Milesight

VS121

AI Workplace Occupancy Sensor

User Guide

Contents

Chapter 1. Preface

Copyright Statement

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Safety Instruction

Milesight will not shoulder responsibility for any loss or damage resulting from not following the instructions of this operating guide.

Warning:

Serious injury or death may be caused if any of these warnings is neglected.

- This installation must be conducted by a qualified service person and should strictly comply with the electrical safety regulations of the local region.
- To avoid risk of fire and electric shock, do keep the product away from rain and moisture before installation.
- Do not touch components which may be hot.
- Make sure the plug is firmly inserted into the power socket.
- Make sure the device is firmly fixed when installing.

CAUTION:

Injury or equipment damage may be caused if any of these cautions are neglected.

- The device must not be disassembled or remodeled in any way.
- Do not place the device where the temperature is below/above the operating range.
- The device must never be subjected to shocks or impacts.
- Do not expose the device to where a laser beam equipment is used.
- To prevent heat accumulation, do not block air circulation around the device.

- Use a soft, dry cloth to clean the lens of the device. Stubborn stains can be removed using a cloth dampened with a small quantity of detergent solution, then wipe them dry.
- Do not use volatile solvents such as alcohol, benzene or thinners as they may damage the surface finishes.

Revision History

Date	Doc Version	Description
Apr. 26, 2021	V 1.0	Initial version
Jan. 18, 2022	V 1.1	1. Support line crossing counting feature; 2. Support D2D feature; 3. Support people counting debounce; 4. Support uploading max number of people; 5. Support downlink control.
Apr. 8, 2022	V 1.2	1. Milesight LOGO update; 2. Support recognition scheme selection.
June 20, 2022	V 1.3	1. Update web GUI menu; 2. Support customize people counting detection area to 16 regions; 3. Add recommended installation guide and line drawing note.
Dec. 14, 2022	V 1.4	1. Support per region people counting uplinks 2. Add private mask feature 3. Add LoRaWAN single channel mode 4. Add Wi-Fi SSID broadcast option 5. Delete Auto Reboot and LoRaWAN V1.1.0 option 6. Support live view blur process and delete Image Config

Date	Doc Version	Description
Mar. 9, 2023	V1.5	1. Add privacy mode under activation page 2. Support filter U-turns feature
Apr. 20, 2023	V1.6	Add installation height of high ceiling mount version
July 15, 2023	V1.7	1. Add people flow analysis feature; 2. Reporting interval range is extended to 5~86400s; 3. Add report interval downlink control command; 4. Add rejoin 9~16 people uplink definition. 5. Adjust illuminance of region people counting.
Apr. 8, 2024	V1.8	1. Support region dwell time detection; 2. Support to report data with timestamp; 3. Support data retransmission feature; 4. Support time sync with Milesight gateway.
Jul.30	V1.9	1. Add configuration of Wi-Fi passwords at login, user passwords are required to contain 4 styles. 2. Add Log Management. 3. Support to configure TX Power. 4. Support Trigger Report. 5. Add Detection Persistence Time Setting. 6. Privacy mode switching is available on the web page. 7. Add Schedule Setting. 8. Add 5 timestamps to reset cumulative data. 9. Add downlink commands. 10. D2D supports for region association and test mode.

Chapter 2. Product Introduction

Overview

VS121, based on Artificial Intelligence (AI) technology, is an AI workplace sensor designed to monitor occupancy & utilization in modern workspace, which can reach up to 98% recognition rate. Only counter values are transmitted over LoRaWAN® network to prevent privacy concerns. VS121to prevent the privacy concerns. VS121 is equipped with Wi-Fi for easy configuration without any tools.

Sensor data are transmitted in real-time using standard LoRaWAN® protocol. LoRaWAN® enables encrypted radio transmissions over long distance while consuming very little power. The user can obtain sensor data and view the trend of data change through the user's own network server.

Key Features

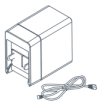
- Recognition rate is up to 98% based on advanced AI identification and analysis technology and wide detection range
- Support people counting,occupancy detection and dwell time detection
- Support to map up to 16 custom regions
- Allow for bi-direction line crossing people counting
- Support U-turn detection for effective data and precise detection
- Support people flow analysis to calculate the traffic from different directions
- No image data is collected, free from privacy concerns
- Equipped with Wi-Fi for web GUI configuration
- Function well with standard LoRaWAN® gateways and network servers

Chapter 3. Hardware Introduction

Packing List

1 × VS121 Device

4 × Wall Mounting Kits



1 × Type-C Cable (1 m) & Power Adapter

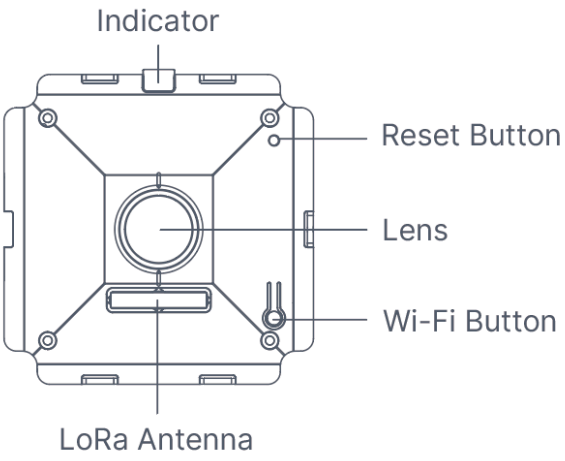
1 × Mounting Sticker

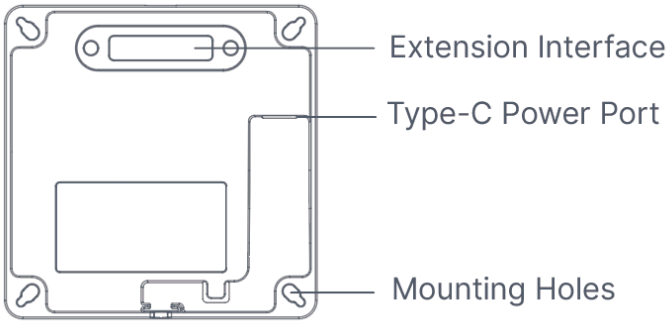
1 × Warranty Card

1 × Quick Start Guide

Note:
If any of the above items is missing or damaged, please contact your sales representative.

Hardware Overview

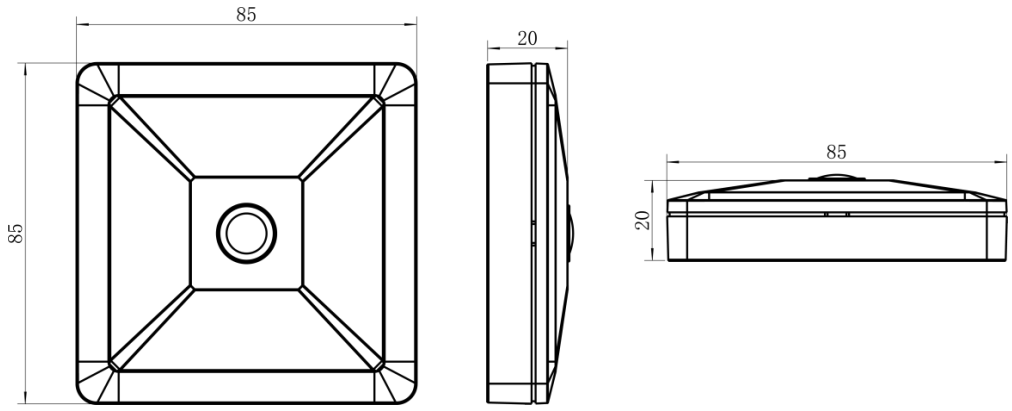




Buttons and LED Indicators

Function	Action	LED Indication
Turn On/Off Wi-Fi	Press and hold the Wi-Fi button for more than 3 seconds.	Off → Green Light On
	Press and hold the Wi-Fi button for more than 3 seconds.	Green Light On → Off
Reset to Factory Default	Press and hold the reset button for more than 10 seconds.	Blinks 6 times.

Dimensions (mm)



Chapter 4. Installation

Preparation before Installation

To better utilize the advantages of AI algorithm, there are some important steps to follow:

Recommended Height for Certain Object

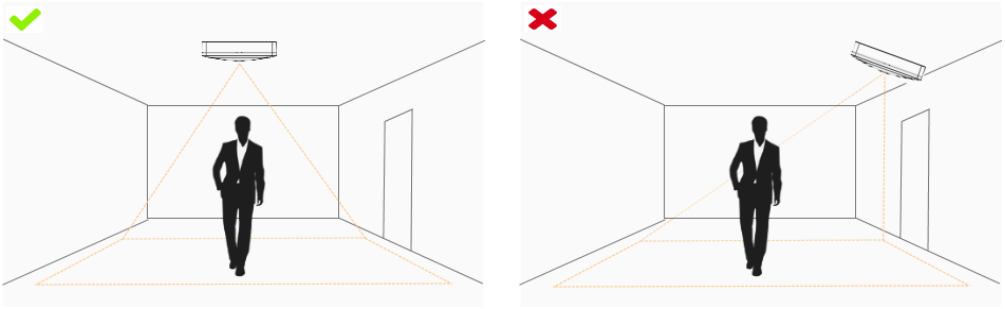
Object	Installation Height	Note
Sedentary object	> 2.5m (8.2ft)	Commonly used for Region People Counting
Standing object	> 3m (9.8ft) (the optimum height is 3m)	Commonly used for Line Crossing Counting and People Flow Analysis

Covered detection area for region people counting and people flow analysis at different heights:

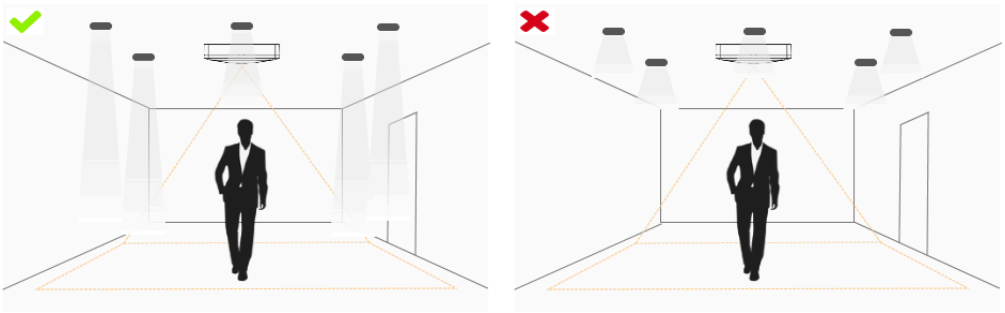
Version	Recommended Installation Height	Covered Detection Area
Standard Version	2.3m	2.6m × 8.6m
	2.5m	3.2m × 9.8m
	2.7m	4.2m × 13.6m
	3m	4.8m × 14m
	3.2m	5.2m × 15.4m
	3.5m	6m × 17m
	4m	6.8m × 18.8m
High Ceiling Mount Version	5m	3.5m × 10m
	6m	4.5m × 12m
	7m	5.5m × 14m

Recommended Installation for Line Crossing Counting

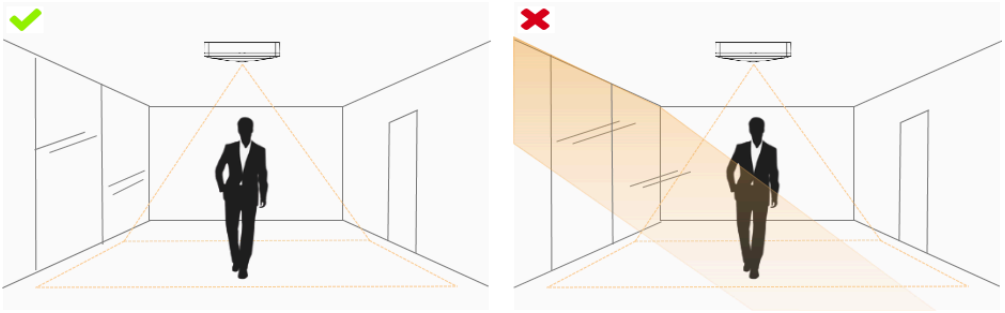
- Make sure the sensor is facing straight down, in line with the ceiling.



