# AFDM Series Electric Controlled Continuous Zoom and Autofocus Digital Microscope

Contents

# 1　The Basic Characteristic of AF Series

**AFDM** is a series of electric controlled continuous zoom and autofocus all-in-one digital microscope with a large field of view by ToupTek Photonics. It is integrated with **HDMI** camera, **Electric Controlled Continuous Zoom Auto-focus Objective** and **LED Integrated Illumination Light**. **AFDM** is the abbreviation of **Auto-focus Digital Microscope**. Different products in the **AFDM** series can be formed with different part to satisfy the application requirement.

**AFDM** can be assembled with various brackets or arms and can offer a continuous zooming ratio from 1X to 20X through digital zoom. **AFDM** also supports autofocus mode and manual focus mode.

**AFDM** comes with a high-performance SONY CMOS sensor. It also has an embedded ARM core, allowing the camera to be connected directly to the HDMI monitor. The camera has **XFCAMView** software built within it, including **Camera Control Panel**, **Auto Focus Control Panel**, **Measurement Toolbar,** and **Synthesis Camera Control Toolbar**. Users can directly control the camera and perform various operations through a USB mouse. The images and videos captured by **AFDM** can be saved on an SD card for on-site analysis and follow-up research.

**AFDM** can be widely used in industrial inspection, medical observation, teaching and scientific research, automation system, and other fields.

The first model of **AFDM** series is **AFDM101**.

Figure 1 AFDM's front and back view

Figure 2 AFDM's side and front(with LED light) view

# 1.1 The Module Specifications of AFDM Series Product

## 1.1.1 AFDM Camera Module Datasheet

| Order Code | Sensor & Size(mm) | Pixel(μm) | G Sensitivity Dark Signal | FPS/Resolution | Binning | Exposure(ms) |
|---|---|---|---|---|---|---|
| **H1080PA** | Sony IMX462LQR-C 1/2.8"(5.57x3.13) | 2.9x2.9 | 921mv with 1/30s 0.15mv with 1/30s | 60/1920*1080 (HDMI) | 1x1 | 0.06~918 |

C: Color; M: Monochrome;

### AFDM Lens Module Datasheet

| Order Code | Working Distance(mm) | Zoom Range | MTF(lp/mm) | Distortion | Distortion | FOV@20X(mm) |
|---|---|---|---|---|---|---|
| **EMZO-20XA** | 156~196 | 0.028X~0.56X | 160 | 0.5% | 200x112.5 | 10x5.6 |

1X and 20x are defined as the normalized magnification, which is only used to represent the relative relationship between the lowest and highest magnification. Here, the normalized equation 1x = 0.028/0.028; 20X=0.56/0.028;

## 1.1.2 AFDM Light Module

| Order Code | LED | Power | Inner Dia.(mm) | Out Dia.(mm) | | |
|---|---|---|---|---|---|---|
| **DRL-5076A-NPC** | 8 CREE xpes | 3V/3A | 50 | 76 | | |

DRL: LED direct ring light with adjustable brightness; NPC: No power cable

## 1.2 AFDM101 Characteristic and Specification

The **AFM101** comes with **H1080PA HDMI** camera, **EMZO-20XA** lens and **DRL-5076A-NPC** light source(**Optional**);

### 1.2.1 The Basic Characteristic of AFDM101

- 5 groups 16 elements EMZO with 0.028~0.56X, 20 zoom ratio, supports auto and manual focus;
- 195mm standard working distance with 156~196mm depth of field;
- At standard working distance, the large field of view 200mm*112.5mm at low magnification, helping users to quickly locate the target object, the small field of view 10mm*5.6mm at higher magnification, helping users to observe microscopically.
- Sony 1/2.8" 1080P CMOS with high signal-to-noise ratio;
- Connect to HDMI monitor with 1080P@60FPS video format;
- SD card storage supports 1080P pictures and video streams(asf format);
- Built-in mouse control software **XFCAMView**, all functions can be realized with USB mouse;
- Embedded mouse Camera Control Panel, Measurement Toolbar, Synthesis Control Toolbar, AF Control Panel;
- Multi-language support;
- Head suction LED ring light, the brightness can be directly controlled by **XFCAMView**;
- With the adapter bracket of 76mm diameter, a electric controlled continuous zoom AFDM can be built.



Figure 3 TPS-30A(bracket)+AFDM101



Figure 4 TPS-30A(bracket)+AFDM101+1080P monitor

## 1.2.2    Specification of AFDM101

| Interface & Button Functions | |
| --- | --- |
| **USB Mouse** | USB mouse for **XFCAMView** control |
| **USB2.0** | USB keyboard or other USB control device |
| **HDMI** | HDMI output |
| **ON/OFF** | Power on/off switch |
| **LED** | Power LED indicator |
| **SD** | SD card slot |
| **DC12V3A** | DC12V3A power input |

| Software Funcitons | |
| --- | --- |
| **UI Operation** | With USB mouse to operate on the embedded **XFCAMView** |
| **Image Capture** | JPEG format with 2M Resolution in SD card |
| **Video Record** | ASF format 1080P 30fps in SD card |
| **Camera Control Panel** | Including **Exposure, Gain**, **White Balance**, **Color Adjustment**, **Sharpness** and **Denoising** control |
| **Measurement Toolbar** | Including **Calibration**, **Measurement**, and measurement parameter **Export** functions |
| **Synthesis Control Toolbar** | Including software **Zoom**, **Flip**, **Freeze**, **Crosshair**, **LED Control**, **Auto-focus**, **Comparison**, **Browser** , **Setting**, **Version Check** function |
| **Auto Focus Control Panel** | Including **Zoom**, **Auto Focus**, **One Push**, **Manual Focus**, **Reset**, and other functions |

| Operating Environment | |
| --- | --- |
| **Operating Temperature(in Centidegree)** | -10~ 50 |
| **Storage Temperature(in Centidegree)** | -20~ 60 |
| **Operating Humidity** | 30~80%RH |
| **Storage Humidity** | 10~60%RH |

| Dimension | |
| --- | --- |
| **Length x Width x Height** | 80mm x 80mm x 80mm |
| **Shipping Weight** | 0.75kg |

## 1.2.3    Dimension of AFDM101

Figure 5 Dimension of AFDM101

## 1.2.4 Packing Information of AFDM101



Figure 6 Packing information of AFDM101

| Standard Packing List | | |
|---|---|---|
| A | Gift box: L:220cm W:220cm H:110cm (1pcs, 2.0kg/box) | |
| B | AFDM101 | |
| C | USB Mouse | |
| D | HDMI Cable | |
| E | Power Adapter: Input: AC 100~240V 50Hz/60Hz, Output: DC 12V 3A | American Standard: Model: HKA03612030-7K：UL/CE/FCC(With American Standard AC Power Cable) European Standard: Model: HKA03612030-7K：UL/CE/FCC(With European Standard AC Power Cable) EMI Standard: FCC Part 15 Subpart B EMS Standard: EN61000-4-2,3,4,5,6 |
| Optional Accessory | | |
| F | LED Ring Light(DRL-5076A-NPC) | |
| G | SD card(16G) | |

## 2   Installation and Operation of AFDM Series Product

Before use, please install the **AFDM** series product on an adaptive bracket.

