R9-L420N 1 Inch 4K60 PTZ Camera

User Guide



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Important Information

Thank you for purchasing our product. If there are any questions, please contact the authorized dealer.

Before operating the unit, please read this manual thoroughly and retain it for future reference.

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Attention:
To ensure account security, the user should change the password after their first login. The user is recommended to set a strong password (no less than eight characters). Password login does not apply to certain models that do not require password login.

The contents of this document are subject to change without prior notice. Updates will be added to the new version of this manual. Improvements or updates to the products or procedures described in the manual will be made readily.

The best effort has been made to verify the integrity and correctness of the contents in this document, but no statement, information, or recommendation in this manual shall constitute a formal guarantee of any kind, expressed or implied. Responsibility for any technical or typographical errors in this manual will not be held. The product appearance shown in this manual is for reference only and may be different from the actual appearance of the user's device.

This manual is a guide for multiple product models and so it is not intended for any specific product.

In this manual, the illustrations of the displayed interface, parameters displayed, drawings, and value ranges may vary with models. The user should refer to the actual product for details.

Due to uncertainties such as the physical environment, discrepancies may exist between the actual values and reference values provided in this manual.
Use of this document and the subsequent results shall be entirely at the user's own responsibility.

Before operating the unit, the user should read this manual thoroughly and retain it for future reference.

Important Safety and Usage Notices

```
WARNING: Contains important safety instructions and indicates situations that may cause bodily injury.
CAUTION: Users must be careful. Improper operations may cause damage or malfunction of product.
NOTE: Indicates useful or supplemental information about the use of the product.
```

Safety Information

```
WARNING: Installation and removal of the unit and its accessories must be carried out by qualified personnel. You must read all of the Safety Instructions supplied with your equipment before installation and operation.
```

• If the product does not work properly, please contact your dealer. Never attempt to disassemble the camera

yourself. (We will not assume any responsibility for problems caused by unauthorized repair or maintenance.)
• This installation should be made by a qualified service person and should conform to all the local codes.
• When shipping, the camera should be packed in its original packaging.
• Make sure the power supply voltage is correct before using the camera.
• Do not drop the camera or subject it to physical shock.
• Do not touch sensor modules with fingers. If cleaning is necessary, use a clean cloth with a bit of ethanol and wipe it gently. If the camera will not be used for an extended period of time, put on the lens cap to protect the sensor from dirt.
• Do not aim the camera lens at strong light such as the sun or incandescent lamp. The strong light can cause fatal damage to the camera.

Maintenance Precautions:
• If there is dust on the front glass surface, remove the dust gently using an oil-free brush or a rubber dust blowing ball.
• If there is grease or a dust stain on the front glass surface, clean the glass surface gently from the center outward using anti-static gloves or an oil-free cloth. If the grease or the stain still cannot be removed, use anti-static gloves or an oil-free cloth dipped with detergent and clean the glass surface gently until it is removed.
• Do not use organic solvents, such as benzene or ethanol, when cleaning the front glass surface.

Regulatory Compliance

FCC Part 15

This equipment has been tested and found to comply with the limits for digital devices, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This product complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

This device may not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

CE	**LVD/EMC Directive** This product complies with the European Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC.
	**WEEE Directive–2002/96/EC** The product this manual refers to is covered by the Waste Electrical & Electronic Equipment (WEEE) Directive and must be disposed of in a responsible manner.

What's In the Box

	R9-L420N **- 1 Inch 4K60 PTZ Camera**
	VCC-RC-2 - IR Remote Controller
	Lens Cap
	P12-4L **- Power Adapter 12VDC 4A with Lock**
	Power Cord Options Included : **United States / Japan, United Kingdom, Europe**
	VCC-CC45RS - RS422/232 RJ45 Adapter
	4 - Screws
	Safety Cable

	Bolin Protective Dust Cover
	Bolin Welcome Card

Optional Accessories

	C-WM3B or C-WM3W - **Large PTZ Camera Wall Mount Bracket - Black or White**
	C-WM3B-CV or C-WM3W-CV - **Cover Set for Large PTZ Camera Wall Mount Bracket - Black or White**
	C-PMSB or C-PMSW - **PTZ Camera Pendant Mount System for Drop Ceiling - Black or White**
	C-PMBA - **Pendant Mount Base Adaptor**
	QR-M - **Quick Release Plate for Indoor PTZ Cameras**
	BL-CM-01 - **Indoor PTZ Ceiling Mount Bracket**

	BLA-10 - 10-Pin LEMO to Balanced XLR Connector
	B-OSM-12 - Optical 12G-SDI SFP Transceiver

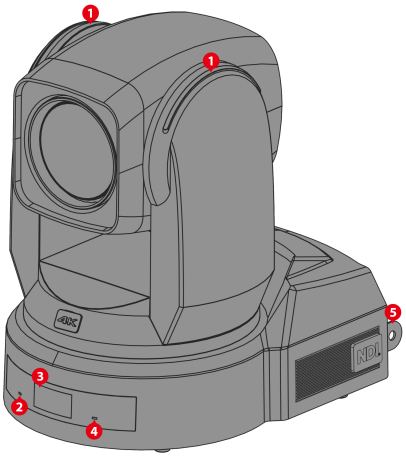
Recommended Peripherals

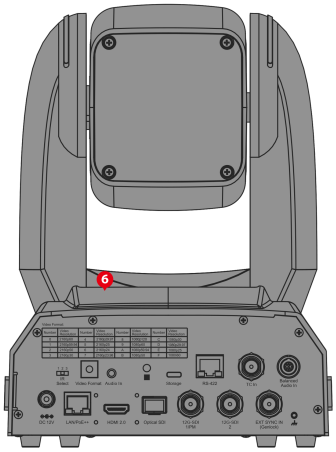
	BL-PP97 - 97W POE Injector
	EG40F - FAST HEVC 4K60 IP Video Decoder EG40N - High Bandwidth NDI Decoder
	KBD-1020N - PTZ Camera Controller
	KBD PLUS - Advanced PTZ Production Controller

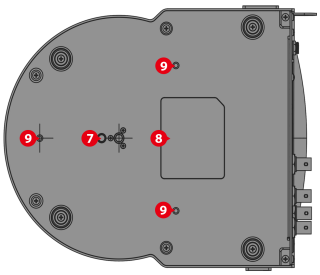
Overview

The R9-L420N is a professional 4K60 PTZ camera designed for broadcast, live events, sports, corporate productions, and performance venues. Featuring a 1-inch Sony CMOS sensor, 20x optical zoom, hybrid autofocus with AI-assisted subject detection, and support for both traditional and IP-based workflows, it delivers exceptional image quality and operational flexibility. With simultaneous 12G-SDI, HDMI, fiber, and IP outputs, integrated audio embedding, local USB-C recording, Genlock and LTC synchronization, and support for NDI®, SRT, and other industry-standard protocols, the R9-L420N integrates seamlessly into modern production environments while providing reliable, high-performance operation.

Diagram & Dimensons

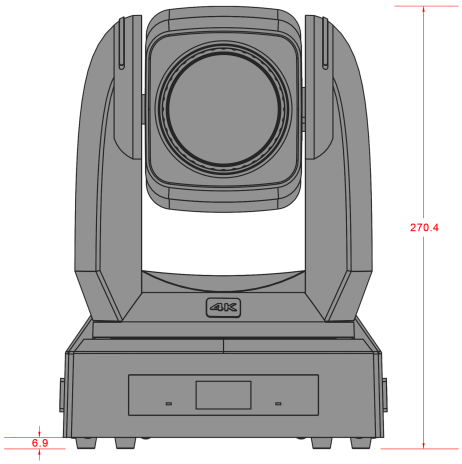


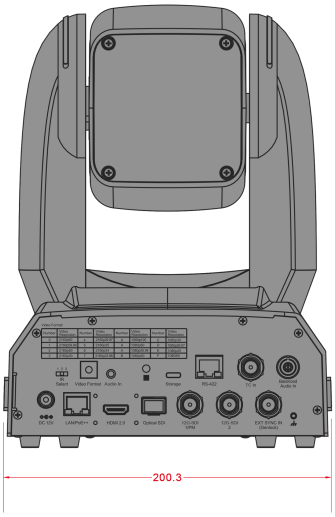


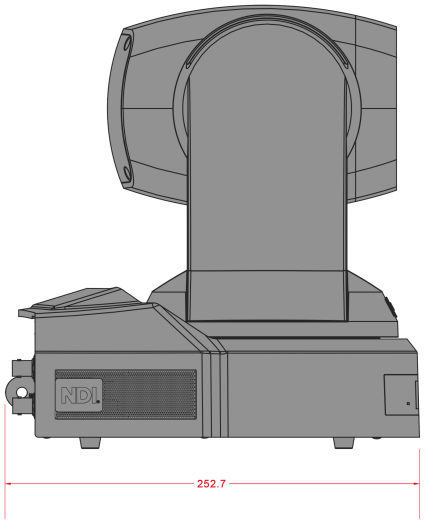


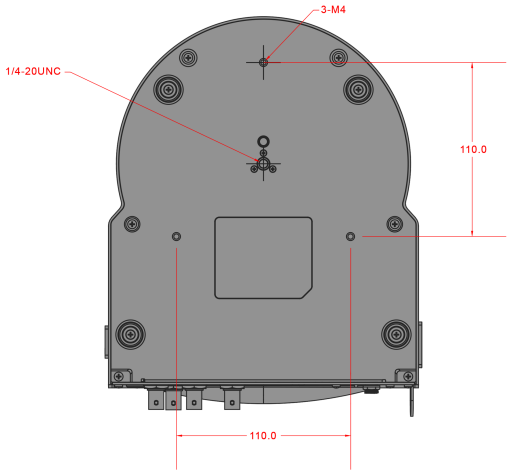
1. Tally Lights
2. Power Indicator Light
3. LCD Screen
4. Network Indicator Light
5. Safety Cable Anchor Point
6. Carrying Handle
7. 1/4" Tripod Mount
8. Product Info & Serial Number Label
9. Mounting Points for Bolin Wall/ Ceiling Mounts

NOTE: All dimensions listed are in millimeters.









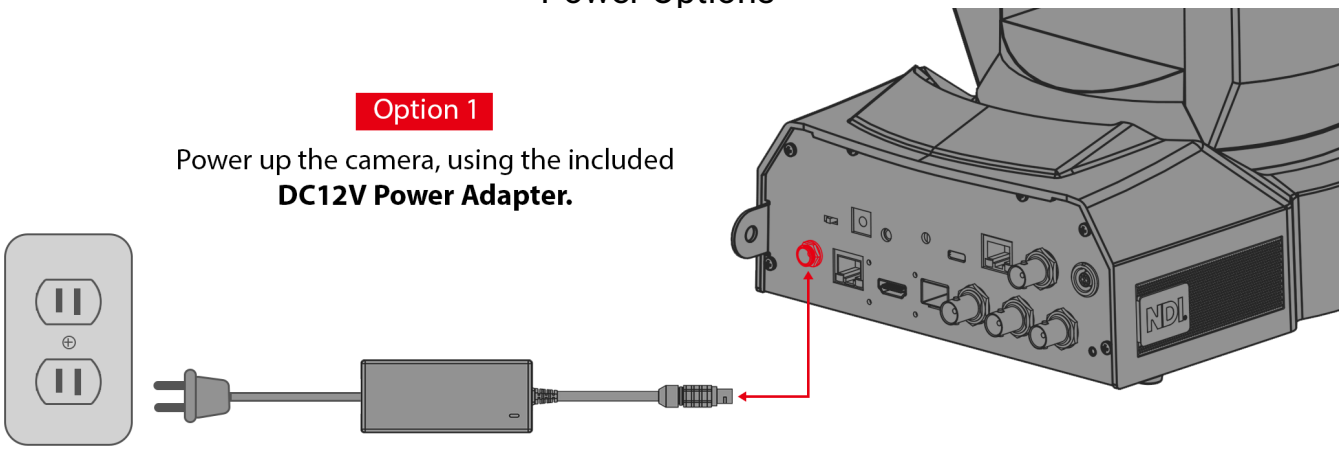
Quick Start

The R9 Series Indoor PTZ Camera has multiple connection options for video output, power input, control input, audio input and output, and synchronization. You can choose the appropriate connection points based on your requirements.

Power Options

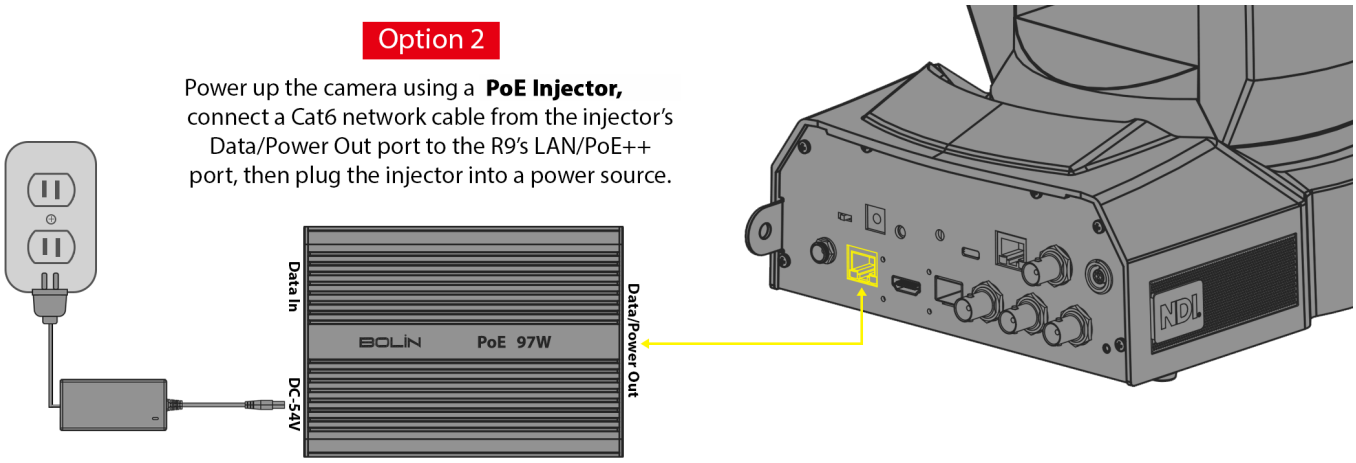
Option 1

Power up the camera, using the included **DC12V Power Adapter.**



Option 2

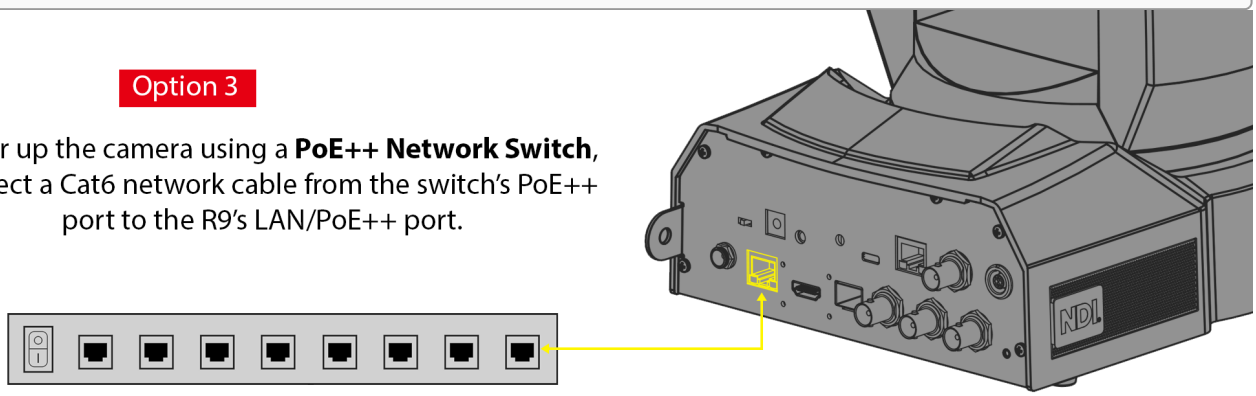
Power up the camera using a **PoE Injector,** connect a Cat6 network cable from the injector's Data/Power Out port to the R9's LAN/PoE++ port, then plug the injector into a power source.



NOTE: When using a third-party PoE injector, ensure it supplies at least **45 W.**

Option 3

Power up the camera using a **PoE++ Network Switch**, connect a Cat6 network cable from the switch's PoE++ port to the R9's LAN/PoE++ port.

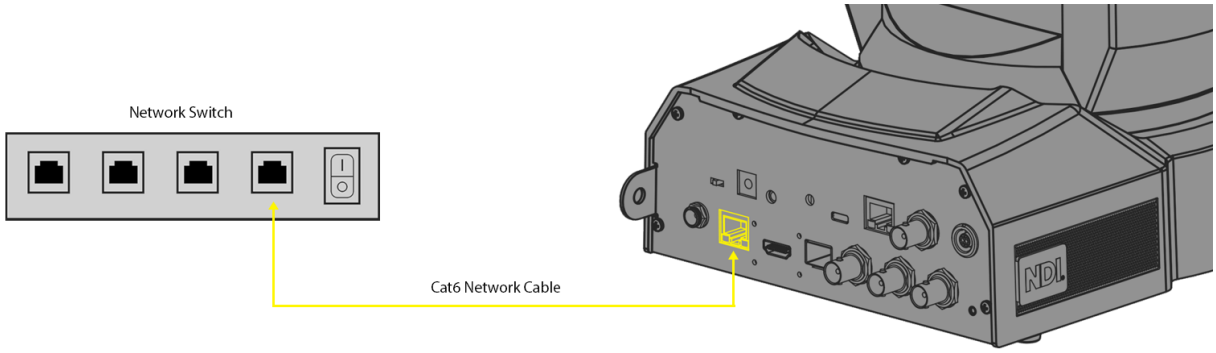


Network Options

This camera offers a variety of functionalities via a network connection. Besides being powered over Ethernet, a network connection enables the user to adjust camera settings remotely, stream video from the camera to a distant location, and control the PTZ camera functions via the Web Interface. To set up your camera's network connection, choose one of the following methods:

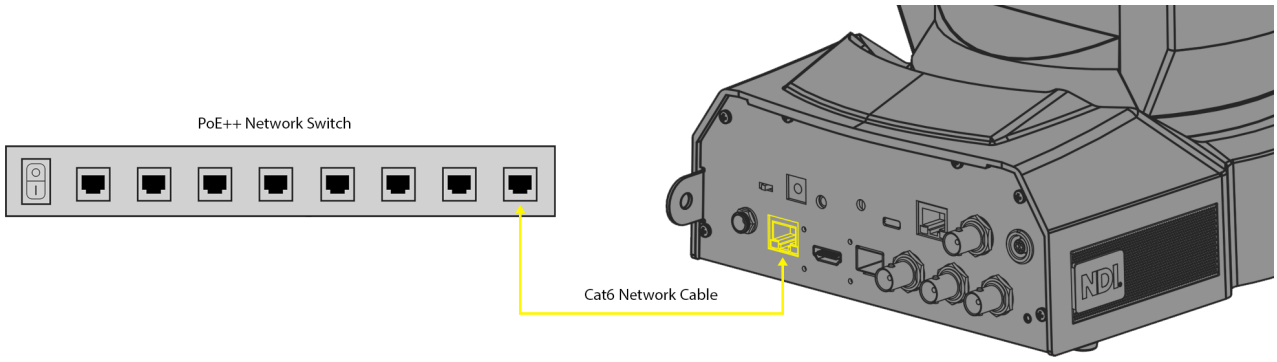
Option 1: **Using the Power Adapter and a Network Switch**

1. Connect the provided power adapter to the camera's DC input.
2. Use a Cat6 Ethernet cable to connect the camera's LAN port to a standard network switch.
3. Ensure the network switch is connected to your network for data transmission.



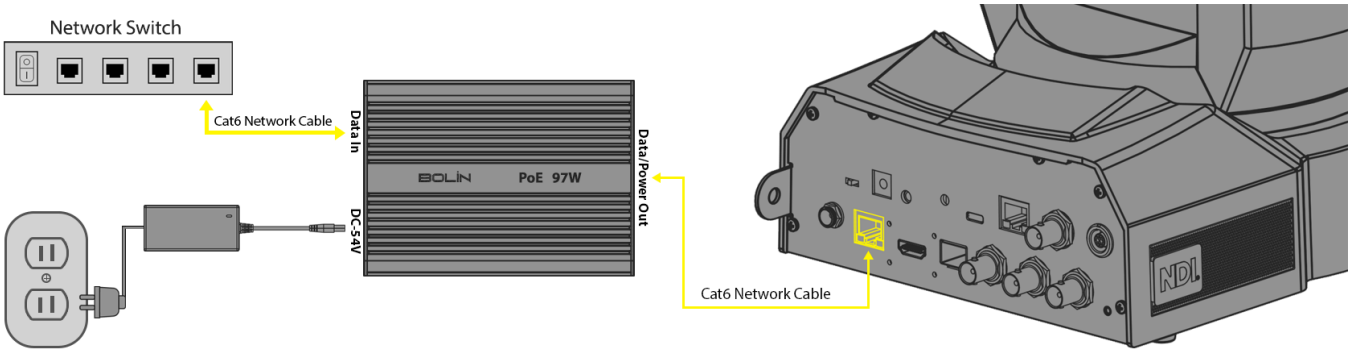
Option 2: **Using a PoE++ Network Switch (Single Cable Connection)**

1. Connect a Cat6 Ethernet cable from the camera's LAN/PoE++ port directly to a PoE++-enabled network switch.



Option 3: **Using a PoE Injector for Extended Distance**

1. Connect a Cat6 Ethernet cable from the PoE injector's PoE output to the camera's LAN/PoE++ port.
2. Connect another Cat6 Ethernet cable from the PoE injector's Data In port to a network switch.
3. Plug the DC power adapter into the PoE injector.



NOTE: When using a third-party PoE injector, ensure it supplies at least **45 W**.

Locating a Bolin camera on the Network

The camera uses DHCP by default to obtain an IP address automatically. If no DHCP server is detected, it falls back to **192.168.0.13**.

Use one of the following methods to locate and access your camera.

1. Using the Bolin Discovery Tool

The Bolin Discovery Tool is the recommended method for locating Bolin cameras on a network.

1. Download and install the Bolin Discovery Tool **- Windows** from the Bolin website. **(**Bolin Discovery Tool v2.0 - MacOS**)**
2. Connect your computer and camera to the same network.

