AFDM101 Electric Controlled Continuous Zoom and Autofocus Digital Microscope

Contents

1 Introduction to AFDM101

AFDM is the abbreviation of Auto-focus Digital Microscope. Different products in the AFDM series can be formed with different part to satisfy the applicatuon requirement. 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 Illumintaion Light.

AFM101 comes with H1080PA HDMI camera, EMZO-20XA lens and DRL-5076A-NPC light source(Optional); The camera use 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 AFDM101 can be saved on an SD card for on-site analysis and follow-up research.

AFDM101 can be widely used in industrial inspection, medical observation, teaching and scientific research, automation system, and other fields.

Figure 1 AFDM101's front and back view

Figure 2 AFDM101's side and front(with LED light) view

1.1 The Module Specifications of AFDM101

1.1.1 AFDM Camera Module Datasheet

Order Code	Sensor & Size(mm)	Pixel(μm)	G SensitivityDark Signal	FPS/Resolution	Binning	Exposure(ms)
H1080PA	Sony IMX462LQR-C 1/2.8"(5.57x3.13)	2.9x2.9	921/0.15mv with 1/30s	60/1920*1080 (HDMI)	1x1	0.06~918
H4KPA	Sony IMX415LQR-C 1/2.8"(5.57x3.13)	1.45x1.45	300/0.13mv with 1/30s	30@3840*2160(HDMI) 30@3840*2160(NW) 30@3840*2160(USB)	1x1	0.04~1000

C: Color; M: Monochrome;

1.1.2 AFDM Lens Module Datasheet

Order Code	Working Distance(mm)	Zoom Range	MTF(lp/mm)	Distortion	FOV@1X(mm)	FOV@20X(mm)
EMZO-20XA	150~195	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;

1.1.3 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 150~195mm 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

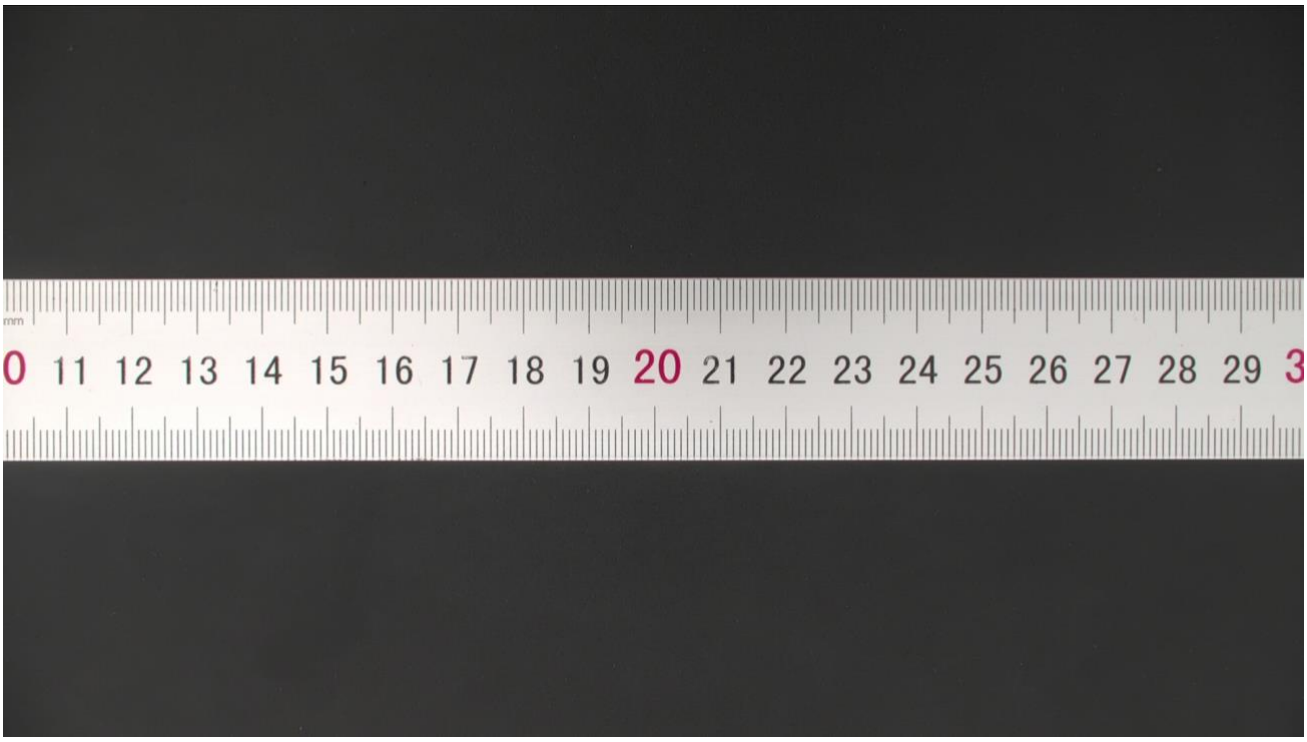
E	Power Adapter: Input: AC 100~240V 50Hz/60Hz, Output: DC 12V 3A	American Standard: Model: HKA03612030-7K : UL/CE/FCC(With American Standard AC Power Cable) European Standard: Model: HKA03612030-7K : UL/CE/FCC(With European Standard AC Power Cable) EMI Standard: FCC Part 15 Subpart B EMS Standard: EN61000-4-2,3,4,5,6
Optional Accessory		
F	LED Ring Light(DRL-5076A-NPC)	
G	SD card(16G)	