1.   Plug HDMI cable into the **HDMI** port to connect **AFDM** and HDMI monitor;

2.   Plug a USB mouse into **USB Mouse** port, to get control of the **AFDM** by using built-in software

**XFCAMView**;

3. Plug DC12V3A power adapter into **DC12V3A** port, to supply power for the **AFDM**, the **LED Indicator** will turn into red;

4. Insert SD card into **SD card Slot** for saving captured images and recorded videos;

5. Press **ON/OFF** button to start the **AFDM**, **LED Indicator** will turn into blue;

6. Move mouse to the left side of the video window, the **Camera Control Panel** will appear. It includes **Manual/Automatic Exposure**, **White Balance**, **Sharpness**, **Denoise,** and other functions, please refer to section 3.2 for details;

7. Move mouse to the upper side of the video window, the **Measurement Toolbar** will appear. It includes **calibration**, measurement of **lines**, **angles**, **rectangles**, **circles**, etc, and supports data export(*.CSV format), please refer to section 3.3 for detail;

8. Move mouse to the bottom side of the video window, the **Synthesis Camera Control Toolbar** will appear. Operations like **Zoom In**, **Zoom Out**, **Flip**, **Freeze**, **Crossline**, **LED brightness control**, **Autofocus**, **SD card contents browsing**, **Settings,** and **Camera Version** can be executed. See section 3.4 for details;

9. Move mouse to the bottom side of the video window, the **Synthesis Camera Control Toolbar** will pop up automatically. Click **AF** button, and **Auto Focus Control Panel** will show up for autofocus operation, it supports 20X optical zoom, **Autofocus**, **Manual Focus**, **Reset**, and **One Push** operation. See section 3.5 for details.
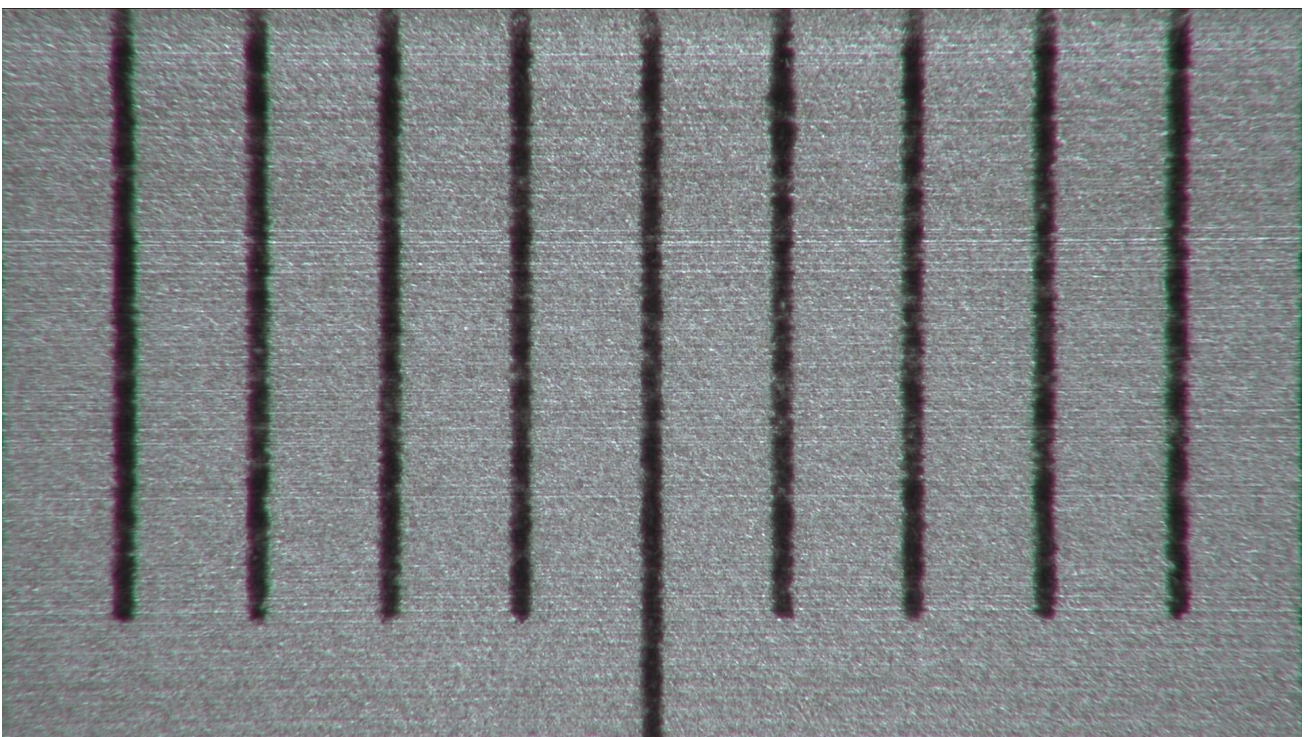
# 3 Images Captured with AFDM101
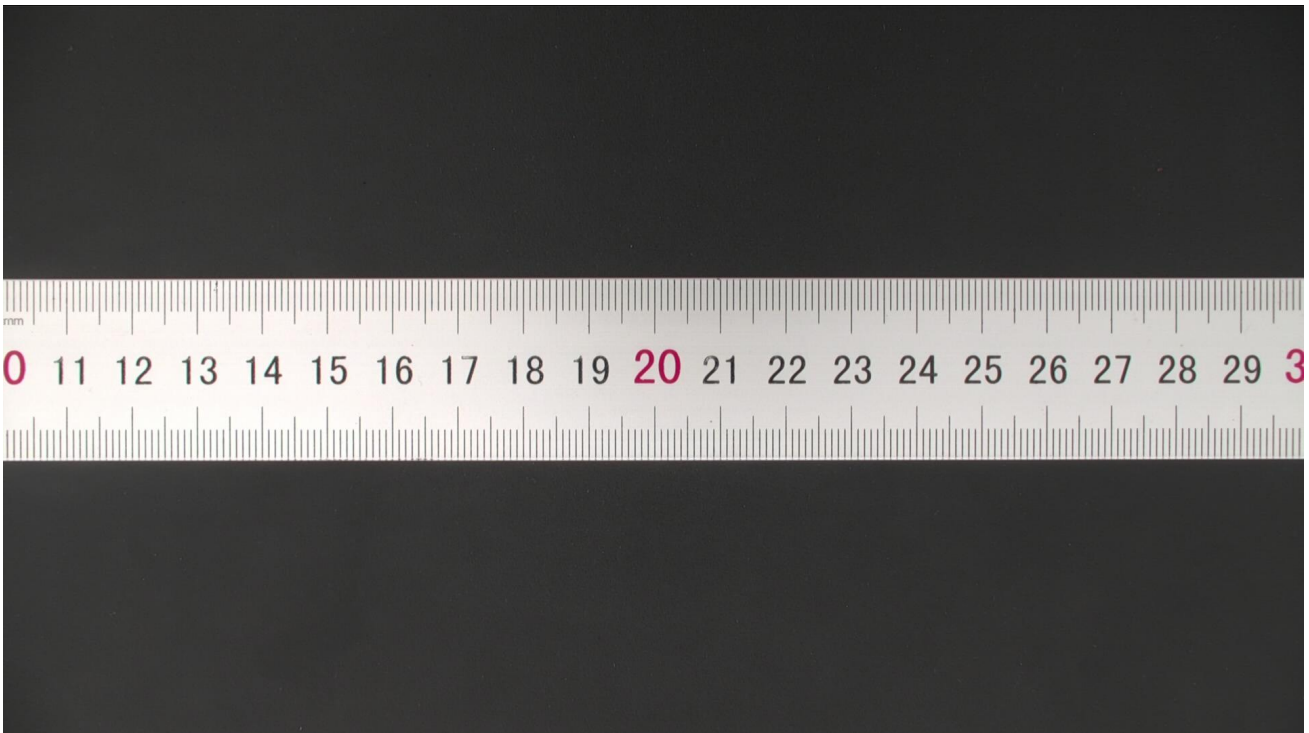