Alternatively, the camera can be connected directly to the computer's Ethernet/LAN port. When using a direct connection, power the camera using the supplied power adapter.

3. Launch the Bolin Discovery Tool.
4. The tool will scan the network and display detected Bolin cameras along with information such as their assigned IP addresses.
5. Select the desired camera to identify its current network settings.

NOTE: When connecting directly to a camera configured with the default static IP address, the computer's network adapter must be configured within the same IP subnet.

2. Accessing the Camera Manually Using a Web Browser

For cameras using the default static IP address:

1. Configure the computer's Ethernet adapter with an IP address within the same subnet as the camera. For example:
   - **Computer IP Address:** 192.168.0.X
   - **Subnet Mask:** 255.255.255.0
2. Open a supported web browser.
3. Enter the camera's default IP address in the address bar:

192.168.0.13

4. When the camera's Web GUI opens, log in using the default credentials or the credentials previously configured for the camera.

IMPORTANT: Do not assign 192.168.0.13 to the computer, as this address is already assigned to the camera. Each device on the network must have a unique IP address.

3. Using an IP Scanner Utility

A third-party network/IP scanning utility can also be used to locate devices on the network.

1. Connect the computer to the same network as the camera.
2. Run the IP scanner and scan the appropriate network range.
3. Review the detected devices to identify the camera and its assigned IP address.

Depending on the scanning utility, the camera may appear under the manufacturer name **Bolin** or by its configured hostname.

4. Checking the IP Address Through the Camera OSD Menu

If the camera is connected to a display, its current IP address can also be viewed through the camera's **On-Screen Display (OSD) Menu**.

1. Point the IR remote controller toward the camera.
2. Open the camera's **OSD Menu**.
3. Navigate to **STATUS**.
4. Locate the network information to view the camera's current IP address and other network settings.

```
NOTE: An IR remote controller is not included with the SD530 and EX1030 Series cameras.
```

5. Using NDI Tools

For NDI enabled Bolin cameras, **NDI Tools** can also be used to discover the camera on the network.

1. Download and install NDI Tools.
2. Connect your computer and camera to the same network and ensure the camera's NDI output is enabled.
3. Open **NDI Studio Monitor** on Windows or **NDI Video Monitor** on macOS.
4. Open the source selection menu and select your camera from the available NDI sources to view its video feed.
5. If available, select **Device Webpage** or click the **gear icon** to open the camera's Web GUI in your browser.

```
NETWORK CONNECTION NOTE:
The computer and camera must be on the same network/subnet to communicate directly.
For cameras using the default static IP address of 192.168.0.13, configure the computer with
a unique address in the 192.168.0.X range and use a subnet mask of 255.255.255.0.
For DHCP-enabled cameras, the assigned IP address will depend on the network's DHCP server.
Use the Bolin Discovery Tool or the camera's OSD Status menu to determine the assigned
address.
```

Video Output

The PTZ camera has multiple video outputs, which can be used simultaneously, and the resolutions can be configured independently. The outputs vary based on the camera model and are as follows:

IP Stream Out

The camera's IP stream(s) can be configured through its web interface. To access the web interface, the camera must be connected to a **Local Area Network (LAN)** using a **CAT6 cable**, either through a network switch or directly to a computer. Streaming to the Internet also requires an active **internet (WAN) connection**. Follow these steps to set up IP streaming:

1. **Connect the Camera to the Network** – Plug one end of a **CAT6 cable** into the camera's **LAN/PoE++** port and connect the other end to either a network switch or directly to a computer.
2. **Access the Web Interface** – On a computer, open an **HTML5-enabled web browser** and enter the camera's **IP address**. By default, the camera is set to DHCP, so the IP address is assigned by the network.
3. **Enable and Configure Streaming** – In the web interface, navigate to the **"AV Setup"** menu on the left side. From here, enable and adjust the IP stream settings as needed.

HDMI Out

Follow these steps to connect the camera:

1. **Connect the HDMI Cable** – Plug one end of an HDMI cable (compatible with the required resolution) into the camera's HDMI output. Connect the other end to your desired device, such as a switcher, converter, or display.
2. **Power On the Camera** – Turn on the camera and wait for it to initialize. Once it's ready, the video feed will appear on the screen. During the first five seconds, the camera's initial settings will be displayed.
3. **Adjust Output Settings** – Use the OSD (On-Screen Display) menu or the web interface to configure the output resolution and frame rate as needed. For detailed instructions, refer to the Web Interface Configuration section of this guide.

> **NOTE:** It is recommended for the user to utilize a certified "**Premium High Speed HDMI**" cable to guarantee the attainment of the maximum signal quality from their camera.

HDMI Standard	Bandwidth	Max Resolution Supported
HDMI 1.4	10.2 Gigabits/Second	1080p, 120 Hz 4K, 30 Hz
HDMI 2.0	18.0 Gigabit/Second	4K, 60 Hz
HDMI 2.1	48.0 Gigabit/Second	8K, 120 Hz

SDI Out

Follow these steps to connect the camera:

1. **Connect the SDI Cable** – Plug one end of a properly rated SDI cable into one of the camera's two SDI outputs. Make sure the BNC connector is securely fastened to prevent it from coming loose during use. Connect the other end to your desired device, such as a switcher, video router, converter, or display.
2. **Power On the Camera** – Turn on the camera and allow it to initialize. Once ready, the video feed will appear on the screen. For the first five seconds, the camera's initial settings will be displayed.
3. **Adjust Output Settings** – Use the OSD (On-Screen Display) menu or the web interface to configure the output resolution and frame rate. For detailed instructions, refer to the Web Interface Configuration section of this guide.

> **NOTE:** It is recommended to use a high-quality, shielded SDI cable rated for the required resolution and transmission distance to ensure optimal signal integrity and reliability.

The following table is for general reference only. Supported resolutions and frame rates vary by camera model. Refer to your camera's datasheet to confirm its SDI output specifications:

SDI Standard	Bandwidth	Resolution Supported
SD-SDI	270 Megabits/Second	480i
HD-SDI	1.485 Gigabit/Second	720p / 1080i
3G-SDI	2.970 Gigabit/Second	1080P, 60FPS
6G-SDI	6 Gigabit/Second	4K, 30FPS
12-SDI	12 Gigabit/Second	4K, 60FPS

Optical Fiber

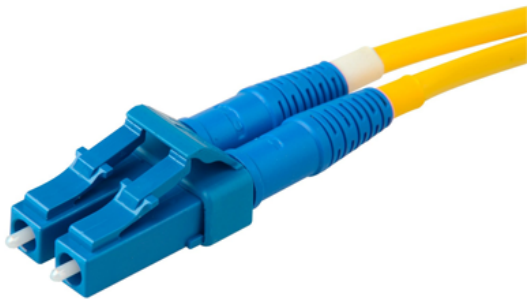
Follow these steps to set up a fiber connection for your camera:

1. **Obtain the Necessary Components** – Acquire **two** single-mode 1310 nm SFP+ 12G optical modules (transceivers) with LC duplex fiber connectors—one for each end of the signal chain. Additionally, select a single-mode duplex fiber cable with LC connectors that meets your required length.

2. **Install the SFP+ Modules** – Insert one SFP+ module into the camera's fiber port. Ensure it is fully seated before proceeding. Then, connect one end of the fiber cable to the LC connectors on the module.
3. **Repeat at the Receiving End** – Insert the second SFP+ module into the receiving device (such as a fiber converter, monitor, or recorder) and connect the other end of the fiber cable.
4. **Power On the Camera** – Turn on the camera and allow it to initialize. Once ready, the video feed will appear on the screen. The camera's initial settings will be displayed for the first five seconds.
5. **Adjust Output Settings** – Use the OSD (On-Screen Display) menu or the web interface to configure the output resolution and frame rate. For detailed instructions, refer to the *Web Interface Configuration and System Menu* section of this guide.

Recommended SFP+ Modules: We recommend the **Bolin SFP+ 12G Optical Module (Part No. B-OSM-12)**. Based on thorough testing, we also recommend modules from **FS** and **LR-TECH**. The **LR-TECH LR-8910D-SDI-LR** module, tested under serial number **BS190909052**, demonstrated exceptional performance.

> **NOTE:** The Optical Fiber connection provides **video only** and does not support network/Ethernet connectivity or IP camera control. The Optical Fiber output uses the **same resolution setting as the SDI outputs**; these video outputs are **not independent**.

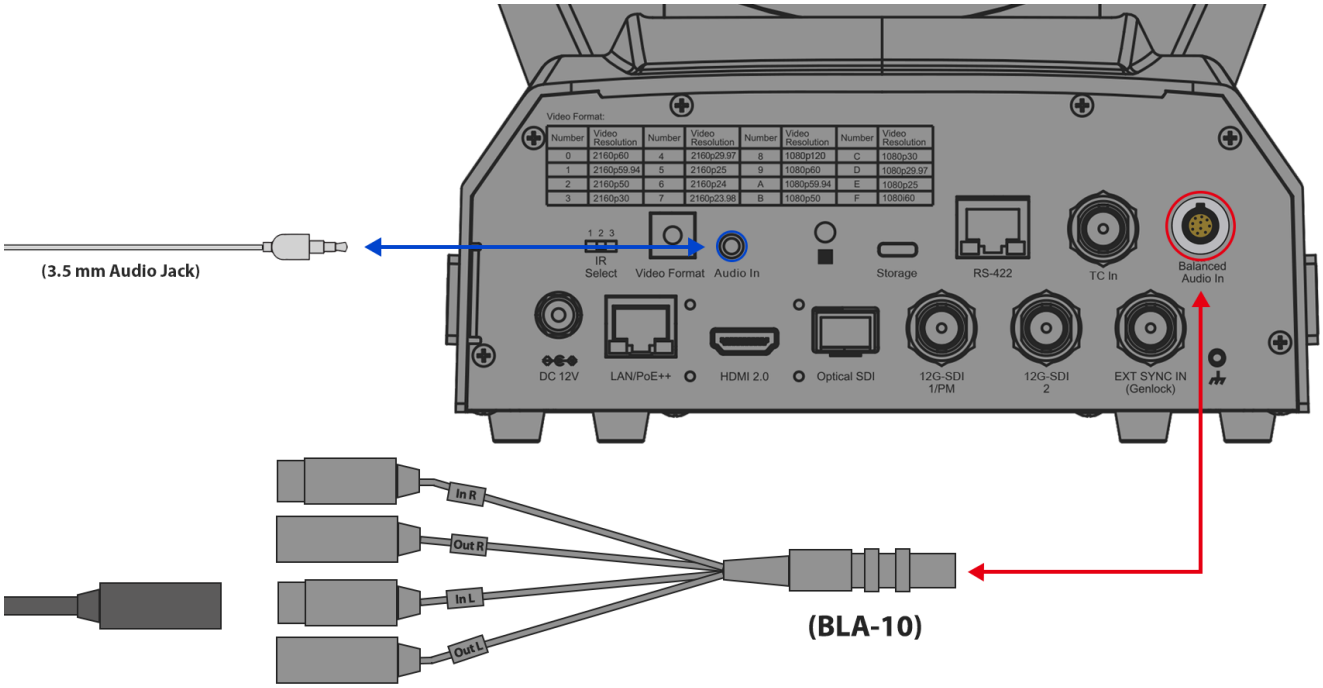
Bolin SFP+ 12G Optical Module (B-OSM-12)	LC Duplex Fiber Connector
	

> **CAUTION:** Make sure you keep the LC connectors on the fiber cable and SFP modules covered when not in use. Leaving connectors uncovered could lead to damage and signal degradation.

Audio

Connecting an Audio Source to the Camera

The camera supports a **3.5 mm stereo audio input** and an **XLR balanced audio input** through the **Bolin BLA-10** breakout cable.



1. **Connect your audio source.**
   - **3.5 mm input:** Connect your audio source to the camera's **Audio In** jack.
   - **XLR input:** Connect the **BLA-10 10-pin LEMO-to-XLR breakout cable**, or a compatible third-party cable, to the camera's **Balanced Audio In** port. Connect your audio source to the breakout cable's female XLR connectors labeled **In L** and **In R**.

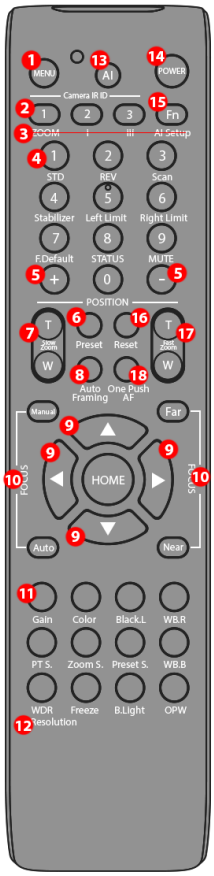
   > **NOTE:** The XLR input supports stereo audio through separate left and right connections. If only **In L** or **In R** is connected, audio will be received only on that channel. Connect both inputs to receive audio on both channels.

2. **Enable audio in the camera's OSD menu.** Navigate to **SYSTEM > AUDIO > AUDIO** and select **ON**.

Once connected and enabled, audio is embedded in the camera's **HDMI, SDI, and IP outputs**.

Control Input

The R9 PTZ cameras have multiple ways of being controlled that can be used simultaneously to provide the user with the flexibility they need for their setup. The control methods are as follows :
Infrared (IR) Remote Controller



1. **Menu** - On-Screen Display (OSD) Toggle
2. **IR ID Selector** - Select which IR Channel (Camera) to be controlled
3. **AI Function Buttons** - Disabled
4. **Buttons 1-9** - Used to set & recall corresponding presets. (See #6 to set a preset and #16 to erase a preset)
5. **+ & - Buttons** - Used in conjunction with image adjustment buttons (11) to increase or decrease parameters.
6. **Preset** - To save a preset, hold down the "Preset" button and the preset number you would like to assign it to.
7. **Slow Zoom** - Zoom's the camera in or out in a slow speed.
8. **Auto Framing** - Disabled
9. **Direction Arrows** - Pan and Tilt the camera in the corresponding direction. Navigate the OSD Menu when open.
10. **Focus Adjustments** - Use the "Auto" button to enable autofocus. To make manual focus adjustments, press the "Manual" button first, followed by the "Far" or "Near" buttons to adjust.
11. **Image Adjustments** - Select the property you would like to adjust, followed by the + and - buttons (5) to make the appropriate adjustment, unless otherwise noted below. The selected function and corresponding options will glow when selected.
    - **Gain** - Image gain settings
    - **Color** - Color saturation settings
    - **Black.L** - Image black level settings
    - **WB.R** - White Balance, Red settings
    - **PT.S** - Pan/Tilt speed settings
    - **Zoom.S** - Zoom speed settings
    - **Preset.S** - Preset speed settings
    - **WB.B** - White Balance, Blue settings
    - **WDR** - Wide Dynamic Range Settings
    - **Freeze** - Freeze the video on the current frame. (Doesn't use + and - buttons)
    - **B.Light** - Back light compensation
    - **OPW** - One Push White Balance (Hold the button down while pointing the camera at a gray card to set white balance.)
12. **Resolution** - Used to change the video format/resolution. Press and hold the Fn button (15) and Resolution button to select the desired format. The image block will restart after the format is changed, and the screen will go black for a few seconds.
13. **AI Button** - Disabled
14. **Power** - Press and hold for three seconds to turn the camera on/off.
15. **Fn Button** - Press and hold in conjunction with other buttons in dark brown text (Stabilizer, Mute, Scan, etc...) to adjust parameters.

Using the IR Remote Control to Save and Recall Preset Positions

The IR Remote Control allows users to save camera positions as presets and recall them quickly.

Saving a Preset

1. Adjust the camera to the desired position (pan, tilt, and zoom).
2. Press and **hold the [PRESET]** button.
3. While holding [PRESET], press one of the **[POSITION]** buttons (1–9) to save that position.

Recalling a Preset

1. Press the corresponding **[POSITION]** button (1–9) to recall the saved camera position.

Resetting a Preset

1. Press and **hold the [RESET]** button.
2. While holding [RESET], press the **[POSITION]** button (1–9) that you want to clear.

Please Note:

- Each preset stores the camera's pan, tilt, and zoom positions.
- Preset positions can be redefined at any time using the same steps.
- To prevent accidental changes, avoid pressing [PRESET] and [RESET] simultaneously.
- The remote also includes a **Backlight** button for visibility in low-light environments.

Control Protocols

BCX (Bolin Control Extended) (Recommended)

BCX is Bolin's advanced control protocol, designed for fast, responsive two-way communication between

Bolin cameras and controllers. BCX goes beyond traditional PTZ control by providing real-time camera and parameter status, while enabling direct control of advanced camera functions that conventional protocols cannot support. This deeper integration gives operators greater control, immediate feedback, and a more connected experience between the KBD Plus and Bolin cameras. When used with the KBD Plus, BCX is the recommended connection method.
To set it up, follow these steps:

1. Connect the camera to the network by inserting one end of a CAT6 cable into the 10/100/1000 LAN port on the camera and the other end into a network switch.
2. Configure the camera's IP address and network settings so it can communicate with your controller.
3. Connect the KBD Plus to the same network using a CAT6 cable.
4. Configure the KBD Plus's network settings, select BCX as the protocol, and enter the camera's IP address.

VISCA over IP

Using VISCA over IP allows users to control the camera from anywhere on the same LAN. To set it up, follow these steps:

1. Connect the camera to the network by inserting one end of a CAT6 cable into the 10/100/1000 LAN port on the camera and the other end into a network switch.
2. Configure the camera's IP address and network settings so it can communicate with your PTZ controller.
3. Connect a PTZ controller that supports VISCA over IP to the same network using a CAT6 cable.
4. Configure the controller's network settings, then enter the camera's IP address and VISCA over IP port number: 52381.

NDI Control

NDI control allows compatible software and controllers to discover the camera on the network and control it alongside its NDI video stream. To set it up, follow these steps:

1. Connect the camera to the network by inserting one end of a CAT6 cable into the 10/100/1000 LAN port on the camera and the other end into a network switch.
2. Make sure NDI is enabled on the camera.
3. Connect a computer or controller that supports NDI PTZ control to the same network and subnet as the camera.
4. In your NDI-compatible software or controller, locate the camera in the list of available NDI sources and select it to begin controlling it.

ONVIF Protocol

Bolin PTZ cameras support **ONVIF 2.4 (Profile T)** for integration with compatible third-party applications, including PTZ controllers and streaming software. The cameras use ONVIF port 2000 for communication. ONVIF supports device discovery, video streaming, and PTZ control.
To integrate the camera with ONVIF-supported software, follow these steps:

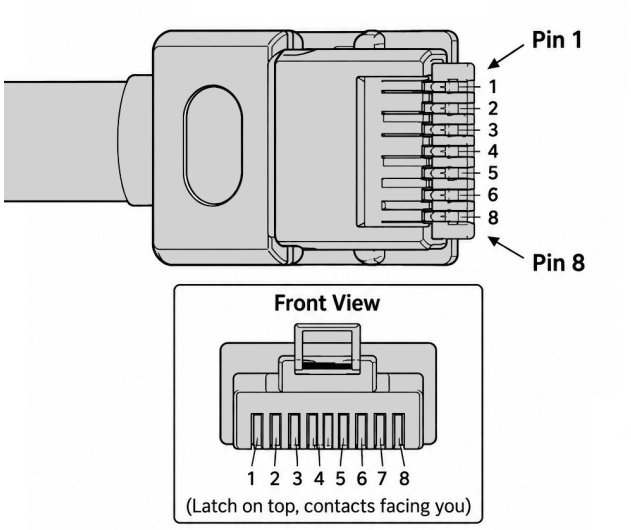
1. Connect the camera to the network and configure its network settings.
2. Use an ONVIF-compatible application to discover the camera.
3. Enter the camera's IP address, ONVIF credentials (the camera's web login credentials), and port 2000.
4. Configure the video and PTZ settings as required by the application.

VISCA Serial Commands (RS-422/485)

The camera is equipped with an RS-422 port, which facilitates VISCA control over serial commands. This RS-422 port is also compatible with RS-485. The camera can be connected via a serial connection to a PTZ controller or a computer. This allows for the execution of pan, tilt, and zoom operations, as well as the performance of preset recalls.

> **CAUTION:** When one connects the camera via serial to a Sony PTZ controller, it differs from the process with a non-Sony PTZ controller. It is crucial to verify the pin settings for the specific controller in use.

1. The camera should be powered on, and the OSD menu should be opened or the Web Interface should be logged into using any web browser. Proceed to the system settings and adjust the baud rate to match that of the controller. The VISCA ID should be set to a number between 1 and 7.
2. A standard terminated CAT5 or CAT6 cable can be used to directly connect the camera to the controller. Alternatively, the included RJ45 to RS422 Control Cable Adapter can be used to connect unterminated CAT5/CAT6 cables between the camera and controller. The pin connection diagrams provided below should be followed, taking into account the specific controller in use and the desired connection.



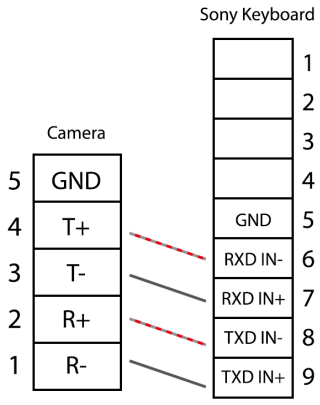
Pin No.	Function	Color
1	TX-	Orange/White
2	TX+	Orange
3	GND	Green/White
4	-	Blue
5	-	Blue/White
6	-	Green
7	RX-	Brown/White
8	RX+	Brown

Use RS-422 (VISCA) / RS485 (PELCO P/D)

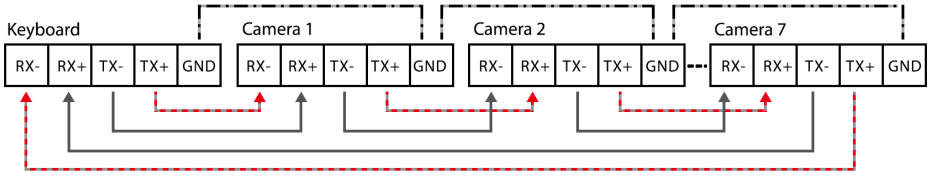
For camera operations, the RS-422/485 port can be utilized to connect controllers, such as a joystick keyboard or a PC station. This allows for the effortless management of pan, tilt, and zoom functions, as well as access to all preset functions using the controller's buttons.
To operate a PC station, it is essential to have a software application that is compatible with this unit.

