# AmScope™

## HHD2100HD-P Handheld Digital Microscope

**Introduction**

This manual applies to the HHD2100HD-P digital microscope. The information in this manual is provided to help you familiarize yourself with the assembly and use of the product. Please read thoroughly before using the products, and keep this manual with the product for reference.

## Safety

Before using your AmScope microscope, please read the following safety precautions carefully to avoid causing damage to your AmScope product, or injury to yourself or others.

**Turn off power if the instrument exhibits unusual or dangerous behavior** such as emitting smoke or unusual odors. These can be indications of electrical problems, in which case the instrument should be disconnected from any power source if safe to do so. Other indicators can be a loud buzzing sound or crackling. Contact AmScope to report such behavior.

**Do not use around flammable liquids or gases.** Electric instruments can ignite flammable substances which could result in an explosion or fire.

**Do not use in a wet environment.** Electrical components of the instrument can discharge when exposed to water, potentially resulting in damage to the instrument, or injury to yourself or others.

**Only use the provided power adapter or authorized replacement.** Incompatible power adapters can cause damage to the instrument. If you should lose the included power adapter, please contact AmScope for information about a replacement.

**Do not dismantle.** Dismantling can result in damage to the instrument, and potential exposure to dangerous materials or electric current.

## Notices

AmScope reserves the right to change specifications of the hardware and software at any time without notice. Continuous efforts are made to improve performance and reliability, which can result in changes to design and compatibility. Please contact AmScope for any concerns regarding such changes.

### Proposition 65 Notice for California Residents

Cables included with the products described in this manual can expose you to chemicals including lead, which is known by the state of California to cause cancer, birth defects or other reproductive harm. Visit www.P65Warnings.ca.gov for more information.

## Trademark Information

Windows is a trademark of Microsoft Corporation. Mac OS (macOS) is a trademark of Apple Inc., and iOS is a trademark owned by Cisco and leased by Apple Inc.. Linux is a trademark of Linus Torvalds. Android is a trademark of Google LLC. AmScope is a trademark of United Scope LLC.

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5V2A

TF

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7. USB Mouse Port

8. 12VDC Power Port

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| Model Specifications | |
|---|---|
| Model | HHD2100P-HD |
| Zoom Magnification | 0.1X-3.3X |
| Sensor | IMX307 (color) |
| Sensor Type | CMOS |
| Sensor Optical Format | 1/2.8" |
| Integrated Reduction | 0.5X |
| Active Pixels | 2M (1920 x 1080) |
| Pixel Size | 2.9µm x 2.9µm |
| Active Sensor Area | 5.57mm x 3.13mm |
| Shutter | electronic rolling shutter |
| Sensitivity | 1300mV @ 1/30s, f/5.6 |
| Exposure Time | 0.01ms - 1000ms |
| Spectral Response | 380-650nm with IR-cut filter |
| Capture Resolution and Maximum Framerate | 60fps @ 1920x1080 (HDMI)<br>50-60fps @ 1920x1080 (SD) |
| Connectivity | HDMI video out (v1.4 standard)<br>USB input (mouse) |
| Media Reader/Writer | Secure Digital (SDIO 3.0 standard) |
| Video Format | H264, H265 encoded MP4 |
| Power | 12VDC, 1A |
| Operating Conditions | -10°C to 50°C, 30%-80% relative humidity |
| Storage Conditions | -20°C to 60°C, 10%-60% relative humidity |

