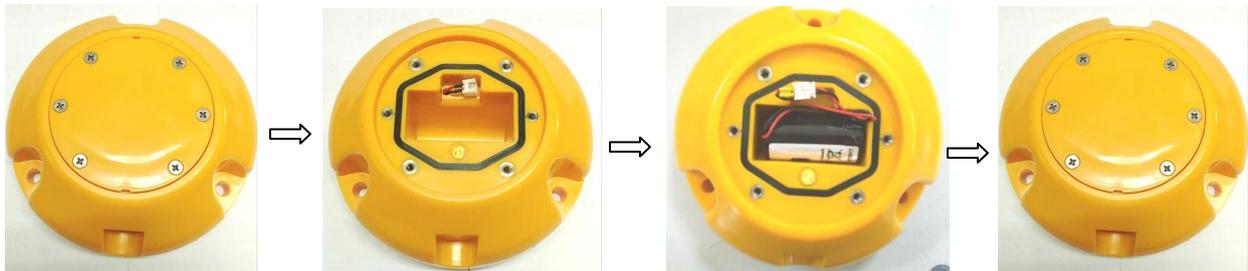


Figure 4 Battery installation or replacement

Open the cover to plug in the battery connector, the product is powered on.

Note: After installing the battery, cover the battery compartment cover, tighten the screws, and make sure the sealing ring is properly installed. If the seal is missing or the screws are not tightened, it will lose the waterproof performance.

#### 3.3 Initial angle acquisition

After power on, there is 30 minutes for installation. After 30 minutes, the initial angle value of the manhole cover in the normal closed state at the wellhead will be collected as the reference angle value for judging whether the manhole cover is abnormal or not. Make sure that the manhole cover is not disturbed by external vibration and other factors during this period.

If the initial angle value is wrong in the product report data information, it can cause false alarm information. This problem can refer to the terminal communication protocol to collect the

initial angle command, re-collect and update the initial angle value to ensure the accuracy and reliability of the initial angle value.

### **3.4 Network Description**

#### **3.4.1 LoRaWAN Networking Instructions**

LoRaWAN devices support OTAA and ABP network access. The network access parameters can be default parameters. The user can also provide the network access parameters before the product leaves the factory. The user can also choose to configure the network access parameters.

If you choose to configure your own network configuration, you can obtain configuration documentation from the manufacturer.

The DEVEUI is printed on the product casing and can be used directly when entering the network.

#### **3.4.2 NB-IoT Networking Instructions**

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

### **3.5 Communication Protocol**

Product communication protocol related documents are available from the manufacturer.

## 4 Installation method

### 4.1 Installation of Floating Ball and Heavy Hammer

The plastic ring above the circular hole is sheathed on the cable, set to the position of the water level exceeding the limit line, and gently push the weight hammer to pull out the cable until the plastic ring is fastened in the center of the weight hammer, that is, it will not fall off. As shown in Figure 5.

Note: If this plastic ring is damaged or lost, it can be replaced by cable with bare copper wire of the same diameter.



Figure 5 Installation diagram

The control height of the liquid level is determined by the length of the cable in the liquid and the position of the weight hammer in the cable.

The method of fixing the weight hammer is as follows:

1. the clamp ring at the non-horn end of the heavy hammer is removed and sheathed in the proper position of the cable.
2. When the cable is penetrated from one end of the bell mouth of the hammer, the clamp ring on the cable limits the position of the hammer.
3. Fix the cable in the proper place. Avoid using the intermediate joint as far as possible. If there is a joint, it must not be immersed in liquid.

Note: Plastic hammer non-bell end clasp can also not be dismantled, directly through the cable from the bell end, and then wrapped with waste bare wires in the appropriate position of the cable to clamp the plastic hammer can be.