2 Installation and Operation of AFDM101

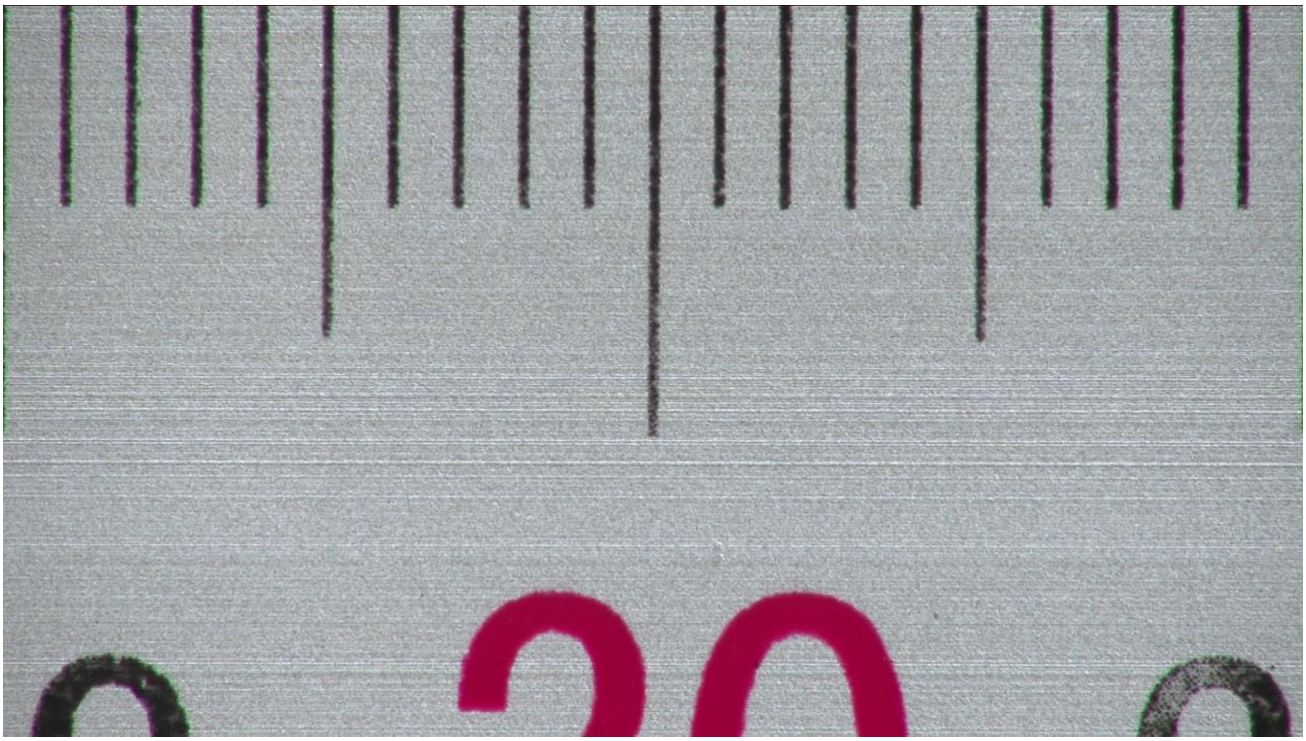
Before use, please install the AFDM series product on an adaptive bracket.

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.