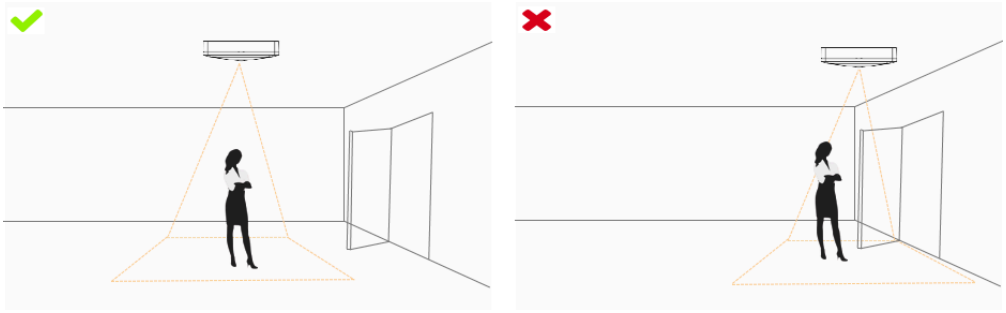
- Make sure there is sufficient white light on site.



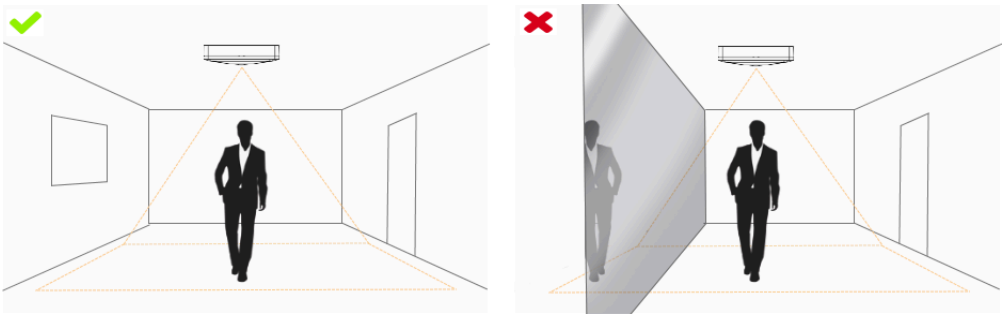
- Avoid getting very strong light, like sunlight.



- Make sure there are no moving objects interfering in the counting area. For example, do not install the sensor too close to a door.



- Avoid installing the sensor near a mirror or avoid drawing the line to the mirror.



Illuminance Requirements for AI Analysis

Region People Counting

- We recommend that the illuminance is greater than 20Lux.
- We recommend enabling WDR function, which will make the image effect better.

Line Crossing Counting and People Flow Analysis

- We recommend that the illuminance is greater than 50Lux.
- When the illuminance is between 20~50Lux, we recommend disabling WDR function.
- When the illuminance is > 50Lux and the scene has a clear contrast between light and dark (such as a corridor), we recommend enabling WDR function.

To know the illuminance of the current scene, you must use an illuminance meter, or you can refer to the following common environmental illuminance values:

Place/Environment	Illuminance
Indoors at dusk	10 Lux

Place/Environment	Illuminance
cloudy indoor	5~50 Lux
sunny indoor	100~1000 Lux

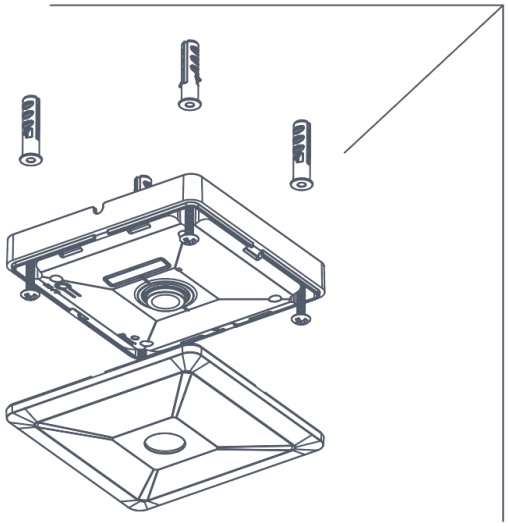
Installation Step

Step 1: Ensure the thickness of ceiling is more than 30 mm, then attach the mounting sticker to the ceiling and drill 4 holes with a diameter of 6 mm.

Step 2: Fix the wall plugs into the ceiling holes.

Step 3: Remove the cover on the device, then fix the device to the wall plugs via mounting screws; remember to adjust the mounting direction according to the detection area requirement and direction sticker on the inner cover.

Step 4: Take the cover back to device; note that the Milesight Logo should be facing the LED indicator.



Factors Affecting Accuracy

1. When the color of hair or clothes is close to the floor color, it becomes difficult for the algorithm to identify the correct object.
2. When the floor and wall colors are black, it reduces the brightness of the scene due to light absorption.
3. When the contrast between light and dark in the scene is too strong, it can cause people to be backlit, making detection more difficult.

Chapter 5. Access the Sensor

VS121 sensor provides user-friendly web GUI for configuration and users can access it via Wi-Fi connection. The recommended browsers are Internet Explorer, Firefox, Chrome, Microsoft Edge, Safari. The default IP of sensor is 192.168.1.1, and default SSID is Workplace Sensor_XXXXXX (can be found on the label).

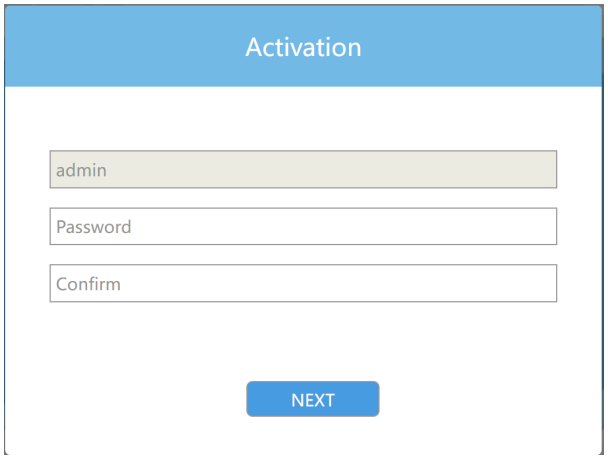
Note:
Please ensure the device is connected to a power source before connecting.

Access without Plugin

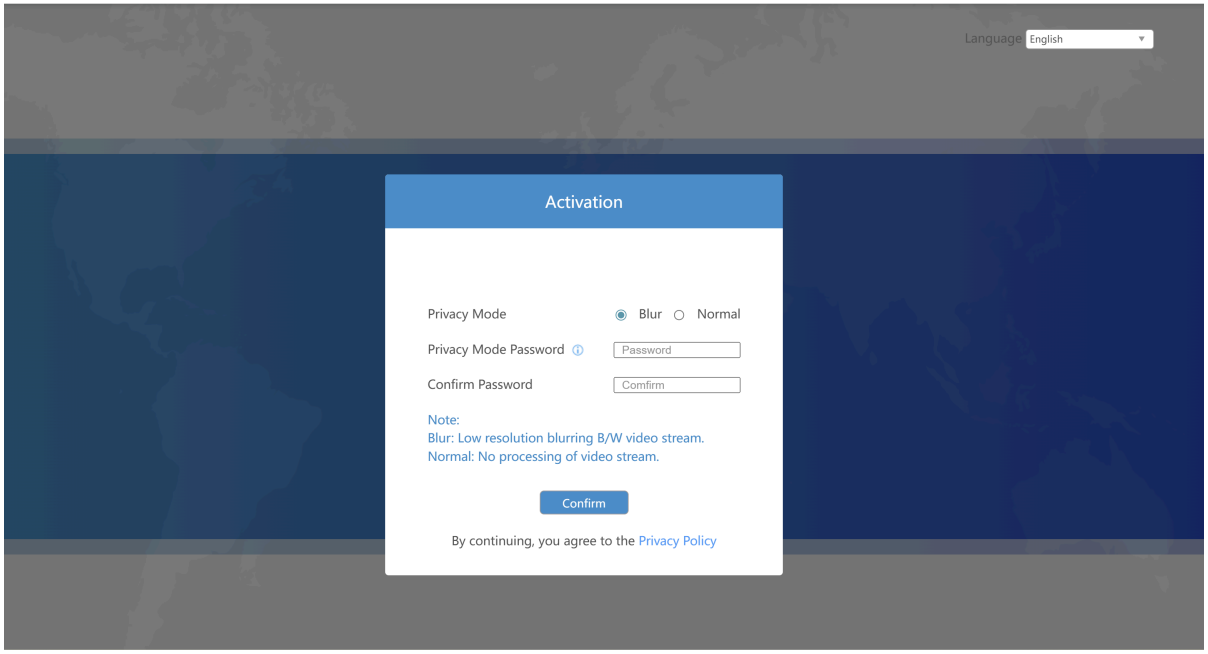
Step 1: Enable the Wireless Network Connection on your computer and search for corresponding access point, then connect computer to this access point.

Step 2: Open the Browser (except Internet Explorer), and type 192.168.1.1 to access the web GUI.

Step 3: Users need to set the password and three security questions when using the sensor for the first time.

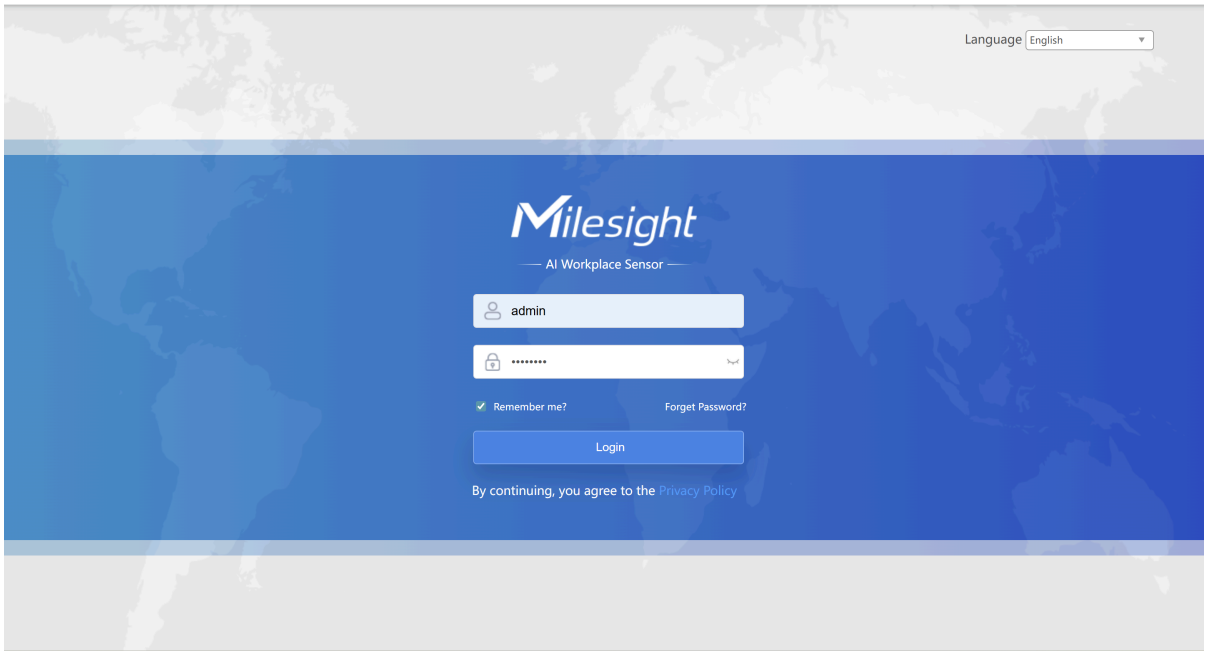


Step 4: Select the Privacy Mode for the live view display.