SONY Keyboard RS422 Connection

Guide for Establishing RS422 Connection and Daisy Chain Configuration for Multiple Cameras with a SONY Controller.



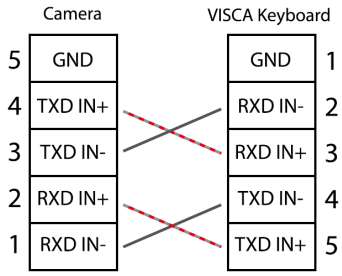
Sony Keyboard Connection



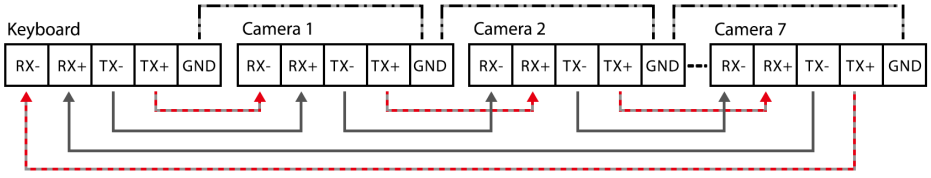
RS422 (VISCA) Daisy Chain Multiple Cameras Connection (Sony Keyboard)

VISCA (Non-Sony) Keyboard RS422 Connection

Guide for Establishing RS422 Connection and Daisy Chain Configuration for Multiple Cameras with a Non-Sony Controller:



VISCA Keyboard Connection



RS422 (VISCA) Daisy Chain Multiple Cameras Connection

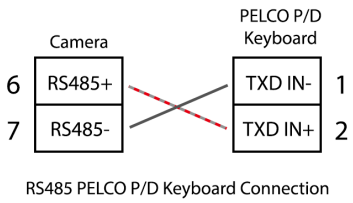
The included extension cables, along with the RJ45 to RS422 Phoenix connector adapter, should be utilized to establish an RS422 connection for the control device.

PELCO P/D Keyboard RS485 Connection

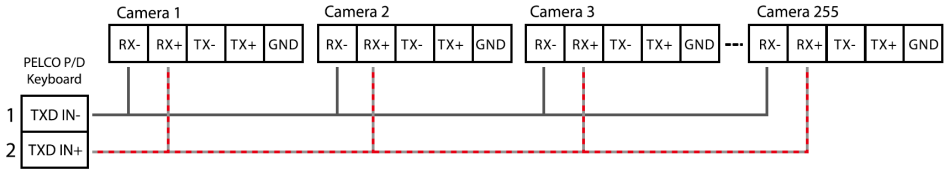
Important: Utilize RS422 ports when establishing an RS485 connection. Only employ TX+ and TX- for RS485 connections.

- Set the RS422 control method using the OSD menu or Web interface.
- Set the camera ID on the OSD menu using the remote controller.
- To ensure the settings have been applied, restart the camera by switching it off and then back on.
- Use a PELCO P/D compatible keyboard for seamless integration.
- Utilize preset # 95 on the keyboard to access/exit the camera OSD menu.
- Navigate the OSD menu using the joystick and buttons "OPEN" or "CLOSE."
- For the keyboard operation details, refer to the user manual of the specific keyboard in use.

PELCO RS485 Connection



RS485 PELCO P/D Keyboard Connection



RS485 PELCO P/D Multiple Cameras Connection

Synchronization (Genlock)

Genlock (Generator Locking) is an external synchronization signal input, which supports BBS (Black Burst Sync) and tri-level synchronization. External synchronization (genlock) can be applied to achieve precise frequency-locked video signals where every device (audio and video) knows when a frame starts and ends. Genlock is an industry standard and conforms to SMPTE standards.

To connect a genlock signal to your camera, follow these steps:

1. Connect one end of a 75-ohm SDI cable with BNC connectors into the "Genlock" port of the camera.
2. Connect the other end of the 75-ohm SDI cable with BNC connectors to a device that is outputting the Genlock signal or providing timing reference (Sync Generator, Video Switcher, Audio Mixer, etc...)
3. Open the camera's OSD menu and turn on External Synchronization. Other Genlock settings can be configured in this menu as well.

CAUTION: Once the Genlock cable is connected, ensure that Genlock is enabled in the camera's menu. Otherwise, the camera will not synchronize with the rest of the system. External synchronization is supported **only via SDI**. It is **not possible** to achieve synchronization through HDMI or IP video signals.

For detailed information on configuring Genlock, refer to the Genlock section *of the Web GUI settings.*

Timecode

Timecode

Linear Timecode (LTC) provides a common time reference for cameras, audio recorders, and other production devices. It carries timecode information as an audio-frequency signal, helping align video and audio recordings during editing. This is especially useful in multi-camera productions.

The camera accepts external LTC through its dedicated **Timecode (TC In) BNC connector**. Depending on the system configuration, the camera can embed the received timecode in the video signal or use it as an internal timecode reference.

Connecting an LTC Source

1. Connect one end of a **75-ohm BNC cable** to the camera's **TC In** connector.
2. Connect the other end to the **LTC output** of a compatible device, such as a timecode generator or audio recorder.

3. Power on the camera and the LTC source.
4. Open the camera's web interface and navigate to **General > Timecode**.
5. Configure the timecode settings to match the external LTC source, and confirm that the camera is receiving the signal before recording.

> **NOTE:** Configure all connected devices to use the same frame rate, such as 23.98, 24, 25, 29.97, or 30 fps, and the same timecode format, including drop-frame or non-drop-frame where applicable. Mismatched settings can cause incorrect timecode interpretation and prevent recordings from aligning accurately during editing.

Storage

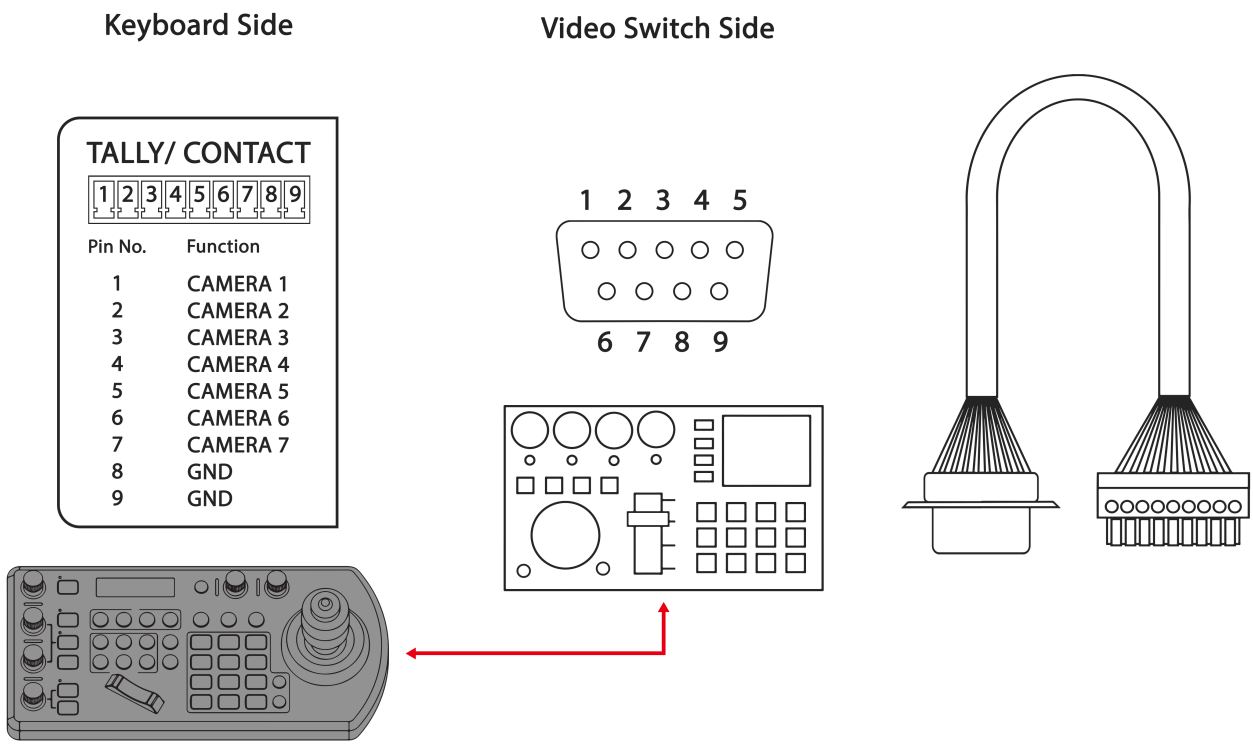
The R9-L420N supports local recording to an external **SSD** connected to its **USB 3.0 Type-C port**. The SSD must support **USB Mass Storage Class (USB MSC)** and be formatted with the **exFAT file system** before connecting it to the camera.
The camera records video at resolutions up to **4K at 60 fps**, using **H.264 or H.265** compression, and saves recordings as **MP4 files** with embedded audio.
Storage requirements depend on the recording resolution, bitrate, and duration:

Recording format	Specified bitrate	Approximate storage per hour*
1080p60	10–20 Mbps	4.5–9 GB
4K60	30–50 Mbps	13.5–22.5 GB

Tally Light

Tally Light GPI I/O connection
The camera is equipped with two Tally lights, serving as visual indicators. When illuminated, these lights signal that the camera is actively operational. One front Tally light improves visibility, and an additional Tally light positioned behind the camera block improves rear visibility. To activate the camera's Tally Light function, you need a video switch and a keyboard (not included).

GPI connection with RS422 VISCA control connection
Cable Configuration:
1. Set up a standardized RS-422 daisy chain control connection to seamlessly control multiple cameras from the keyboard controller. (For detailed RS422 control information, refer to the Keyboard Controller user guide.)
2. Established a Tally/Contact Function cable connection between the Keyboard Controller and the Video Switcher (Sony).



1. On the keyboard side, connect pins 1-8. On the Video Switch side, connect pins 1-9, excluding pin 8.
2. Link keyboard pin 8 with video switch pin 9.
3. Connect keyboard pin 1 to video, switch pin 1, pin 2 to pin 2, and continue similarly (you can decide the rest based on the pattern), ensuring pin 7 is connected to pin 7.

Set Up

1. GPI I/O Input Mode for Tally Signal from Video Switch:

a. Connect the camera to the keyboard using a standard RS-422 control cable.
b. Establish a connection between the keyboard and the video switch using a tally function cable.
c. Navigate to KEYBOARD SETTING > GPI I/O > Setting, and switch it to Input mode. Exit to the home directory.
d. After completing the above steps, you can switch between cameras using the video switch. For instance, selecting camera 1 on the video switch sends a tally signal to the keyboard via the tally function cable. The keyboard then transmits this tally signal to camera 1 through the standard RS-422 control cable, activating camera 1's tally light. The keyboard can now control camera 1's pan and zoom.
e. If you switch to camera 2 on the video switch, the tally light for camera 2 will turn on, and the tally light for camera 1 will turn off.

2. GPI I/O Output Mode for Tally Signal Sent by Keyboard Controller:

a. Connect the camera to the keyboard using a standard RS-422 control cable.
b. Navigate to KEYBOARD SETTING > GPI I/O > Setting, and switch it to Output mode. Exit directly to the home menu.
c. After completing the above operation, you can switch between different cameras using the keyboard. For instance, selecting camera 1 on the keyboard sends a tally signal to camera 1 via the standard RS-422 control cable. As a result, camera 1's tally light turns on, and the keyboard gains control over camera 1's pan and zoom.
d. If you switch to camera 2 on the keyboard, the tally light for camera 2 will turn on, and the tally light for camera 1 will turn off.

Web Interface Configuration

Once connected to the network, the camera can be configured and controlled through its web interface using any web browser that supports HTML5. The following sections describe the available web interface settings and functions.

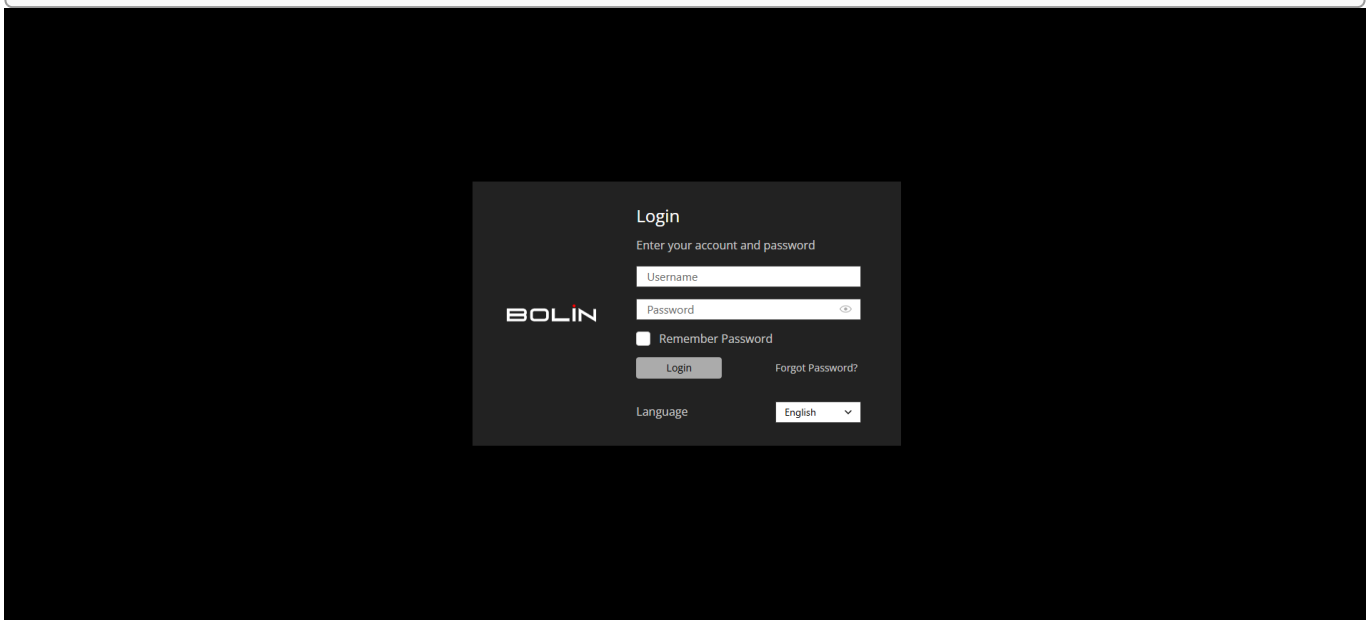
Web Interface Login

To access the web interface, first ensure that the camera is connected to the network and that the computer is connected to the same network.

Factory—Default Camera Network Settings

By default, the camera is configured for **DHCP** and will automatically obtain an IP address from the network's DHCP server.

> **NOTE:** The IP address assigned to the camera may vary depending on the network. Use the camera's **OSD Status page**, your network's DHCP client list, or the **Bolin Discovery Tool** to locate the camera's current IP address.



Enter the camera's IP address in your web browser to open the login page.
Use the default credentials:

- **Username:** admin
- **Password:** admin

> **NOTE:** On your first login, you will be prompted to create a new password. For best security, use at least 8 characters and include **one uppercase letter**, **one lowercase letter**, **one number**, and **one symbol**.

Click **Login** to continue.

Live View



Once logged in to the camera, the home page is the Live View page.
On the **"Live View"** page, the user has access to the following features:

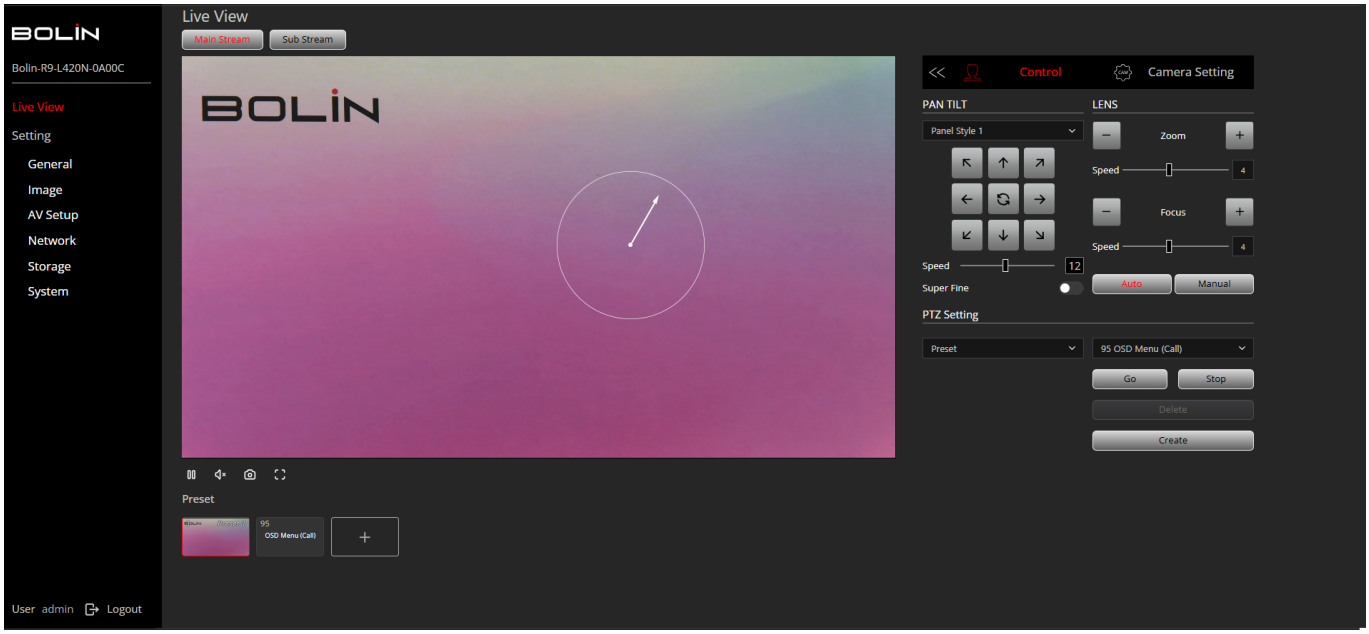
- Viewing a preview of the video output (*Please note, this feed will be delayed by 1–2 seconds.*)
- View the camera's Main Stream or Sub Stream and control it from the web interface.
- Adjusting and controlling PTZ functions.
- Setting and recalling camera presets.

Below the **Live View** image, the user will find the following icons:

- **Pause:** This will pause the live preview feed.
- **Audio Disabled:** This will silence the audio.
- **Snapshot:** This allows the user to capture images from the live view.
- **Full Screen:** This will expand the preview feed to fill the display.
- **Preset Thumbnail:** 95 OSD Menu (Call) to open On-Screen Menu and click a saved preset to move the camera to that position. Click **+** to create a new preset.

Adjusting and Controlling PTZ Functions

Click **>>** to expand the side panel and show the camera controls for control panel styles, pan, tilt, zoom, focus, and presets.



Pan/Tilt Control: The Live View page offers **three ways** to move the camera.

1. **Panel Style 1** to use directional arrow buttons.
2. **Panel Style 2** to use a virtual joystick.
3. 

4. You can also move the camera by using your mouse directly on the live video.

PTZ Setting and Recalling Presets

The camera supports up to **255 saved presets**. You can display up to **64 preset thumbnails** on the Live View page for quick access. Presets can also be recalled through the IR remote or a Bolin PTZ controller.

Save a preset

1. Use the web interface, IR remote, or PTZ controller to move the camera to the desired position.
2. On the Live View page, select **Preset** from the **PTZ Settings** menu and click **Create**.
3. Select a preset number, enter a name if desired, and click **Save**. The camera captures a snapshot of the view and displays it as a thumbnail.

Update or recall a preset

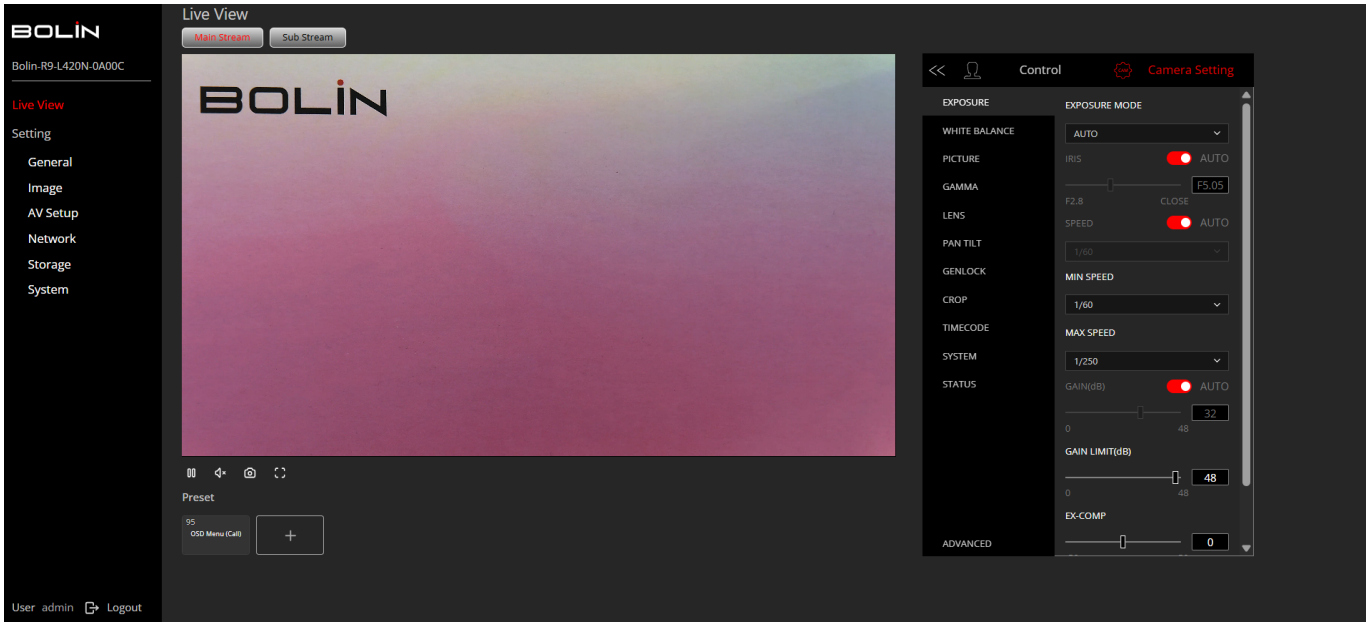
- To update a preset, move the camera to the new position and save it under the same preset number. Click **Confirm** when prompted to overwrite it.

