Traffic Signal Controller

User's Manual

V2.0.0

Foreword

General

This manual introduces the installation, functions and operations of the Traffic Signal Controller (hereinafter referred to as "the signal controller"). Read carefully before using the device, and keep the manual safe for future reference.

Safety Instructions

The following signal words might appear in the manual.

Signal Words	Meaning
⚠ DANGER	Indicates a high potential hazard which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a medium or low potential hazard which, if not avoided, could result in slight or moderate injury.
⚠ CAUTION	Indicates a potential risk which, if not avoided, could result in property damage, data loss, reductions in performance, or unpredictable results.
⊙ᴛᴛ TIPS	Provides methods to help you solve a problem or save time.
📖 NOTE	Provides additional information as a supplement to the text.

Revision History

Version	Revision Content	Release Time
V2.0.0	Updated the web client version and display.	May 2022
V1.1.0	Updated the figure of phase sequence and the corresponding phase description.	December 2021
V1.0.0	First release.	June 2020

Privacy Protection Notice

As the device user or data controller, you might collect the personal data of others such as their face, fingerprints, and license plate number. You need to be in compliance with your local privacy protection laws and regulations to protect the legitimate rights and interests of other people by implementing measures which include but are not limited: Providing clear and visible identification to inform people of the existence of the surveillance area and provide required contact information.

About the Manual

- The manual is for reference only. Slight differences might be found between the manual and the product.
- We are not liable for losses incurred due to operating the product in ways that are not in compliance with the manual.
- The manual will be updated according to the latest laws and regulations of related jurisdictions. For detailed information, see the paper user's manual, use our CD-ROM, scan the QR code or visit

our official website. The manual is for reference only. Slight differences might be found between the electronic version and the paper version.

- All designs and software are subject to change without prior written notice. Product updates might result in some differences appearing between the actual product and the manual. Please contact customer service for the latest program and supplementary documentation.
- There might be errors in the print or deviations in the description of the functions, operations and technical data. If there is any doubt or dispute, we reserve the right of final explanation.
- Upgrade the reader software or try other mainstream reader software if the manual (in PDF format) cannot be opened.
- All trademarks, registered trademarks and company names in the manual are properties of their respective owners.
- Please visit our website, contact the supplier or customer service if any problems occur while using the device.
- If there is any uncertainty or controversy, we reserve the right of final explanation.

Important Safeguards and Warnings

This section introduces content covering the proper handling of the device, hazard prevention, and prevention of property damage. Read carefully before using the device, and comply with the guidelines when using it.

Transportation Requirements

⚠️

Transport the device under allowed humidity and temperature conditions.

Storage Requirements

⚠️

Store the device under allowed humidity and temperature conditions.

Installation Requirements

⚠️ WARNING

- Do not connect the power adapter to the device while the adapter is powered on.
- Strictly comply with the local electric safety code and standards. Make sure the ambient voltage is stable and meets the power supply requirements of the device.
- Do not connect the device to two or more kinds of power supplies, to avoid damage to the device.

⚠️

- Personnel working at heights must take all necessary measures to ensure personal safety including wearing a helmet and safety belts.
- Do not place the device in a place exposed to sunlight or near heat sources.
- Keep the device away from dampness, dust, and soot.
- Put the device in a well-ventilated place, and do not block its ventilation.
- Use an adapter or cabinet power supply provided by the manufacturer.
- The power supply must conform to the requirements of ES1 in IEC 62368-1 standard and be no higher than PS2. Please note that the power supply requirements are subject to the device label.
- The device is a class I electrical appliance. Make sure that the power supply of the device is connected to a power socket with protective earthing.

Operation Requirements

⚠️

- Check whether the power supply is correct before use.
- Do not unplug the power cord on the side of the device while the adapter is powered on.
- Operate the device within the rated range of power input and output.
- Use the device under allowed humidity and temperature conditions.
- Do not drop or splash liquid onto the device, and make sure that there is no object filled with liquid on the device to prevent liquid from flowing into it.
- Do not disassemble the device without professional instruction.

Table of Contents

1 Introduction

1.1 Overview

The traffic signal controller is a major device of the urban traffic control system. It controls the coordination of traffic signals at an intersection and makes traffic signals arranged properly.
The 036B series signal controller independently developed by us is an innovative and high-performance centralized and coordinated road traffic signal controller. It supports multiple intersection control and various control modes: Central control, cableless linking control, actuated control, multiple schedule pretimed control, manual control, yellow flashing, light off, all red, and more, suitable for vehicular and pedestrian movement control of various intersections. You can flexibly set the traffic signal color and scheme of clearance the interval.
The signal controller can be connected to traffic enforcement cameras, coils, pedestrian pushbuttons, and more to offer you integrated solution of traffic signal control. One or more controllers can be used for signal control of either one intersection or multiple intersections.

1.2 Features

- Easy maintenance: Modular design and compact structure.
- Reliable performance: Adopts embedded central control system.
- Green conflict prevention: Automatic detection of green conflicts.
- Enhanced safety: Outdoor cabinet designed with lightning protection and surge protection devices, suitable for working in various weather conditions.
- Power supply protection: Overvoltage, overcurrent, and reverse polarity protection allow safe and stable power supply.
- Multiple periods can be configured: 54 cycle schemes, 48 periods for each daily plan (max 112 daily plans), flexible for working day and holiday settings.
- Various communication interfaces: Expandable RS-232 and RS-485 interfaces facilitate communication with host computer.
- Flexible configuration: The status and the flashing time of each traffic signal are adjustable.
- Fault diagnosis: Easy to locate faults with the fault diagnosis function.

1.3 Functions

Remote Management

The signal controller can be remotely controlled by the central traffic signal control system or traffic platform. You can set control schemes, make manual adjustments, and configure intersection parameters on such system or platform to coordinate the traffic signals in real-time.

Multiple Schedule Control

The traffic conditions of an intersection vary at different time. Different control schedules can be set to improve traffic efficiency. You can set a maximum of 48 schedules for each day and 54 cycle

schemes. Phasing orders of different schemes can be set.

Cableless Linking Control

For cableless linking control, signal controllers do not communicate, but their time is required to be completely synchronized, and the same schedule scheme must be configured. The traffic signal coordination at each intersection is achieved by setting the offset.

Actuated Control

When working independently, the signal controller changes the status of traffic signals according to the traffic flow data collected by the vehicle detector or traffic enforcement camera.

Manual Control in Emergency

Yellow flashing in emergency and manual step control through operations of LCD screen buttons.

Traffic Flow Information Collection

After configuring the vehicle detector, the detector status can be reported in real time, and traffic information such as vehicle flow and occupancy rate can be automatically collected, stored, and transmitted. When traffic enforcement camera is configured, traffic information such as vehicle flow and occupancy rate can be reported in real time based on video detection.

Search and Statistics

Make statistics of traffic flow information at intersections and road sections by list or chart.

Real-time Fault Detection and System Log Recording

Fault self-detection; after detecting the fault, automatically record the date, time, and fault details.

Automatic Degradation

Automatic degradation in sequence in case of system failure: Actuated control, pretimed control, software yellow flashing, and hardware yellow flashing.

Automatic Maintenance

Set the restart time, and the signal controller automatically restarts at the defined time.

Countdown Timer

Self-learning, pulse, and RS-485 communication countdown timers are available. For the pulse countdown timer, models of different manufacturers are supported, and the time can be adjusted. Supports setting different baud rates.

2 Structure

2.1 Panel Appearance

Figure 2-1 Panel
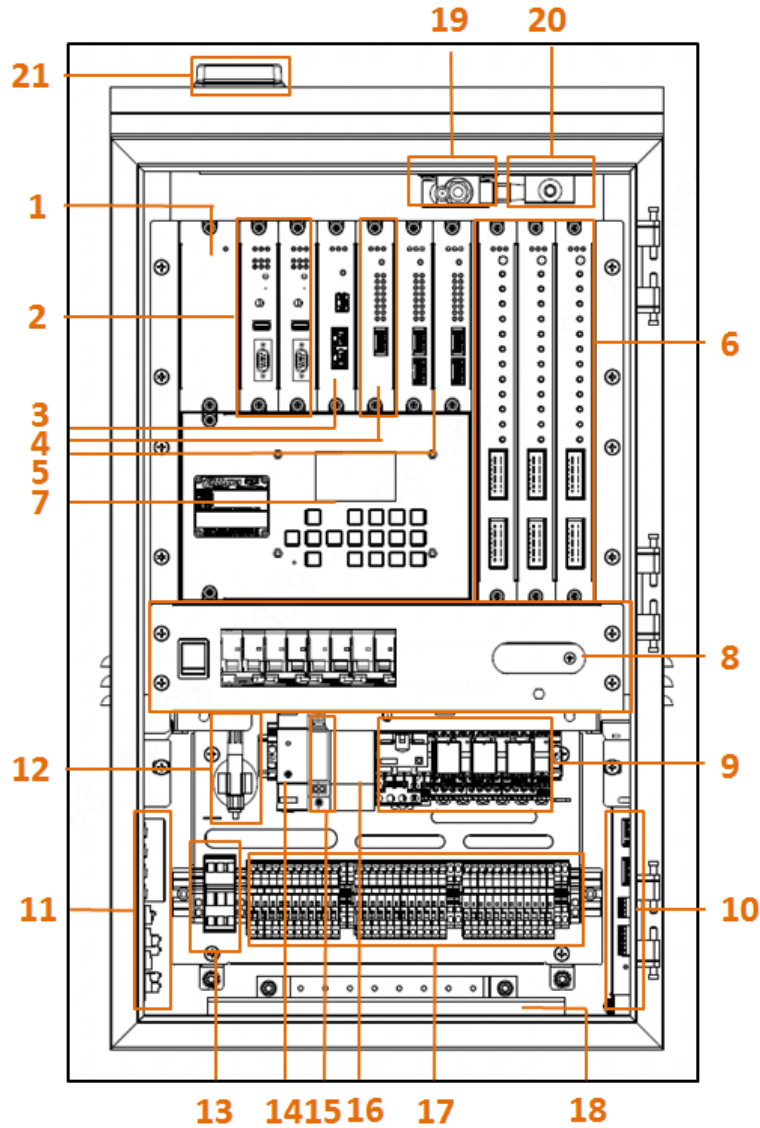
Table 2-1 Front panel description

No.	Description	No.	Description
1	Power board	12	Temperature and humidity sensor
2	Main control board	13	Mains terminal
3	Communication board	14	Ethernet surge protector
4	Pedestrian detection board	15	Electricity meter
5	Vehicle detection board	16	Power surge protector
6	Traffic signal control board	17	Traffic signal terminal
7	LCD	18	Lighting tube

No.	Description	No.	Description
8	Power switch	19	Lighting button that relates to the door status
9	Relay	20	Button that relates to open or close of door
10	Flasher	21	GPS antenna
11	Adapter board	—	

2.2 Panel Description

Table 2-2 Panel icons

Icon	Name	Description
⏻	Power status indicator	The indicator is solid red when the power supply is normal.
⚠	Alarm status indicator	The indicator flashes yellow when alarm signal is received.
💡	Running status indicator	The indicator flashes green when the panel runs normally.