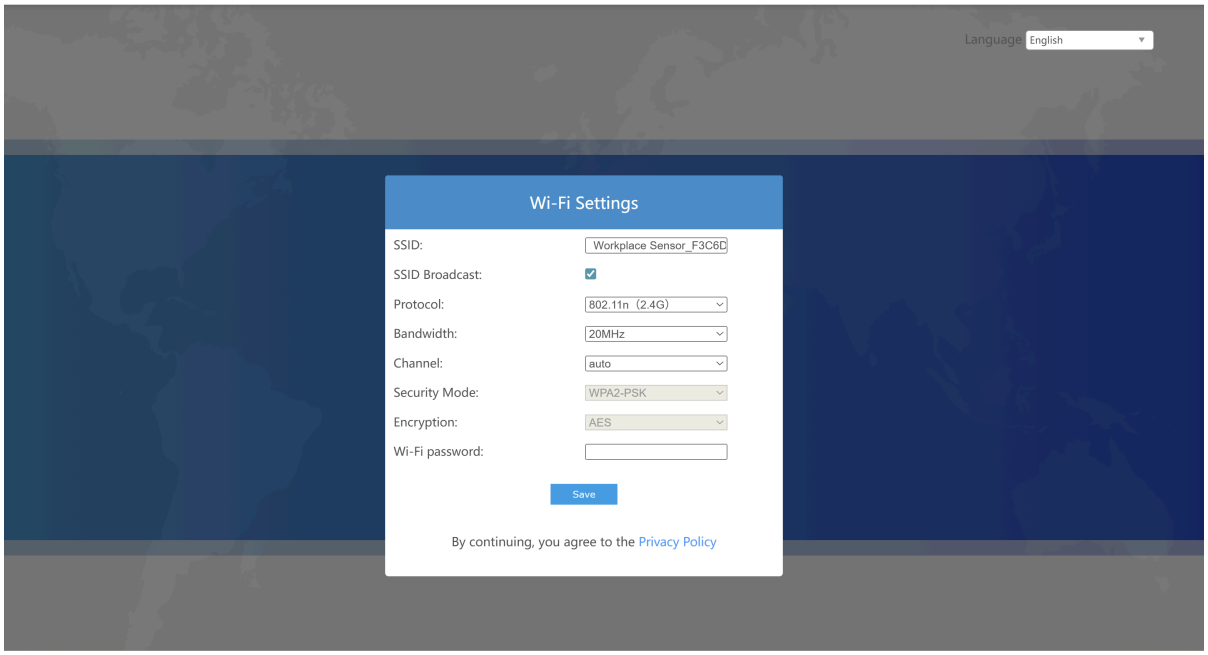


If you would like to switch modes in the future, please go to Privacy Settings.

Step 5: After configuration, log in with username (admin) and custom password.



Step 6: Set the Wi-Fi password.



Note:

1. Login password and Wi-Fi password must be 8 to 63 characters long and contain numbers, lowercase letters, uppercase letters and special characters. If the password is entered incorrectly five times, the account will be locked for 10 minutes.
2. It is recommended that users regularly update their passwords to enhance device security and prevent unauthorized access.
3. You can click the “forgot password” in login page to reset the password by answering three security questions when you forget the password if you set the security questions in advance.

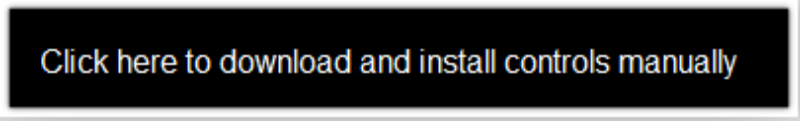
Access with Plugin

For IE browser access, users need to install the MsActiveX firstly. You can refer the steps as follows:

Step 1: Launch the IE browser and enter the IP address of the sensor.

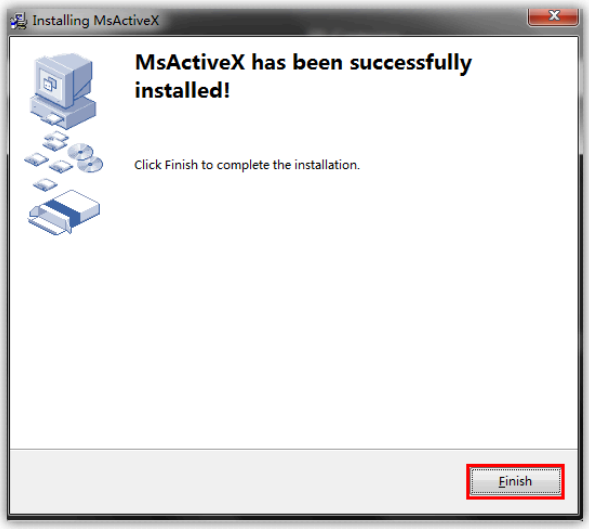
Step 2: Enter the user name and custom password and click "Login".

Step 3: At the first time to log in the device, the browser will prompt to install Controls, please click “Click here to download and install controls manually” as shown below:



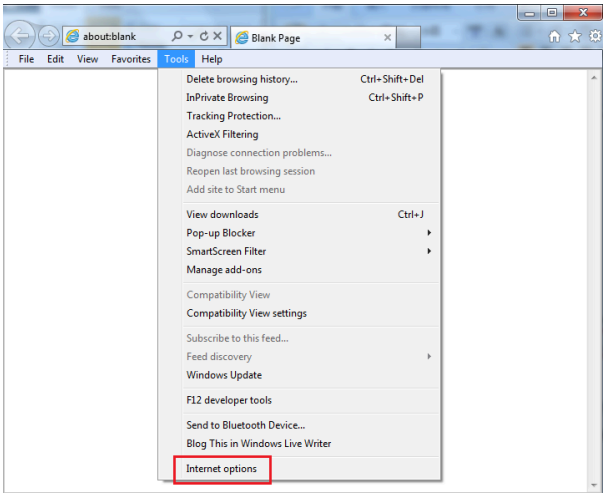
Note:
During installing the controls, please keep the browsers close.

Step 4: Follow the prompts to install the Controls, when it`s finished, it will pop out a window as shown below. Please click “Finish” and refresh the browser, then you will see the video.

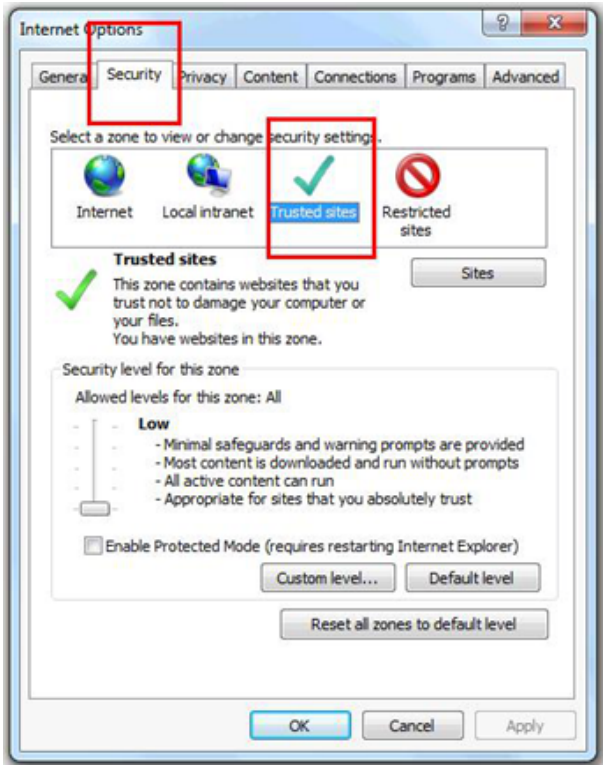


If IE9 or higher version browser is used, it is suggested that the web link should be added as a trusted site. See the instructions as follows:

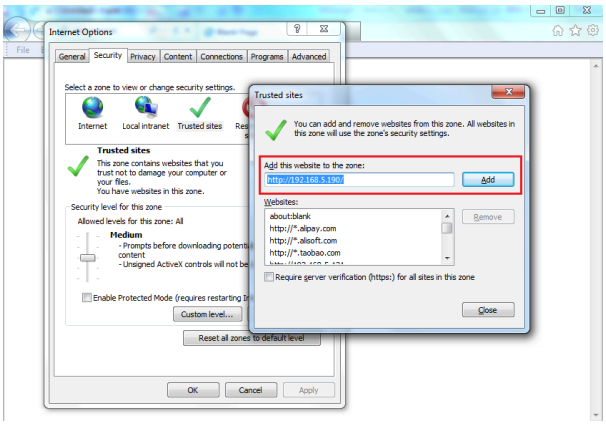
Step 1: Start the IE9 or higher version browser, and select "Tools"→ "Internet Options".



Step 2: Select "Security" to "Trusted".



Step 3: Enter the IP address of the device in the blank and click “Add”.



Step 4: Enter the IP address. After logging on web GUI successfully, user is allowed to view live video.

Chapter 6. Operation Guide

Live Video

After logging on to the device web GUI successfully, user is allowed to view live video as follows:

Parameters	Description
Configuration	Click to access the configuration page.
People Counting (Region)	**People Counting (Region):** show the mapped or non-mapped regions of people counting. **Line Crossing Counting:** show the detection line and counting people it detected. **People Flow Analysis:** show the detection area and people it detected.

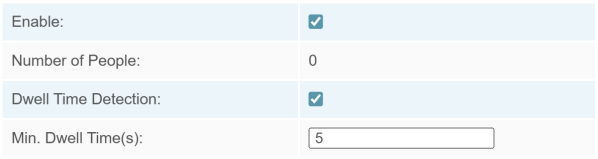
People Counting

Region People Counting

Region People Counting provides automatic, real-time statistics on the number of people within specified regions. With high-precision sensors ensuring seamless data collection, managers can easily track the current occupancy status of each space. It is ideal for conference centers and other venues that require dynamic monitoring of space utilization. Enable this feature if you need to monitor real-time headcount, detect overcrowding, or track personnel movement within certain regions.

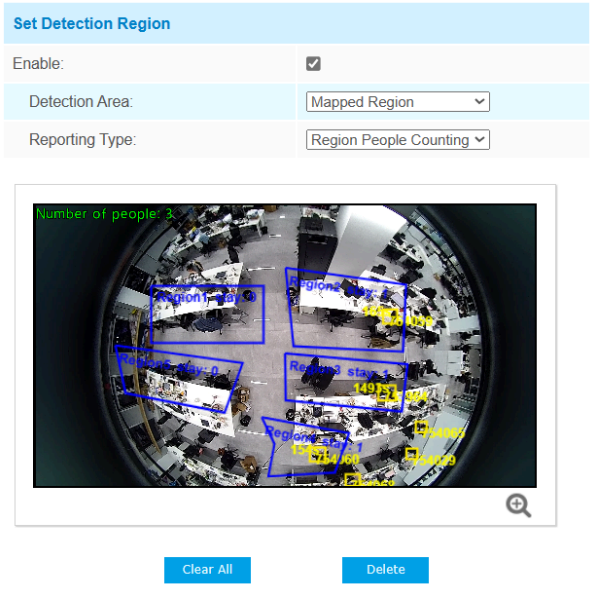
Step 1: Go to **People Counting** → **Region People Counting**, to enable region people counting feature, it will show current number of people.

If you want to know dwell time of objects within the area, enable **Dwell Time Detection** and set **Min. Dwell Time**. When the object dwells in the area longer than the set **Min. Dwell Time**, its dwell time will be reported.



Note:
Dwell time detection reports both the average and maximum dwell times for **all** regions.

Step 2: Draw the detection region. If you want to count the total number of people in the live view, skip this step.



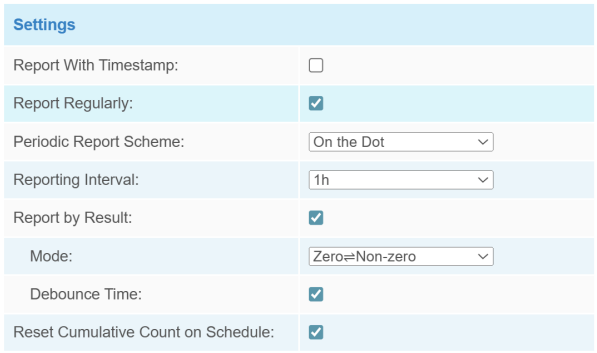
1. When you want to distinguish multiple areas within the live view, enable **Set Detection Region**, choose Mapped/Non-mapped Region.

Parameters	Description
Mapped Region	Only people who are in the mapped region will be detected. There are two reporting types:

Parameters	Description
	Occupancy: report the occupancy status of per mapped region. **Region People Counting:** report the specific number of people of per mapped region.
Non-mapped Region	Only people who are not in the mapped region will be detected.

