SIMTRUM

Ultra-high speed digital micro mirror spatial light modulator V2.6

operation instruction

V2.6 20260127

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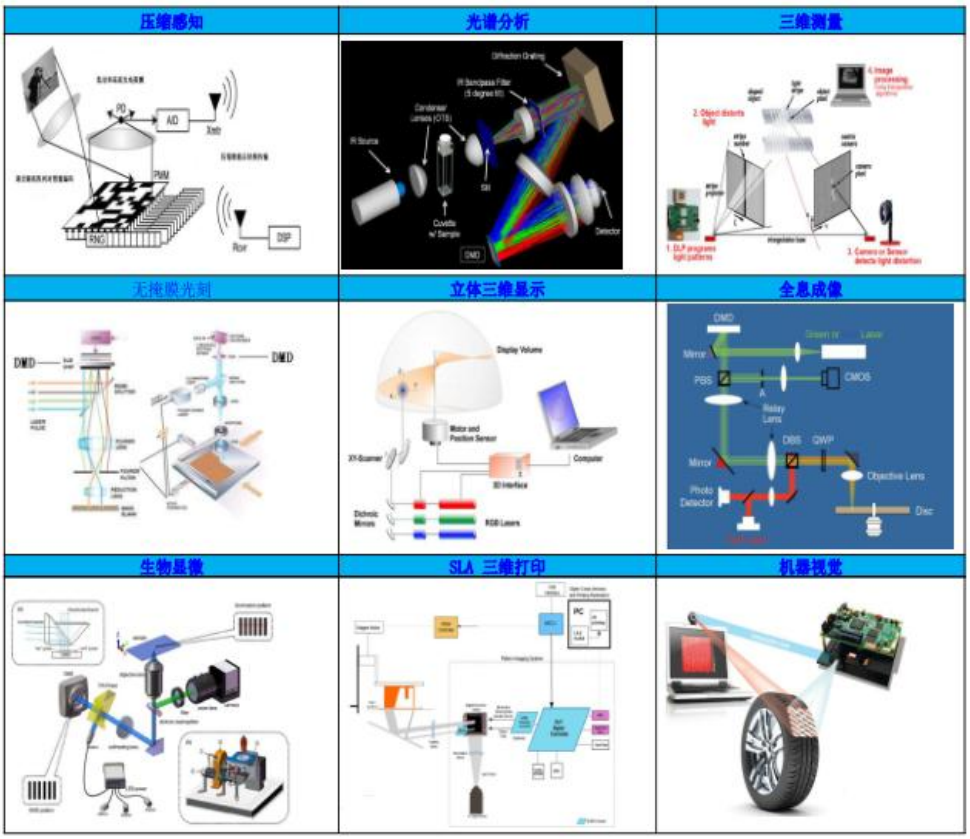
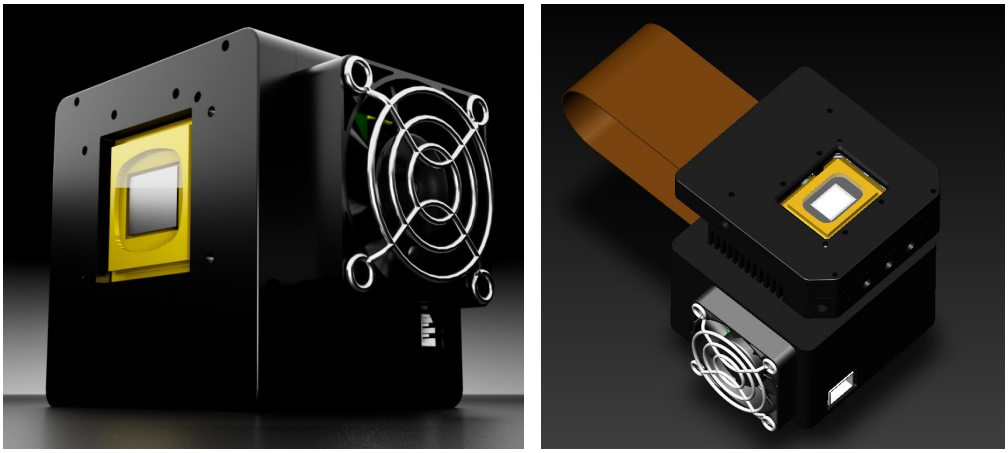
1. Product introduction

The core of digital micro mirror spatial light modulator is digital micro mirror device (DMD), which is an optical semiconductor module and a MEMS chip. Each lens of DMD can be deflected around the hinge axis by 10, 12 or 17 respectively. The DMD chip mainly adjusts the rotation angle of each micro mirror on the chip according to different digital signals transmitted by the front-end circuit to the CMOS chip, so that the light irradiated on the micro mirror can be selectively reflected to the imaging surface for imaging. Because the deflection of the lens is controlled separately by the bottom CMOS control circuit and the binary information of the lens reset signal, the digital modulation of the light field can be realized. Because DMD is imaged by micro mirror with aluminum film, it hardly absorbs energy, and is controlled by CMOS technology, so it is far superior to other spatial light modulators in light modulation speed, accuracy, energy and efficiency.DMD technology has a wide range of applications, including spectral analysis, maskless lithography, 3D measurement, naked eye 3D display, holographic imaging, compressive sensing, biomicroscopy, SLA 3D printing, machine vision, etc.



HS/SS ultra-high-speed digital micro mirror spatial light modulator(hereinafter referred to as HS/SS) is designed with advanced digital signal processing technology and high-speed serial communication technology, and adopts the advanced 7-series chip XC7K325T of Xilinx Company as the main controller, which can support complex algorithms and has higher performance. The product is shown in the following figure:

Ultra-high speed spatial light modulator series

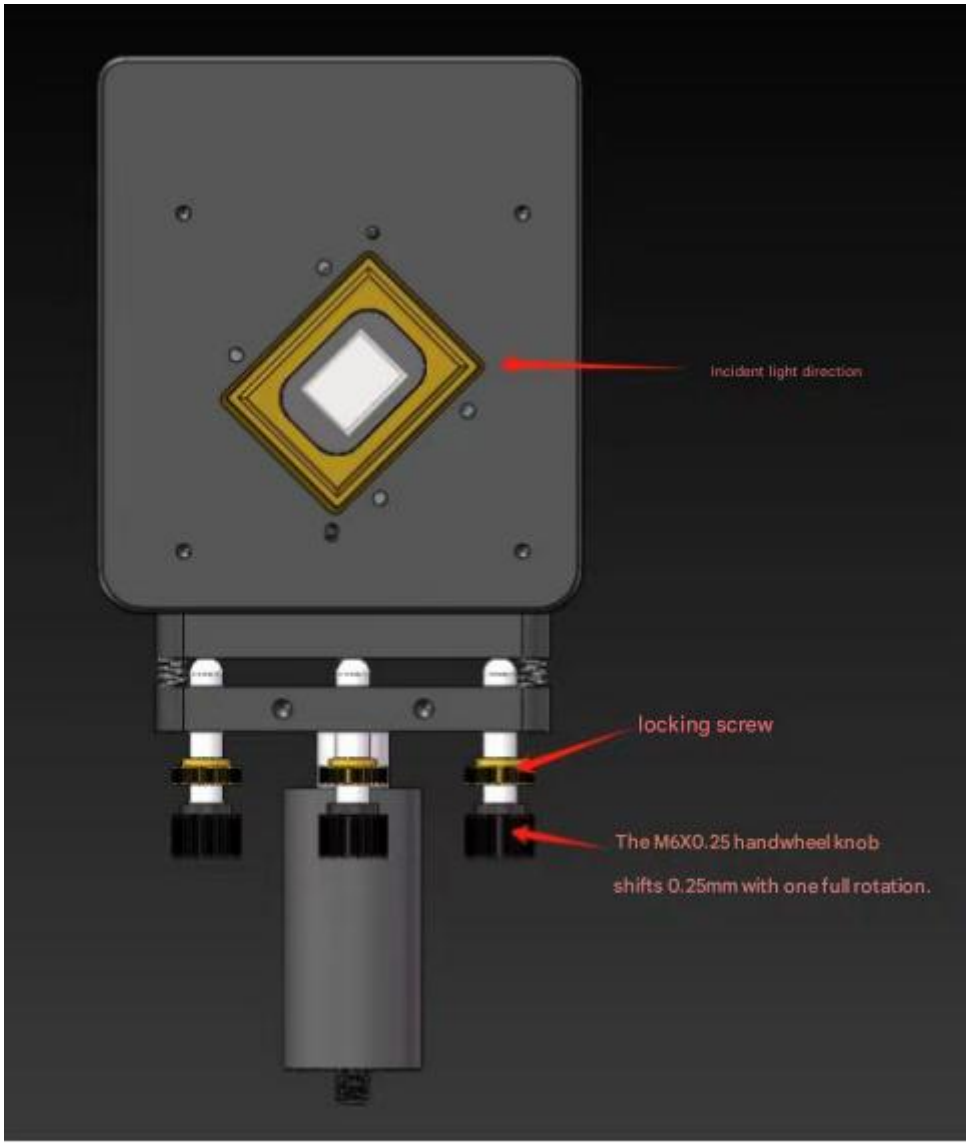


Ultra small space light modulator series

HS1-4/SS1-4 is designed with TI DLP4100 suite, and HS5-6/SS5-6 is designed with TI DLP9100 suite. HS/SS is composed of three parts: Control Board, DLP Cable and DMD Board.

In order to take the light path conveniently, DMD Board has designed two versions, one of which is tilted 45 degrees in structure, So that the incident light can enter from the horizontal direction. At the same time, a three-dimensional leveling bracket has been designed and

developed, and the angle of DMD in three -dimensional space can be fine-tuned by rotating three precise knobs at the bottom of the bracket. As shown in the figure below:



Three-dimensional leveling bracket

2. Hardware connection and power on

HS1-4/SS1-4 can support DMD with five resolutions of 0.55, 0.65, 0.7, 0.95 and 0.96, and HS5-6/SS5-6 can support DMD with two resolutions of 0.65 and 0.9, of which 0.65 can be selected in near infrared band and visible band, and 0.7, 0.95 and 0.9 DMD can be selected in ultraviolet band and visible band.

The hardware connection is as follows:

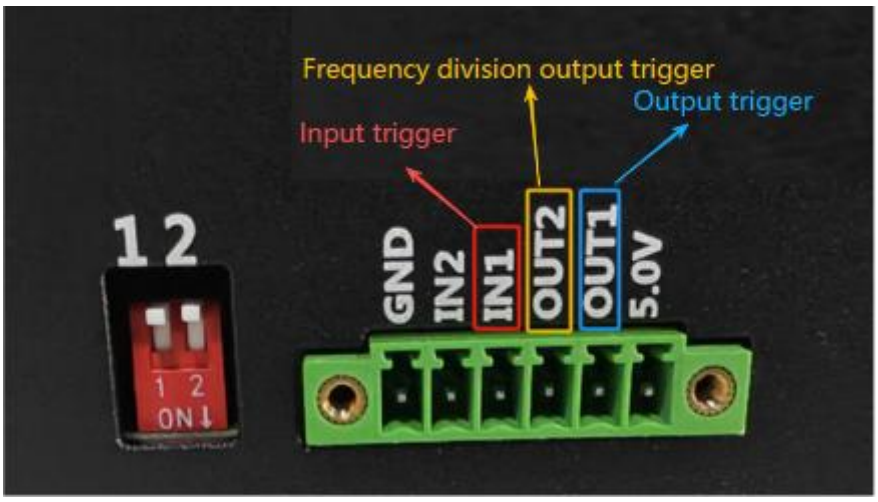
① Ultra-high-speed spatial light modulator is powered by 12V 5A power adapter, as shown in the following figure:

② The power interface on the spatial light modulator is shown in the following figure:

③ Connect the network cable, and connect the spatial light modulator with the host computer with the network cable. Note that the computer needs to support Gigabit Ethernet;

④ after the system power supply is connected, press the power switch to connect the power supply.

Spatial light modulator supports input and output triggering. The input and output trigger level standard is 5.0V CMOS level standard, and the default rising edge trigger. Parameters such as frequency division triggered by trigger edge can be modified by software. Input and output triggers are shown in the following figure:



When the input and output trigger signals are connected with external systems, such as cameras and grating rulers, it is necessary to ensure that the level standard (5.0V CMOS) is consistent, and at the same time, it is necessary to connect GND. The trigger signal of gray-scale image output is obtained by triggering frequency division. For example, when the 8-8bit gray-scale image is output, the trigger signal of gray-scale image is set to 8. The trigger signal is explained as follows:

IN1: input a trigger signal, and switch one image per pulse;

IN2: reserved;

OUT1: Output a trigger signal, each pulse corresponds to an image,and the rising edge of the trigger signal indicates that the image has been displayed. When the camera collects an image, it can start integrating by judging the rising edge of the OUT1 signal, and at the same time, N images can be set to correspond to an output trigger signal;

OUT2: output trigger signal, each pulse corresponds to an image.

3. HS/SS technical parameters

3.1 HS1-4 parameters

HS1-4 technical parameters					
Serial number	DMD type	0.65NIR DMD	0.7 DMD or 0.55 DMD	0.95 DMD	0.96DMD
DMD parameters					
1	Diagonal dimension of DMD	0.65 inch	0.7 inch or 0.55 inch	0.95 inch	0.96 inch
2	Physical resolution of DMD	1280*800	1024*768	1920*1080	1920*1200
3	DMD Micro mirror size	10.8um	13.68um or 10.8um	10.8um	10.8um
Full screen play parameters					
4	Maximum frame rate (binary)	11560Hz	26867Hz	20120Hz	18348Hz
5	Maximum frame rate (8-bit grayscale)	1004Hz	1683Hz	1422Hz	1348Hz
6	Maximum frame rate (ten-bit grayscale)	513Hz	691Hz	631Hz	613Hz
7	Maximum frame rate (12-bit grayscale)	192Hz	217Hz	209Hz	207Hz
8	Maximum frame rate (16 bits grayscale)	14.9Hz	15Hz	15Hz	15Hz
9	Number of images to store	134215(binary)	174760(binary)	62136(binary)	55923(binary)
		16776(8-bit grayscale)	21845(8-bit grayscale)	7767(8-bit grayscale)	6990(8-bit grayscale)
10	Minimum number of vertical scan steps	1/row	1/row	1/row	1/row
11	Maximum number of vertical scan steps	4294967295	4294967295	4294967295	4294967295
12	Maximum frame rate for vertical scanning	11560Hz	26867Hz	20120Hz	18348Hz
13	Gigabit Ethernet (or USB 3.0) real-time maximum frame rate	908Hz	1182Hz	420Hz	378Hz

	(binary)				
14	Gigabit Ethernet (or USB 3.0) real-time maximum frame rate (8-bit grayscale)	113Hz	147Hz	52Hz	47Hz
15	10 gigabit real-time maximum frame rate (binary) (Optional)	9082Hz	11825Hz	4204Hz	3784Hz
16	10 gigabit real-time maximum frame rate(8-bit grayscale) (Optional)	1135Hz	1478Hz	525Hz	472Hz
17	HDMI real-time play frame rate (Optional)	60Hz	60Hz	60Hz	60Hz
Windowing playback parameters (support cache, mutable sequence, vertical scan, Ethernet real-time binary mode)					
18	Set the maximum under 50 KHZ display rows	132/row	337/row	337/row	337/row
19	Number of images to store (binary)	813428/pieces (132/row)	398266/pieces (337/row)	199133/pieces (337/row)	199133/pieces (337/row)
20	Maximum frame rate under the number of rows — binary	50kHz	50kHz	50kHz	50kHz
	Maximum frame rate under the number of rows — 8-bit grayscale	2167Hz	2193Hz	2149Hz	2149Hz
	Maximum frame rate under the number of rows — ten-bit grayscale	780Hz	784Hz	777Hz	777Hz
	Maximum frame rate under the number of rows — 12-bit grayscale	227Hz	227Hz	227Hz	227Hz
	Maximum frame rate under the number of rows — 16 bits grayscale	15Hz	15Hz	15Hz	15Hz
21	Gigabit real-time maximum frame rate (binary)	5504Hz (132/row)	2694Hz (337/row)	1347Hz (337/row)	1347Hz (337/row)
22	10 gigabit real-time maximum frame rate (binary) (Optional)	55042Hz (132/row)	26949Hz (337/row)	13474Hz (337/row)	13474Hz (337/row)
23	Maximum frame rate for vertical scanning	50kHz (132/row)	50kHz (337/row)	50kHz (337/row)	50kHz (337/row)
Other parameters					
24	Memory size	128Gb	128Gb	128Gb	128Gb
25	Range of band	700nm-2500nm	400nm-700nm	400nm-700nm	400nm-700nm

26	Contrast ratio	More than 2000:1
27	On-board memory	2 DDR3 memory bars, 64Gb each, ping-pong operation
28	External interface	Gigabit Ethernet interface (or USB3.0 interface), 10 Gigabit Ethernet interface (optional).
29	Trigger interface	Two output-triggered IO, one input-triggered IO, and one idle interface, 5.0V level standard.
Description: Support single micro mirror precise control, any time lock; If you need to use USB3.0 interface, you need to connect to USB3.0 network card; The real-time maximum frame rate is related to network speed, DMD resolution and program. Support vertical scanning (scroll play). HDMI interface and ten Gigabit Ethernet interface are optional.		

3.2 HS5-6 parameters

HS5-6 _DDR technical parameters			
Serial number	DMD type	0.65 DMD	0.9 DMD
DMD parameters			
1	Diagonal dimension of DMD	0.65 inch	0.9 inch
2	Physical resolution of DMD	1920*1080	2560*1600
3	DMD Micro mirror size	7.56um	7.56um
Full screen play parameters			
4	Maximum frame rate (binary)	10764Hz	11560Hz
5	Maximum frame rate (8-bit grayscale)	940Hz	997Hz
6	Maximum frame rate (ten-bit grayscale)	491Hz	510Hz
7	Maximum frame rate (12-bit grayscale)	188Hz	191Hz
8	Maximum frame rate (16 bits grayscale)	14.8Hz	14.9Hz
9	Number of images to	62136(binary)	33553(binary)

	store		7767(8-bit grayscale)	4194(8-bit grayscale)
10	Minimum number of vertical scan steps		1/row	1/row
11	Maximum number of vertical scan steps		4294967295	4294967295
12	Maximum frame rate for vertical scanning		10764Hz	11560Hz
13	Gigabit Ethernet (or USB 3.0) real-time maximum frame rate (binary)		420Hz	227Hz
14	Gigabit Ethernet (or USB3.0) real-time maximum frame rate(8-bit grayscale)		52Hz	28Hz
15	10 gigabit real-time maximum frame rate (binary)(Optional)		4204Hz	2270Hz
16	10 gigabit real-time maximum frame rate (8-bit grayscale) (Optional)		525Hz	283Hz
17	HDMI real-time play frame rate(Optional)		60Hz	60Hz
Windowing playback parameters (support cache, mutable sequence, vertical scan, Ethernet real-time binary mode)				
18	Set the maximum under 50 KHZ display rows		168/row	268/row
19	Number of images to store(binary)		399451/pieces(168/row)	200321/pieces(268/row)
20	Maximum frame	binary	50kHz	50kHz
		8-bit grayscale	2086Hz	2130Hz

	rate under the number of rows	ten-bit grayscale	767Hz	774Hz
		12-bit grayscale	225Hz	226Hz
		16 bits grayscale	15Hz	15Hz
21	Gigabit real-time maximum frame rate (binary)		2702Hz(168/row)	1355Hz(268/row)
22	10 gigabit real-time maximum frame rate (binary) (Optional)		27029Hz(168/row)	13555Hz(268/row)
23	Maximum frame rate for vertical scanning		50kHz(168/row)	50kHz(268/row)
Other parameters				
24	Memory size		128Gb	128Gb
25	Range of band		VIS:400nm-700nm	VIS:400nm-700nm UV:363nm-420nm
26	Contrast ratio		More than 2000:1	
27	On-board memory		2 DDR3 memory bars, 64Gb each, ping-pong operation	
28	External interface		Gigabit Ethernet interface (or USB3.0 interface), 10 Gigabit Ethernet interface (optional).	
29	Trigger interface		Two output-triggered IO, one input-triggered IO, and one idle interface, 5.0V level standard.	
Description: Support single micro mirror precise control, any time lock; If you need to use USB3.0 interface, you need to connect to USB3.0 network card; The real-time maximum frame rate is related to network speed, DMD resolution and program. Support vertical scanning (scroll play). HDMI interface and ten Gigabit Ethernet interface are optional.				

3.3 SS1-4_MINI parameters

SS1-4_MINI technical parameters					
Serial	DMD type	0.65NIR DMD	0.7 DMD or	0.95 DMD	0.96DMD

number			0.55 DMD		
DMD parameters					
1	Diagonal dimension of DMD	0.65 inch	0.7 inch or 0.55 inch	0.95 inch	0.96 inch
2	Physical resolution of DMD	1280*800	1024*768	1920*1080	1920*1200
3	DMD Micro mirror size	10.8um	13.68um or 10.8um	10.8um	10.8um
Full screen play parameters					
4	Maximum frame rate (binary)	11560Hz	26867Hz	20120Hz	18348Hz
5	Maximum frame rate (8-bit grayscale)	1004Hz	1683Hz	1422Hz	1348Hz
6	Maximum frame rate (ten-bit grayscale)	513Hz	691Hz	631Hz	613Hz
7	Maximum frame rate (12-bit grayscale)	192Hz	217Hz	209Hz	207Hz
8	Maximum frame rate (16 bits grayscale)	14.9Hz	15Hz	15Hz	15Hz
9	Number of images to store	67107(binary)	87380(binary)	31068(binary)	27961(binary)
		8388(8-bit grayscale)	10922(8-bit grayscale)	3883(8-bit grayscale)	3495(8-bit grayscale)
10	Minimum number of vertical scan steps	1/row	1/row	1/row	1/row
11	Maximum number of vertical scan steps	4294967295	4294967295	4294967295	4294967295
12	Maximum frame rate for vertical scanning	11560Hz	26867Hz	20120Hz	18348Hz
13	Gigabit Ethernet (or USB3.0) real-time maximum frame rate (binary)	908Hz	1182Hz	420Hz	378Hz
14	Gigabit Ethernet (or USB3.0) real-time maximum frame rate (8-bit grayscale)	113Hz	147Hz	52Hz	47Hz
15	10 gigabit real-time maximum frame rate (binary)(Optional)	9082Hz	11825Hz	4204Hz	3784Hz
16	10 gigabit real-time maximum frame rate	1135Hz	1478Hz	525Hz	472Hz

	(8-bit grayscale) (Optional)				
Windowing playback parameters (support cache, mutable sequence, vertical scan, Ethernet real-time binary mode)					
17	Set the maximum under 50 KHZ display rows	132/row	337/row	337/row	337/row
18	Number of images to store (binary)	406714/pieces (132/row)	199133/pieces (337/row)	99566/pieces (337/row)	99566/pieces (337/row)
19	Maximum frame rate under the number of rows — binary	50kHz	50kHz	50kHz	50kHz
	Maximum frame rate under the number of rows — 8-bit grayscale	2167Hz	2193Hz	2149Hz	2149Hz
	Maximum frame rate under the number of rows — ten-bit grayscale	780Hz	784Hz	777Hz	777Hz
	Maximum frame rate under the number of rows — 12-bit grayscale	227Hz	227Hz	227Hz	227Hz
	Maximum frame rate under the number of rows — 16 bits grayscale	15Hz	15Hz	15Hz	15Hz
20	Gigabit real-time maximum frame rate(binary)	5504Hz (132/row)	2694Hz (337/row)	1347Hz (337/row)	1347Hz (337/row)
21	10 gigabit real-time maximum frame rate (binary) (Optional)	55042Hz (132/row)	26949Hz (337/row)	13474Hz (337/row)	13474Hz (337/row)
22	Maximum frame rate for vertical scanning	50kHz (132/row)	50kHz (337/row)	50kHz (337/row)	50kHz (337/row)
Other parameters					
23	Memory size	64Gb	64Gb	64Gb	64Gb
24	Range of band	700nm-2500nm	400nm-700nm	400nm-700nm	400nm-700nm
25	Contrast ratio	More than 2000:1			
26	On-board memory	1 DDR3 memory, 64Gb capacity, ping-pong operation			
27	External interface	Gigabit Ethernet interface (or USB3.0 interface), 10 Gigabit Ethernet interface (optional).			
28	Trigger interface	Two output-triggered IO, one input-triggered IO, and one idle interface, 5.0V level standard.			
Description: Support single micro mirror precise control, any time lock; If you need to use USB3.0 interface, you need to connect to USB3.0 network card; The real-time maximum frame rate is related to network speed, DMD resolution and program. Support vertical scanning (scroll play). HDMI interface and ten Gigabit Ethernet interface are optional.					

3.4 SS5-6_MINI parameters

SS5-6_MINI technical parameters			
Serial number	DMD type	0.65 DMD	0.9 DMD
DMD parameters			
1	Diagonal dimension of DMD	0.65 inch	0.9 inch
2	Physical resolution of DMD	1920*1080	2560*1600
3	DMD Micro mirror size	7.56um	7.56um
Full screen play parameters			
4	Maximum frame rate (binary)	10764Hz	11560Hz
5	Maximum frame rate (8-bit grayscale)	940Hz	997Hz
6	Maximum frame rate (ten-bit grayscale)	491Hz	510Hz
7	Maximum frame rate (12-bit grayscale)	188Hz	191Hz
8	Maximum frame rate (16 bits grayscale)	14.8Hz	14.9Hz
9	Number of images to store	31068(binary)	16776(binary)
		3883(8-bit grayscale)	2097(8-bit grayscale)
10	Minimum number of vertical scan steps	1/row	1/row
11	Maximum number of vertical scan steps	4294967295	4294967295
12	Maximum frame rate for vertical scanning	10764Hz	11560Hz
13	Gigabit Ethernet (or USB3.0) real-time maximum frame rate	420Hz	227Hz

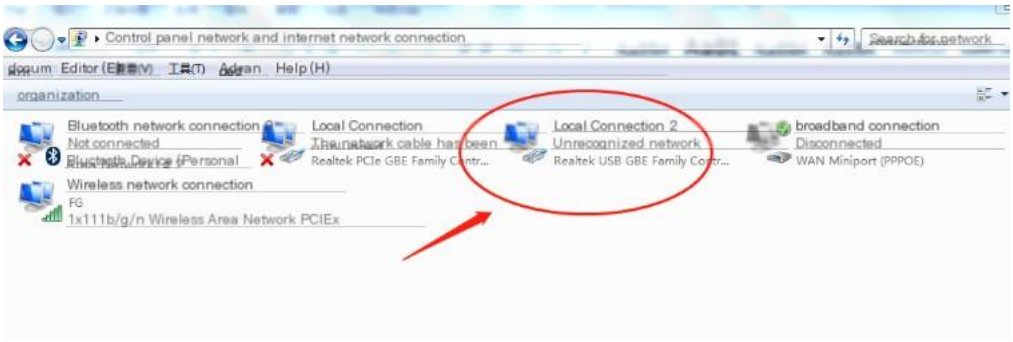
	(binary)			
14	Gigabit Ethernet (or USB3.0) real-time maximum frame rate (8-bit grayscale)		52Hz	28Hz
15	10 gigabit real-time maximum frame rate (binary) (Optional)		4204Hz	2270Hz
16	10 gigabit real-time maximum frame rate (8-bit grayscale) (Optional)		525Hz	283Hz
Windowing playback parameters (support cache, mutable sequence, vertical scan, Ethernet real-time binary mode)				
17	Set the maximum under 50 KHZ display rows		168/row	268/row
18	Number of images to store(binary)		199725/pieces(168/row)	100160/pieces(268/row)
19	Maximum frame rate under the number of rows	binary	50kHz	50kHz
		8-bit grayscale	2086Hz	2130Hz
		ten-bit grayscale	767Hz	774Hz
		12-bit grayscale	225Hz	226Hz
		16 bits grayscale	15Hz	15Hz
20	Gigabit real-time maximum frame rate (binary)		2702Hz(168/row)	1355Hz(268/row)
21	10 gigabit real-time maximum frame rate (binary) (Optional)		27029Hz(168/row)	13555Hz(268/row)

22	Maximum frame rate for vertical scanning	50kHz(168/row)	50kHz(268/row)
Other parameters			
23	Memory size	64Gb	64Gb
24	Range of band	VIS:400nm-700nm	VIS:400nm-700nm UV:363nm-420nm
25	Contrast ratio	More than 2000:1	
26	On-board memory	1 DDR3 memory, 64Gb capacity, ping-pong operation.	
27	External interface	Gigabit Ethernet interface (or USB3.0 interface), 10 Gigabit Ethernet interface (optional).	
28	Trigger interface	Two output-triggered IO, one input-triggered IO, and one idle interface, 5.0V level standard.	
Description: Support single micro mirror precise control, any time lock; If you need to use USB3.0 interface, you need to connect to USB3.0 network card; The real-time maximum frame rate is related to network speed, DMD resolution and program. Support vertical scanning (scroll play). HDMI interface and ten Gigabit Ethernet interface are optional.			

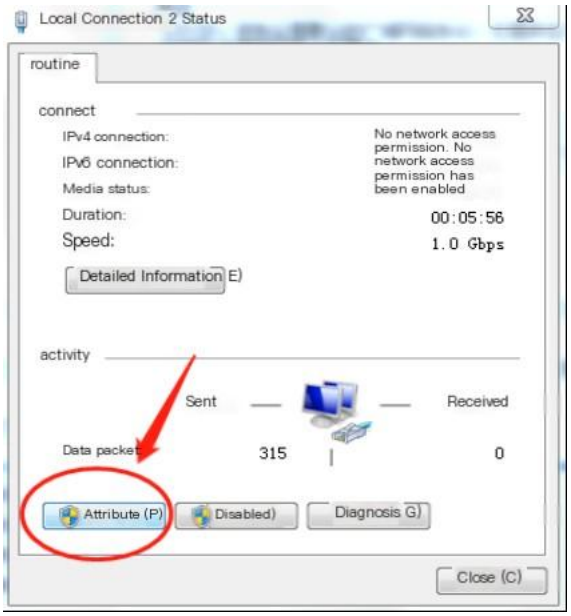
4. Introduction of upper computer software

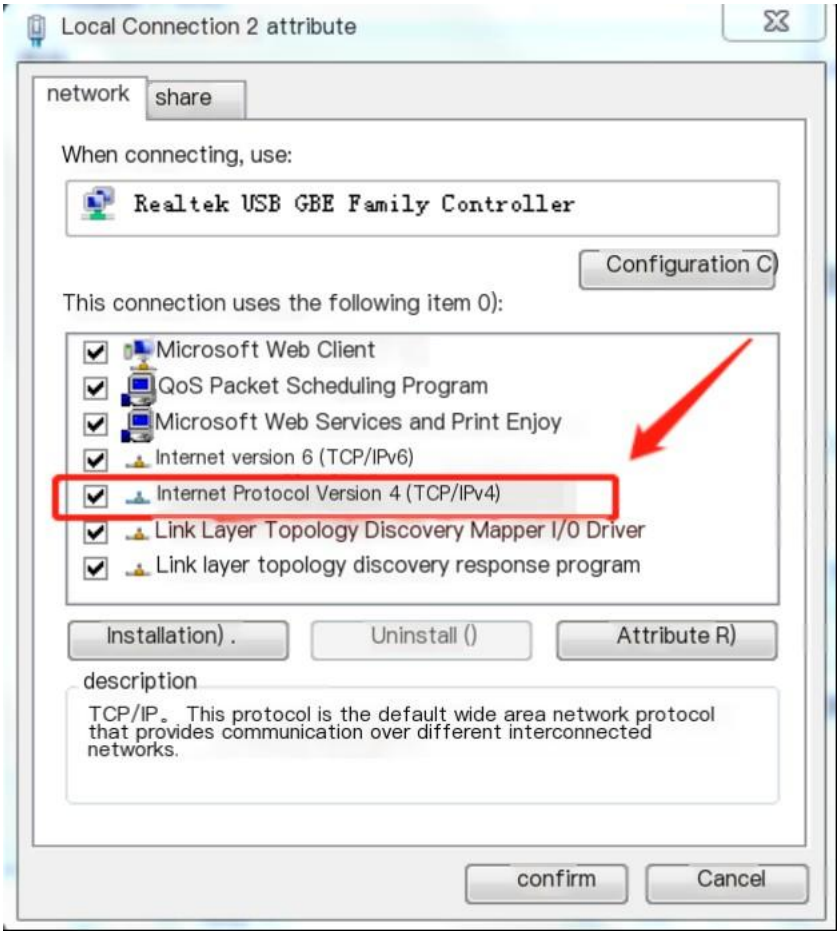
4.1 IP address setting

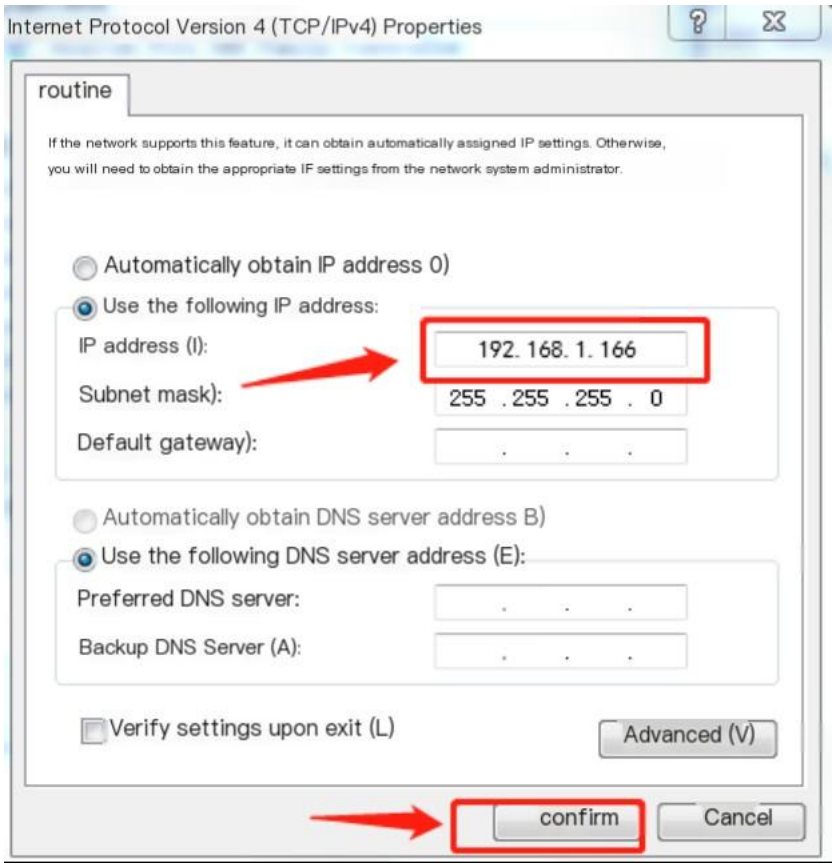
1. Make sure that the product is connected to the PC network port,and you can see that it is connected in the PC network connection (Control Panel-> Network and Internet-> Network and Sharing Center-> Change the adapter settings).



2. Right-click the icon above, select Properties, double-click Internet Protocol Version 4, set the IP address manually, as shown in the figure, and then confirm to exit.




Local Connection 2 attribute
network
share
When connecting, use:
Realtek USB GBE Family Controller
Configuration C)
This connection uses the following item 0):
Microsoft Web Client
QoS Packet Scheduling Program
Microsoft Web Services and Print Enjoy
Internet version 6 (TCP/IPv6)
Internet Protocol Version 4 (TCP/IPv4)
Link Layer Topology Discovery Mapper I/O Driver
Link layer topology discovery response program
Installation) .
Uninstall ()
Attribute R)
description
TCP/IP。 This protocol is the default wide area network protocol that provides communication over different interconnected networks.
confirm
Cancel

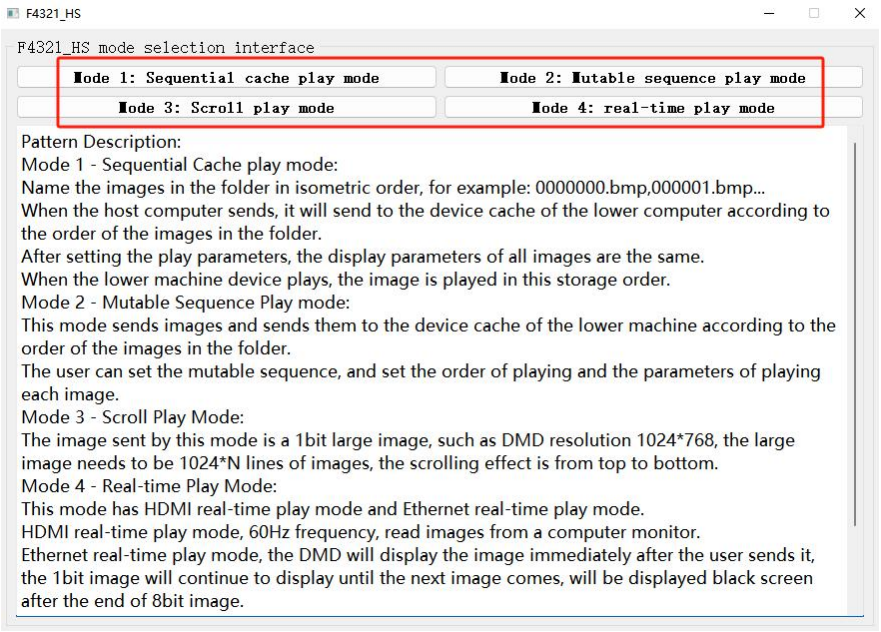

Internet Protocol Version 4 (TCP/IPv4) Properties
routine
If the network supports this feature, it can obtain automatically assigned IP settings. Otherwise, you will need to obtain the appropriate IF settings from the network system administrator.
Automatically obtain IP address 0)
Use the following IP address:
IP address (I):
192. 168. 1. 166
Subnet mask):
255 .255 .255 . 0
Default gateway):
Automatically obtain DNS server address B)
Use the following DNS server address (E):
Preferred DNS server:
Backup DNS Server (A):
Verify settings upon exit (L)
Advanced (V)
confirm
Cancel

Allocation of IP addresses of hosts and devices: When using Gigabit ports for communication, the IP address should be configured as 192.168.1.X(X is any suitable value, it is recommended not to be 1 or255), and when using 10 Gigabit ports, the IP address should be configured as 192.168.3.X(X is any suitable value, it is recommended not to be 1 or 255).