### 4.2 Installation of power double-layer manhole cover

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



Figure 6 Physical Map of Double Cover

The construction steps and technical requirements are as follows:

Installation accessories: CS-ITWM-A03

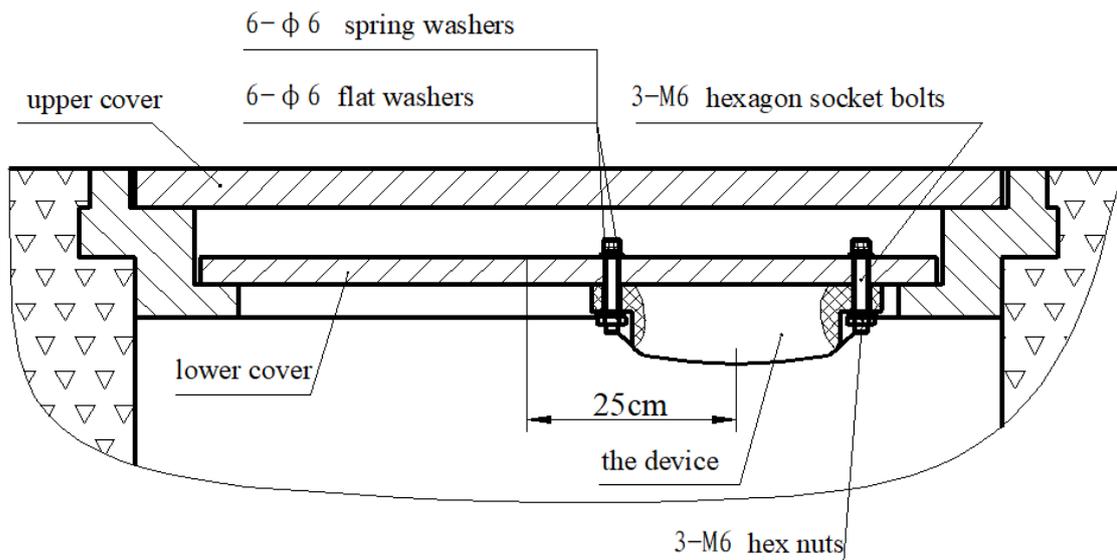


Figure 7 Installation instruction with CS-ITWM-A03

- 1) The maintenance worker uses a special tool to 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.
- 3) Place the monitoring device flat on the pre-installation position of the lower protective cover, use the pencil to align the 3-φ8mm holes centers to describe the pre-punching position on the lower cover;

4) Remove the monitoring device, install the  $\phi 6$  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 3-M6\*35mm hexagon socket bolts with spring washers and flat washers through the 3- $\phi 8$ mm holes, tighten the 3-M6 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, the maintenance worker put the upper manhole cover back and lock it with the special tool.

### 4.3 Installation of non-metal composite manhole cover

For composite or non-metallic manhole covers, in order not to damage the structure of the manhole cover itself, the monitoring terminal can be fixed onto the manhole cover using special kits, shown as follows.



Figure 8 Installation instruction with CS-i

For such manhole covers, the installation method of the monitoring device is as follows:

Installation accessories: CS-iTWM-A02

1) Select the longitudinal beam or beam with higher dimension, use the proper U-shaped stainless steel channel steel, shown as below, the width A of the channel should be slightly larger

than the width of the beam cover beam, and cut the channel into a small section of length C. The dimension C should be less than the gap width between the staggered longitudinal beams on the manhole cover to ensure that the U-Steel can insert in between the manhole beams.

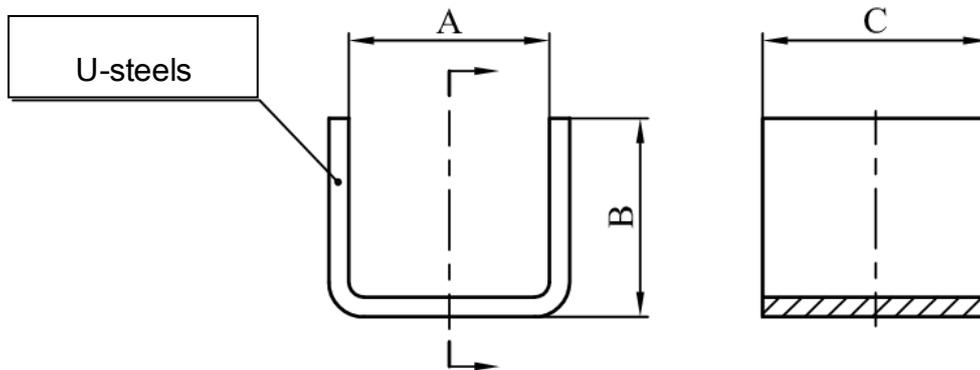


Figure 9 Processing instruction of U-steels

2) Cut the U-steel into small sections as follows.