2. Move the mouse inside the live view to begin drawing the region, click to zoom in on the display.
3. Left-click to start drawing and drag the mouse to draw a line, left-click again to continue drawing an edge in a different direction, and right-click the mouse to complete the drawing. The point can be dragged to adjust the location and length, up to 16 regions are supported with maximum 10 segments each. You can click on a specific area to **Delete** it, or click **Clear All** to remove all regions.
4. Click **OK** to finish drawing.

Step 3: Report setting.

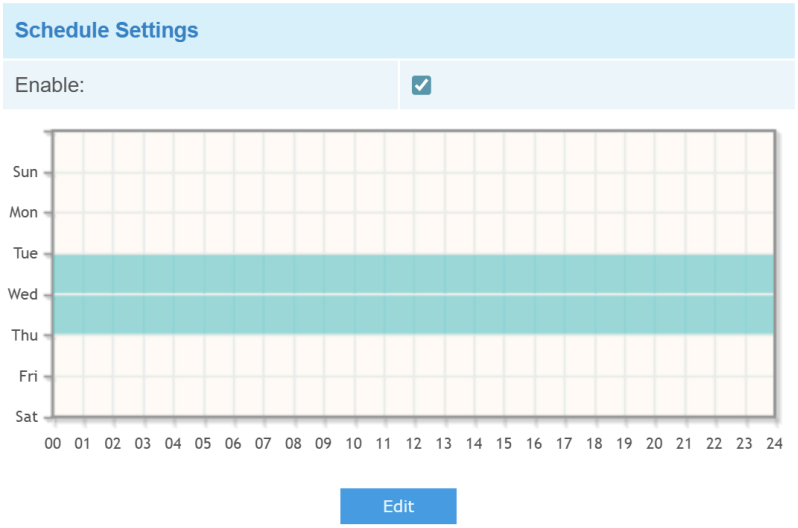


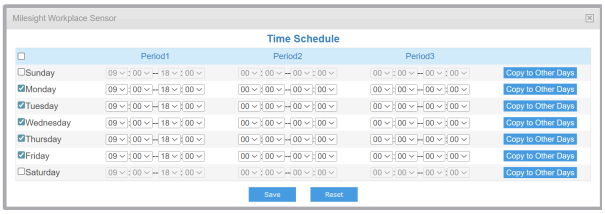
Parameters	Description
Report with Timestamp	Enable or disable report the data with timestamp.
Report Regularly	Select the periodic report of "On the Dot" or "From Now On".
Periodic Report Scheme	**On the Dot:** Report at each integer moment. For example, current time is 0:07, when the interval is set to 10 minutes, it will report at 0:10, 0:20, 0:30, and so on.
Reporting Interval	

Parameters	Description
	From Now On: Begin reporting from this moment onwards and regularly report based on the interval cycle.
Report by Result	Report according to the following changes of people number result: • Zero to Non-zero/Non-zero to Zero • Once result changes
Debounce Time	VS121 will reduce the count value only when the people come out of the detection area for more than 2 s.
Reset Cumulative Count on Schedule	Enable to periodically reset cumulative count on schedule. Support up to 5 reset schedules. Cumulative Count includes: Total In/Out counting of each detection region. Max./Avg. Dwell Time of each detection region. Whenever you modify a reset time record, the reset schedule for line crossing counting will be automatically updated accordingly.

Step 4: If you want the device to count and report data continuously, skip this step.

To pause during specific periods, enable **Schedule Settings** and define weekly time blocks.





For example, as illustrated in the figure, if you select 9:00 AM to 6:00 PM from Monday to Friday, the device will only upload data within this time window. Data reporting will be disabled during all other periods. By clicking **Copy to Other Days** button on the right, you can copy all time periods at once, without having to modify each one individually.

Step 5: After completing all the settings, scroll to the bottom and click **Save** to save all your changes.

Line Crossing Counting

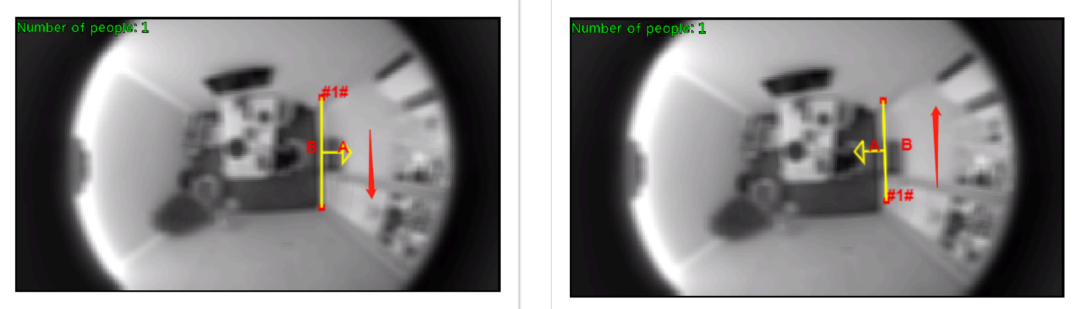
Line Crossing Counting uses a virtual line to accurately count people entering and exiting, with direction detection. It is suitable for entrances, passageways, and partitions. Enable this feature if you need to track the number of people entering or leaving an area, manage access, or distinguish the direction of foot traffic.

Step 1: Go to **People Counting** → **Line Crossing Counting**, to enable line crossing counting feature.

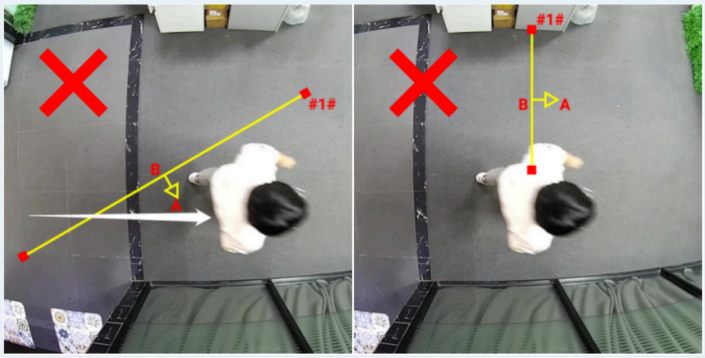
Step 2: Navigate to the live view at the bottom of the page, and click **Draw Line** to draw a detection line. You can draw only one line, click to zoom in on the display, consisting of up to four segments, crossing along the direction of the arrow means “In” and the opposite is “Out”.

Note:

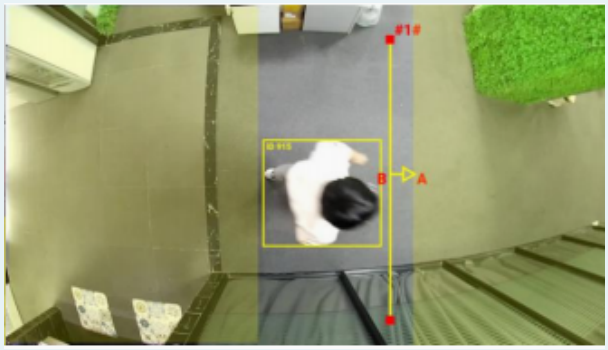
1. The arrow direction of the detection line depends on your drawing direction.



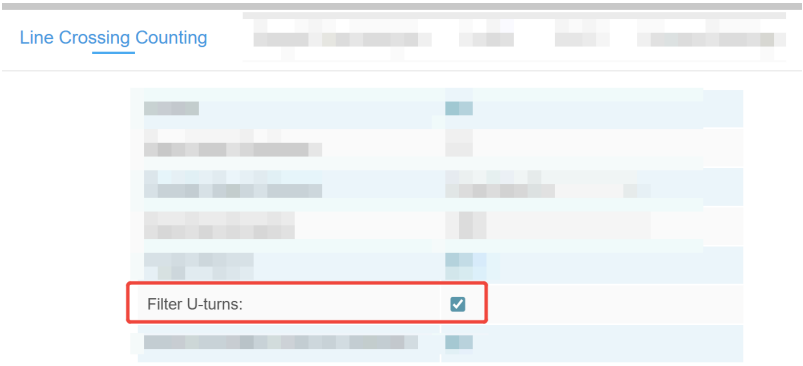
2. Ensure that the detected targets can pass through the detection line completely. It's recommended that the detection line is perpendicular to the In/Out direction and on the center of detection area without other objects around.



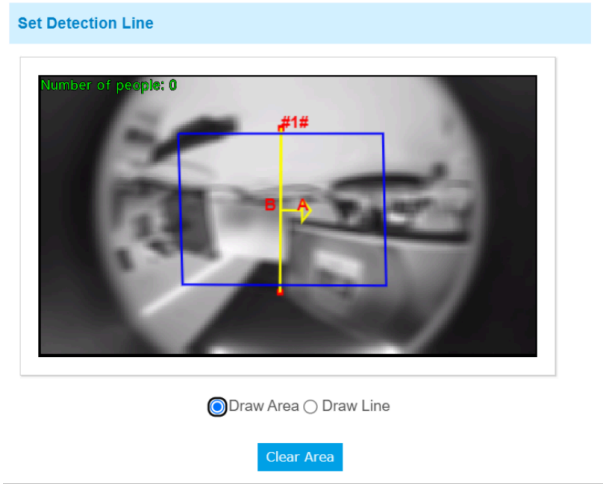
3. A redundant identification area needed to be left on both sides of the detection line for the target. This is to ensure that the sensor has stable recognition and tracking of this target before it passes the detection line, which will make the detection and count more accurate.



Step 3: The device supports the Filter U-turns function, filtering out the people who are actually not entering or exiting the entrance, to avoid repeated counting. If you don't have a need to filter out people, skip this step.

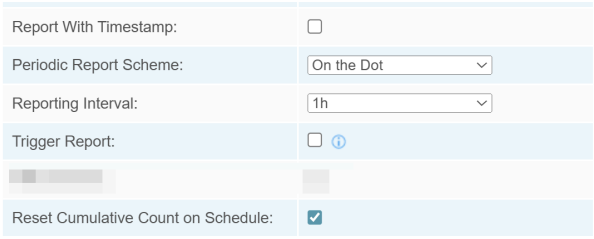


1. Enable Filter U-turns, navigate to the live view at the bottom of the page, and click **Draw Area** to draw a area around the detection line. People who remain or loiter within this area will not be included in the count. You can click to zoom in on the display.



2. Left-click to start drawing and drag the mouse to draw an edge. Then left-click again to continue drawing an edge in a different direction. Right-click the mouse to complete the drawing. The area can be dragged to adjust the location and length.
3. Click **OK** to finish drawing.

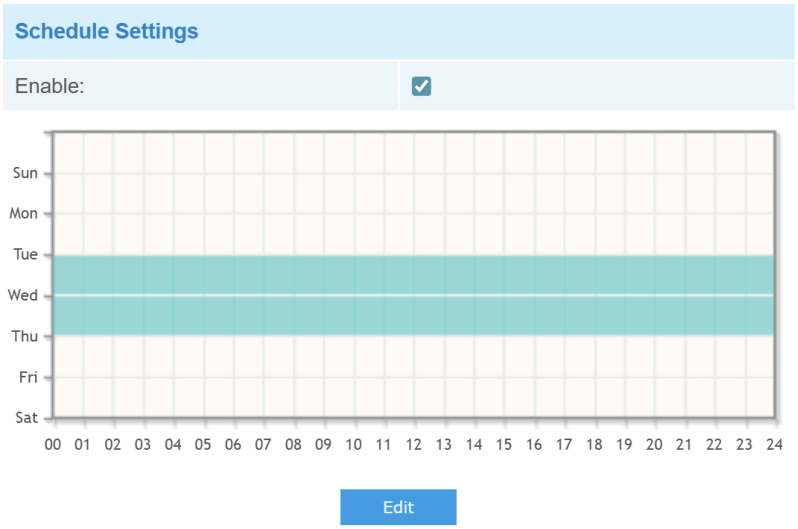
Step 4: Report setting.