4.2 Software operation flow

4.2.1 play mode selection

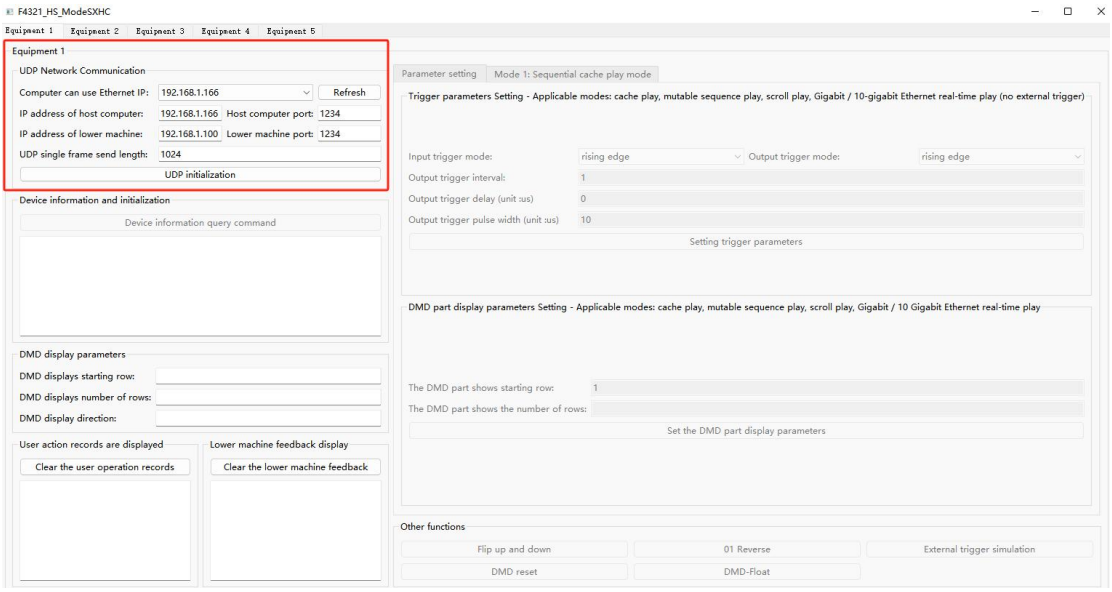
Open the upper computer software and enter the mode selection interface. There are four modes to choose from, namely, sequential cache play mode, mutable sequence play mode, scrolling play mode and real-time play mode. Select the corresponding mode to enter the new interface as required.



Note: In any mode, after playing, you need to click Stop to send other settings and playing instructions. Except for Mode 4, in the other three modes, after clicking the Start Play button, this button is switched to the Pause/ Continue Play button, which can send a pause/ continue instruction during the play process to achieve the effect of pausing the play.

4.2.2 UDP network communication

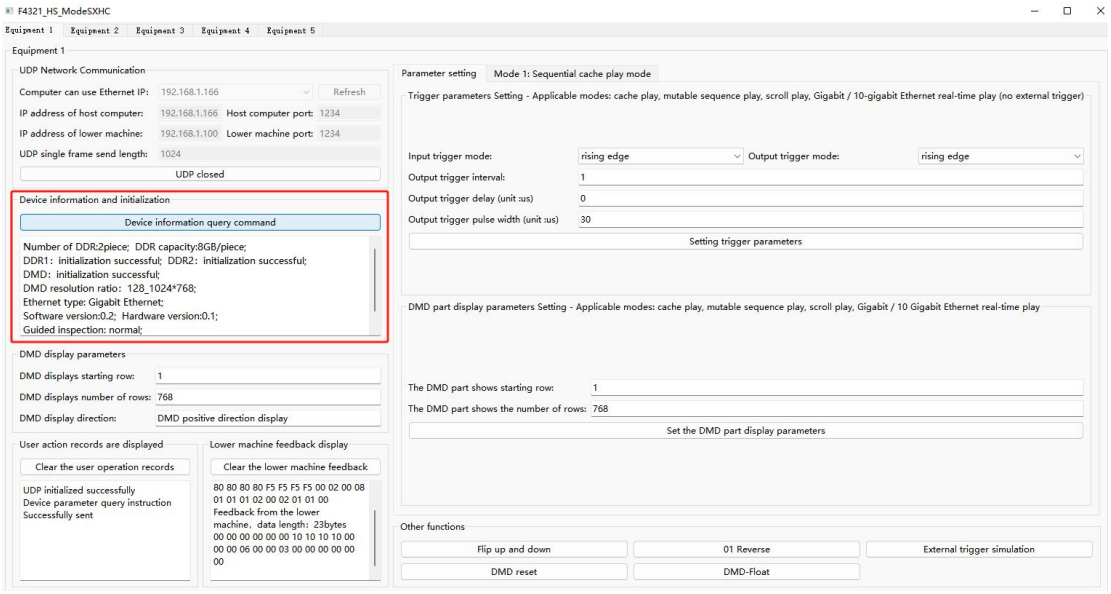
1. Click the refresh button, and select the set IP address from the drop-down list of Ethernet IP available for computers in the software interface, as shown in the figure below, and set the IP address of the lower computer in the software as 192.168.1.100 (Gigabit network port),so that the port of the lower computer is consistent with the port of the upper computer. The length of UDP single frame transmission (how many bytes is the effective data of Ethernet UDP packet) can be kept unchanged at 1024 When using 10 Gigabit network port, the IP address of the lower computer is configured as 192.168.3.10, and the length of UDP single frame can be changed to 8192 to achieve full-speed transmission (the minimum length of UDP single frame is 1024, with 128 superimposed each time).



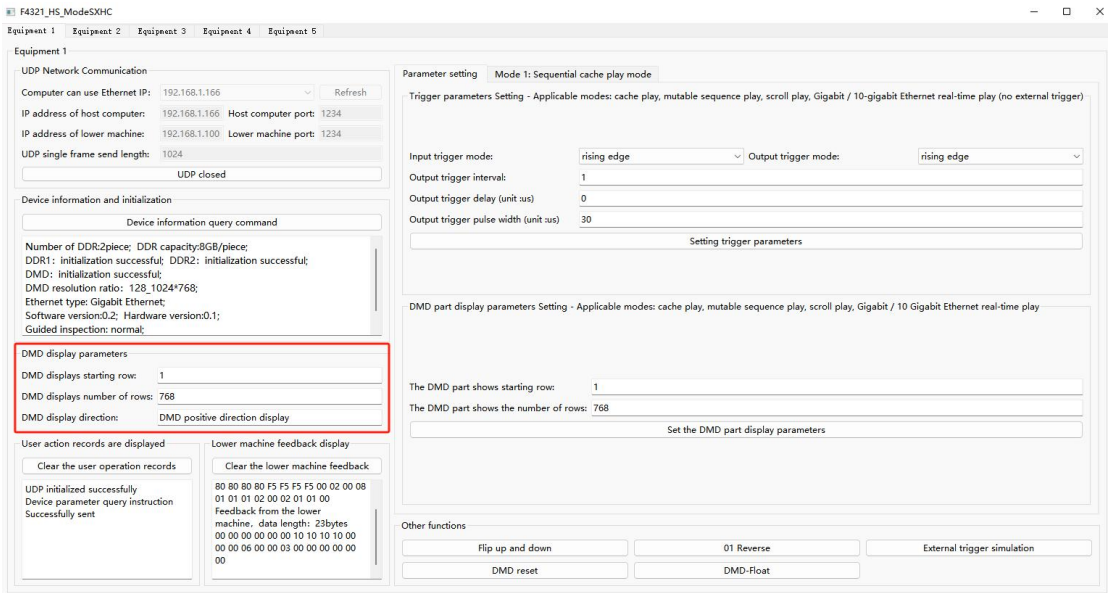
2. Click the UDP initialization button after confirming that the settings are correct. If the initialization is successful, the user's operation record will be prompted. At this time, the device information query command button will light up and enter the device information and initialization interface.

4.2.3 Equipment information and initialization

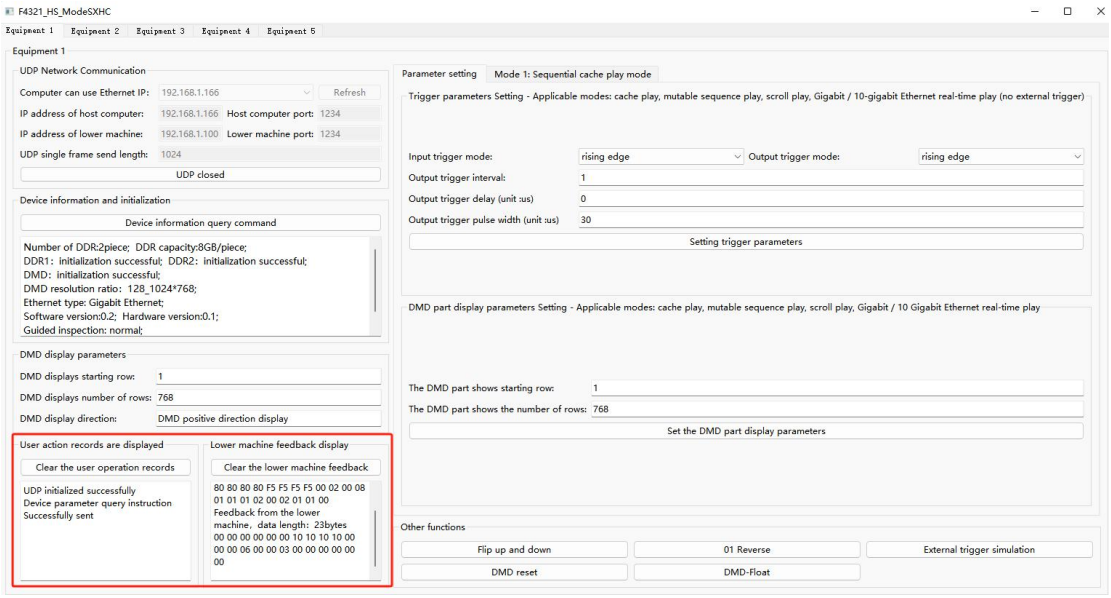
1. Click the device information query command button. If the device information query is successful, the following information will be feedback: the number of DDR, the capacity of a single DDR, the initialization status of DDR and DMD, the resolution of DMD, Ethernet type, software version and hardware version, and the results of the boot check. If the feedback fails, try to power on again and perform the above operations again.



2. At the same time, you can see the DMD display start row, DMD display row number and DMD display direction of the current device in the DMD display parameter interface.



3.User operation record display and lower computer feedback display are used to feed back user operation and software running status;

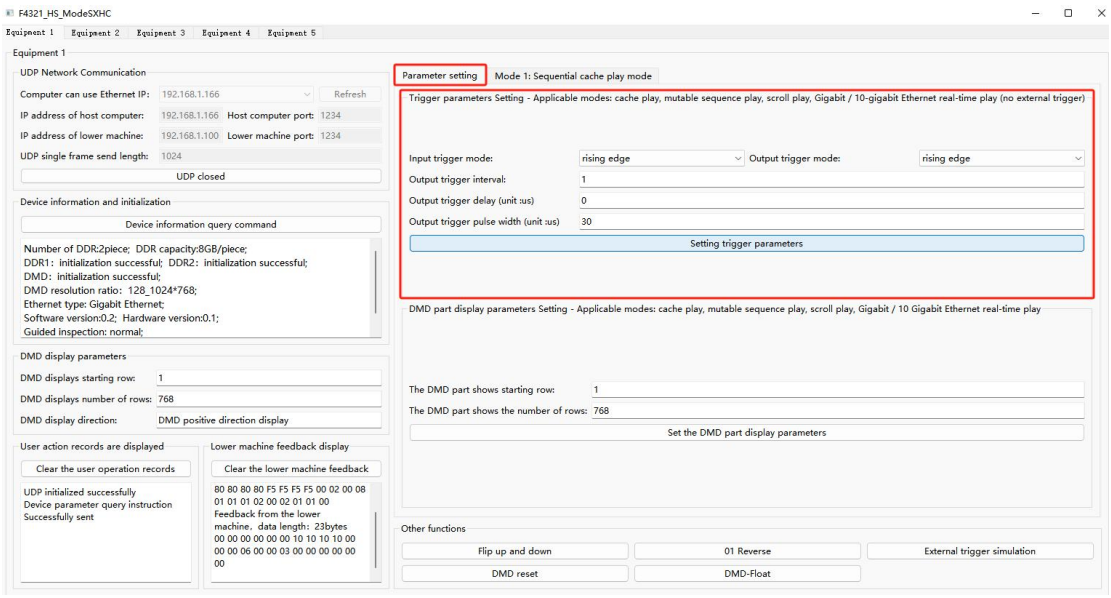


4. Unlock the parameter setting and play mode after the query feedback is completed.

4.2.4 Parameter setting

4.2.4.1. Trigger parameter setting

The module is used to set the parameters of input trigger and output trigger. The input trigger is an external trigger given by the user to the IO port, which is mainly used for the external trigger play mode. Every time the external trigger is received, a picture is played, which can be seen in the sequential cache play mode. The output trigger is at rigger signal that will be given every time before the picture starts playing. The parameters are set as follows:



Input trigger mode: optional rising edge or falling edge trigger.

Output trigger mode: optional rising edge or falling edge trigger.(Connect an oscilloscope to observe the trigger waveform diagram)

Output rigger interval: it means that several pictures are displayed and triggered once. The default value is 1, which means that the output will be triggered before each picture is displayed.

Output trigger delay: set the delay time to delay the output trigger signal and adjust the phase of the output trigger.

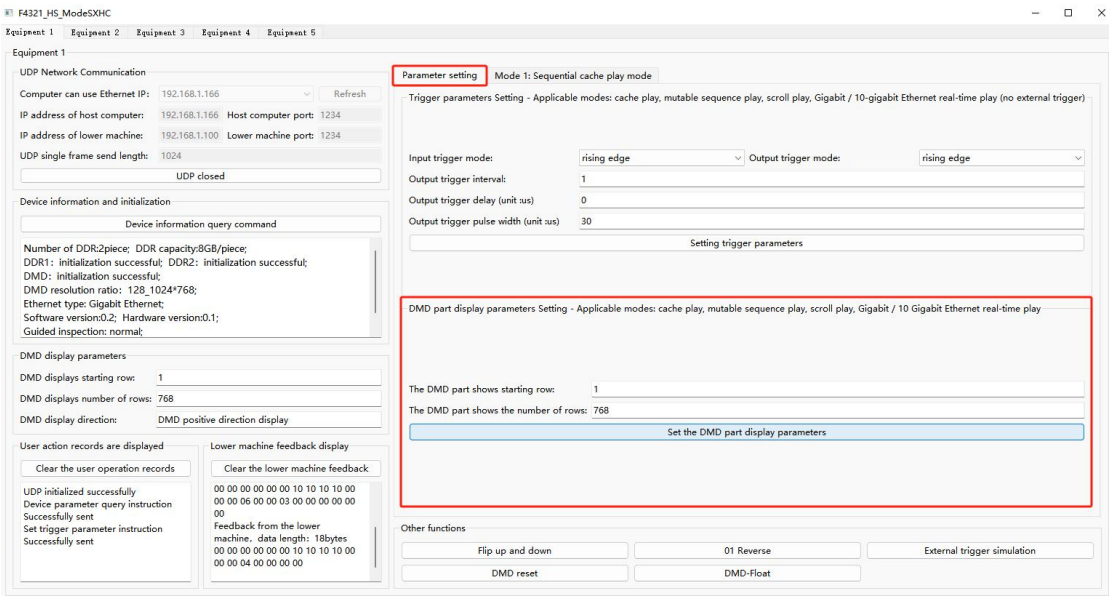
Output trigger pulse width: set the period of output trigger signal.The pulse width of the output trigger should not be greater than the playing time t of each picture, which can be modified as needed.

Note: After the initialization is successful, there will be a set of default values: every picture is triggered once, the trigger delay is 0, and the trigger pulse width is the default value. If there is no special demand,

just click the button of setting trigger parameters, otherwise, change it as needed.

4.2.4.2 DMD part displays parameter settings

This module is mainly used for DMD display row number and start row setting. You can set the display start row and the total number of display rows of the picture. When it is not set, the default display row number is the maximum row number of DMD (768 rows for the sample product), and the default start row is the first row.



Note: If there is no special requirement, it is not necessary to set it,otherwise it will be changed as needed.

Note: The adaptation modes of trigger parameters and some parameters of DMD are as follows:

①sequential cache play mode

②Mutable sequence play mode

③Scroll play mode

④Gigabit/10 Gigabit Ethernet real-time display

4.2.5Other functions

Other functional modules, including image flip up and down, image 01 reverse, analog trigger, DMD reset and DMD float function.

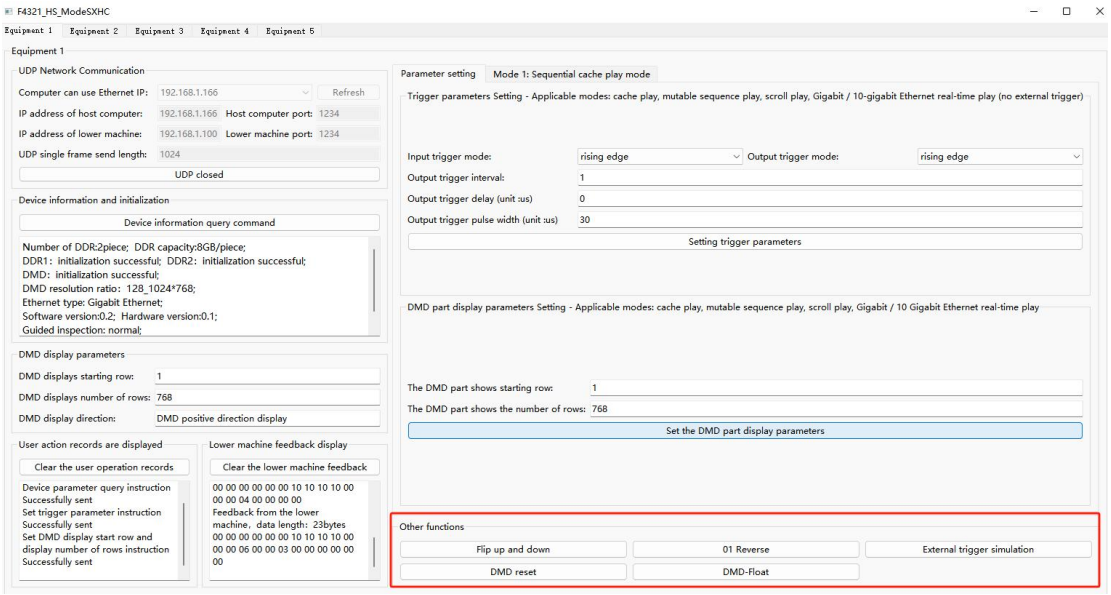


Image Flip Up and Down: Flip the output image up and down, and the new image is symmetrical with the original image.

Note: After setting the image flip, you need to click the button to set the display parameters of the DMD part, and the DMD part will display the parameter of the starting row (if the starting row before setting is 1 and the number of displayed rows is 1080, the starting row will be set to 1080 after setting the image flip up and down, and the number of displayed lines will remain unchanged).

Image data 01 inversion: the output image data 01 is inverted, and

the visual effect is that the black and white parts of the image are interchanged.

Analog external trigger: Click this button to send a simulated external trigger signal. (First set the parameters and external trigger play mode, click the play button, and then click the simulate external trigger button). The specific operation example will have detailed steps.

DMD reset: resets the DMD driver module.

DMD-Float: send the Float command. Use before the product is powered off, and prolong the service life.

4.2.6 Sequential Cache play Mode

4.2.6.1 image loading

The image loading module is mainly responsible for storing image data in sequential cache play mode.

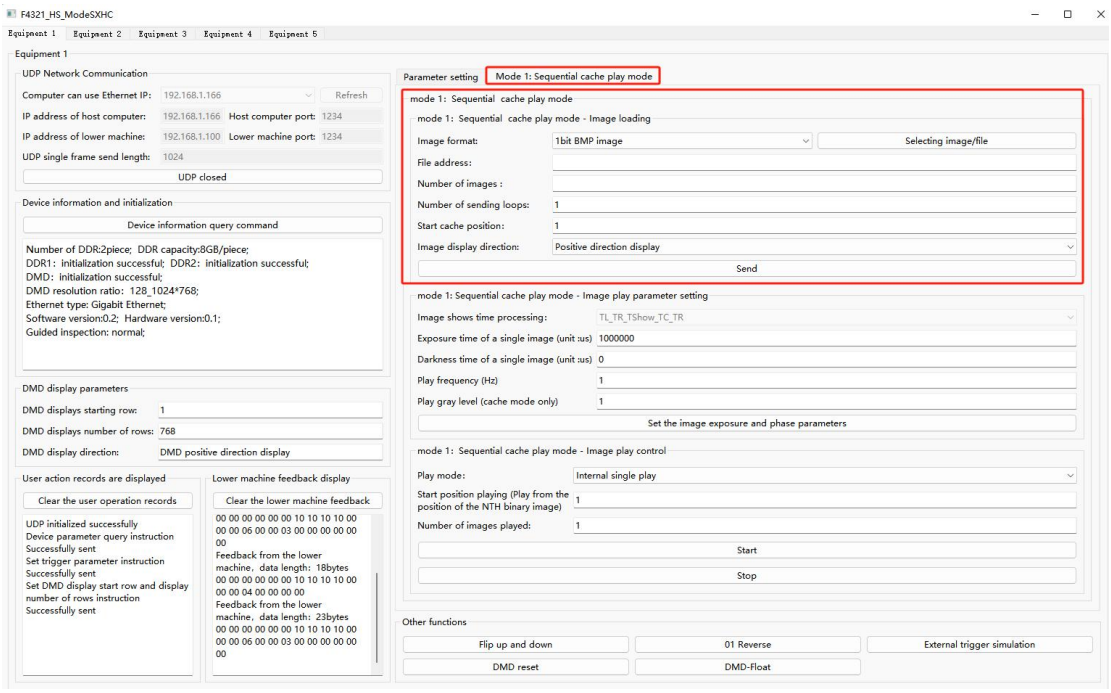


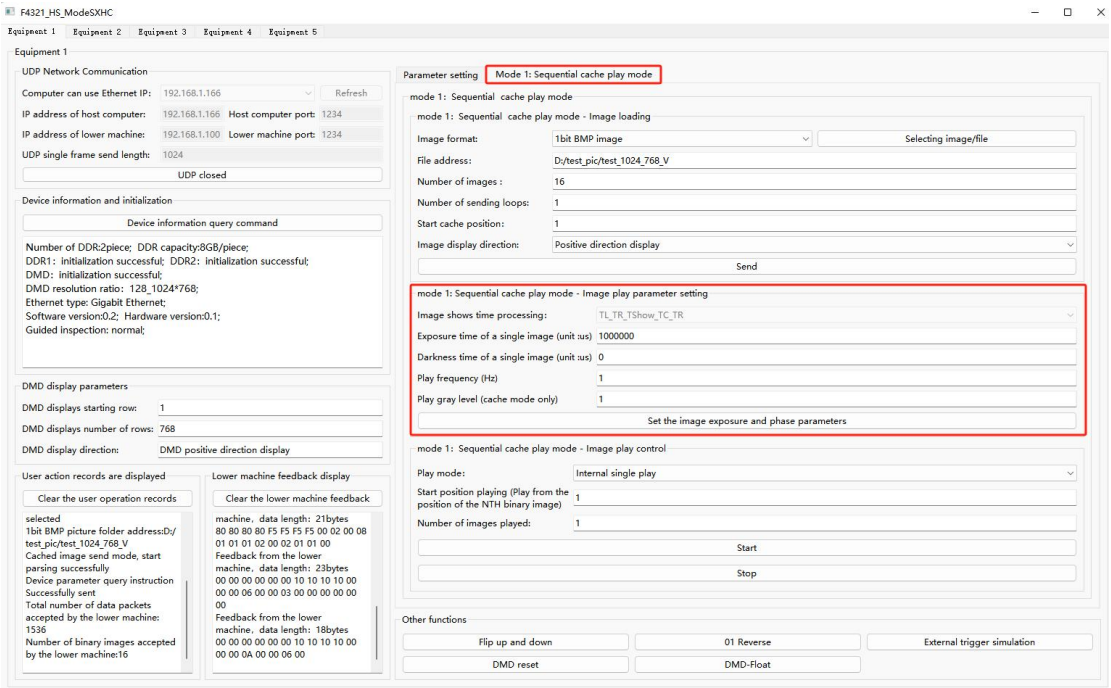
Image file format: 1bit/8bit bmp file, 1bit/8bit bmp folder and 1bit/8bit bin file are supported.

After selecting the image file format, click the Select Image File button. At this time, the file address path and image number of the added image will be detected, So that it is convenient to check whether the path and number are correct. Set the number of times to send the image circularly and the starting position of the image cache (generally fill in 1),select the image display direction, and then click Send Image.

Image display direction: refers to the direction of the image when it is displayed.You can choose forward display, up-and-down mirror display, left-and-right mirror display and center symmetry display as required.

4.2.6.2 image play parameter settings

Image play parameters need to set the exposure time, dark time, play frequency and play gray level of a single output image.



Exposure time of single output image: set the exposure time of single image. Exposure time =TL+TR+TShow+TC+TR, which can be regarded as equal to loading time+maintaining display time+clearing time. The loading time and clearing time of each product are fixed values.

Single output image dark time: set the dark time of a single image. Exposure time+dark time is the playing time of an image.

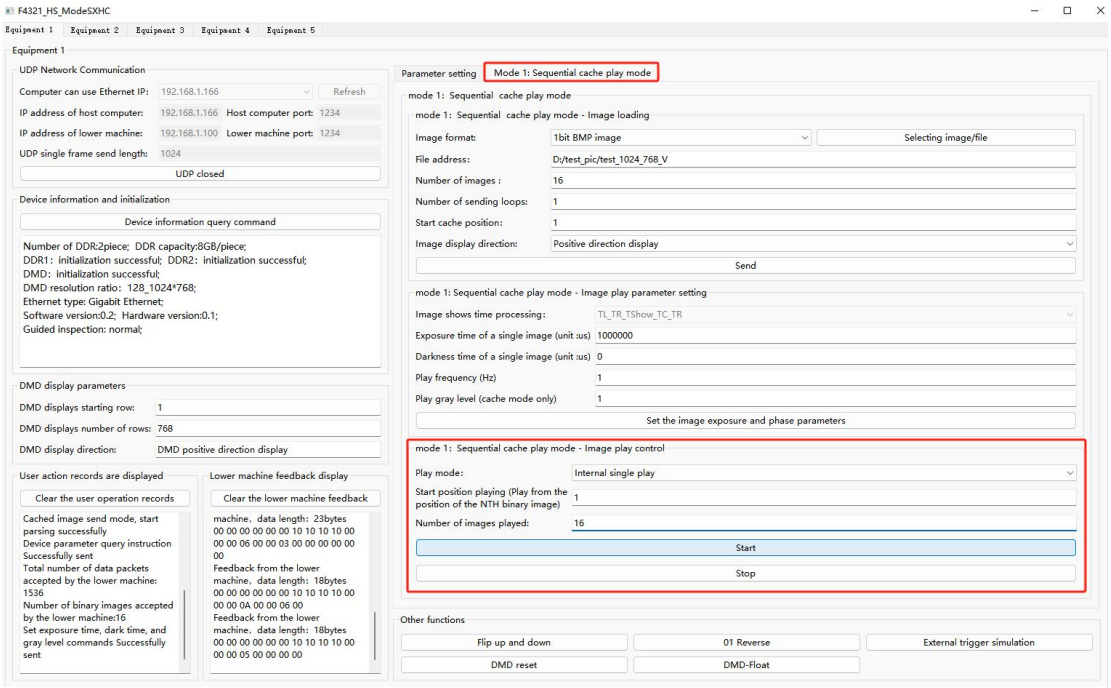
play frequency: the number of image frames played per second, which is used to control the speed of image playing.

play Gray Level: Set the gray level of image play.

Click the Set Image Exposure and Phase Parameters button after setting the parameters.

4.2.6.3 image play control

Image play needs to select the play mode, set the play start position (which picture) and the number of pictures to be played, and then click the Start Play button.



Play mode: internal single shot, internal loop, external single shot and external loop; When internal single shot and internal loop are selected, the picture will be played according to the set exposure time and dark time, and the playing period = exposure time+dark time; When external single shot and external loop are selected, every time an external trigger signal is received, a binary image will be played, and the image will be displayed according to the set exposure time and the

external trigger signal will be responded again after the display is completed.

Play Start Position: select the start picture of this play (if 1, play will start from the first stored picture).

Number of Played Pictures: how many pictures are played at a time? If the gray level selected in parameter setting is not 1, the number of played pictures should be an integer multiple of the gray level (for example, if the gray level is set to 8, the minimum number of played pictures is 8).

Supplementary note: There are three kinds of display situations of sequential cache playback mode. According to the above -mentioned display time, the module settings can be divided into:

a. The gray level is 1 and the dark time is 0.

b. The gray level is 1 and the dark time is not 0.

c. The gray level is not 1.

From the above, the display period of an image = exposure time+dark time, which can be regarded as equal to loading time+display time+clearing time+dark time. The display periods of the above three cases are displayed according to the following rules:

a. Display period = loading time+display time.

b. Display period = loading time+display time+clearing time+dark time.

c. Taking gray level 8 as an example, the display period = loading time 1+ display time 1+ clearing time 1+ loading time 2+ clearing time 2.....+loading time 8+ display time 8+ clearing time 8+ dark time.

It can be seen that when the gray level is 1 and the dark time is 0, it is a special case. In the unit display period, the proportion of display time is increased. Compared with case 2 where the dark time is not 0, under the condition that the required display time is the same, the required display period of Case 1 is shorter, and a faster playback frequency can be set.

4.2.7 Mutable sequence play mode

4.2.7.1 image loading

The image loading module is mainly responsible for storing the image data in the mutable sequence play mode.

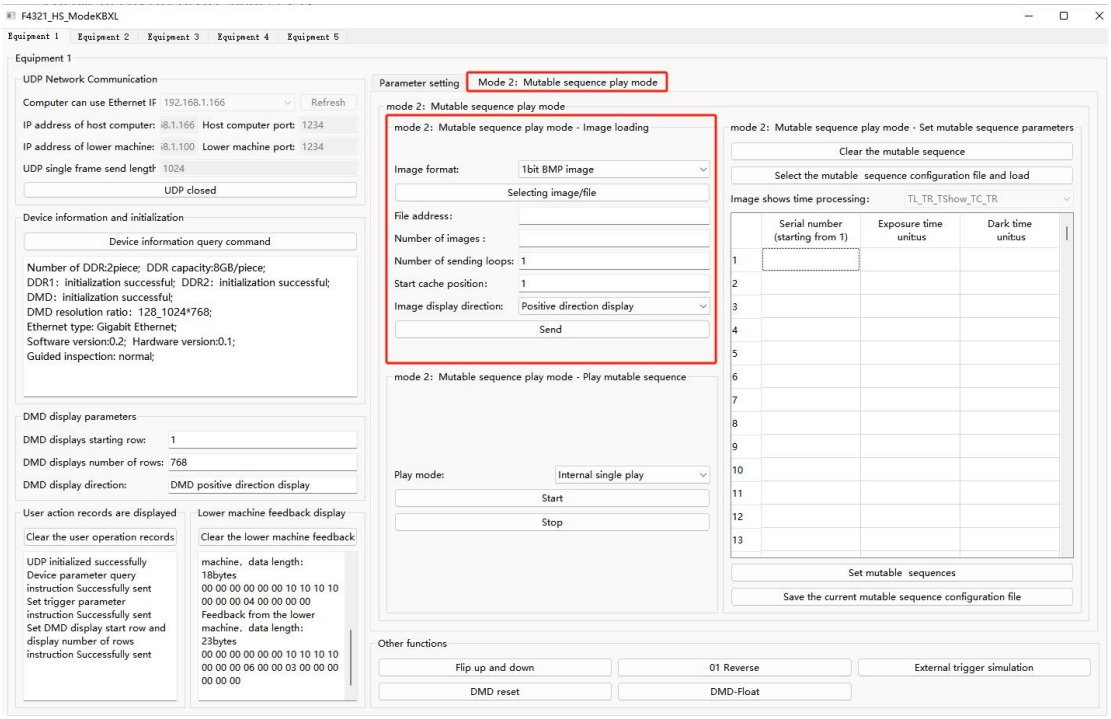


Image file format: supports 1-bit bmp file, 1-bit bmp folder and 1-bit bin file.

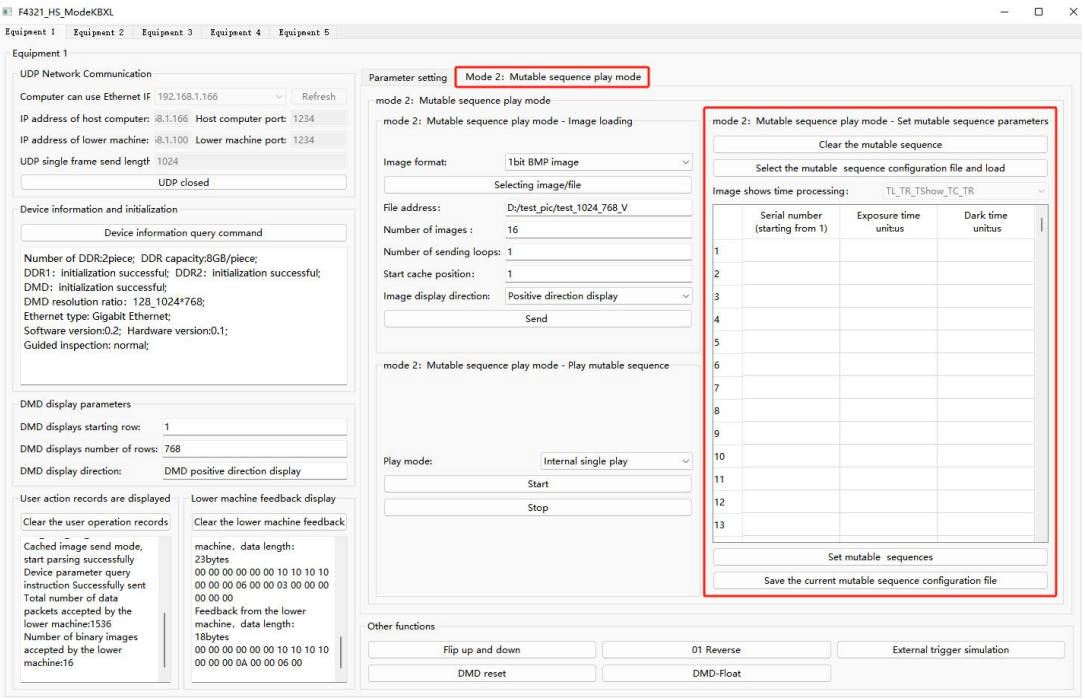
After selecting the image file format, click the Select Image File button. At this time, the file address path and image number of the added image will be detected, so that it is convenient to check whether the path and number are correct. Set the number of times to send the image circularly and the starting position of the image cache (generally fill in 1), select the image display direction, and then click Send Image.

Image display direction: refers to the direction when the image is displayed, and different display directions can be selected as required.

4.2.7.2 Sets mutable sequence parameters.

Set the serial number, exposure time and dark time of the picture to

be played.

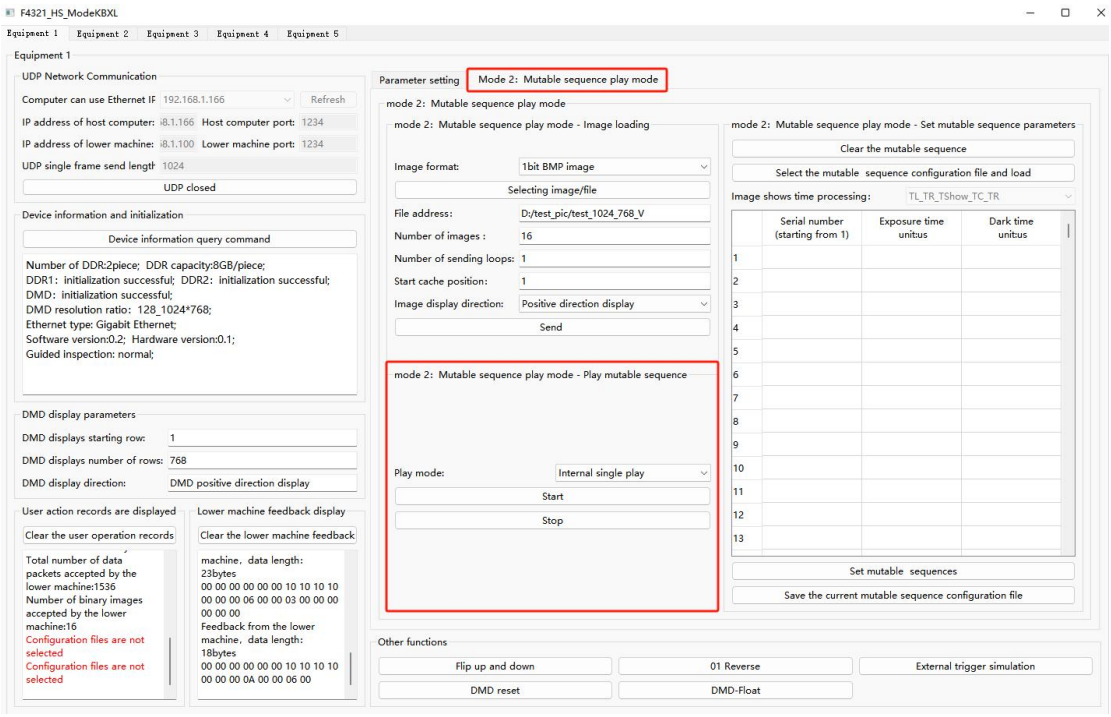


Set the serial number, exposure time and dark time of the picture to be played from top to bottom. The serial number represents which binary picture to play, and you can fill in any serial number as needed, (Example: 100 binary pictures are stored in the image loading module, and the serial number can be any value from 1 to 100.)

Set the parameters of the mutable sequence, and click Start to play the mutable sequence. The pictures will be played according to the set parameters from top to bottom.

Note: the serial number, exposure time and dark time must be filled in, or there will be an error.

4.2.7.3 Plays mutable sequence



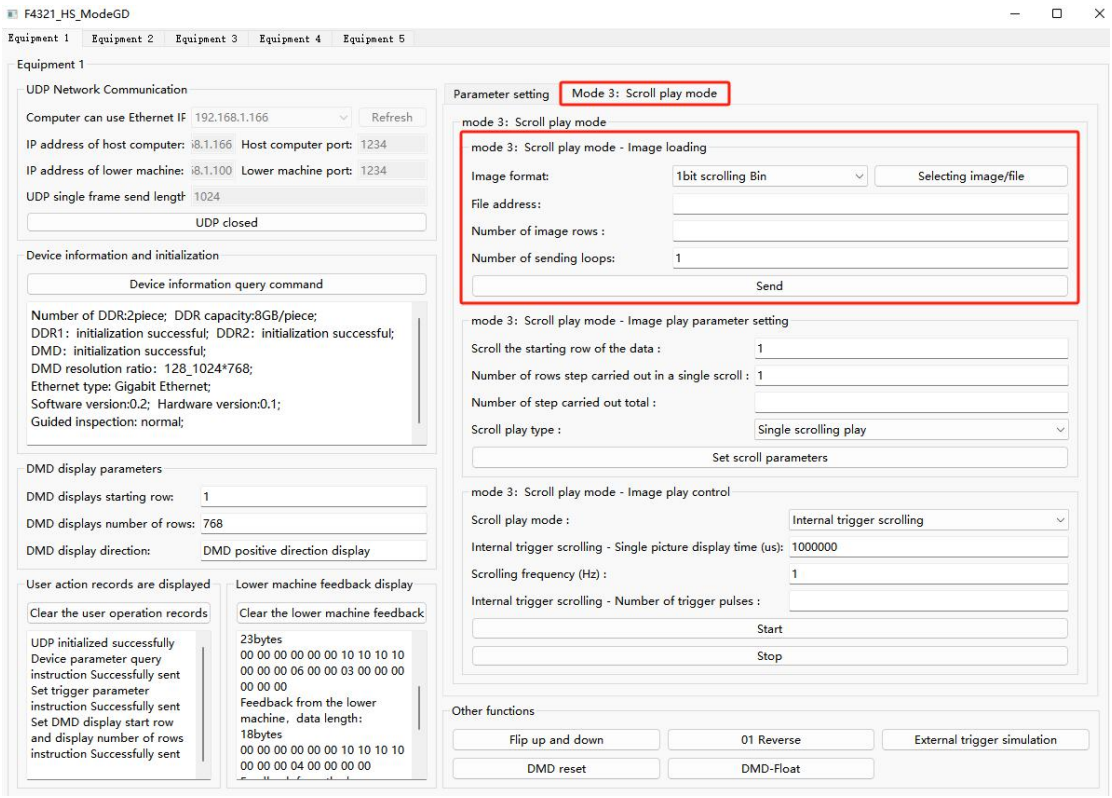
Play modes of mutable sequence: internal single shot, internal loop, external single shot and external loop. The relevant rules are consistent with the above-mentioned sequential cache playback. Just click the button to start playing mutable sequence after selecting the play mode and setting the mutable sequence parameters.