Ruler captured with AFDM101 at 1X
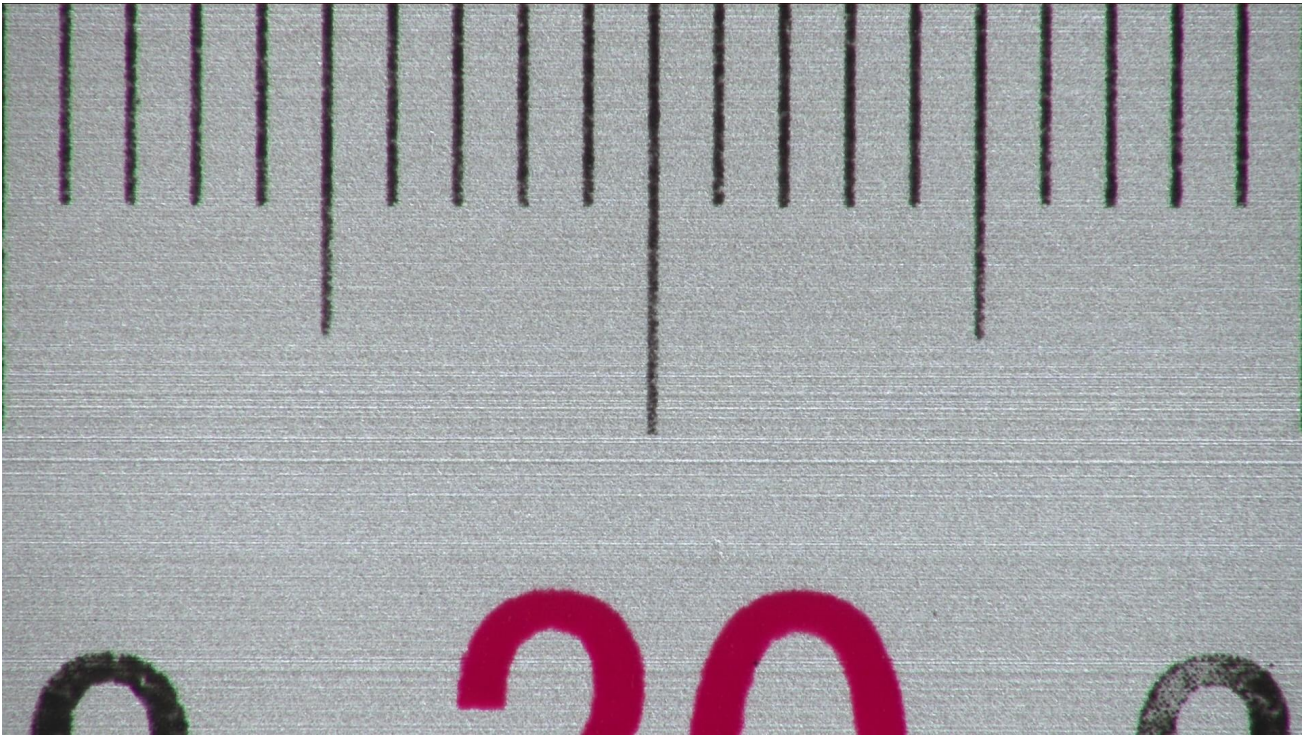
Ruler captured with AFDM101 at 10X