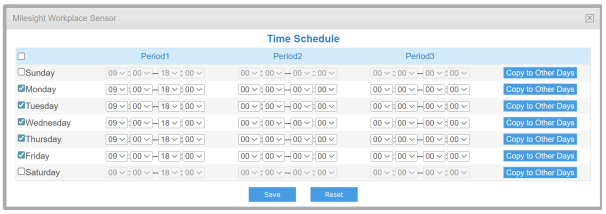


Parameters	Description
Report with Timestamp	Report the data with timestamp.
Periodic Report Scheme	Select the periodic report of "On the Dot" or "From Now On". **On the Dot:** Report at each integer moment. For example, current time is 0:07, when the interval is set to 10 minutes, it will report at 0:10, 0:20, 0:30, and so on. **From Now On:** Begin reporting from this moment onwards and regularly report based on the interval cycle.
Reporting Interval	
Trigger Report	Report immediately when there is a change of the line crossing people counting number. Any further crossings within 15 seconds are accumulated and reported together at the end of the 15-second period. **Note:** Please set the periodic reporting interval to over 30 seconds when both trigger and periodic reporting are enabled.
Reset Cumulative Count on Schedule	Enable to periodically reset cumulative line cross counting values on schedule. Support up to 5 reset schedules. Whenever you modify a reset time record, the reset schedule for region people counting will be automatically updated accordingly.

Step 5: If you want the device to count and report data continuously, skip this step.

To pause during specific periods, enable **Schedule Settings** and define weekly time blocks.





For example, as illustrated in the figure, if you select 9:00 AM to 6:00 PM from Monday to Friday, the device will only upload data within this time window. Data reporting will be disabled during all other periods. By clicking **Copy to Other Days** button on the right, you can copy all time periods at once, without having to modify each one individually.

Step 6: After completing all the settings, scroll to the bottom and click **Save** to save all your changes.

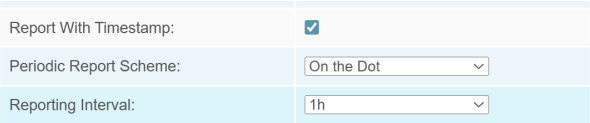
People Flow Analysis

People Flow Analysis uses custom polygonal zones to track and visualize real-time movement between different boundaries. The system records how people enter and exit through various sides, showing clear patterns of flow within the area. This is ideal for public spaces and other settings where in-depth analysis of movement paths and flow directions is needed.

Step 1: Go to **People Counting** → **People Flow Analysis**, to enable people flow analysis feature.

Step 2: Move the mouse inside the live view to begin drawing the region, click to zoom in on the display. Customize a triangle or a convex quadrangle to count the flow of people moving from one edge to another, such as from B to D.

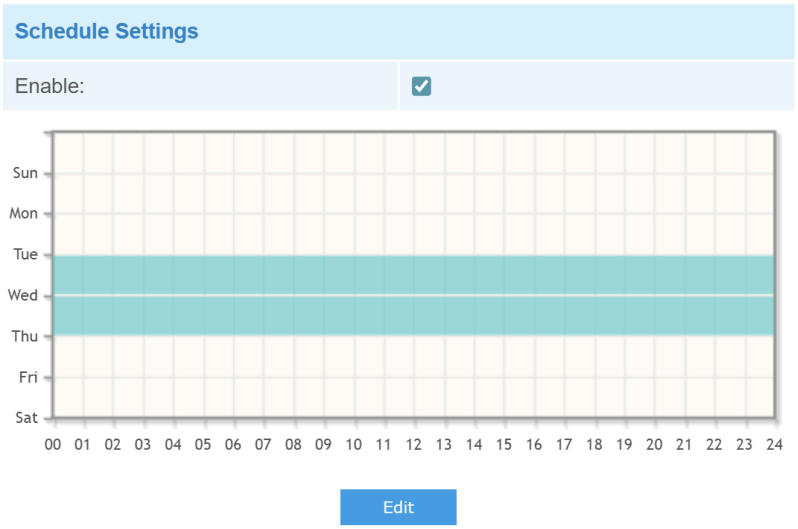
Step 3: Report setting.

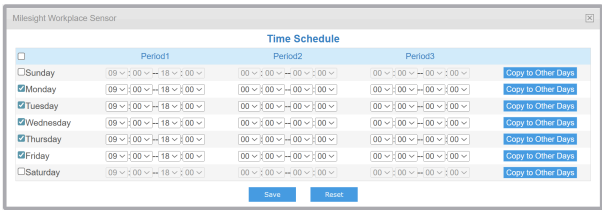


Parameters	Description
Report with Timestamp	Report the data with timestamp.
Periodic Report Scheme	Select the periodic report of "On the Dot" or "From Now On". **On the Dot:** Report at each integer moment. For example, current time is 0:07, when the interval is set to 10 minutes, it will report at 0:10, 0:20, 0:30, and so on. **From Now On:** Begin reporting from this moment onwards and regularly report based on the interval cycle.
Reporting Interval	

Step 4: If you want the device to count and report data continuously, skip this step.

To pause during specific periods, enable **Schedule Settings** and define weekly time blocks.



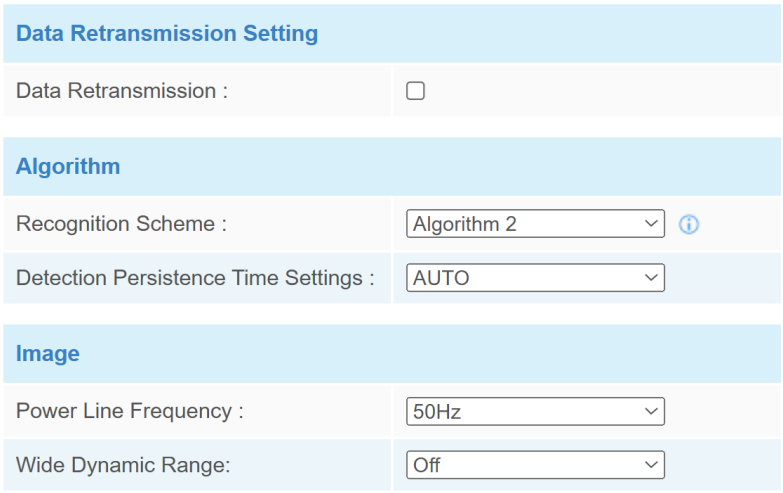


For example, as illustrated in the figure, if you select 9:00 AM to 6:00 PM from Monday to Friday, the device will only upload data within this time window. Data reporting will be disabled during all other periods. By clicking **Copy to Other Days** button on the right, you can copy all time periods at once, without having to modify each one individually.

Step 5: After completing all the settings, scroll to the bottom and click **Save** to save all your changes.

Advance Settings

General Settings

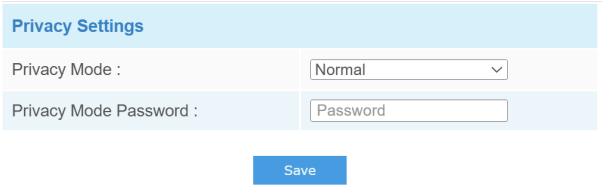


Parameters	Description
Data Retransmission Setting	Enable to resend stored data packets from the disconnected period when the device's network connection is restored. The device supports to store 1,000 pieces of data at most. The historical data format is different from regular reports.
Recognition Scheme	Select the recognition scheme of region people counting based on your detection environment. **Algorithm 1:** Suitable for monitoring complex environments which have many objects, like office supplies (books, printers, lamps, etc.) **Algorithm 2:** Suitable for monitoring simple and clean environments like meeting rooms.
Detection Persistence Time Settings	To address the issue of short-term detection interruptions caused by partial occlusion (e.g., raised hands or clothing), the device introduces a Detection Persistence Time setting. This feature allows the system to retain the same target ID within a defined duration, even if the target momentarily disappears from view. It ensures more accurate dwell time statistics, especially in environments like elevators or meeting rooms.

Parameters	Description
	1. If the target remains at or returns to its original position before the duration expires, the original ID is preserved. 2. If the target fails to return to its original position after the duration expires, a new ID will be assigned. 3. If another target occupies the original position before the duration expires, the IDs of the two targets may be exchanged. Users can choose between two modes: **Auto:** The device automatically determines persistence based on algorithm logic. **Custom:** Users can manually define a time to maintain the target ID after disappearance for improved tracking continuity. **Note:** This feature is intended for environments with low movement and a limited number of people, such as elevator waiting areas. Using it in crowded or highly dynamic settings may reduce detection accuracy.
Image	**Power Line Frequency:**Select based on your power source frequency standard, 60 Hz and 50 Hz are available.
	Wide Dynamic Range: This function which can capture and display both bright and dark areas in the same frame that enables details of objects in both bright and dark areas to be visible. It's recommended to enable this function when the scene has a clear contrast between light and dark (such as a corridor).

Privacy Setting

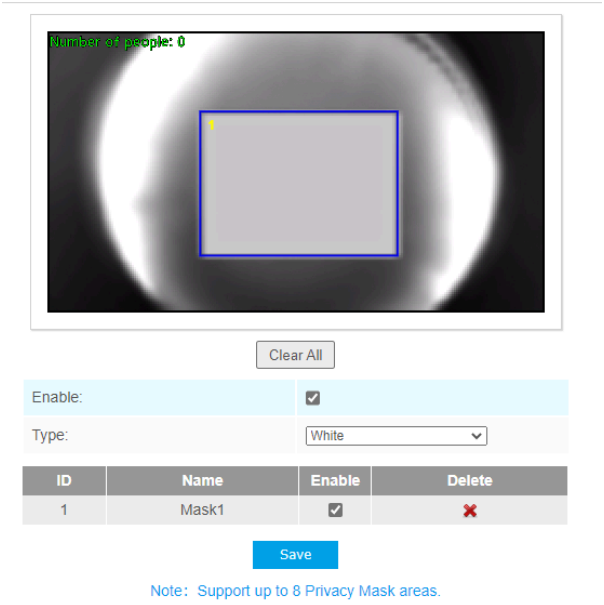
Users can switch the view mode here when they want to change how the screen is presented. This password is the same one you set when you first enabled Privacy Mode during login.



Note:
If you want to change Privacy Mode password, press and hold the reset button on the device for more than 10 seconds. After the device resets, log in again and follow the prompts to set a new password.

Privacy Mask

Privacy mask enables to cover certain areas on the live video to prevent certain spots in the surveillance area from being viewed and prevent people within the area from being counted. You can set 8 mask areas at most.

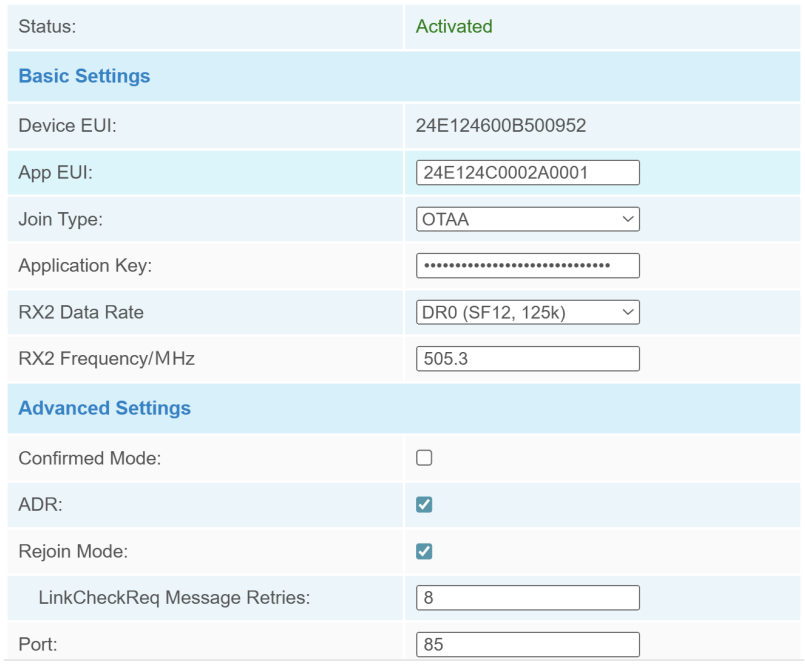


Parameters	Description
Enable	Check the checkbox to enable the Privacy Mask function.
Clear All	Clear all areas you drew before.
Type	Select the color for the privacy areas, there are two colors available: White and Black.