Save mutable sequence configuration file: the set parameters can be saved by clicking the Save current mutable sequence configuration file button, which is convenient to directly select the mutable sequence configuration file and load it (the set mutable sequence configuration) for use in the future.

4.2.8 Scroll play mode

4.2.8.1 image loading

The image loading module is mainly responsible for storing the image data in the mutable sequence playback mode.



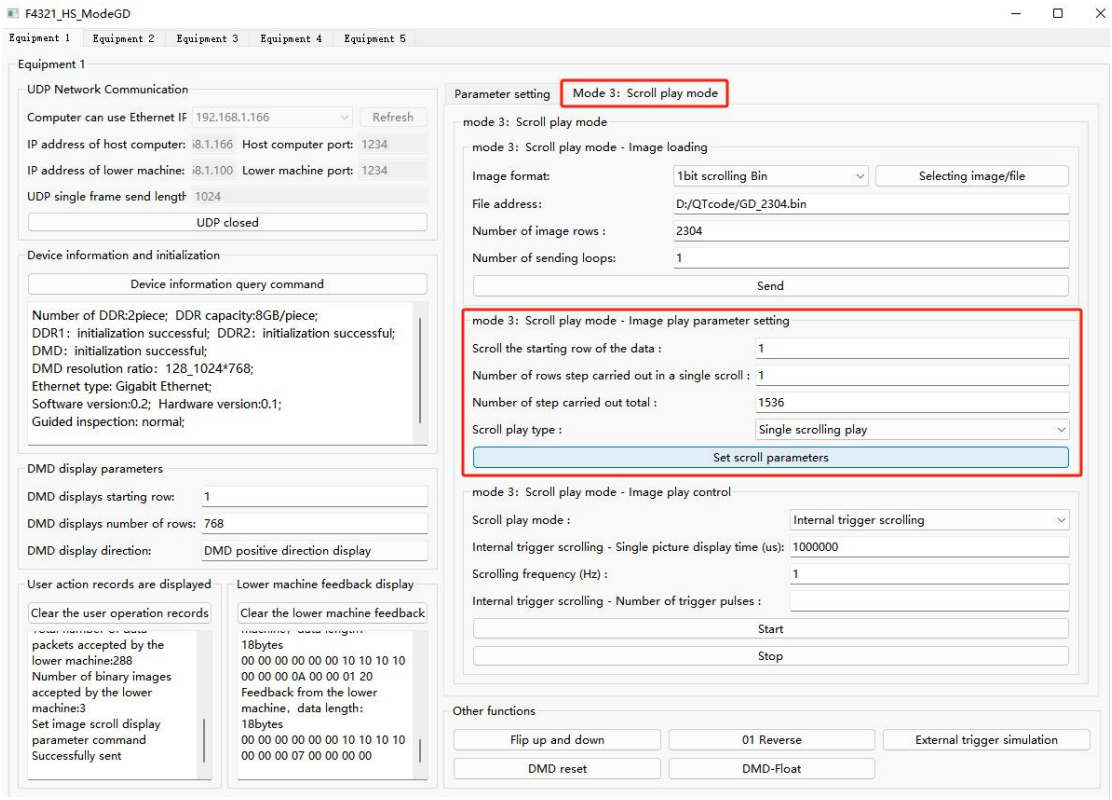
Before setting the scrolling playback, select the image file format to be scrolled (the image file needs to be made by yourself, select the image file and load it. A this time, the file address path of the added image will be detected, which is convenient for checking whether the path is correct, Set the number of rows of scrolling images and the number of times to send images circularly, and click the Send Image button.

Calculation of the total number of scrolling image rows:

Resolution number of columns * total number of rows in the picture /8/UDP single frame transmission length number of packets

4.2.8.2 image play parameter settings

Image playback parameters need to set the starting line of scrolling data, the number of stepping lines in a single scrolling and the total number of stepping lines, and also need to select the playback type of scrolling.



Starting row of scrolling data: select the line from which the scrolling data starts to scroll in the stored image.

For example, if the number of DMD display lines ls set to 1080, setting the scrolling start behavior 1 means scrolling from the first line of the

first picture, and 1085 means scrolling from the fifth line of the second picture. Generally, just keep the default.

Number of steps in a single scroll: after a picture is displayed, the number of lines at the beginning of the next displayed picture is increased compared with the beginning of the previous picture.

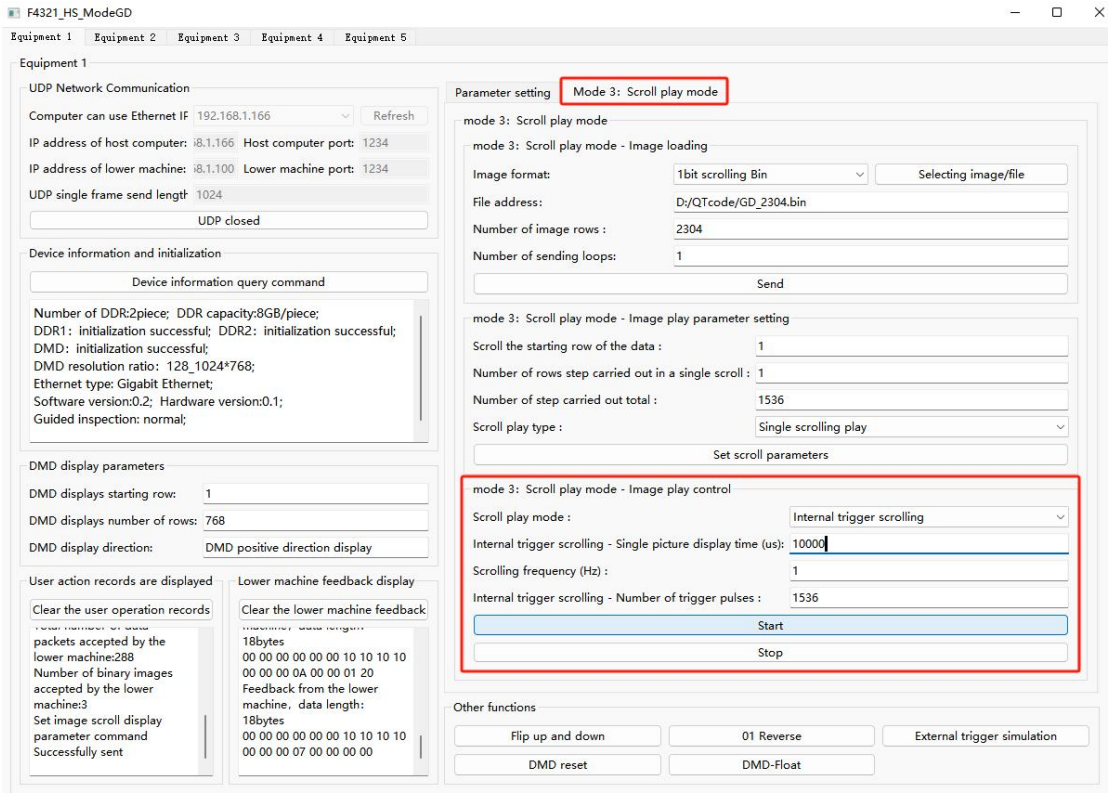
Total Step Times: Set the total step times for scrolling. (Total number of steps = total number of lines in the picture-number of lines with resolution)

Scroll playback type: single scroll playback and cyclic scroll play can be selected.

Click the Set Scroll Parameters button after the above four parameters are set.

4.2.8.3 image play control

Scroll playback needs to select the playback mode and set the number of trigger pulses for internal trigger scrolling-single image display time,scrolling frequency and internal rigger scrolling.



Scroll play mode: divided into internal trigger scrolling and external trigger scrolling. The internal and external trigger rules are the same as those mentioned above. The internal trigger is the trigger source according to the set time, and the external tiger is the trigger source provided by the user.

Internal trigger scrolling-singe image display time: only the internal trigger scrolling mode is available which is equivalent to the play period.

Scroll frequency: the number of times of scrolling per second In an image play system.

Internal trigger scrolling-number of trigger pulses: consistent with the total number of steps. (Note: This parameter is invalid when the scrolling type is circular scrolling.)

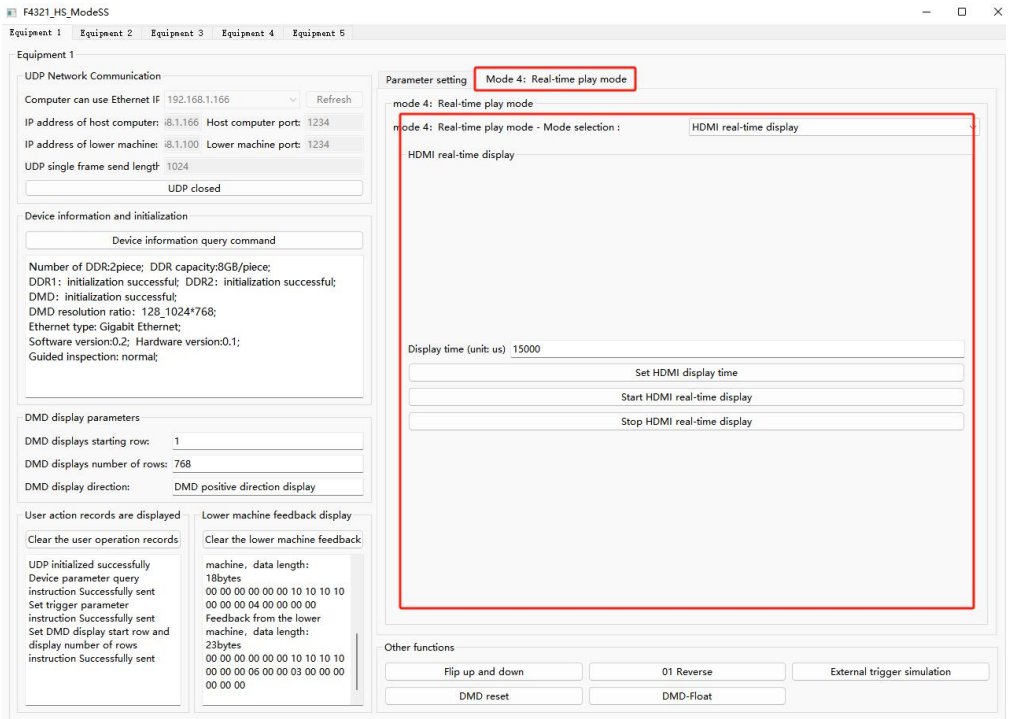
When scrolling is triggered externally, the scrolling parameters should be strictly followed. The tw0 parameters of scrolling triggered internally are invalid, and the display time of a single scrolling image= the time interval between two adjacent external triggers.

After the setting is completed, click Start Scrolling Play to start scrolling display.

4.2.9 Image Real-time Mode

4.2.9.1 HDMI real-time display

The following figure shows the HDMI real-time playback interface.In the drop -down list of real-time playback mode, select HDMI real-time display (this function is optional, and you need to purchase additional hardware. This function is only available if the hardware supports it).

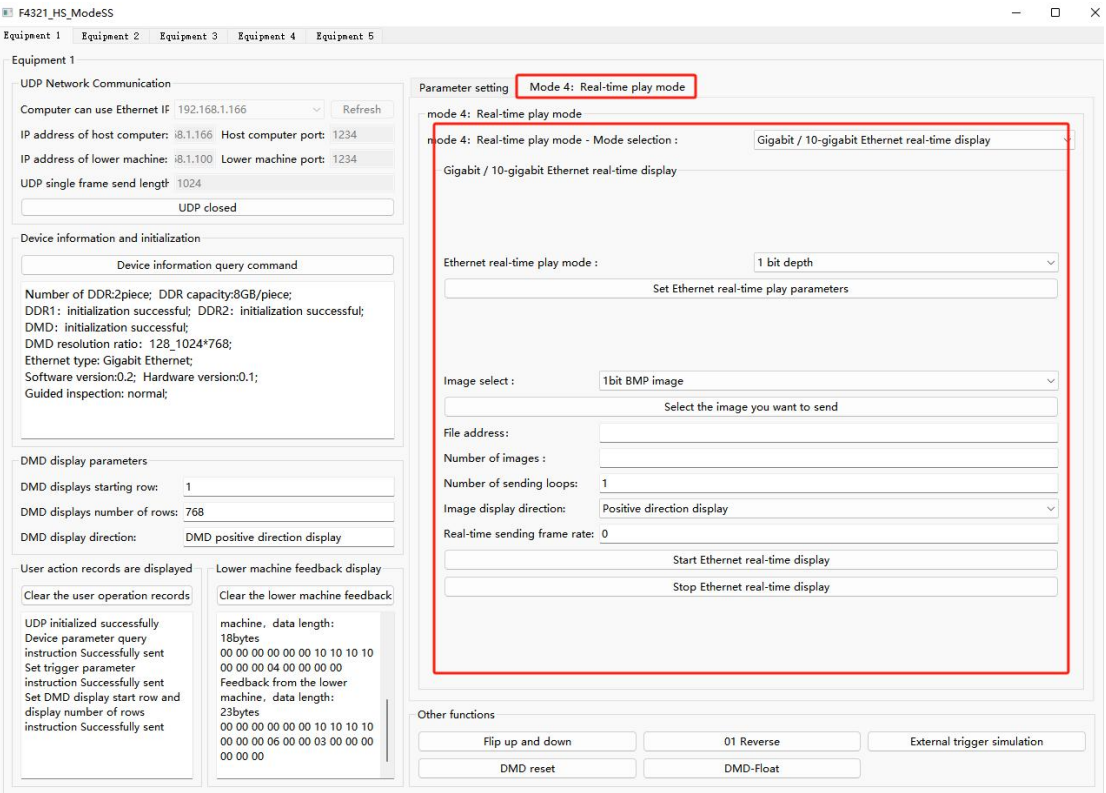


Display time: HDMI playback is 60HZ/0.9 pseudo-synchronous play, and the default display time is 15000us, which can be modified as needed. Reducing the display time will increase the dark time, and generally it is enough to keep the default.

Click Start HDMI Real-time Display after setting the display time, and then click Stop HDMI Real-time Display to exit the HDMI play state.

4.2.9.2 Gigabit/10Gigabit Ethernet Real-time Display

The following figure shows the Ethernet real-time play module.This product supports Gigabit/10Gigabit real-time playback. In the drop-down list of real-time playback, select Gigabit/10 Gigabit Ethernet real-time display.



Ethernet real-time playback mode: 1-bit depth or 8-bit depth can be selected.

Image selection: support 1bit BMP/BIN.

Click Set Real-time Playing Parameters of Ethernet after setting; Click to select the file address of the image and the number of pictures to be detected after sending the image, fill in the cycle sending times and real-time sending frame rate of the image, select the image display direction, and click to start the Ethernet real-time display.

Image display direction: refers to the direction of the image when it is displayed. You can choose forward display, up-and-down mirror display, left-and-right mirror display and center symmetry display as required.

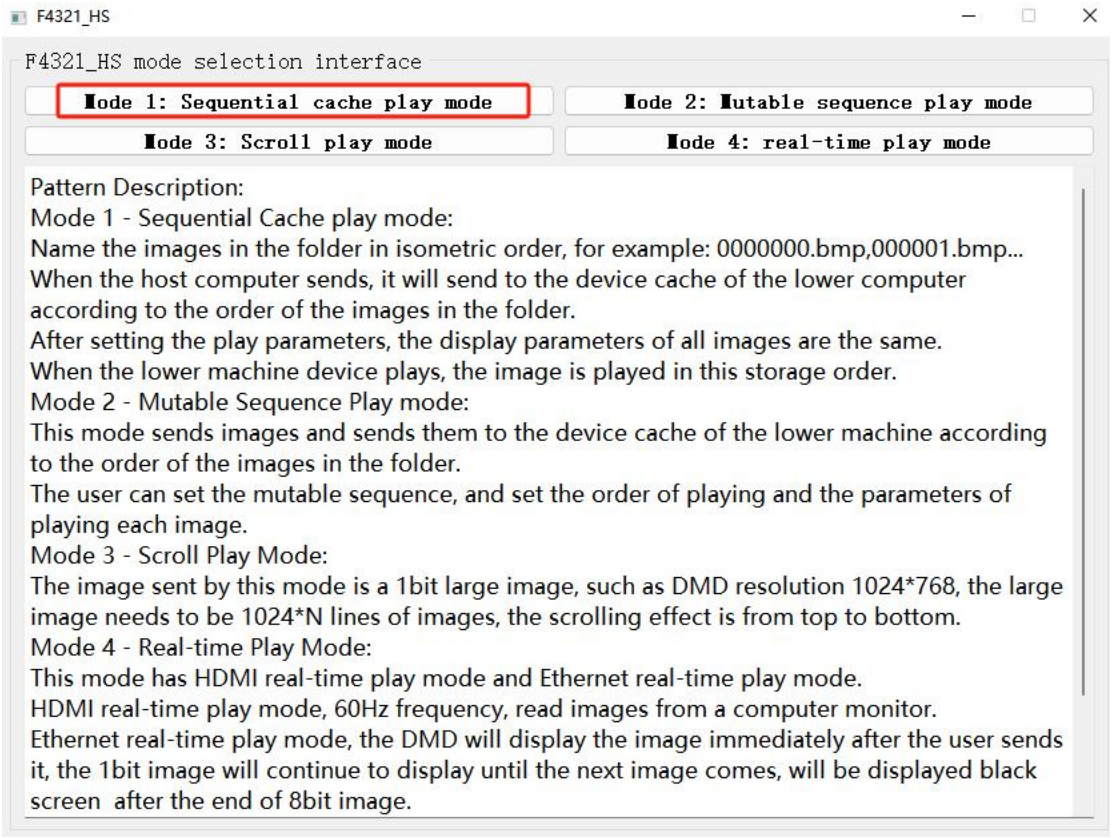
Real-time transmission frame rate: refers to the frame rate of image transmission, that is, the number of image frames transmitted per second.

Note: When you click Stop Real- time Display over Ethernet before the play is over, the image play will stop, but the data transmission over Ethernet has not stopped. You need to wait for a few seconds (within 5s) before playing again, depending on whether the corresponding Ethernet in Task Manager-Performance finishes sending.

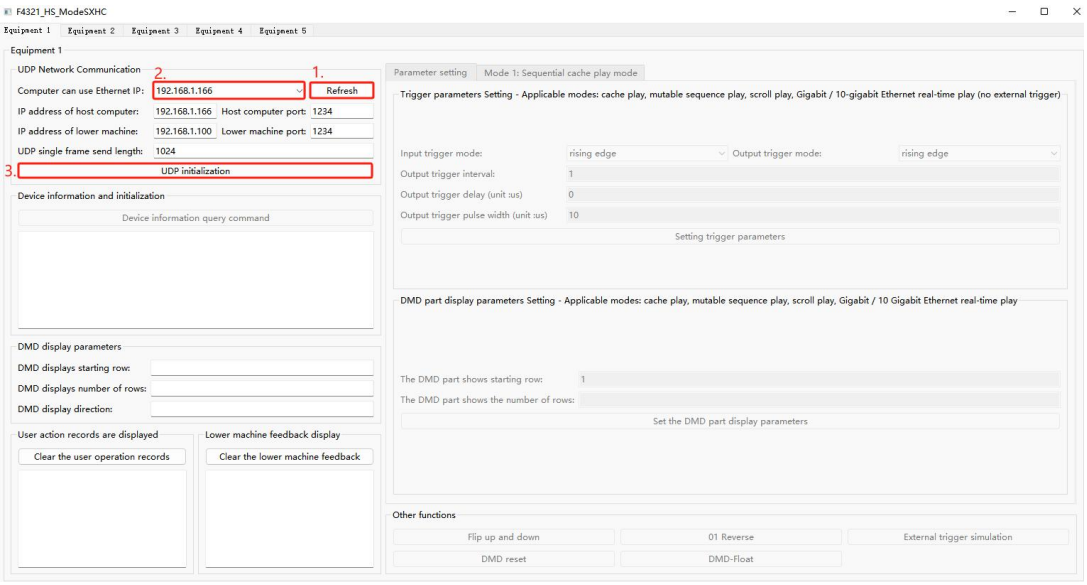
5. Example of upper computer software operation

5.1 Sequential cache mode - binary picture play example

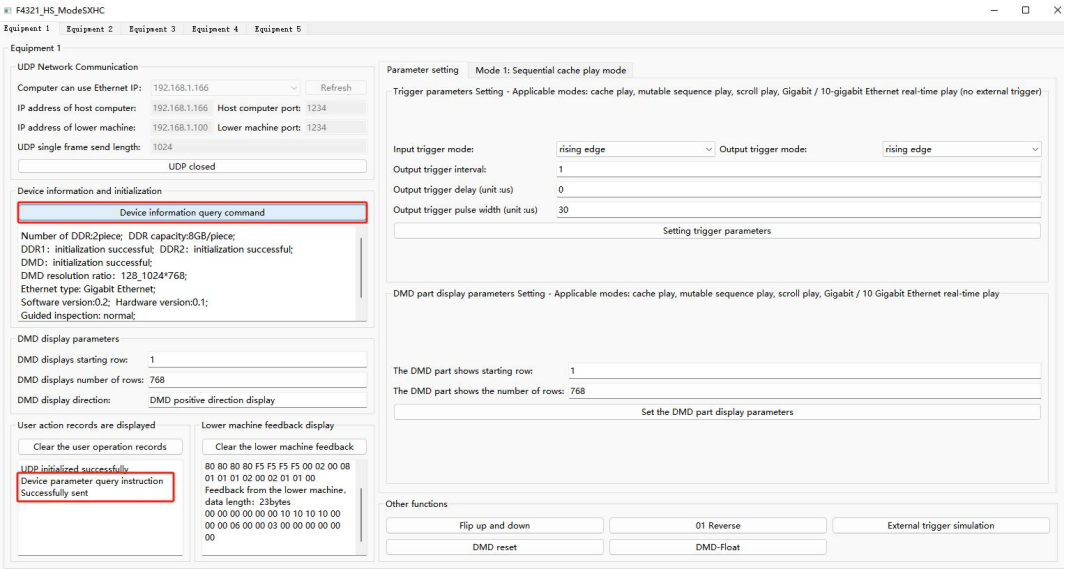
1. Connect the network port and power supply, open the upper computer software, select the sequential cache playback mode, and enter a new interface.



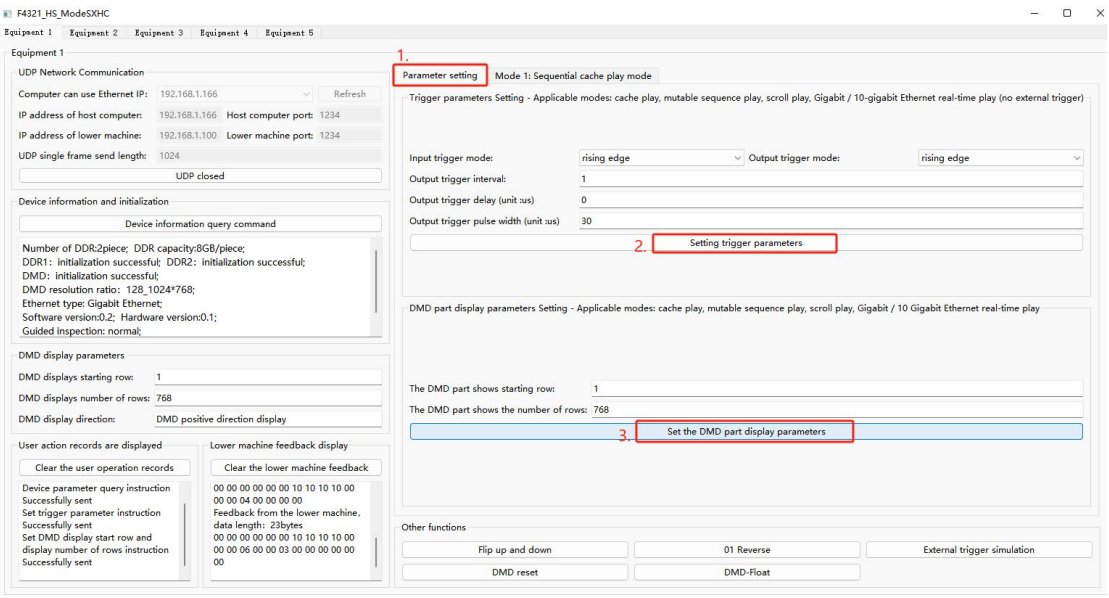
2. Click the refresh button, select the set IP address, and click the UDP initialization button, After the initialization is successful, the user operation record will show that UDP initialization is successful.



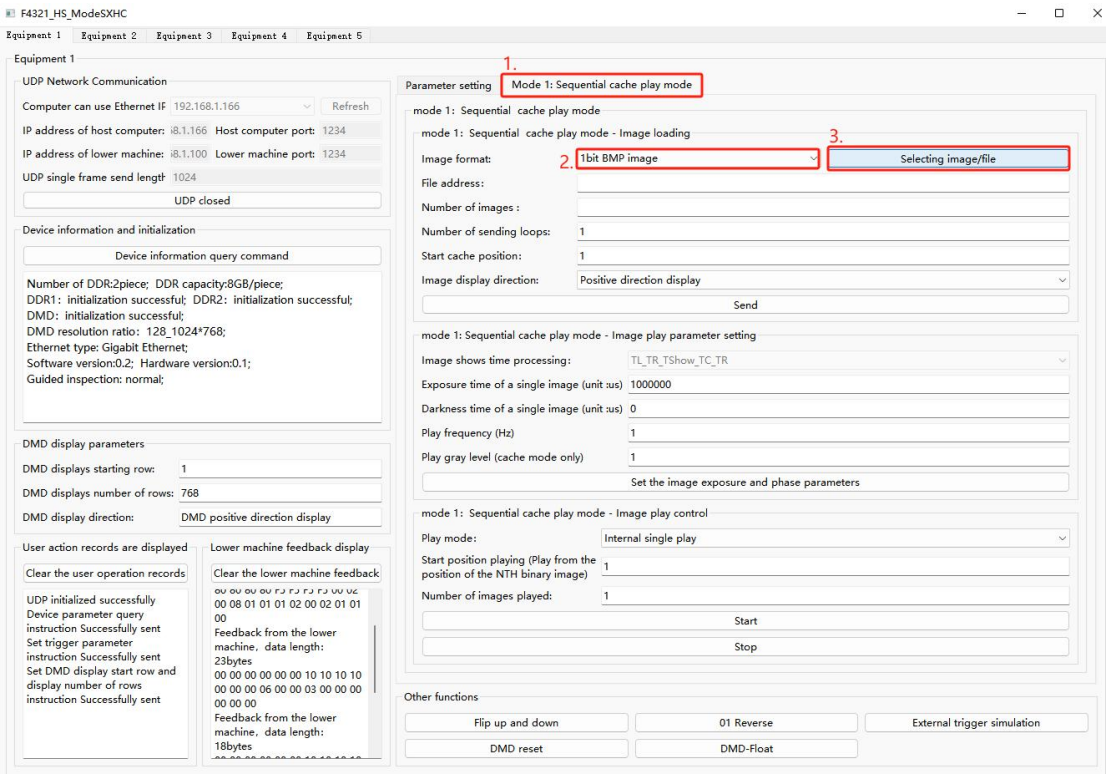
3. Click the device information query command to detect the initialization status, some parameter information and DMD display parameters.



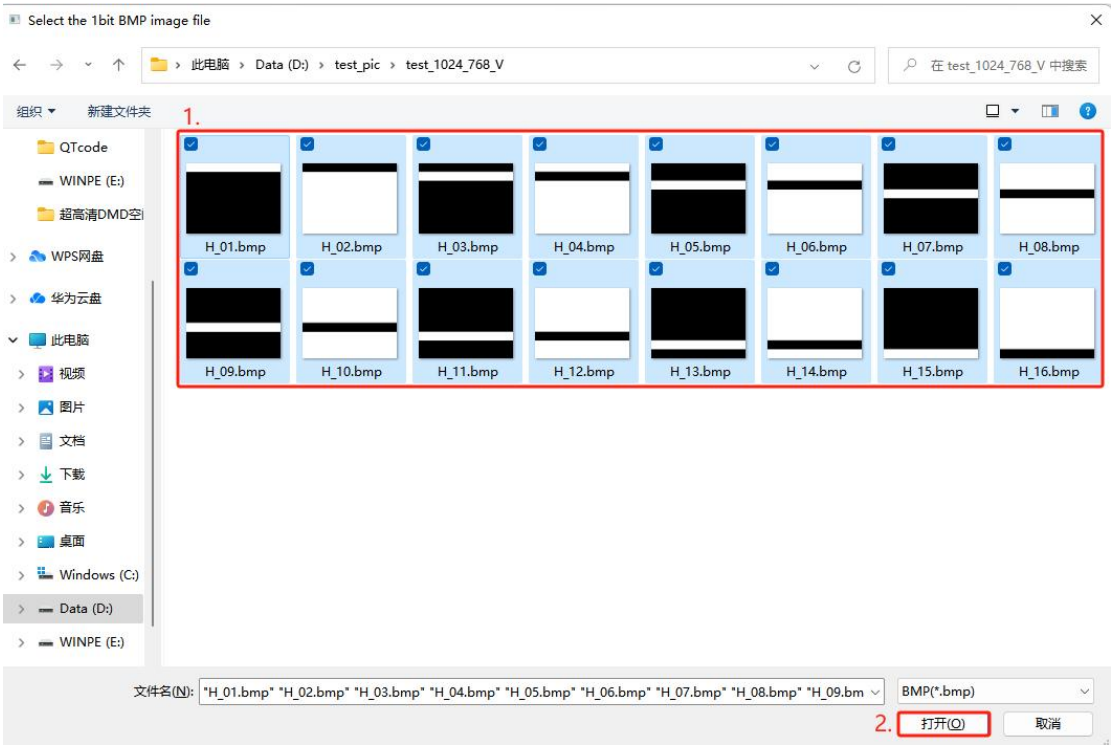
4. Click on the parameter setting page to set the trigger parameters and DMD parameters (if there is no special requirement, just click on the button of setting the trigger parameters according to the system default values, and then click on the button of setting the DMD display parameters).



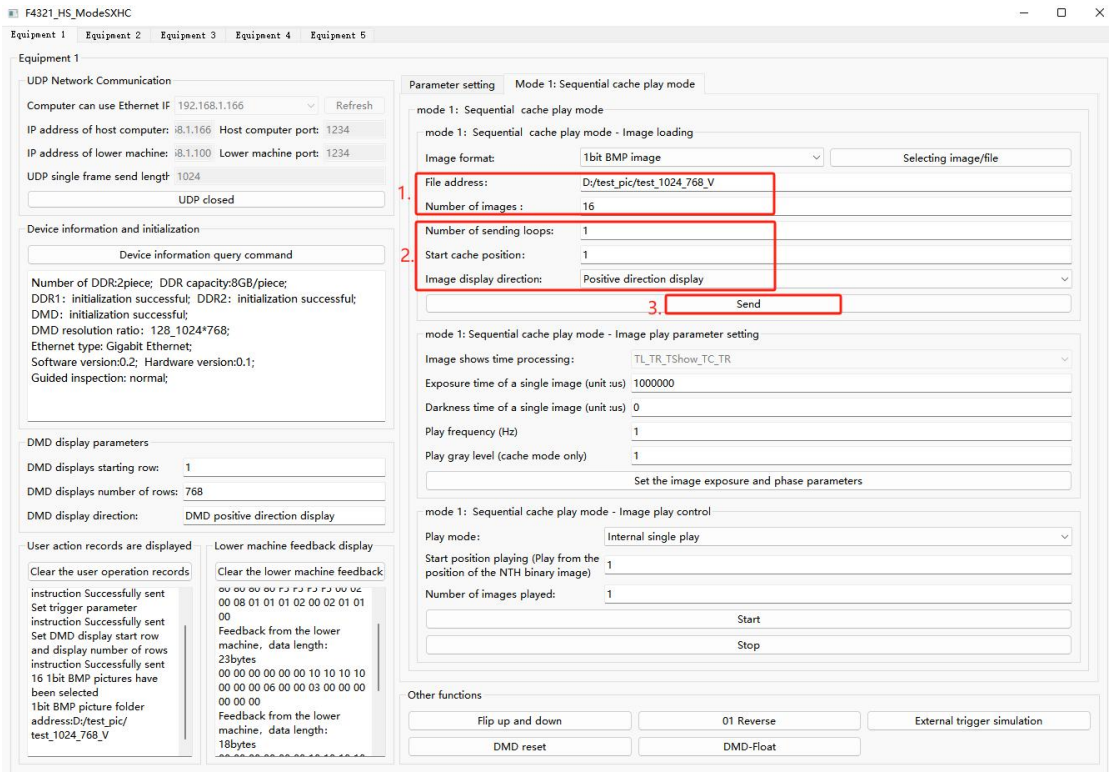
5. After setting the parameters, enter the sequential image cache mode, select the image file format to be loaded, and click the Select Image File button to enter the image folder selection page of the corresponding image format.



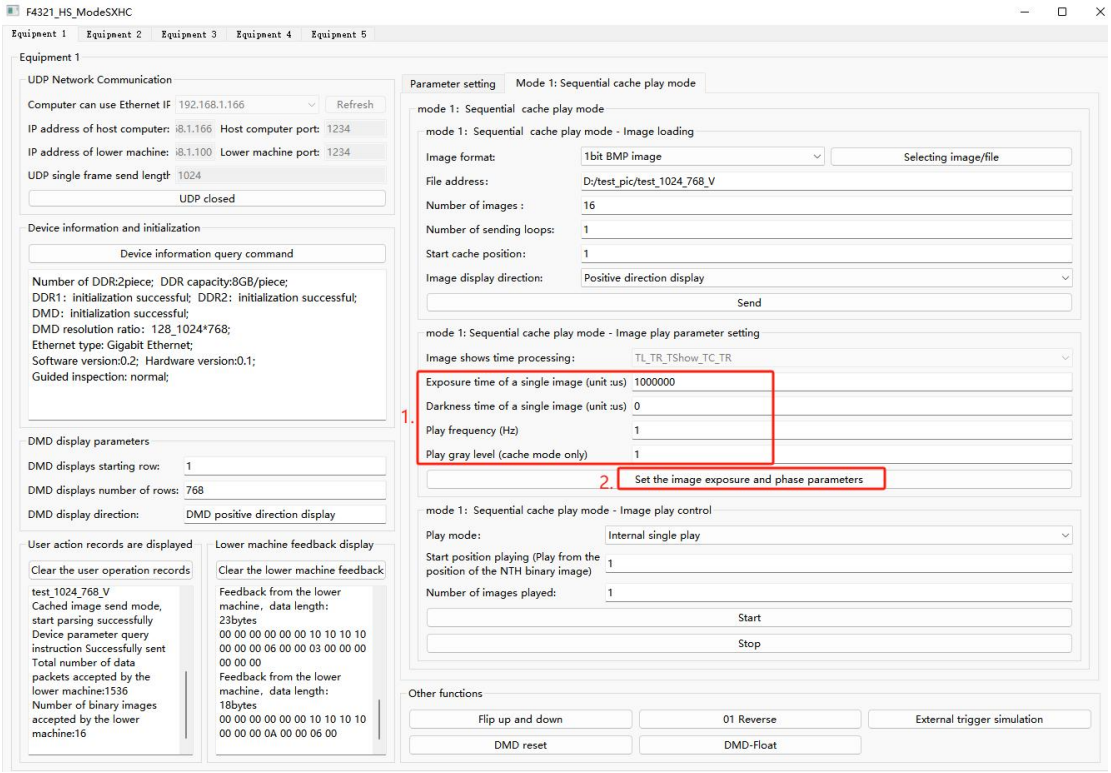
6. Select the image folder with corresponding resolution, select the desired image and click Open.



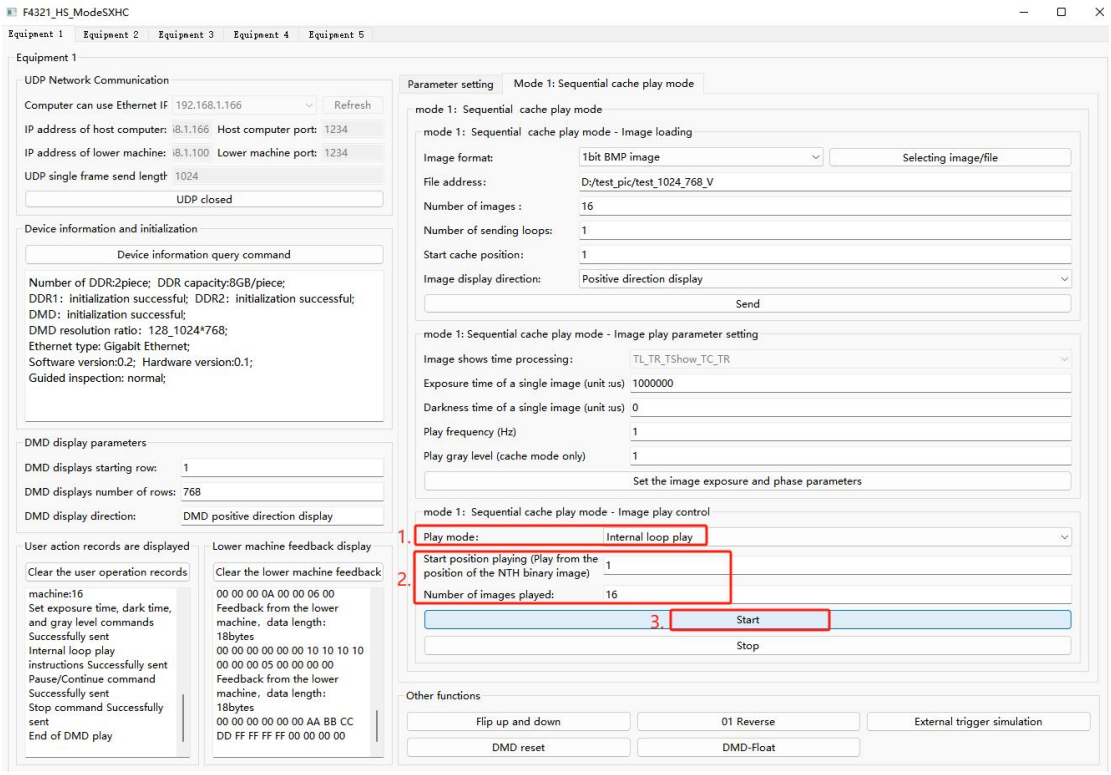
7. The file address and number of images will be automatically detected. At this time, you only need to check whether it is the same as the image address and number you loaded, then fill in the number of times the image is sent circularly and the location of the initial cache, select the image display direction, and click the Send Image button. After the image is sent successfully, the user operation record will display the number of accepted data packets and the number of binary images.