Ruler captured with AFDM101 at 20X

the Basic Characteristic of AFDM101

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195mm standard working distance with 156~196mm depth of field;
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Head suction LED ring light, the brightness can be directly controlled by XFC
Sony 1/2.8" 1080P CMOS with high signal-to-noise ratio;
Connect to HDMI monitor with 1080P@60FPS video format;
SD card storage supports 1080P pictures and video streams(asf format);
Built-in mouse control software XFCAMView, all functions can be realized w
Embedded mouse control panel, Measurement Toolbar, Comprehensive Contro
Multi-language support;
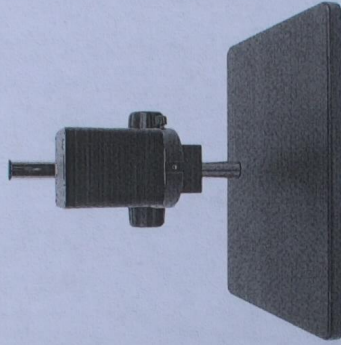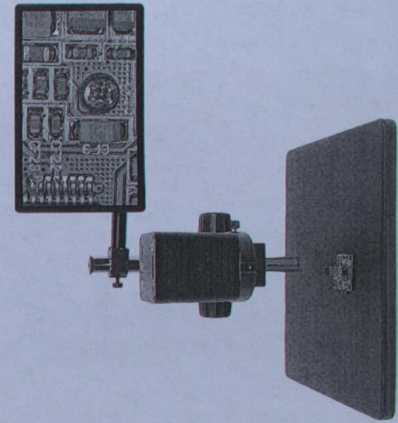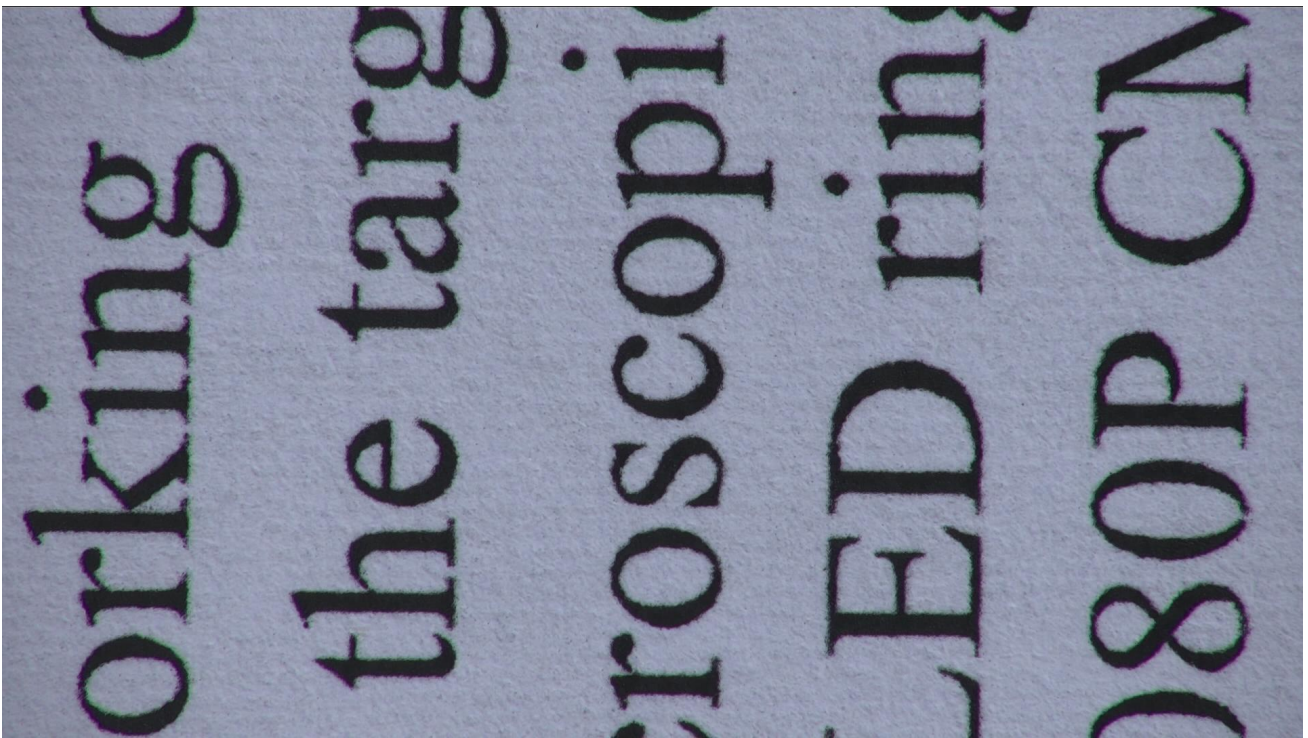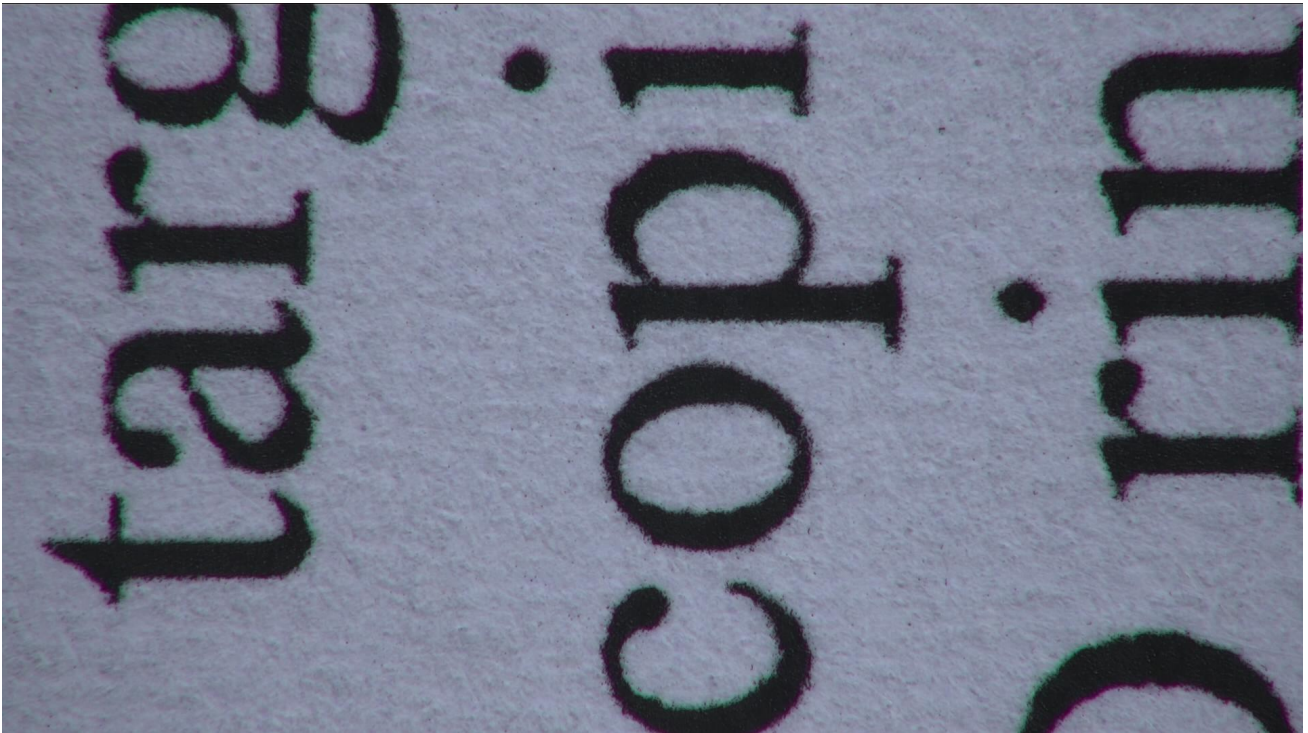With the adapter bracket of 76mm diameter, a electric controlled continuous z