- To recall a preset, select its number and click **Go**, or click its thumbnail below the live video.
- To edit a thumbnail's title or preview image, right-click the thumbnail and select the appropriate option. To remove a thumbnail, right-click it and select **Delete**.

The **PTZ Setting** menu also includes:

- **Position Limitations:** Set limits for camera movement in each direction.
- **Trace:** Recall a series of presets in a specified order.
- **Cruise:** Record and replay a sequence of camera movements.
- **Scanning:** Pan between up to 12 user-defined points at a selected speed from 1 to 8.
- **Power On Action:** Choose an action, such as recalling a preset or starting a scan, trace, or cruise, when the camera powers on.

Camera Settings



To adjust camera settings without displaying the On-Screen Display (OSD) menu over the live video, click **>>** to expand the side panel, then select **Camera Settings**. This panel provides access to the camera's configuration options, which are described in the following sections.

Exposure Mode

The **Exposure Mode** menu allows users to configure how the camera manages light levels and image brightness.

- **Auto Exposure:** The camera automatically adjusts the iris, shutter speed, and gain to maintain proper exposure. Use **Min Speed** and **Max Speed** to set the shutter speed range, and **Gain Limit (dB)** to cap how much gain the camera can apply. **EX-COMP** lets you make the image brighter or darker while keeping automatic exposure enabled.
- **Manual Exposure:** Set the iris, shutter speed, and gain yourself to control image brightness. The camera will keep these settings until you change them, even when the lighting changes.
- **Shutter Priority:** Select the shutter speed you want to maintain. The camera automatically adjusts the iris and gain to keep the image properly exposed. Use **Gain Limit (dB)** to cap automatic gain, and **EX-COMP** to make the image brighter or darker.
- **Iris Priority:** Set the iris opening you want to maintain. The camera automatically adjusts shutter speed

and gain to keep the image properly exposed. Use **Min Speed** and **Max Speed** to limit the shutter speed range, **Gain Limit (dB)** to cap automatic gain, and **EX-COMP** to make the image brighter or darker.

- **Gain Priority:** In this exposure mode, the camera prioritizes the selected gain level while automatically adjusting the iris and shutter speed to maintain proper exposure. Turn on **Auto** next to Gain (dB) to let the camera set the gain, or turn it off to choose a value manually. Use **Min Speed** and **Max Speed** to limit the shutter speed range.

White Balance

White Balance adjusts the camera's color to match the lighting in the scene. Select a mode from the **White Balance Mode** dropdown:

- **Auto:** Automatically adjusts white balance as lighting changes.
- **Indoor:** Uses a setting suited to typical indoor lighting.
- **Outdoor:** Uses a setting suited to daylight and outdoor lighting.
- **OPW (One Push White Balance):** Adjusts white balance once using a white reference, such as a white card, under the current lighting. The setting remains fixed until you trigger another adjustment.
- **ATW (Auto Tracking White Balance):** Continuously adjusts white balance as lighting conditions change to help maintain natural-looking colors.
- **User:** Allows you to adjust red and blue gain manually to fine-tune the image's color balance.
- **SVL (Sodium Vapor Lamp):** Uses a fixed white balance setting designed to compensate for the orange tint produced by sodium vapor lamps.
- **Manual:** Allows you to set white balance manually for consistent color under controlled lighting. The available adjustments depend on the camera.
- **WB Sensitivity (White Balance Sensitivity)** controls how quickly the camera's automatic white balance responds to changes in lighting or color temperature.

Picture

Use the **Picture** section to adjust image detail, color, orientation, and performance under different lighting conditions. Move a slider or enter a value to change an image setting.

- **Sharpness:** Adjusts how defined image edges appear.
- **2DNR / 3DNR:** Reduces visible image noise.
- **Flip / Mirror:** Flips the image vertically or mirrors it horizontally.
- **Hue / Saturation:** Adjusts color tone and intensity.
- **Contrast / Bright:** Adjusts the difference between light and dark areas and the overall brightness.
- **Scene / Effect:** Selects an image preset or visual effect.
- **ND Filter:** Controls the neutral density filter for bright scenes.
- **Defog Mode / Defog Level:** Enhances the image in hazy or foggy conditions. The level control becomes available when an applicable mode is enabled.
- **De Flicker:** Helps reduce flicker caused by certain lighting.
- **HLC Mode:** Reduces the effect of intense highlights.

- **Backlight Com.:** Helps make subjects visible when bright light is behind them.
- **WDR / WDR Level:** Balances detail in bright and dark areas. The level control becomes available when WDR is enabled.

Controls that are unavailable for the selected mode appear dimmed.

Gamma

Gamma Curve adjusts how midtones appear in the image while preserving detail in darker and brighter areas. Compare the live image after selecting a preset and choose the one that best suits the scene. Select a preset from the dropdown menu:

- **Default:** Factory-balanced gamma profile suitable for general use.
- **Standard:** Selecting **Standard** under **Gamma Curve** displays additional controls for adjusting the image's tonal range:
  - **Offset:** Adjusts the overall position of the gamma curve.
  - **Level:** Adjusts the strength of the gamma correction.
  - **Black Gamma:** Adjusts detail in darker areas of the image.
  - **Black Gamma Range:** Selects the range of dark tones affected by Black Gamma.
  - **Black Level:** Adjusts the image's darkest level.
  - **Visibility Enhancer:** Turns enhancement of details in difficult lighting conditions on or off.
- **0.50/0.55/0.63:** Predefined gamma curves that adjust mid-tone brightness and contrast response
- **Straight** under **Gamma Curve** displays controls for fine-tuning the image's tonal range:
  - **Offset:** Shifts the gamma curve.
  - **Level:** Adjusts the strength of the gamma adjustment.
  - **Black Gamma:** Adjusts detail in darker areas of the image.
  - **Black Gamma Range:** Selects which range of dark tones Black Gamma affects.
  - **Black Level:** Adjusts the image's darkest level.
  - **Visibility Enhancer:** Turns visibility enhancement on or off.

Lens

Use the **Lens** section to configure digital zoom and focus behavior. The available controls are:

- **Digital Zoom:** Turns digital zoom on or off. Digital zoom enlarges the image beyond the lens's optical zoom range.
- **Focus Mode:** Selects how the camera focuses. **Auto** allows the camera to adjust focus automatically.
- **Focus Area:** Selects the area of the image the camera uses to determine focus.
- **Smart Focus:** Turns the Smart Focus feature on or off.
- **AF Sensitivity:** Adjusts how readily autofocus responds to changes in the scene.
- **MF Speed:** Adjusts the speed of manual focus changes.
- **Near Limit:** Sets the closest distance at which the camera attempts to focus.

Pan Tilt

Use the **Pan Tilt** section to configure camera movement and preset behavior.

- **Adaptive PT:** Turns adaptive pan and tilt movement on or off.
- **PT Speed:** Adjusts the speed of manual pan and tilt movement.
- **Pan Direction:** Selects the direction the camera pans in response to a control command.
- **Tilt Direction:** Selects the direction the camera tilts in response to a control command.
- **Preset Memory:** Selects how preset positions are stored or recalled.
- **Preset Speed:** Adjusts how quickly the camera moves to a preset position.
- **Preset Zoom Speed:** Adjusts the zoom speed when recalling a preset.
- **Motionless Preset:** Turns motionless preset behavior on or off.
- **Reload Preset 1:** Controls whether the camera recalls Preset 1 when it starts up.

Genlock

The **Genlock** section displays the camera's synchronization status and provides a phase adjustment when a reference signal is available.

- **Genlock Status:** Shows whether the camera is synchronized to an external reference signal.
- **Ref. Signal:** Shows the detected reference signal.
- **H Phase:** Adjusts the horizontal timing of the camera's video output relative to the reference signal. Use this control when aligning the camera with other synchronized video sources.

When no reference signal is detected, **Genlock Status** and **Ref. Signal** appear unavailable.

Crop

Use the **Crop** section to configure a cropped view of the camera image and choose how it appears on the available outputs.

- **Crop Mode:** OFF, 1080p or 720p.
- **Crop Select:** Selects the crop area color. CROP CYAN, CROP BLUE, CROP YELLOW.
- **SDI-2 Output:** Selects the image crop color sent through the second SDI output.
- **IP Output:** Selects the image crop color sent through the IP stream.
- **Frame Display:** Shows or hides the crop frame on the image.

Refer to *the Crop* section of the web interface for more info.

Timecode

Use the **Timecode** section to configure the camera's timecode.

- **TC Mode:** Select **Preset**, **Regen**, or **Ext Regen** from the dropdown menu. Preset starts from a set timecode value; Regen continues from an existing timecode; Ext Regen uses an external timecode reference.
- **Run:** Displays the timecode counting mode.
- **TC Format:** Displays the timecode format.
- **TC Value:** Click **Reset** to reset the timecode value.

System

Use the **System** section to configure camera control, on-screen information, audio, and general operation.

- **Pelco ID / VISCA ID:** Set the camera ID used by the corresponding control protocol.
- **IR ID / IR Receive:** Set the camera's IR remote ID and enable or disable reception of IR commands.
- **Comm Type / Baud Rate:** Configure the serial communication type and baud rate used for camera control.
- **Monitor Info:** Choose whether camera information appears on the **HDMI**, **SDI1 & SDI2**, and **IP** outputs.
- **Degree:** Select the temperature unit used for displayed information.
- **Display Info:** Turn the camera information display on or off.
- **Video Parameters OSD:** Show or hide video parameter information on screen.
- **Tally Mode / LED Screen:** Enable or disable the tally function and LED screen.
- **Audio:** Turn audio input on or off.
- **Audio Select / Input Type:** Select the audio source and its input type.
- **Volume Level / Audio Delay:** Adjust the audio level in dB and its delay in milliseconds.
- **Plugin Power:** Enable or disable power for a supported audio input device, when available.
- **Color Space:** Select the output color space.
- **Factory Reset:** Restore the camera's factory image settings only.

Status
The **Status** section displays the camera's current configuration and device information for reference. Use it to check settings without opening each individual menu.

- **Control settings:** Pelco ID, VISCA ID, IR ID, baud rate, and communication type.
- **Video formats:** Current HDMI, SDI 1, and SDI 2 output formats.
- **Firmware:** FPGA and MCU firmware versions.
- **Network information:** IP address and MAC address.
- **Image settings:** Exposure mode, white balance mode, hue, contrast, saturation, flip, and mirror.
- **Movement settings:** Pan and tilt speed, preset speed, and scene setting.

Scroll through the Status panel to view all available information.

Advanced
To control access to the camera's on-screen display (OSD) menu.

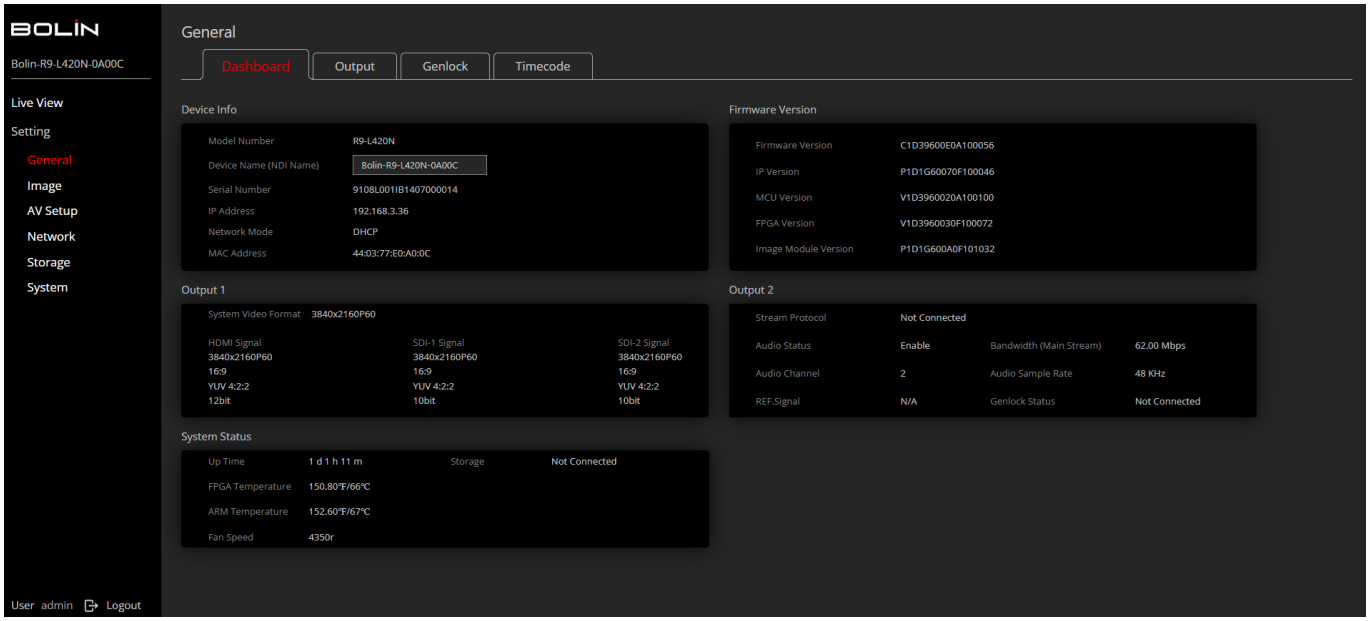
- **OSD Menu:** Select **On** or **Off** in the Web Interface to open or close the OSD menu remotely.

The OSD menu can be viewed through the **Web Interface (WebUI)**, **NDI**, **HDMI**, or **SDI** output.

General

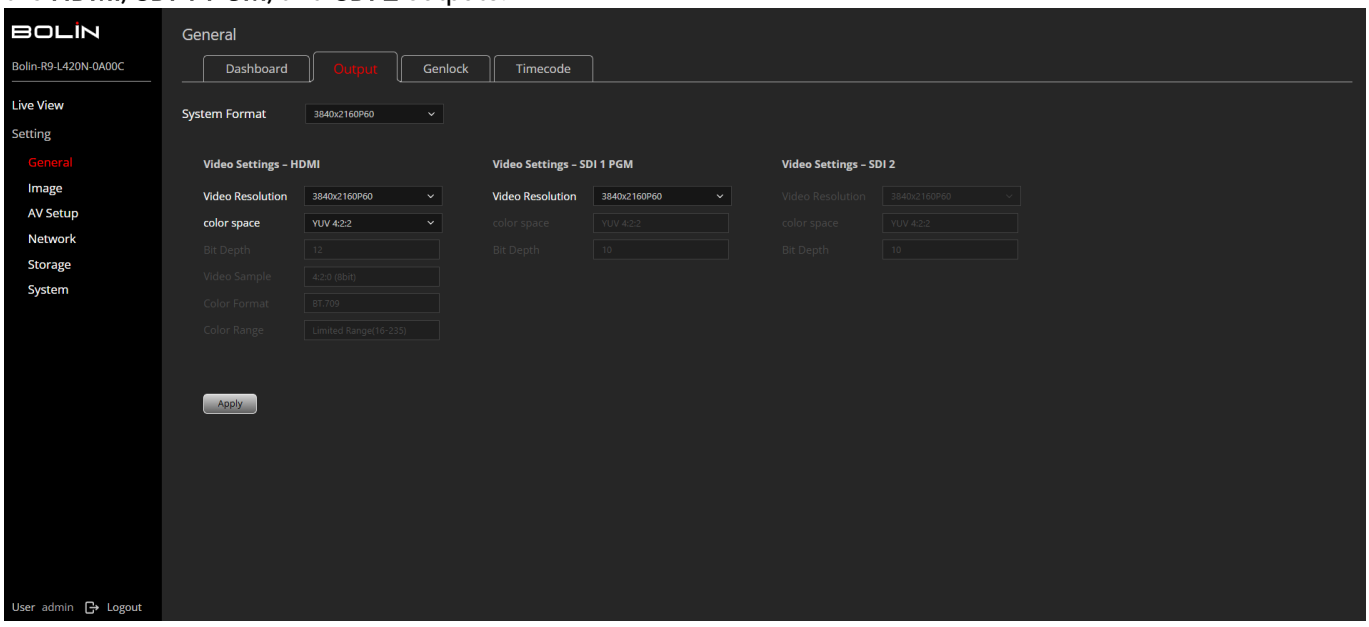
Under the General page, there are four tabs: Dashboard, Output, Genlock, and Timecode.

Dashboard
The **Dashboard** tab gives you a single page where you can view details of the camera such as temperature, power consumption, bandwidth utilization, firmware versions, and device serial number.



Output

The **Output** tab allows you to configure the camera's system video format and review or adjust settings for the **HDMI**, **SDI 1 PGM**, and **SDI 2** outputs.

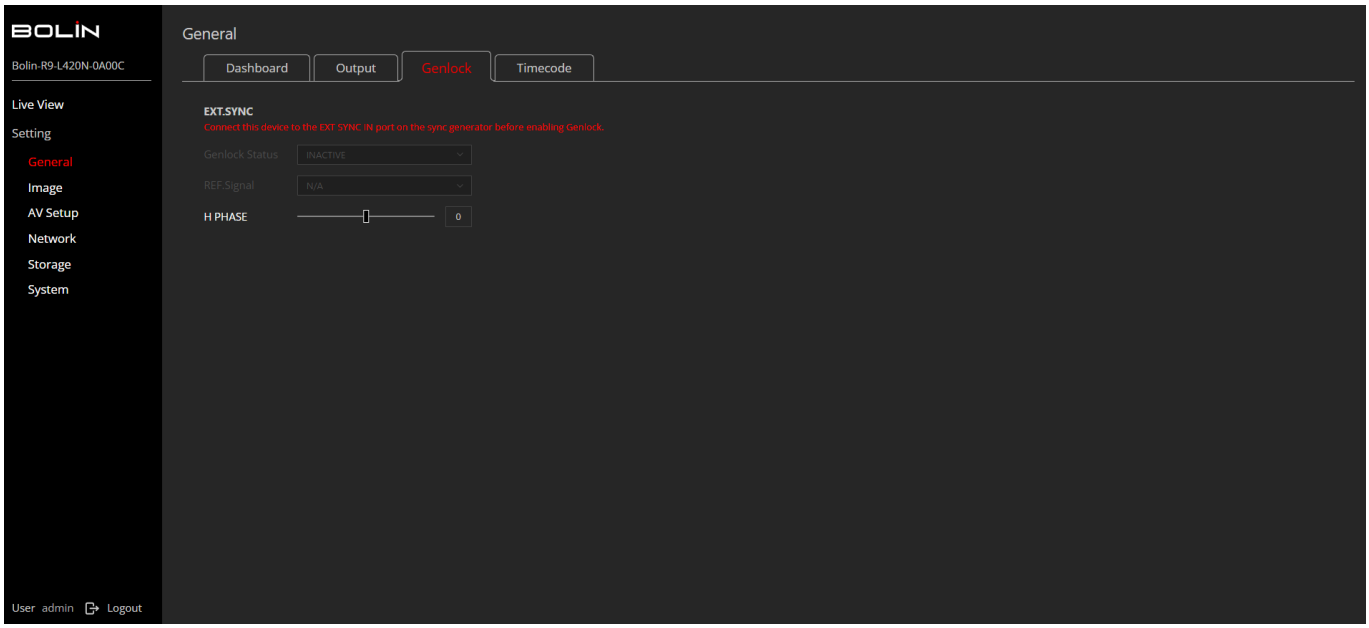


- **System Format:** Select the camera's operating video resolution and frame rate.
- **Video Resolution:** Select the resolution and frame rate for each output where available. For example, **3840 × 2160P60** represents a 4K UHD progressive signal at 60 frames per second.
- **Color Space:** Select the output color space where available, such as **YUV 4:2:2**.
- **Bit Depth:** Displays the number of bits used to represent color information.
- **Video Sample:** Displays the video's chroma sampling and bit depth.
- **Color Format:** Displays the color standard, such as **BT.709**.
- **Color Range:** Displays the signal range, such as **Limited Range (16–235)**.

Grayed-out fields display the current values and cannot be edited in the current configuration. Click **Apply** to save your changes.

Genlock

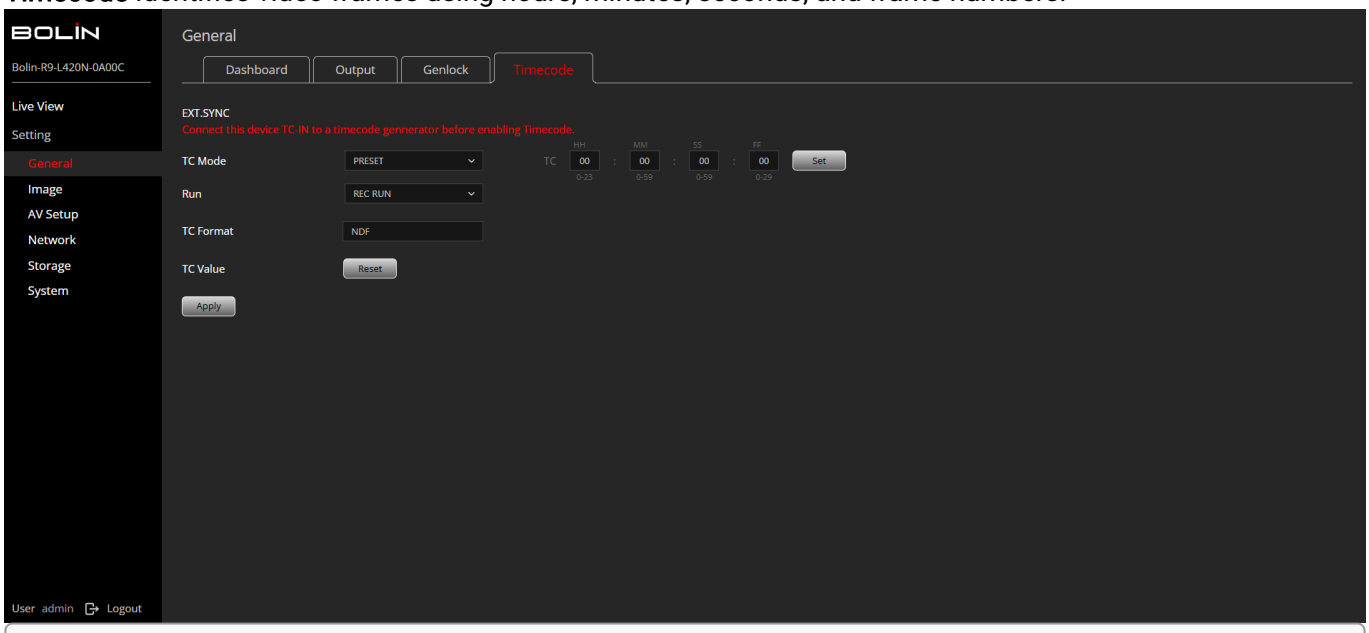
Genlock (generator locking) is a technique used to maintain synchronization. On this page the user can see the status of a connected Genlock device, as well as information on the Ref. Signal, and adjust the Horizontal Phase.