Network

LoRaWAN®

LoRaWAN settings is used for configuring the transmission parameters in LoRaWAN® network.



Parameters	Description
Status	LoRaWAN® network status of this device.
Basic Settings	
Device EUI	Unique ID of the device which can be found on the device. **Note:** please contact sales for device EUI list if you have many units.
App EUI	The default App EUI (join EUI) is 24E124C0002A0001.
Join Type	OTAA and ABP mode are available. **Note:** it's necessary to select OTAA mode if connecting device to Milesight IoT Cloud.
Application Key	Appkey for OTAA mode, default value: "Device EUI" + "Device EUI" (since Q4 of 2025). Example: 24e124123456789024e1241234567890

Parameters	Description
	Note: • The default value of earlier devices is 5572404C696E6B4C6F52613230313823. • Please contact sales before purchase if you require random App Keys.
Device Address	DevAddr for ABP mode, default is the 5th to 12th digits of SN.
Network Session Key	Nwkskey for ABP mode, the default is 5572404C696E6B4C6F52613230313823.
Application Session Key	Appskey for ABP mode, the default is 5572404C696E6B4C6F52613230313823.
RX2 Data Rate	RX2 data rate to receive downlinks or send D2D command.
RX2 Frequency/MHz	RX2 frequency to receive downlinks or send D2D command.
Advance Settings	
Confirmed Mode	If the device does not receive ACK packet from network server, it will re-send data once.
ADR Mode	Enable or disable network server to adjust Spreading Factor, Bandwidth an Tx Power to optimize data rates, airtime and energy consumption in the network.
Rejoin Mode	Reporting interval≤35 mins: the device will send a specific number of Link-CheckReq MAC packets to the network server every reporting interval or every double reporting interval to validate connectivity; If there is no re-sponse, the device will re-join the network. Reporting interval > 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval to validate connectivity; If there is no response, the device will re-join the network.

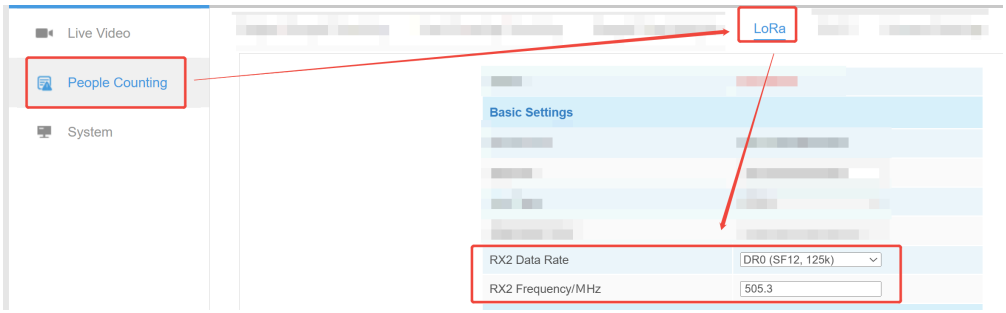
Parameters	Description
	Note: 1. Only OTAA mode supports rejoin mode. 2. The actual sending number is **Set the number of packets sent** +1.
Port	The port used for sending and receiving data, default port is 85.
Spreading Factor	If ADR mode is disabled, the device will send uplink data following this SF parameter. The higher the spreading factor, the longer the transmission distance, the slower the transmission speed and the more the consumption.
Tx Power	Tx power (transmit power) refers to the strength of the outgoing signal transmitted by the device. This is defined by LoRa alliance.
LoRaWAN® Version	V1.0.2 and V1.0.3 are available.
Region	Frequency plan of this device.
Single-channel Mode	When enabled, only one channel can be selected to send uplinks. Please enable this mode if you connect device to DS7610.
Channel	Enable or disable the frequency to send uplinks. If frequency is one of CN470/AU915/US915, enter the index of the channel to enable in the input box, making them separated by commas. **Examples:** 1, 40: Enabling Channel 1 and Channel 40 1-40: Enabling Channel 1 to Channel 40 1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60 All: Enabling all channels Null: Indicate that all channels are disabled

D2D Settings

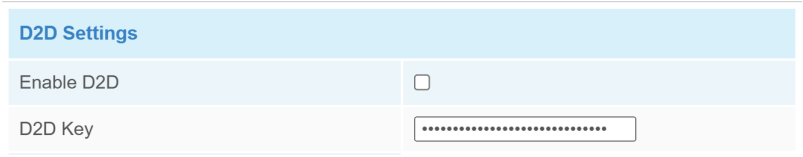
Milesight D2D protocol is used for setting up transmission among Milesight LoRaWAN® devices without gateway. When the Milesight D2D setting is enabled, VS121 can work as a Milesight D2D controller for sending control commands to trigger D2D agent devices.

Step 1: Configure the RX2 datarate and RX2 frequency.

Note:
It is suggested to change the default values if there are many LoRaWAN® devices around.



Step 2: Enable D2D feature and define an unique D2D key which is the same as Milesight D2D agent devices. (Default D2D key: 5572404C696E6B4C6F52613230313823)

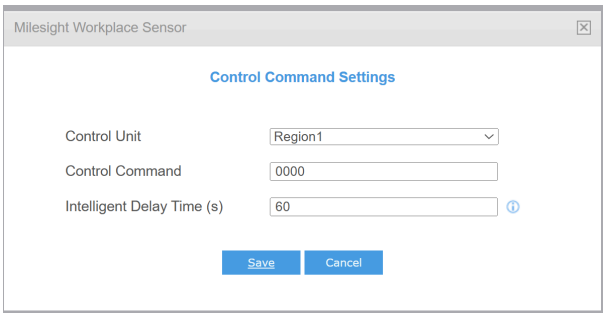


Step 3: Scroll to control setting, then choose a condition.

Occupied:when total people counter value is non-zero in detection area.

Vacant: when total people counter value is 0 in detection area.

Step 4: Click the "**+**" to add control information.

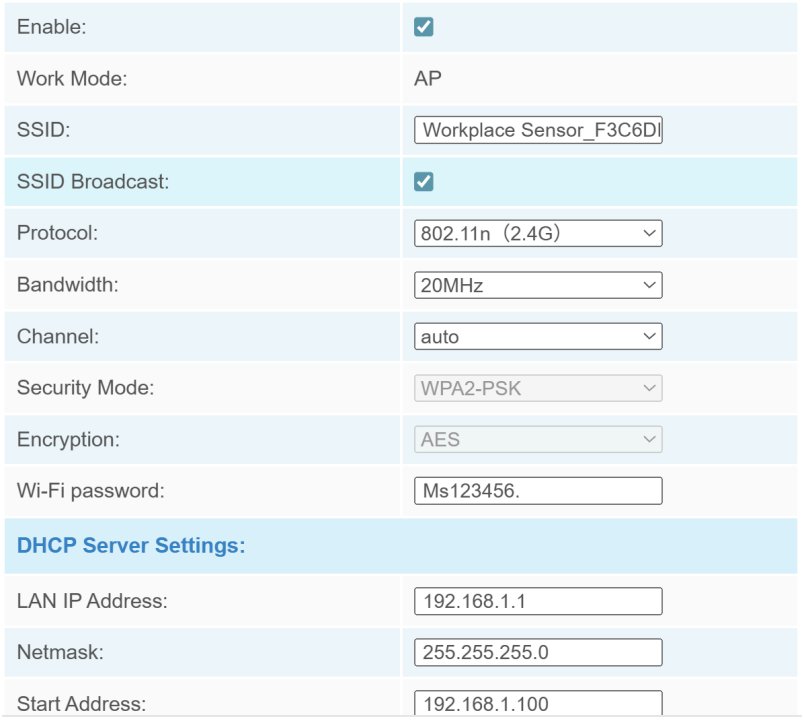


Parameters	Description
Control Unit	Choose the region to associate.
Control Command	Define a 2-byte hexadecimal control command (0x0000 to 0xffff). When the condition is meet, the device will send the control command to corresponding D2D agent devices.
Intelligent Delay Time (s)	The device will send the control command only when the detected condition remains Vacant (number of people =0) during this delay time.

Step 5: After adding, click the **Test** button to send the command directly to D2D agent devices. This helps you verify whether the current configuration is correct.

Note:
When this feature is enabled, the control command from this device will not send to LoRaWAN® gateway.

Wi-Fi



Parameters	Description
Enabled	Enable Wi-Fi feature.
Work Mode	Work mode is fixed as AP and can not connect to other access point.
SSID	The unique name for this device Wi-Fi access point. The default SSID is `Workplace Sensor_XXXXXX` (can be found on the label).
SSID Broadcast	When disabled, other wireless devices can't find the SSID, and users should enter the SSID manually to get access to the wireless network.
Protocol	802.11b (2.4 GHz), 802.11g (2.4 GHz), 802.11n (2.4 GHz) are optional.
Bandwidth	20 MHz or 40 MHz are optional.
Channel	Select the wireless channel. Auto, 1,...11 are optional.
Security Mode	It's fixed as WPA2-PSK.

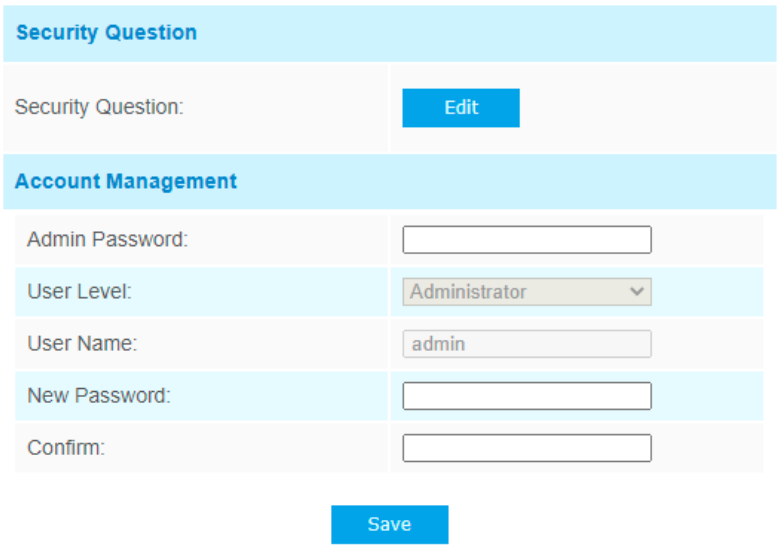
DHCP Server Settings	
Parameters	**Description**
LAN IP Address	IP address that used to access the web GUI of sensor.

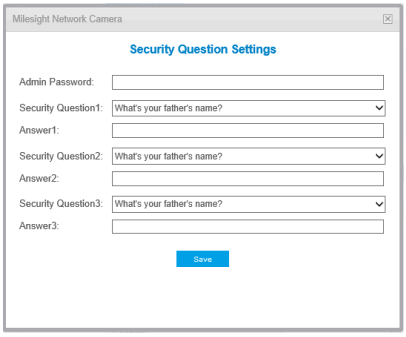
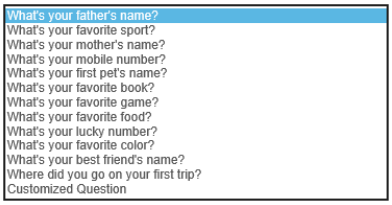
DHCP Server Settings	
Parameters	**Description**
Netmask	Identify the subnet where the sensor is located.
Start Address	Define the beginning of IP address pool which assigns to DHCP clients.
End Address	Define the end of IP address pool which assigns to DHCP clients.
Lease Time (min)	The lease time on which DHCP client can use the IP address assigned by the sensor.
Primary DNS Server	Translate the domain name to IP address.
Secondary DNS Server	Backup DNS server.