2.2.1 Power Board

Designed to supply power to the 7U board in the upper side of the signal controller.

Figure 2-2 Power board

2.2.2 Main Control Board

The main control board is designed to realize traffic control.

Figure 2-3 Main control board

Table 2-3 Description of main control board

Button/Port	Name	Description
A1, A2, A3	Status indicator	- A1: Green conflicts. - A2: Red light off. - A3: Red and green conflicts.
B1, B2, B3		- B1: Manual control status. - B2: Networking status. - B3: GPS.
CLEAR	Clear button	Press and hold it to restore default settings.
RESET	Reset button	Press it to restart the signal controller.
GPS	GPS antenna port	Connect to GPS antenna for GPS time synchronization.
USB	USB port	Connect USB flash drive for update.
DEBUG RS232	RS-232 debugging	Debug device configurations.

2.2.3 Communication Control Board

The communication control board helps communication of traffic data and device (such as camera) data.

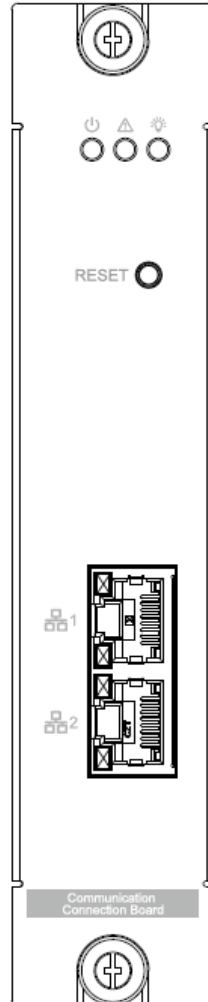Figure 2-4 Communication board

Table 2-4 Description of communication board

Icon/Button	Name	Description
RESET	Reset button	Reset the communication board.
品1	Network port 1	100 M Ethernet port.
品2	Network port 2	

2.2.4 Traffic Signal Control Board

📖

A traffic signal control board supports displaying 4 groups of traffic signals, and one signal controller supports 3 traffic signal control boards.

The traffic signal control board is designed for output monitoring, signal blocking, fault input, filter control, and traffic signal status confirmation. It can suppress the surge voltage, and protect the traffic signals and the internal circuit of the signal controller.

Red, yellow, and green LEDs are designed to indicate the status of each phase in real time.
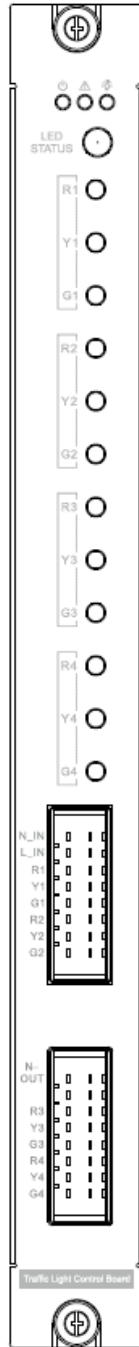
Figure 2-5 Traffic signal control board

Table 2-5 Description of traffic signal control board

Port	Name	Description
R, Y, G	Traffic signal indicator	• R: Indicator of red traffic signal. • Y: Indicator of yellow traffic signal. • G: Indicator of green traffic signal. 📖 A traffic signal control board supports displaying 4 groups of traffic signals.
R1, R2, R3, R4	Fuse status indicator	Displays the fuse status of red, yellow, and green signal circuits. Fuse can be replaced if it is damaged.
Y1, Y2, Y3, Y4		
G1, G2, G3, G4		

2.2.5 LCD Panel

Figure 2-6 LCD

Table 2-6 Description of LCD

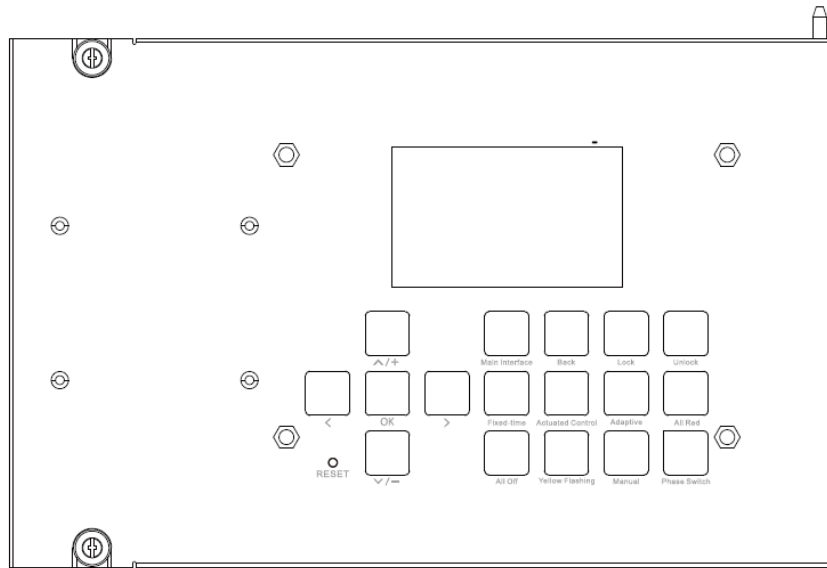| Button	Name	Description
Main Interface	—	Switch to the main interface for preview, and then turn the page to go to system settings and view system information.
Back		Go back to your previous selection.
Lock/Unlock	Lock or unlock phase	Select the channel or phase that you want to lock, and the locked channel or phase stays in green light status. Unlock the channel or phase, and the green light status ends. Locking only takes effect when a phase is selected after entering the Cycle Scheme.
Fixed time	Mode switch	Select the corresponding mode button to switch to the desired mode.
Actuated Control		
Adaptive		
All Red		
All Off		
Yellow Flashing		
Manual	Manual mode	Press it, the current phase runs to the green light status, and the phase is locked. Press it again, the phase is unlocked, and the green light flashes, followed by running other stages in the cycle. After the cycle ends, it enters the next phase.
Phase Switch	—	End the current green phase, and enter green flashing status.

Button	Name	Description
</>	Select	Select the previous or the next item, and then increase or decrease the number.
^/+		
^/-		
OK	—	Confirm your selection or save the settings.
RESET		Restart the signal controller with one button.

2.2.6 Flasher

The flasher ensures that the traffic signals at the intersection do not appear disordered when there is hardware failure or other serious faults.

- In the yellow flashing status, only the yellow light flashes, other lights are off.
- Hardware failure might occur when the board of the connected traffic signals or device is abnormal.
- For serious fault, see "6.2 Serious Fault".

Figure 2-7 Flasher

Table 2-7 Description of flasher
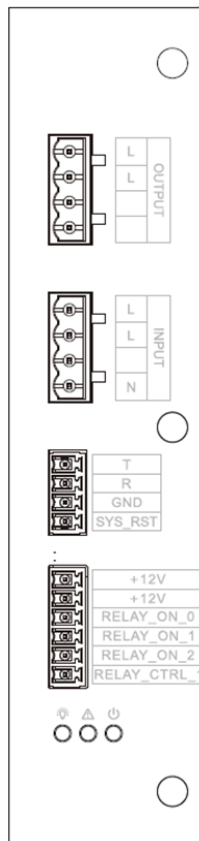
Icon	Name	Description
PWR	Power status indicator	The indicator is solid red when the power supply is normal.
RUN	Running status indicator	The indicator flashes green when the flasher runs normally.

Icon	Name	Description
YFS	Hardware yellow flashing indicator	The indicator flashes yellow when yellow flashing happens.

2.2.7 Vehicle Detection Board

The vehicle detection board detects traffic information, such as the existence of vehicles, vehicle movement direction, traffic flow, and more.

Figure 2-8 Vehicle detection board
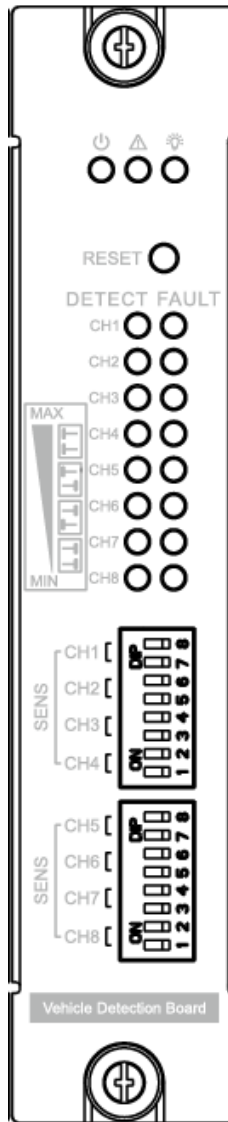
Table 2-8 Description of vehicle detection board

Port/Button	Name	Description
FAULT	Fault indicator of vehicle detector	The indicator is red when there is no coil, or there is coil failure.
DETECT	Detection indicator of vehicle detector	The indicator is red when vehicle is detected.
CH1–CH8	Channel	Each channel corresponds to a group of DIP switches and a group of status indicators (FAULT and DETECT).

Port/Button	Name	Description
RESET	Reset button	Reset the vehicle detection board.

2.2.8 Pedestrian Detection Board

The pedestrian detection board detects the signals requested by pedestrians when they want to go across the intersection.
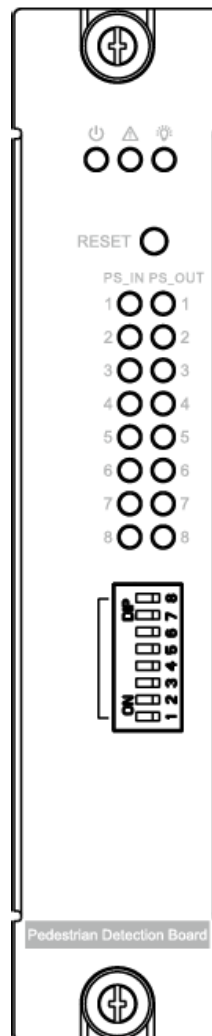
Figure 2-9 Pedestrian detection board

Table 2-9 Description of pedestrian detection board

Button/Port	Name	Description
RESET	Reset button	Reset the pedestrian detection board.
PS_IN (1–8)	Input signal indicator	A signal controller supports 1 pedestrian detection board, which includes 8 signal input channels and 8 signal output channels.
PS_OUT (1–8)	Output signal indicator	The signal input channel can be connected to pedestrian pushbutton, and the signal output channel responds to pedestrian crossing requests.
	DIP switch	Reserved function.

2.2.9 Adapter Board

The adapter board helps connect coil, pedestrian input and output devices, and temperature and humidity sensor to reserved ports of main control board and communication board, such as alarm port, RS-232 port, and RS-485 port.