Install the stainless steel rivet nuts on the three sides of the U-steel. The positions of each side are shown in the figure below.

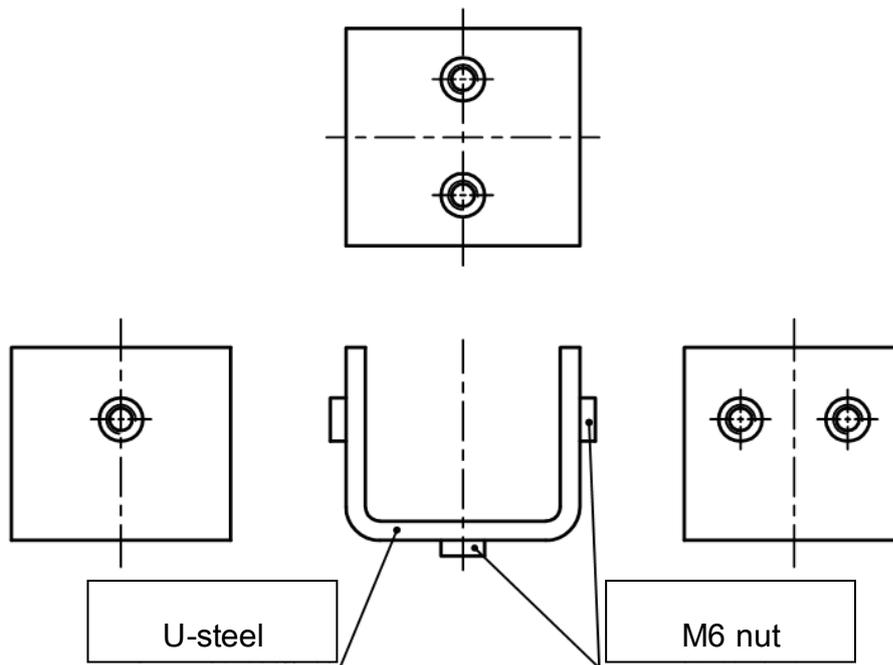


Figure 10 Installation instruction with rivet nut

3) Make the U-steels with the rivet nut clamped and fixed to the beams with the M6 taper end screws, tighten the M6 hex nuts to lock it.

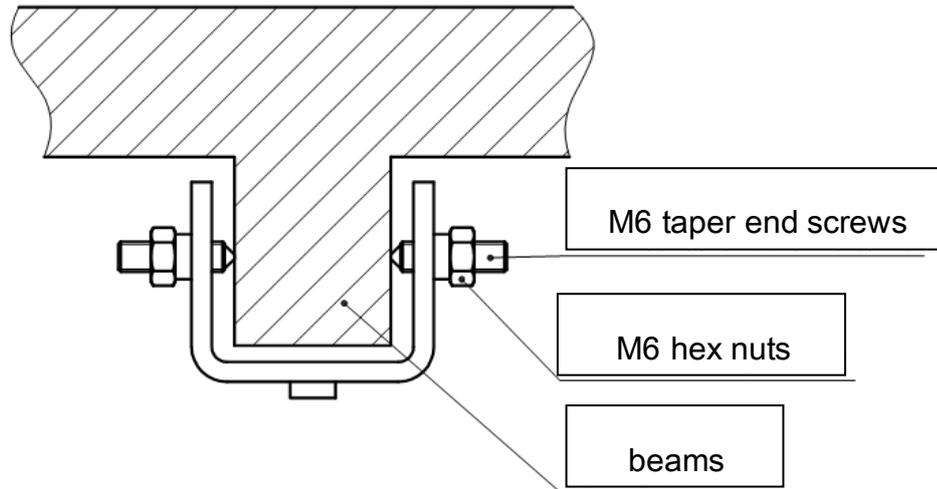


Figure 11 Installation instruction with U-steels

4) Install the device on the fixed U-steels as shown in the figure.