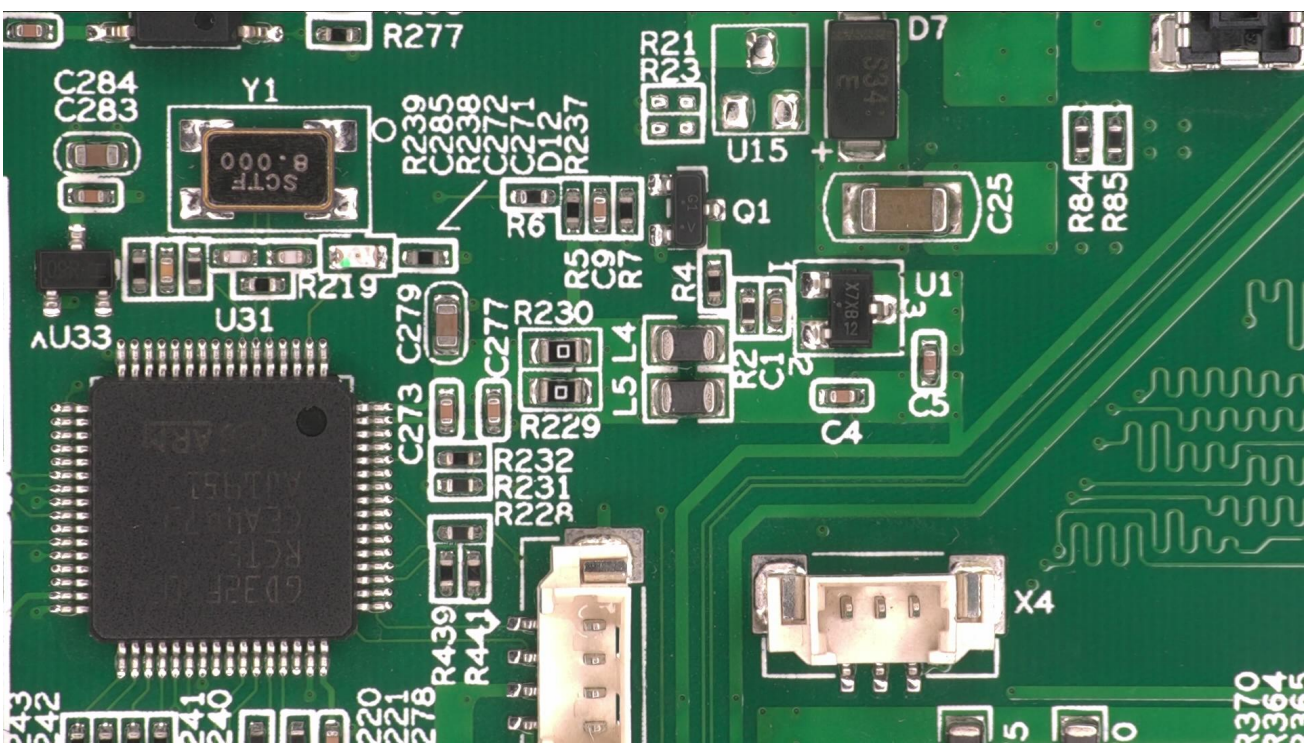Figure 3 TPS-30A(bracket)+AFDM101
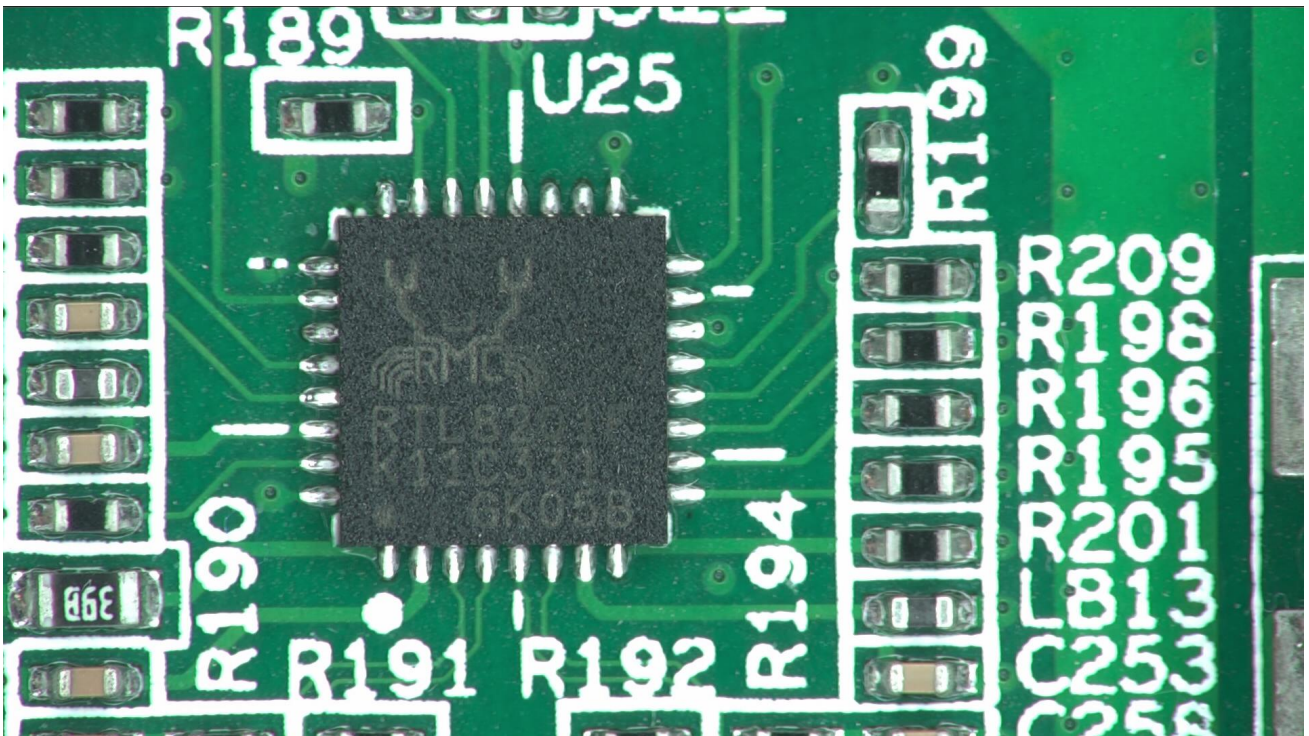
Print captured with AFDM101 at 1.0X
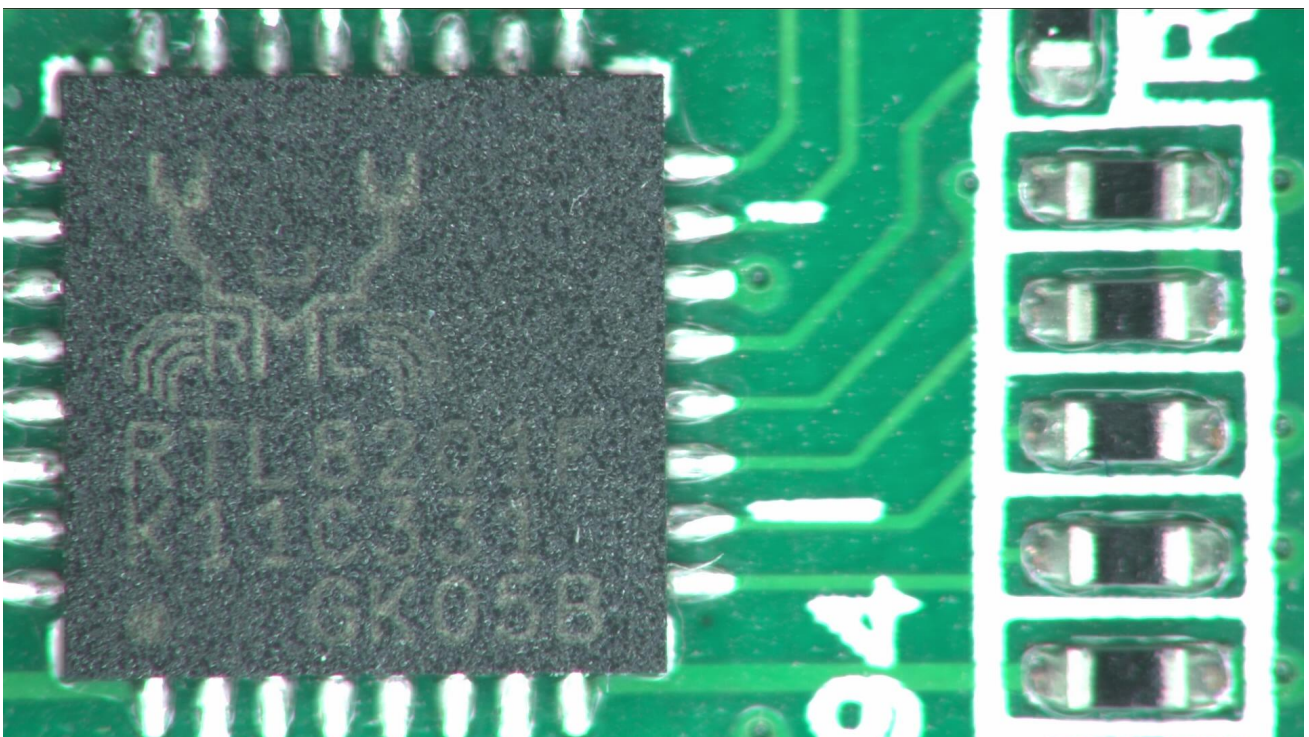
Print captured with AFDM101 at 10X