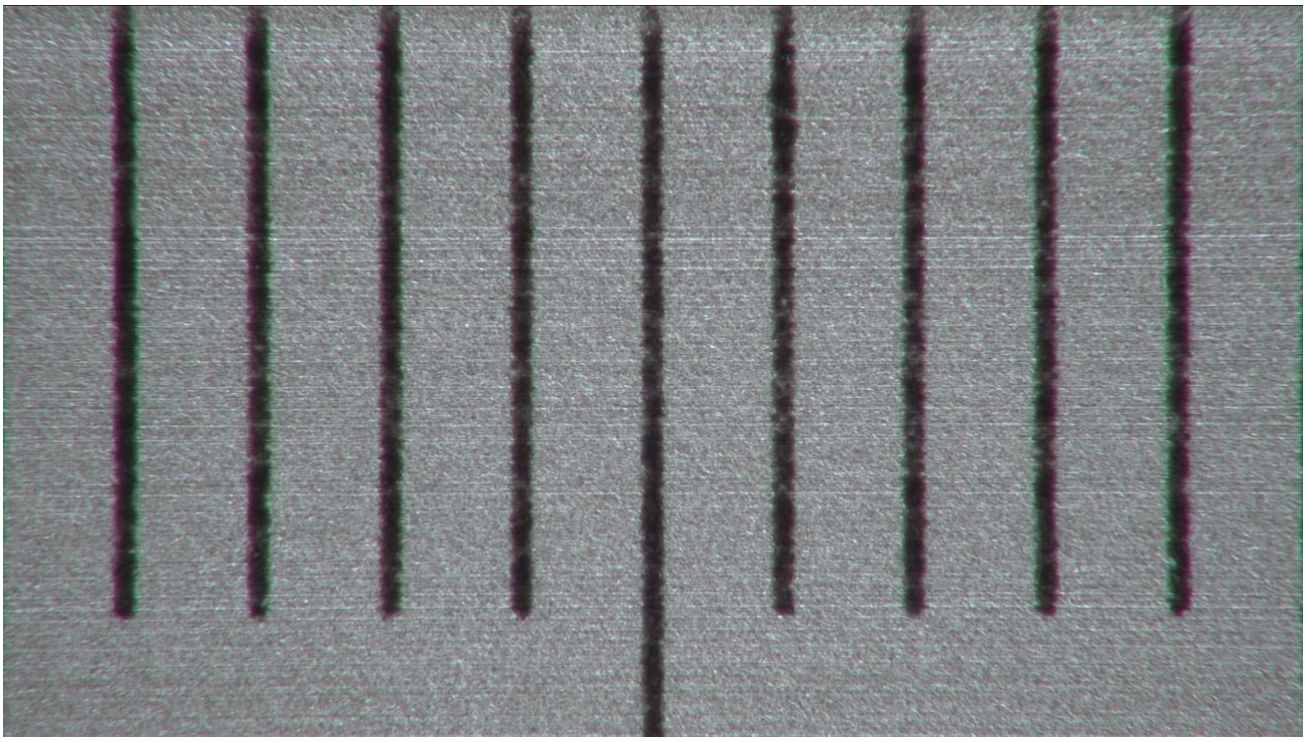
3 Images Captured with AFDM101



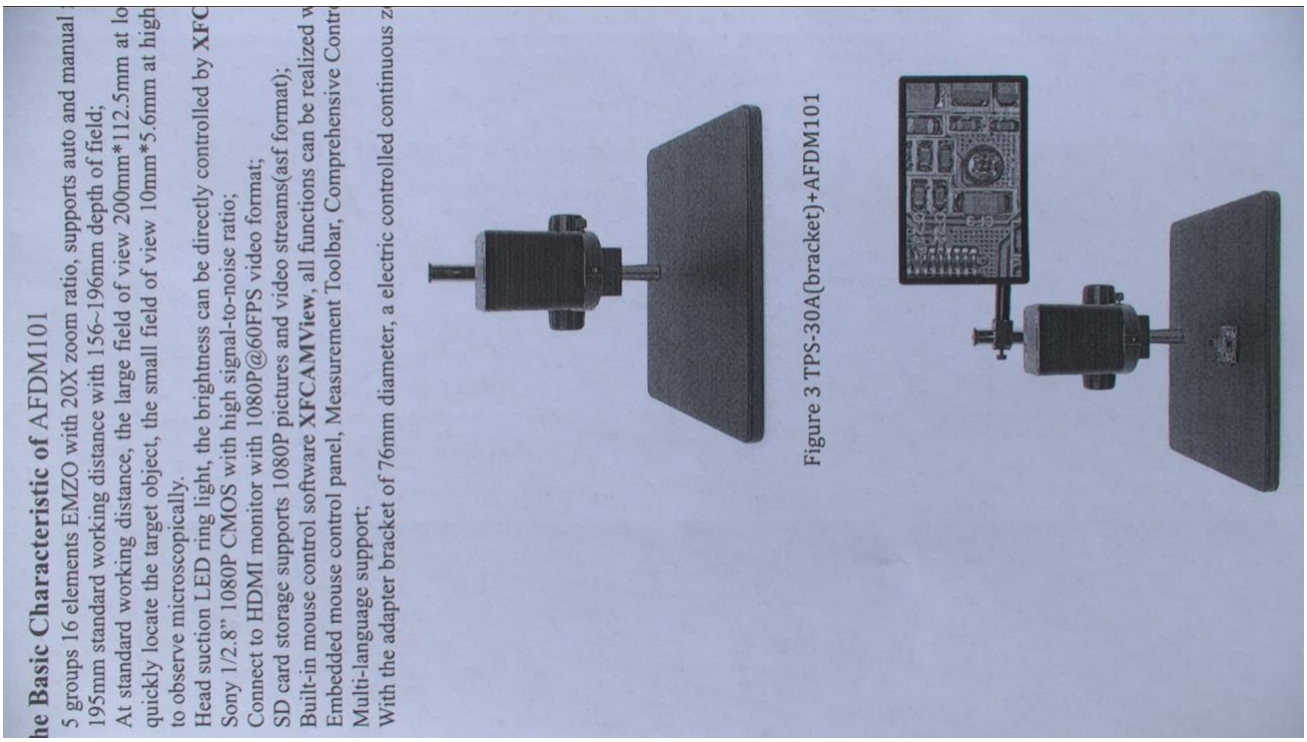
Ruler captured with AFDM101 at 1X



Ruler captured with AFDM101 at 10X



Ruler captured with AFDM101 at 20X