H Phase: This is used for finely adjusting the horizontal phase during Genlock.

Timecode

Timecode identifies video frames using hours, minutes, seconds, and frame numbers.



NOTE: A timecode generator must be connected before enabling Timecode.

Enables or disables the on-screen display of timecode information. When enabled, the active timecode value is shown in the video output or monitoring interface.

Mode: Selects the timecode operating mode:

- **PRESET** – Allows a manually defined timecode value to be used as the starting reference.
- **REGEN** – Continuously regenerates timecode based on incoming or internal reference signals.
- **EXT REGEN - Uses an external timecode signal received through the TC-IN port.**

Run: Controls how the timecode is generated or applied during operation:

- **OFF** – Disables timecode generation or output.
- **FREE RUN** – Timecode runs continuously regardless of video signal or system state.
- **REC RUN** – Timecode runs only during recording or active signal operation.

Time Code Format (TC Format)

Selects the timecode format type:

- **NDF (Non-Drop Frame)** -Counts all frames sequentially without adjustment, used where exact frame accuracy is required.

Time Code Value (TC Value): Defines the active timecode value used by the system:

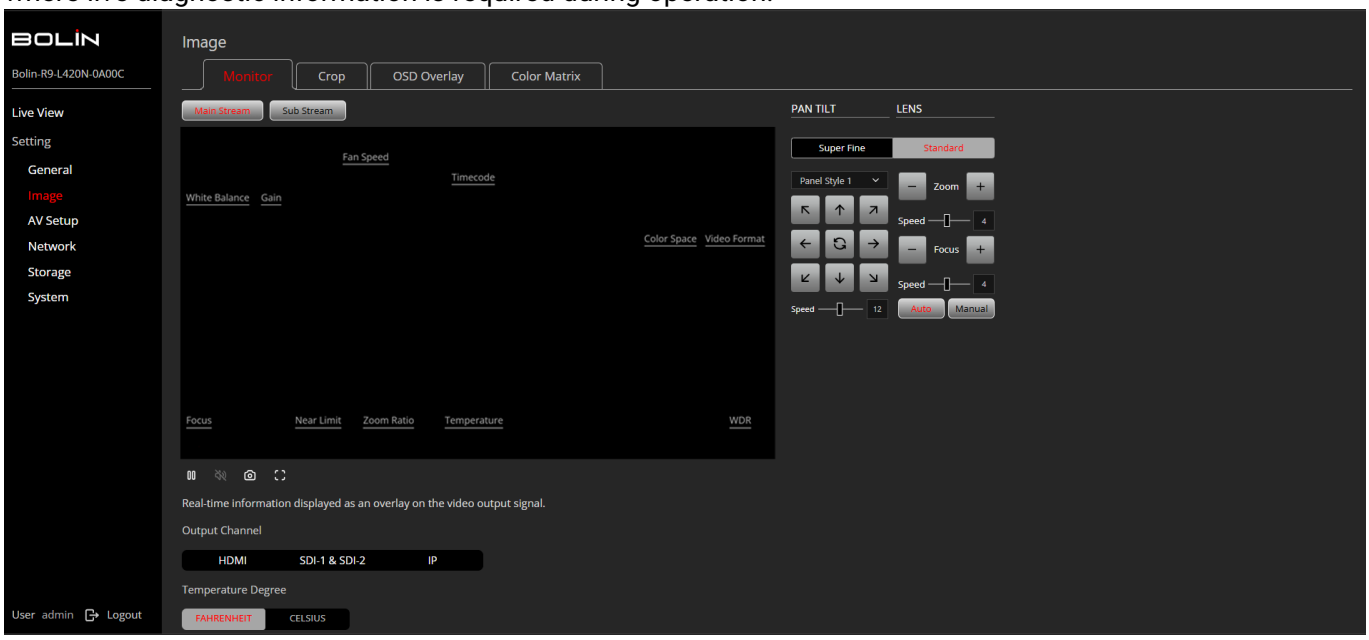
- **Reset** - Restores the timecode to its default or preset starting value.

Image

Under the Image page, users can monitor some of the camera's current parameter settings, and various overlays to the camera outputs, and adjust the color balance of the image.

Monitor

The Monitoring Information page allows the user to overlay real-time camera status data onto selected video outputs. This feature is designed for system monitoring, technical verification, and production environments where live diagnostic information is required during operation.



The following data parameters can be displayed as on-screen overlays:

- White Balance
- Gain
- Fan Speed
- Timecode
- Color Space
- Video Format
- Focus Position

- Near Limit
- Zoom Ratio
- Temperature
- WDR (Wide Dynamic Range) status

Monitoring overlays can be independently enabled for each available output. The following output channels are supported:

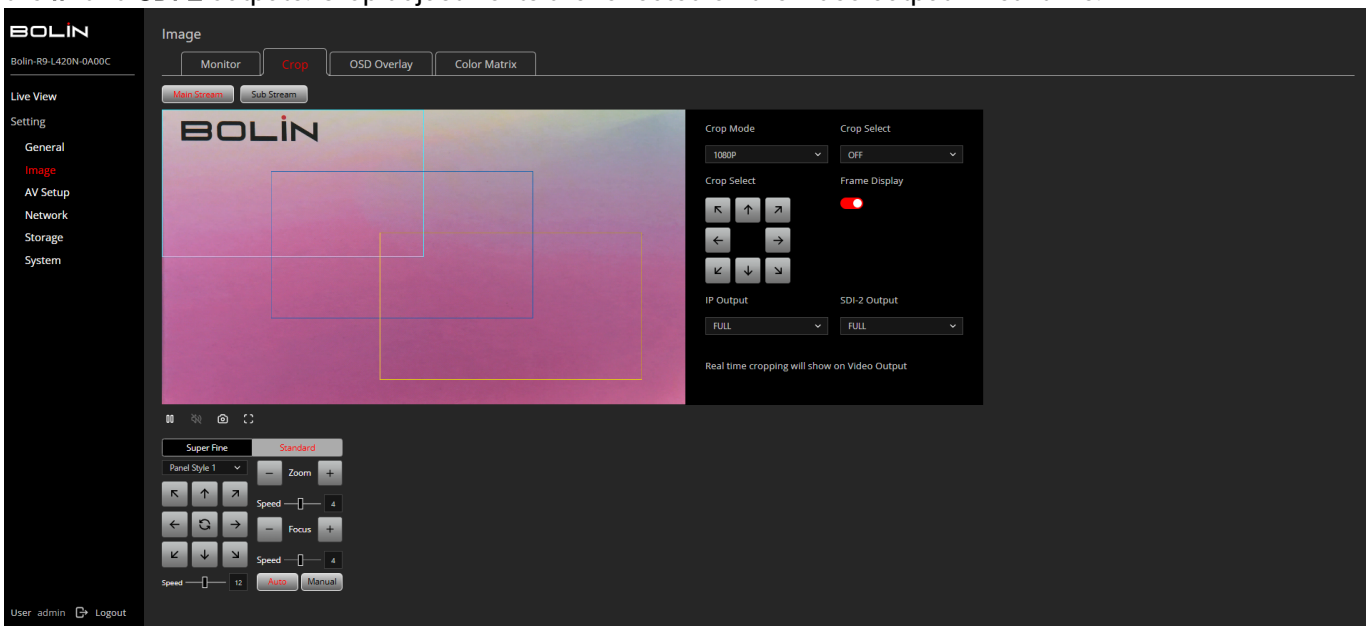
- HDMI
- SDI-1
- SDI-2
- IP Stream

To enable or disable overlays, simply select the corresponding output name. Each output acts as a toggle, allowing monitoring information to be shown or hidden per channel as required.
The temperature display format can also be configured between:

- **Celsius (°C)**
- **Fahrenheit (°F)**

Crop

The **Crop** page allows you to create separately framed views from the camera's full image and assign them to the **IP** and **SDI-2** outputs. Crop adjustments are reflected on the video output in real time.



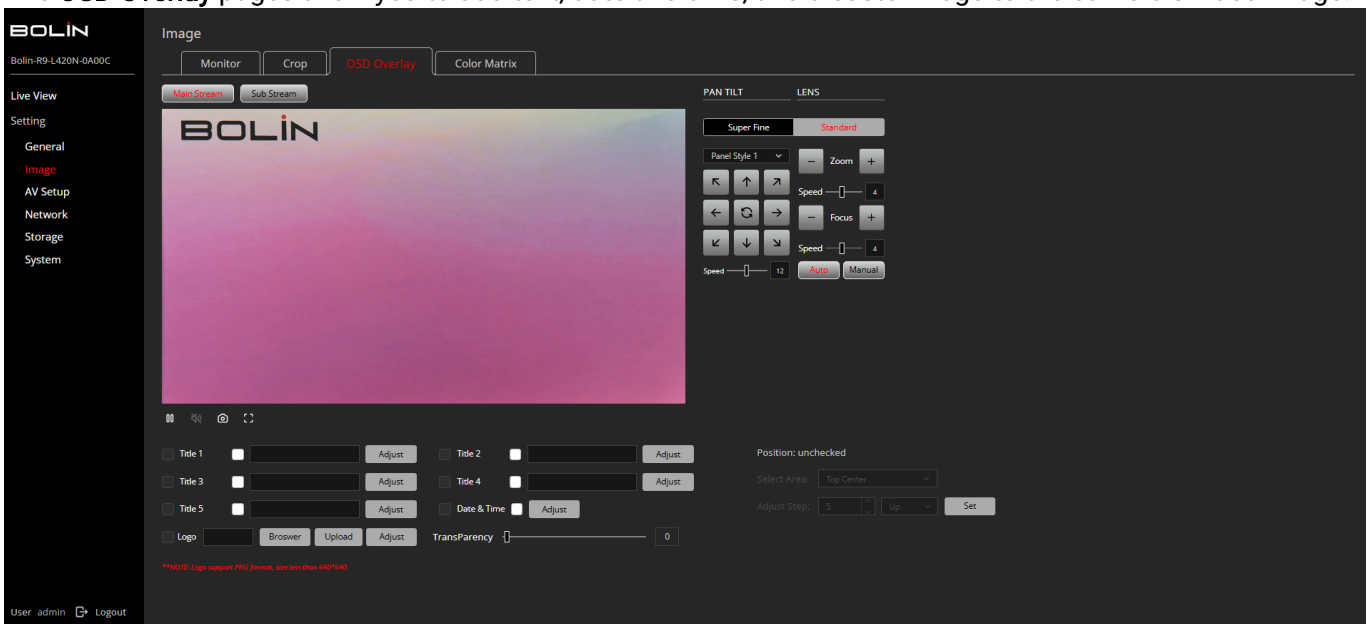
- **Main Stream / Sub Stream:** Select the stream shown in the live preview.
- **Crop Mode:** Select **Off**, **1080P**, or **720P** to disable cropping or set the cropped output resolution.
- **Crop Select:** Select **CROP CYAN**, **CROP BLUE**, or **CROP YELLOW** to choose the region you want to adjust. Each region appears as a matching color-coded frame in the preview.
- **Directional Buttons:** Move the selected crop region horizontally, vertically, or diagonally. You can also reposition the region by clicking and dragging it within the live preview.
- **Frame Display:** Show or hide the crop frames in the live preview.

- **IP Output / SDI-2 Output:** Select **FULL** to output the complete image, or select a crop region to output that view.

Below the live preview, the camera controls allow you to adjust **pan, tilt, zoom, and focus**, including movement speed and automatic or manual focus. Use **Panel Style** to select your preferred button or joystick control layout.

OSD Overlay

The **OSD Overlay** pages allow you to add text, date and time, and a custom logo to the camera's video image.



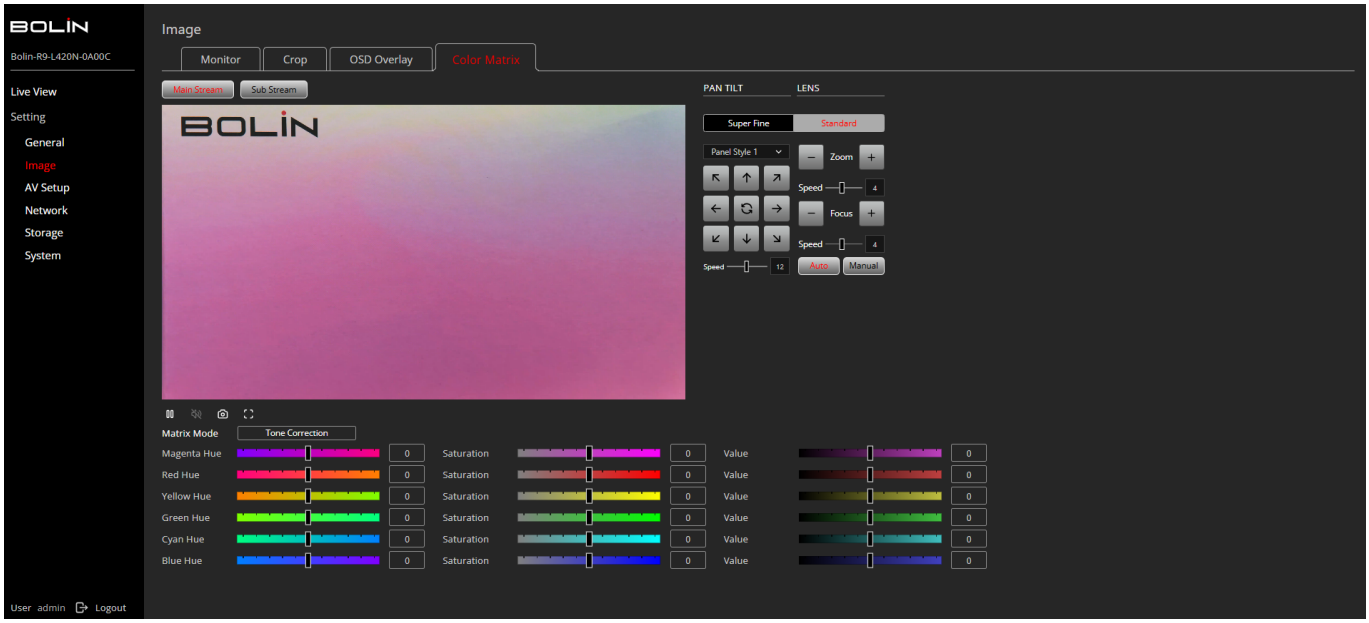
- **Title 1–5:** Enable the checkbox for the desired title and enter the text in the corresponding field. Use the color selector to choose the text color.
- **Date & Time:** Enable this option to display the date and time. Use the color selector to choose its color.
- **Logo:** Enable this option to display a custom logo. Click **Browser** to select a file, then click **Upload**. Logos must be in **PNG format** with dimensions smaller than **640 × 640 pixels**.
- **Transparency:** Adjust the transparency of the logo using the slider or numeric field.
- **Adjust:** Select the overlay you want to reposition. Under **Position**, choose a screen area using **Select Area**, then select an **Adjust Step** and movement direction. Click **Set** to apply the position adjustment.

Use the live preview to check overlay placement. Select **Main Stream** or **Sub Stream** to change the preview stream. The **Pan/Tilt** and **Lens** controls allow you to adjust camera position, zoom, and focus.

```
NOTE: Only PNG format images are supported, with a resolution of 640*640 or lower.
```

Color Matrix

The **Color Matrix** page allows to fine-tune individual colors while viewing the camera's live image. These adjustments can help match colors between cameras or achieve a desired appearance.



- **Matrix Mode:** Displays the selected color adjustment mode, shown here as **Tone Correction**.
- **Hue:** Adjusts the color tone of the selected color.
- **Saturation:** Adjusts the intensity of the selected color. Lower values produce more muted colors, while higher values produce more vivid colors.
- **Value:** Adjusts the brightness of the selected color.

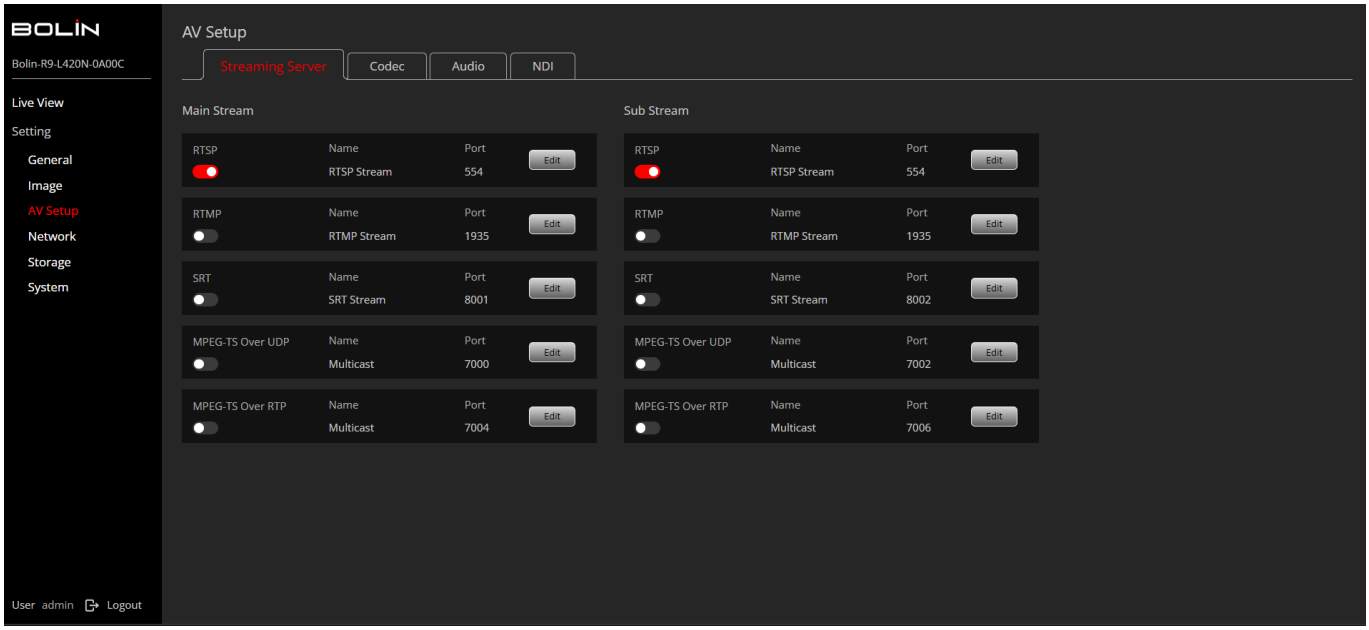
Separate **Hue**, **Saturation**, and **Value** controls are provided for **Magenta, Red, Yellow, Green, Cyan, and Blue**.
Use the sliders or numeric fields to adjust each setting while monitoring the live preview.
Select **Main Stream** or **Sub Stream** to choose the preview stream. The **Pan/Tilt** and **Lens** controls on the right allow you to adjust camera position, zoom, and focus while evaluating color changes.

AV Setup

Under the AV Setup page, users are able to configure and enable IP streams, manage the video codec settings, adjust audio settings, and configure NDI streams and features.

Streaming Server

The **Streaming Server** page allows you to enable and configure streaming protocols separately for the **Main Stream** and **Sub Stream**.



To configure video streaming follow these steps:

1. **Choose the stream.** Configure either the **Main Stream** or **Sub Stream**. Both use the camera's video image but can have different codecs, resolutions, and encoding settings, configured under the **Codec** tab.
2. **Configure the protocol.** Click **Edit** beside the desired protocol in the appropriate stream column. Enter the required settings, such as the destination URL, stream key, stream mode, or maximum connections. Available settings vary by protocol. You can also enter a name to identify the stream.
3. **Enable streaming.** Turn on the toggle for the configured protocol. A **red toggle** indicates that it is enabled.
4. **Connect the receiving application.** For **RTSP** and **SRT**, the stream URL appears in red at the bottom of the protocol settings window. Copy this URL into a compatible video player, decoder, or ingest application that can reach the camera over the network.