Print captured with AFDM101 at 20X



PCB captured with AFDM101 at 4.0X

PCB captured with AFDM101 at 10X



PCB captured with AFDM101 at 20X

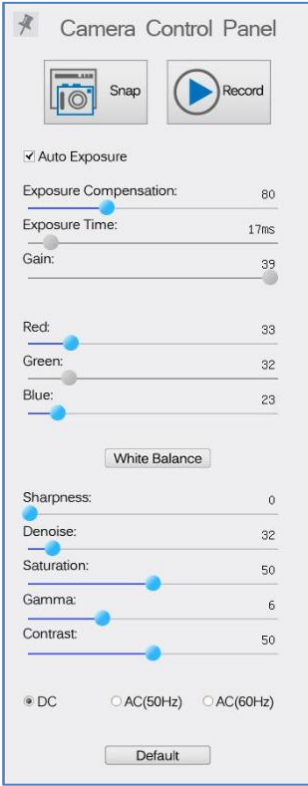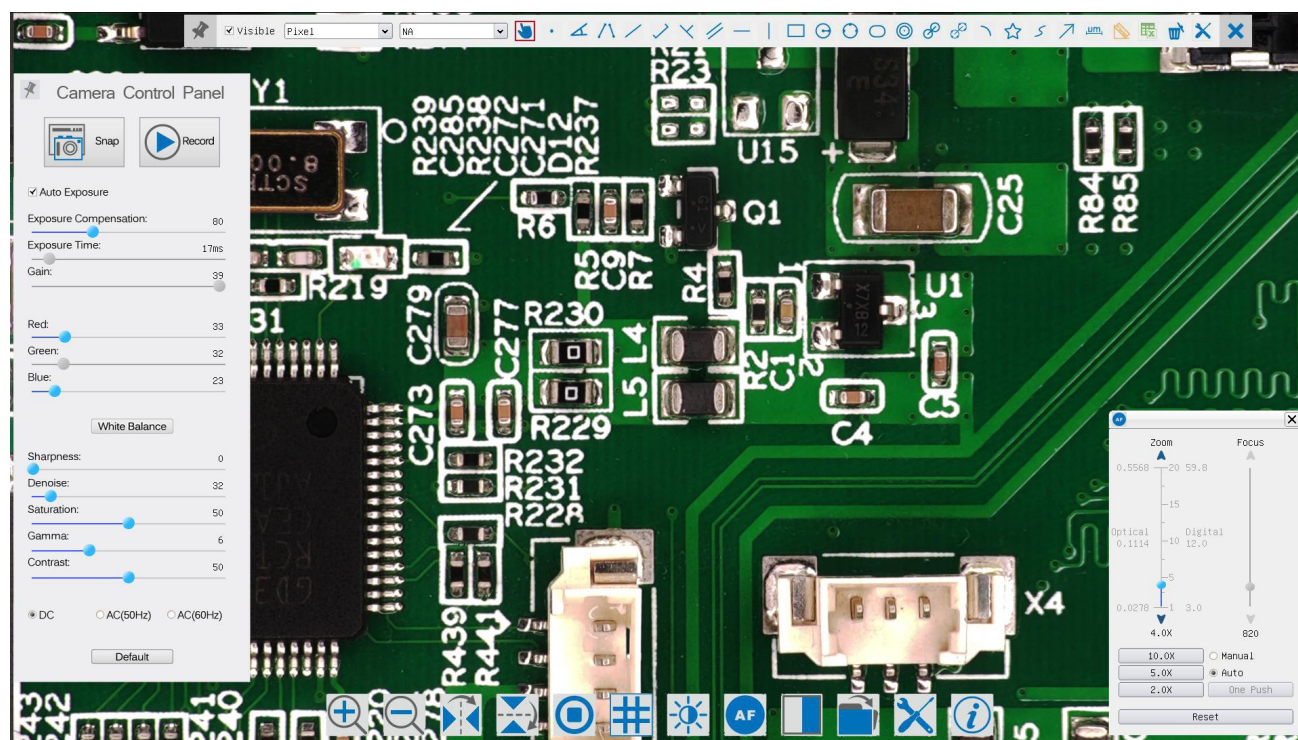# 4 Introduction of XFCAMView UI and Functions

## 4.1 Control UI



Figure 7 XFCAMView and Its Control UI

**AFDM 's XFCAMView** software operation UI shown in Figure 7 includes **Camera Control Panel** on the left side of the video window, **Measurement Toolbar** on the top of the video window, **Synthesis Camera Control Toolbar**, and **Autofocus Control Panel** on the right side of the video window.

| Notes | |
|---|---|
| 1 | Move the mouse to the left side of the video window, the **Camera Control Panel** will pop up automatically; |
| 2 | Move the mouse to the bottom of the video window, the **Synthesis Camera Control Toolbar** will pop up automatically; |
| 3 | Move the mouse to the bottom of the video window, the **Synthesis Camera Control Toolbar** will pop up automatically. Click the [AF] button and the **Auto Focus Control Panel** will appear for autofocus operation; |
| 4 | Move the mouse to the upper side of the video window, the **Measurement Toolbar** will pop up for the calibration and measurement operations. When the user left-clicks the **Float/Fixed** button [pin icon] on the **Measurement Toolbar**, the **Measurement Toolbar** will be fixed. In this case, the **Camera Control Panel** will not pop up automatically even if user moves mouse to the left side of the video windows. Only when the user left-clicks the [X] button on the **Measurement Toolbar** to exit from the measuring procedure will he be able to do other operations on **Camera Control Panel**, **Autofocus Control Panel,** or **Synthesis** |

| | | |
|---|---|---|
| **Camera Control Toolbar**. During the measuring process, when a specific measuring object is selected, an **Object Location & Attributes Control Bar** ◀ ▶ ▲ ▼ ♣ 🗑 will appear for changing location and properties of the selected objects. | | |

## 4.2 The Camera Control Panel on the Left Side of the Video Window

| Camera Control Panel | Function | Function Description |
|---|---|---|
|  | Snap | Capture or **Snap** image from the current video window |
| | Record | Record video from the current video window |
| | Auto Exposure | Checking **Automatic Exposure** box will automatically adjust exposure time according to the **Exposure Compensation** value |
| | Exposure Compensation | Available when **Auto Exposure** is checked. Slide to left or right to adjust **Exposure Compensation** according to current video brightness to achieve proper video brightness |
| | Exposure Time | Available when **Auto Exposure** is unchecked. Slide to left or right to decrease or increase the exposure time to adjust the video brightness |
| | Gain | Adjust **the gain value** to decrease or increase the video brightness. The noise will be reduced or increased accordingly |
| | Red | Slide to left or right to decrease or increase the proportion of **Red** in the video window |
| | Green | **Green** is a base for reference and cannot be adjusted |
| | Blue | Slide to left or right to decrease or increase the proportion of **Blue** for the video |
| | White Balance | Auto **White Balance** adjustment according to the video window |
| | Sharpness | Adjust **Sharpness** level of the video window |
| | Denoise | Adjust **Denoise** level of the video window |
| Saturation | | Adjust **Saturation** level of the video window |
| Gamma | | Adjust **Gamma** level of the video. Slide to the right side to increase the gamma value and to the left to decrease the gamma value. |
| Contrast | | Adjust **Contrast** level of the video. Slide to the right side to increase and to the left to decrease video contrast |
| DC | | For **DC** illumination, there will be no fluctuation under the light source so no need for compensating light flickering |
| AC(50HZ) | | Check **AC(50HZ)** to eliminate flickering "strap" caused by 50Hz illumination |
| AC(60HZ) | | Check **AC(60HZ)** to eliminate flickering "strap" caused by 60Hz illumination |
| Default | | Set all the settings in the **Camera Control Panel** to the default values. |

The **Camera Control Panel** controls the camera to achieve the best image quality according to the specific applications; It will pop up automatically when the mouse is moved to the left side of the video window (in measurement status, the **Camera Control Panel** will not pop up. Only when the measurement process is terminated will the **Camera Control Panel** pop up by moving mouse to the left side of the video window). Left-clicking 📌 button to achieve **Display/ Auto Hide** switch of the **Camera Control Panel**;

## 4.3 The Measurement Toolbar on the Upper Side of the Video Window

### 4.3.1 Introduction to Measurement Toolbar

The **Measurement Toolbar** will pop up when moving the mouse to any place near the upper side of the video window.