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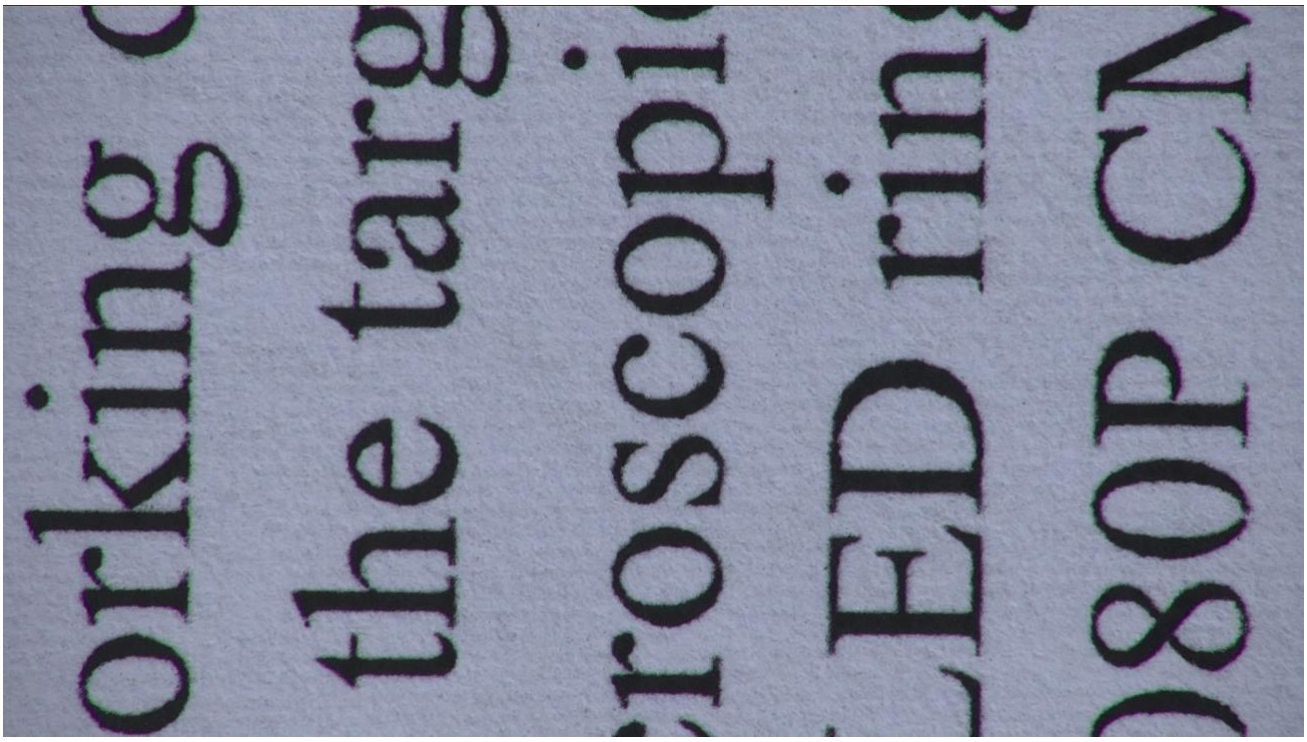
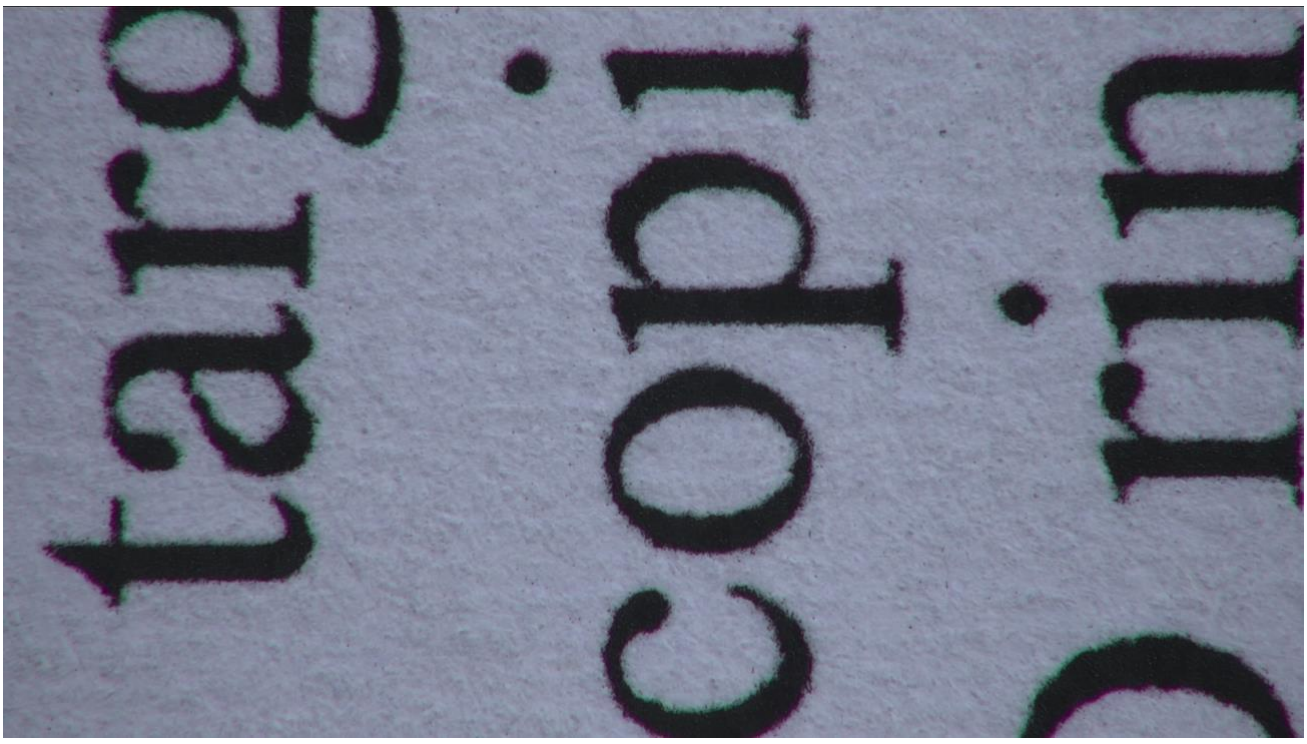
Embedded mouse control panel, Measurement Toolbar, Comprehensive Contr
Multi-language support;
With the adapter bracket of 76mm diameter, a electric controlled continuous z