| Interface Specifications | |
|---|---|
| **Port Layout** | |
| HDMI Port | Complies with HDMI1.4 standard, 1080P format video output for standard FHD monitor |
| USB Mouse | Connect the included USB Wireless mouse for easy operation with embedded XCamView software |
| Power Output | 12V/1A |
| LED | LED status indicator |
| SD | Complies with SDIO3.0 standard. SD card is used to save, store, and transfer images and video |
| **Camera Hardware** | |
| Sensor | Sony IMX307(C), 1/2.8"(5.57x3.13), Pixel size 2.9x2.9um |
| G Sensitivity /Dark Signal/Dynamic Range /SNR | 1300mv with 1/30s/NA/NA/NA |
| FPS/Resolution | 60@1920*1080(HDMI) |
| Exposure Time | 0.01~1000ms |
| Software | |
| Video Saving | Video format: 2MP(1920*1080) H264 encoded MP4 file<br><br>Frame Rate: 50~60fps (related with SD card performance); |
| Image Capture | 2MP (1920*1080) JPEG image in SD card |
| Measurement Saving | Measurement information saved in different layer with image content;<br><br>Measurement information is saved together with image content in burn in mode. |
| ISP Function | Exposure(Automatic / Manual Exposure) / Gain, White Balance(Manual / Automatic / ROI Mode), Sharpening, 3D Denoise, Saturation Adjustment, Contrast Adjustment, Brightness Adjustment, Gamma Adjustment, Color to Gray, 50HZ/60HZ Anti-flicker Function |
| Image accessibility | Zoom In/Zoom Out, Mirror/Flip, Freeze, Cross Line, Overlay, Embedded Files Browser, Video Playback, Measurement Function |
| Multiple Language Support | English / Simplified Chinese / Traditional Chinese / Korean / Thai / French / German / Japanese / Italian |
| **Polarization and Lighting** | |
| Brightness Control | Adjust the light intensity through software GUI |
| Polarization adjustment | Manually adjust the polarization direction 0-90 degrees |

# HHD2100HD-P Magnifications, Working Distances, and Fields of View

## System Magnification

Digital microscopes often present smaller fields-of-view when compared to optical microscopes with equivalent magnifications. This is due to the digital microscope's image sensor. The dimensions of the sensor determine the field-of-view much like the aperture of an eyepiece (usually printed on the eyepiece as its field number). Each model will list its sensor's dimensions which can be used to calculate the field-of-view.