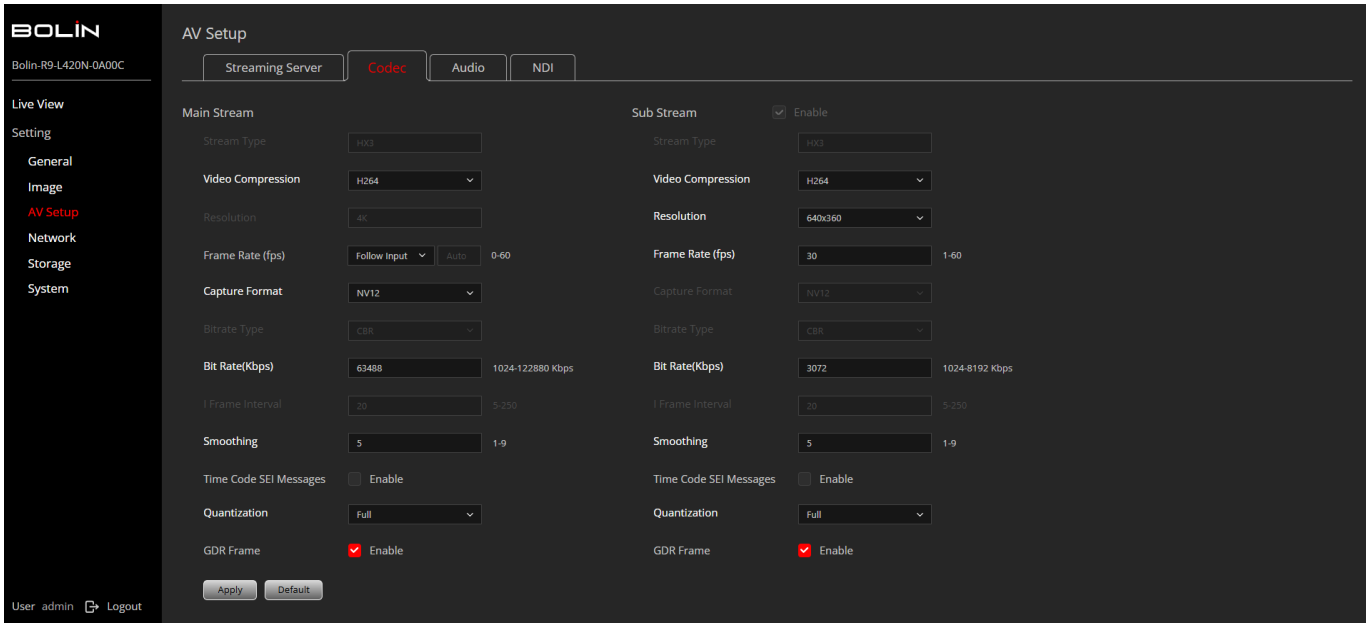
Use the following connection formats and port values:

Protocol	Connection Format	Main Stream Port	Sub Stream Port
RTSP	`rtsp://<camera-IP>:<port>/media/video1` for Main Stream; `/media/video2` for Sub Stream	554	554
SRT	`srt://<camera-IP>:<port>?streamid=live/channel/0` for Main Stream; `live/channel/1` for Sub Stream	8001	8002
RTMP	Destination RTMP URL and stream key supplied by the streaming platform	1935	1935
MPEG-TS Over UDP	`udp://@<destination-IP>:<port>`	7000	7002
MPEG-TS Over RTP	`rtp://@<destination-IP>:<port>`	7004	7006

Replace the placeholders with the IP addresses and ports configured for your setup. For RTSP and SRT, use the URL displayed by the camera and ensure the receiving application matches the selected streaming mode.
RTMP setup: Sign in to your streaming platform and obtain its RTMP server URL and stream key. Enter these details in the camera's RTMP settings, save the configuration, and enable RTMP for the desired stream.
MPEG-TS setup: Configure the destination IP address and port in the camera's protocol settings, then open the corresponding address in a compatible receiving application. For multicast streaming, use the configured multicast group address.

Codec

The **Codec** tab allows you to configure video encoding settings separately for the **Main Stream** and **Sub Stream**. Available controls depend on the current stream mode. Grayed-out fields cannot be edited in the current configuration.



Stream Type: Displays the current streaming mode. When NDI HX3 is enabled, this field displays **HX3**, as shown. This field is read-only.
Sub Stream Enable: Enables or disables the Sub Stream. This control may be unavailable in certain streaming modes.
Video Compression: Select the video encoding standard:

- **H.264 (AVC):** Provides broad compatibility with receiving devices and software.
- **H.265 (HEVC):** Provides more efficient compression, generally requiring less bandwidth for comparable image quality.

Select a codec supported by your receiving equipment.
Resolution: Displays or selects the encoded video resolution. In the configuration shown, the Main Stream is fixed at **4K**, while the Sub Stream resolution can be selected from its drop-down menu.
Frame Rate (fps): Sets the number of frames encoded per second.

- **Main Stream:** Select **Follow Input** to match the camera's input frame rate, or configure a manual value when available. The displayed range is **0–60 fps**.
- **Sub Stream:** Enter a value from **1–60 fps**.

Higher frame rates provide smoother motion but generally require more bandwidth.
Capture Format: Selects the video pixel format used for encoding. The configuration shown uses **NV12**. This field is editable for the Main Stream and grayed out for the Sub Stream.
Bitrate Type: Selects how the encoder manages the video data rate, when available.

- **CBR (Constant Bitrate):** Targets a consistent data rate.
- **VBR (Variable Bitrate):** Varies the data rate according to scene complexity.

In the HX3 configuration shown, both streams display **CBR**, and this setting is grayed out.
Bit Rate (Kbps): Sets the video encoding bitrate within the displayed range:

Stream	Bitrate Range
Main Stream	1,024–122,880 Kbps
Sub Stream	1,024–8,192 Kbps

Higher bitrates can preserve more image detail but require additional network bandwidth. Lower bitrates reduce bandwidth usage but may introduce compression artifacts. Choose a value appropriate for the resolution, frame rate, scene complexity, and receiving equipment.
I Frame Interval: Sets the number of frames between full-image I-frames. The displayed range is **5–250**.

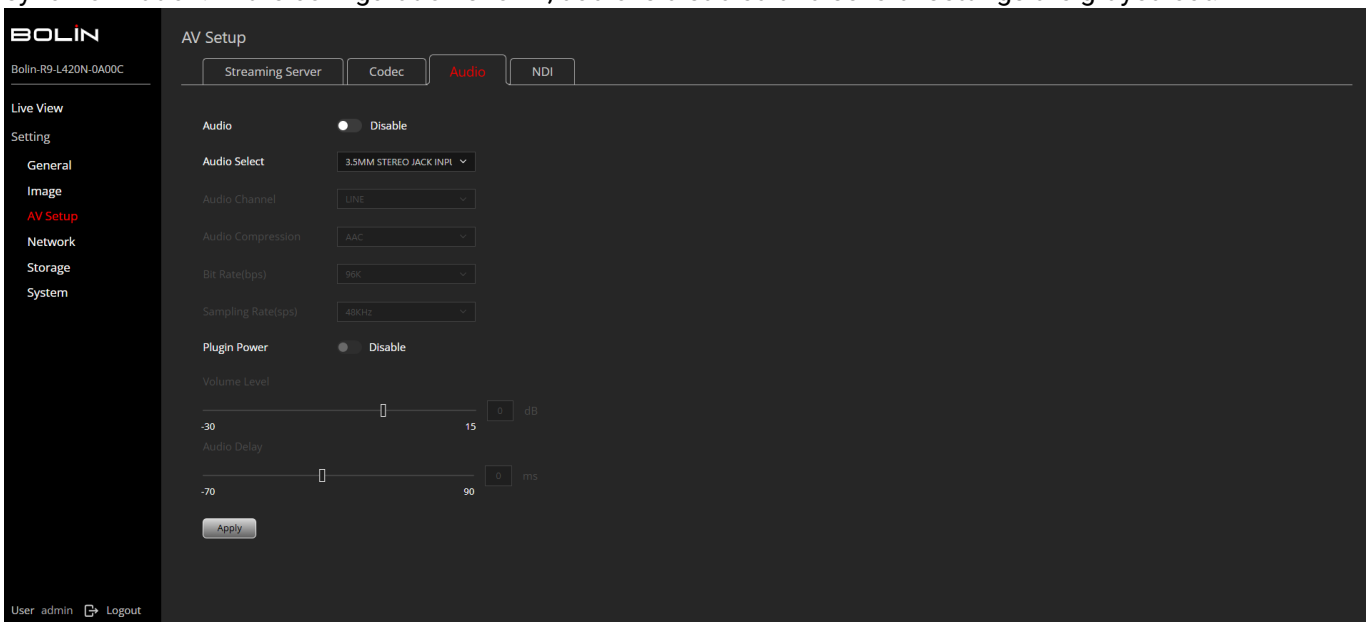
Shorter intervals refresh the complete image more frequently and may increase bandwidth usage. This control is grayed out in the configuration shown.
Smoothing: Adjusts the encoder's smoothing setting from **1–9** to help maintain consistent stream delivery.
Time Code SEI Messages: Enable this option to include timecode metadata as Supplemental Enhancement Information (SEI) in the encoded video stream. The receiving device or software must support this metadata to use it.
Quantization: Selects the encoded video's signal range:

- **Full (0–255):** Uses the full signal range.
- **Limited Range (16–235):** Uses the standard video signal range.

Match this setting to the receiving equipment to maintain correct black and white levels. This setting controls signal range rather than compression strength.
GDR Frame: Enables **Gradual Decoding Refresh**, which refreshes portions of the image over successive frames instead of relying solely on a complete I-frame refresh. Ensure your receiving equipment supports GDR before enabling it.
Click **Apply** to save your changes. Click **Default** to restore the default codec settings.

Audio

The **Audio** tab allows you to enable audio, select an input source, and configure audio encoding, volume, and synchronization. In the configuration shown, audio is disabled and several settings are grayed out.



Audio: Enable or disable audio processing using the toggle switch.
Audio Select: Select the physical input connected to your audio source:

- **3.5 mm Stereo Jack Input**
- **XLR Balanced Input**

Audio Channel: Select the input signal type:

- **Line:** For line-level sources, such as audio mixers.
- **Mic:** For microphone-level sources.

Audio Compression: Select the audio encoding format. The interface shown uses **AAC**.
Bit Rate (bps): Select **16K, 32K, 48K, 64K, 96K, or 128K bps**. Higher bitrates can improve audio quality but require more bandwidth.
Sampling Rate (sps): Audio uses a sampling rate of **48 kHz**.
Plug-in Power / Phantom Power: The power option depends on the selected input:

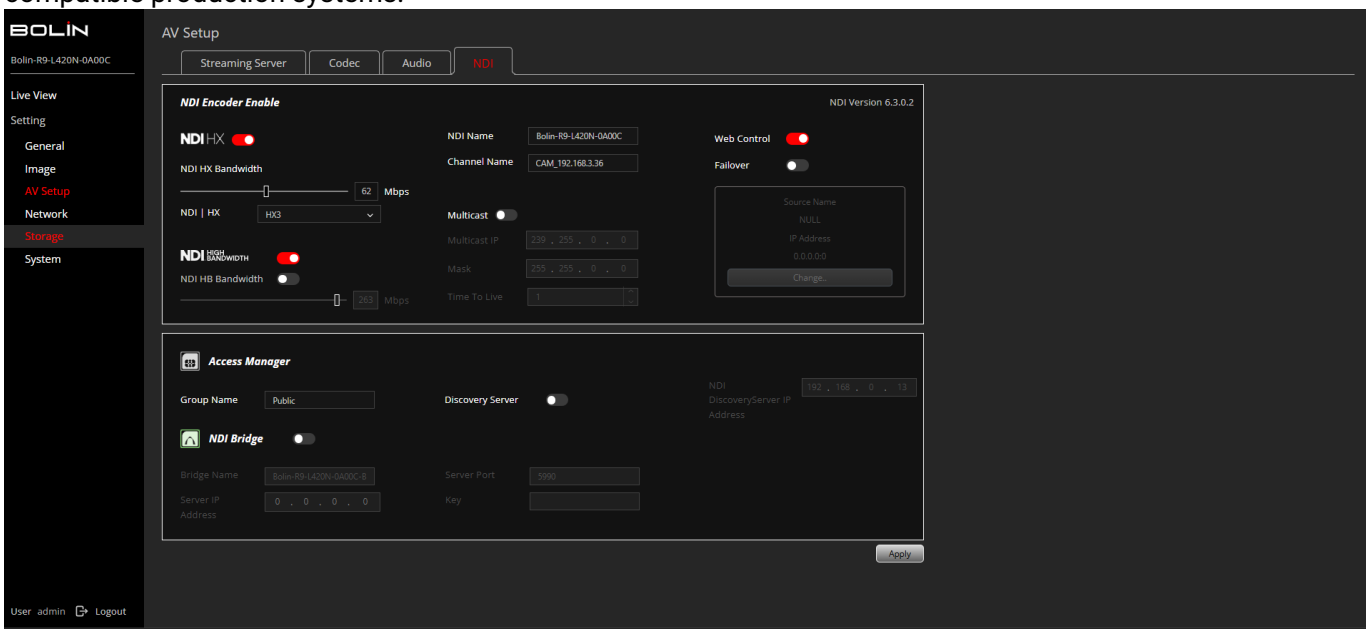
- **3.5 mm Stereo Jack Input:** Enable **Plug-in Power** if required by the connected microphone.
- **XLR Balanced Input:** Enable **Phantom Power** if required by the connected microphone.

> **NOTE:** Enable power only when the connected microphone supports and requires it.

Volume Level: Adjust the input audio level from **−30 to +15 dB**. Set an appropriate level to avoid distortion or audio that is too quiet.
Audio Delay: Adjust audio timing from **−70 to +90 ms** to synchronize audio with video.
Click **Apply** to save and apply your changes.

NDI

From the **NDI** tab, users can configure all settings required for NDI video streaming, discovery, and network integration. This includes encoder configuration, device identification, multicast settings, access control, and NDI Bridge connectivity.
These settings determine how the camera appears on the NDI network and how video is transmitted to compatible production systems.



NDI Encoder Enable: Use the separate toggles to enable or disable **NDI HX** and **NDI High Bandwidth** output.

- **NDI HX:** Provides compressed video transmission with lower bandwidth requirements.
- **NDI HX Bandwidth:** Adjust the bandwidth using the slider or numeric field. Values are displayed in **Mbps**.
- **NDI | HX:** Select the available HX mode from the drop-down menu. The configuration shown uses **HX3**.
- **NDI High Bandwidth:** Enables high-bandwidth NDI video transmission.
- **NDI HB Bandwidth:** Enables manual bandwidth adjustment for High Bandwidth output. When enabled, use the associated slider or numeric field.

NDI Version: Displays the camera's NDI software version in the upper-right corner.
NDI Name: Enter a descriptive device name to identify the camera in NDI-compatible software.
Channel Name: Enter a name for the camera's NDI video channel.
Multicast: Enable multicast delivery when required by your network workflow. Multicast can reduce duplicate network traffic when multiple receivers access the same stream. When enabled, configure:

- **Multicast IP:** The multicast group address.
- **Mask:** The mask used for multicast address configuration.
- **Time To Live:** Limits how far multicast packets can travel through routed networks.

Web Control: Enables access to the camera's web control page through compatible NDI applications.
Failover: Enables configuration of a backup NDI source. Click **Change…** to select the source. Its **Source Name**

and **IP Address** appear in the failover panel.
Access Manager: Configures NDI grouping and discovery settings.

- **Group Name:** Assigns the camera to an NDI discovery group. The displayed value is **Public**. Configure receiving applications to include the appropriate group.
- **Discovery Server:** Enables use of an NDI Discovery Server. When enabled, enter its address in the **NDI DiscoveryServer IP Address** field.

NDI Bridge: Enables a connection to an NDI Bridge server for remote or cross-network workflows. When enabled, configure:

- **Bridge Name:** The name identifying the bridge connection.
- **Server IP Address:** The address of the NDI Bridge server.
- **Server Port:** The port configured on the bridge server.
- **Key:** The connection key configured on the bridge server.

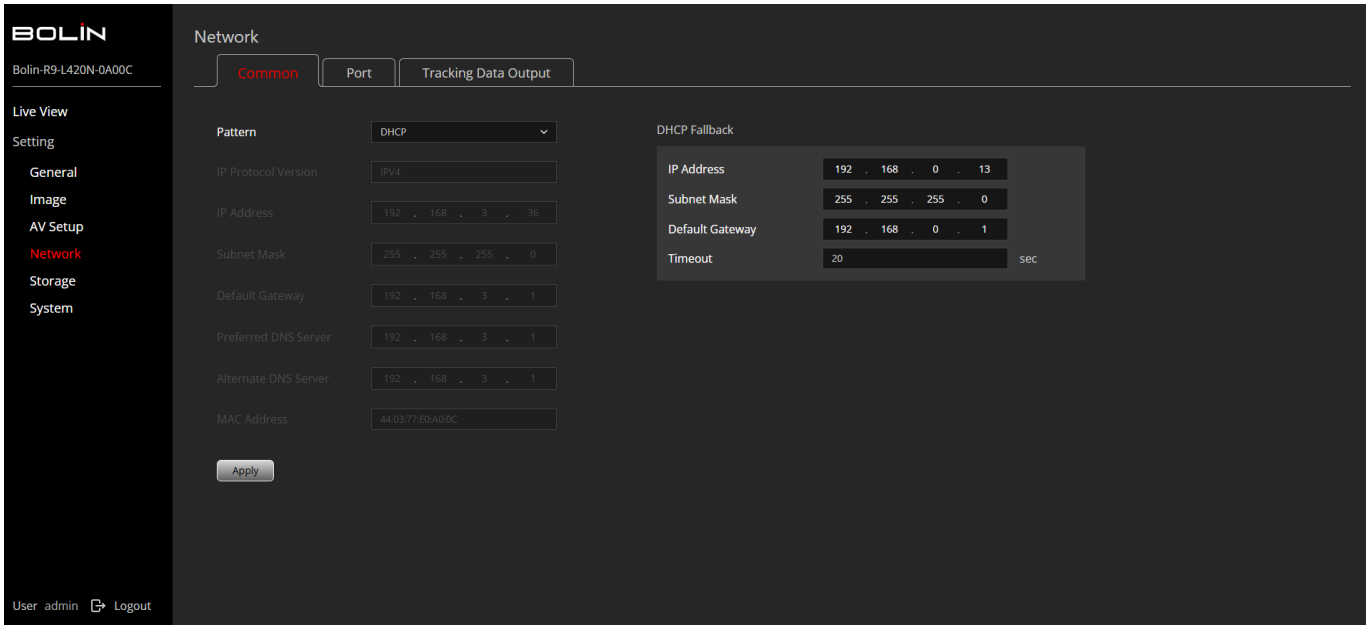
Grayed-out fields are unavailable until the corresponding function is enabled. Click **Apply** to save and apply your changes.

```
NOTE: To receive NDI streams on Mac devices, GDR must be disabled in the camera's settings.
```

Network

Common

From this tab, users can configure the camera's primary network settings, including IP addressing, DNS configuration, and network fallback behaviour. Proper configuration of these settings is required for web access, IP streaming, NDI operation, and remote control.



Pattern: Select the network addressing mode. In **DHCP** mode, the camera obtains its network settings automatically from a DHCP server. Fields managed by DHCP are grayed out.

- **IP Protocol Version:** Displays the IP version in use, shown here as **IPv4**.
- **IP Address:** The camera's network address.
- **Subnet Mask:** Defines the camera's local network subnet.
- **Default Gateway:** The router address used to communicate outside the local subnet.

- **Preferred DNS Server / Alternate DNS Server:** Server addresses used to resolve hostnames.
- **MAC Address:** Displays the camera's hardware network address.

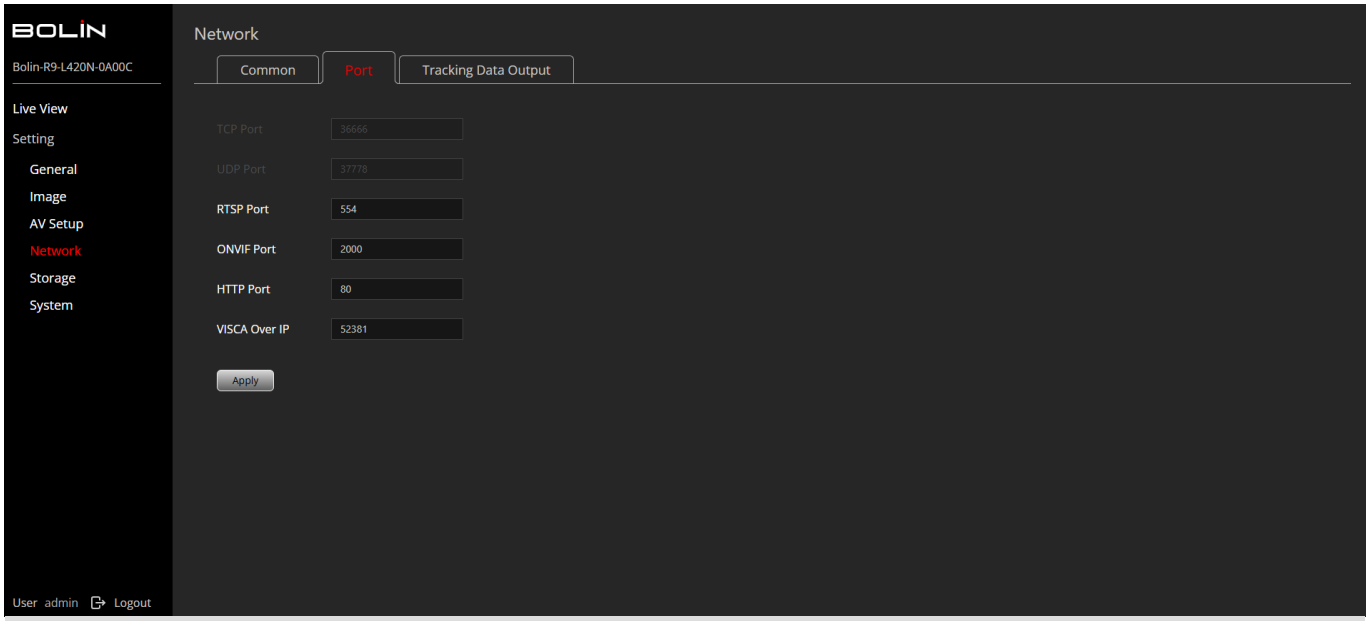
DHCP Fallback: Configures the network settings the camera uses if it cannot obtain an address from a DHCP server within the specified timeout.

Setting	Value Shown
IP Address	192.168.0.13
Subnet Mask	255.255.255.0
Default Gateway	192.168.0.1
Timeout	20 seconds

Set the fallback address to suit your network and avoid conflicts with other devices.
Click **Apply** to save your changes. If the camera's IP address changes, reconnect to the web interface using the new address.

Port

The **Port** tab allows you to view and configure the network ports used for streaming, web access, and camera control.