Figure 3 TPS-30A(bracket)+AFDM101

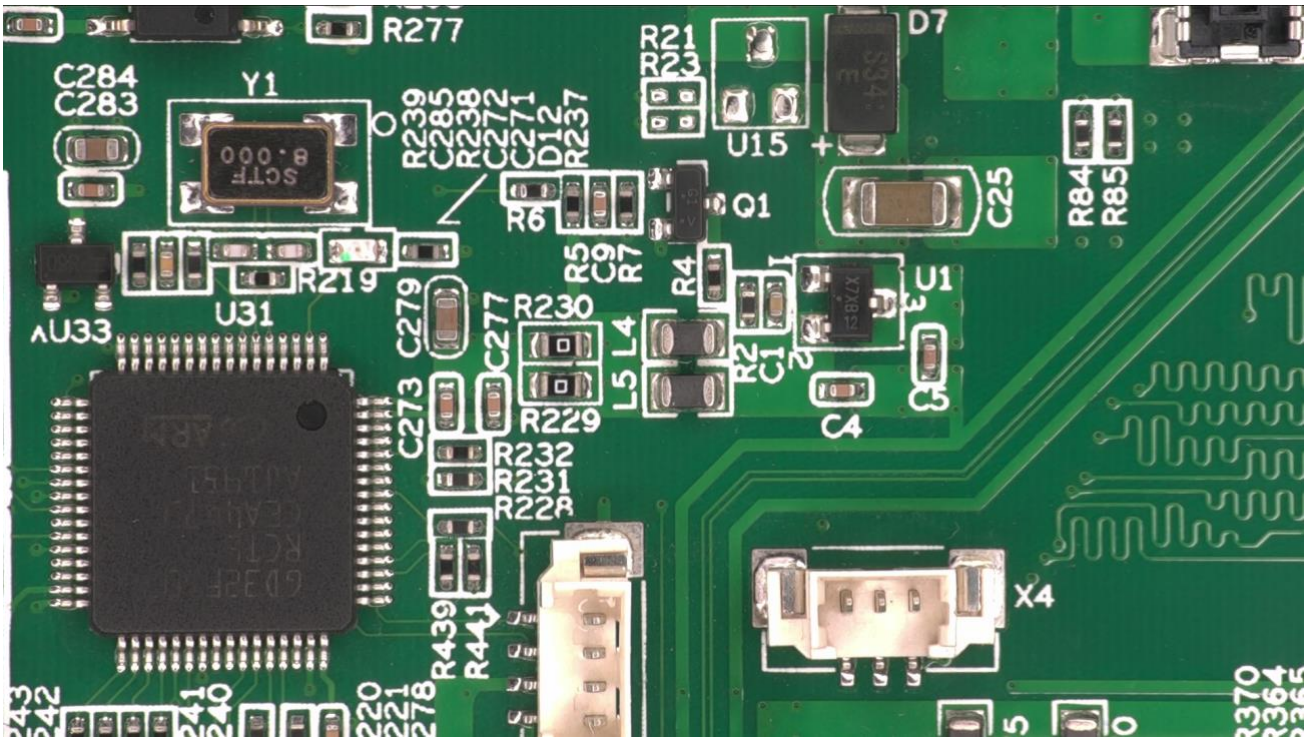
Print captured with AFDM101 at 1.0X



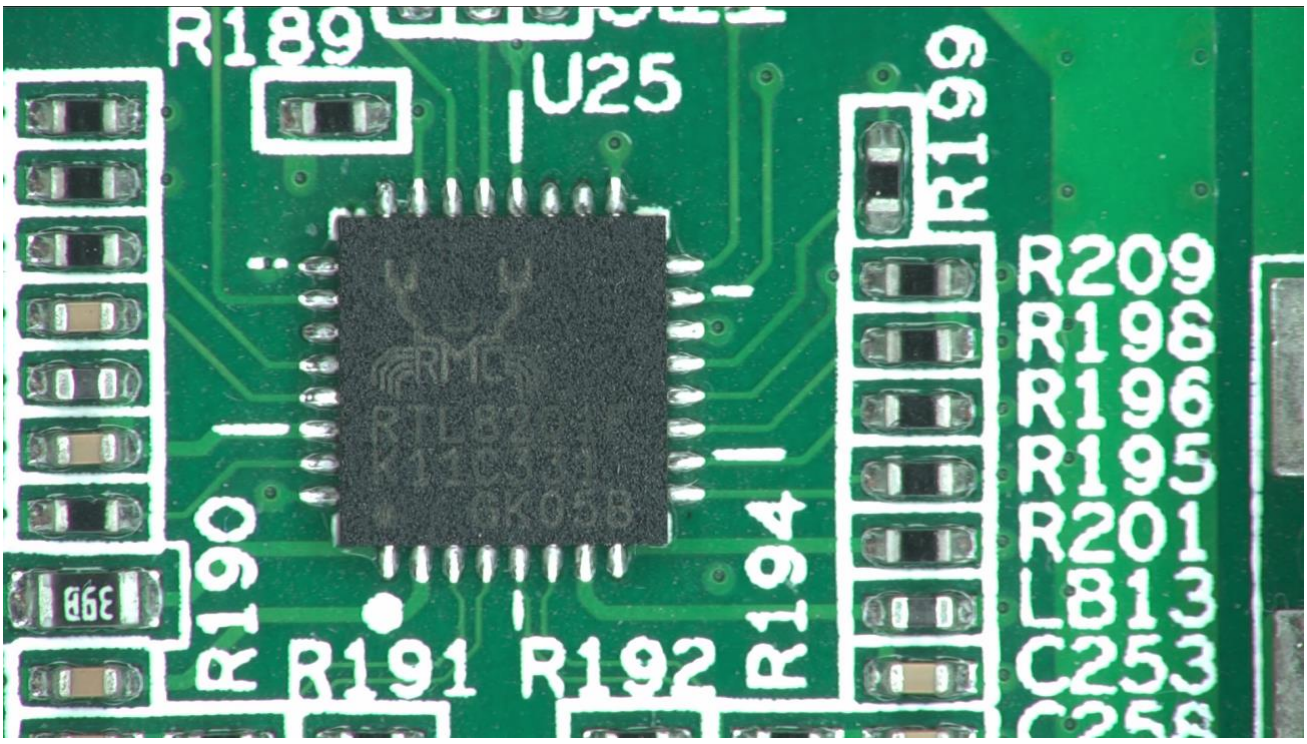
Print captured with AFDM101 at 10X



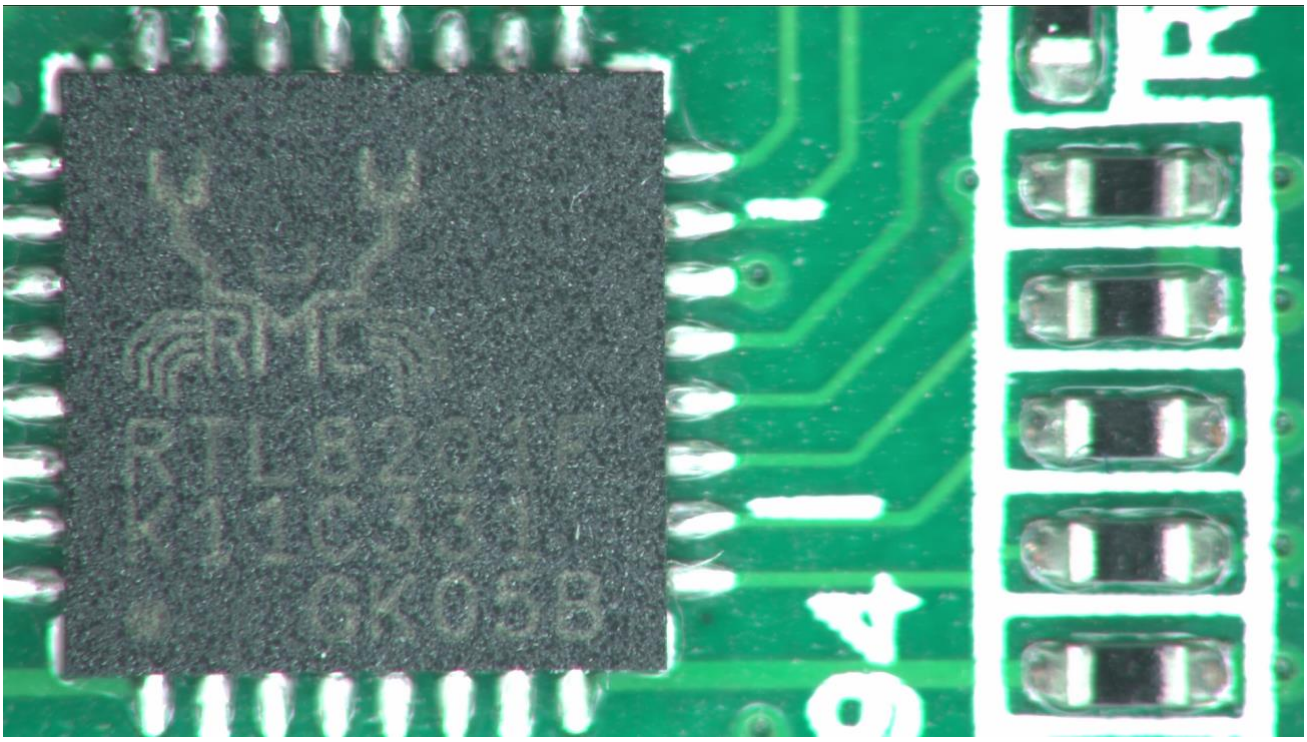
Print captured with AFDM101 at 20X



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

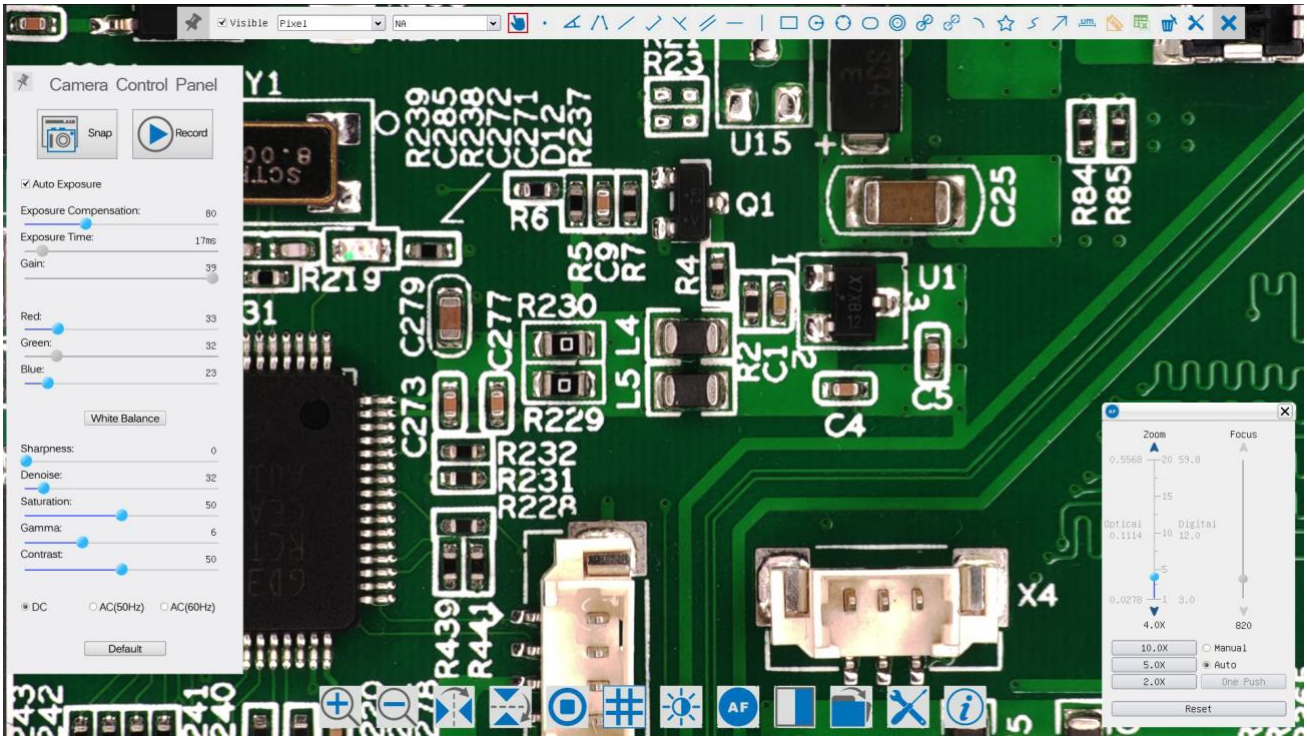


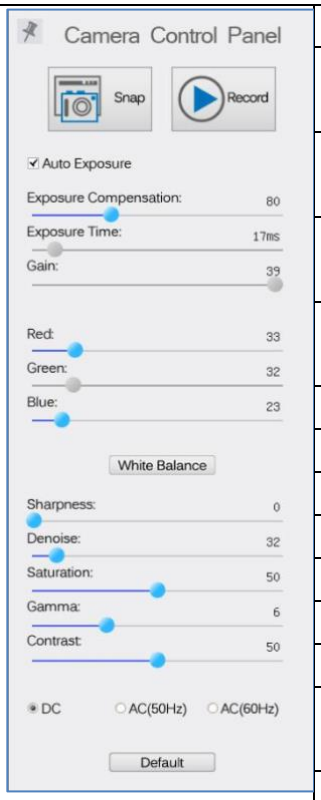
Figure 7 XFCAMView and Its Control UI

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 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 