| Magnification | Working Distance | Field of View (X) mm | Field of View (Y) mm |
|---|---|---|---|
| 10 | 134.63 | 48.09 | 27.07 |
| 20 | 73.65 | 24.05 | 13.54 |
| 30 | 50.85 | 16.03 | 9.02 |
| 40 | 40.39 | 12.02 | 6.77 |
| 50 | 33.51 | 9.62 | 5.41 |
| 60 | 29.30 | 8.02 | 4.51 |
| 70 | 26.02 | 6.87 | 3.87 |
| 80 | 23.76 | 6.01 | 3.38 |
| 90 | 21.84 | 5.34 | 3.01 |
| 100 | 20.32 | 4.81 | 2.71 |
| 110 | 19.18 | 4.37 | 2.46 |
| 120 | 18.14 | 4.01 | 2.26 |
| 130 | 17.33 | 3.70 | 2.08 |
| 140 | 16.58 | 3.44 | 1.93 |
| 150 | 15.97 | 3.21 | 1.80 |
| 160 | 15.40 | 3.01 | 1.69 |
| 170 | 14.90 | 2.83 | 1.59 |
| 180 | 14.49 | 2.67 | 1.50 |
| 190 | 14.09 | 2.53 | 1.42 |
| 200 | 13.75 | 2.40 | 1.35 |
| 210 | 13.43 | 2.29 | 1.29 |
| 220 | 13.15 | 2.19 | 1.23 |
| 230 | 12.88 | 2.09 | 1.18 |
| 240 | 12.65 | 2.00 | 1.13 |
| 250 | 12.42 | 1.92 | 1.08 |
| 260 | 12.21 | 1.85 | 1.04 |
| 270 | 12.03 | 1.78 | 1.00 |
| 280 | 11.85 | 1.72 | 0.97 |
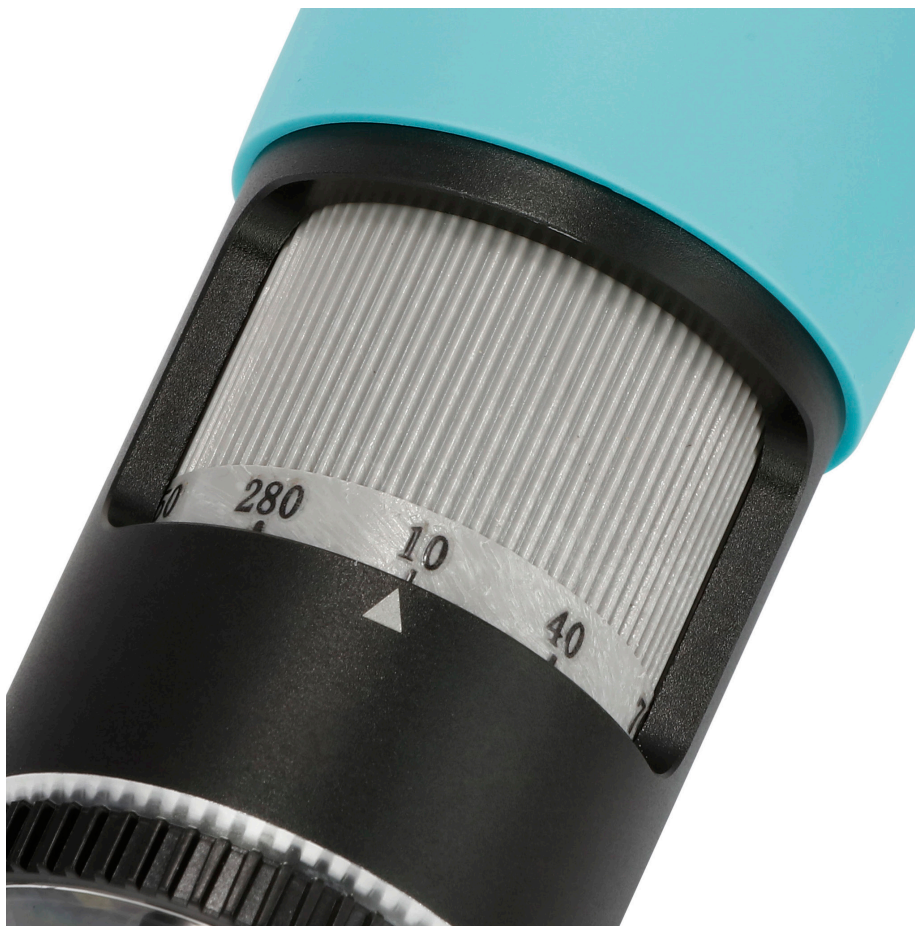
Zoom Wheel

## Zoom Wheel

The zoom wheel controls the magnification of the microscope by adjusting the internal zoom mechanism. The wheel can be rotated in a continuous movement until either terminus has been reached. By rotating the wheel to the right, the magnification will decrease until it reaches 0.1X. Rotating the wheel to the left will increase the magnification until it reaches 3.3X.

## 8 LED Illuminator

The ring-light's intensity can only be controlled via the built-in software.

## Using Support Systems

The HHD2100HD-P is designed for use with a variety of support systems, including those typically used with stereo microscopes such as table stands, boom-arm stands, and articulating stands. Due to the HHD2100HD-P's high magnifications, it is recommended to always use a support to avoid shaking which will result in poor-quality images.
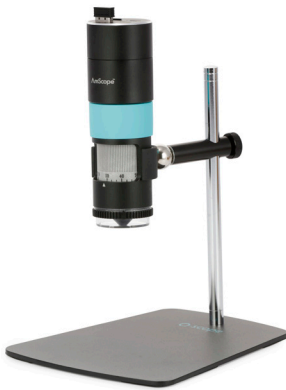
## Quick Start Guide

The HHD2100HD-P portable HDMI interface digital microscopic all-in-one machine consists of 5G high-definition optical lenses, a 1080P HDMI camera, and an 8 LED polarization ring lightsource module. This model is designed for stand-alone use – so no need for a computer. Connect it directly to an HDMI monitor or television for live viewing and recording. You'll be impressed by the responsiveness of the real-time video, and the smooth 60fps output. As a stand-alone system, the microscope uses internal software to provide on-screen controls for capturing photos and videos, with a built-in Secure Digital reader/writer to store the files. Use the included mouse to navigate the microscope's settings and its large assortment of editing and measuring tools.