Figure 2-10 Adapter board
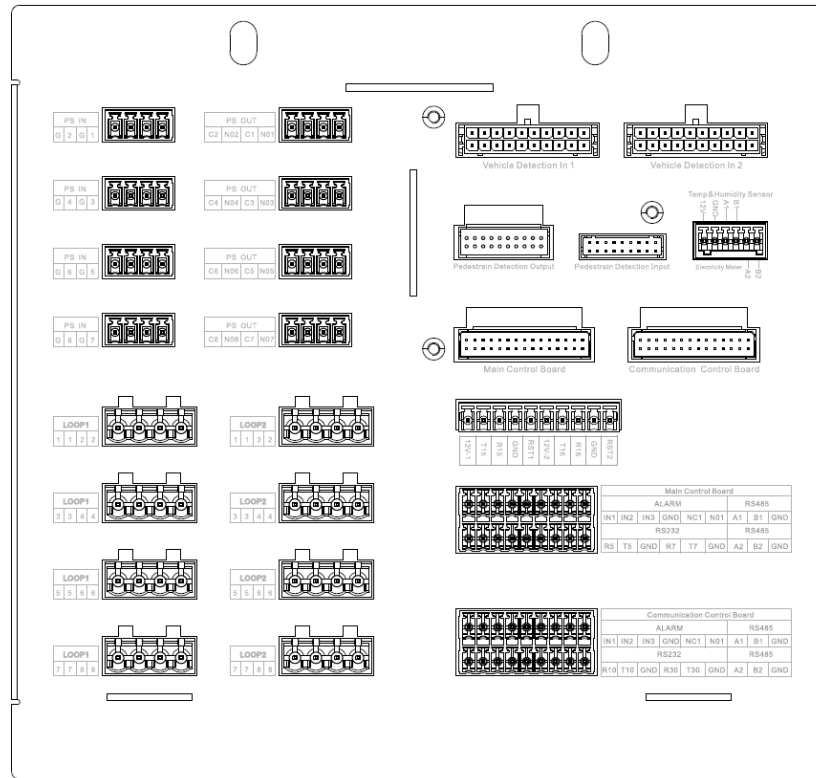
Table 2-10 Description of adapter board

| Button/Port	Name	Description
LOOP	Coil connection port	Ports with the same number connect to the same coil.
PS IN	Pedestrian input port	Connects to pedestrian input signals. Connect G to ground.
PS OUT	Pedestrian output port	Connects to pedestrian output signals. "C" means negative.

Button/Port	Name	Description
Pedestrian Detection Out	—	• **Pedestrian Detection Out**: Connects to output port of pedestrian board. • **Pedestrian Detection In**: Connects to input port of pedestrian board.
Pedestrian Detection In		
Vehicle Detection In		Connects to input port of vehicle board.
Temp&Humidity Sensor/Electricity Meter	Communication port for temp/humidity sensor and electricity meter	Connects to communication cable of temp&humidity sensor and electricity meter.
Main Control Board	Reserved port	Alarm port, RS–232 port, and RS–485 port.
Communication Control Board		

2.2.10 Power Switch

The power switch includes:
● Lighting switch: Controls the lighting system.
● General power supply switch: Controls the power of the whole machine.
● Controller power supply switch: Controls the power board.
● External traffic signal switch: Controls the signal light output.
● YFS switch (flasher switch): Controls the flasher.

Figure 2-11 Power switch
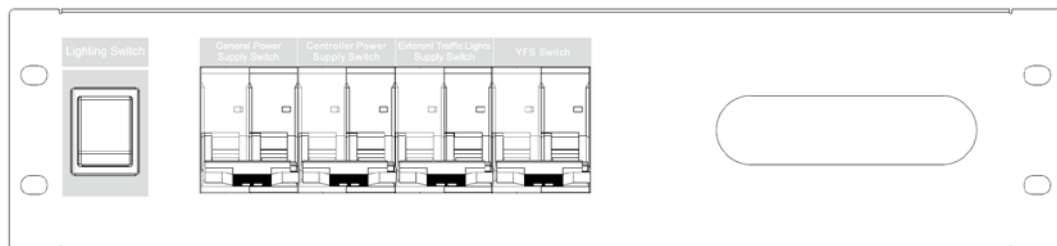
3 Basic Concepts

3.1 Phase

Definition

Phase refers to the right-of-way, yellow change, and clearance intervals in a cycle assigned to an independent traffic movement or a combination of multiple traffic movements.
A phase possibly contains vehicle phase and pedestrian phase. Vehicles and pedestrians in a phase enjoy the same right-of-way.

Figure 3-1 Phase
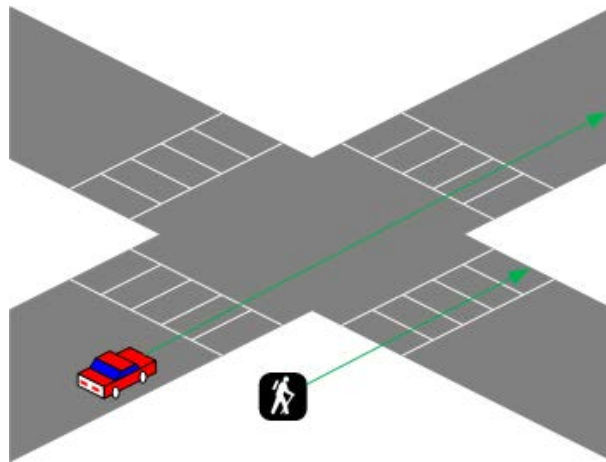
Notes

Phase in a cycle includes timing stage and waiting stage.

Figure 3-2 Release stage
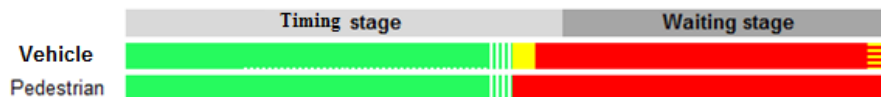
Parent Phase Extension Time

Extension time refers to the duration that the timing of a phase is extended. Each parent phase can be set with independent extension time, especially for multiple-cycle plan.

Figure 3-3 Parent phase extension time
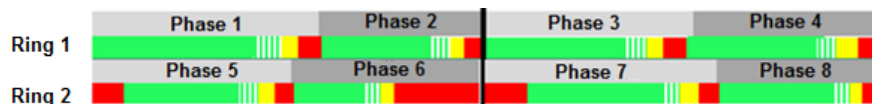
3.2 Overlap

An overlap is a traffic signal that is associated with the signal status of its parent phase. See Figure 3-4.

- When the parent phase is timed, the overlap phase is also timed (no extension time is set).

● When the parent phase stops timing, the overlap phase will also stop timing.

Figure 3-4 Overlap phase

In Figure 3-5, overlap phase has parent phase 1.

Figure 3-5 Parent phase and overlap phase

3.2.1 Extension Time

Overlap phase extension time refers to the duration of timing that is extended for overlap phase according to the extension time of its parent phase. This allows more convenient control over the timing of overlap phases.
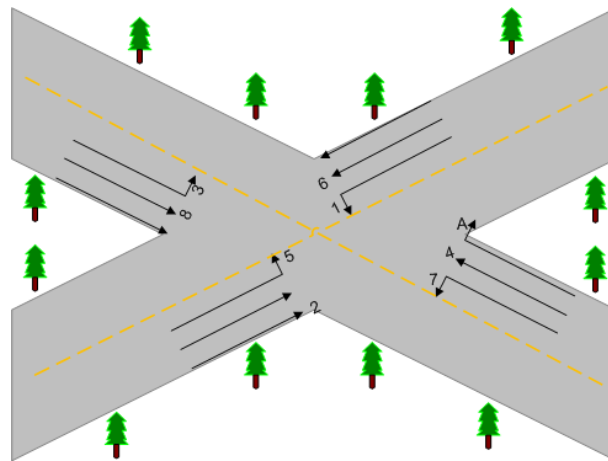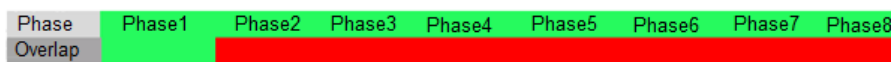
If no overlap phase extension time is set, then the overlap phase will be timed concurrently with the parent phase. See Figure 3-6.

If overlap phase extension time is set, then the red time will be extended, and the green time and red-yellow time will be correspondingly postponed (generally, red-yellow time is not set. In this case, the red-yellow time is set as 0). See Figure 3-7.

Figure 3-6 No overlap extension time is set

Figure 3-7 Overlap extension time is set

3.2.2 Phasing Sequence

Phasing sequence of overlaps: Red time (or red-yellow time) > green time > green flashing time > yellow time > red clearance interval.

3.2.3 Overlap Phasing

Overlaps can be associated with one or more parent phases for timing, and overlap extension time can be set.

- When associated with multiple parent phases, the timing status of an overlap might vary, depending on the timing sequence of parent phases.

  See the following figures for overlap phasing sequence in a ring (overlap extension time is set as 0):

  ◇ Overlap A has parent phases 1 and 4 (A=1+4).

Figure 3-8 Multiple parent phases (1)

  ◇ Overlap A has parent phases 1 and 2 (A=1+2).

Figure 3-9 Multiple parent phases (2)

  ◇ Overlap A has parent phases 1, 2, 3, and 4 (A=1+2+3+4).

Figure 3-10 Multiple parent phases (3)

- For multiple rings, overlaps are associated with multiple parent phases, starting from the phase that is timed first, and ending at the phase that is timed last. The overlap phasing sequence is shown in Figure 3-11.

Figure 3-11 Multiple parent phases (4)
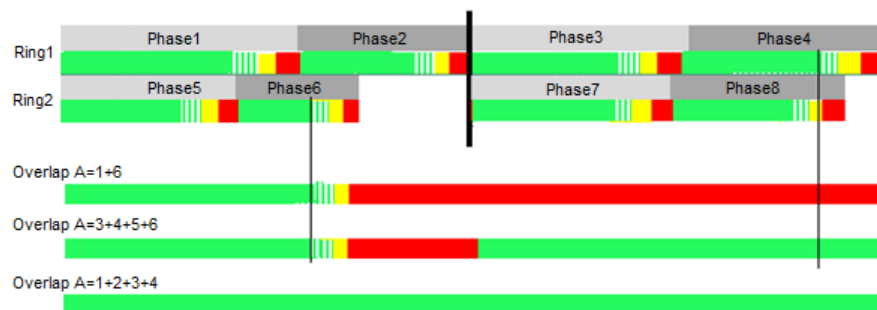
- When associated with multiple parent phases, the timing status of an overlap might vary, depending on the timing sequence of parent phases.

  See the following figures for overlap phasing sequence in a ring (overlap extension time is set):

  📖

  When an overlap is associated with multiple consecutive phases, and overlap extension time is set as 0, then green timing will run continuously.

  ◇ Overlap A has parent phases 1 and 2 (A=1+2). Overlap extension time is set when the overlap is associated with parent phase 2.