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 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**		**Define measuring object in Show up/ Hide mode**
	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:

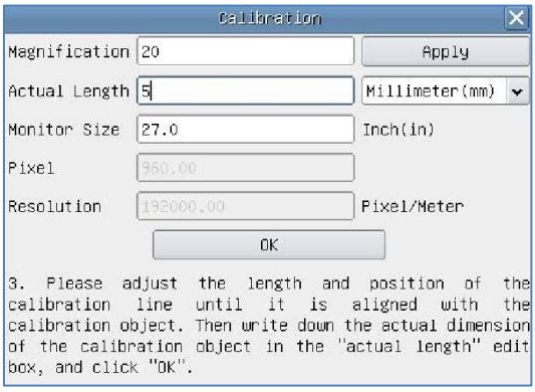


Figure 8 A Dialog for Calibration

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		**Auto Focus Control Panel**
	Comparison of video and pictures saved in SD card, or		**Browse** images and videos in the SD card

	Comparison of pictures and pictures		
	Settings		**Check Version** of **XFCAMView**

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

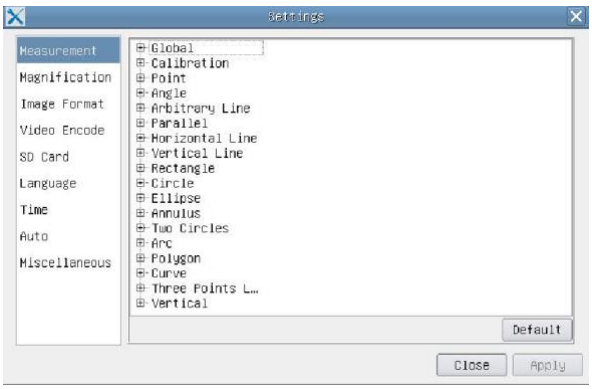


Figure 9 Comprehensive Measurement Settings Page

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.

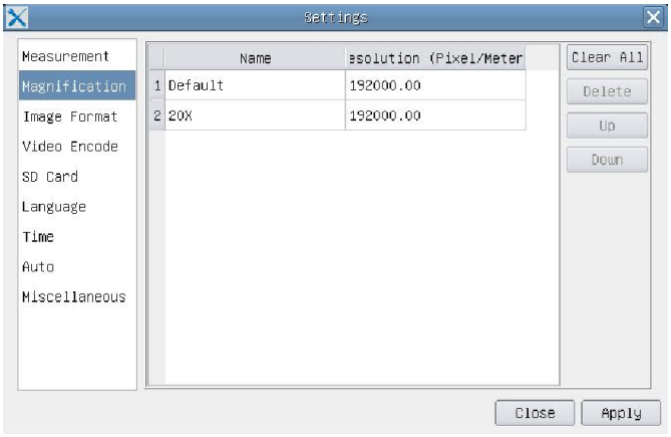


Figure 10 Comprehensive Measuring Units, Calibration, Magnification Management Settings Page

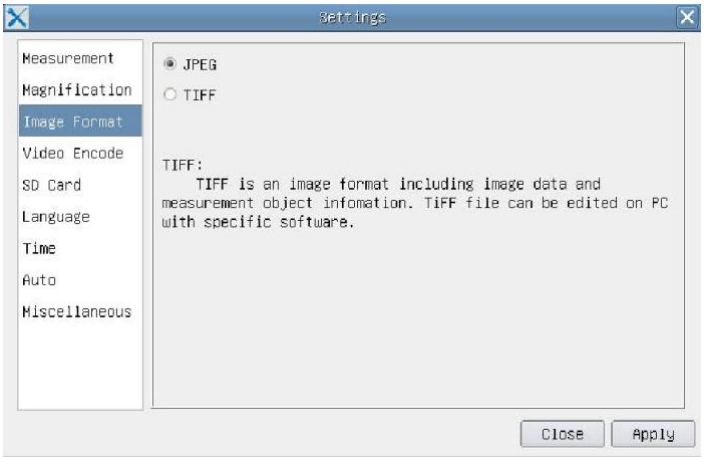


Figure 11 Comprehensive Setting of Image Format Setting Page

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;