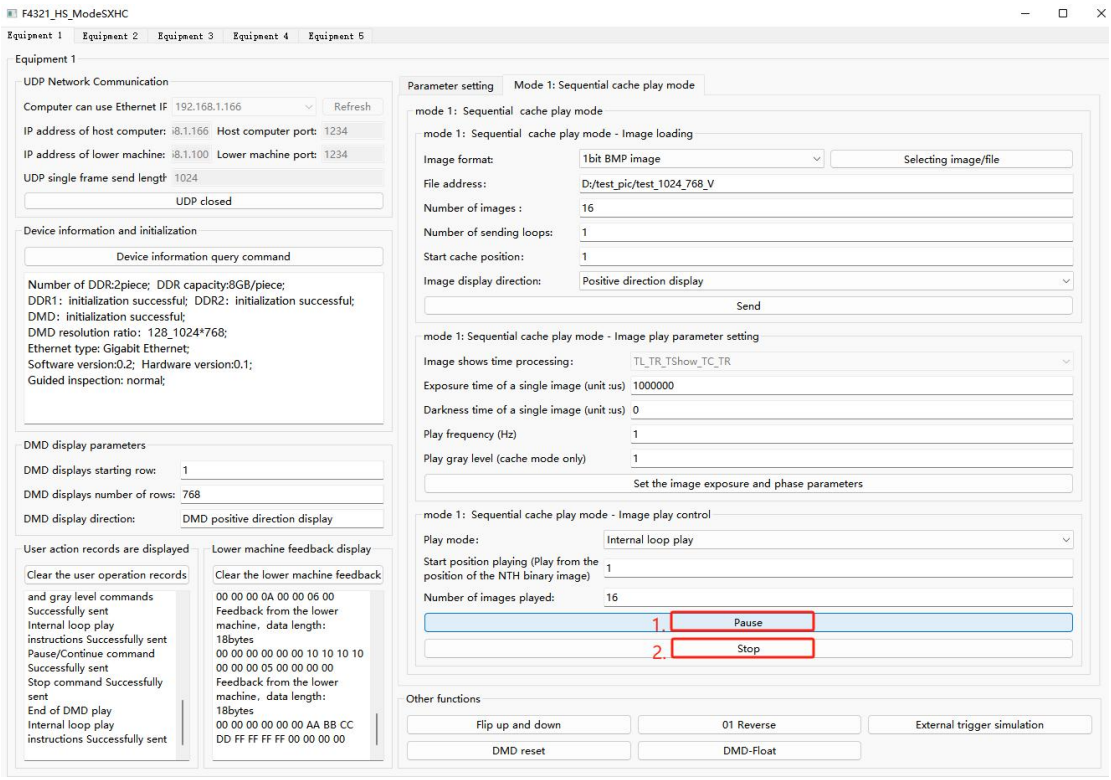
8. Set the exposure time of single image output to 1 second, the dark time to 0, the playback frequency to 1 and the playback gray level to 1,and click the Set Image Exposure and Phase Parameters button.



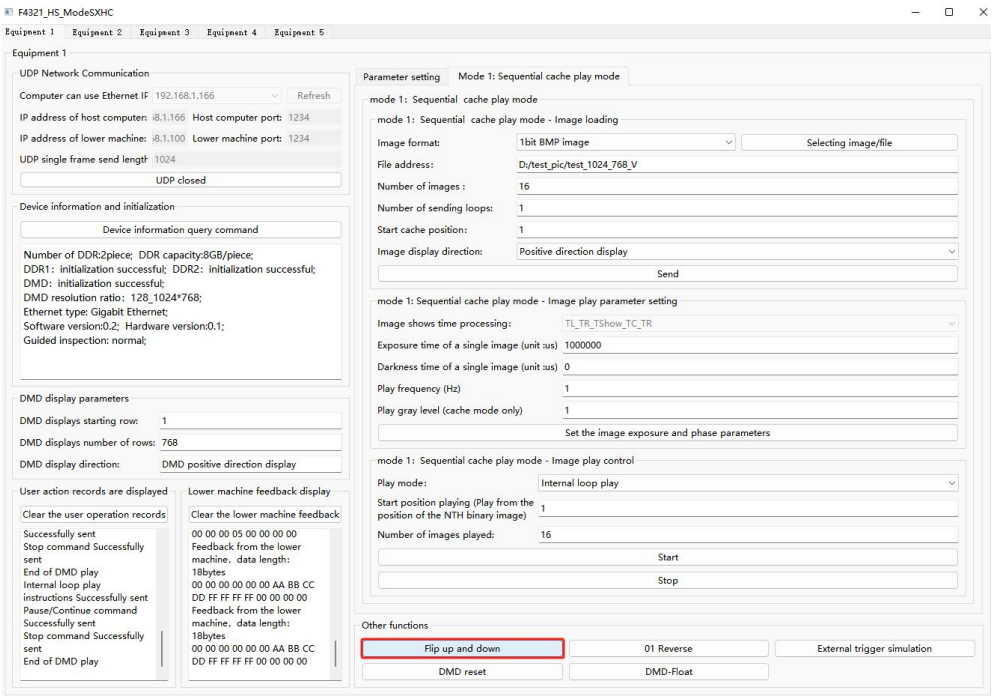
9. Select the play mode as cache playback-internal loop, set the starting position of picture playback to 1 and the number of pictures to be played to 16, and click the Start Play button. At this time, the loaded pictures will be played on the DMD according to the set playback mode.



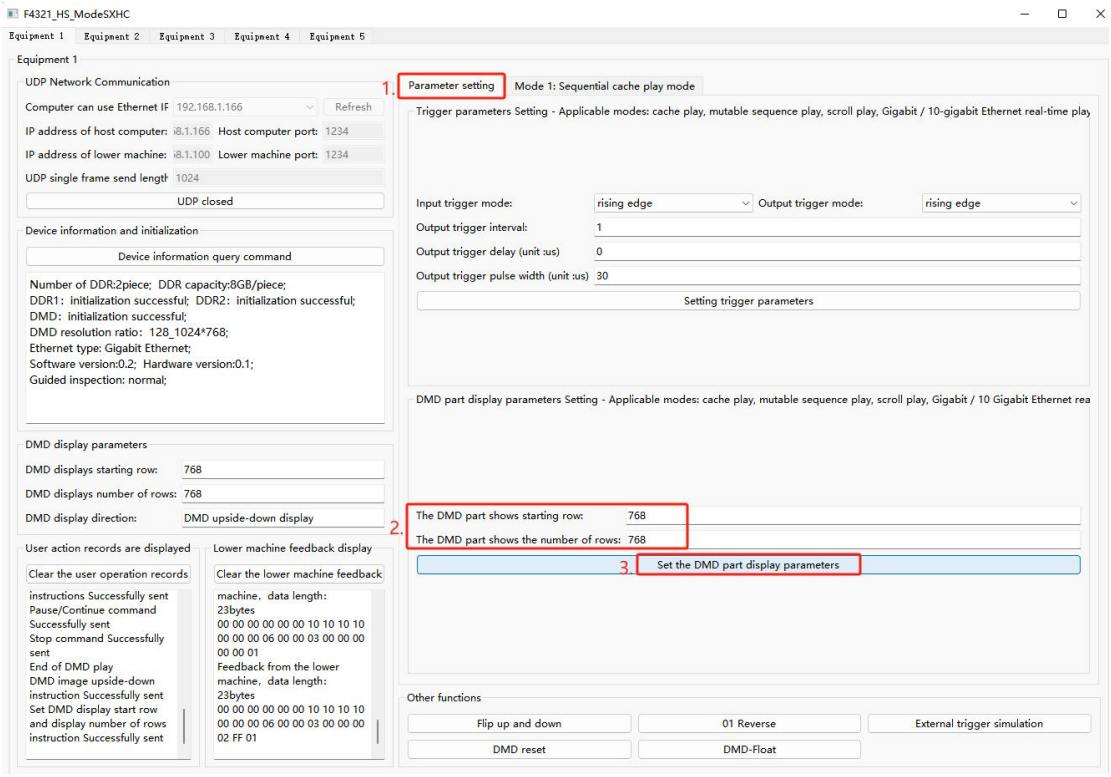
10. After playing, click Pause to pause the current playing state. At this time, the Pause button will become the Continue Playing button. Click the Continue Playing button to resume playing from the last paused picture position. If you need to stop playing DMD, you need to click the Pause button first, and then click the Stop button.



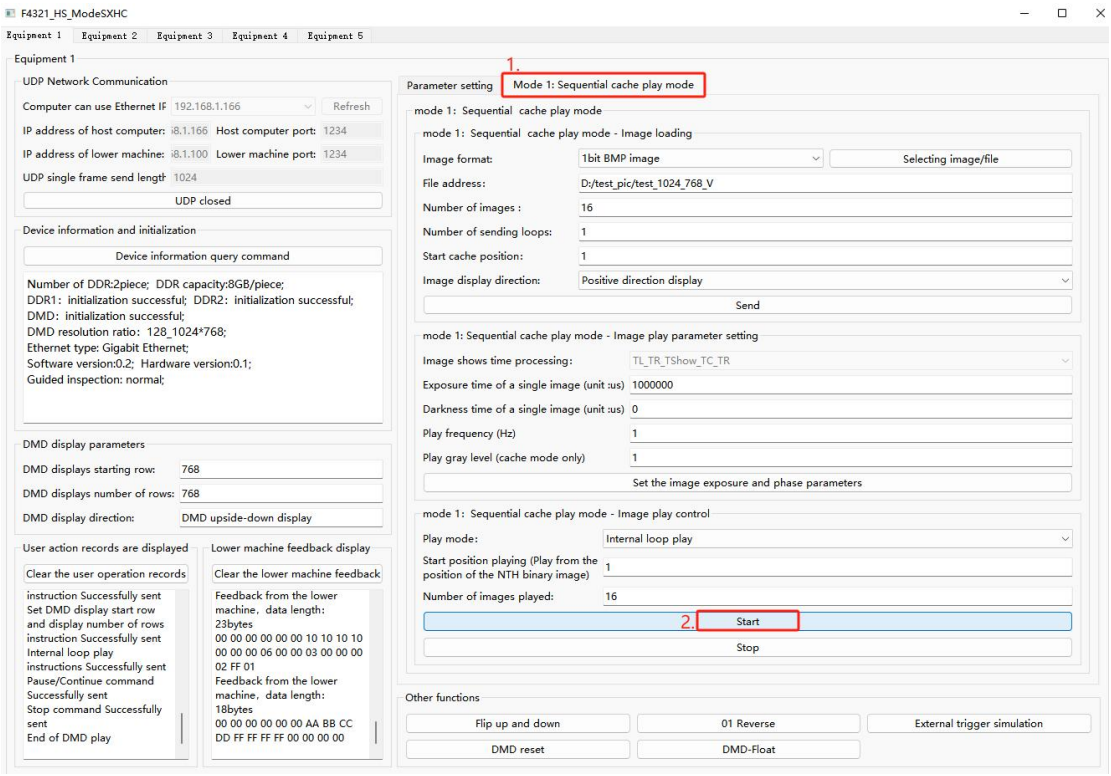
11. Next, realize the function of flipping the image up and down (the operation steps of other playback modes are the same). Next, click the button of flipping the image up and down after the DMD stops playing.



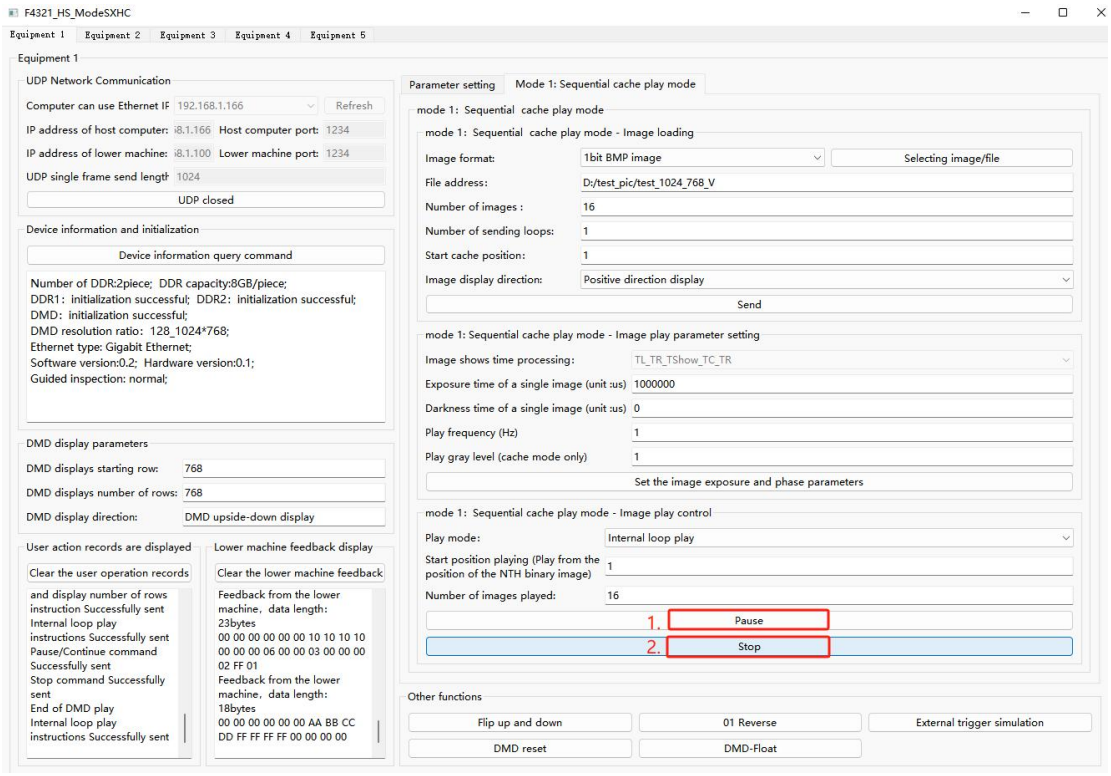
12. Enter the parameter setting interface, and set the starting behavior of DMD display 768 (here, take 1024*768 equipment as an example), and the number of lines of DMD display is 768. Click the button of setting DMD display parameters.



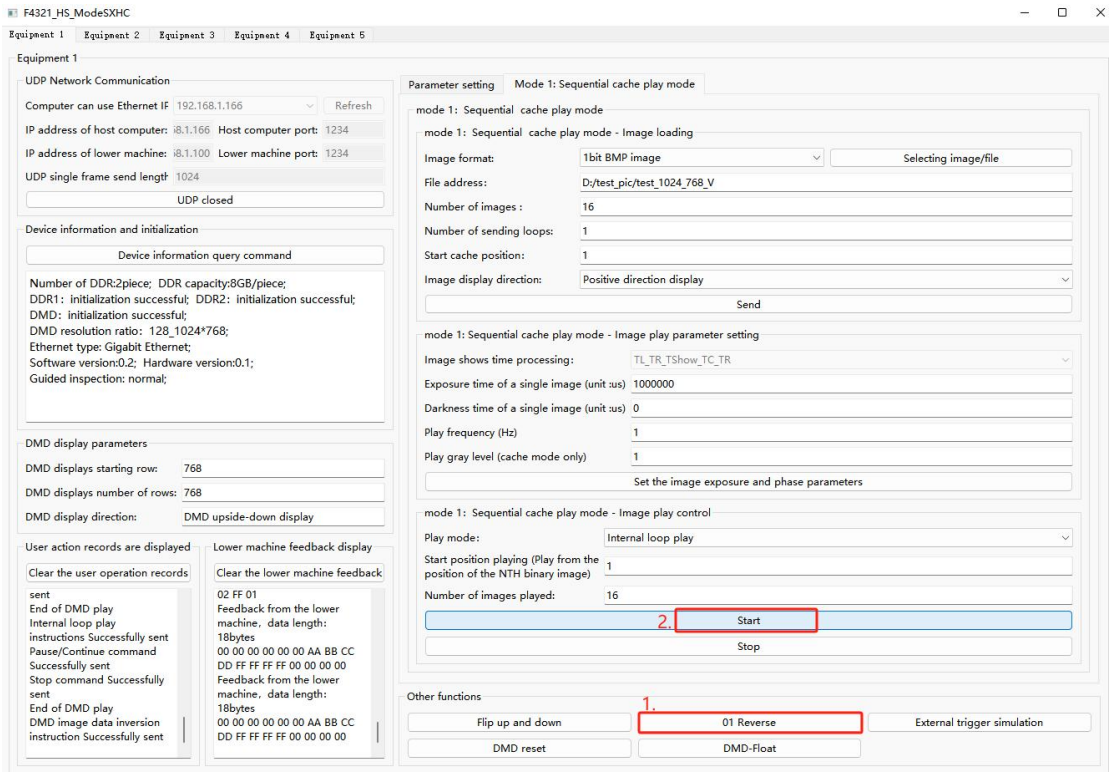
13. Return to the interface of sequential cache play mode, and directly click the Start Play button.



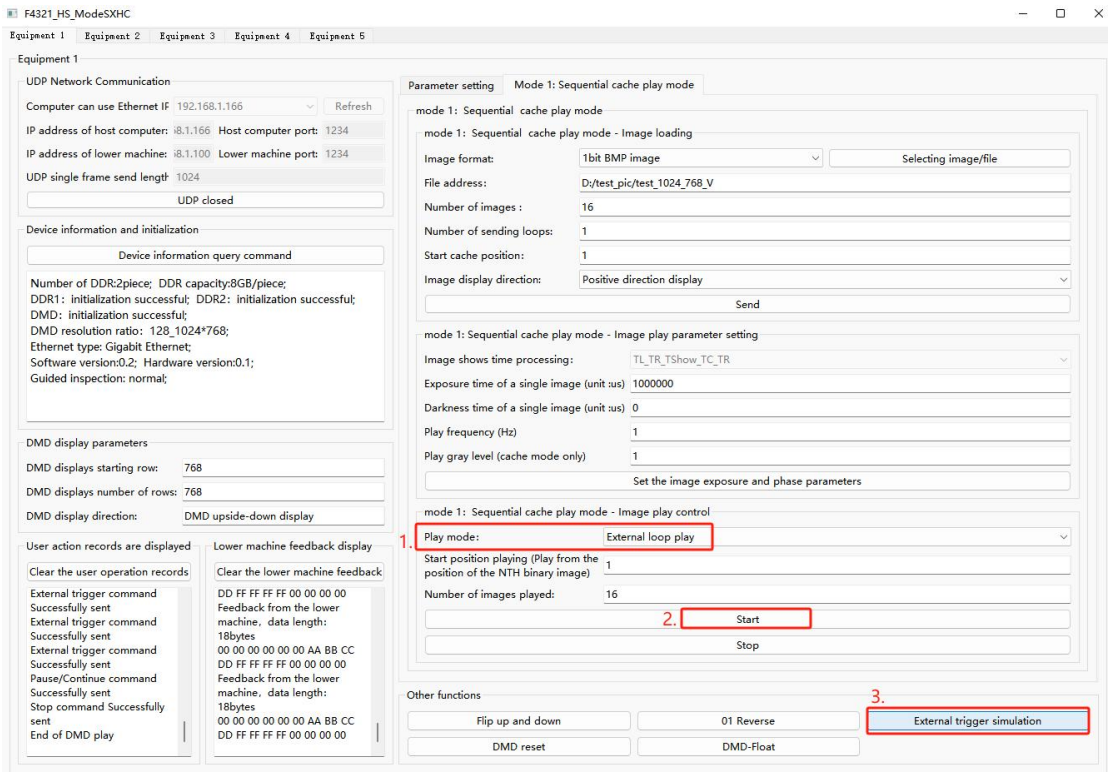
14. After the playback is completed, click Pause, and then click the Stop button.



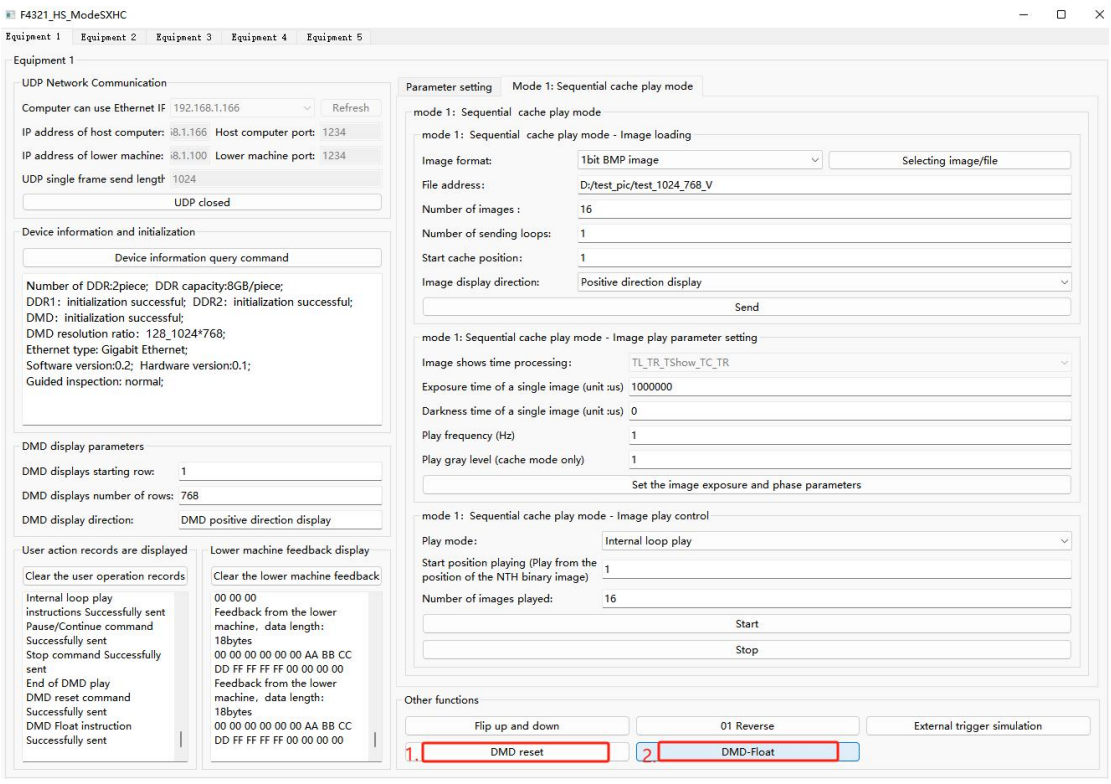
15. Next, realize the reverse function of image data 01, directly press the reverse button of image data 01, and then click start playing. After playing, lick the pause button first, and then click the stop button.



16. Next, realize the function of simulating external trigger. First, select the buffer play-external loop in the image play control interface, then click the start play button, and then click the simulate external trigger button to send instructions. The operation steps of stopping play are the same as above.

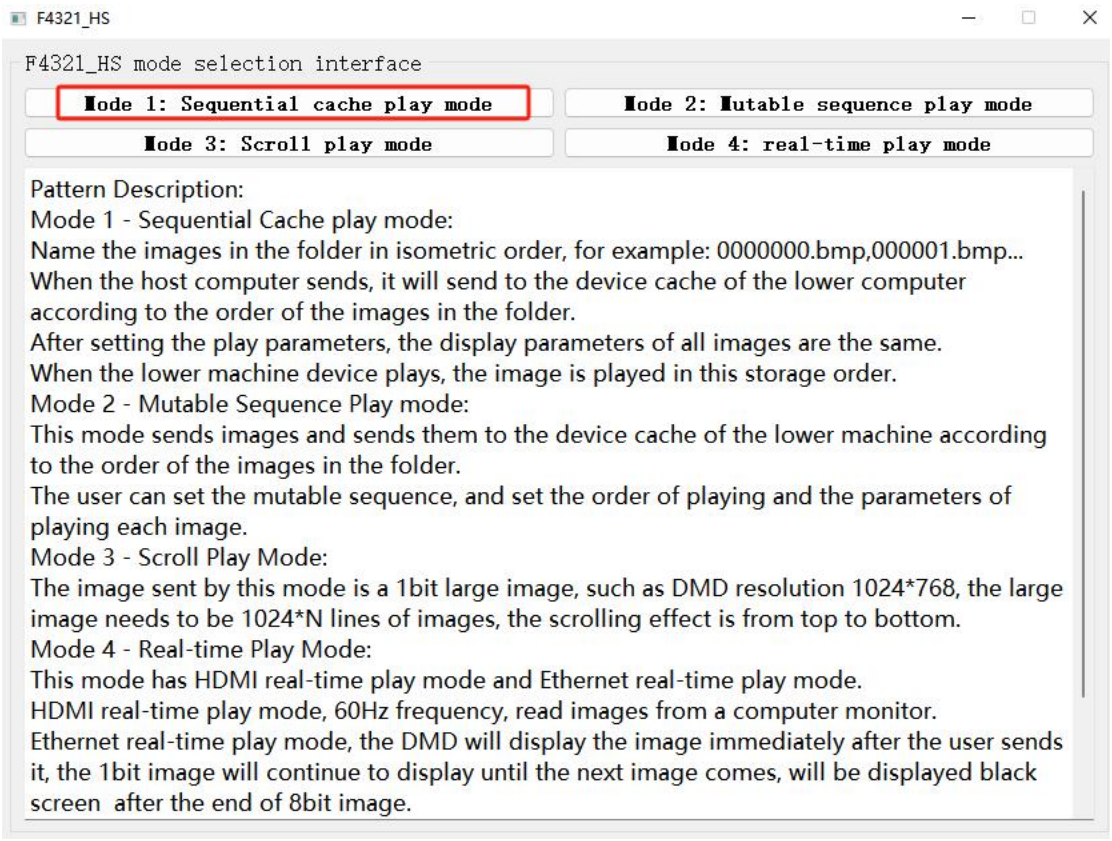


17. If you don't plan to realize the function again, click DMD reset after stopping playing, and then click DMD-Float to turn off the power.

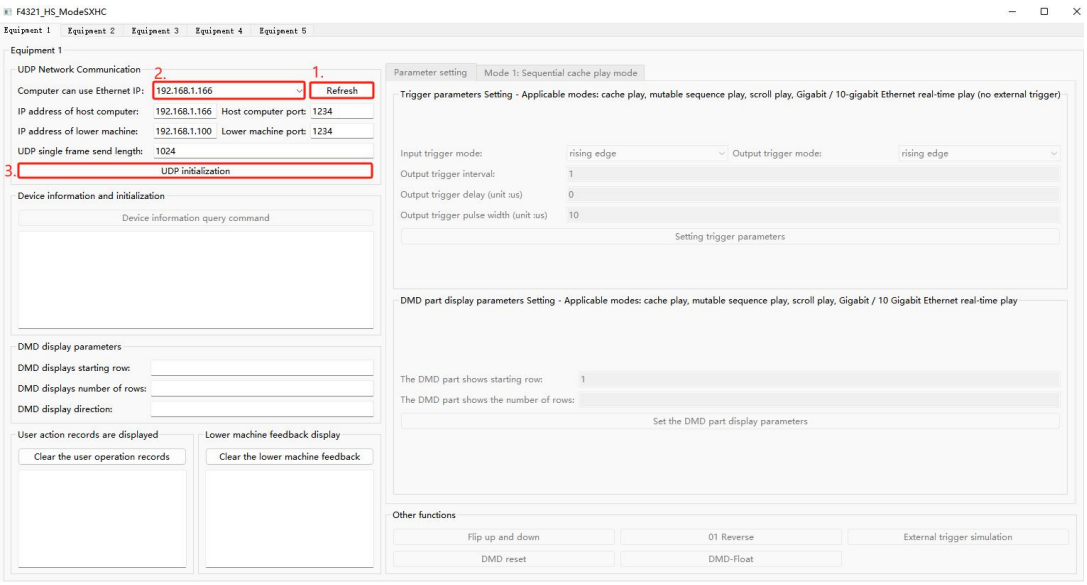


5.2 Normal cache mode - 8-bit picture play example

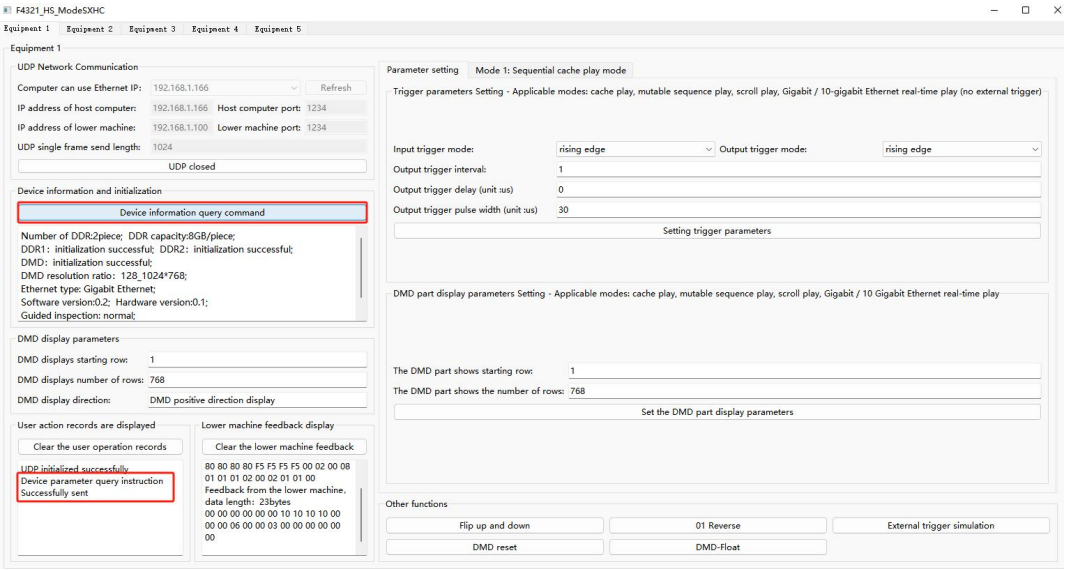
1. Connect the network port and power supply, open the upper computer software, select the sequential cache playback mode, and enter a new interface.



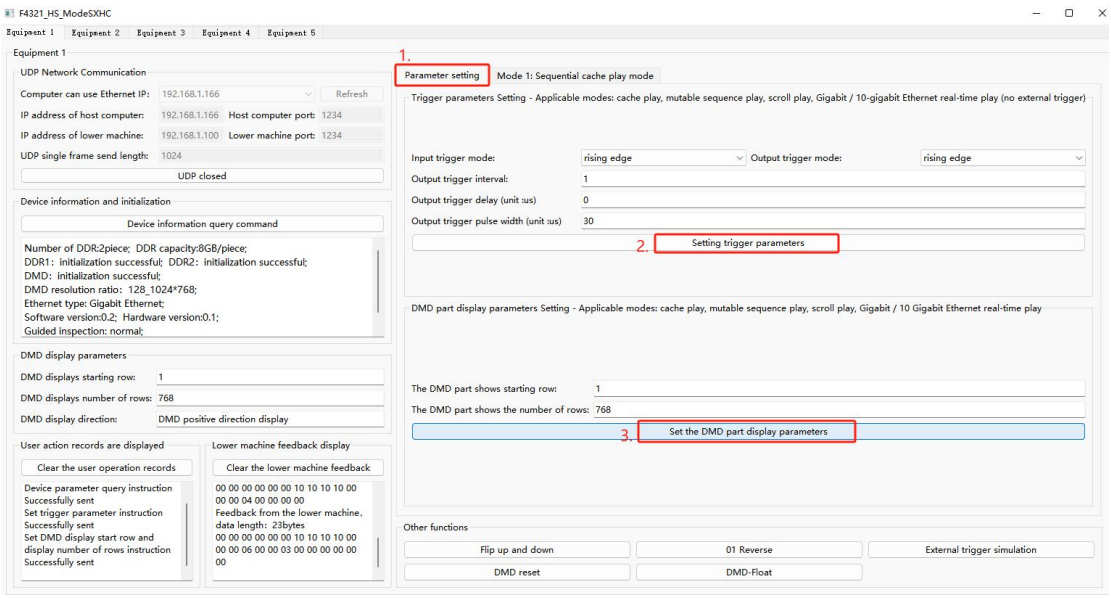
2. Click the refresh button, select the set IP address, and click the UDP initialization button. After the initialization is successful, the user operation record will show that UDP initialization is successful.



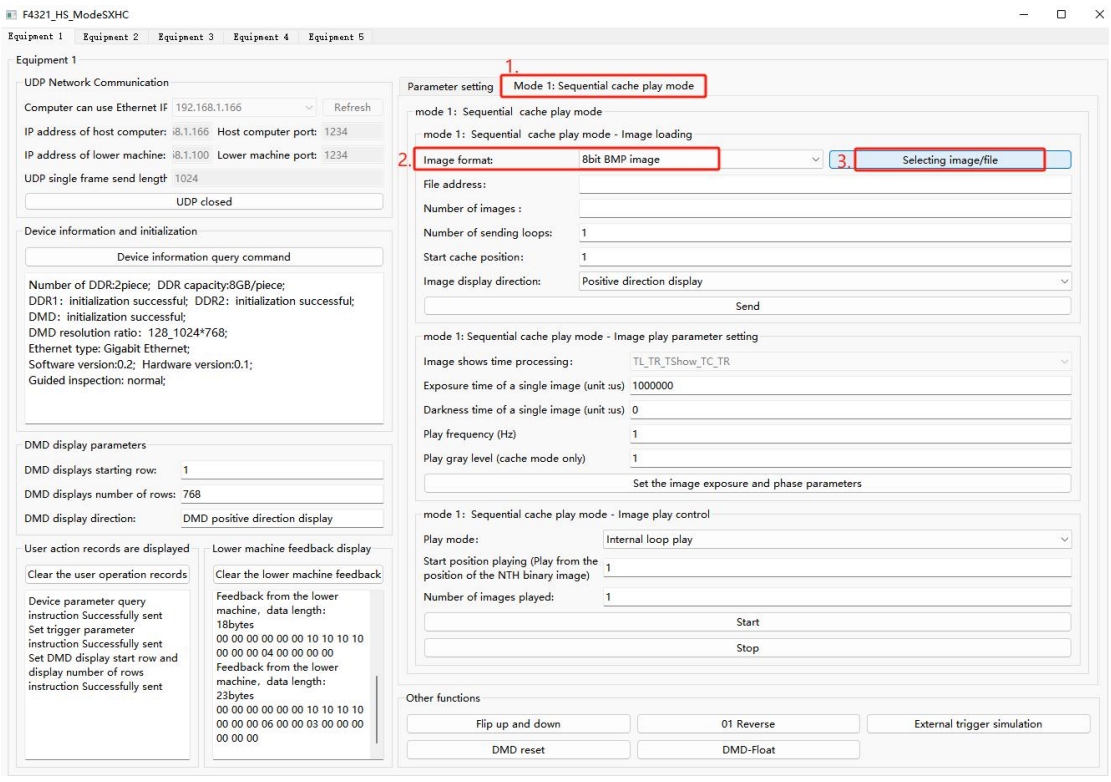
3. Click the device information query command to detect the initialization status,some parameter information and DMD display parameters.



4. Click on the parameter setting page to set the trigger parameters and DMD parameters (if there is no special requirement, just click on the button of setting the trigger parameters according to the system default values, and then click on the button of setting the DMD display parameters)

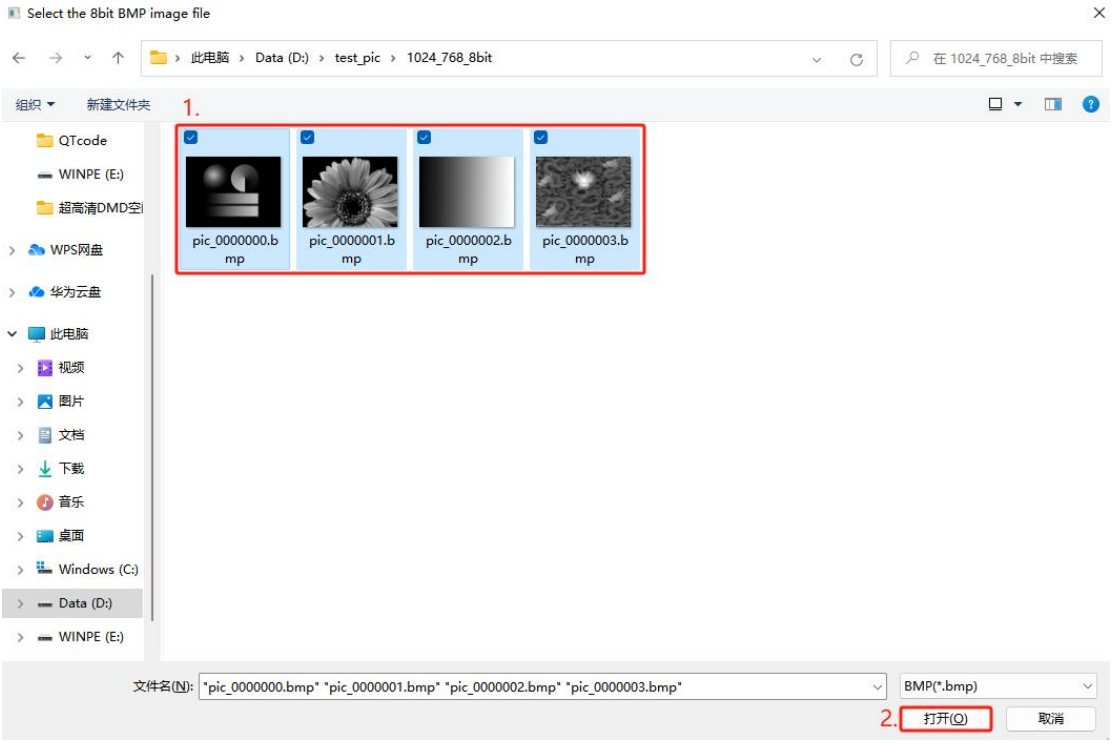


5. After setting the parameters, enter the sequential image cache mode, select the image file format to be loaded, and click the Select Image File button to enter the image folder selection page of the corresponding image format.