Figure 3-12 Multiple parent phases (5)
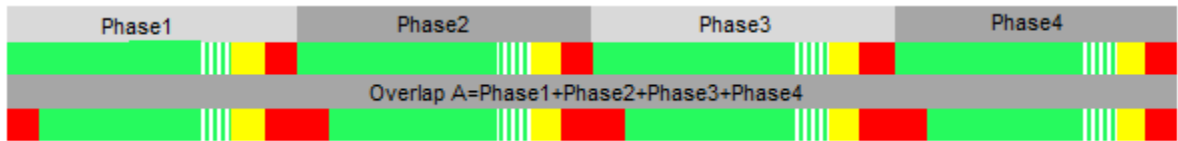
◇ Overlap A has parent phases 1, 2, 3, and 4 (A=1+2+3+4). Overlap extension time is set when the overlap is associated with the four phases.
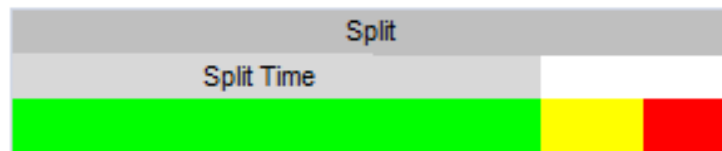
Figure 3-13 Multiple parent phases (6)

3.3 Split

Background Information

Split refers to the ratio of phase time and cycle length in a cycle. Split time is represented by phase timing length (when red-yellow time is not set).

Figure 3-14 Split

Split might vary for vehicle and pedestrian phases, depending on the phase itself.

- For vehicular phase, split contains green time (vehicular phase is timed), green flashing time, yellow time, and red time (which are clearance intervals for vehicles).
- For pedestrian phase, split contains green time (pedestrian phase is timed), green flashing time, and red time (which are clearance intervals for pedestrians).

Figure 3-15 Phase split
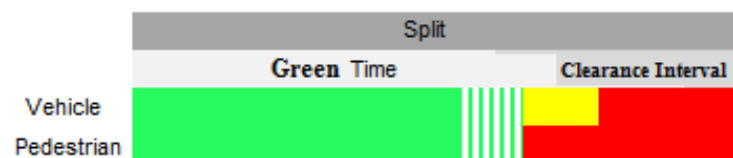
Procedure

Step 1   Confirm phase split time.

Step 2   Set vehicular phase's green flashing time, yellow time, and red clearance interval.

Step 3   Set pedestrian phase's red time, green time, and green flashing time.

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- Pedestrian phase' and vehicular phase's green time and green flashing time are the same.
- Split time must be greater than the sum of vehicular phase's green flashing time, yellow time, and red time.
- If vehicular phase contains red time and yellow time, then red time and yellow time must be included in split.

3.4 Ring

Definition

Ring refers to a set of conflicting phases that occur in an established sequential order.

Figure 3-16 Dural-ring 8-phase intersection
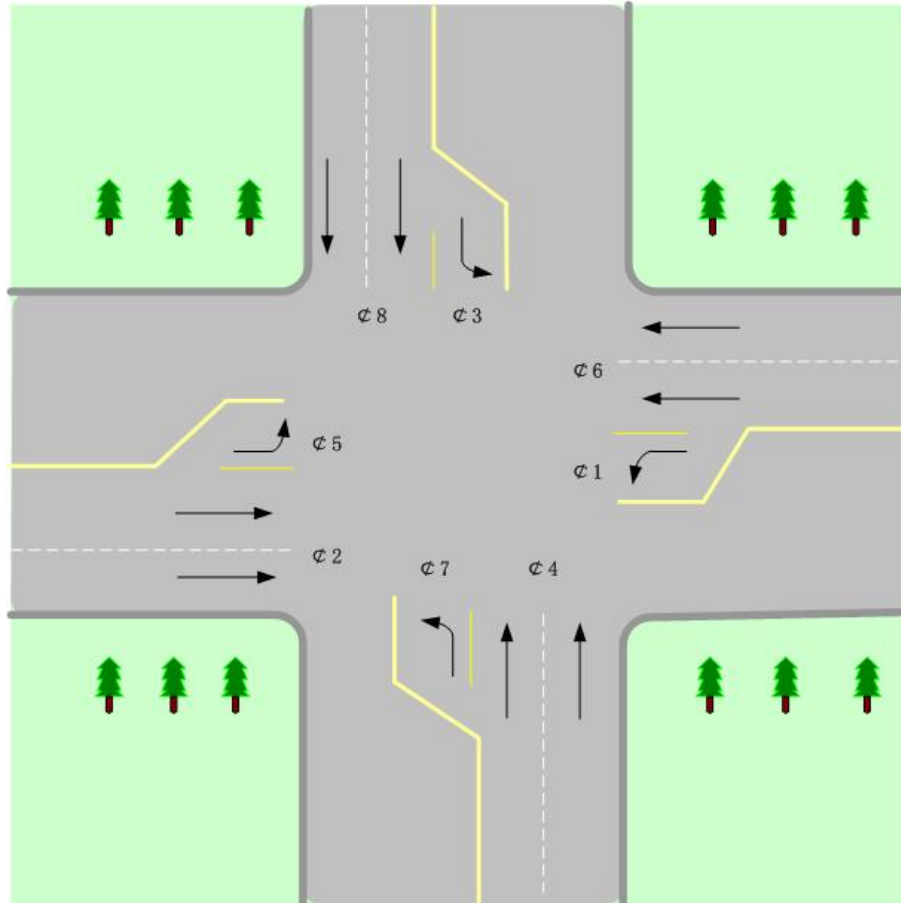
Notes

In a cycle, rings occur concurrently, and the timing sequence of phases is shown in the following figure.

Figure 3-17 Ring

3.5 Barrier

In dual ring operations, some phases are not allowed to be timed concurrently in a cycle, so the ring might be divided into several segments. Barrier is used for separating the rings.

Figure 3-18 Phase barrier
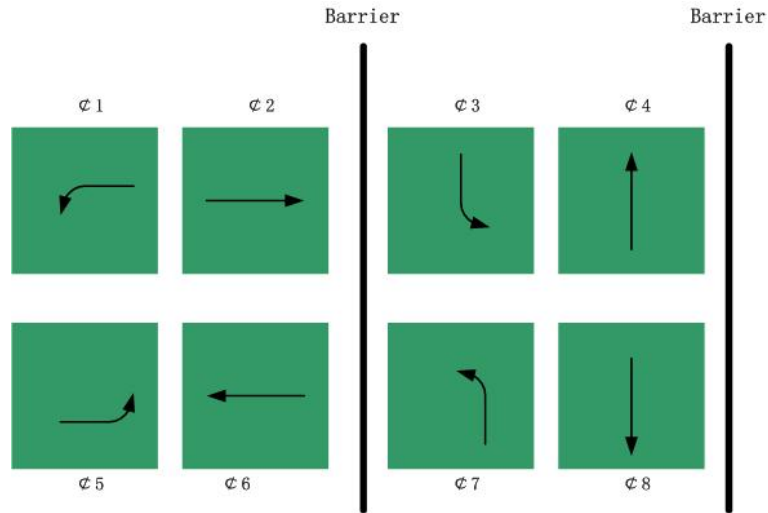
Figure 3-19 Phase sequence (phase with barrier)
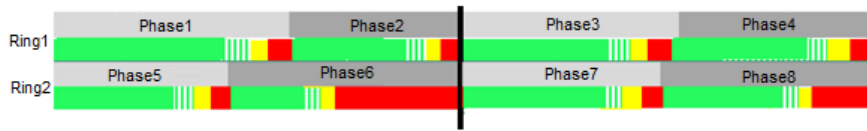
Figure 3-20 Phase sequence (phase without barrier)

3.6 Concurrent Phase

Concurrent phase refers to a phase that is timed simultaneously with another phase (for example phase A) in a cycle. Concurrent phase and phase A are in different rings and at the same side of a barrier. In Figure 3-21, phase 1 has concurrent phases 5 and 6.

Figure 3-21 Concurrent phase

3.7 Cycle Length

Cycle length refers to the time required to complete a full sequence of phase movements, usually covers two or more phases. Phases in a cycle will be timed according to the sequence.
In a cycle, each ring runs concurrently, so that concurrent phases can be timed concurrently or alternately.

Figure 3-22 Cycle length
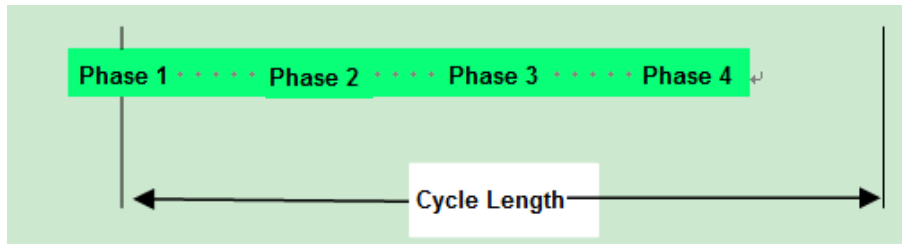
3.8 Offset

Offset includes absolute offset and relative offset. In a coordinated signal control system:
- With one signal as the reference point, absolute offset refers to the minimum time difference between the coordinated phase green interval start time of other signals and that of the reference point.
- Reference offset refers to the minimum time difference between the coordinated phase green interval start time of two adjacent signals along the vehicle movement direction.

3.9 Green Wave

Green wave band refers to the technology of coordinating three or more traffic signals to avoid red lights over several intersections in one direction, so as to reduce vehicle wait time at intersections and ensure continuous traffic flow.

3.10 Phase Sequence

The sequence of a phase.

Figure 3-23 Phase sequence
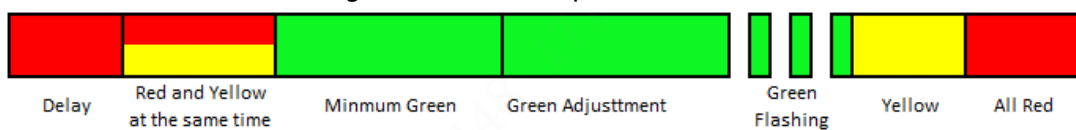
Delay

Set the time that starts later than the parent phase. Generally applied when the vehicles turning right yield to pedestrians going straight.

Red and Yellow at the Same Time

The starting status of the next phase that informs the driver and to prepare to drive.

Minimum Green

The shortest allowable duration of the green interval in a phase. An interval is a period of time during which the signal indications do not change. Set it to 4 s–5 s to ensure that a vehicle can go through the intersection, taking road slope, vehicle type and performance into account.

Green Adjustment

- In actuated control mode, the vehicle detector collects the passing vehicle information at current, and the signal controller adjusts the green time of the current phase accordingly.
- In adaptive control mode, the signal controller analyzes the history data of passing vehicles, and adjusts the green time of the current phase accordingly.

Green Flashing

The period of time during which the green light flashes. Set it to 3 s–5 s, depending on the size of the intersection.

Yellow

Generally, set it to 3 s to ensure that a vehicle has sufficient time to stop safely after the stop line after the green light ends.

All Red

The last stage of a phase, used to clear vehicles that stop a little bit ahead of the stop line (vehicles that run the yellow light).

3.11 Control Mode

3.11.1 Pretimed Control

Pretimed control consists of a fixed sequence of phases that occur in repetitive order. For pretimed control, the cycle length, split, and phase sequence do not change according to road condition changes.

3.11.2 Actuated Control

Actuated signals vary the amount of green time allocated to each phase based on the detected real-time traffic volume. The minimum green time runs for each phase, and if any vehicle passes, an extended green time will run; if continuous vehicle volume is detected during the extended green time, then the time will be continuously extended, until maximum green time occurs.