Here is the introduction of the various functions on the **Measurement Toolbar**:

| Icon | Function | Icon | Function |
|---|---|---|---|
| 📌 | Float/ Fix switch of the Measurement Toolbar | ☑ Visible | Define measuring object in Show up/ Hide mode |
| Pixel | Select the desired Measurement Unit | | |
| Default | Choose the same Magnification as the digital microscope current Zoom Ratio to ensure accuracy of measurement result when measurement unit is not in Pixel unit | | |
| 👆 | Object Select | • | Point |
| ⊿ | Angle | /\ | Four-point method to measure the angle |
| / | Arbitrary Line | ∕ | Three-Point method to measure the spacing |
| ✕ | Three-Point method to measure vertical line | ∕∕ | Parallel Line |
| — | Horizontal Line | \| | Vertical Line |
| ☐ | Rectangle | ⊕ | Center + Radius Circle |
| ◯ | Three-points Circle | ◯ | Ellipse |
| ◎ | Annulus | ∞ | Two Circles |
| ◦⌀ | Three-points Two Circles | ⌐ | Arc |
| ☆ | Polygon | ∫ | Curve |
| ↗ | Arrow | ㎛ | Scale Bar |
| 🖉 | Make Calibration to determine the corresponding relation between magnification and resolution, this will establish the corresponding relationship between the measurement unit and the sensor pixel size. The monitor's size can be input to achieve the accurate value of the digital magnification. The Calibration needs to be done with the aid of a ruler with an accuracy of more than 1mm. The detailed Calibration process is as follows. | | |
| 📊 | Export the measurement information to CSV file(*.csv) | | |
| 🗑 | Delete all the Measurement Objects | | |
| ✕ | Setting | ✖ | Exit from Current Measurement Mode |
| ◀ ▶ ▲ ▼ 🔴 🗑 | When the measurement ends, left-click on a single measuring object and the Object Location & Properties Control Bar will show up. The icons on the control bar mean Move Left, Move Right, Move Up, Move Down, Color Adjustment, and Delete. | | |

**Note**:1) When the user left-clicks **Display/Hide** button 📌 on the **Measurement Toolbar**, the **Measurement Toolbar** will be fixed. In this case, the **Camera Control Panel** will not pop up automatically even if moving the mouse cursor to the left side of the video window. Only when users left-click the ✖ button on the **Measurement Toolbar** to exit from the measurement mode will they be able to perform other operations in the **Camera Control Panel**, the **Autofocus Control Panel,** or the **Synthesis Camera Control Toolbar**.

2) When a specific measuring object is selected during the measuring process, the **Object Location & Attributes**

**Control Bar** ◀ ▶ ▲ ▼ ♣ 🗑 will appear for changing the object location and properties of the selected objects.

3) To ensure accuracy of the measurement, after the calibration is turned on, the camera will automatically reset, and then sets the normalization magnification to 20X, and adjusts the focus to the required standard object distance. If the "**Calibration Object**" on the stage is not clear on the monitor, you need to manually adjust the height of the bracket to the clearest position, which is the standard object distance. After the **Calibration** is completed, use the **Measurement Toolbar** to measure the 1mm physical distance on the ruler, which should display 1mm on the monitor.

4) Even if the **Calibration** has been completed, once the user needs to measure, but is not sure whether the camera is at the standard object distance position, it is always better to reset it first, adjust the stand height in the reset state to make the observation object clear, and ensure that the camera is at the standard object distance position before measurment.

## 4.3.2    Calibration Method

User needs to prepare an **Calibration Object** such as ruler before **Calibration**;

Move the mouse to the upper side of the video window, the **Measurement Toolbar** will appear. Clicking 📝 **Calibration** on the **Measurement ToolBar** to start the calibration.

1)The **XFCAMView** will pop up a message box:  "**1. Camera resetting for calibration...**"

2)After the reset is finished, a message box:  "**2. Please put the calibration object on the stage(if not), adjust the height of the stand until the calibration object is in focus, then click OK button**;" will pop up.

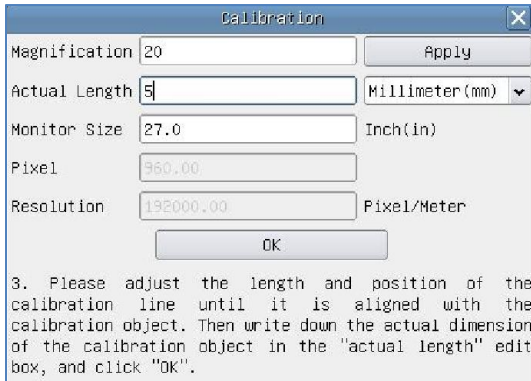3)After clicking the **OK** Button, **XFCAMView** will pop up a **Calibration** dialog shown below:



Figure 8 A Dialog for Calibration

**Magnification:**      the **Magnification** edit box, can be set from 1 to 20 as user want, Click **Apply** Button to confirm;

**Actual Length**:      the **Actual Length** of the **Calibration** object on the stage, the unit can be selected with the right drop-down list box. Read the hint on the **Calbration** dialog to get the correct **Calibration** result;

**Monitor Size**: the **Monitor Size** in Inch for the magnification calculation of the object displayed on the monitor;

**Pixel**:        the length in **Pixel** of the **Calibration Line** on the monitor;

**Resolution**:    the resolution in **Pixel/Meter** unit which is arrived by **Pixel/Actual Length**;

**OK**:        Click **OK** button to end the **Calibration**;

Users can refer to the message: "**3. Please adjust the length and position of the calibration line until it is**

**aligned with the calibration object. Then write down the actual dimension of the calibration object in the actual length edit box, and click OK."** to **get the correct calibration result.**

The default monitor size is 27 inches. Users can enter the practical monitor size.

## 4.4 Synthesis Camera Control Toolbar at the Bottom of the Video Window

| Icon | Function | Icon | Function |
|------|----------|------|----------|
| ⊕ | **Zoom In the Video Window** | ⊖ | **Zoom Out the Video Window** |
| ▷◁ | **Horizontal Flip** | ⤢ | **Vertical Flip** |
| ◉ | **Video Freeze** | ⌗ | **Cross Line** |
| ☼ | **LED brightness control** | AF | **Auto Focus Control Panel** |
| ▮ | **Comparison** of video and pictures saved in SD card, or **Comparison** of pictures and pictures | 🗀 | **Browse** images and videos in the SD card |
| ✗ | **Settings** | ⓘ | **Check Version** of **XFCAMView** |

The ✗ **Setting** function is relatively more complicated than the other functions. Here is more info about it:
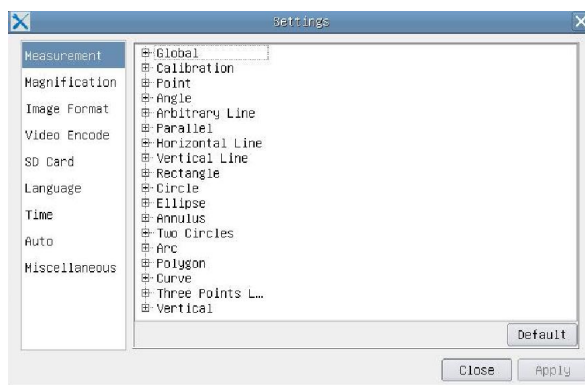


Figure 9 Comprehensive Measurement Settings Page

**Global**： Used for setting digits behind the decimal point for measurement results;

**Calibration**　**Line Width**: Used for defining the width of the lines in measurement and calibration;

　　　　　　**Color**: Used for defining color of the lines in measurement and calibration;

　　　　　　**EndPoint Type**: Used for defining the shape of the endpoints of lines in measurement and calibration: Null means no endpoints, rectangle means rectangle type of endpoints. It makes it easier to calibrate;

**Point, Angle, Arbitary Line, Parallel, Horizontal Line, Vertical Line, Rectangle, Circle, Ellipse, Annulus, Two Circles, Arc, Polygon, Curve, Three Points L, Vertical**:

　　　　Left-clicking the ⊞ beside the measuring patterns mentioned above will unfold the corresponding attribute settings to set the individual property of the measuring objects.