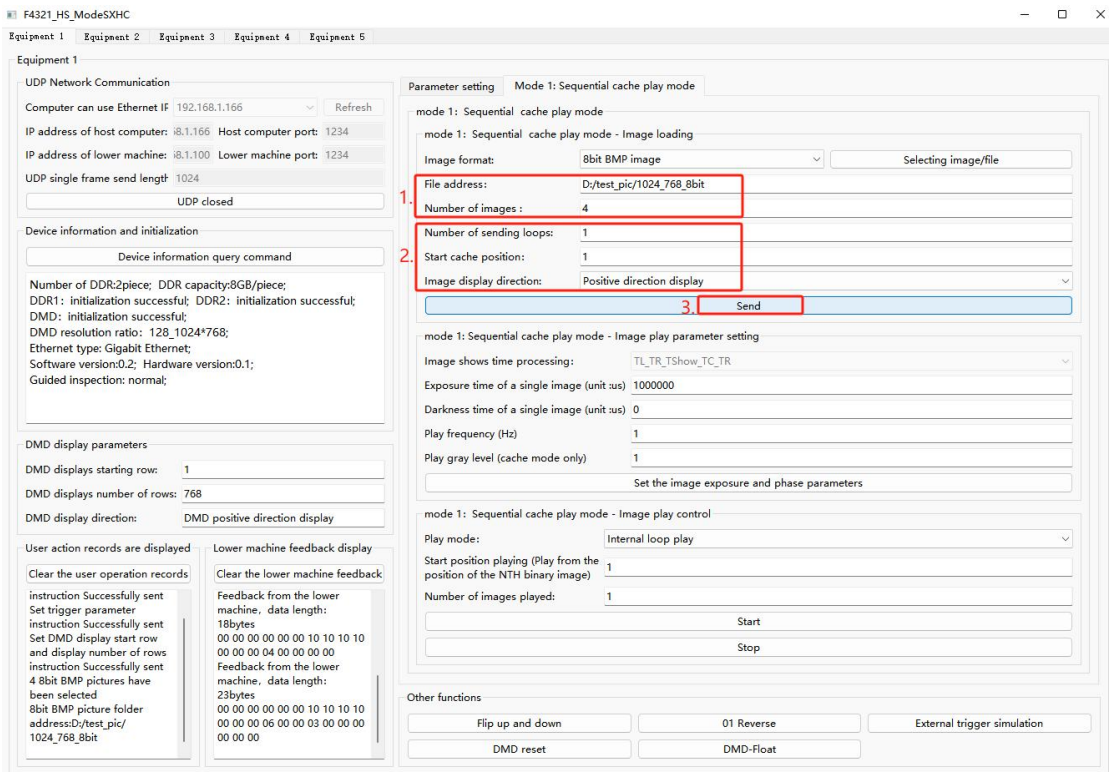


6. Select the image folder with corresponding resolution, select the

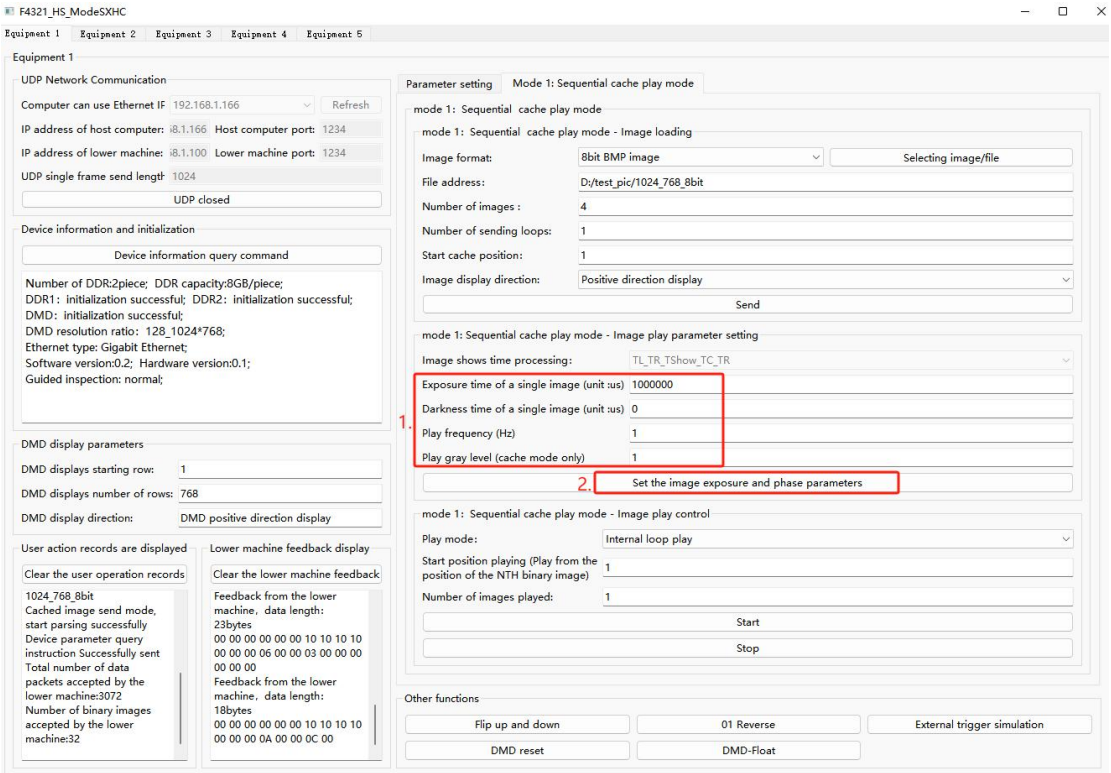
desired image and click Open.



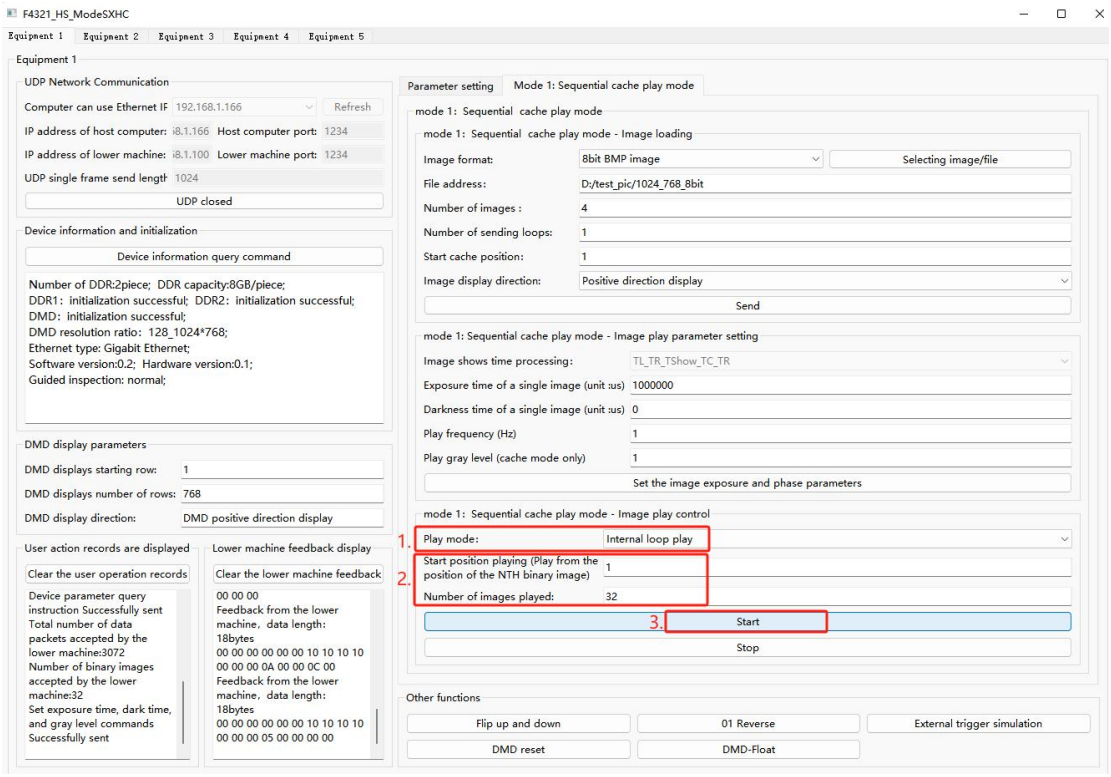
7. The file address and number of images will be automatically detected. At this time, you only need to check whether it is the same as the image address and number you loaded, then fill in the number of times the image is sent circularly and the location of the initial cache, select the image display direction, and click the Send Image button. After the image is sent successfully, the user operation record will display the number of accepted data packets and the number of binary images.



8. Set the exposure time of single image output to 1 second, the dark time to 0, the playback frequency to 1 and the playback gray level to 8, and click the Set Image Exposure and Phase Parameters button.



9. Select the playback mode as cache playback-internal loop, set the starting position of picture playback to 1 and the number of pictures to be played to 32, and click the Start Play button. At this time, the loaded pictures will be played on the DMD according to the set playback mode.

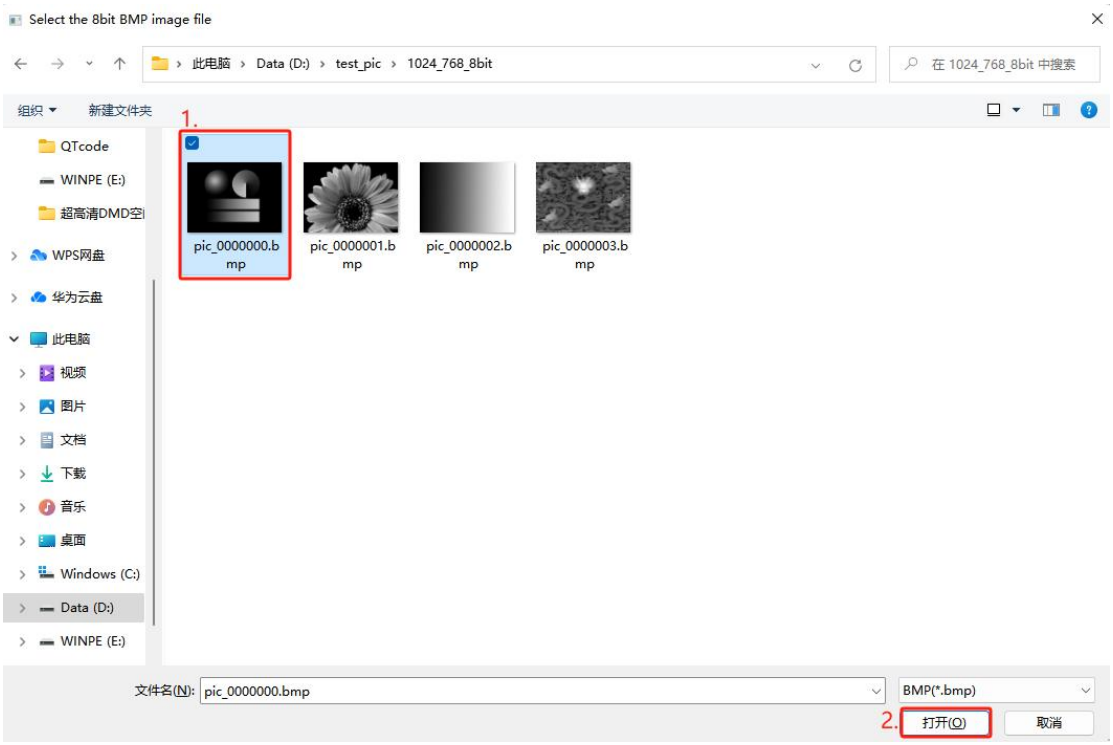


10. After the image is played, click the Pause button first, and then click the Stop button.

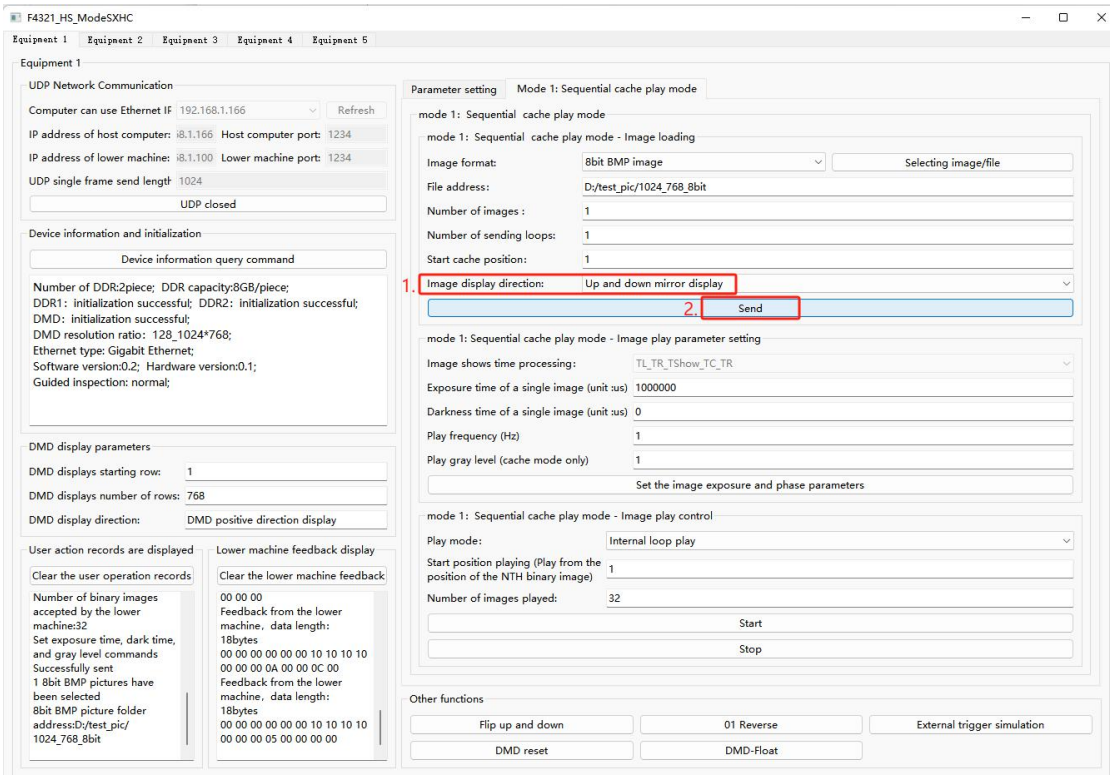
Next, the function of changing the image display direction is realized. There are four image display directions: image forward display, image up- and-down mirror display, image left-and-right mirror display, and image center symmetrical display. Take image up-and-down mirror display as an example, and the other operation steps are the same.

11. In the previous step, after the DMD stops playing, click the

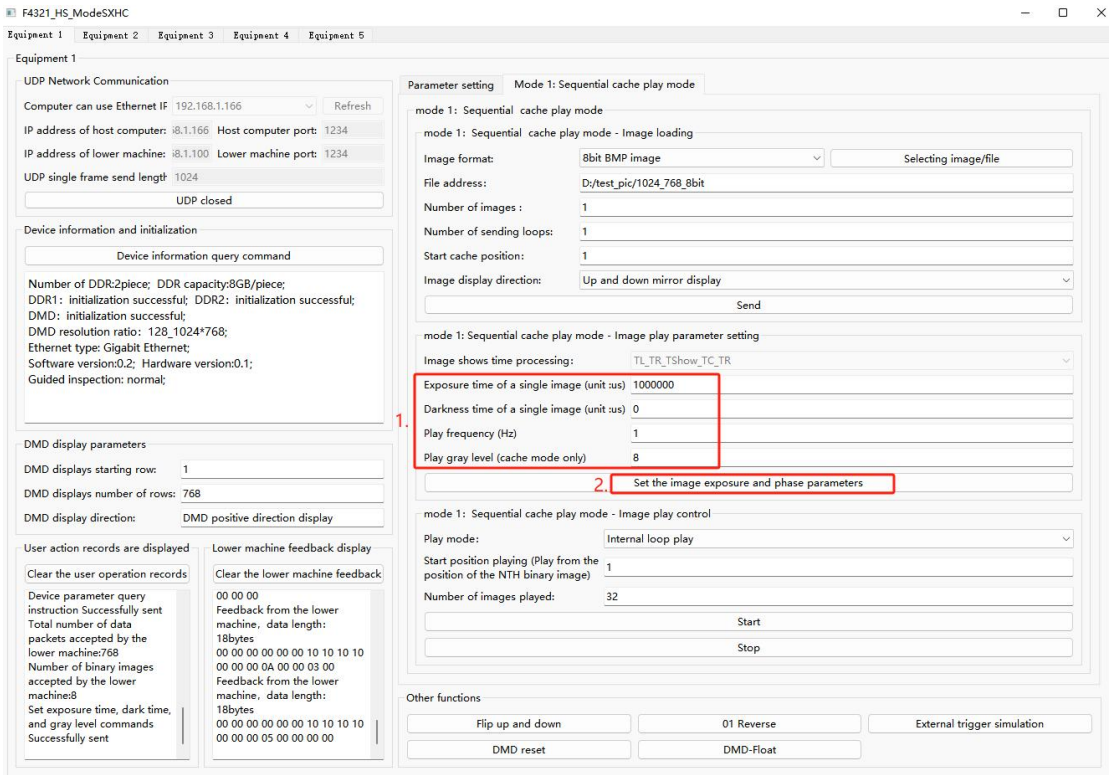
Select Image File button to reload an 8-8bit image (select the image with obvious difference to the mirroring result), and click Open.



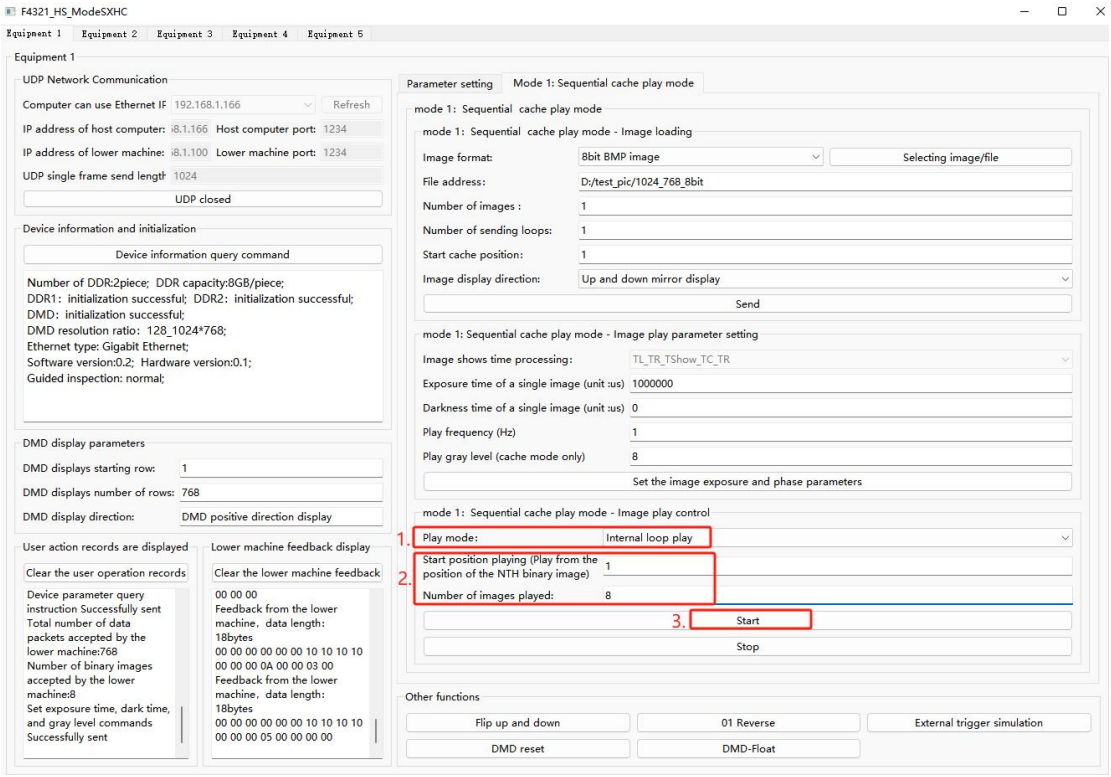
12. Check the address and quantity, fill in the corresponding parameters, select the image display direction as the image up and down mirror display, and click the Send Image button.



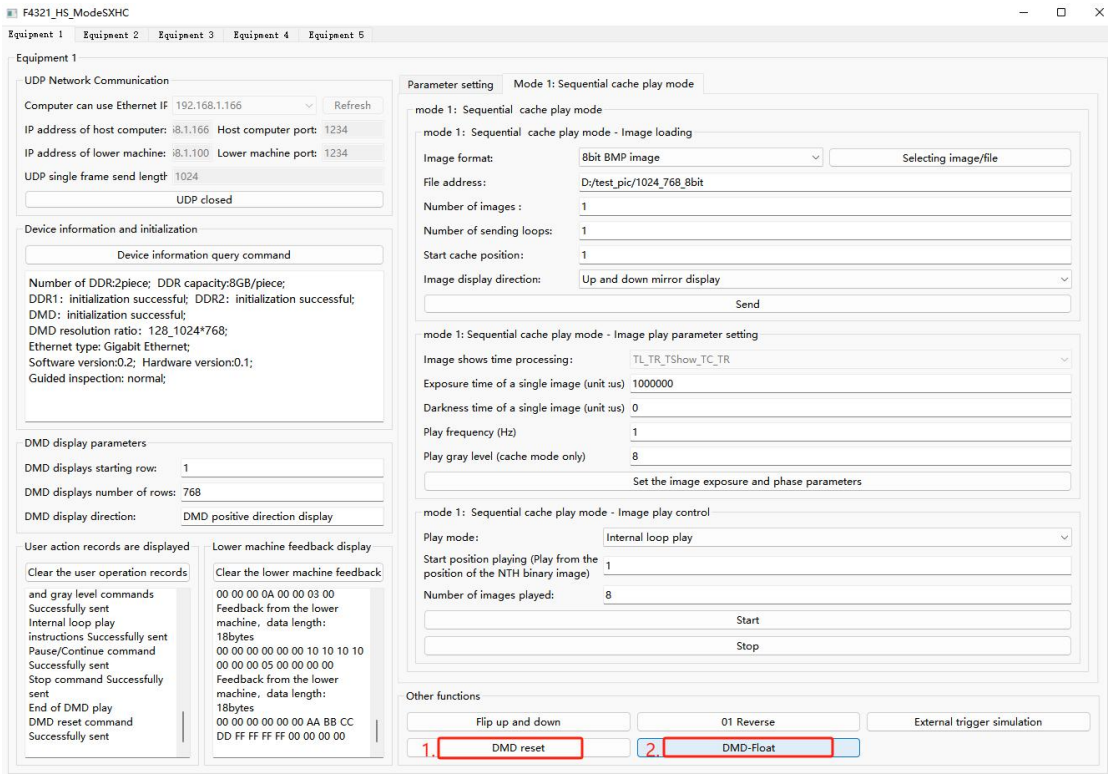
13. Fill in the exposure time, dark time, playing frequency and playing gray level of a single output image, and click the button of setting image exposure and phase parameters.



14. Select the playback mode as internal loop, set the playback start position and the number of pictures to be played, and click the start play button.

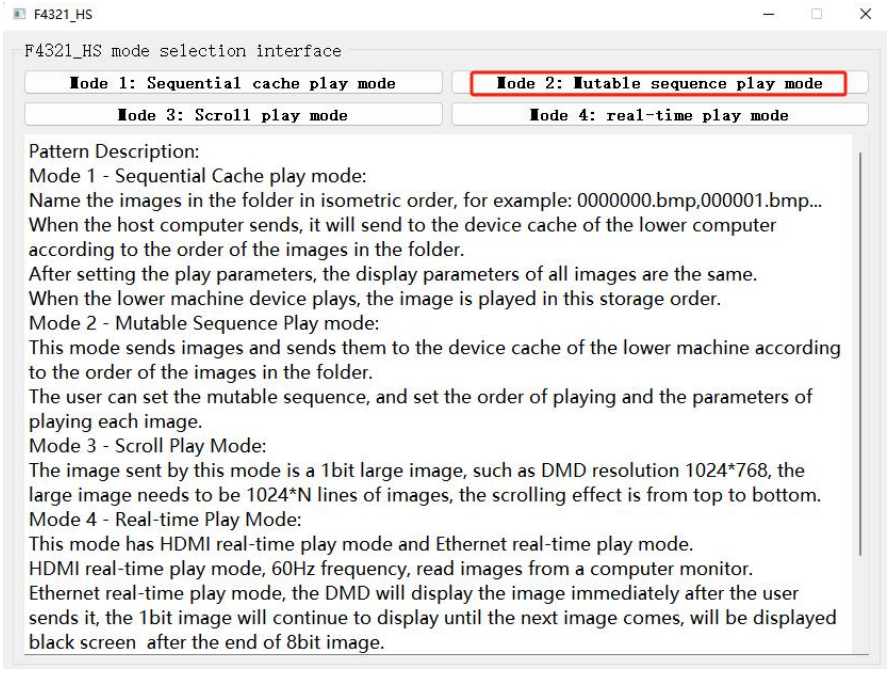


15. If you don't plan to realize the function again, click DMD reset after stopping playing, and then click DMD-Float to turn off the power.

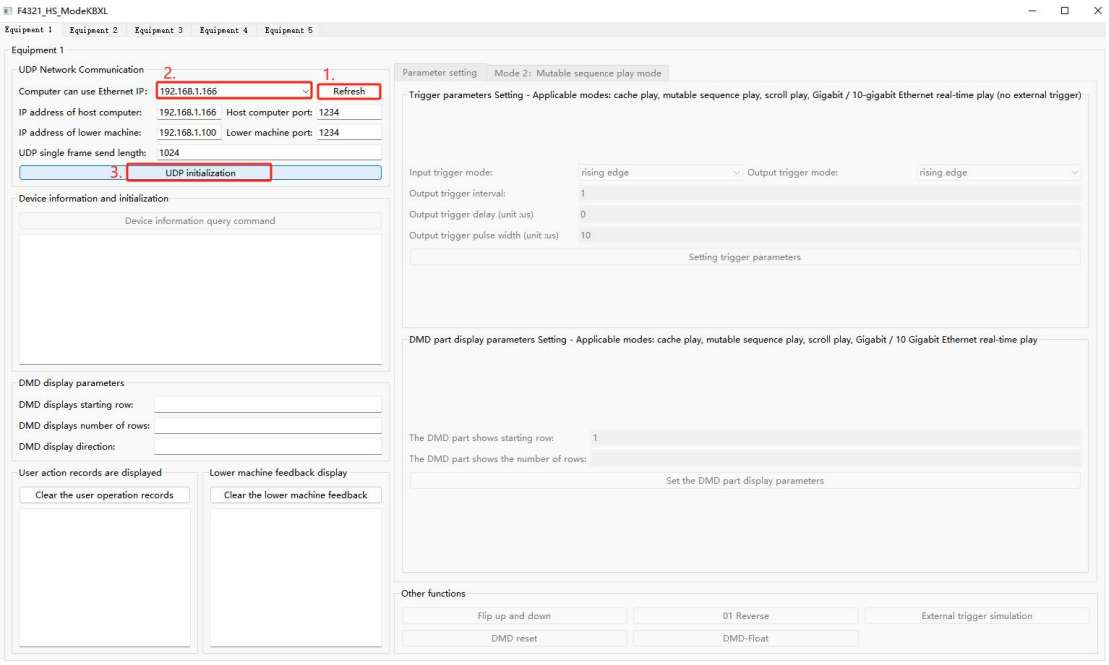


5.3 Mutable sequence play mode - Image play example

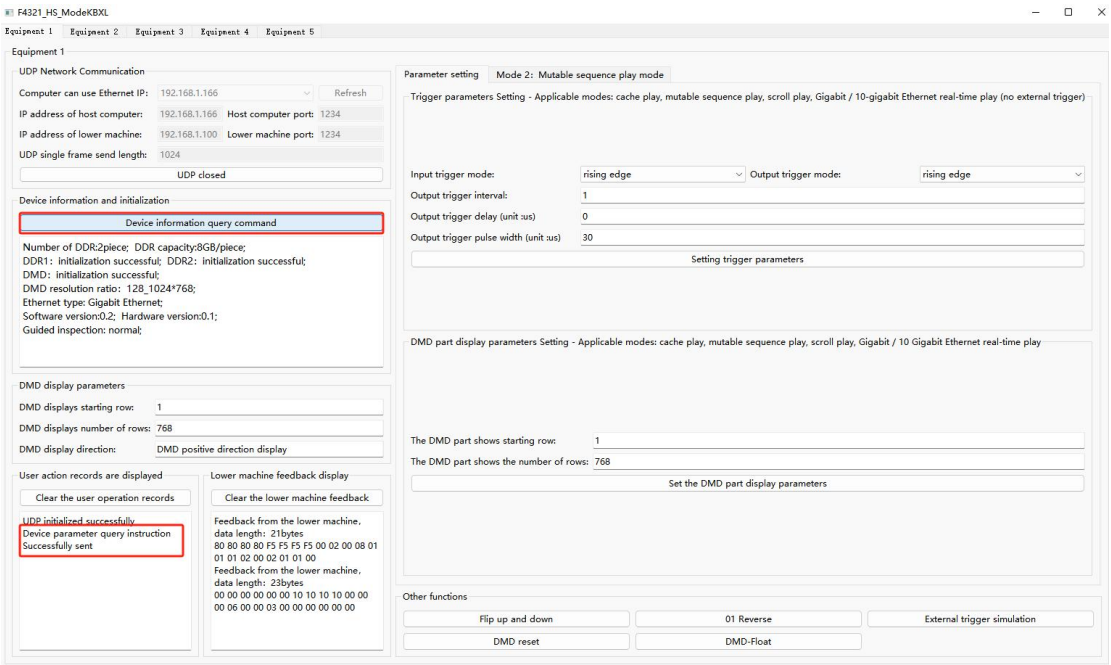
1.Connect the network port and power supply, open the PC software, select the mutable sequence play mode, and enter the new interface.



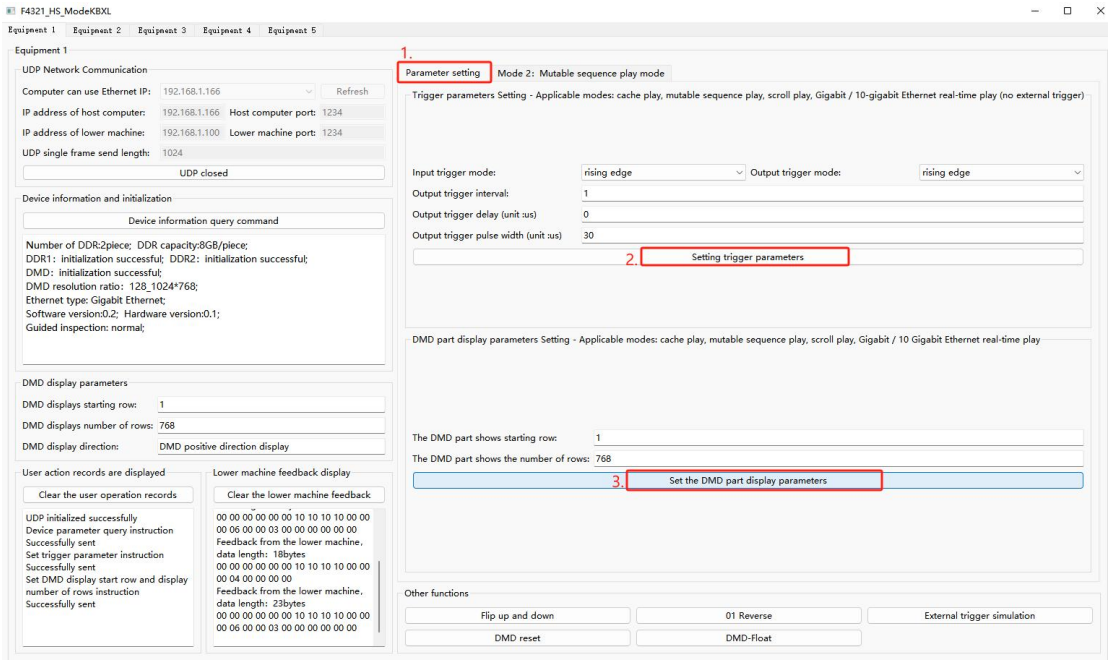
2.Click the Refresh button, select the IP address that has been set, and click the UDP initialization button. After successful initialization, the user operation record will show that the UDP initialization is successful.



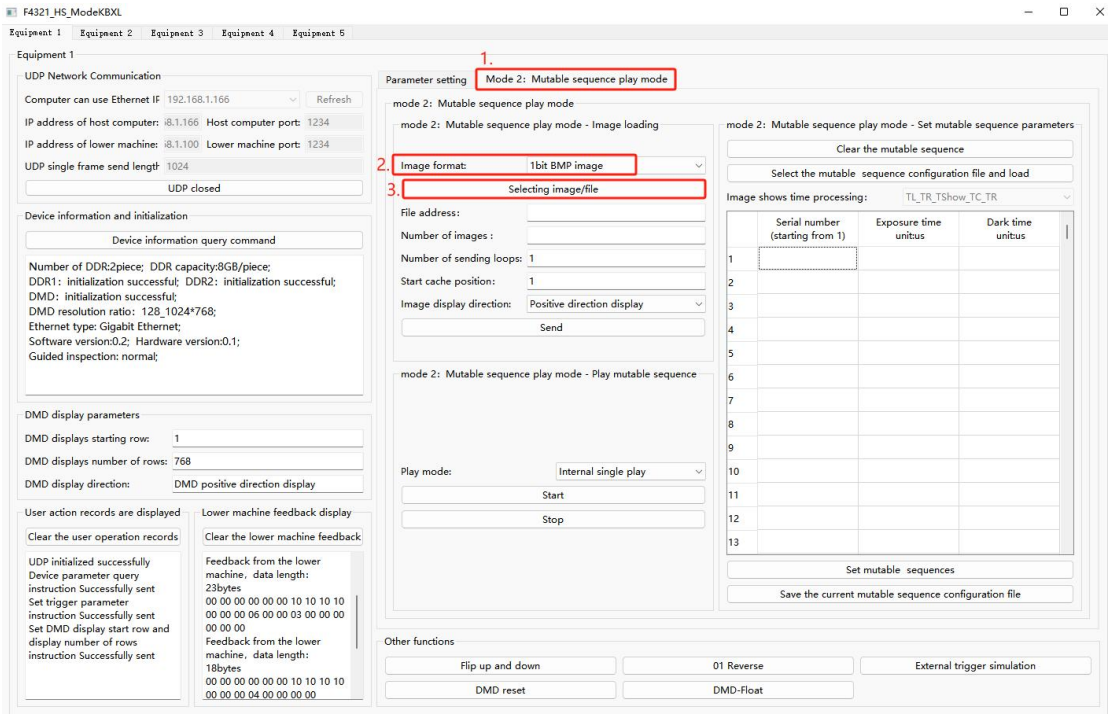
3.Click the device information query command to detect the initialization status and some parameter information as well as the DMD display parameters of.



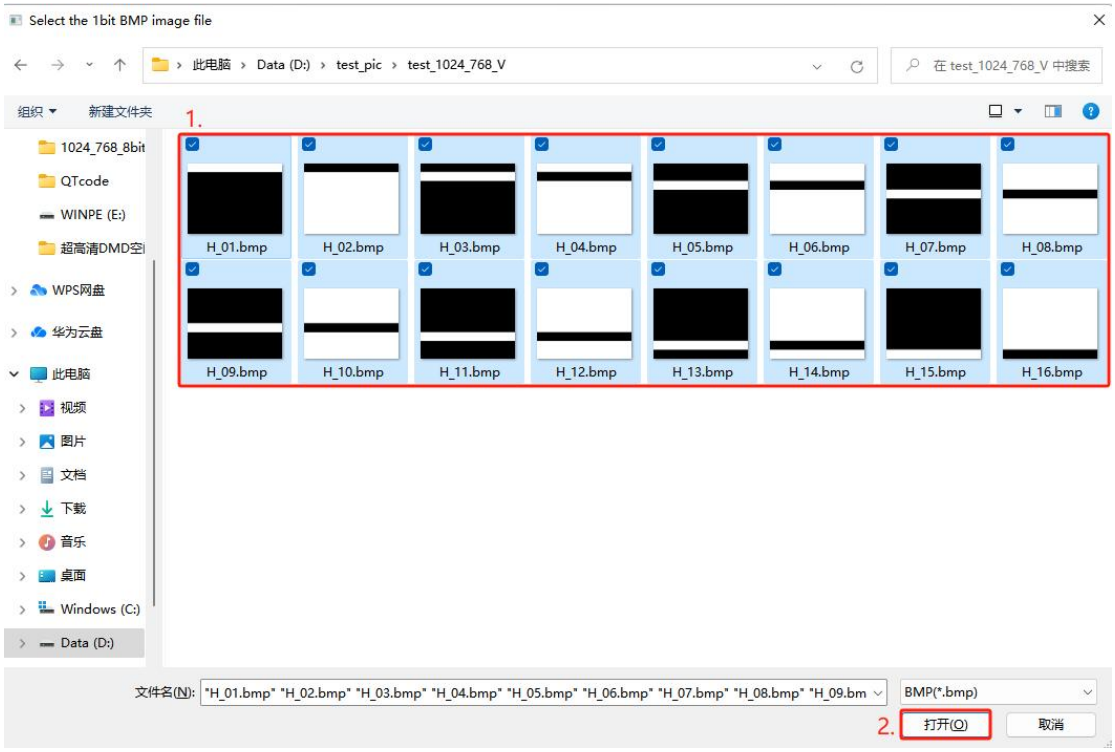
4.Click the parameter setting page to set the trigger parameters and DMD parameters (if there is no special requirement, click the button of setting trigger parameters directly according to the default value of the system, and then click the button of setting DMD part display parameters).



5.After setting the parameters, enter the mutable sequence playback mode, select the image file format to be loaded, click the "Select image file" button, and enter the image folder selection page of the corresponding image format.