- Coil detection actuated control: Green time allocated to each phase depends on the real-time traffic volume detected by vehicle detector.

Figure 3-24 Coil detection actuated control
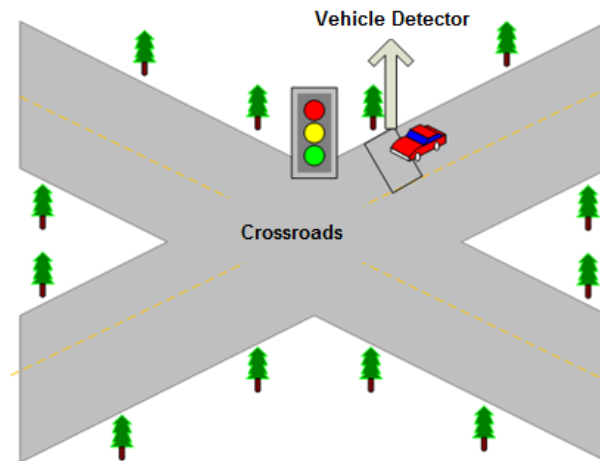
- Video detection actuated control: Green time allocated to each phase depends on the real-time traffic volume detected by camera.

Figure 3-25 Video detection actuated control
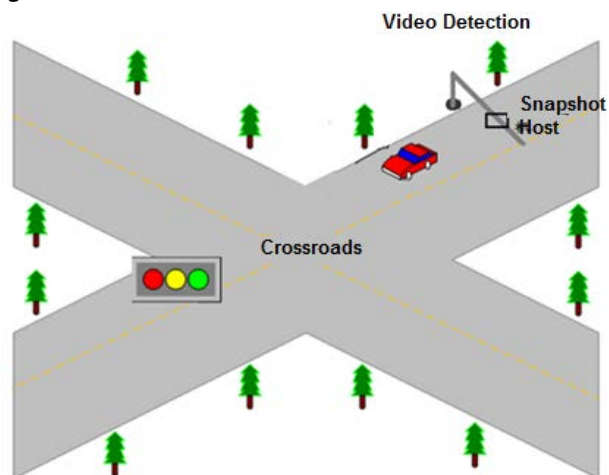
3.11.3 Yellow Flashing Control

In flashing control mode, each signal output channel outputs yellow signal, and makes the signal flashes at a certain frequency.

Startup Flashing

After the signal controller is powered on, in order to ensure safety, the startup flashing mode is performed for a period of time after the controller starts. The duration is 10 seconds by default.

Period Flashing

Yellow flashing plan is configured by using the configuration tool.
The period flashing mode runs when the current control mode of the signal controller finishes.

Command Flashing

When yellow flashing demand is required, yellow flashing signal command can be sent to the signal controller through the configuration tool, remote control, or side panel. After sending command, the controller runs yellow flashing mode no matter what the current phase is.

Command priority: Side panel > remote control > configuration tool.

Degradation Flashing

- Two cases might be applicable for degradation flashing control:
- Software yellow flashing control runs when scheme is incorrectly configured.
- Hardware yellow flashing control runs immediately when a serious fault occurs during system operation.

Exit Flashing

When the system finishes flashing control (except finishes flashing after startup) and then enters ring control, it starts running from the first phase of the current cycle.

3.11.4 All Red Control

In all red control mode, each channel of the signal controller outputs red signals.

Startup All Red

After the signal controller is powered on, in order to ensure safety, an all red mode is performed for a period of time after the controller starts. The duration is 5 seconds by default.

Period All Red

It is the all red plan mode in special scheme.
The period all red mode runs when the current control mode of the signal controller finishes.

Command All Red

The configuration tool sends all red control command to the signal controller, and after the current mode finishes, the controller runs all red control mode.

3.11.5 Light Off Control

In light off control mode, each channel of the signal controller has no signal output, and all signal groups turn off.
Fixed-time light off: The light off mode in special scheme. The fixed-time light off mode runs when the current control mode of the signal controller finishes.

3.11.6 Step Control

Step control is used for quick stage switch in a phase. It helps decrease the green time in a phase, and quickly switch to the next stage of the phase.

3.12 Phase Change Sequence

Change sequence of phase signal might vary depending on the different parameters.

- Vehicular phase conversion order

  Red> green> green flashing > yellow> red (> red and yellow at the same time)
- Pedestrian conversion order

  Orange > white > orange flashing > orange

4 Web Operations

4.1 Web Configuration

You can configure the network settings and view system logs on the web interface of the signal controller.
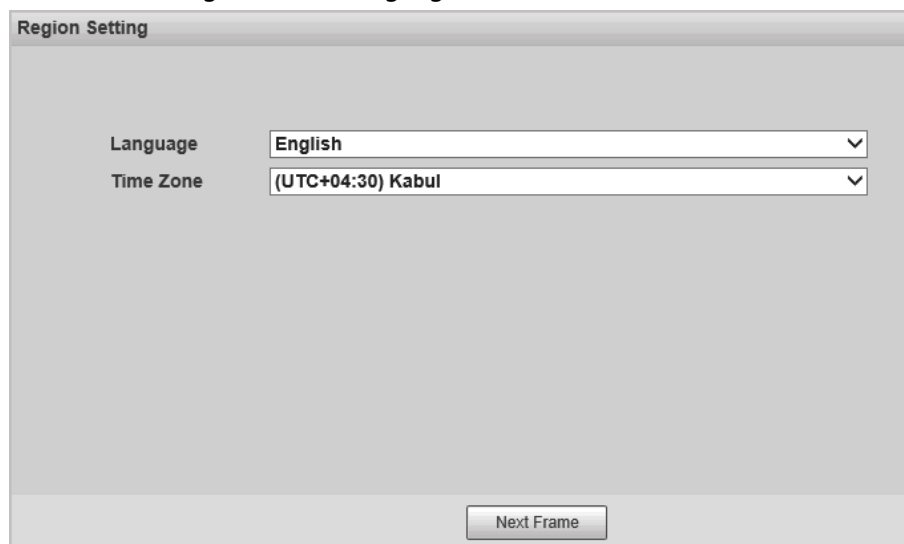
4.1.1 Initialization

You need to set the language, time zone and password of the signal controller when logging in to it for the first time.

Step 1　Open a browser, enter the IP address of the signal controller in the address bar, and then press the Enter key.

Step 2　Set the language and time zone, and then click **Next Frame**.

Figure 4-1 Set language and time zone

Step 3　Confirm the date format and time based on the time zone you have selected, and then click **Next Frame**.

Figure 4-2 Date format

◎━┚

- Click **Sync PC** to sync the time of the signal controller with that of the computer.
- You can change the date and time from **SETTING** > **System** > **General** > **Date & Time**.

Step 4   Enter Password and Confirm Password.

Figure 4-3 Device Initialization

📖

- The new password must consist of 8–32 characters and contain at least two types from upper cases, lower cases, numbers, and special characters (excluding ' " ; : and &).
- If you want to modify your password again after login, go to **SETTING** > **System** > **ACCOUNT**.

Step 5   Select the **Email Address** check box, and then enter your email address. The email address helps you reset your password when your password is lost or forgotten.

Step 6   Click **Confirm**.

Step 7   Enter the username and password, and then click **Login**.

A pop up appears when username or password is incorrect, and it will remind you of remaining attempts. The account will be locked for 300 s if user enters incorrect username or password for 5 times consecutively.

4.1.2 Logging In

Background Information

You can log in to the web by following the steps below. For first-time login, see "4.1.1 Initialization".

Procedure

Step 1   Enter the IP address of the signal controller in the browser address bar, and then press Enter.

Step 2   Enter username and password on the displayed interface, and then click **Login**.

Figure 4-4 Login

- A box pops up when the username or password is incorrect.
- The account will be locked for 5 minutes after 5 wrong attempts.

4.1.3 Resetting Password

You can reset your password through email when it is lost or forgotten. Make sure that your email is correctly entered during initialization (see "4.1.1 Initialization"). Email address can be changed from **SETTING** > **System** > **ACCOUNT**.

Step 1   Enter the IP address of the signal controller in the browser address bar, and press Enter.

Step 2   On the login page, click **Forgot password?**

Step 3   In the pop-up dialog box, click **OK**.

Step 4   Scan the QR code according to the interface prompt, and send the scanning result to the designated email to acquire security code.

Scan the actual QR code. Do not scan the QR code in this manual.

Step 5   Enter received security code in the text box of **Security code**.

Figure 4-5 Reset password

Step 6   Click **Next**.

Step 7   Set **Password**, and enter your new password again in **Confirm Password**.

Step 8   The new password must consist of 8–32 characters, and contain at least two types from upper cases, lower cases, numbers and special characters (excluding ' " ; : and &). The new password must be the same as the **Confirm Password**. Follow the password security notice to set a high-security password.

Step 9   Click **Yes** and the password is reset.

Figure 4-6 Reset password (2)

4.1.4 Web Functions

- **SETTING**: Set network, system, log, and more parameters of the signal controller.
- **Logout**: Log out the web interface of the signal controller.

4.2 Settings

You can configure parameters such as network, safety, and system information.

4.2.1 Network

You can set IP address, port and other parameters of the signal controller.

4.2.1.1 TCP/IP

Configure the IP address of the signal controller and DNS server. Make sure that it is connected to other devices in the network.

Step 1   Select **SETTING** > **Network** > **TCP/IP** > **Mainboard**.
Step 2   Configure the parameters.

Figure 4-7 Mainboard

Table 4-1 Description of host parameters

Parameter	Description
Host Name	Enter a name for the host device. Maximum 15 characters are supported.
Mode	Network mode, including static and DHCP. ● **Static**: It needs to manually set IP, subnet mask and gateway. ● **DHCP**: Automatically acquire IP, at this moment IP, subnet mask and gateway cannot be set.
MAC Address	Host MAC address.
IP Version	IP version, including **IPv4** and **IPv6**. The IP address of both versions can be accessed.
IP Address	IP Address of signal controller.
Subnet Mask	The corresponding subnet mask of device IP address.
Default Gateway	Corresponding gateway of device IP address.
Preferred DNS	IP address of DNS server.
Alternate DNS	Alternate IP address of DNS server.

Step 3   Click **OK**.

Step 4   Click the **Communication Board** tab.

Step 5   Configure the parameters of network ports 1 and 2.