### AmScope Imaging Software

AmScope imaging software for Windows, Mac OS, and Linux is used to capture and edit images generated by the microscope. While the microscope may work with 3rd-party UVC-compatible software, it is recommended to use the provided software to ensure full functionality. For the most up-to-date version, please visit the AmScope website at www.amscope.com, and navigate to the software download page.

### Setup

1. Connect the camera to a HDMI monitor using the HDMI cable;



2. Insert the supplied Wireless USB mouse Receiver to the camera's USB port;



3. Insert the supplied MicroSD card into the HDMI camera MicroSD card slot;



4. Connect the camera to the power adapter(USB5V/2A) and switch it on;
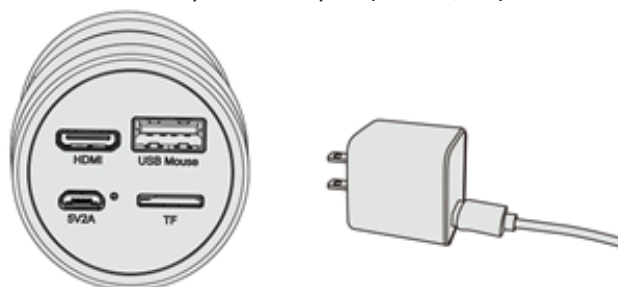
# HDMI

## User Interface

The HDMI model uses an on-screen UI to operate. The camera controls are located in the panel on the left side of the window, the measurement toolbar on the top, and additional display controls and settings are on the bottom.

📌 By default, the panels will only display when the mouse cursor is hovering over the appropriate area. Left-clicking on the "pin" icon will maintain the panel's visibility, but will prevent other panels from opening.
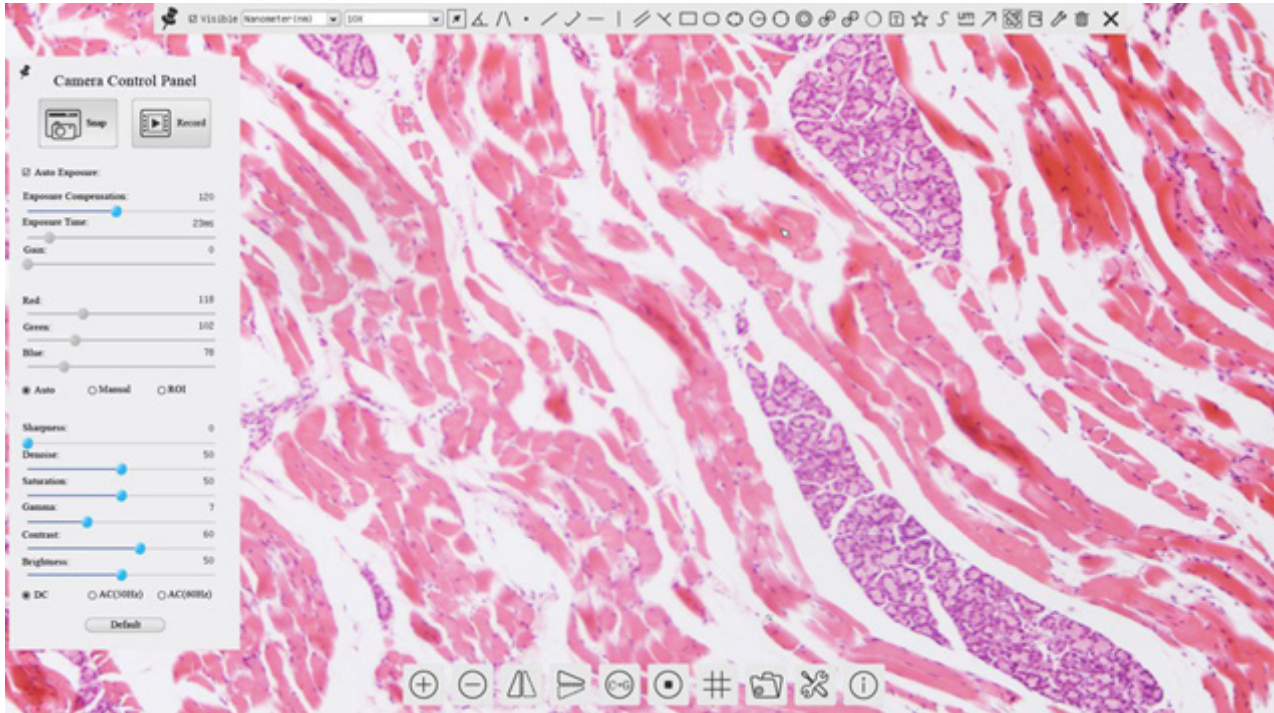