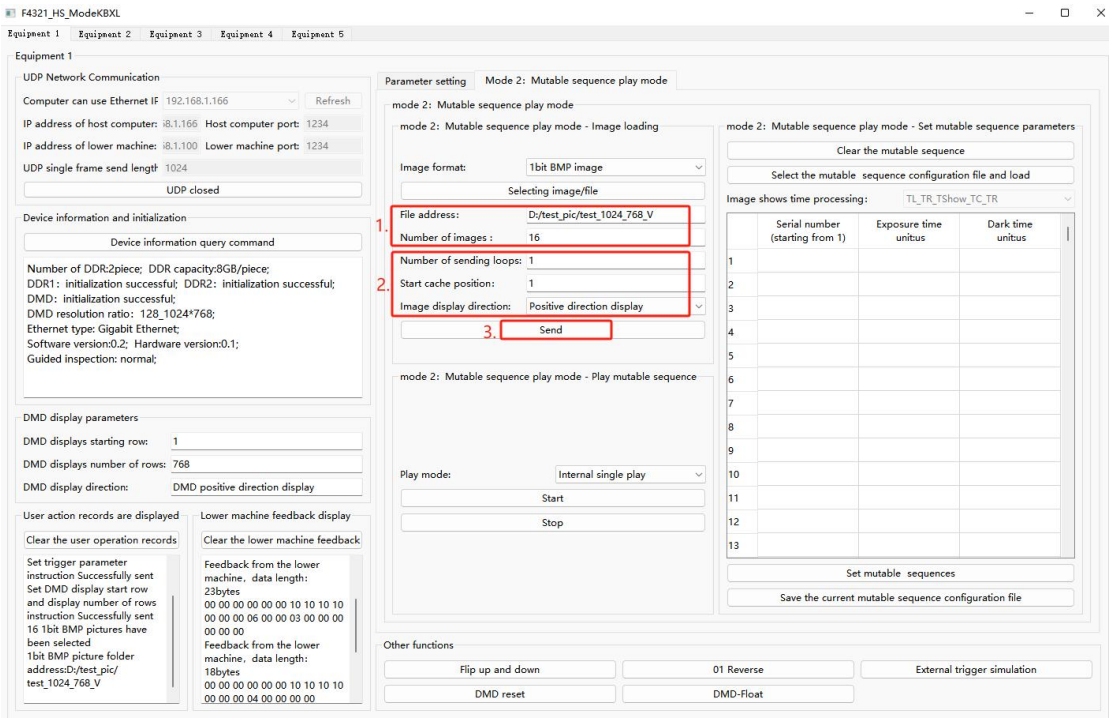


6. Select the image folder corresponding to the resolution, select the desired image and click open.

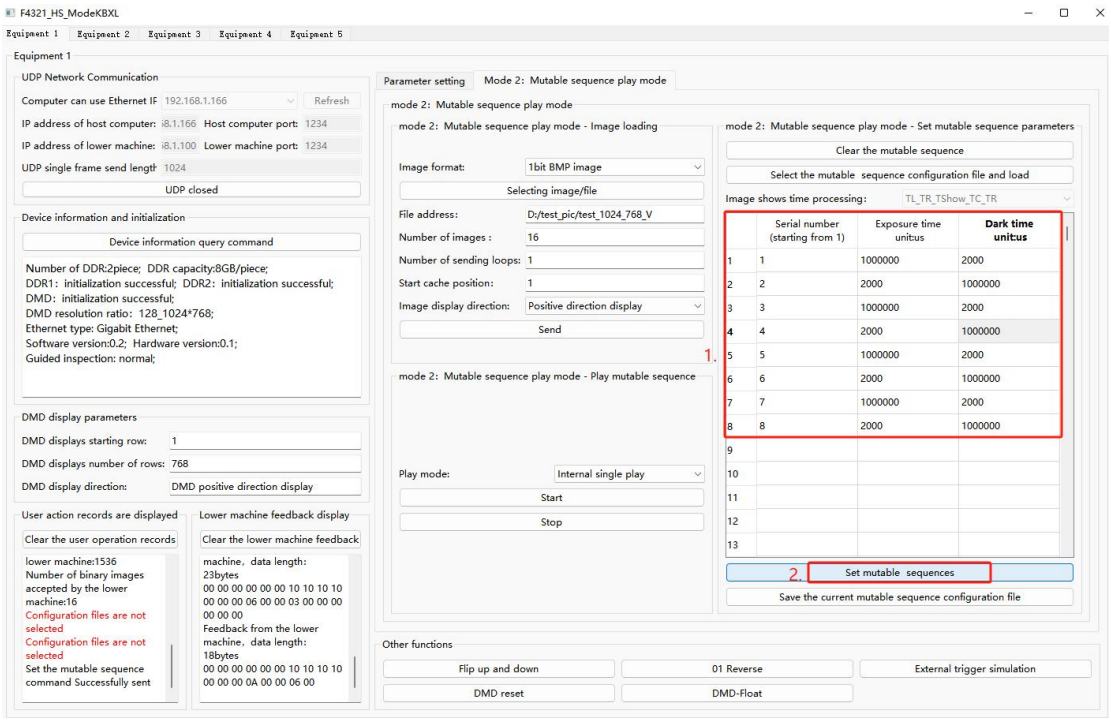


7. The file address and number of pictures will be automatically detected, at this time, you only need to check whether the address and

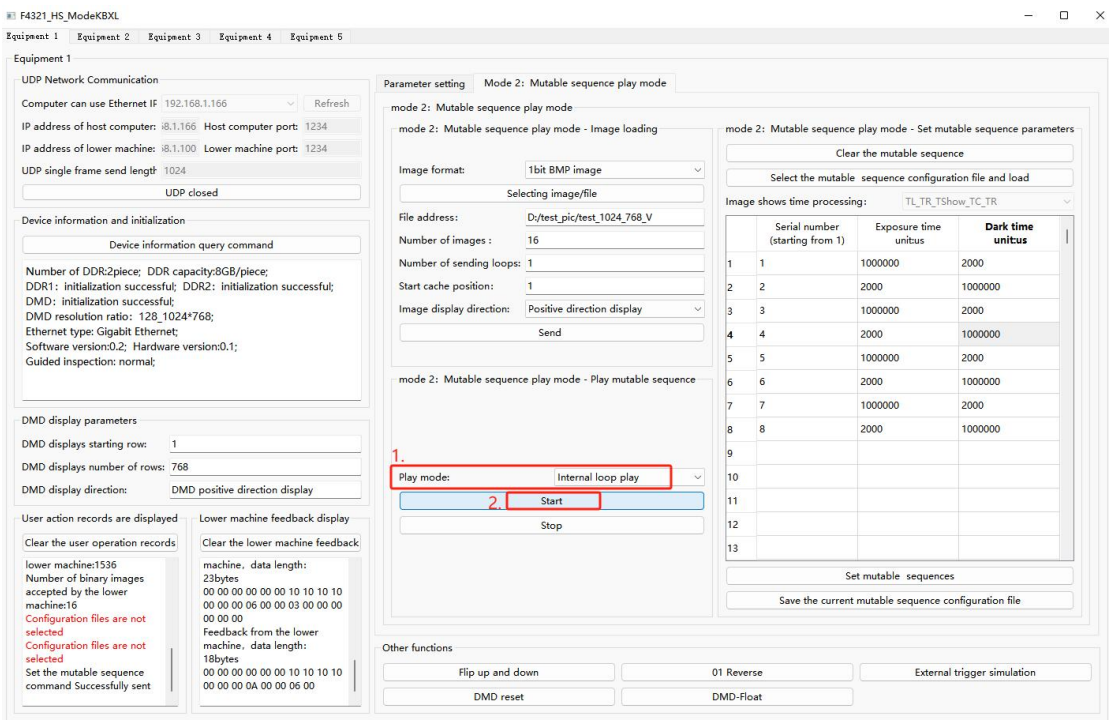
number of pictures are the same as the loaded picture, and then fill in the number of times the image is sent in cycles and the location of the starting cache, select the image display direction, and click the send image button. After the image is sent successfully, the user operation record will show the number of data packets accepted and the number of binary pictures.



8. Fill in the sequence number, exposure time and dark time of the pictures to be played in turn, and click the "Set mutable sequence" button. When the operation record bar prompts that the mutable sequence instruction is successfully sent, it means that the parameters of the mutable sequence have been set.

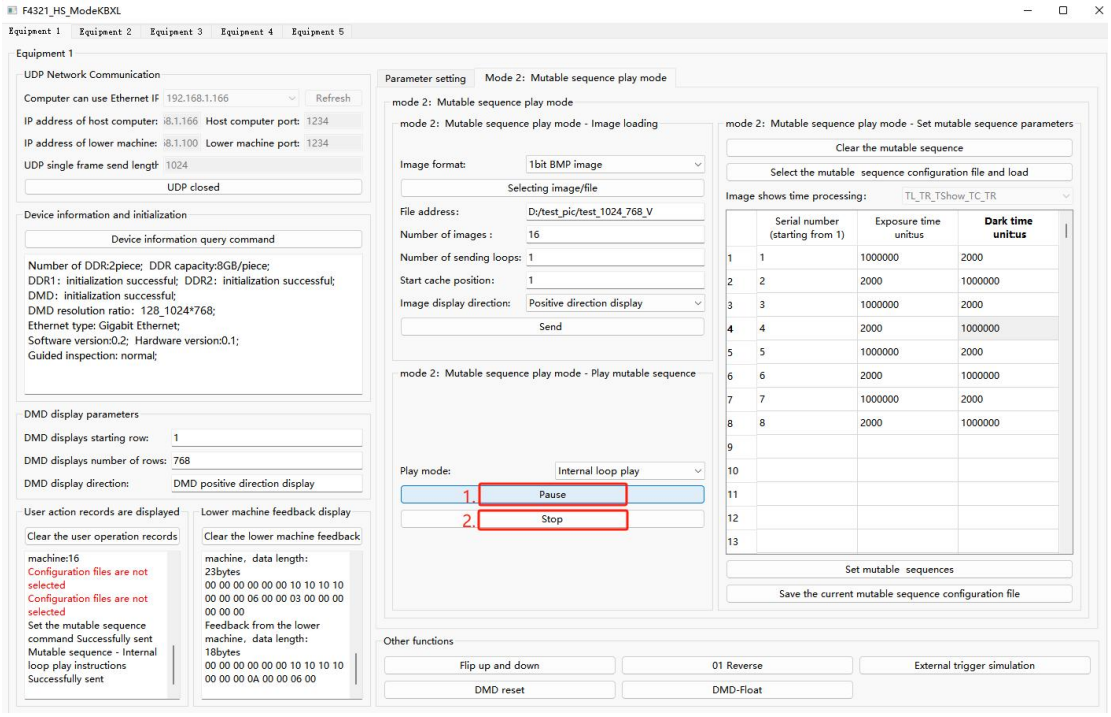


9. Select mutable sequence - Internal Loop in the Play mode drop-down box for playing mutable sequence, and click the Start Playing mutable sequence button.

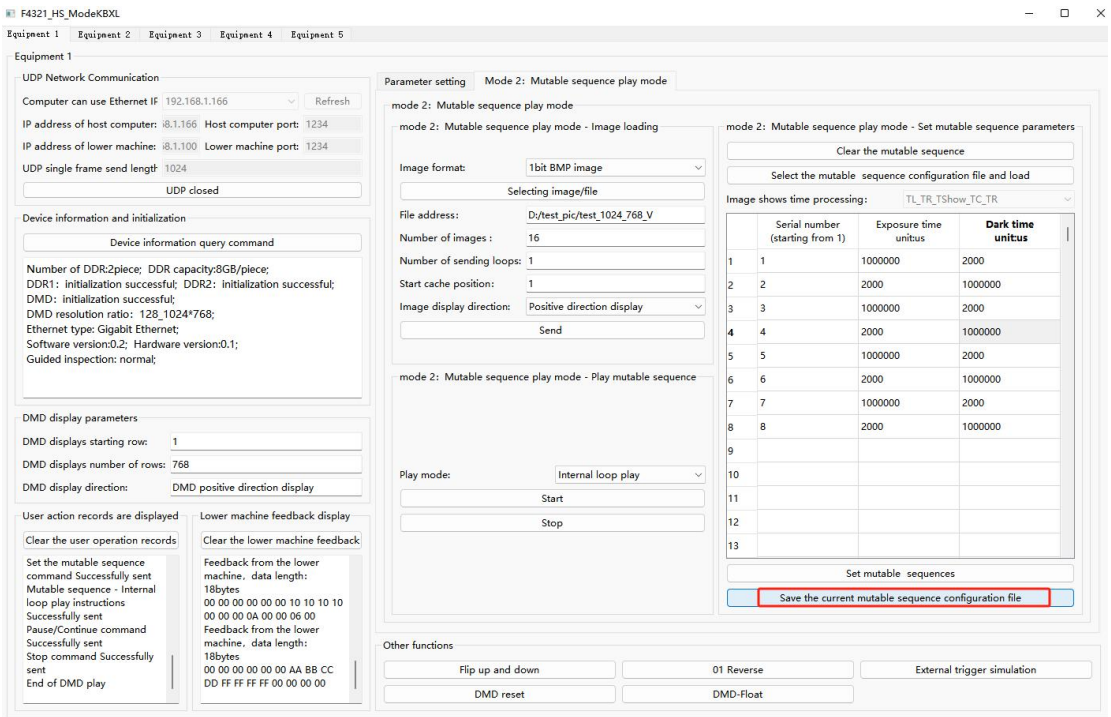


10. After playing, click pause to play the mutable sequence to pause

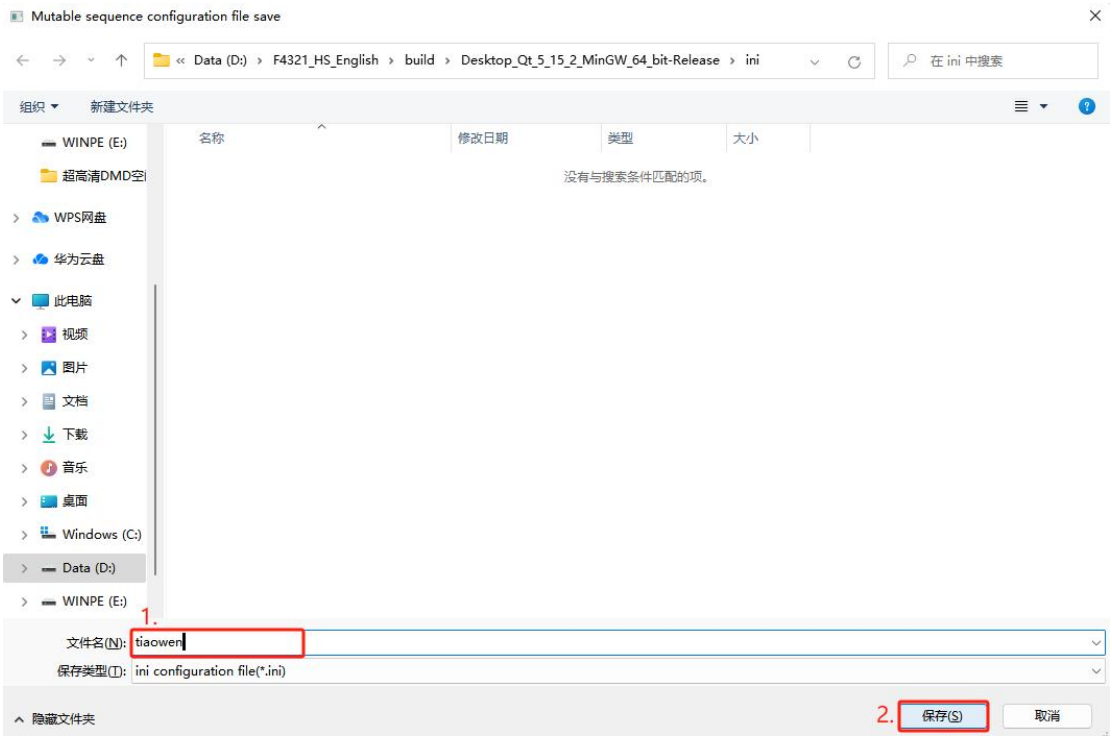
the current playing state. Click the button to stop playing the mutable sequence to stop the current playing sequence picture.



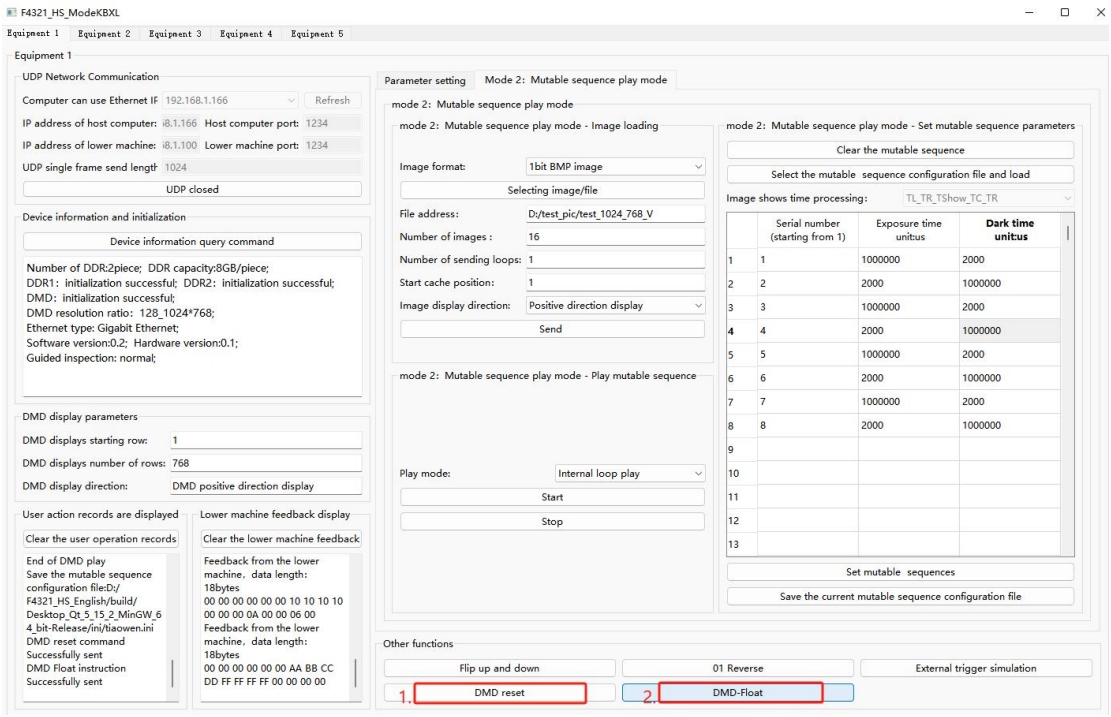
11. Click Save Current mutable sequence profile 11. Click Save current mutable sequence profile.



12. Fill in the saved name in the pop-up dialog box, so that the mutable sequence parameter information just set is saved to ini file. Next time, you can directly click the button to select mutable sequence configuration file and load, and use the configuration ini file.

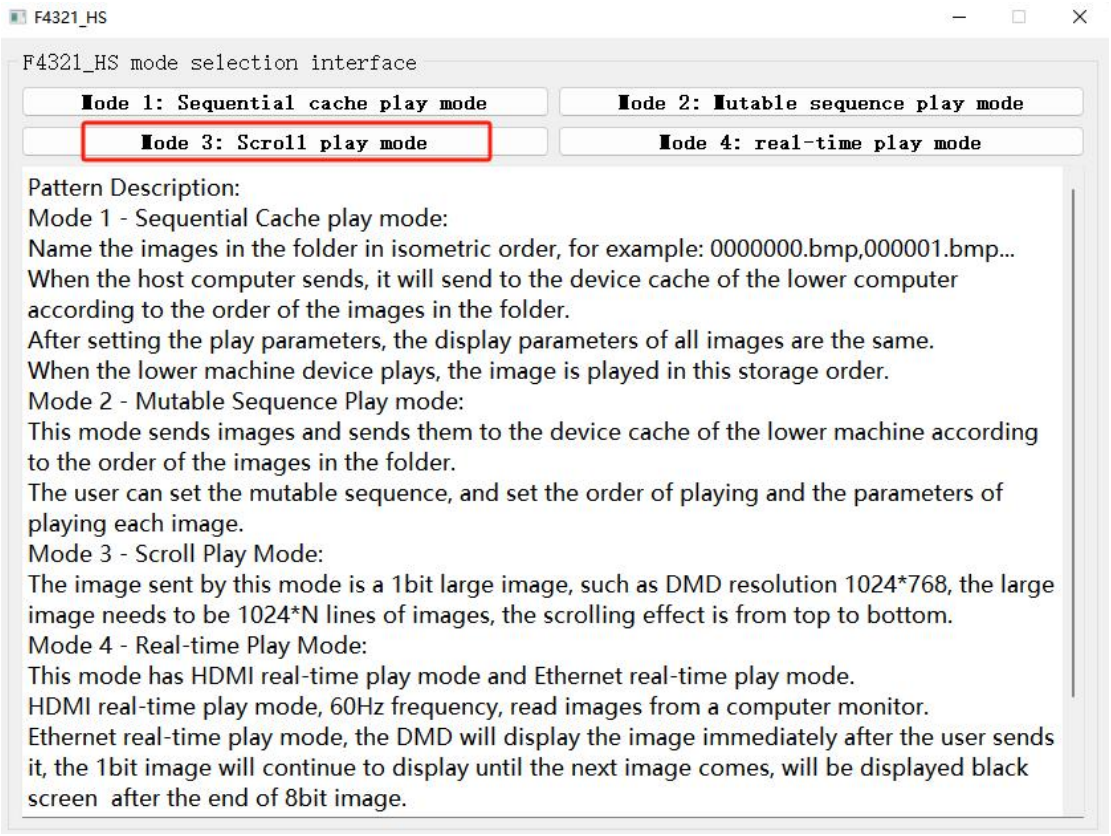


13.Then click DMD reset, and then click DMD-float, power off

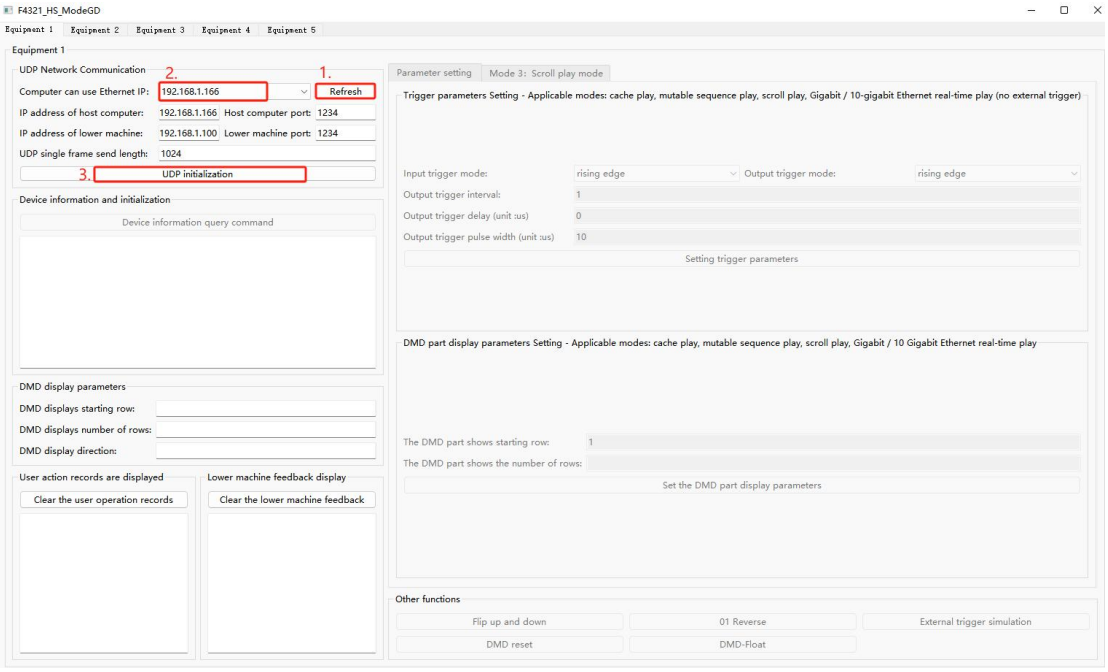


5.4 Scroll Play mode - Image play instance

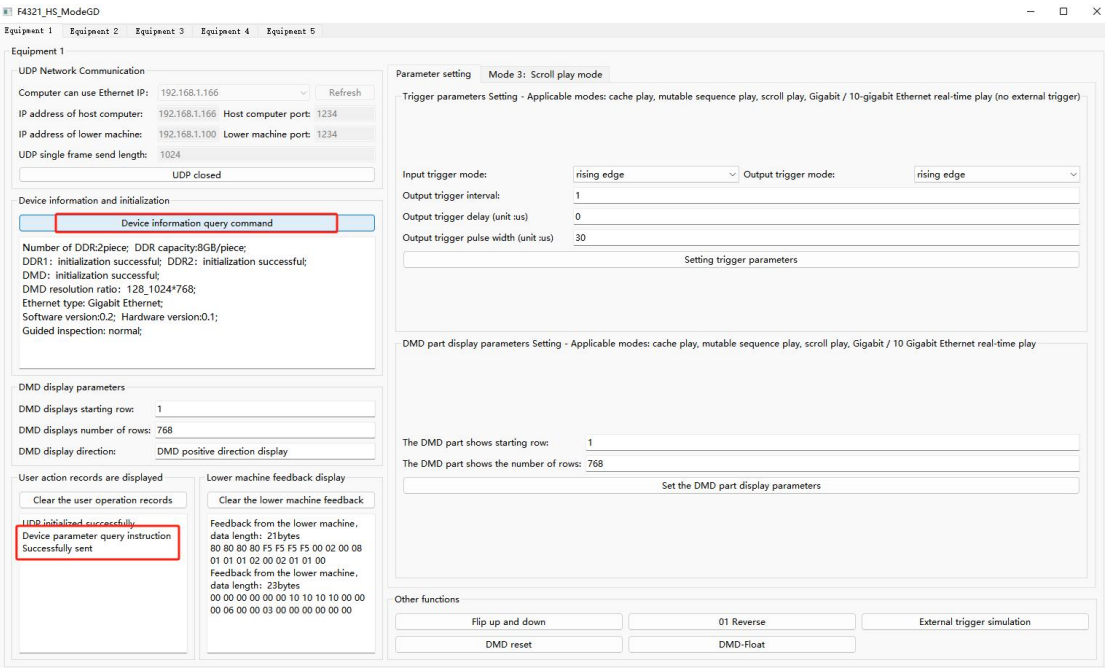
1.Connect the network port and power supply, open the PC software, select the scroll play mode, and enter the new interface.



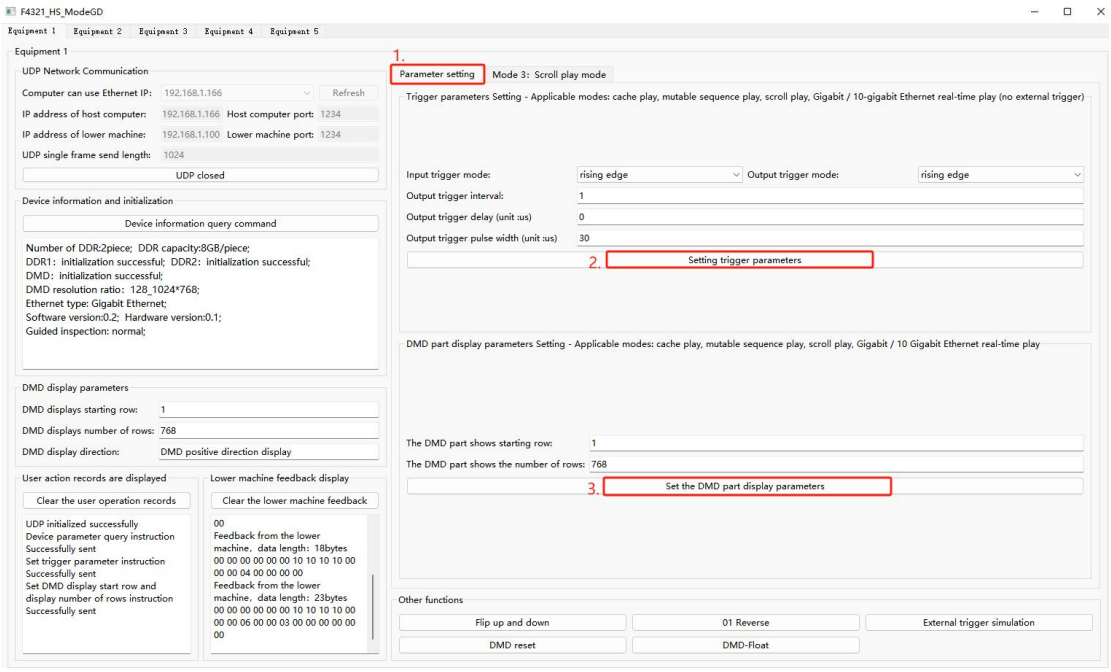
2.Click the Refresh button, select the IP address that has been set, and click the UDP initialization button. After successful initialization, the user operation record will show that the UDP initialization is successful.



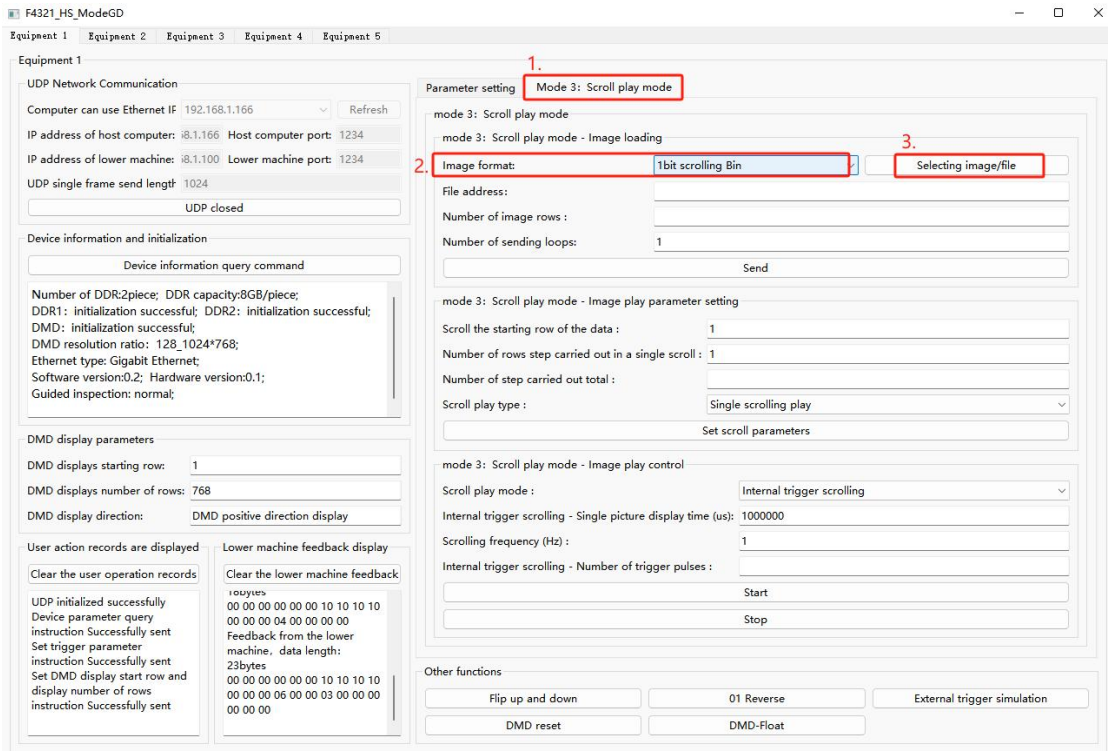
3.Click the device information query command to detect the initialization status, some parameter information and the DMD display parameters.



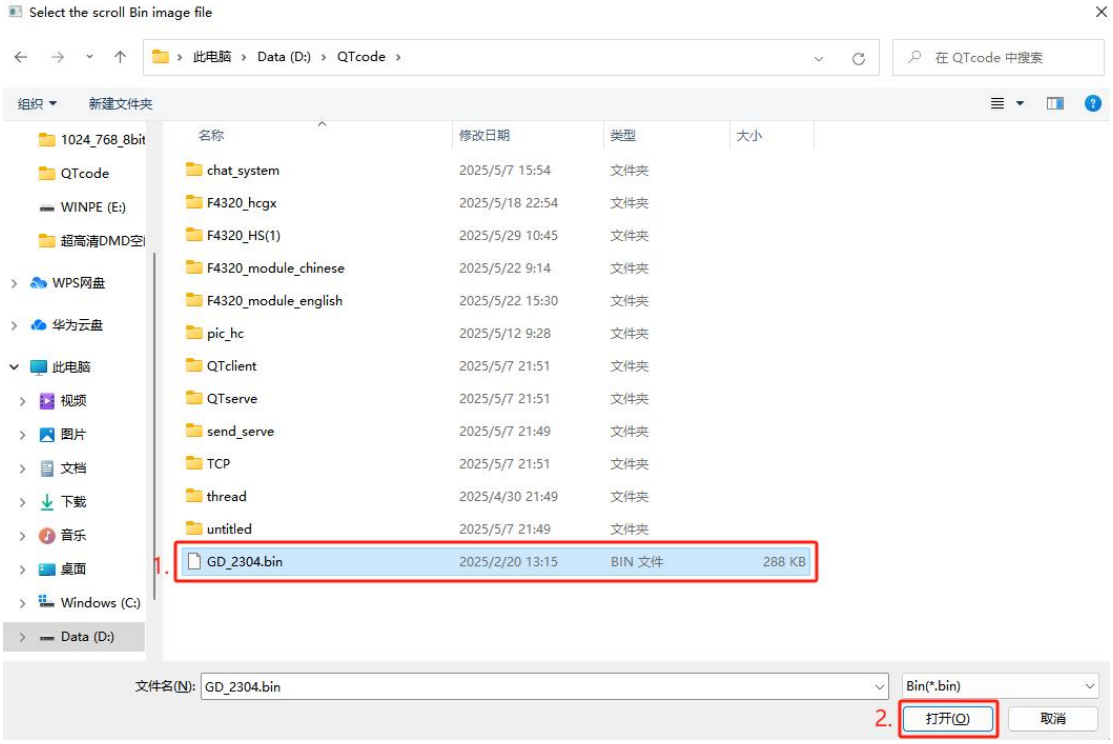
4.Click the parameter setting page to set the trigger parameters and DMD parameters (if there is no special requirement, click the button of setting trigger parameters directly according to the default value of the system, and then click the button of setting DMD part display parameters).



5.After setting the parameters, enter the image cache mode, select the image format to be loaded as the rolling Bin format (currently, the rolling BMP format is not supported in this mode), and then click the "Select image file" button to enter the image folder selection page of the corresponding image format to select the required image file.

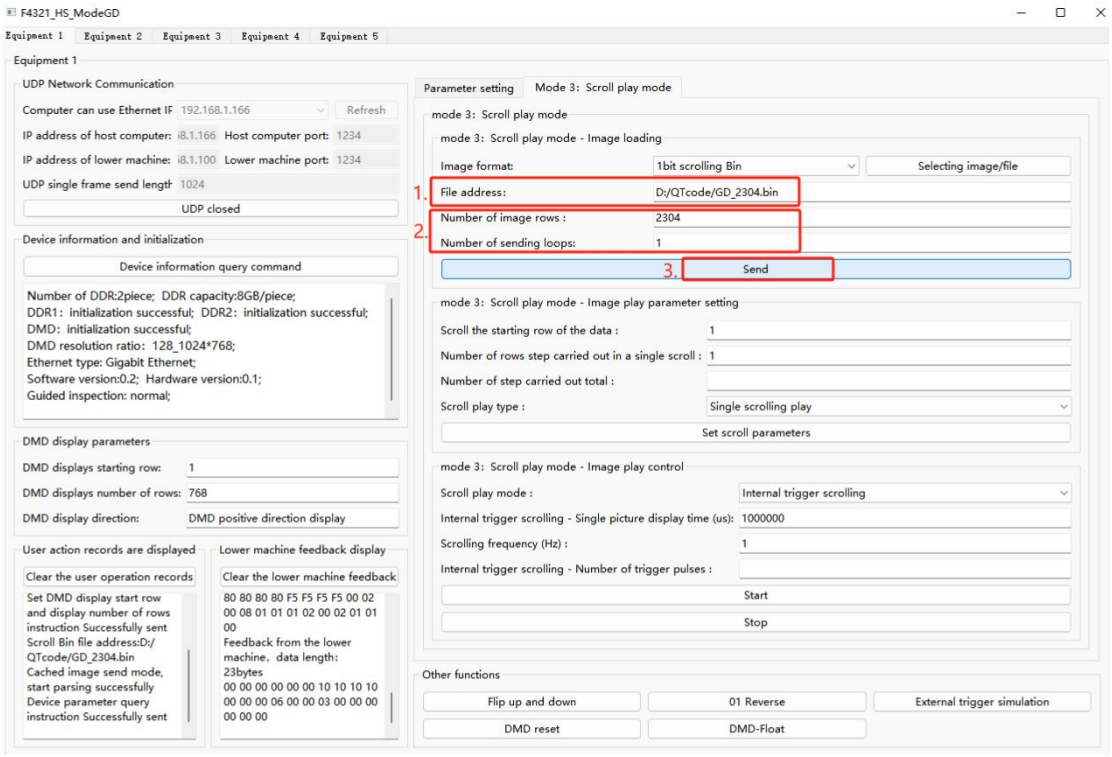


6.Select the appropriate resolution of the .bin file and click open.



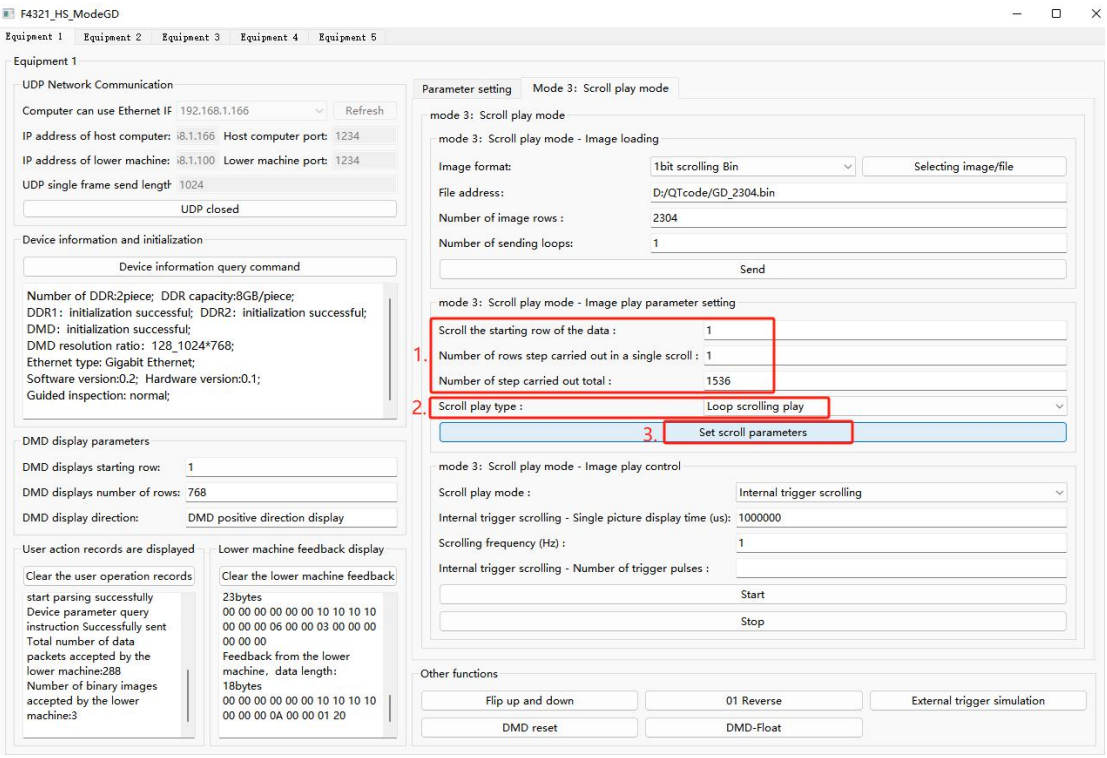
7.The address of the file will be automatically detected, check whether the address of the loaded file is correct, and then fill in the number of images as 2304 (refer to the specific calculation method in

Section 4.2.8.2 of Chapter 4), set the number of cyclic image sending, and click the button of Send image.