Figure 4-8 Communication board
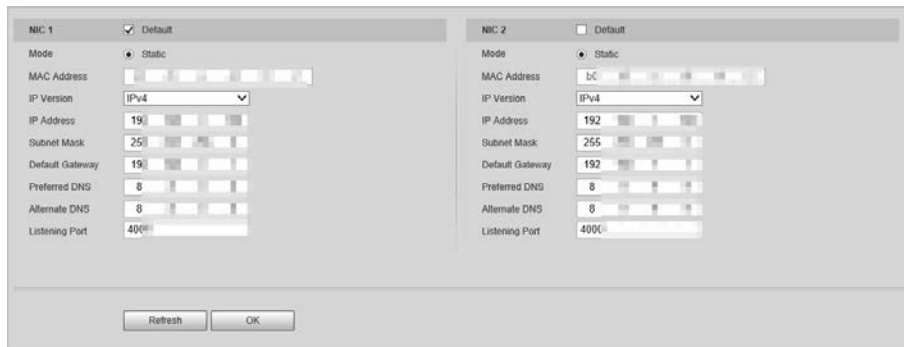
Table 4-2 Description of network port parameter

Parameter	Description
Mode	Only **Static** network mode is supported. You need to manually set IP, subnet mask and gateway.
IP Version	IP version, including **IPv4** and **IPv6**. The IP address of both versions can be accessed.
IP Address	IP Address of network port.
Subnet Mask	The corresponding subnet mask of network port IP address.
Default Gateway	The corresponding gateway of network port IP address.
Listening Port	Set the listening port of the network port, so the host server can listen to the client.

Step 6   Click **OK**.

4.2.1.2 Port

Set the ID, TCP port, configuration tool port, and HTTP port of the signal controller.

Step 1   Select **SETTING** > **Network** > **Port**.

Step 2   Configure the parameters.

Figure 4-9 Port
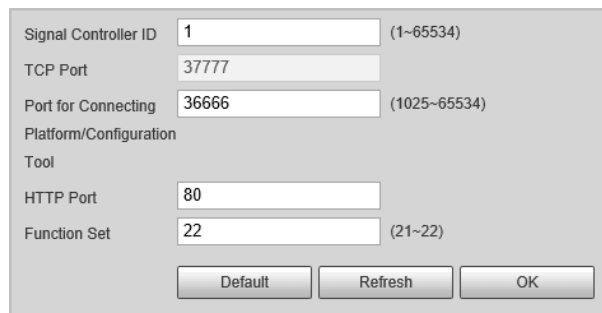
Table 4-3 Port description

Parameter	Description
Signal Controller ID	The ID that identifies the signal controller.
TCP Port	Protocol communication port. It is 37777 by default.

Parameter	Description
Port for Connecting Platform/Configuration Tool	Port for connecting to platforms or the configuration tool. It is 36666 by default.
HTTP Port	HTTP communication port. It is 80 by default.
Function Set	Enter the number of functions that are open to users on the signal controller.

Step 3　Click **OK**.

4.2.2 System Settings

You can configure general information, adding user, restoring default settings, and more.

4.2.2.1 General

This section introduces how to configure date and time, time zone, and more.

Step 1　Select **SETTING** > **System** > **General** > **Date & Time**.

Figure 4-10 Date and time

Step 2　Configure the parameters.

Table 4-4 Description of date and time parameters

Parameter	Description
Date Format	Select the format of the date and time, and time zone of the signal controller.
Time Format	
Time Zone	
System Time	Set the system time of the signal controller. The settings take effect immediately.

Parameter	Description
Sync PC	Sync the time of the signal controller with that of the computer.
DST	Enable the function, and then set begin time and end time of DST based on the selected **DST Type**.
Time Synchronization	**NTP**: Enable **NTP** (network time protocol) time synchronization. In this case, you need to set the NTP server IP address, port, and time synchronization interval. **Positioning System Time Synchronization**: Synchronize the time according to the positioning system. In this case, you need to enable **GPS** or **BeiDou** positioning first.

Step 3   Click **OK**.

4.2.2.2 Account

You can change user login password and email information.

Step 1   Select **SETTING** > **System** > **ACCOUNT**.
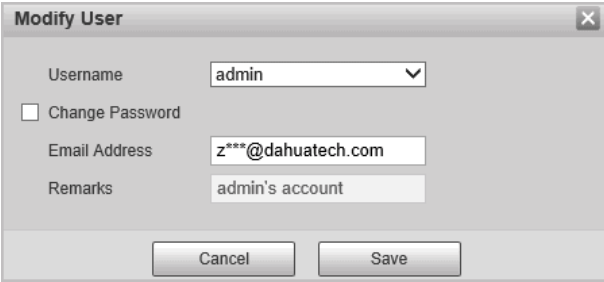
Step 2   Click ⚙ corresponding to the admin account.

Figure 4-11 Change user information

Admin user cannot be deleted.

Step 3   Click **Save**.

4.2.2.3 Security

4.2.2.3.1 System Service

Select the system service which needs to be enabled according to actual requirements.

Step 1   Select **SETTING** > **System** > **Security** > **SYSTEM SERVICE**.

Figure 4-12 System service

Step 2 Select the needed system service.

Table 4-5 System service parameters description

Parameter	Description
SSH	SSH (Secure Shell) implements data encrypted transmission and effectively avoid information leakage during remote management.
Multicast/Broadcast Search	Multicast: It realizes point-to-multipoint network connection between sender and receiver. Broadcast: Broadcast data packet in IP subnet, all the hosts in the subnet will receive these data packets.
Password Reset	When you forget the password of admin user, you can set new password through password reset function.
CGI	CGI is the port between external application program and web server.
Private Protocol Authentication Mode	Keep the recommended **Security Mode**.

Step 3 Click **OK**.

4.2.2.3.2 HTTPS

Prerequisites

- For first-time use of HTTPS or after changing device IP address, you need to create server certificate, and install root certificate.
- After creating server certificate, and installing root certificate, if you change a computer to log in to the web client, then you need to download and install the root certificate again on the new computer or copy the downloaded root certificate on the new computer, and install it.

On the **HTTPS** page, users can make PC log in normally through HTTPS by creating certificate or uploading authenticated certificate. It can ensure security of communication data, and provide guarantee for user information, and device safety through reliable, and stable technical approach.

Procedure

Step 1 Create certificate or upload the authenticated certificate.

- **Create Certificate**.
  1. Select **Setting** > **System** > **Safety** > **HTTPS**.

Figure 4-13 HTTPS
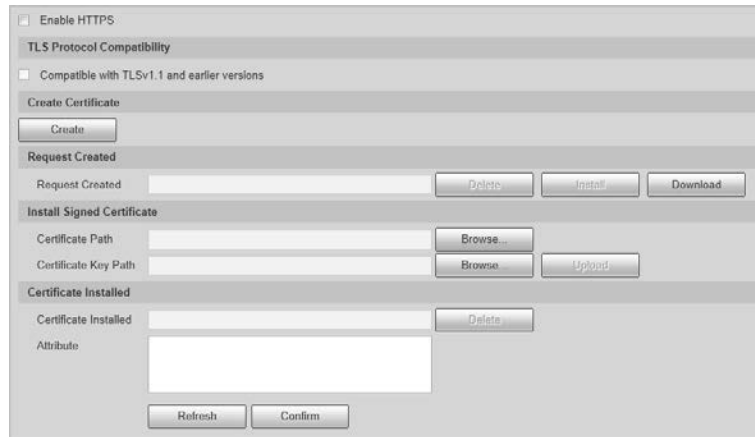
2. Click **Create**.

Figure 4-14 Create a certificate
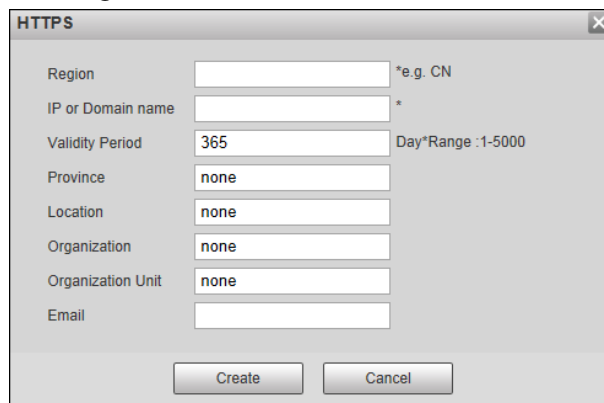
3. Enter the required information such as region, IP or domain name, and then click **Create**.

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The entered **IP or Domain name** must be the same as the IP or domain name of the signal controller.

4. Click **Install** under **Request Created**, and then click **Download** to download root certificate.

The system pops up **Save As** dialog box, select storage path, and then click **Save**.

5. Double-click the RootCert.cer icon.

6. Click **Install Certificate...**

Figure 4-15 Install certificate
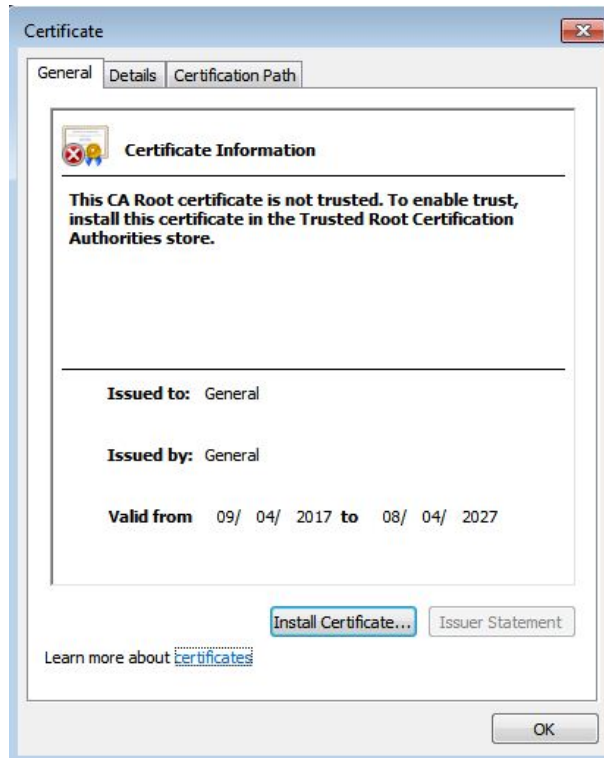
7. Click **Next**.

Select as needed.

Figure 4-16 Certificate store
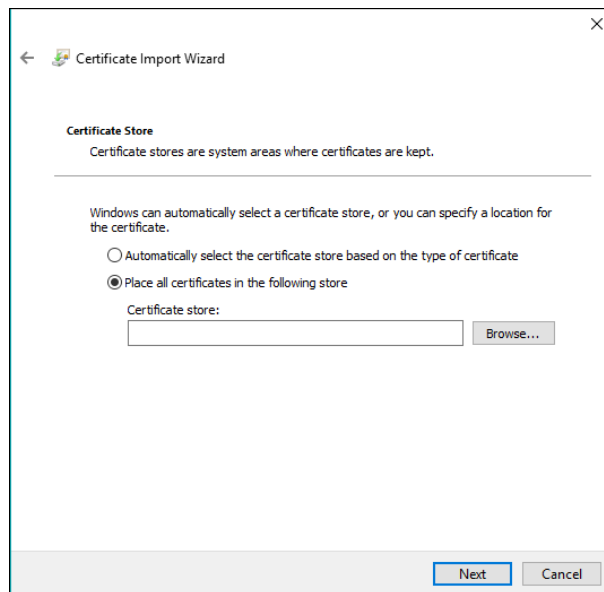
8. Click **Next**.