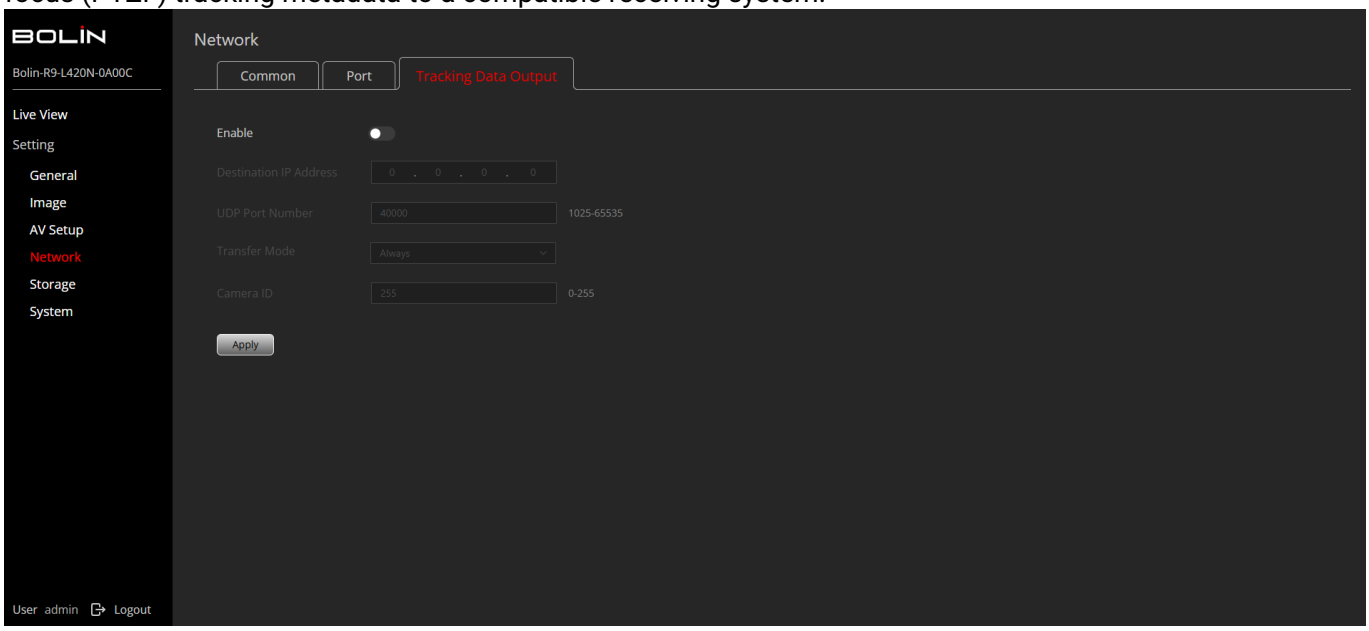


Setting	Description	Value Shown
TCP Port	Displays the camera's TCP service port. Grayed out in this configuration.	36666
UDP Port	Displays the camera's UDP service port. Grayed out in this configuration.	37778
RTSP Port	Port used to access RTSP video streams.	554
ONVIF Port	Port used by compatible ONVIF applications to communicate with the camera.	2000
HTTP Port	Port used to access the camera's web interface.	80
VISCA Over IP	Port used for VISCA camera control over the network.	52381

Ensure the port settings in your receiving applications and controllers match the camera's configuration. Grayed-out fields cannot be edited.
Click **Apply** to save your changes. If you change the **HTTP Port**, include the new port when accessing the web interface—for example, `http://<camera-IP>:8080`.

Tracking Data Output

The **Tracking Data Output** tab allows you to configure FreeD transmission of the camera's pan, tilt, zoom, and focus (PTZF) tracking metadata to a compatible receiving system.



Enable: Turns tracking metadata transmission on or off. A red toggle indicates that transmission is enabled.
Destination IP Address: Enter the IP address of the computer or tracking system receiving the FreeD data. This address is used in **Always** transfer mode.
UDP Port Number: Enter the destination UDP port configured on the receiving system. The supported range is **1025–65535**. The value shown is **40000**.
Transfer Mode: Determines when FreeD data is transmitted. **Always** is the currently supported mode and continuously sends data to the configured destination.
Camera ID: Assign a FreeD camera identifier in decimal format, from **0–255**. The default value is **255**. Use distinct IDs to identify cameras in a system with multiple tracking sources.

```
NOTE: The R9-L420N supports D1 and Extended FreeD protocol types.
```

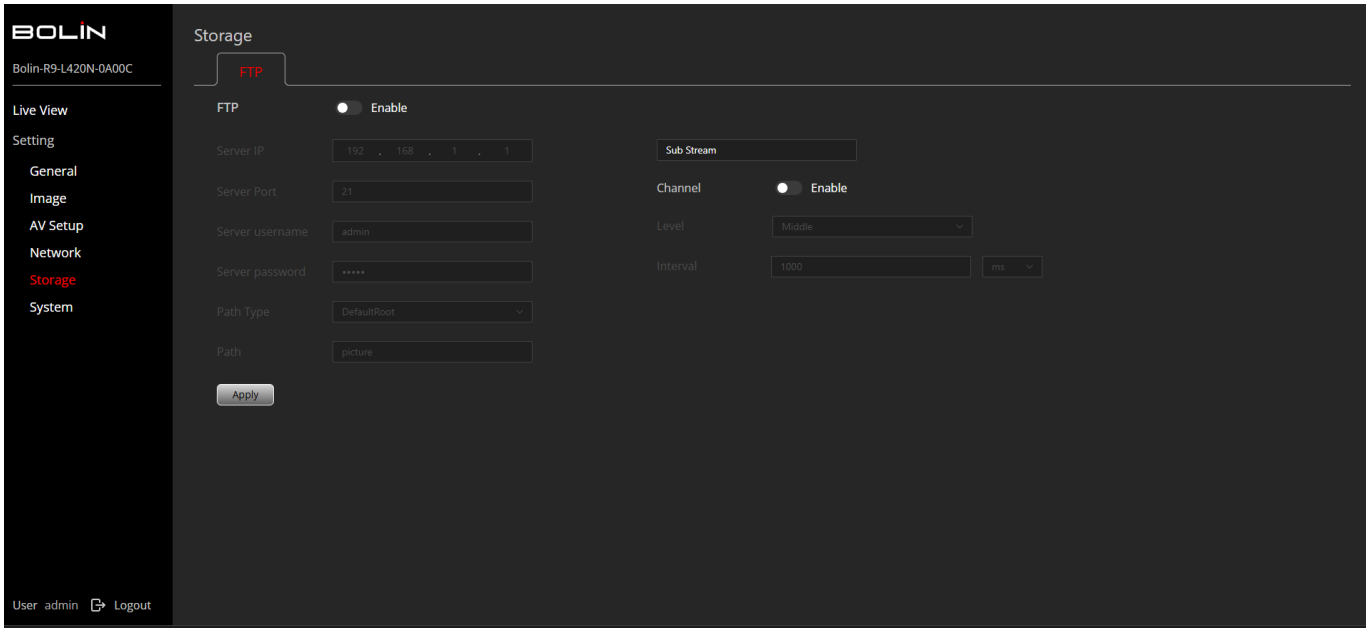
Ensure the destination IP address and UDP port match the receiving system's settings, then click **Apply** to save and apply your changes.

Storage

The Storage section allows users to configure file storage, remote upload, and recording behavior for the camera. This includes FTP transfer settings and local recording management.

FTP

The **FTP** tab allows you to configure an FTP server destination for image uploads and adjust the upload interval.



FTP: Enable or disable FTP uploads. A red toggle indicates that FTP is enabled.
Server IP: Enter the IP address of the FTP server.
Server Port: Enter the FTP server's port number. The value shown is **21**.
Server username / Server password: Enter the credentials for an FTP account with permission to upload files. Click the eye icon to show or hide the password.
Path Type: Select how the upload destination folder is defined. **DefaultRoot**, shown here, uses the FTP account's default root directory.
Path: Enter the destination folder when available for the selected Path Type. This field is grayed out when **DefaultRoot** is selected.
The **Sub Stream** section includes the following upload controls:

- **Channel:** Enable or disable uploads for this channel.
- **Level:** Select the image quality level. The value shown is **Middle**.
- **Interval:** Set the time between image uploads and select the time unit. The configuration shown is **1000 ms**, equivalent to one upload per second.

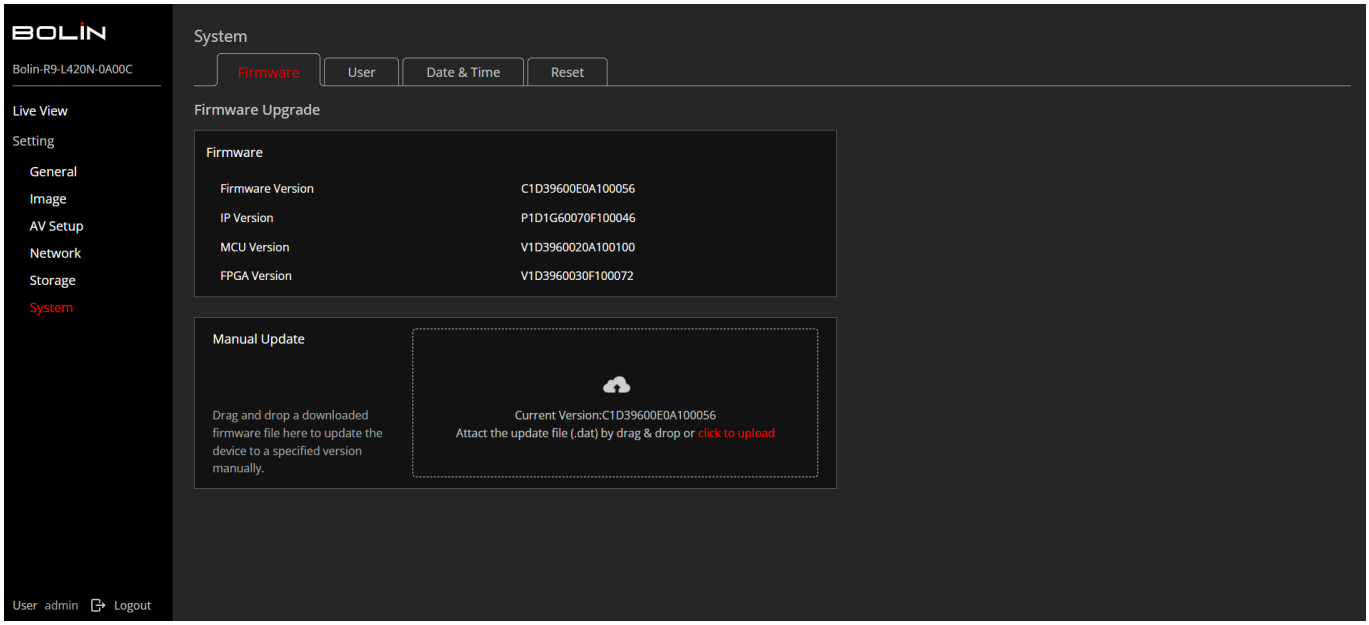
Click **Apply** to save and apply your changes.

> **NOTE:** Ensure the FTP server is reachable on the network and that user credentials have write permissions to the selected directory.

System

Firmware

There are two parts to the **Firmware** tab. The upper part identifies the firmware versions that the device is currently running. The lower part is where users can upload a new firmware file to update the device firmware.



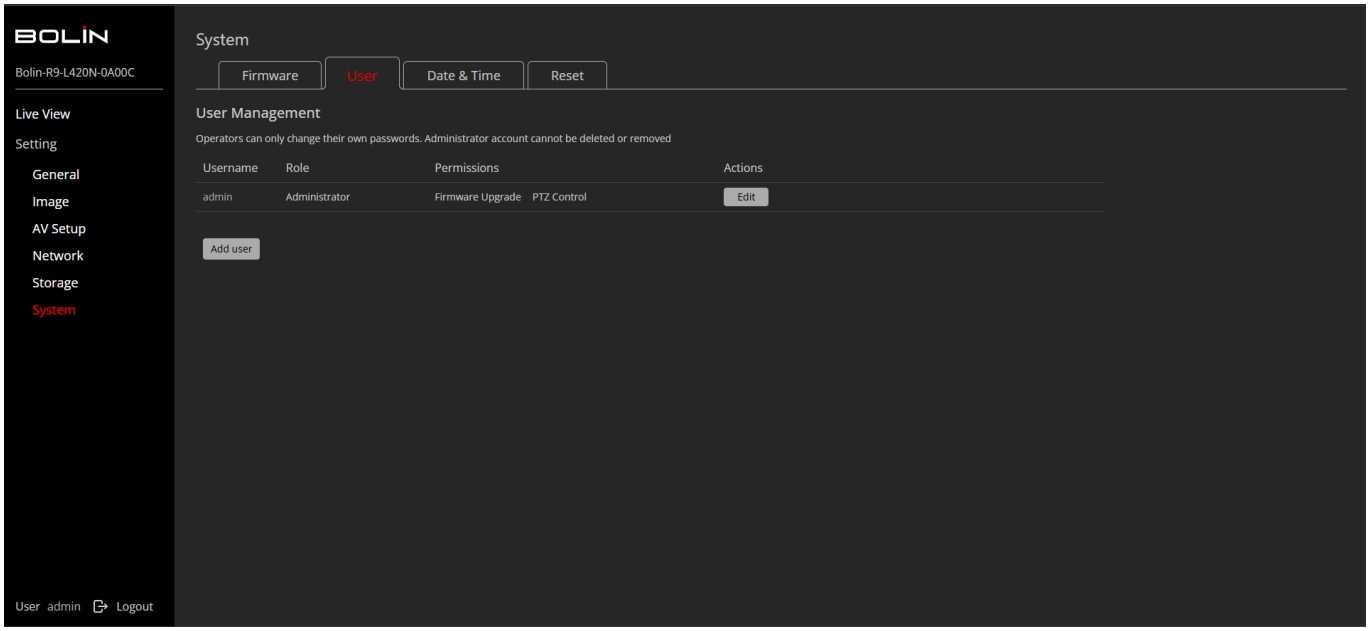
To update the firmware, follow these steps:

1. Visit Bolin Technology's official website at www.bolintechnology.com
2. Navigate to the "Support Center" and select the "Download Center" option.
3. Search for the model number of the device and select the correct device from the results.
4. Download the firmware file and save it to a location on the computer.
5. Access the web interface of the device. The downloaded firmware file can be dragged and dropped into the designated box or the box can be clicked to manually select the file for upload.
6. After the device has verified the validity of the file, initiate the update process by clicking on the red "Update" button. During the update process, refrain from navigating away from the current tab, page, or window, and avoid clicking elsewhere on the page to prevent the update from failing.
7. Upon successful installation of the update, a prompt will appear instructing to restart the device. Follow this prompt to complete the update process.

```
NOTE: It is crucial to maintain the current page active during the update process to ensure
a successful update. Any navigation away from the page could result in a failed update.
```

User

The **User** tab, found under the System section, is where operators who have access to the camera can be managed. It should be noted that operators do not possess the same level of access to system settings as administrators.



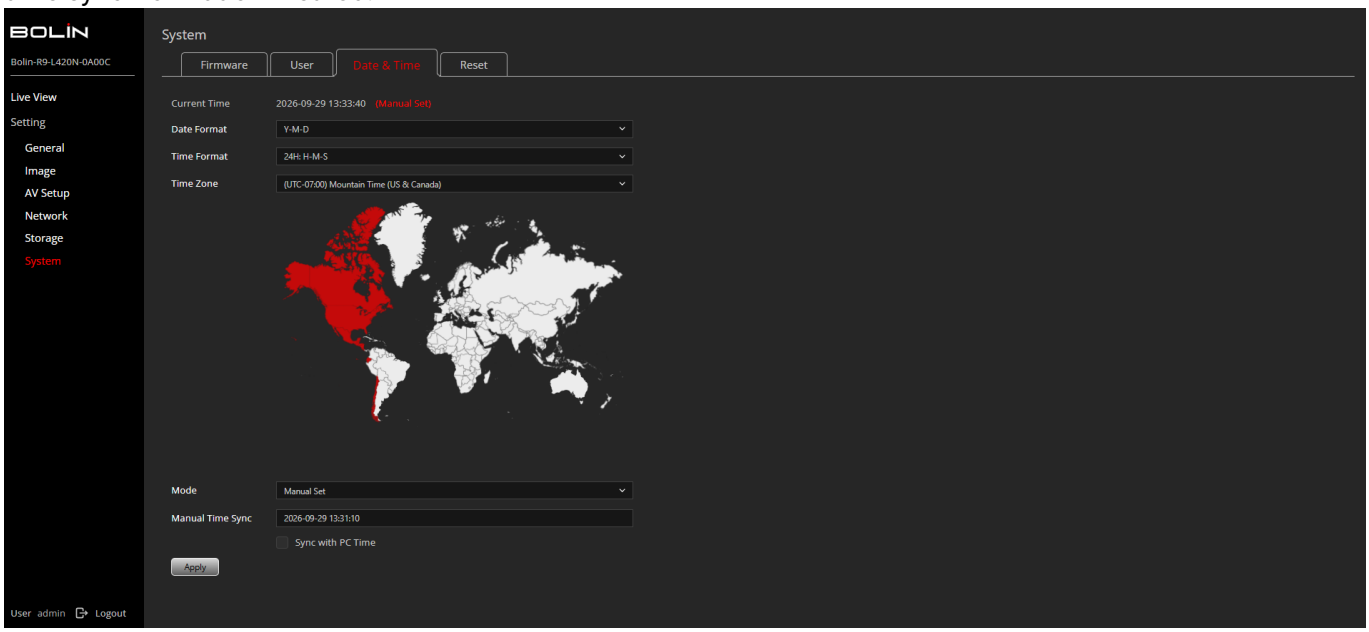
To add a new operator, follow these steps:

1. Under the System section, find the User tab.
2. Click on the ‘Add User’ button.
3. In the new window that appears, enter a username that is between 3–12 characters long, and a password. As you type the password, you can click on the eye icon to preview it. It’s recommended to use a strong password that includes a capital letter, a lowercase letter, a number, and a special character.
4. Once you’ve confirmed the password, click on ‘Add’ to save the new operator. You can add up to 12 additional operators.

> **NOTE:** Only administrators can delete users.

Date & Time

The **Date & Time** settings page allows you to configure the camera’s clock, display formats, time zone, and time synchronization method.

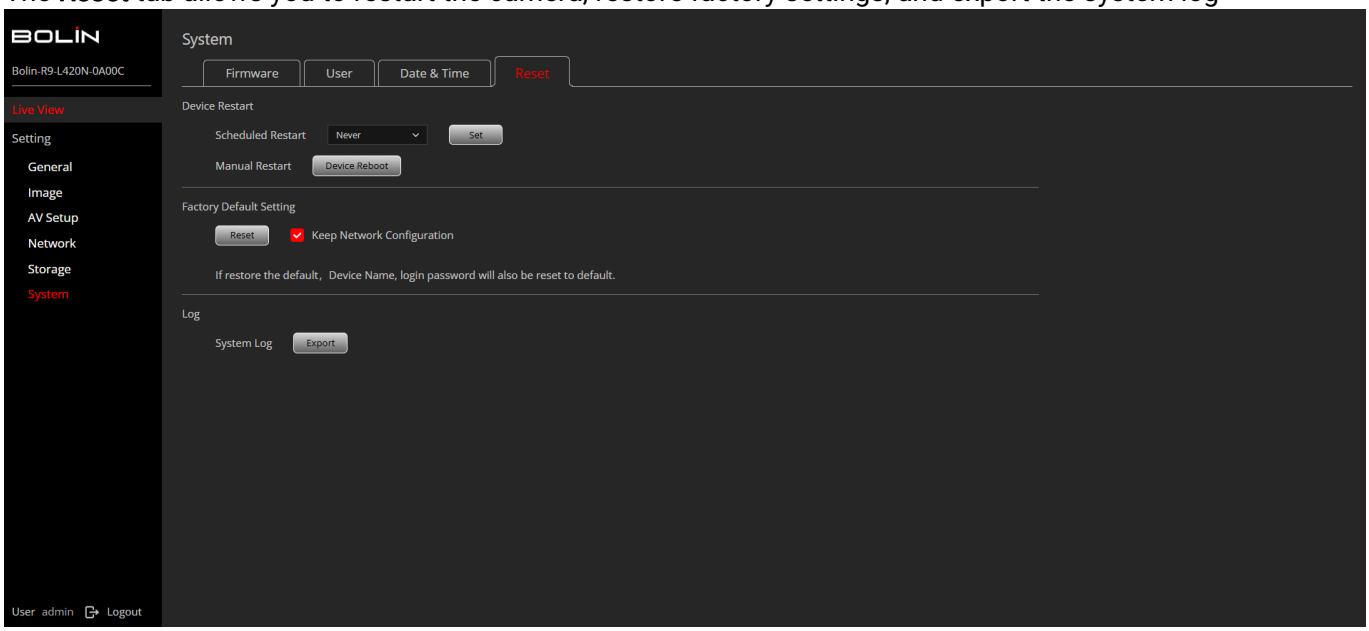


- **Current Time:** Displays the camera's current date and time, along with the active time-setting mode.
- **Date Format:** Select the date display format. **Y-M-D** displays the year, month, and day.
- **Time Format:** Select the time display format. **24H: H-M-S** uses a 24-hour clock with hours, minutes, and seconds.
- **Time Zone:** Select the time zone appropriate for the camera's location. The map provides a visual reference for the selected region.
- **Mode:** Select the time-setting method. In **Manual Set** mode, enter the date and time manually.
- **Manual Time Sync:** Enter the desired date and time in **YYYY-MM-DD HH:MM** format.
- **Sync with PC Time:** Select this checkbox to synchronize the camera's clock with the computer's current time.

Click **Apply** to save and apply your changes.

Reset

The **Reset** tab allows you to restart the camera, restore factory settings, and export the system log



Scheduled Restart: Select an automatic restart option from the drop-down menu, then click **Set** to save the schedule. Select **Never** to disable scheduled restarts.
Manual Restart: Click **Device Reboot** to restart the camera. Video output and network access will be temporarily interrupted during the reboot.
Factory Default Setting: Click **Reset** to restore the camera's settings to their factory defaults.