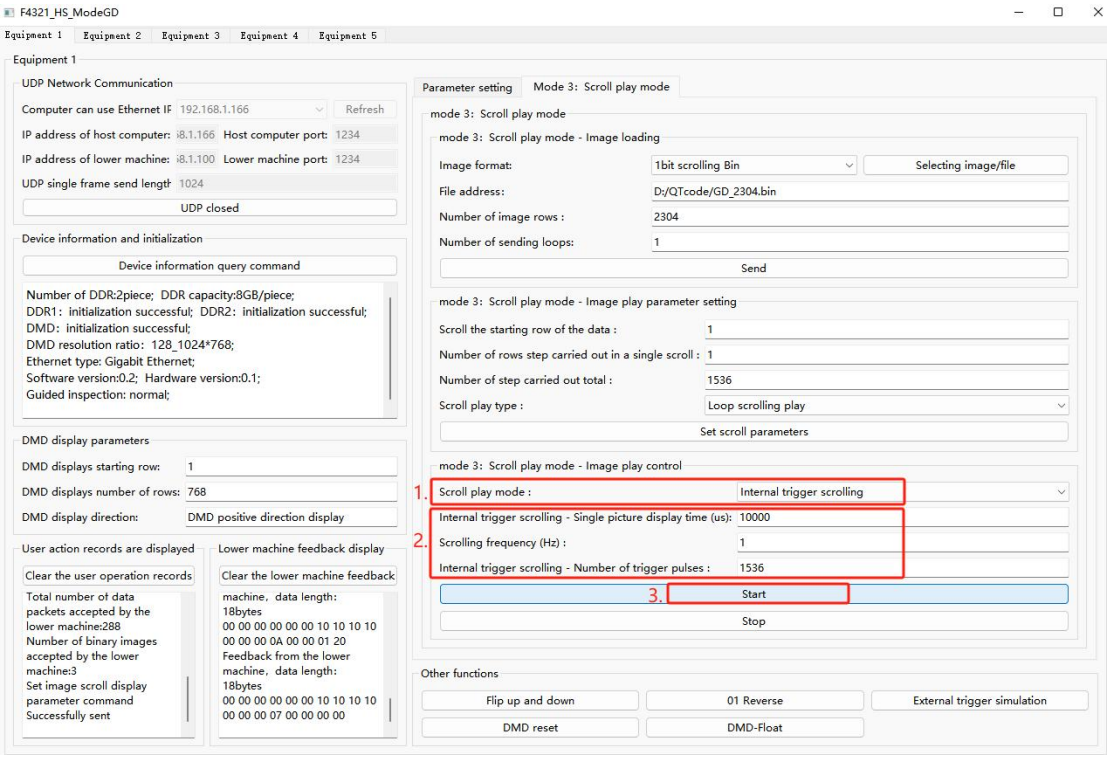


Note: Number of resolution columns * total number of image rows /8/UDP single frame sending length = number of data packets (here mainly depends on the number of data packets, calculate the total number of image rows according to the number of data packets, not the number of binary pictures).

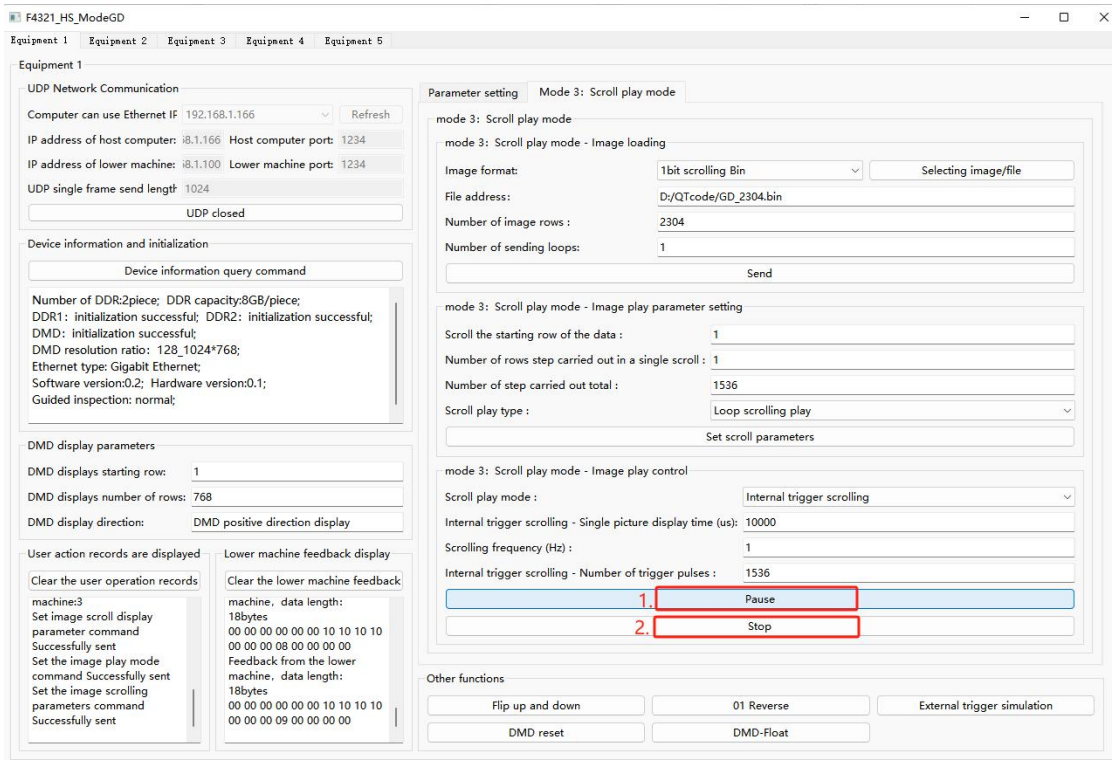
8.Set the starting behavior of scroll data 1, the number of single scroll steps is 1, the total number of steps is 1536 (the total number of steps = the total number of lines of the picture - the number of lines of resolution), set the type of scroll play to cyclic scroll play, and click the button of Set scroll parameters.



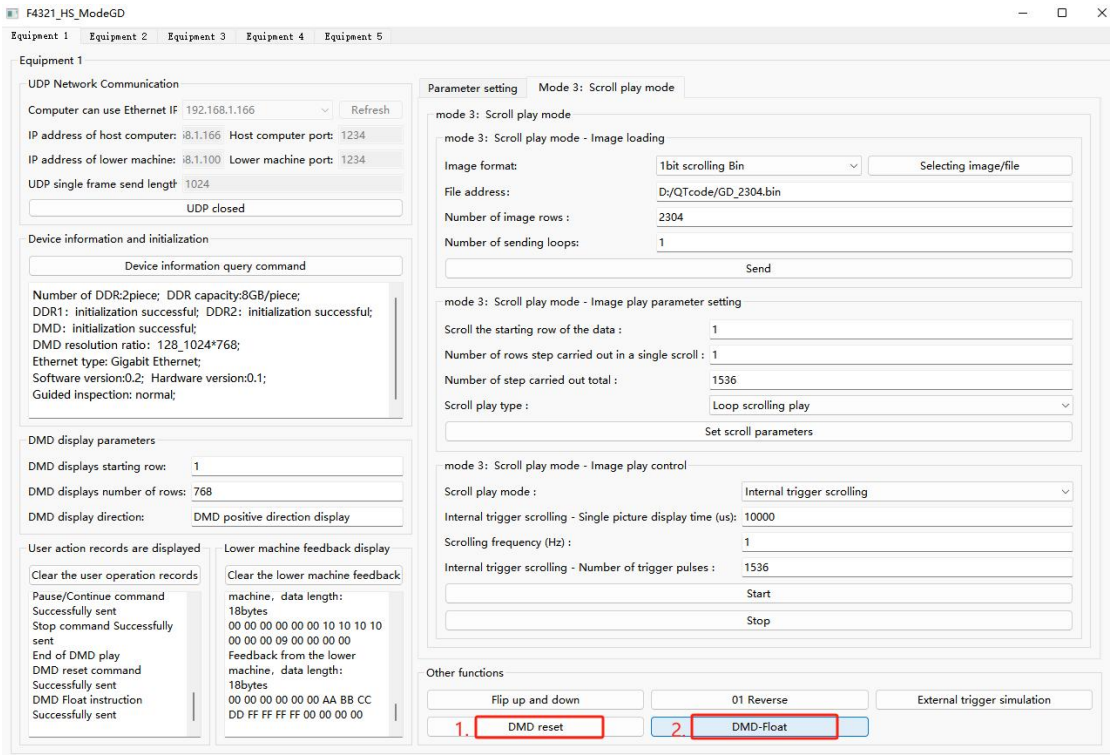
9.The scroll play mode is set as internal trigger scroll, the display time of a single image is 10000us, the scroll frequency is 1Hz, the number of trigger pulses is consistent with the total number of steps in step 8, and click to start the scroll play.



10.Click the button to stop scrolling after the completion of play, you can pause the current scrolling state, click the button to stop scrolling, you can stop the current scrolling picture.

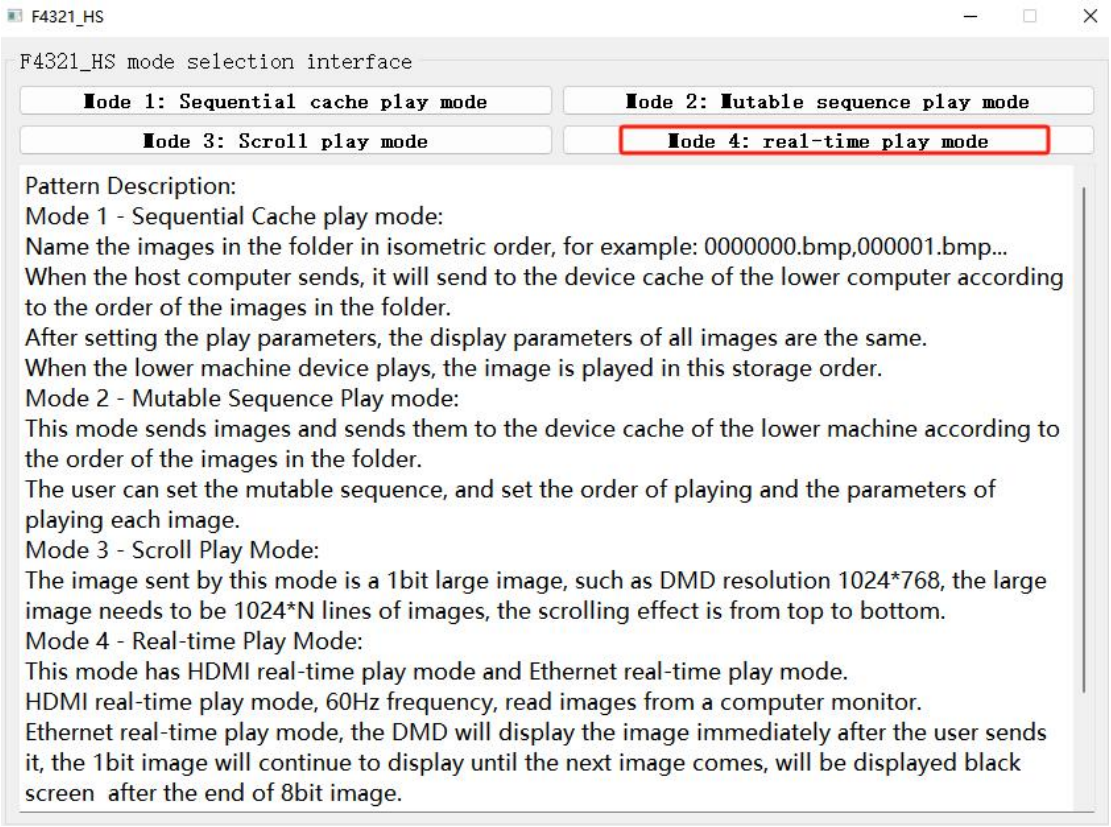


11.After playing, click DMD reset, then click DMD-float, power off.

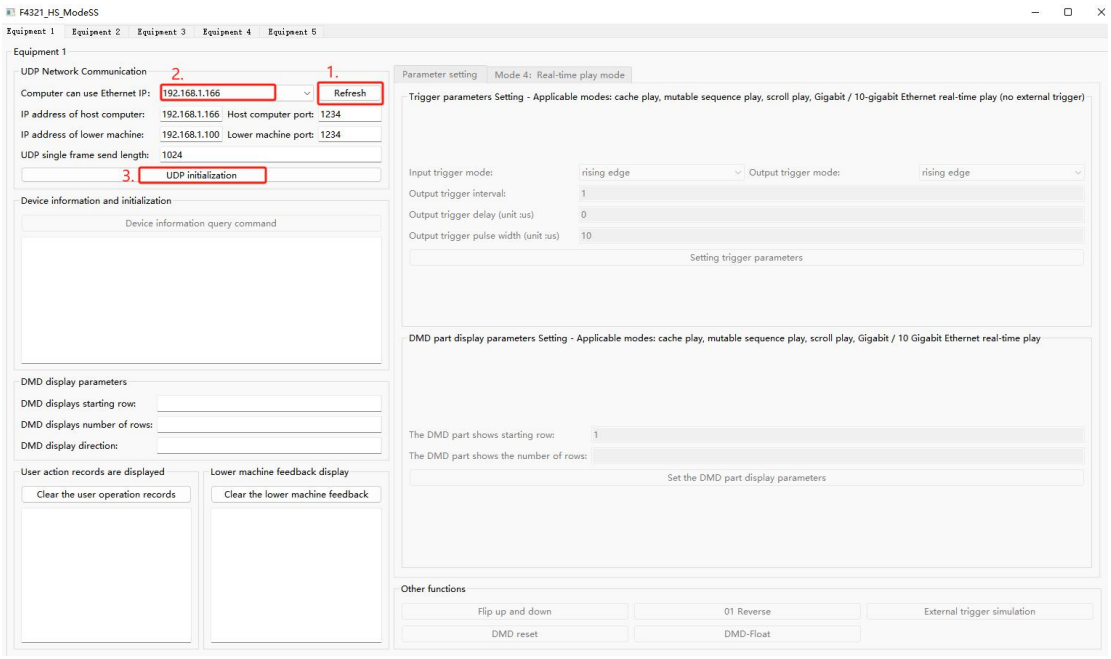


5.5 HDMI real-time play mode

1.Connect the network port and power supply, open the PC software, select the scroll play mode, and enter the new interface.

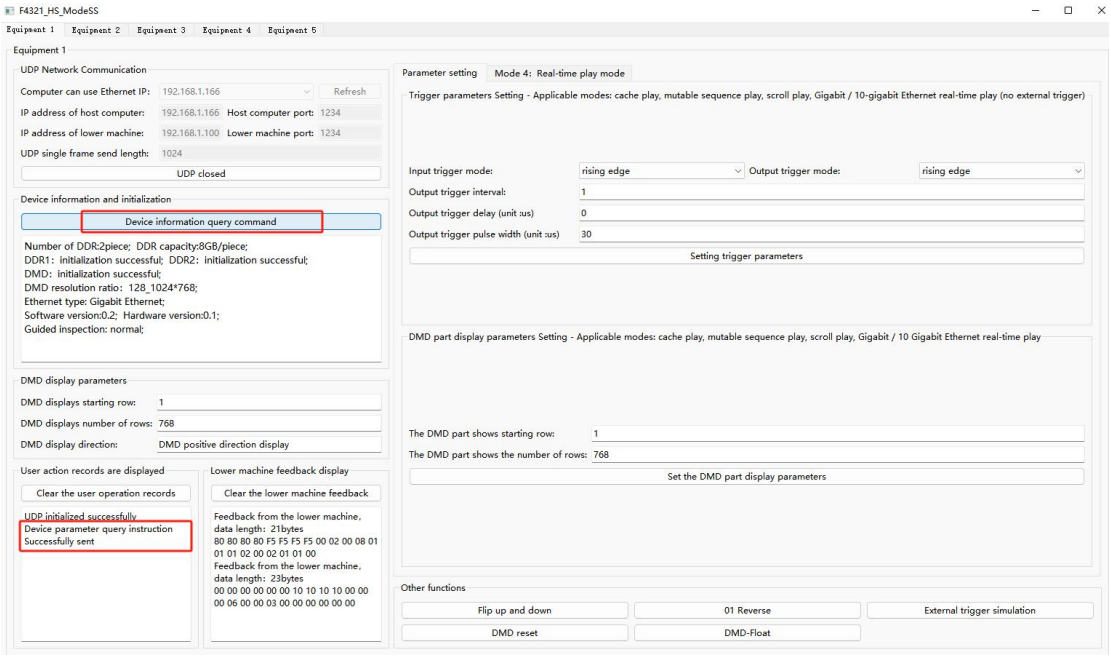


2.Click the Refresh button, select the IP address that has been set, and click the UDP initialization button. After successful initialization, the user operation record will show that the UDP initialization is successful.

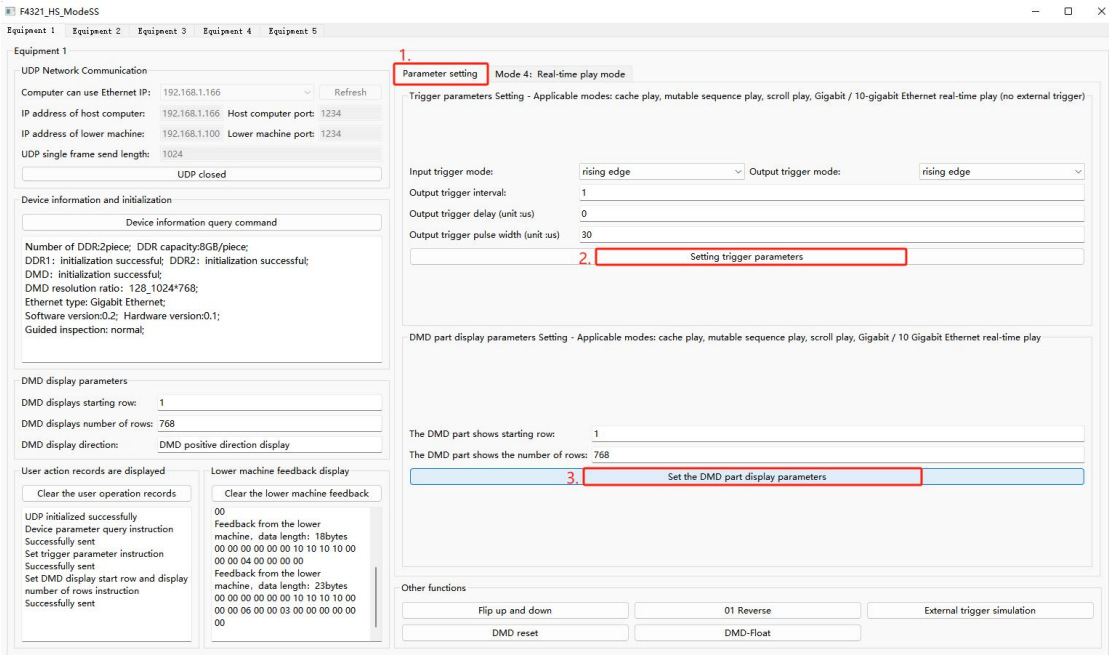


3.Click the device information query command to detect the

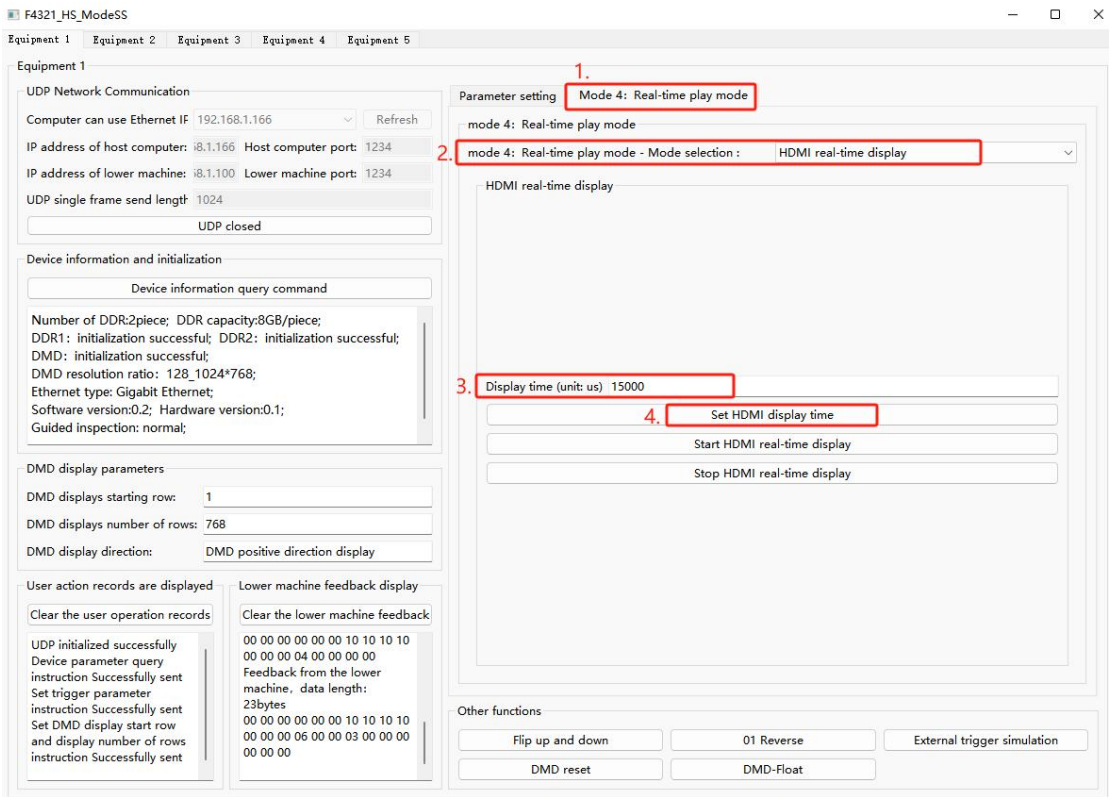
initialization status, some parameter information and the DMD display parameters.



4.Click the parameter setting page to set the trigger parameters and DMD parameters (if there is no special requirement, click the button of setting trigger parameters directly according to the default value of the system, and then click the button of setting DMD part display parameters).

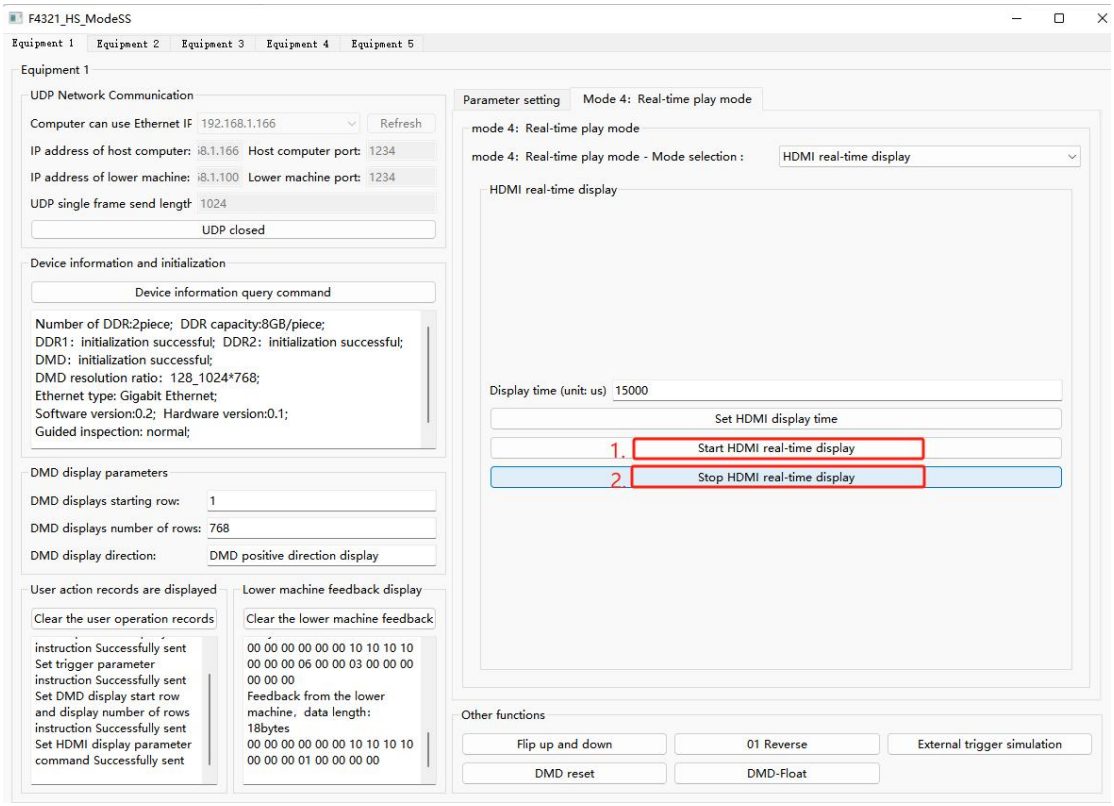


5.Enter the real-time playback mode, select HDMI real-time display, set the display time to 15000us, and click the set HDMI display time button.

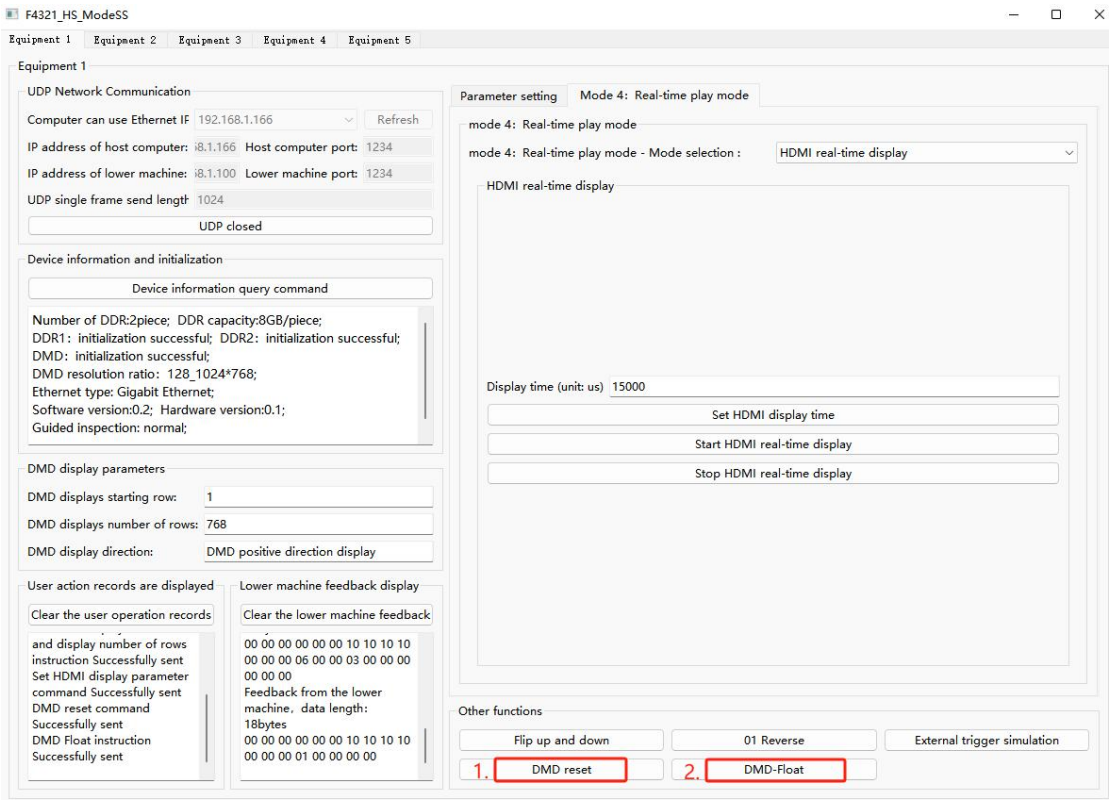


6.Click start HDMI real-time display to play real-time display data on

DMD, and click stop HDMI real-time display button to stop playing current real-time playback.

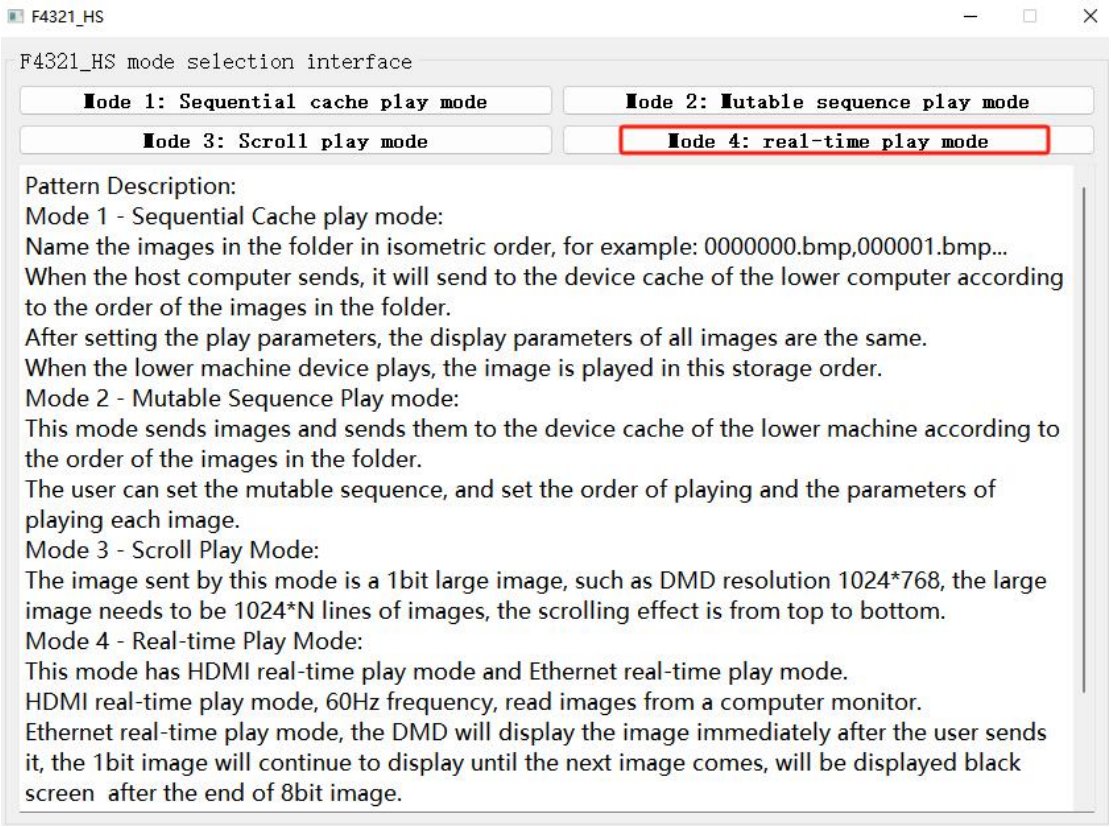


7.After stopping play, click DMD reset, then click DMD-float, power off.

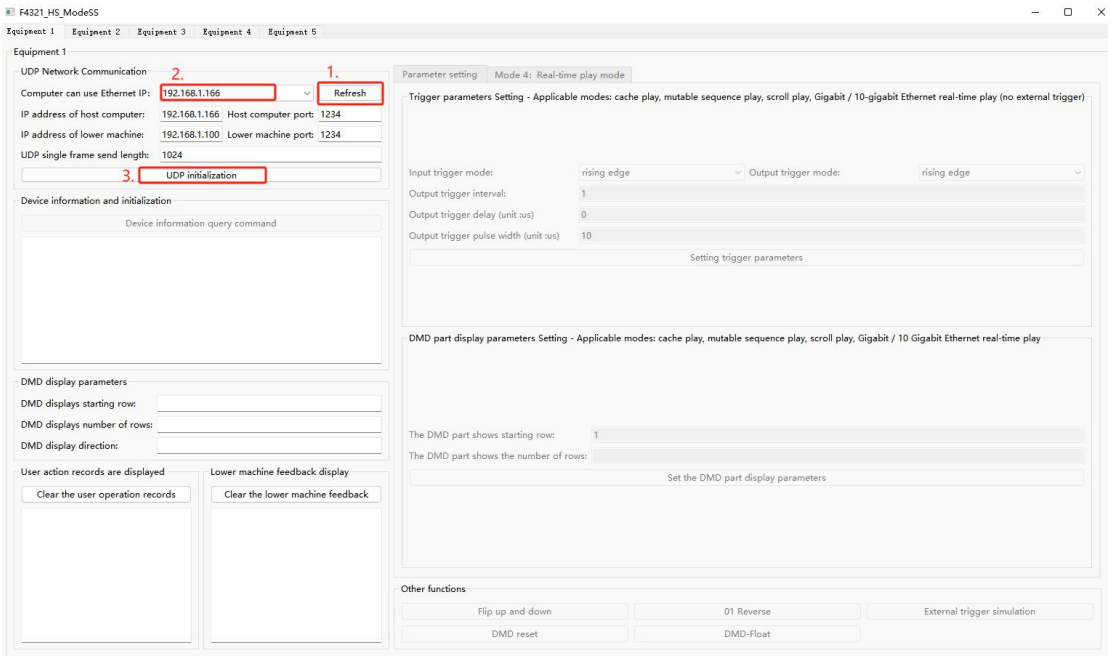


5.6 Gigabit / 10Gigabit Ethernet real-time play mode

1.Connect the network port and power supply, open the PC software, select the real-time play mode, and enter the new interface.

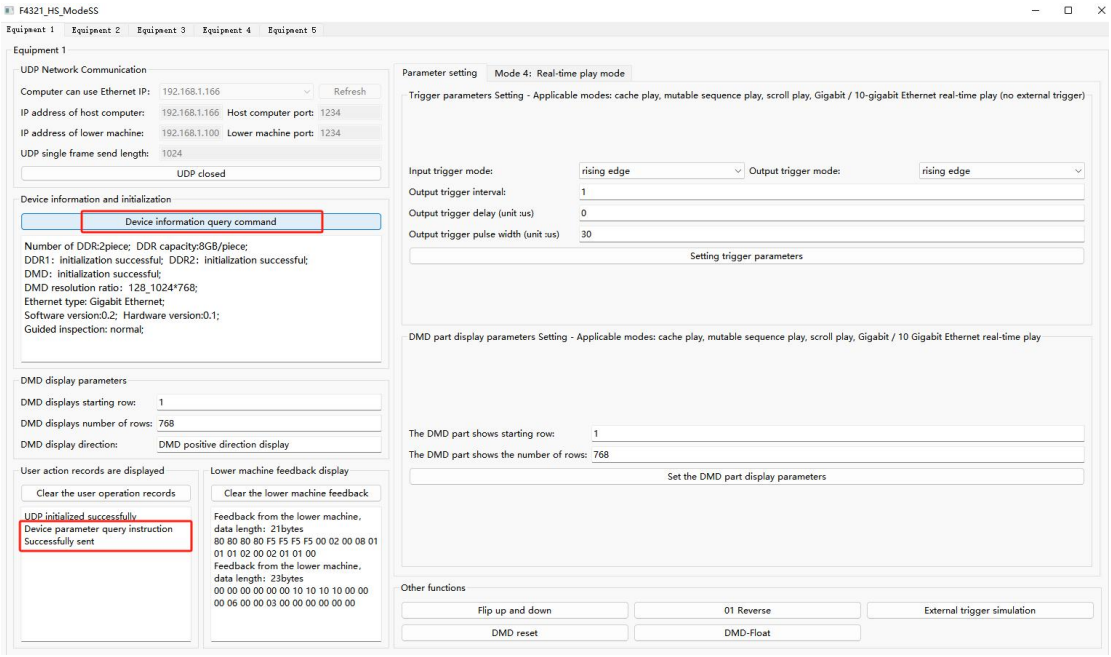


2.Click the Refresh button, select the IP address that has been set, and click the UDP initialization button. After successful initialization, the user operation record will show that the UDP initialization is successful.

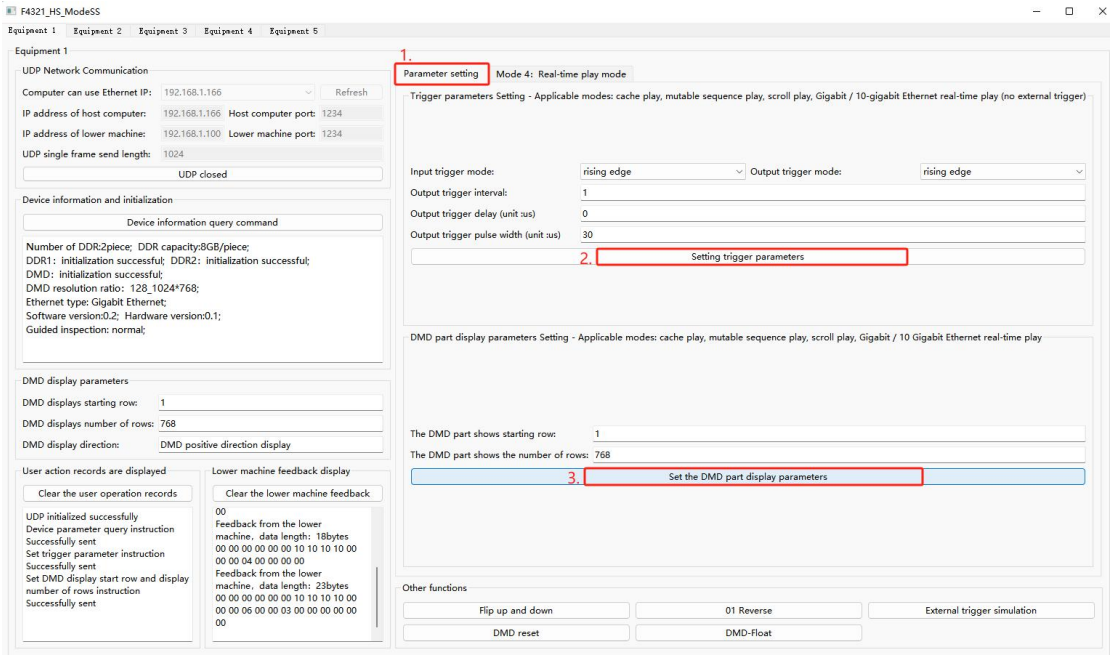


3.Click the device information query command to detect the

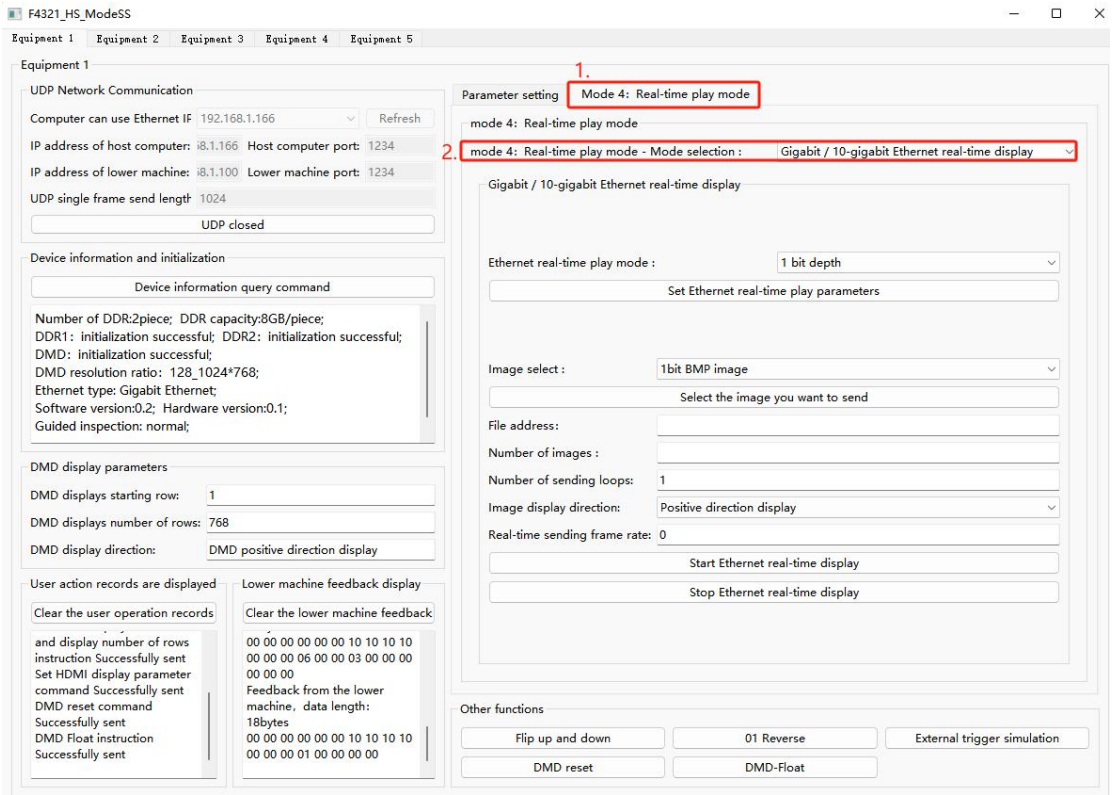
initialization status, some parameter information and the DMD display parameters.