Figure 4-17 Complete certificate import wizard
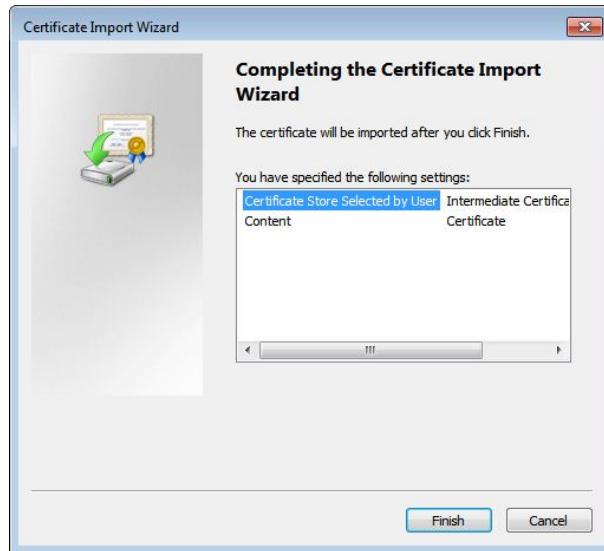
9. Click **Finish**.

Figure 4-18 Security warning
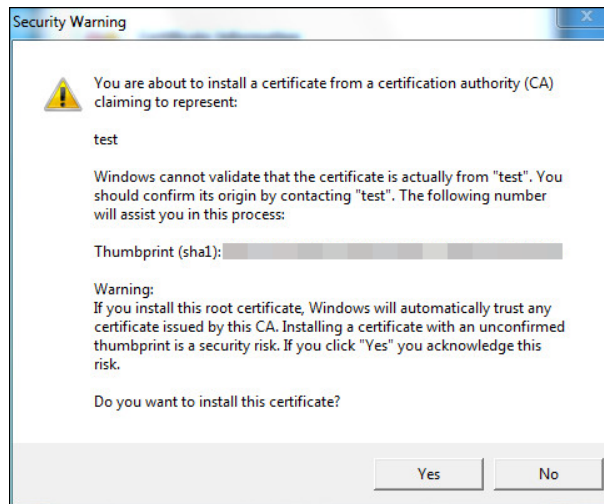
10. Click **Yes**, and then click **OK** on the pop-up window.

● **install signed certificate**.

1. Select **Setting Safety** > **System** > **Safety** > **HTTPS**.

2. Select **Enable HTTPS**, and **Compatible with TLSv1.1 and earlier versions**.

3. Click **Browse** to upload the signed certificate, and certificate key, and then click **Upload**.

4. To install the root certificate, see operation steps from 4 to 10 in **Create Certificate**.

Step 2   Select **Enable HTTPS**, and click **Confirm**.

The configuration takes effect until the signal controller restarts.

Step 3   Use HTTPS to log in to the signal controller.

1. Enter https://*xx.xx.xx.xx* in the browser.

xx.xx.xx.xx is the signal controller IP address or domain name.

2. Enter the username, and password to log in to the signal controller.

4.2.2.3.3 Firewall

Set the security rules to protect the safety of your camera system.

Step 1   Select **SETTING** > **System** > **Security** > **Firewall**.

Figure 4-19 Firewall
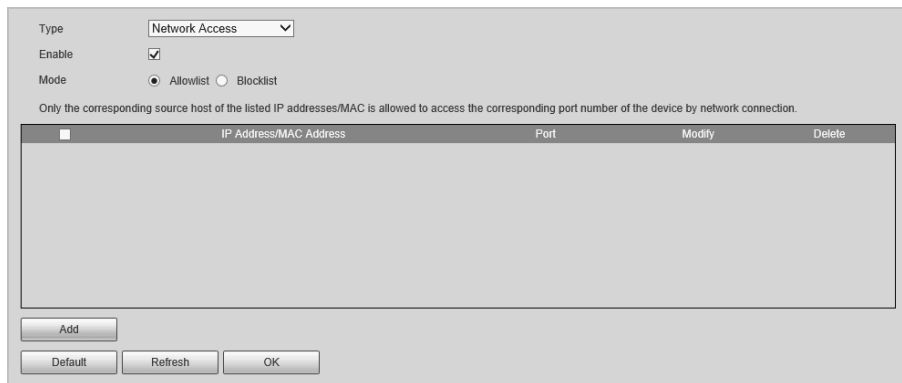
Step 2   Select **Rule Type**.

- **Network Access**: Add the IP address to allowlist or blocklist to allow or restrict it to access corresponding ports of the device.
- **PING Prohibited**: IP address of your camera is prohibited from ping. This helps prevent attempt of accessing your network system without permission.
- **Prevent Semijoin**: Prevents half-open SYN attacks.

Step 3   Select **Enable** to enable the rule type that you selected, and you can start configuring the blocklist and allowlist.

Devices on the blocklist cannot access the corresponding ports of the signal controller.

1) Select **Allowlist** or **Blocklist**, and then click **Add**.
2) Add devices by **IP Address**, **IP Segment**, **MAC Address**, or **All IP addresses**.
   When adding devices by IP address or IP segment, you can set the start port and end port, or all ports that will be added to allowlist or blocklist.

Figure 4-20 Add IP/MAC address

3) Click **OK**.

Step 4   Click **OK**.
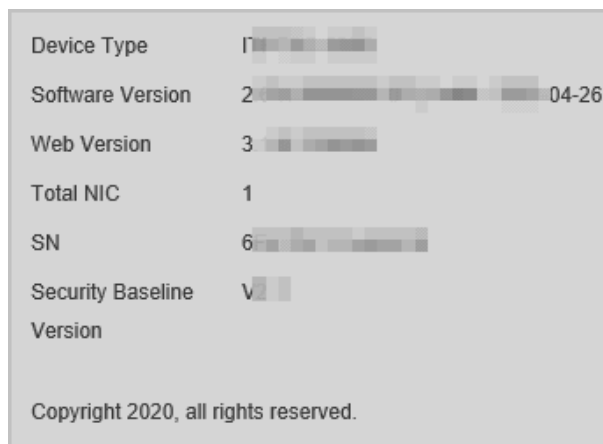
4.2.3 System Information

The system supports viewing version, user and log, and more.

4.2.3.1 Version

You can view the version information of the signal controller by selecting **SETTING** > **System Info** > **Version**.

Figure 4-21 Version information

4.2.3.2 Log

4.2.3.2.1 System Log

You can view log information such as system, configuration, data, event, record, user management, and also clear log records.

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The earliest log records will be covered when the number of log records reaches 1024.

Step 1   Select **SETTING** > **System Info** > **Log** > **Log**.

Step 2   Set the filters, and then click **Search**.

Figure 4-22 System log
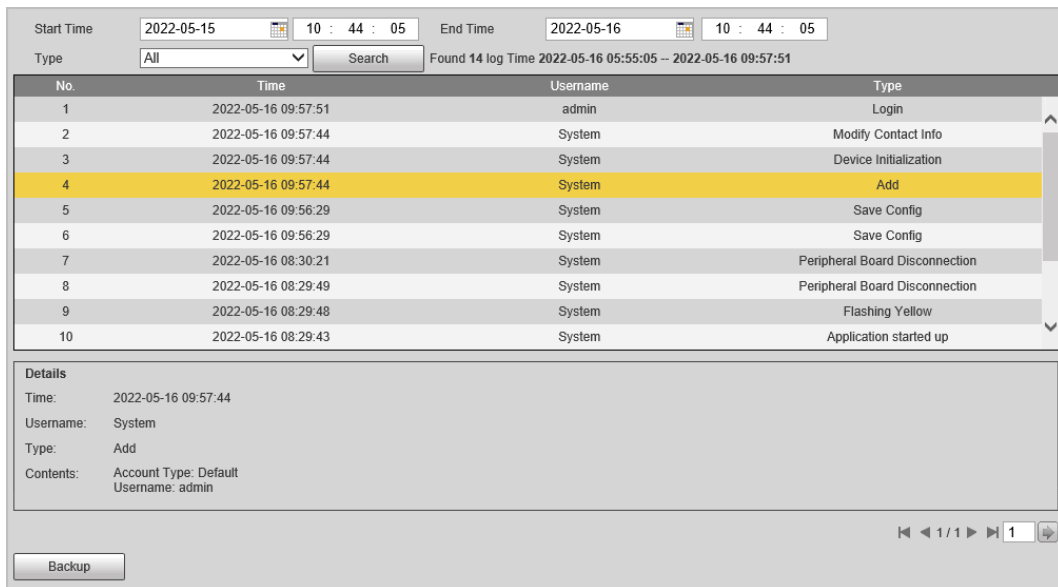
Step 3 Select one log, you can view the details in the lower section.

Step 4 (Optional) Click **Backup** to export all logs to the local computer.

4.2.3.2.2 Remote Log

You can save your important logs to log server. This helps provide important clues to the source of security incidents. Log server needs to be deployed in advance by a professional or system administrator.

Step 1 Select **SETTING** > **System Info** > **Log** > **Remote Log**.

Step 2 Select **Enable** to enable remote log.

Step 3 Configure the IP address, port, and device number.

Figure 4-23 Remote log

Step 4 Click **OK**.

4.3 Logout

Click **Logout** to exit the system.

5 Update

You can change IP address and update the signal controller by using ConfigTool.

To acquire ConfigTool, go to our official website, and then select **Support** > **Download Center** > **Tools** > **Maintenance Tools**. Find **ConfigTool**, and download and install it according to onscreen instructions.

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- There might be risks in the update process. On-site update by technical personnel is recommended.
- This section takes ConfigTool 4.07.0 as the example. Different versions might have different interfaces, and the actually downloaded ConfigTool shall prevail.

5.1 Changing IP Address

You can acquire and change IP addresses of devices accessed through wired network. This section uses changing IP address with ConfigTool as the example. For other methods of changing IP address, see the user's manual.

Step 1   Start ConfigTool, and then click **Modify IP** on the homepage.
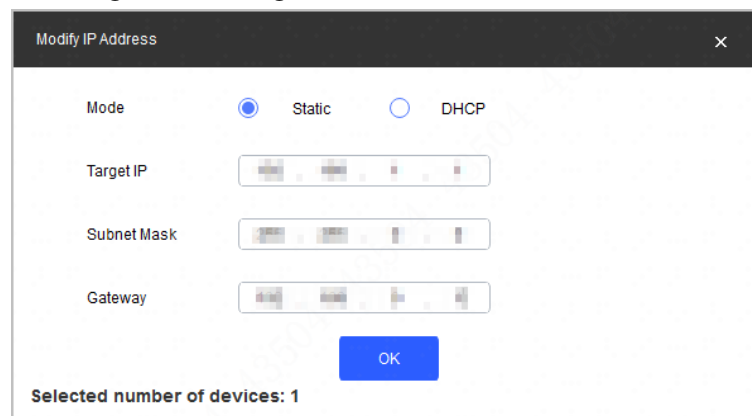
Step 2   Select the device(s) whose IP need(s) to be changed.

- Change one IP address: Click ✅ corresponding to the device.
- Change IP addresses in batches: Select the devices, and then click **Modify IP**.

Step 3   Set mode, IP, subnet mask and gateway.

Step 4   Click **OK**.

Figure 5-1 Change IP addresses in batches

5.2 Updating Signal Controller

Single upgrade and batch upgrade are supported.