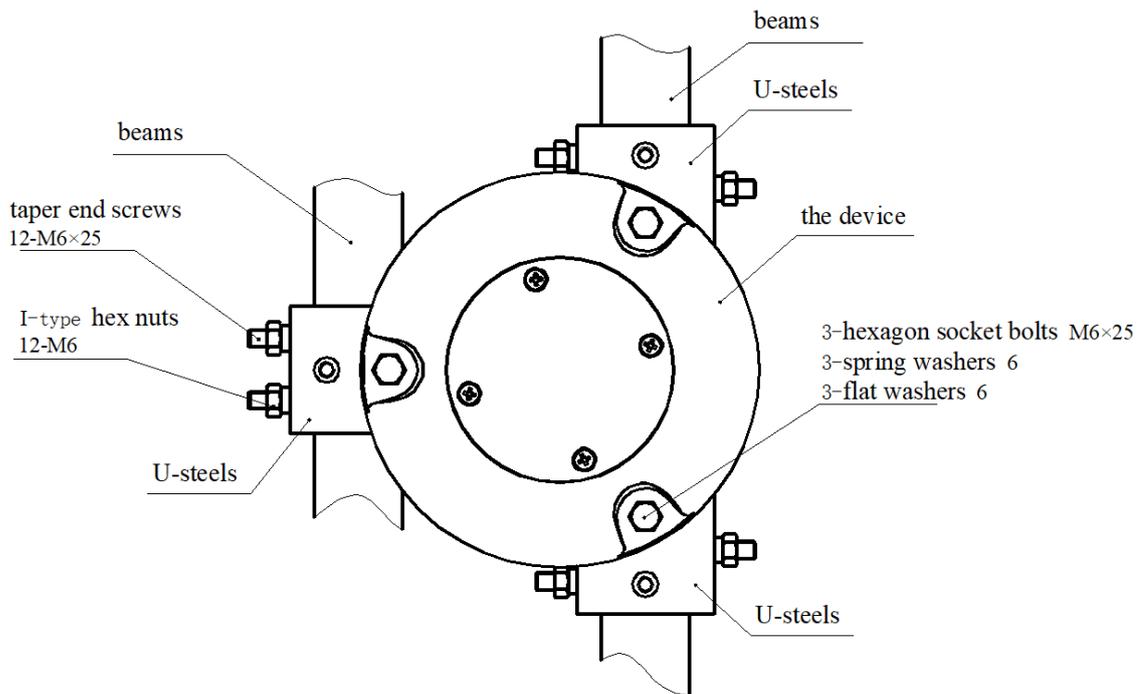


Figure 12 Installation Instruction with CS-iTWM-A02

#### 4.4 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.



Figure 13 Iron manhole cover

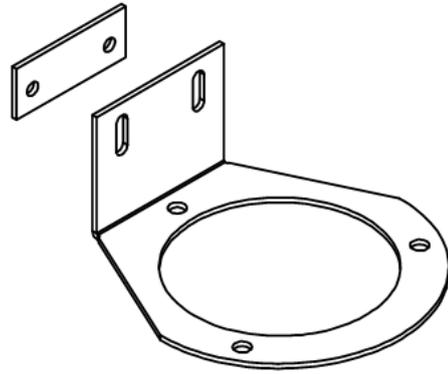


Figure 14 Bracket

The construction steps and technical requirements are as follows:

Installation accessories: CS-ITWM-A01

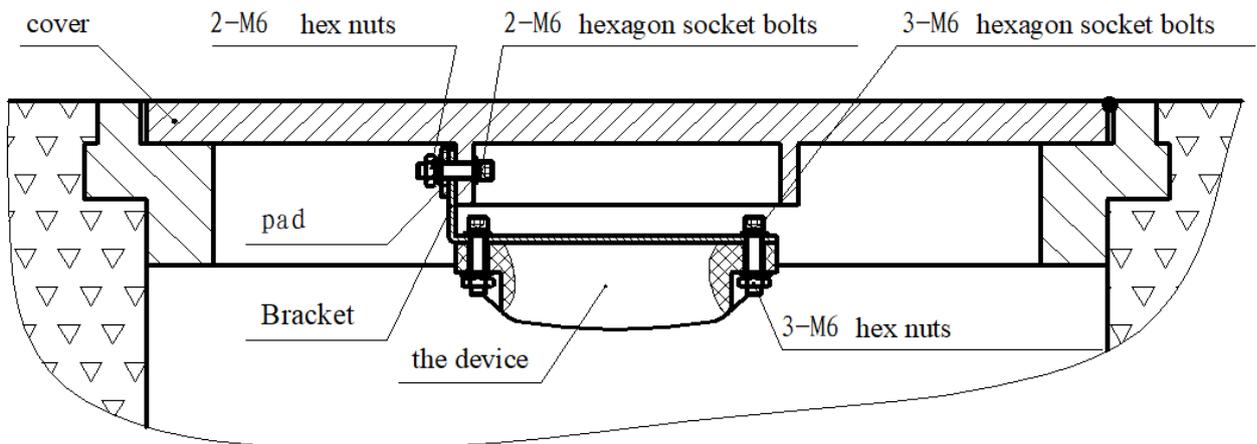


Figure 15 Installation Instruction with CS-ITWM-A01

- 1) The maintenance worker opens the manhole cover. After the manhole cover is pulled open, 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- $\phi 6.5\text{mm}$  hole centers on the gasket;
- 3) Use a hand-held electric drill with a  $\phi 6$  cobalt drill bit, and drill 2 holes at the fixed position, make sure the drill right at the center of drawing holes;

4) Place the 2-M6\*35mm hex socket bolts with spring washers and flat washers in sequence, as shown in Figure 15, through the 2 holes on the manhole cover, mounting bracket and gasket. Drip the thread glue on the bolts and nuts, pre-tighten the 2-M6 nuts by hand, adjust the top surface of bracket to the same level of the bottom of the manhole cover, and then tighten the bolts and nuts with the inner hexagonal wrench.

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) Insert the 3-M6\*25 hex socket bolts one by one, with the spring washer and flat washer, through the 3- $\phi$ 8 holes on the mounting bracket. Drip the thread glue on the bolts and nuts, screw and pre-tighten them by hands, then use the inner hexagon wrench to tighten the bolts and nuts;

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;

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

## selection guide

Table 2 Terminal selection table

Model				
CS-ITWL M-05				
	Communication			
	LW	LoRaWAN		
	NB	NB-IoT		
	G	GPRS		
		Frequency		
		B1	NB-IOT	
		B3	NB-IOT	
		B5	NB-IOT	
		B8	NB-IOT	
		B20	NB-IOT	
		BG	B1/B3/ B5/ B8/B20 (NB-IOT)	
		EU433	433MHz ( LORAWAN )	
		CN470	470MHz ( LORAWAN )	
		EU868	868MHz ( LORAWAN )	
		US915	915MHz ( LORAWAN )	
AS923	923MHZ ( LORAWAN )			
*	Please indicate the other frequency bands, including GPRS scenes.			
				
CS-ITWL M-05	NB	B8		

Example:

CS-ITWLM-05\_NB\_B8: NB-IoT , B8。

CS-iTWLM-05\_LW\_868: LORAWAN 868MHZ。

CS-iTWLM-05\_G\_900/1800: GPRS 900/1800MHZ。

Note:

Our company can provide Industrial SIM Card and Consumer SIM Card. If the product is required to be equipped with SIM Card, please indicate the type of SIM Card when purchasing. Please refer to Table 1 in Section 2.1 for the operating temperature range of Industrial SIM Card and Consumer SIM Card.

## 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 3 Annex selection table

Annex	Description	Remarks
PL2303	USB to UART-TTL adapter. Customers use the product when they make their own products. If they are not configured, they are not needed.	
ER26500+SPC1550	The product comes with a battery when it leaves the factory. If you need extra battery, please specify when purchasing.	
CS-iTWM-A01	Mounting fittings for the manhole terminal of the end of the manhole cover	
CS-iTWM-A02	Mounting fittings for manhole cover with "well" shaped beams on the back of the non-metallic composite manhole cover	
CS-iTWM-A03	Mounting fittings installed in the second floor or direct perforated manhole terminal	Factory default install accessory

## 6 Precautions

### 6.1 Terminal networking is unsuccessful

Check if the node module is registered in the server;

Check if the battery has power or the battery is too low

Check if there is a fee for the SIM card and whether the data service is open;

Please contact the supplier for other questions.

### 6.2 The product may be underreported due to the following reasons

The SIM card is damaged or the SIM card is not installed;

The battery is exhausted;

False negatives occur when the signal is not good or when the signal is blocked;

Other special circumstances

## 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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