Static IP	
Parameters	**Description**
MAC address	Add MAC address and static IP address if users need to add a static IP address to a specific computer.
IP Address	

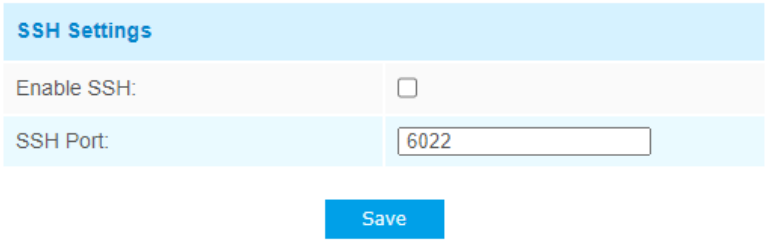
System

User



Parameters	Description
Security Question	Click **Edit** button to set three security questions for your device. In case that you forget the password, you can click **Forget Password** button on login page to reset the password by answering three security questions correctly.  There are twelve default questions below, you can also customize the security questions. 
Account Management	**Admin Password:** enter the correct admin password before adding an account. **User Level:** It's fixed as Administrator. **User Name:** It's fixed as admin. **New Password:** Input password for the account. **Confirm:** Confirm the password.

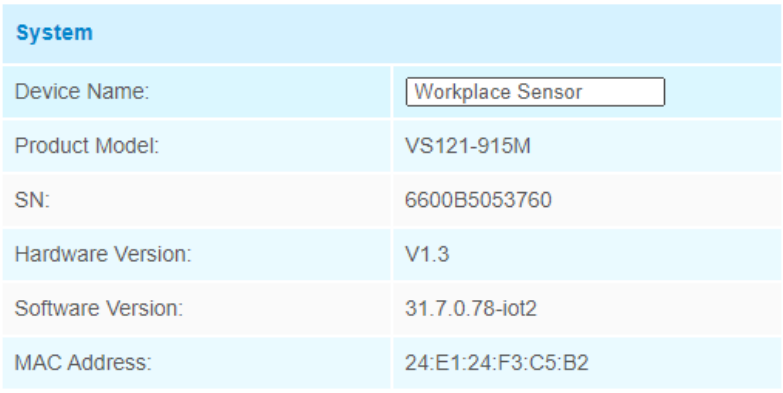
Security Service



Parameters	Description
Enable SSH	Enable SSH feature.
SSH Port	Set the port to access this sensor via SSH.

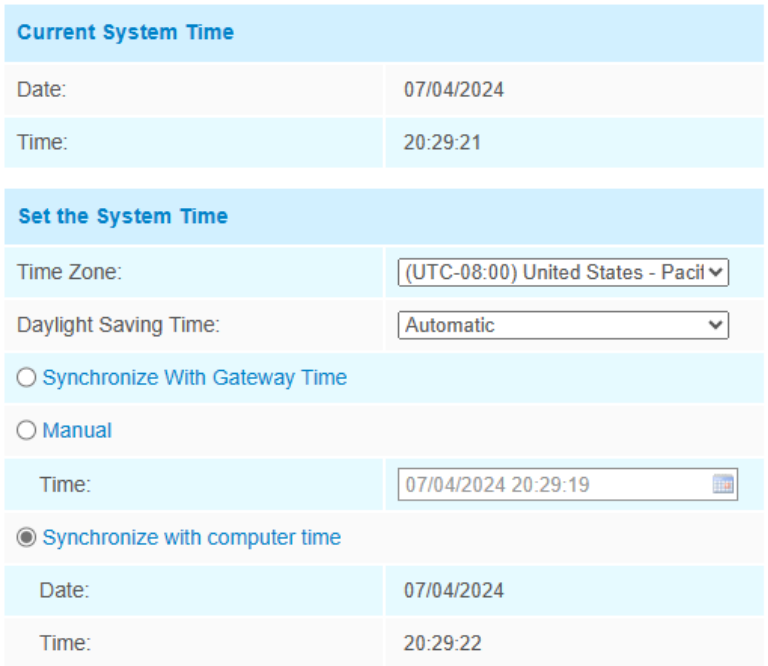
System Info

All information about the hardware and software can be checked on this page.



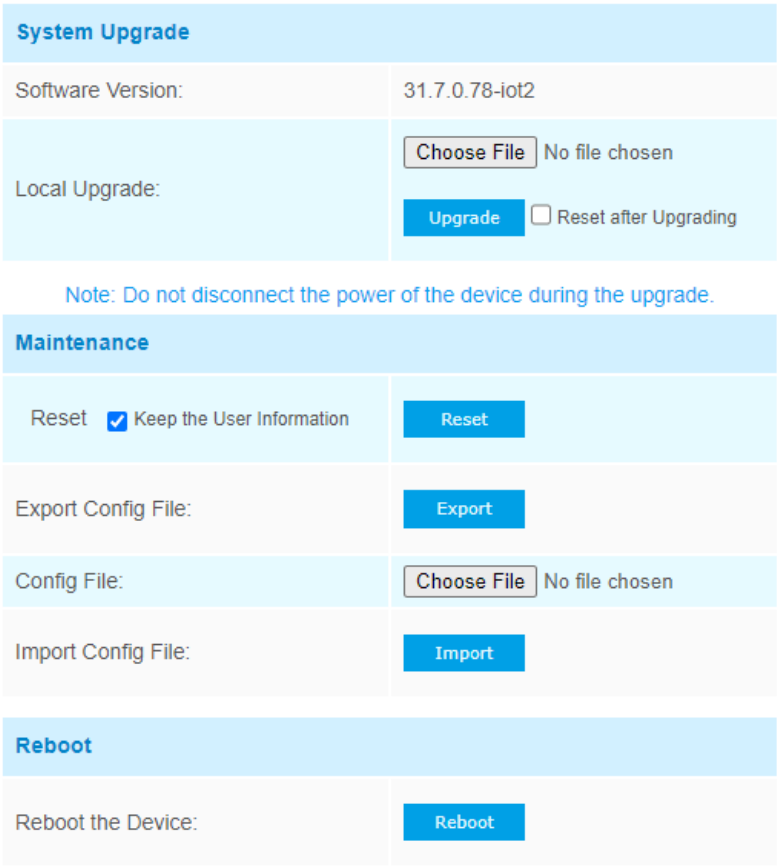
Date & Time

Here you can check and set the system time.



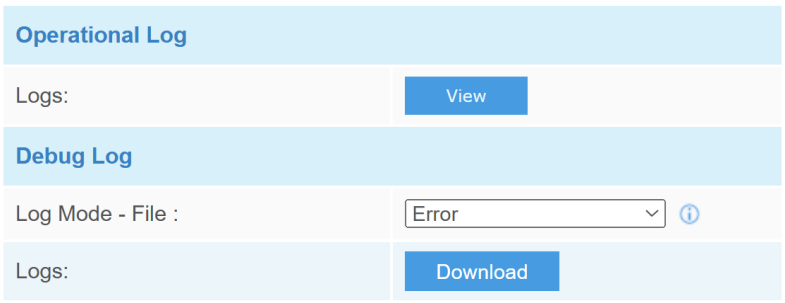
Parameters	Description
Current System Time	Current date & time of the system.
Time Zone	Select a time zone according to your location.
Daylight Saving Time	Enable or disable the daylight saving time.
Synchronize with Gateway time	Synchronize the system time with embedded network server of Milesight gateway when LoRaWAN® version is 1.0.3. The device will sync the time with gateway once when re-joining the network or every 5 days.
Manual	Set the system time manually.
Synchronize with computer time	Synchronize the system time with the computer.

System Maintenance

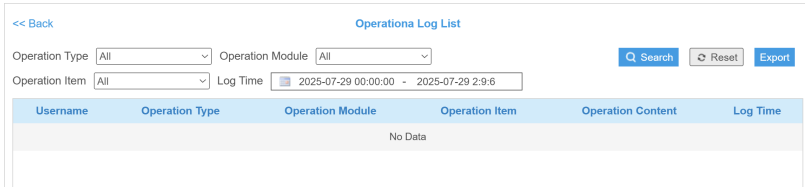


Parameters	Description
System Upgrade	**Software Version:** The software version of the sensor. **Local Upgrade:** Click the **Choose File** button and select the upgrading file, then click the **Upgrade** button to upgrade. After the system reboots successfully, the update is done. You can check **Reset after Upgrading** to reset the device after upgrading it. **Note:** Do not disconnect the power of the device during the upgrade process. The device will be restarted to complete the upgrading.
Maintenance	**Reset settings:** Click **Reset** button to reset the device to factory default settings. **Keep the User Information:** Check this option to keep the user information when re-setting. **Export Config File:** Export configuration file. **Import Config File:** Click the **Choose File** button and select the configuration file, click **Import** button to import configuration file.
Reboot	Restart the device immediately

Log Management



Parameters	Description
Operational Log	
Logs	Please choose the operation and the time range for the logs you wish to view.

Parameters	Description
	 You can choose to **Search**, **Reset**, or **Export** this operation log.
Debug Log	
Log Mode - File	Select the desired level of log files to download for troubleshooting. Error: Records errors that are abnormal and affect critical functions. Debug: Records detailed internal operational and status information. **Note:** For regular use, please select the "Error" log level. Selecting the "Debug" level may cause some earlier logs to be overwritten.
Logs	Click **Download** to export the debug logs.

About

User can view some open source software licenses about the sensor by clicking the View Licenses button.

Chapter 7. Communication Protocol

Overview

All messages are based on following format (HEX), the Data field should follow little-endian:

Channel1	Type1	Data1	Channel2	Type2	Data2	Channel3	...
1 Byte	1 Byte	N Bytes	1 Byte	1 Byte	N Bytes	1 Byte	...

For decoder examples please find files on https://github.com/Milesight-IoT/SensorDecoders.

Uplink Data

The device reports basic information of sensor whenever joining the network and the number of people periodically. For decoder examples please find files on https://github.com/Milesight-IoT/SensorDecoders.

Basic Information

The device will report a basic information packet whenever joining the network.

Item	Channel	Type	Description
Protocol Version	ff	01	01=>V1
Device SN	ff	08	12 digits
Hardware Version	ff	09	01 04 => V1.4
Software Version	ff	1f	1f 07 00 4b => V31.7.0.75

Example:

ff0101 ff086600b0940976 ff090100 ff1f1f07004b		
Channel	**Type**	**Value**
ff	01	Protocol version: 01 (V1)
ff	08	Device SN: 66 00 b0 94 09 76
ff	09	Hardware version: 0100 (V1.0)
ff	1f	Software version: 1f 07 00 4b (V31.7.0.75)

Periodic Report

The device supports to report below types of periodic report packets.

Item	Channel	Type	Byte	Description
Region People Counter	04	c9	4	Byte 1: current total number of people Byte 2: the number of mapped regions Byte 3-4: every bit indicates occupancy status of per mapped region, 0=vacant, 1=occupied
Max People Counter	06	cd	1	Maximum number of people in detection area during the reporting interval of region people counting. This value only report on periodic uplinks.
Per Region People Counter	07	d5	8	region 1 (1B) + region 2 (1B)+... region 8 (1B)
	08	d5	8	region 9 (1B) + region 10 (1B)+... region 16 (1B)
Dwell Time Detection	0e	e4	5	Byte 1: 00=all regions Byte 2-3: Average Dwell Time Byte 4-5: Maximum Dwell Time
Periodic Line Cross Counter	05	cc	4	Byte 1-2: Periodic In Byte 3-4: Periodic Out
Accumulated Line Cross Counter	0d	cc	4	Byte 1-2: Accumulated In Byte 3-4: Accumulated Out
People Flow Analysis	09	da	8	Byte 1-2: number of people from A to A Byte 3-4: number of people from A to B Byte 5-6: number of people from A to C Byte 7-8: number of people from A to D
	0a	da	8	Byte 1-2: number of people from B to A

Item	Channel	Type	Byte	Description
				Byte 3-4: number of people from B to B Byte 5-6: number of people from B to C Byte 7-8: number of people from B to D
	0b	da	8	Byte 1-2: number of people from C to A Byte 3-4: number of people from C to B Byte 5-6: number of people from C to C Byte 7-8: number of people from C to D
	0c	da	8	Byte 1-2: number of people from D to A Byte 3-4: number of people from D to B Byte 5-6: number of people from D to C Byte 7-8: number of people from D to D
Timestamp	0f	85	4	Unix Timestamp, unit: s

Example:

1. Region people counter periodic report when reporting type is Occupancy.

04c9030800a1 06cd05		
Channel	**Type**	**Value**
04	c9	03 => There are 3 people totally currently 08 => there are 8 mapped regions 00 a1=>1010 0001: Region 1, 6 and 8 are occupied, others are vacant
06	cd	05 => during the reporting interval, the maximum number of people is 5

2. Region people counter periodic report when reporting type is Region People Counting.

07d50001000000000003 06cd05 0ee40004000b00		
Channel	**Type**	**Value**
07	d5	Byte 2: 01 => there are 1 person in region 2 currently Byte 8: 03 => there are 3 people in region 8 currently
06	cd	05 => during the reporting interval, the maximum number of people is 5
0e	e4	00: region all 0400 => 0004 = 4s: Average Dwell Time of region 1 to region 8 0b00 => 000b = 11s: Maximum Dwell Time of region 1 to region 8

3. Line cross counter periodic report with timestamp.

0f85e8ba1466 05cc02000100 0dcc10000100		
Channel	**Type**	**Value**
0f	85	e8ba1466 => 6614bae8=1712634600s
05	cc	Periodic In: 02 00 => 00 02 = 2 Periodic Out: 01 00 => 00 01 =1
0d	cc	Accumulated In: 10 00 => 00 10 = 16 Accumulated Out: 01 00 => 00 01 =1

4. People flow analysis periodic report.

09da0001000000000000 0ada0000000000000000 0bda0000000000000000 0cda0000000000000000		
Channel	**Type**	**Value**
09	da	A to A: 00 01=>01 00=256 A to B: 00 00=0 A to C: 00 00=0

09da0001000000000000 0ada0000000000000000 0bda0000000000000000 0cda0000000000000000		
Channel	**Type**	**Value**
		A to D: 00 00=0
0a	da	B to A: 00 00=0 B to B: 00 00=0 B to C: 00 00=0 B to D: 00 00=0
0b	da	C to A: 00 00=0 C to B: 00 00=0 C to C: 00 00=0 C to D: 00 00=0
0c	da	D to A: 00 00=0 D to B: 00 00=0 D to C: 00 00=0 D to D: 00 00=0

Trigger Report

The device supports to report when people triggers.