4.Click the parameter setting page to set the trigger parameters and DMD parameters (if there is no special requirement, click the button of setting trigger parameters directly according to the default value of the system, and then click the button of setting DMD part display parameters).

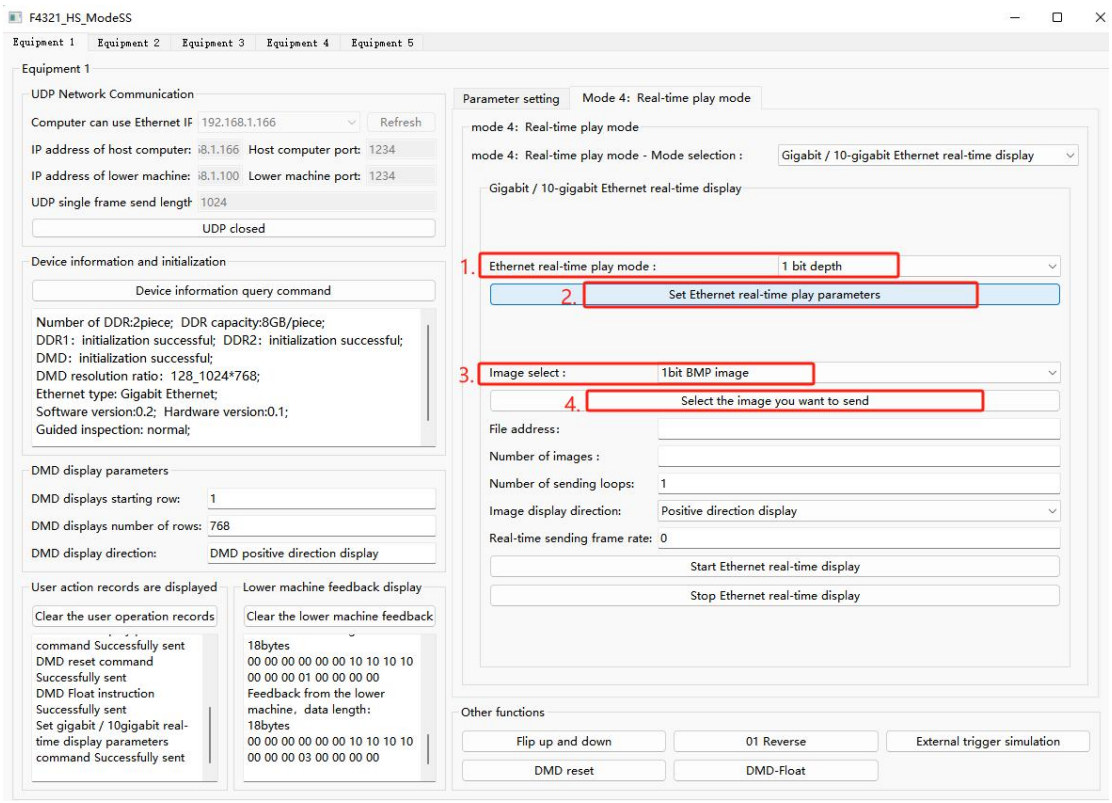


5.Enter real-time playback mode and select Gigabit / 10 Gigabit Ethernet real-time display from the drop-down options of real-time playback mode.

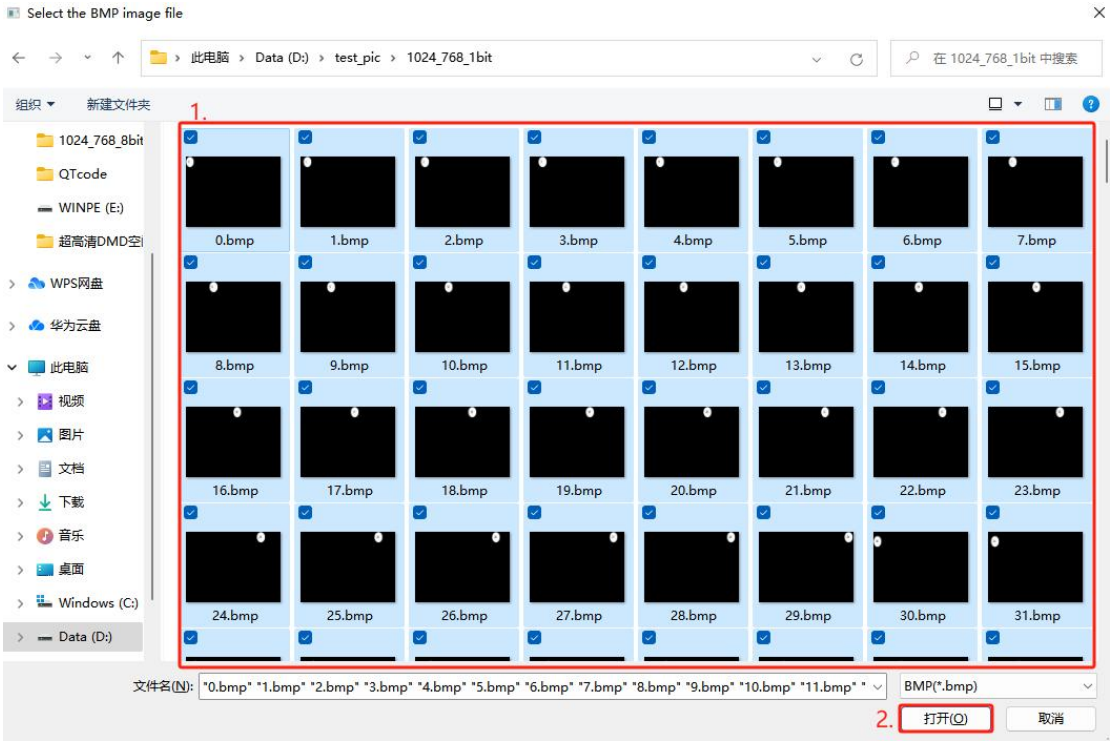


6.Set the bit depth of Ethernet real-time play mode to 1, click the

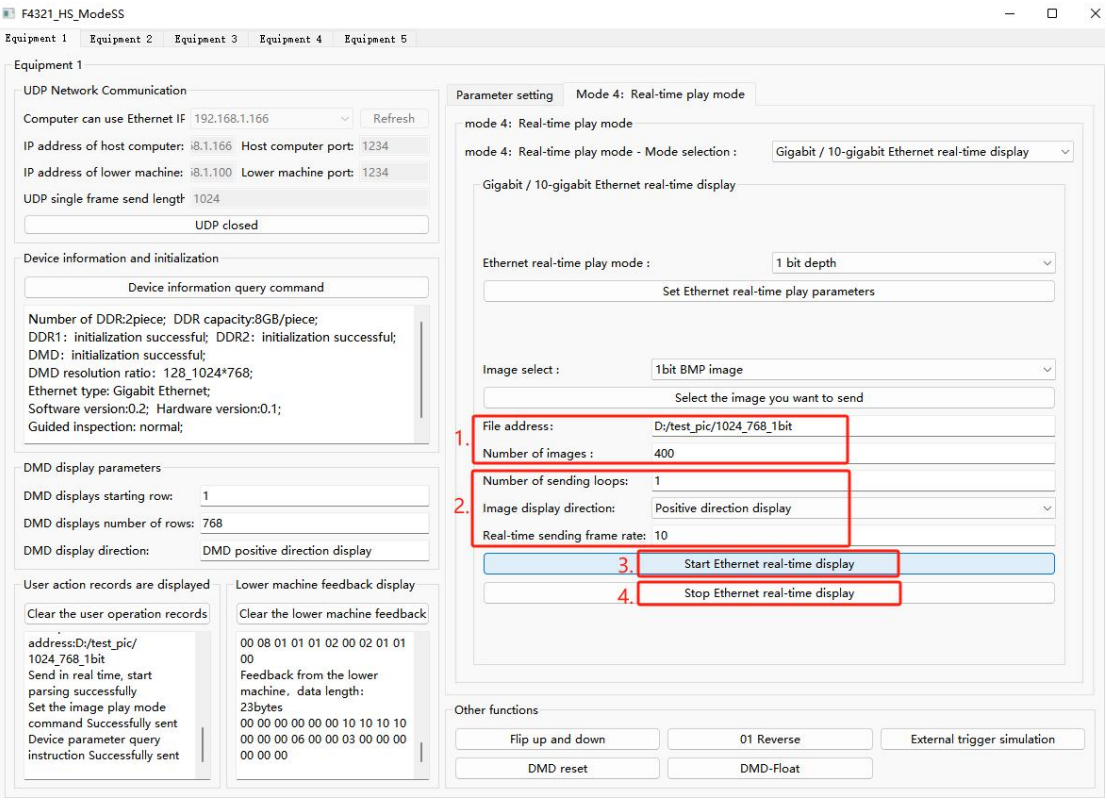
button of Setting Ethernet real-time play parameters, select the BMP file with 1bit image format, click the button of "Send Image", and enter the image folder selection page of the corresponding picture format.



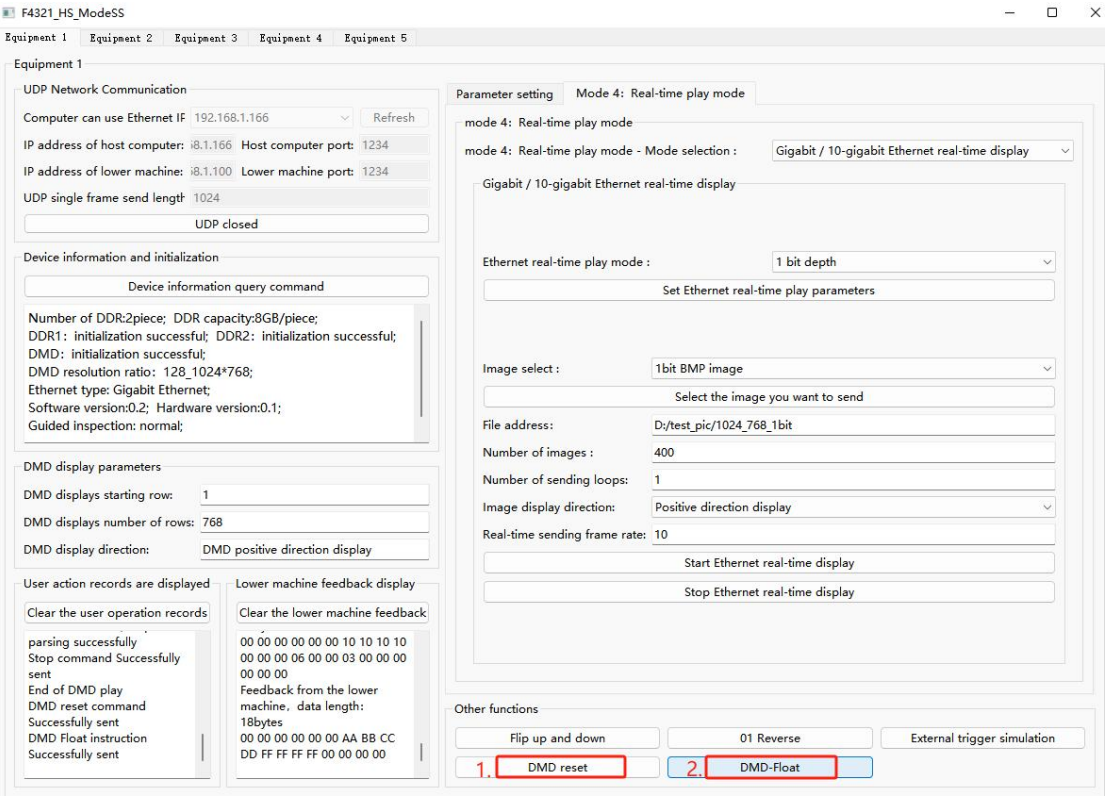
7.Select the image folder corresponding to the resolution, select the desired image and click Open.



8.Check whether the address of the loaded image file and the number of images are correct, set the number of image cycle sending and real-time sending frame rate, select the image display direction, click start Ethernet real-time display, and the loaded picture can be displayed and played on the DMD in real time, click stop Ethernet real-time display, and the picture being played in real time can be stopped.



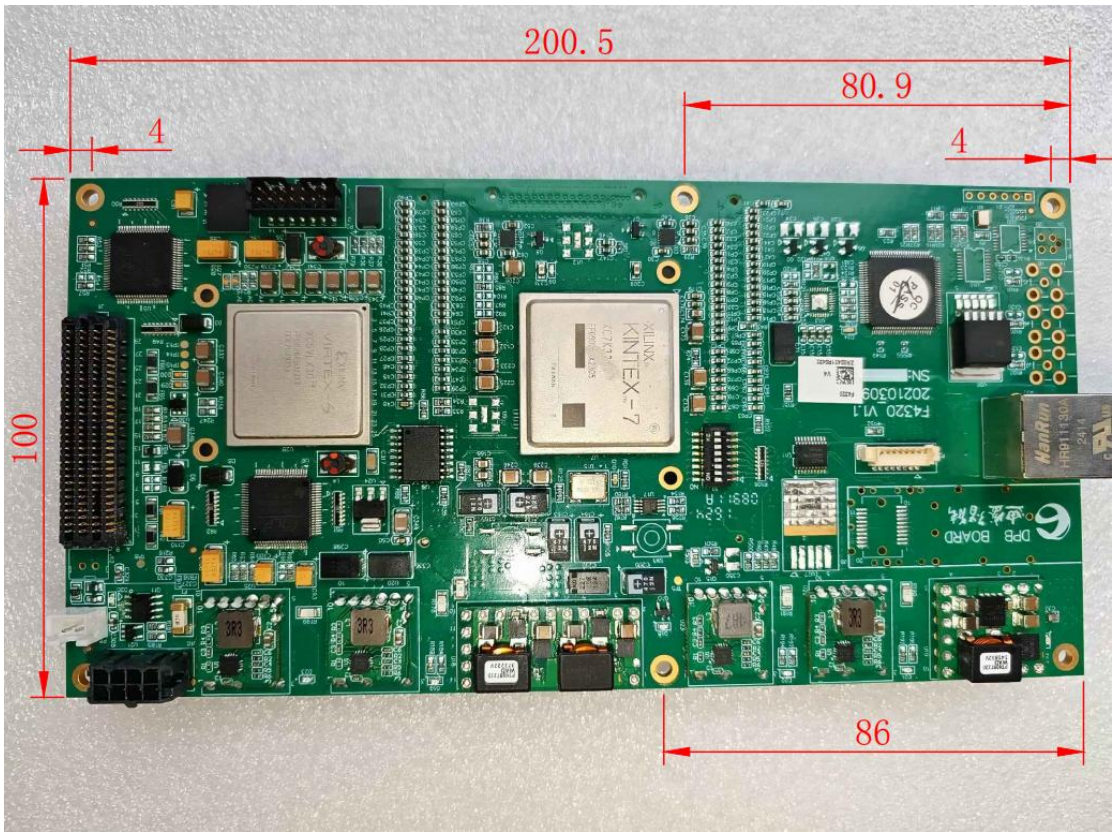
9.After playing, click DMD reset, then click DMD-float, power off.



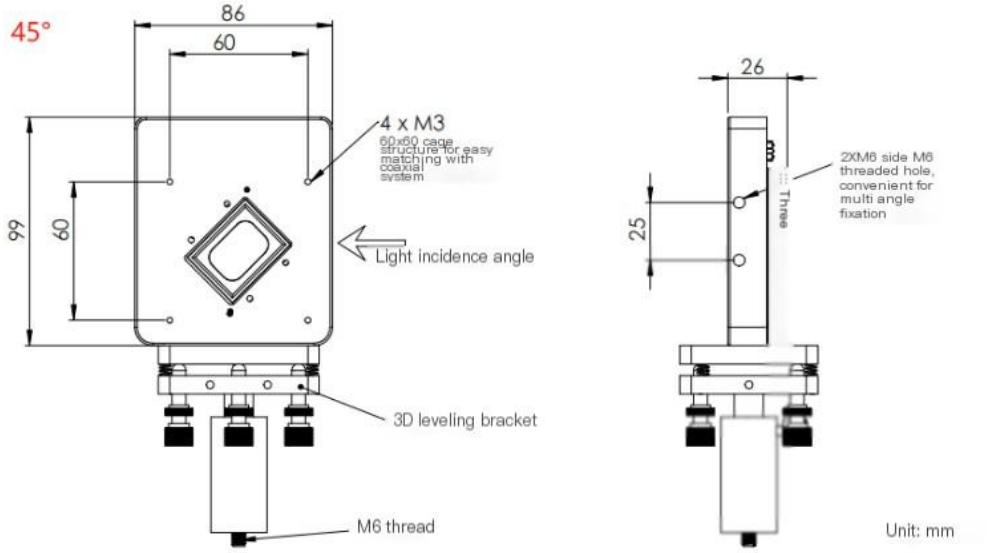
6. Product structure size

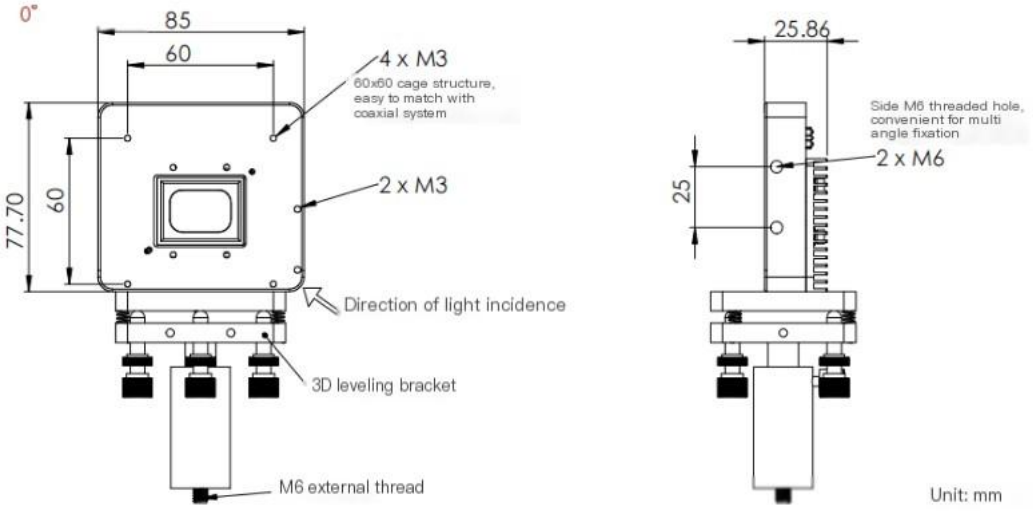
The high-speed flexible Cable HS1-4 Cable structure size is as follows:

The structure size of the HS1-4 control board is shown as follows:

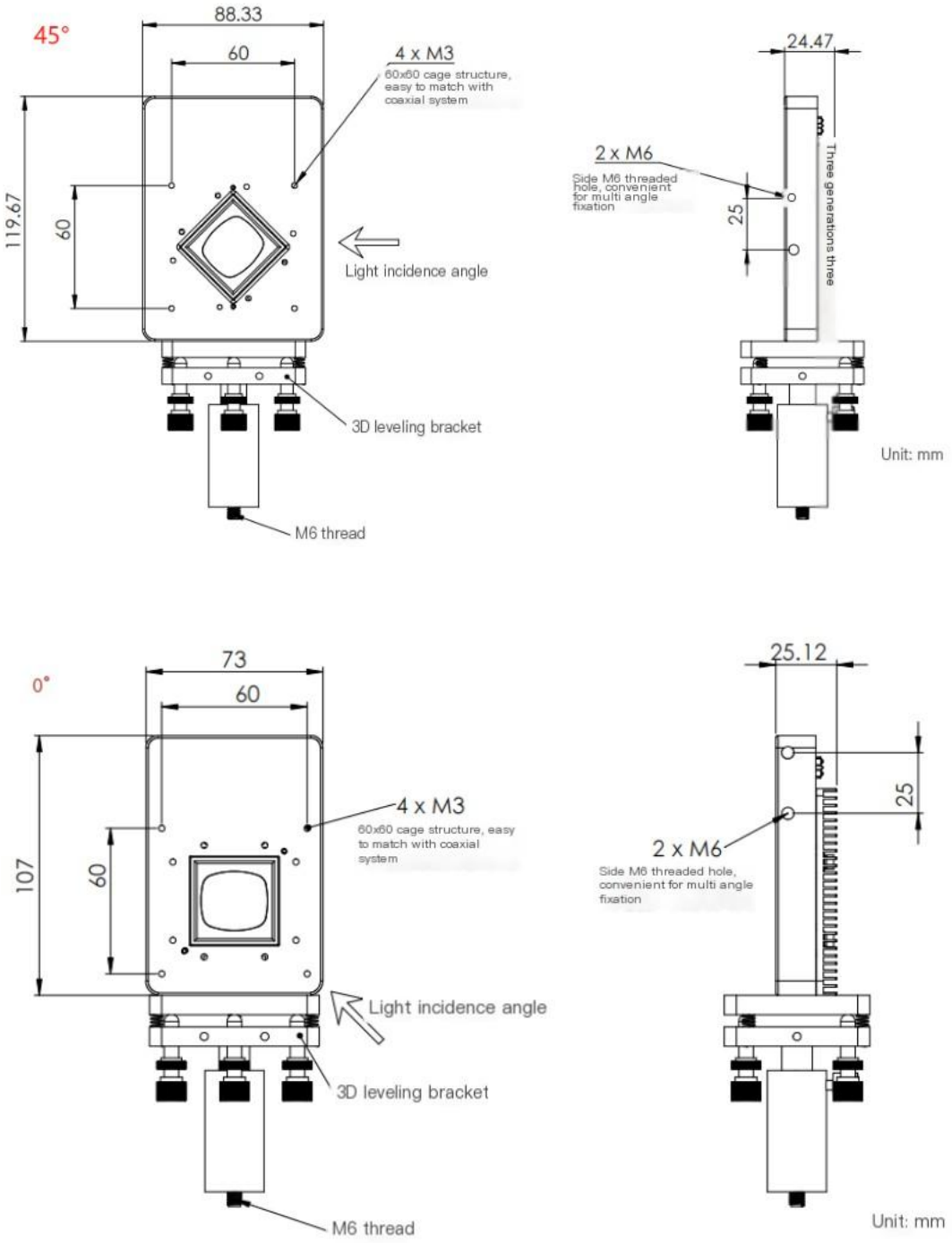


The dimensions of 0.55 and 0.7XGA DMD 3D fine-tuning platform are shown as follows: (each style has two angles of 45° and 0°)

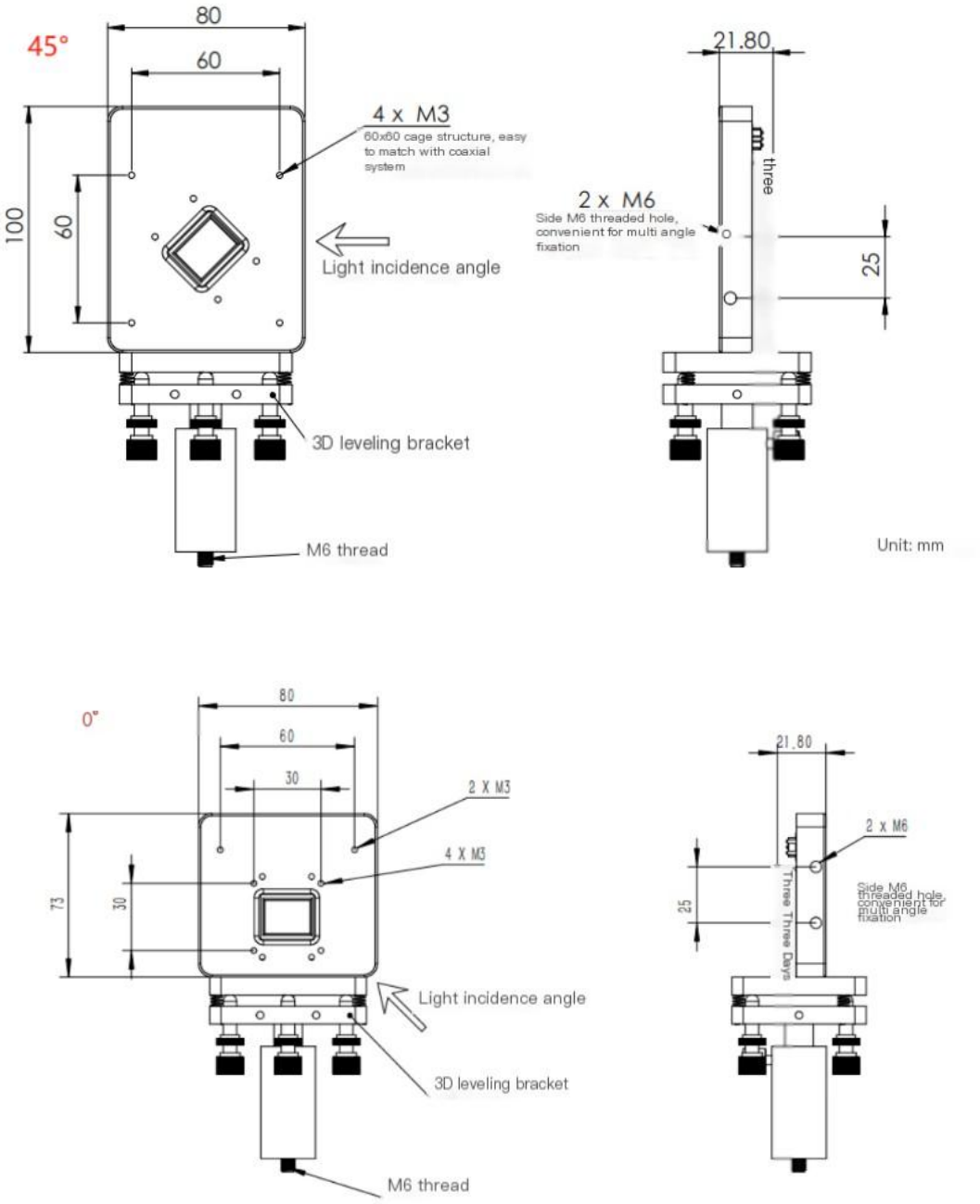




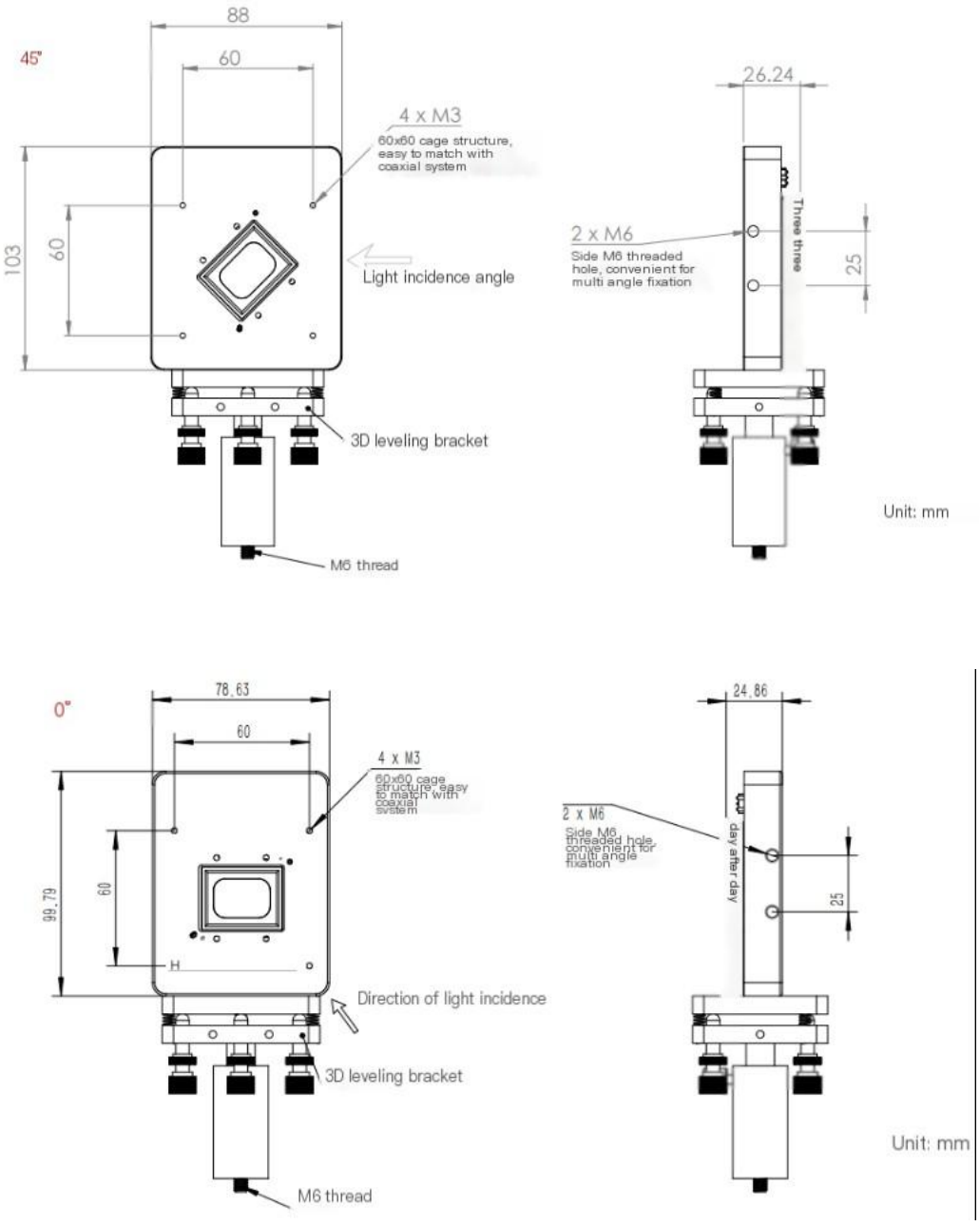
The dimensions of the 0.95 1080P and 0.96 WUXGA DMD 3D fine-tuning platform are shown as follows:



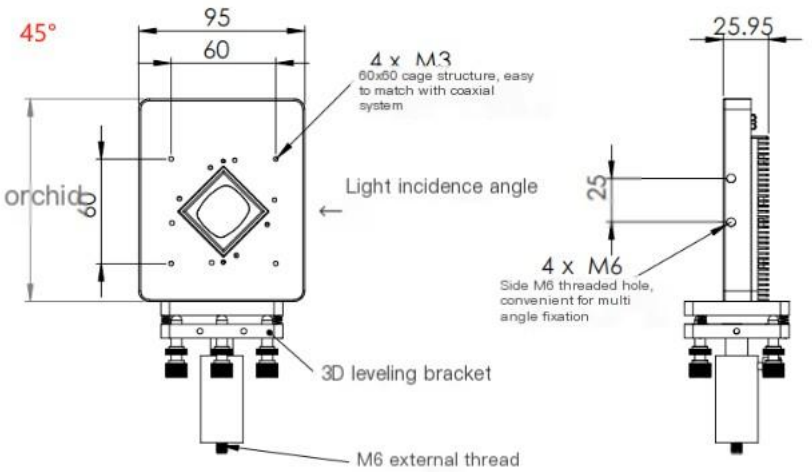
The structure size of 0.65NIR WXGA DMD 3D fine-tuning platform is shown as follows:



The structure size of 0.65 1080P DMD 3D fine-tuning platform is shown as follows:

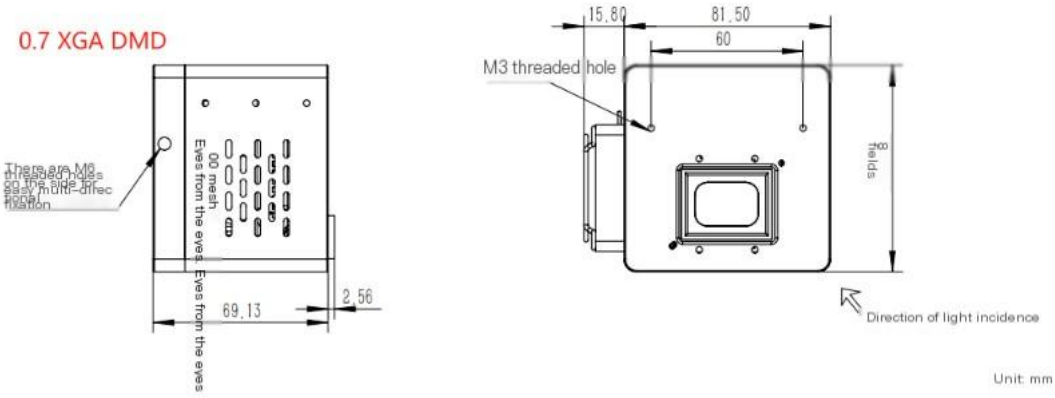


The structure size of 0.9WQXGA DMD 3D fine-tuning platform is shown as follows:



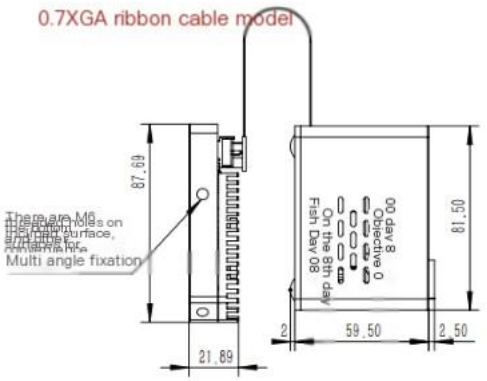
Unit: mm

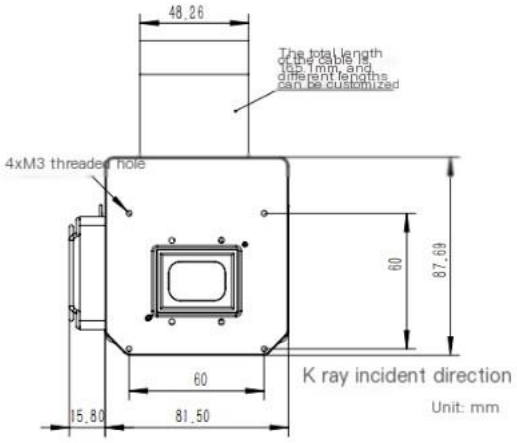
The 3D structure size of the ultra-small space light modulator series is shown in the following figure: (the cable type can be fixed from multiple angles, and the integrated type can be fixed by an external fine-tuning bracket if it needs to be oblique 45°)



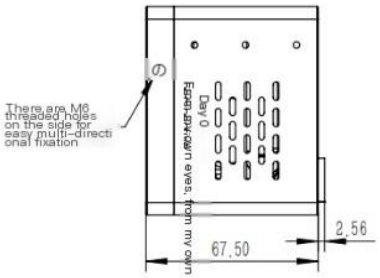
Unit: mm

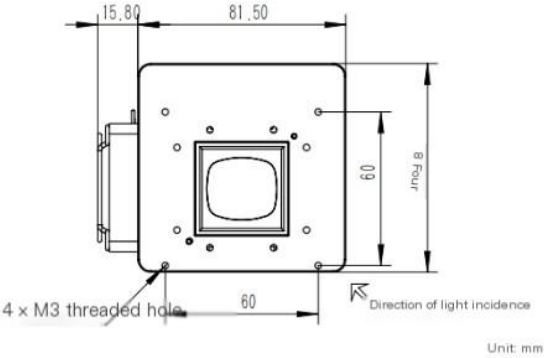
0.7XGA ribbon cable model



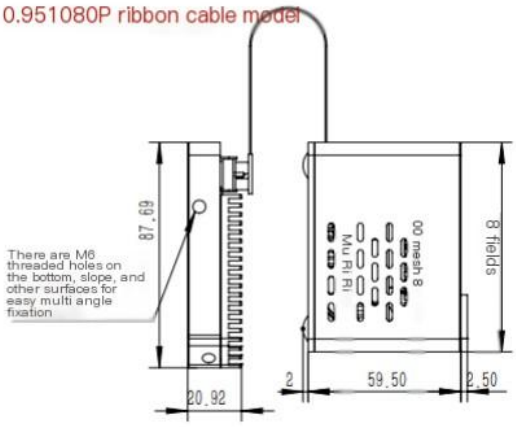


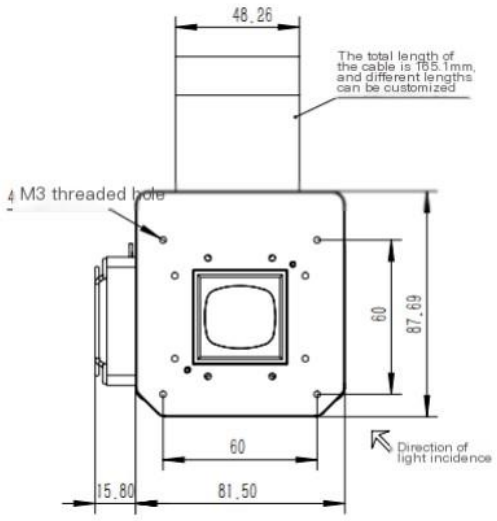
0.95 1080P DMD



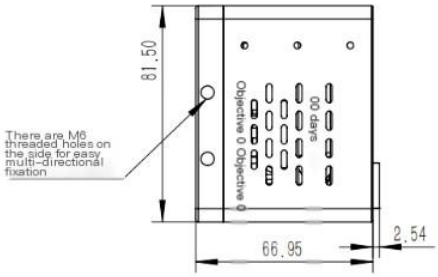


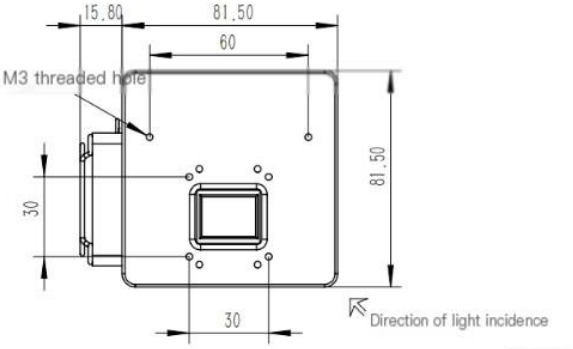
0.951080P ribbon cable model





0.65NIR WXGA DMD





Unit: mm

7. Precautions in Use

1. Do not plug or unplug the circuit board while powered on.

2. When using the DMD, proper heat dissipation must be ensured.

3. It is strictly prohibited to place the development board directly on the metal optical tabletop, nor should any other metal items fall on the circuit board to prevent short circuits.

4. Please do not place the circuit board in areas with a lot of dust for operation to avoid poor contact or short circuit caused by excessive dust.

5. Please do not place the circuit board in a high-temperature environment for long-term operation, or confine it in a narrow and sealed space for continuous long-term operation, unless there are heat dissipation measures (such as fans, etc.).

6. It is not allowed to keep an image still for a long time, especially when exposed to a light source. If not in use, it is recommended to turn off the power.

7. Before power failure, please reset the FPGA board to Float the DMD.