The HDMI model's user interface

## The Camera Control Panel

The Camera Control Panel controls the camera to achieve the best video or image quality according to the specific applications. To open the panel, move the mouse cursor toward the left edge of the video window.

| Control Panel | Function | Description |
|---|---|---|
|  | Snap | Capture image and save it to the microSD card. |
| | Record | Record video and save it to the microSD card. |
| | Auto Exposure | When Auto Exposure is checked, the system will automatically adjust exposure time and gain according to the value of exposure compensation. |
| | Exposure Compensation | Available when Auto Exposure is checked. Slide to increase or decrease the overall brightness to compensate for varying subjects. |
| | Exposure Time | Available when Auto Exposure is not checked. Slide to increase or decrease exposure time for achieving appropriate brightness. |
| | Gain | Available when Auto Exposure is not checked. Slide to increase or decrease signal amplification. Increasing the amplification will increase brightness without adjusting exposure time, but will result in increased noise levels. |
| | Red | Manually adjust the proportional Red level of the RGB video. |
| | Green | Manually adjust the proportional Green level of the RGB video. |
| | Blue | Manually adjust the proportional Blue level of the RGB video. |
| | Auto (White Balance) | Continuously adjusts RGB levels automatically based on the overall video content. |
| | Manual (White Balance) | Enables the manual RGB controls to adjust the color balance. |
| | ROI (White Balance) | Use the on-screen Region-of-Interest selector (rectangle will appear) to define a region which should be used as reference when performing white balance. |
| | Sharpness | Slide to adjust the sharpness level of the video. |
| | Denoise | Slide to adjust the amount of noise-reduction to apply to the video. |
| | Saturation | Slide to adjust the color saturation of the video. |
| | Gamma | Slide to increase or decrease the Gamma level of the video. |
| | Contrast | Slide to adjust the contrast of the video. |
| | DC | Select when using DC powered illumination. No flicker compensation. |
| | AC (50Hz) | Select when using AC powered illumination with 50Hz to remove flickering. |
| | AC (60Hz) | Select when using AC powered illumination with 60Hz to remove flickering. |
| | Default | Restore all values in the Camera Control Panel to their default settings. |

## Image Exposure

### Manual Exposure

Image exposure controls the amount of light captured by the imaging device. Exposure time is used to set the amount of time over which light is collected. More time will result in a brighter image. For most static subjects, increasing exposure time to achieve the appropriate brightness is the preferred method. For moving subjects, too much time will result in blurring as the subject's location changes over time. Exposure time must be limited in these cases to prevent excess movement. Use of the gain setting would therefore be the preferred method to achieve optimal brightness. Gain controls the amount of amplification applied to the signal generated by the imaging sensor. While the signal strength would be increased, noise generated during the imaging process would also be increased.

### Auto Exposure

Auto exposure relies on software to set the exposure time and gain. This simplifies the workflow, especially when capturing images in changing lighting conditions. As a microscope's magnification changes, or the distance from the microscope to the subject changes, the amount of light collected will also change. Auto exposure can continuously compensate for these changes. This method assumes that the optimal amount of light would create an image with levels which would average to a middle tone. Because of this, images of light subjects may appear too dark, and images of dark subjects may appear too bright. For this reason, adjustment can be done using the exposure compensation control, sometimes called exposure target. This allows you to increase or decrease the target level of brightness.