Step 1   Start the ConfigTool.

Step 2   Click **Device Upgrade**.

Step 3   Select the signal controller to be updated.

- Update one by one: Click 🗋 corresponding to the Device.

- Update in batches: Select multiple devices, and then click **Batch Upgrade**.

Step 4   Select the update file.

Step 5   Update the signal controller.

- Update one by one: Click ⬆ to start updating.
- Update in batches: Click **OK** to start updating.

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During update, if the signal controller is disconnected, as long as the ConfigTool stays on the update page, the upgrade will continue when the signal controller is reconnected.

6 Troubleshooting

Refer to this section to troubleshoot any fault. For faults not covered in this section, contact technical support.

6.1 Tools

Slotted screwdriver, Phillips screwdriver, multimeter, electrical tape, test pencil, laptop, network cable, and more.

6.2 Serious Fault

When the following serious faults occur, the signal controller will immediately enter the yellow flashing status.

Table 6-1 Serious fault

Fault	Details
Green conflicts	Green lights are on in the preset conflict phases (phases that should not simultaneously time the green light), resulting in serious traffic crash.
Red and green conflicts of the same signal group	When there is short circuit or other abnormal condition for the signal light wire, the red and green signals of the same light group are timed simultaneously, making the driver confused.
Simultaneous fault of red lights of all signal groups connected to the same output port	When all the red lights of an output do not turn on, there will be no stop signal in the phase.
Other serious faults that influence traffic safety	When the green lights of all four directions at an intersection fail, the drivers might rush to go, even causing traffic accidents.

6.3 General Fault

The traffic signal controller can monitor and record the working conditions of external devices such as detectors. If the following faults occur, it can be automatically downgraded to a more reliable control mode to ensure its continuous work.
● Fault of external devices such as detectors: The signal controller detects whether the detector is disconnected or there is short circuit through the fault detection mechanism.
● Communication fault, which can be detected by the signal controller in real time.
● Other general faults that do not affect traffic safety.

6.4 FAQ

Table 6-2 FAQ

Question	Possible Reasons	Solutions
The traffic signals keep on	Phase plate SCR breakdown	Replace SCR
	Phase plate TVS breakdown	Replace TVS
	Improper connection of cable	Connect the cable properly
	Main control board failure	Replace main control board
The traffic signals keep off	Power failure	Wait power supply to recover
	The main power switch is not turned on	Switch it on
	The light control switch is not turned on	
	Short circuit of light wire, and the switch cannot be closed	Fixt the problem of short circuit
	Relay is not connected properly	Connect the relay properly
	Relay is damaged	Replace the relay
	Phase board is not powered	Power the phase board
	The switching power supply is damaged	Replace the power supply
	Phase board socket is not plugged in	Check the socket, plug in the socket, or replace the parallel cable
	Fault of main control board	Replace main control board
The traffic signals flash yellow	The cable connecting the phase board and the main control board is damaged	Check and replace the cable (if necessary)
	The address selector switch on the phase board is damaged	Replace the phase board
	The time on the main control is not accurate	Sync the time
	The main control board is damaged	Replace the main control board
The red, yellow, or green light of a phase fails	Light burned out	Replace the light
	Incorrect wiring of terminal	Check and correct the wiring
The fuse of red, green, or yellow light on the phase plate fails	Phase plate fuse burned out	Replace the fuse
	The fuse is not in good contact	Connect again, or replace the fuse
Light color green conflicts	Various interference factors cause parameter error	Restart the signal controller

Question	Possible Reasons	Solutions
	The main control board, power module, or phase drive board is damaged	Replace damaged board or module
Coil fault	Coil loop open	Check whether the loop wiring is disconnected
	Coil loop short circuit	Check whether the loop wiring is short connected
Communication with maintenance tool fails	Communication cable is damaged or not connected	Check and replace the cable (if necessary)
	Communication serial port burned out	Check and replace the board (if necessary)
Communication with control center fails	Communication cable is damaged or not connected	Check and replace the cable (if necessary)
	Communication serial port burned out	Check and replace the board (if necessary)

6.5 Fault Troubleshooting

6.5.1 All Traffic Signals Off

Troubleshooting Procedure

Check the voltmeter to see whether the voltage is normal:
- If yes, check whether the general power air switch is turned on.
- If no, use the multimeter to measure the input voltage of the total power supply.

Solutions

- No power supply: Check the power supply circuit.
- Circuit abnormality causing a switch trip: After checking that the power supply is normal, close the circuit, and observe the operation of the signal controller.
- The power supply voltage is out of the normal range: Check the power supply circuit.
- Lightning protection: Check and replace the lightning protection device (if necessary).

6.5.2 Traffic Signals Flash Yellow

Troubleshooting Procedure

1. Check the indicator on the power board.
2. Check the fault indicator on the main control board, and confirm the fault reason according to Table 6-2.
3. Check the air switch status.
4. If there is no fault indication, check the plan and time settings of signal controller.

Solutions

- The power supply voltage is not in the normal range: Check the power supply voltage.
- Power board fault: Replace the power board.
- Red off, green conflict, or red and green on simultaneously: Restart the signal controller, and observe the operation status of the signal controller (by the sequence of yellow flashing, all red, and preset scheme). Check faults of red off, and red and green on simultaneously in all red status, and check faults of green conflict, and red and green on simultaneously in preset scheme status.
- Incorrect time of the signal controller: Change the time or adjust the parameters.

6.5.3 A Traffic Signal Off

Troubleshooting Procedure

1. Confirm the fuse holder according to traffic signal wiring, and then check the fuse.
2. Use a voltmeter to measure the voltage at the left and right ends of the fuse holder.

Solutions

- The fuse is burnt out: Check the wires and lights, and then replace the fuse, restart the signal controller to observe its operating status.
- There is no voltage output at the right end of the fuse holder, indicating signal controller fault. You need to replace the corresponding light control board according to the terminal connection, and then restart the signal controller to observe its operating status.
- There is voltage output at the left end of the fuse holder, indicating traffic signal or circuit fault. Check the traffic signal and the circuit.

6.5.4 Traffic Signals Turn On or Off Abnormally

Troubleshooting Procedure

Confirm the fuse holder according to the wiring of the traffic signals. Remove the fuse, and observe the on and off status of the traffic signals.

Solutions

- The traffic signals continue to turn on and off abnormally: External fault. Check the traffic signals and the cables.
- The traffic signals turn off: Signal controller fault. You need to replace the corresponding light control board according to the terminal connection, and then restart the signal controller to observe its operating status.

6.5.5 Failed to Communicate with Superior Signal Controller

Troubleshooting Procedure

1. Set the IP address of your PC to the IP address of the signal controller, and connect the PC to network.
2. Ping central server.

Solutions

- The central server cannot be pinged: External fault. Check the network and circuit.
- The central server can be pinged: Fault of the main control board. Replace the main control board, and test again.

Appendix 1 Cybersecurity Recommendations

Mandatory actions to be taken for basic equipment network security:

1. **Use Strong Passwords**

   Please refer to the following suggestions to set passwords:
   - The length should not be less than 8 characters.
   - Include at least two types of characters; character types include upper and lower case letters, numbers and symbols.
   - Do not contain the account name or the account name in reverse order.
   - Do not use continuous characters, such as 123, abc, etc.
   - Do not use overlapped characters, such as 111, aaa, etc.

2. **Update Firmware and Client Software in Time**

   - According to the standard procedure in Tech-industry, we recommend to keep your equipment (such as NVR, DVR, IP camera, etc.) firmware up-to-date to ensure the system is equipped with the latest security patches and fixes. When the equipment is connected to the public network, it is recommended to enable the"auto-check for updates" function to obtain timely information of firmware updates released by the manufacturer.
   - We suggest that you download and use the latest version of client software.

"Nice to have" recommendations to improve your equipment network security:

1. **Physical Protection**

   We suggest that you perform physical protection to equipment, especially storage devices. For example, place the equipment in a special computer room and cabinet, and implement well-done access control permission and key management to prevent unauthorized personnel from carrying out physical contacts such as damaging hardware, unauthorized connection of removable equipment (such as USB flash disk, serial port), etc.

2. **Change Passwords Regularly**

   We suggest that you change passwords regularly to reduce the risk of being guessed or cracked.

3. **Set and Update Passwords Reset Information Timely**

   The device supports password reset function. Please set up related information for password reset in time, including the end user's mailbox and password protection questions. If the information changes, please modify it in time. When setting password protection questions, it is suggested not to use those that can be easily guessed.

4. **Enable Account Lock**

   The account lock feature is enabled by default, and we recommend you to keep it on to guarantee the account security. If an attacker attempts to log in with the wrong password several times, the corresponding account and the source IP address will be locked.

5. **Change Default HTTP and Other Service Ports**

   We suggest you to change default HTTP and other service ports into any set of numbers between 1024–65535, reducing the risk of outsiders being able to guess which ports you are using.

6. **Enable HTTPS**

   We suggest you to enable HTTPS, so that you visit Web service through a secure communication channel.

7. **MAC Address Binding**

   We recommend you to bind the IP and MAC address of the gateway to the equipment, thus

reducing the risk of ARP spoofing.

8. **Assign Accounts and Privileges Reasonably**

   According to business and management requirements, reasonably add users and assign a minimum set of permissions to them.

9. **Disable Unnecessary Services and Choose Secure Modes**

   If not needed, it is recommended to turn off some services such as SNMP, SMTP, UPnP, etc., to reduce risks.

   If necessary, it is highly recommended that you use safe modes, including but not limited to the following services:

   ● SNMP: Choose SNMP v3, and set up strong encryption passwords and authentication passwords.

   ● SMTP: Choose TLS to access mailbox server.

   ● FTP: Choose SFTP, and set up strong passwords.

   ● AP hotspot: Choose WPA2-PSK encryption mode, and set up strong passwords.

10. **Audio and Video Encrypted Transmission**

    If your audio and video data contents are very important or sensitive, we recommend that you use encrypted transmission function, to reduce the risk of audio and video data being stolen during transmission.

    Reminder: encrypted transmission will cause some loss in transmission efficiency.

11. **Secure Auditing**

    ● Check online users: we suggest that you check online users regularly to see if the device is logged in without authorization.

    ● Check equipment log: By viewing the logs, you can know the IP addresses that were used to log in to your devices and their key operations.

12. **Network Log**

    Due to the limited storage capacity of the equipment, the stored log is limited. If you need to save the log for a long time, it is recommended that you enable the network log function to ensure that the critical logs are synchronized to the network log server for tracing.

13. **Construct a Safe Network Environment**

    In order to better ensure the safety of equipment and reduce potential cyber risks, we recommend:

    ● Disable the port mapping function of the router to avoid direct access to the intranet devices from external network.

    ● The network should be partitioned and isolated according to the actual network needs. If there are no communication requirements between two sub networks, it is suggested to use VLAN, network GAP and other technologies to partition the network, so as to achieve the network isolation effect.

    ● Establish the 802.1x access authentication system to reduce the risk of unauthorized access to private networks.

    ● Enable IP/MAC address filtering function to limit the range of hosts allowed to access the device.