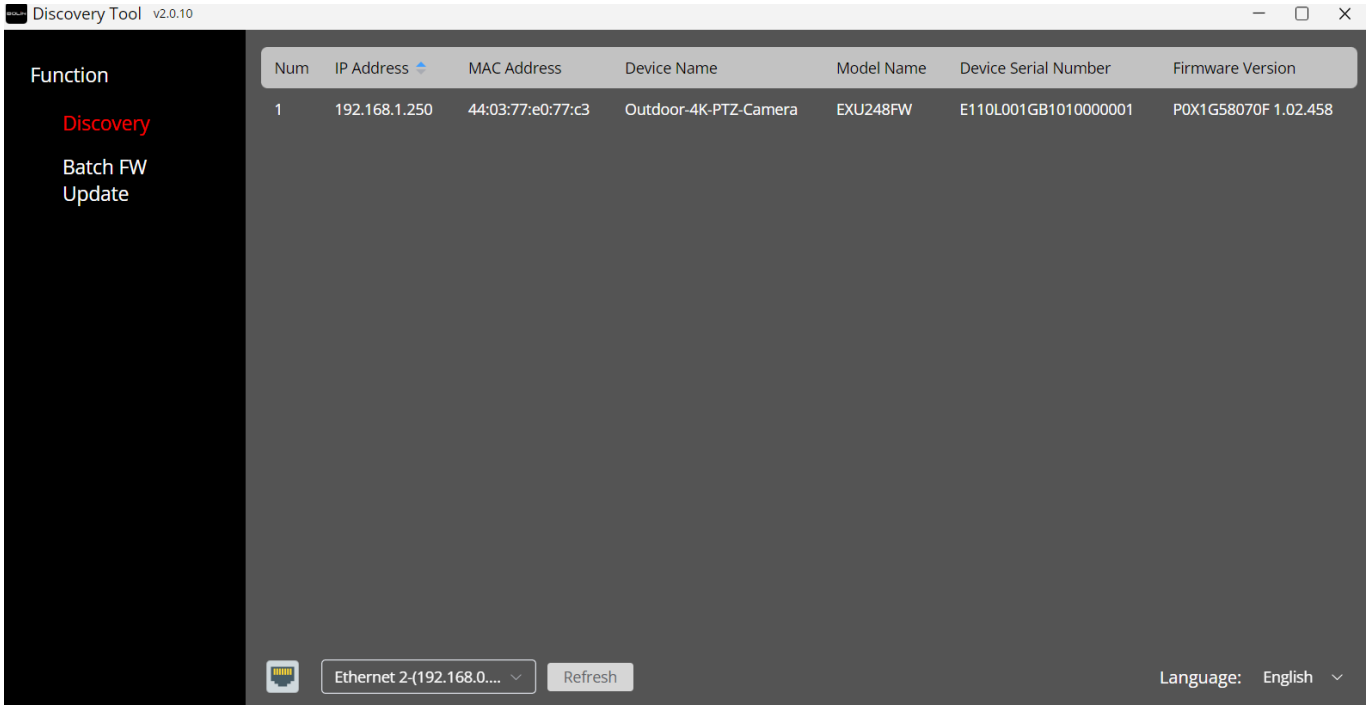
- **Keep Network Configuration checked:** Retains the current network settings during the reset.
- **Keep Network Configuration unchecked:** Restores the network settings to their factory defaults. You may need to reconnect using the camera's default network configuration.

```
NOTE: A factory reset also restores the Device Name and login password to their defaults.
```

System Log: Click **Export** to download the camera's system log for troubleshooting or to share with technical support.

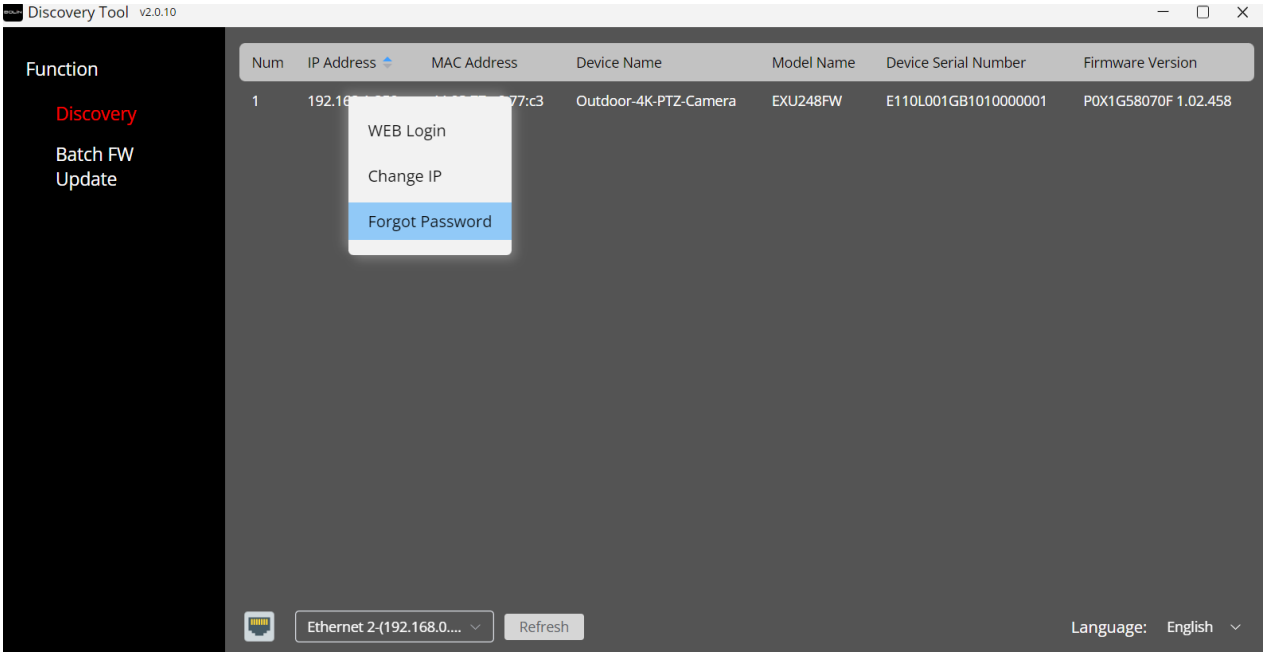
Discovery Tool

The **Bolin Discovery Tool** is a utility available for both **Windows** and **macOS** that is designed to detect and manage Bolin cameras on a network. It allows users to quickly discover connected Bolin devices, view key information such as the IP address, MAC address, model number, serial number, and firmware version, and launch the camera's web interface directly from the application. The tool also provides the ability to reset a camera's password when needed.

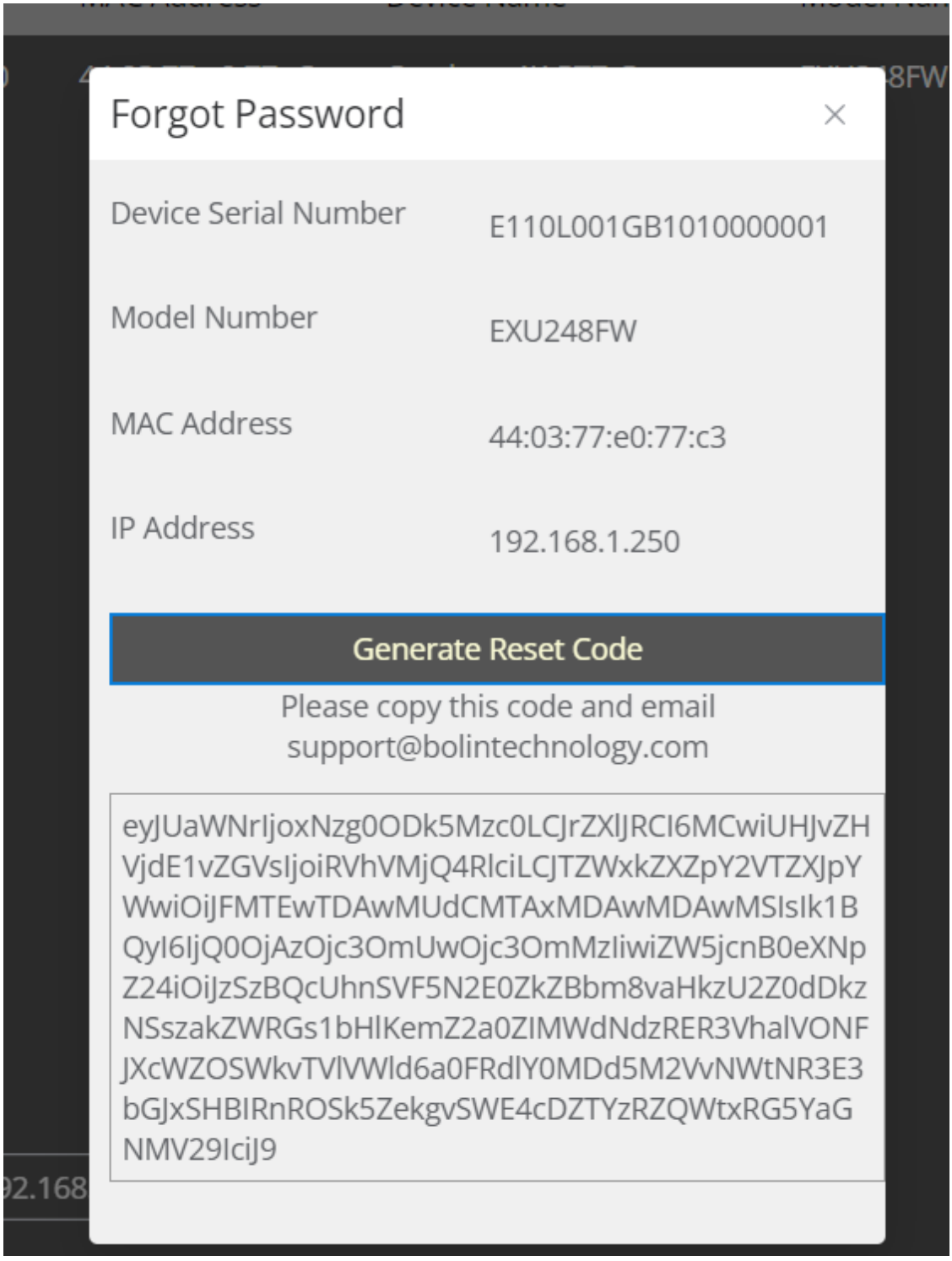


If the password to the camera has been lost or forgotten, follow the steps below to reset it:

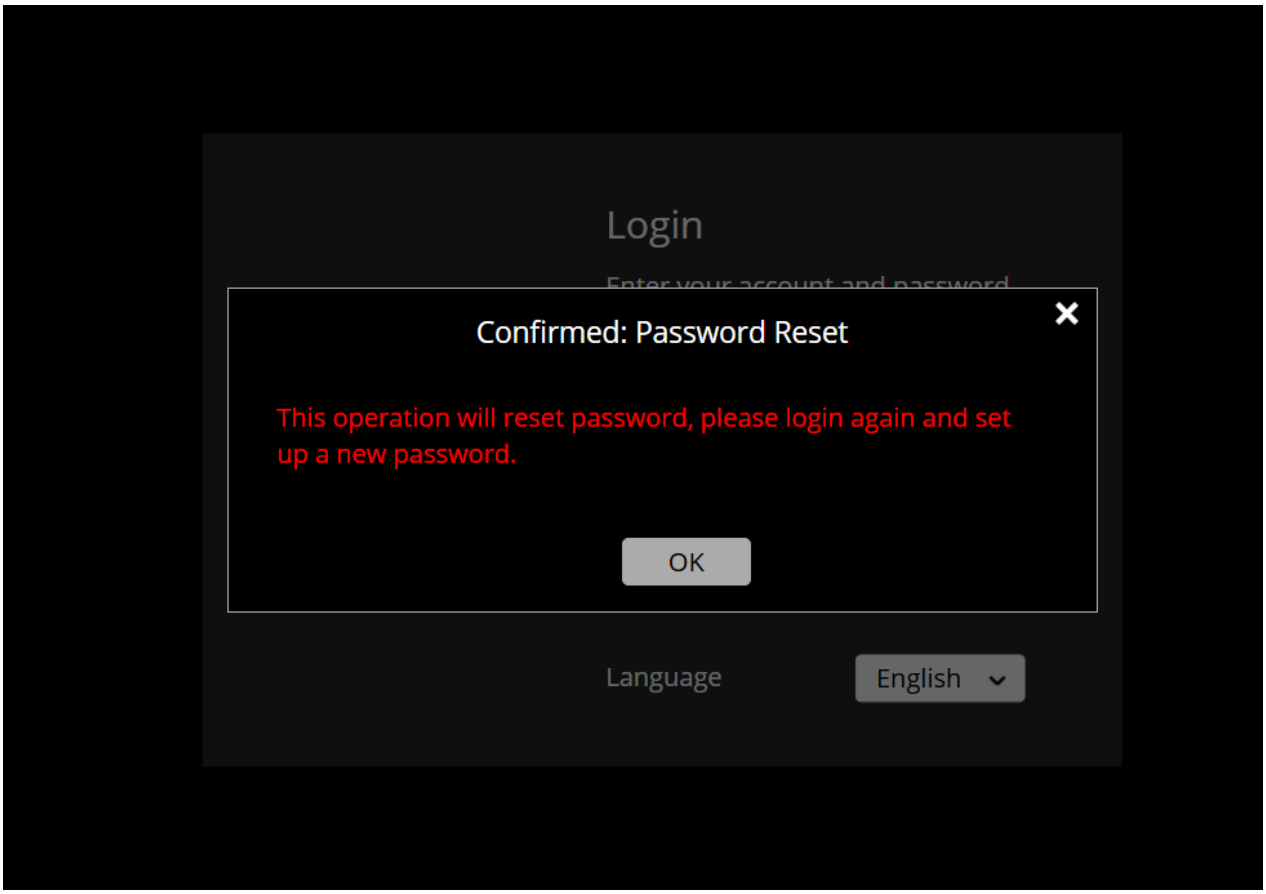
1. **Download the Bolin Discovery Tool:**
   - Visit the **Download Center**.
   - Search for the camera model SKU number.
   - Download the **Bolin Discovery Tool** to the computer.
2. **Run the Bolin Discovery Tool:**
   - After downloading, open the Bolin Discovery Tool.
   - The tool will automatically detect any Bolin cameras connected to the network.
3. **Select the Camera:**
   - In the tool, locate and **highlight** the camera.
   - **Right-click** on the camera and select **"Forgot Password"** from the context menu.

- 

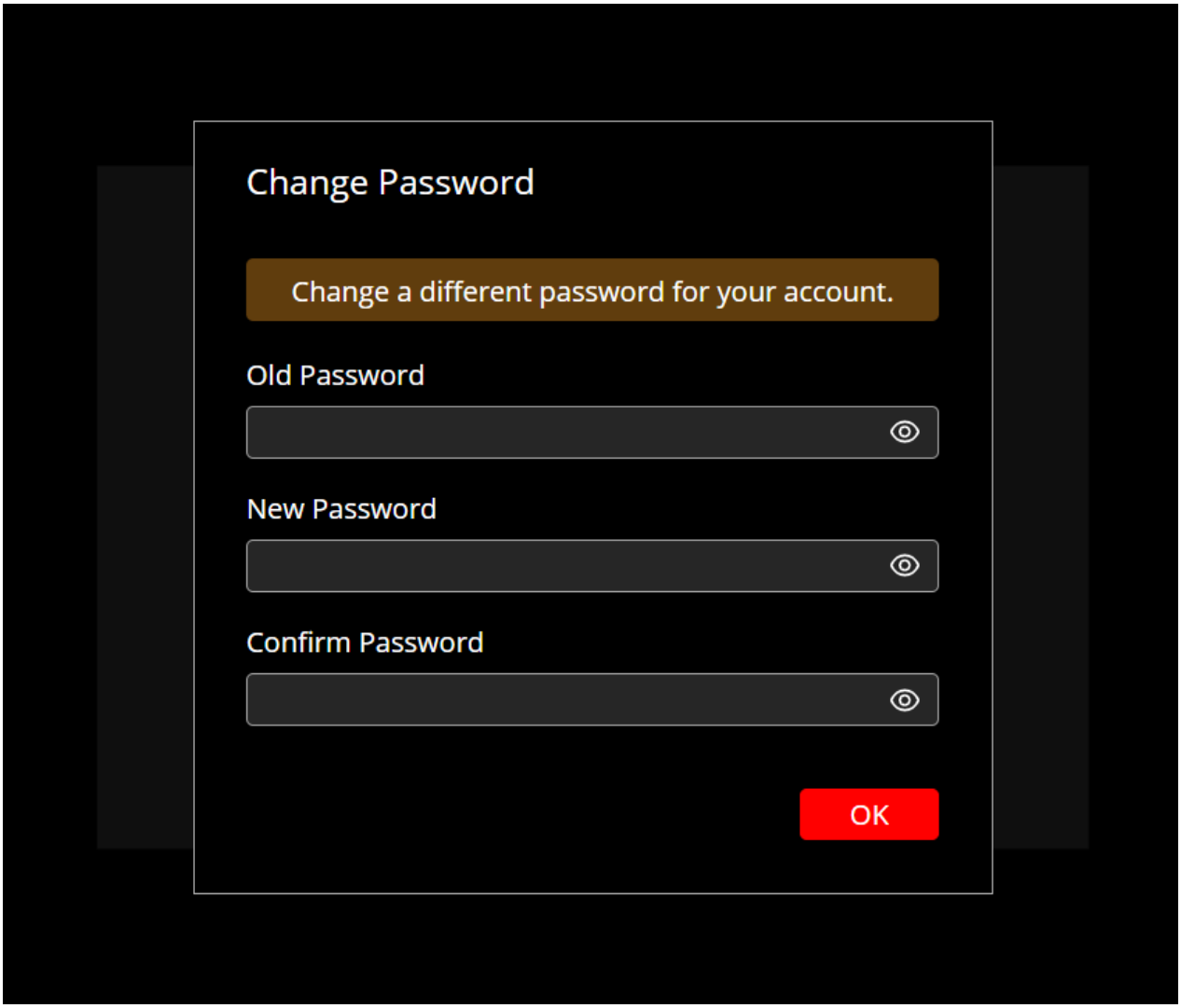
4. **Generate Reset Code:**
   - A new window will appear with device information.
   - Click on **"Generate Reset Code"**.
   - This will generate a unique code.



5. **Contact Support:**
   - Copy the generated code and email it to the technical support team at **support@bolintechnology.com**. For customers in Europe, please send it to **support-europe@bolintechnology.com**.
   - The support team will reply with a **temp password** for the camera.
6. **Login and Set a New Password:**
   - Access the camera's web login page.
   - Enter the **temp password** provided by the support team.

- A prompt will appear confirming the password reset.
- 

- The password has now been reset to the factory default: **admin**



- Entering old password " admin "
- Enter a new password. The password must be 8-16 characters in length and should contain numbers, letters and special characters. Please note this password and save it in a secure place.

Troubleshooting

Camera Not Found on Network

If the camera cannot be discovered on the network or accessed via its IP address, check the following:

- Network Connection - Ensure the camera is properly connected using a CAT6 cable to a working network switch or router, or that Wi-Fi is correctly configured (see Section 6.6).
- Power Status - Confirm the camera is powered via PoE++ or DC supply and has fully booted.
- IP Subnet Mismatch – Ensure the camera and the controlling PC are on the same subnet range.
- IP Address Conflict - Check for duplicate IP addresses on the network which may prevent access to the camera.
- Discovery Tool - Use the Bolin Discovery Tool to locate the device on the network. This can be downloaded

from www.bolintechnology.com

No Video Output

If no video is present on HDMI, SDI, USB-C, or IP streams, verify the following:

- Output Connection - Ensure all cables (HDMI / SDI / USB-C / network) are securely connected and rated for the required signal format.
- Resolution Mismatch - Confirm the connected display, switcher, or computer supports the camera's output resolution and frame rate.
- Stream Configuration - Verify codec and stream settings are correctly configured for the receiving device.
- Boot Status - Allow the camera sufficient time to initialise after power-up before checking output.

NOTE: Some outputs may display a brief startup splash or configuration overlay before the active video signal appears.

PTZ Control Not Working

If pan, tilt, roll, or zoom controls are unresponsive:

- Device ID Conflict - Verify VISCA, Pelco, or IR IDs are unique and correctly configured.
- Network Connectivity - For IP control, confirm the camera is reachable on the network.
- Control Enable Settings - Check that IR Receive or external control interfaces are enabled as required.
- Baud Rate Mismatch - For RS-422 control via the AUX port, ensure the camera baud rate matches the controller.
- Preset Mode Conflict - Confirm the camera is not set to a preset or automation mode that restricts manual movement.
- AUX Port Mode Conflict - Confirm the AUX port is configured for RS-422 control rather than 12V DC power output, since the two functions cannot be used simultaneously.

Image Quality Issues

If the image appears poor, unstable, or incorrectly exposed, check the following:

- Exposure Settings - Verify shutter, gain, and iris settings are appropriate for the lighting environment.
- White Balance - Ensure correct mode is selected (Auto, Indoor, Outdoor, or Manual).
- Noise Reduction - Excessive 2DNR/3DNR may soften image detail; adjust if necessary.
- WDR / Backlight Settings - Disable or adjust if image appears washed out or unnatural.
- Lens Conditions - Check for dirt, smudges, water spots, or obstruction on the lens or protective glass; trigger the wiper if operating outdoors (see Section 2.7).
- Lighting Environment - Ensure sufficient and stable lighting; avoid mixed colour temperature sources where possible.
- Compression Settings - Over-compression (low bitrate or high quantisation) may introduce artefacts in network streams.

Maintenance

This section outlines recommended maintenance procedures to ensure long-term reliability, stable performance, and optimal image quality. Regular maintenance helps prevent environmental damage, reduces system faults, and extends the operational life of the camera.

Cleaning the Camera

Proper cleaning of the camera housing and optical components is essential to maintain image clarity and prevent long-term surface damage.

External Housing

- Use a soft, dry cloth to remove dust and light debris from the camera body
- For heavier contamination, lightly dampen the cloth with a mild, non-abrasive cleaning solution
- Do not use harsh chemicals or solvents that may damage coatings or plastics

Lens / Front Glass

- Use an oil-free lens brush or air blower to remove loose dust particles
- If smudges or grease are present, gently clean using a microfiber cloth
- Wipe from the center outward in a circular motion to avoid streaking
- If required, use a small amount of lens-safe cleaning fluid applied to the cloth (not directly to the lens)

Wiper

- Periodically check the wiper blade for wear, splitting, or debris buildup, and clean or replace as needed to maintain effective clearing
- Trigger a manual wiper sweep (see Section 2.7) after cleaning to confirm smooth operation across the full sweep path

CAUTION: Do not use organic solvents such as benzene or ethanol on optical surfaces.

General Precautions

- Do not touch the lens or sensor window with bare fingers
- Avoid excessive pressure when cleaning optical surfaces
- Always ensure the camera is powered off before performing cleaning procedures where possible