## Color
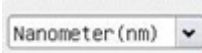
### White Balance

The color of an object is influenced by the color of light reflecting off of it or passing through it. Different light sources produce light with different color-biases. Common examples are incandescent lamps which typically produce warm colors compared to fluorescent or LED lamps which produce cooler colors. This sort of bias is referred to as color temperature. Due to this phenomenon, a white object may appear slightly yellow in morning sunlight, and slightly blue in afternoon shade. To compensate for these variations, digital imaging devices can process images using what is called "white balance." The white balance process shifts colors based on the color of the light source, with the goal of producing a more neutral white or grey.

## The Measurement Toolbar

The Measurement Toolbar will pop up when moving the mouse cursor toward the upper edge of the video window. This panel contains tools and settings for performing measurements.

| Icon | Function |
|------|----------|
| | Pin the Measurement Toolbar |
| ☑ Visible | Show / Hide Measurement Objects |
| Nanometer(nm) | Select Measurement Unit |
| 4X | Select Magnification (requires calibration process) |
| | Object Selector |
| | Angle |
| | 4-Point Angle |
| | Point |
| | Arbitrary-Angle Line |
| | 3-Point Lines |
| | Horizontal Line |
| | Vertical Line |
| | Parallel |
| | 3 Points Vertical Line |
| | Rectangle |
| | Ellipse |
| | 5-Point Ellipse |
| | Circle |
| | 3-Point Circle |
| | Annulus (Concentric Circles) |

| Icon | Function |
|---|---|
| | Two Circles with Distance from Centers |
| | Two 3-Point Circles with Distance from Centers |
| | Arc |
| | Text |
| | Polygon |
| | Curve |
| | Scale Bar |
| | Arrow |
| | Perform magnification calibration. Defines relationship between the measurement unit and pixel size. Requires the use of a micrometer slide. |
| | Export measurement information to CSV file |
| | |
| | Delete measurement object |
| | Exit measurement mode |
| | Left-clicking on a measurement object will open the Object Location & Properties Control Bar. The icons on the control bar:<br>• Move Up<br>• Move Down<br>• Move Left<br>• Move Right<br>• Adjust Color<br>• Delete |

When the Pin icon is clicked to lock the Measurement Toolbar, the Camera Control Panel will not be displayed until the Measurement Toolbar is unpinned by clicking the Exit icon .

## The Camera Control Toolbar

The Camera Control Toolbar provides a subset of tools for controlling the camera's video, as well as general settings and the file viewer.
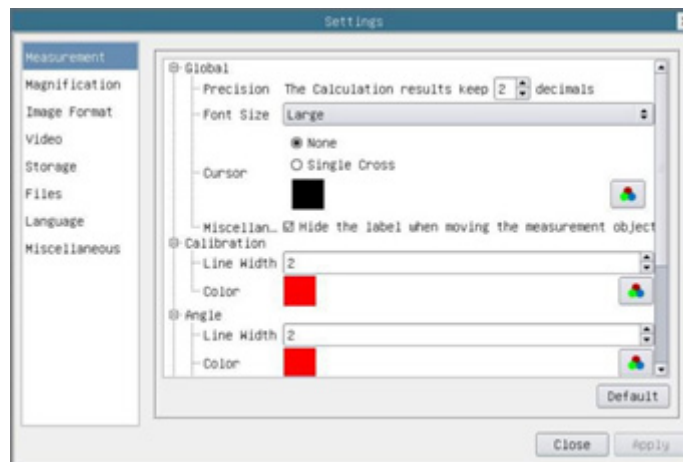
| Icon | Function | Icon | Function |
|---|---|---|---|
| ⊕ | Zoom In | ⊖ | Zoom Out |
| △ | Horizontal Flip | ▷ | Vertical Flip |
| C→G | Color/Grayscale | ⊙ | Freeze Video |
| # | Display Crosshair/Grid | | Browse Images and Videos on SD Media |
| ✕ | Settings | ⓘ | Software Version Information |