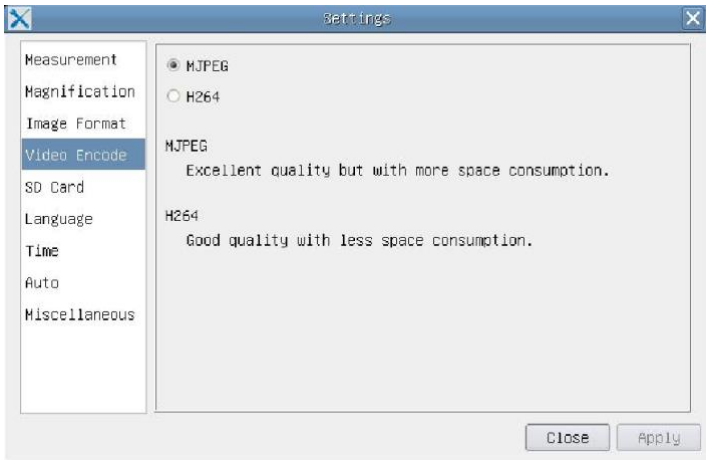


Figure 12 Comprehensive Setting of Video Encode Setting Page

MJPEG: Save the recorded videos in MJPEG coded format;

H264: Save the recorded videos in H264 coded format;

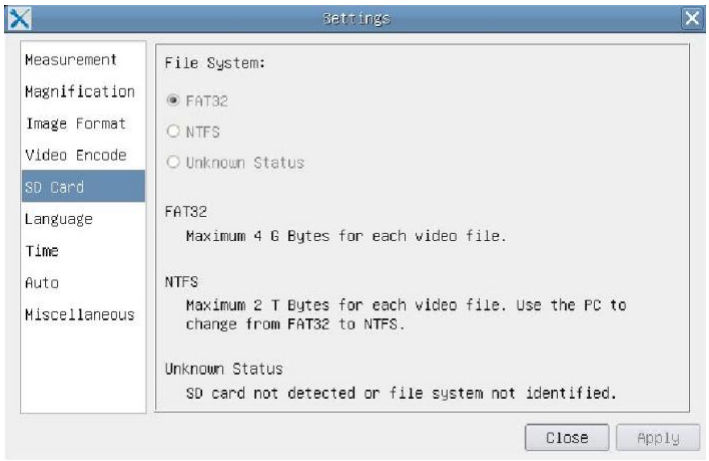


Figure 13 Comprehensive Setting of SD card Setting Page

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;

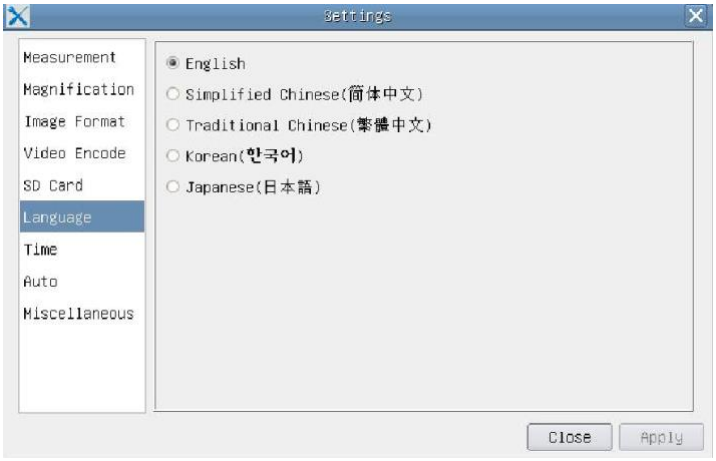
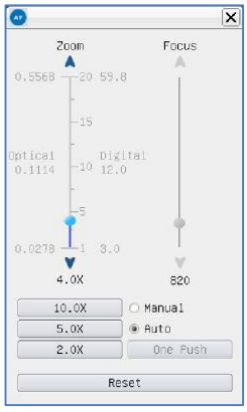


Figure 14 Comprehensive Setting of Language Selection Setting Page

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

<table>
<tr><td rowspan="5"> 
</td><td>Zoom Slider</td><td>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</td></tr>
<tr><td>Zoom Button</td><td>There are 3 Zoom Buttons, users can set specific zoom ratio for the quick control</td></tr>
<tr><td>Optical Magnification</td><td>Optical Magnification is the designed lens magnification</td></tr>
<tr><td>Digital Magnification</td><td>Digital Magnification is the object length on the monitor divided by the actual object length</td></tr>
<tr><td>Focus Slider</td><td>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;</td></tr>
<tr><td>Manual Focus</td><td colspan="2">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</td></tr>
<tr><td>Autofocus</td><td colspan="2">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</td></tr>
<tr><td>One Push</td><td colspan="2">Clicking One Push button will perform a Autofocus operation at a time</td></tr>
<tr><td>Reset</td><td colspan="2">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).</td></tr>
</table>

4.6 Focus Region on the Video Window

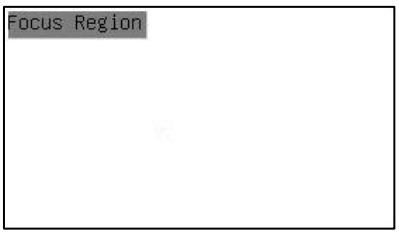


Figure 15 Focus Region

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.