Item	Channel	Type	Byte	Value
Trigger Line Cross Counter	10	f7	4	Byte 1-2: Trigger In Byte 3-4: Trigger Out

Example:

10f7 0100 0300		
Channel	**Type**	**Value**
10	f7	Trigger In: 0100 => 0001=1 Trigger Out: 0300=>0003=3

Historical Data

The device will report retransmission data or stored data as below example.

Item	Channel	Type	Byte	Value
Historical Data	20	ce	N	Byte 1-4: Data unix timestamp, unit: s Byte 5: Data Type 01-Region People Counter 02-Periodic Line Cross Counter 03-Max People Counter 04-Region 1-4 People Counter 05-Region 5-8 People Counter 06-Region 9-12 People Counter 07-Region 13-16 People Counter 08-People Flow Analysis(A to A, A to B) 09-People Flow Analysis(A to C, A to D) 0a-People Flow Analysis(B to A, B to B) 0b-People Flow Analysis(B to C, B to D) 0c-People Flow Analysis(C to A, C to B) 0d-People Flow Analysis(C to C, C to D) 0e-People Flow Analysis(D to A, D to B)

Item	Channel	Type	Byte	Value
				0f-People Flow Analysis(D to C, D to D) 10-Accumulated Line Cross Counter 11-Dwell Time Detection 12-Trigger Line Cross Counter Byte 6-N: Historical Data

Example:

20ce 0d755b63 03 07		
Channel	**Type**	**Value**
20	ce	Time Stamp: 0d 75 5b 63 => 63 5b 75 0d=1666938125s Max People Counter: 03 Historical Data: 07=>7

Downlink Command

The device supports downlink commands to configure the device. Application port is 85 by default.

General Setting

Item	Channel	Type	Byte	Description
Reboot	ff	10	1	ff
Wi-Fi	ff	42	1	00: disable, 01: enable
Manual sys-tem time setting	ff	11	4	Timestamp, unit: s
Time Synchronize	f9	91	5	Byte 1: 00-Synchronize With Gateway Time, 01-Manual Byte 2-5: Timestamp, unit: s. If gateway synchronization is selected, this value is 00000000

Item	Channel	Type	Byte	Description
Debug Log	f9	89	2	Byte 1: 00 Byte 2: 02-Error, 04-Debug

Example:

1. Disable the Wi-Fi.

ff4200		
Channel	**Type**	**Value**
ff	42	00: disable

2. Reboot the device.

ff10ff		
Channel	**Type**	**Value**
ff	10	ff

Reset Setting

Item	Channel	Type	Byte	Description
Reset Cumulative Count	ff	51	1	ff
Enable Reset Cumulative Count on Schedule	f9	94	1	00: disable, 01: enable
Reset Cumulative Count on Schedule	f9	95	5	Byte 1: 00- Modify, 01-Add, 02-Delete Byte 2: Reset Schedule Number Byte 3: Reset Date, Bit 0: Sunday Bit 1: Monday

Item	Channel	Type	Byte	Description
				Bit 2: Tuesday Bit 3: Wednesday Bit 4: Thursday Bit 5: Friday Bit 6: Saturday Bit 7: 0 Byte 4-5: Reset Time, Unit: min

Example:

1. Add a new reset schedule: Daily at 20:00.

f995 01 00 7f b0 04		
Channel	**Type**	**Value**
f9	95	01: Add 00: The first reset schedule. 7f=> 01111111: Everyday. b0 04=04 b0=1200min=20h=20:00

People Counting Setting

Item	Channel	Type	Byte	Description
Region People Counting	ff	50	1	00: disable, 01: enable
Set Detection Region	f9	96	3	Byte 1: 00-disable, 01-enable Byte 2: Detection Area, 00-Mapped Region,01-Non-mapped Region

Item	Channel	Type	Byte	Description
				Byte 3: Reporting Type, 00-Occupancy, 01-Region People Counting
Min. Dwell Time	f9	92	3	Byte 1: 01-Enable; 00-Disable Byte 2-3: Min. Dwell Time, Unit: s, Default: 5
Line Crossing Counting	ff	48	1	00: disable, 01: enable
Filter U-turns	f9	98	1	00-disable, 01-enable
Enable Schedule Setting	f9	97	2	Byte 1: 00-Region People Counting, 01-Line Crossing Counting, 02-People Flow Analysis Byte 2: 00-disable, 01-enable

Example:

1. Set a Detection Region: Mapped Region, Reporting Type is Occupancy.

f996 01 00 00		
Channel	**Type**	**Value**
f9	96	01: Enable 00: Mapped Region 00: Reporting Type is Occupancy

Report Setting

Item	Channel	Type	Byte	Description
Reporting Interval	ff	03	2	Range: 5~65535, unit: s
Periodic Report Scheme	f9	10	1	00: On the Dot 01: From Now On
Reporting Interval (On the Dot)	f9	11	1	00: 5min, 01: 10min, 02: 15min, 03: 30min, 04: 1h, 05: 4h, 06: 6h, 07: 8h, 08: 12h

Item	Channel	Type	Byte	Description
Report by Result Mode	ff	45	1	00: Zero and Non-zero 01: Once result changes
Debounce Time	ff	46	2	Byte 1: 00-disable, 01-enable Byte 2: Debounce time, unit: s, default: 2s
Trigger Report	f9	3d	1	00: disable, 01: enable
Report with Timestamp	f9	93	1	00: disable, 01: enable
Region People Counting Report Regularly	ff	43	1	00: disable, 01: enable
Region People Counting Report by Result	ff	44	1	00: disable, 01: enable

Example:

1. Set reporting interval of region counting, line cross counting or people flow analysis as 20 minutes.

ff03 b004		
Channel	**Type**	**Value**
ff	03	b0 04 => 04 b0 = 1200s = 20 minutes

2. Enable bounce time and set time as 2s.

ff46 01 03		
Channel	**Type**	**Value**
ff	46	01: enable 02: Debounce time is 3s

Schedule Setting

Item	Channel	Type	Byte	Description
Schedule Setting	f9	99	7	Byte 1: 00-Region People Counting, 01-Line Crossing Counting, 02-People Flow Analysis Byte 2: Weekday, 00-Sunday 01-Monday 02-Tuesday 03-Wednesday 04-Thursday 05-Friday 06-Saturday Byte 3: 00-Period 1, 01-Period 2, 02-Period 3 Byte 4: Start Hour Byte 5: Start Minute Byte 6: End Hour Byte 7: End Minute

Example:

1. Set schedule: For region people counting, set the schedule period 1 on Sunday to 08:00–09:00.

f999 00 00 00 08 00 09 00		
Channel	**Type**	**Value**
f9	99	00: Region People Counting 00: Sunday

f999 00 00 00 08 00 09 00		
Channel	**Type**	**Value**
		00: Period 1 08: Start Hour 00: Start Minute 09: End Hour 00: End Minute

LoRaWAN® Setting

Modifying the following parameters triggers the device to rejoin the network.

Item	Chan-nel	Type	Byte	Description
LoRaWAN® Channel Mask	ff	05	3	Byte 1: Channel index range 01: 0-15 02: 16-31 03: 32-47 04: 48-63 05: 64-79 06: 80-95 Byte 2-3: indicate disable or enable via every bit, 0=disable, 1=enable
ADR	ff	40	1	00: disable, 01: enable
Application Port	ff	41	1	[1-223], Default is 85
LoRa Rejoin Mode	f9	85	2	Byte 1: 01-Enable; 00-Disable

Item	Chan-nel	Type	Byte	Description
				Byte 2: The Number of Detection, Range: 4~32
Confirmed Mode	ff	04	1	00: disable, 01: enable
Spreading Factor	f9	86	1	00-SF12, 01-SF11, 02-SF10, 03-SF9, 04-SF8, 05-SF7
TXPower	f9	87	1	Range: 0~14
LoRaWAN® Version	f9	8b	1	01: V1.0.2 02: V1.0.3
RX2 Data Rate	f9	8c	1	00: DR0 (SF12,125k) 01: DR1 (SF11,125k) 02: DR2 (SF10,125k) 03: DR3 (SF9,125k) 04: DR4 (SF8,125k) 05: DR5 (SF7,125k)
RX2 Frequency	f9	8d	4	RX2 Frequency Value

Example:

1. Set AU915 or US915 channel mask as 8-15.

ff0501ff00 ff05020000 ff05030000 ff05040000 ff05050000		
Channel	**Type**	**Value**
ff	05	01: Channel index 0-15, ff00 => 8-15 is enabled 02-05: Channel index 16-79, 0000 => all disabled

2. Set RX2 Frequency as 923.5Mhz.

f98d e07d0b37		
Channel	**Type**	**Value**
f9	8d	e0 7d 0b 37=> 37 0b 7d e0=923500000=923.5Mhz

Milesight D2D Setting

Item	Channel	Type	Byte	Description
Milesight D2D Feature	ff	84	1	01-enable, 00-disable
Milesight D2D Key	ff	35	8	First 16 digits, last 16 digits are fixed as 0
Milesight D2D Control (Occupied) Settings	f9	8e	4	Byte 1: Region Number (00 means region1, 01 means region2, ...) Byte 2: 01-enable, 00-disable Byte 3-4: D2D control command
Milesight D2D Control (Vacant) Settings	f9	90	6	Byte 1: Region Number (00 means region1, 01 means region2, ...) Byte 2: 01-enable, 00-disable Byte 3-4: D2D control command Byte 5-6: Intelligent Delay Time, Unit: s, Range: 0~600

Example:

1. Set Milesight D2D key.

ff35 1234567812345678		
Channel	**Type**	**Value**
ff	35	D2D key: 1234567812345678 0000000000000000

2. Set Milesight D2D Control (Occupied) settings.

f98e 00 01 1011		
Channel	**Type**	**Value**
f9	8e	00: Region 1 01: enable 1011=>1110: D2D control command.

3. Set Milesight D2D Control (Vacant) settings.

f990 02 01 0110 3c00		
Channel	**Type**	**Value**
f9	90	02: Region 3 01: enable 0110=>1001: D2D control command 3c00=00 3c=>60: Intelligent Delay Time is 60s.

Chapter 8. Services

Milesight provides customers with timely and comprehensive technical support services. End-users can contact your local dealer to obtain technical support. Distributors and resellers can contact directly with Milesight for technical support.

Technical Support Mailbox: iot.support@milesight.com

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Resource Download Center: https://www.milesight.com/iot/resources/download-center/

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