Figure 10 Comprehensive Measuring Units, Calibration, Magnification Management Settings Page
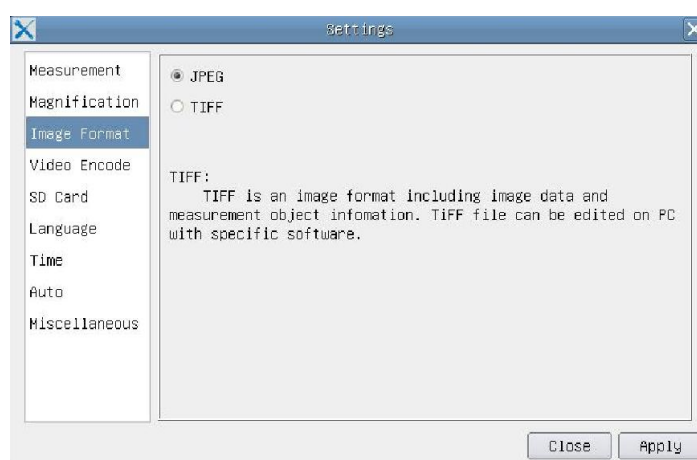


Figure 11 Comprehensive Setting of Image Format Setting Page

**JPEG**: Save the captured image in **JPEG** format into an SD card;

**TIFF**: Save the captured image in **TIFF** format into an SD card. The **TIFF** format saves not only image data but also the measurement data over the image. The camera control & imaging processing software ToupView is capable of opening **TIFF** files;
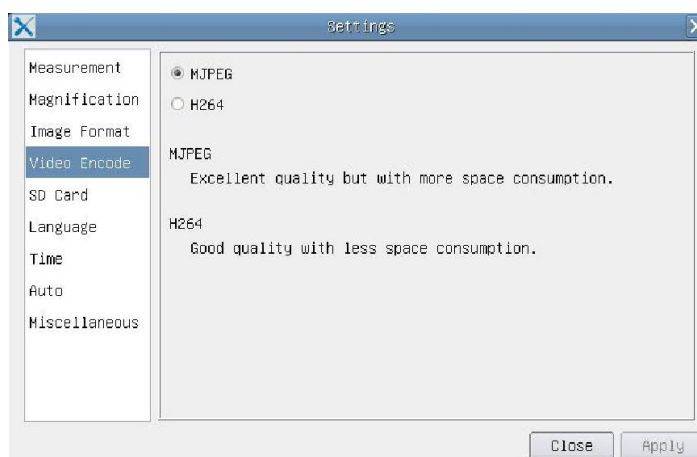


Figure 12 Comprehensive Setting of Video Encode Setting Page

**MJPEG**: Save the recorded videos in **MJPEG** coded format;

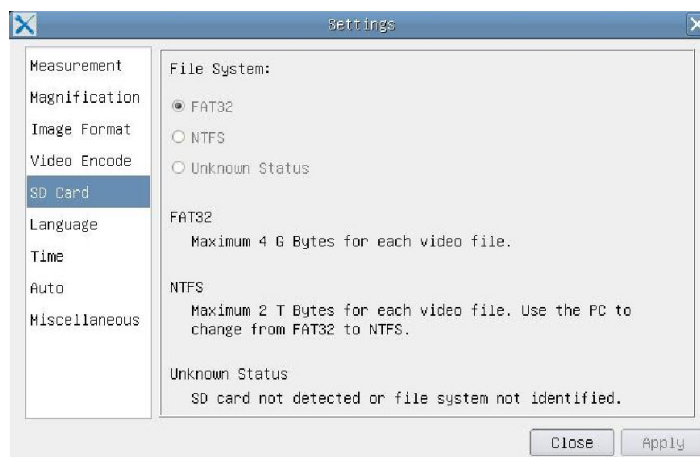**H264**: Save the recorded videos in **H264** coded format;

Figure 13 Comprehensive Setting of SD card Setting Page

**Current File System**: The maximum size of **FAT32** file can store 4G Bytes. As for **NTFS** it is 2048G Bytes. Users are suggested to convert **FAT32** file into **NTFS** format on a PC; **Unknown Status**: SD card is not detected or the file system is not identified;



Figure 14 Comprehensive Setting of Language Selection Setting Page

**English**：            Set language of the whole software into English;
**Simplified Chinese**：  Set language of the whole software into Simplified Chinese;
**Traditional Chinese**： Set language of the whole software into Traditional Chinese;
**Korean**:             Set language of the whole software into Korean;
**Japanese**:           Set language of the whole software into Japanese;

# 4.5   Auto Focus Control Panel on the Right Side of Video Window

| | | |
|---|---|---|
|  | Zoom Slider | Move the **Zoom Slider** to change the **Zoom Ratio**,  **the value** will be displayed below the slider. It can be edited to set the desired **Zoom Ratio** |
| | Zoom Button | There are 3 **Zoom Buttons**, users can set specific zoom ratio for the quick control |
| | Optical Magnification | **Optical Magnification** is the designed lens magnification |
| | Digital Magnification | **Digital Magnification** is the object length on the monitor divided by the actual object length |
| | Focus Slider | Move the **Focus Slider** to change the focus lens position; |

| | | The focus lens position value will be displayed below the slider. It can be edited to set the desired focus lens position; |
|---|---|---|
| Manual Focus | | With **Manual Focus** radio button is checked, users can move the **Focus Slider** to change the focus lens position to get a clear image. The position value of the focus lens below the slider can be set by the user |
| Autofocus | | With **Autofocus** radio button is checked, the system will automatically focus the object on the stage, the focus lens position value under the **Focus Slider** will be refreshed in real-time; When the **ROI** or **Object** state is changed, the camera will perform the **Auto Focus** operation automatically |
| One Push | | Clicking **One Push** button will perform a **Autofocus** operation at a time |
| Reset | | Click **Reset** button to reset the **Zoom** and **Focus** modules. After the process is finished, the **Zoom** is set to 20X normalized magnification, and the Focus is fixed at the standard object distance(195mm in this model), if the object(such as a ruler for **Calibration**) is not clear, adjust the stand bracket to move the object to the standard object distance. Note: (see **Measurement Toolbar>Calibration** items for details). |

# 4.6   Focus Region on the Video Window
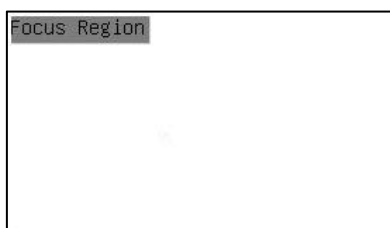
Figure 15 Focus Region

The **Focus Region** is used for selecting the region of interest for **Auto Focus** operation. When user clicks the button on the **Synthesis Camera Control Toolbar**, the **Focus Region** will pop up as well with the **Autfoocus Control Panel**. Users can click any part of the video window to select the focus region for **Auto Focus** operation.

When users close the **Autofocus Control Panel**, the **Focus Region** will be closed automatically.