## Settings

### Measurement

Measurement settings allow you to customize shapes, and define the precision of measurements.



| Global | Precision | Sets the decimal scale: number of digits after a decimal point |
|---|---|---|
| Calibration | Line Width | Sets the width of lines used for calibration |
| | Color | Sets the color of lines used for calibration |
| | Endpoint | Sets the shape used at each endpoint of a line. Includes null or rectangle |
| Point, Angle, Line, Horizontal Line, Vertical Line, Rectangle, Circle, Ellipse, Annulus, Two Circles, Polygon, Curve | | |
| | | Each shape can be customized using attributes such as Line Width and Color |

## Magnification

Magnification settings allow you to edit stored magnification calibrations. Each time the calibration process is completed, you can save the results as a magnification preset. These presets can be selected from the Measurement Toolbar to use the appropriate, calibrated settings.
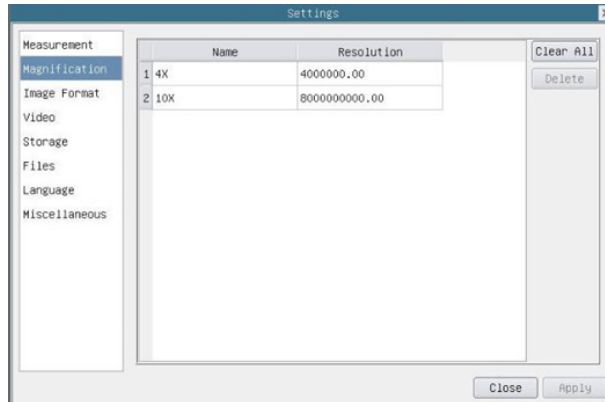


| Name | This is the user-defined name of magnification setting. Names typically incorporate the magnification of the objective lens used, and additional information pertaining to the microscope or camera used. |
|---|---|
| Resolution | The number of pixels per meter. |
| Clear All | Clears all saved calibration data |
| Delete | Clears the selected calibration data |

## Image Format

Image Format settings allow you to determine whether measurement objects will be merged into saved images, or embedded as a separate layer.
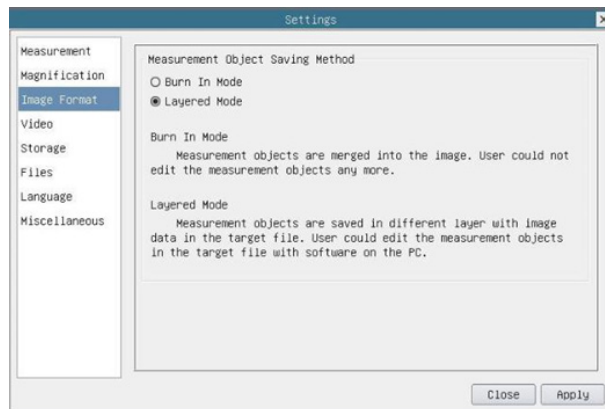


| Measurement Object Saving Method | Burn In Mode | Measurement objects are merged with the image before saving the file. Objects can neither be edited nor removed. |
|---|---|---|
| | Layered Mode | Measurement objects are saved in a separate layer, and can be edited. |

## Video

Video settings allow you to change the fast-forward and reverse intervals, and to choose the video codec.
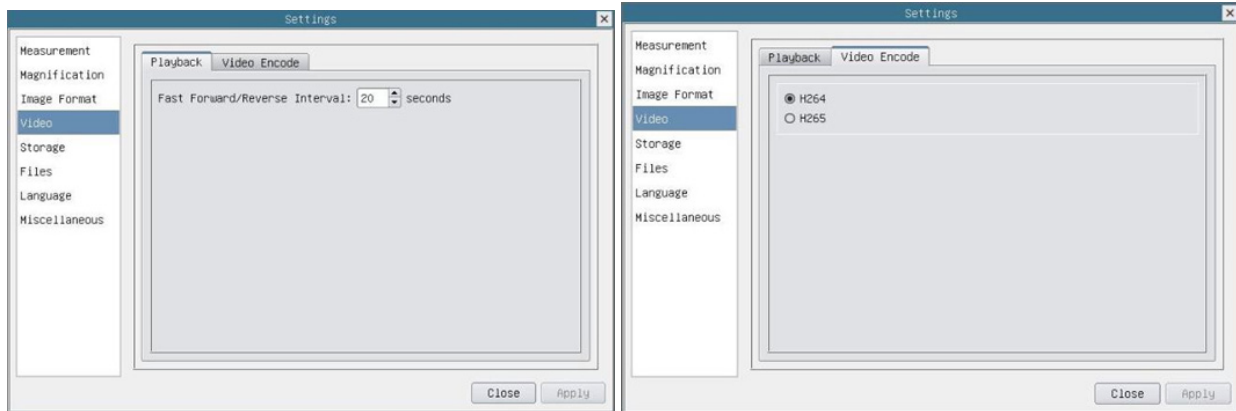


| Playback | Fast Forward/Reverse Interval | The number of seconds to be skipped when fast-forwarding or reversing playback of videos |
|---|---|---|
| Video Encode | H264 | Older AVC video codec with better compatibility across multimedia devices, but less efficient compression compared to H265. |
| | H265 | Newer HEVC video codec with improved compression while retaining high quality |

## Storage

Storage displays the format of the current SD card's file system, such as FAT32, exFAT, and NTFS. Unformatted cards must be formatted on a computer or other device.
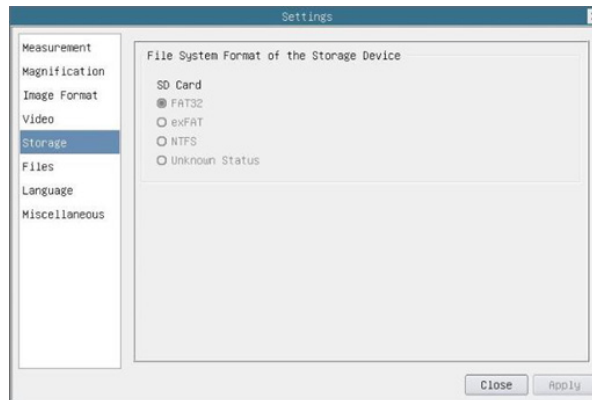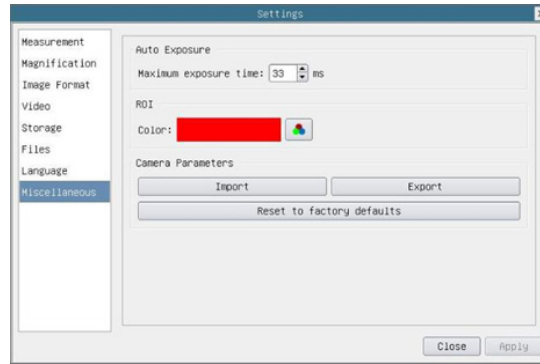


## Language

Language setting selects which language will be displayed.
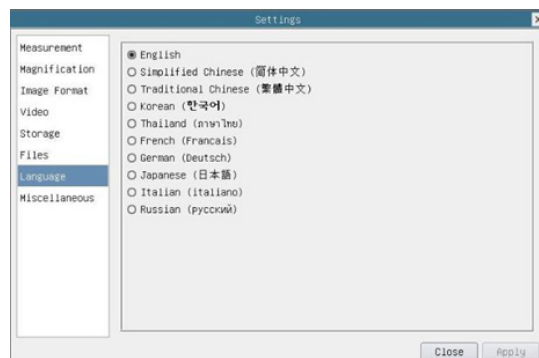
## Miscellaneous

Miscellaneous settings include additional helpful settings.



| Auto Exposure | Set the maximum exposure time for the Auto Exposure mode. Setting a lower number can improve the frame rate. |
|---|---|
| ROI Color | Select the color of the Region of Interest (ROI) frame |
| Camera Parameters Import | Import previously-saved parameters from the SD card |
| Camera Parameters Export | Export current parameters to the SD card |
| Reset to Factory defaults | Restore all parameters to the factory-default values |