

## - Product Overview

The QHY600PRO uses the latest SONY back-illuminated sensor, the IMX455, a full-frame (35mm format) sensor with 3.76um pixels and native 16-bit A/D. This sensor is available in monochrome and color versions. QHY600 is specially designed for scientific and high-end industrial applications, including the 2\*10Gbps fiber interface, USB3.0 interface, 2Gbytes DDR3 memory, 6PIN GPIO / Trig / GPS connector. Support 4.0FPS 16bit full-frame readout and 10FPS 14bit full-frame readout.

QHY600PRO has a back-illuminated structure technology, QE is up to 90%. It has a very low readout noise performance, it can get 1.1e- at the highest gain. It has a typical 51ke full-well in high gain readout mode and a typical 80ke readout in extending full-well mode. The camera supports the 2-cms readout mode (sample the same signal twice and averaged on the sensor) and it can get the readout noise 1.3times less than normal readout mode.

QHY600PRO has an extremely good linear response in the whole full-well range. Please check the following document of the QHY600 Linear Test. It also has zero amplifier glow and zero RBI remains performance.

QHY600PRO includes some special versions. The super-short back focus version has a B.F.L as short as 7mm. The water-cooled version can get typically 45C degrees below ambient with normal temperature water and can get up to 60C degrees below ambient with cold liquid.

### Typical Applications

Sky Survey, Astronomical Photometric, high-resolution LCD/OLED screen inspector/color calibration. All-sky camera. Scientific Measurement, DNA sequencer, Spectrum Instrument.

## + Specifications

<b>Model</b>	<b>QHY600PRO</b>
CMOS Sensor	IMX455
Mono/Color	Both Available. Monochrom version uses the -K industry level sensor. Color version uses the -C consumer level sensor
FSI/BSI	BSI
Pixel Size	3.76um x 3.76um
Effective Pixel Area	9576*6388 9600*6422 with overscan and optically black area)
Effective Pixels	61.17 Megapixels (effective area.
Sensor Size	Full Frame 36mm x 24mm
A/D Sample Depth	16-bit (0-65535 levels) at 1X1 binning 18-bit at 2X2, 19-bit at 3X3, 20-bit at 4X4 software binning *QHY600 uses the software digital binning for 2*2binning. With digital sum, 2*2binning will be four 16-bit summed then it is 18-bit.
Full Well Capacity (1x1, 2x2, 3x3)	Standard Mode >51ke- / >204ke- / >408ke- Super Full Well Mode >80ke- / >320ke- / >720ke-

Full Frame Rate	<b>USB3.0 Port Image Transfer Speed</b> Full Frame Size: 4.0FPS (8-bit output) Full Frame Size: 2.5FPS (16-bit output) 7.2FPS at 9600×3194, 22.5FPS at 9600×1080, 28FPS at 9600×768, 47FPS at 9600×480, 160FPS at 9600×100,
	<b>Fiber Port Image Transfer Speed</b> Full Frame Size: 4FPS (16-bit mode), 10FPS (14-bit mode)
Readout Noise	1.0e- to 3.7e- (Standard Mode)
Dark Current	0.0022e-/p/s @ -20C 0.0046e-/p/s @ -10C
Exposure Time Range	40us – 3600sec
Unity Gain*	25 (Extended Full Well Mode) * *With the improvement of the CMOS technology, the 16bit CMOS camera has been released, like QHY600/268/411/461. For these cameras, even in lowest gain it has beyond the requirement of unit gain (less than 1e/ADU due to sufficient samples) So you can directly set gain0 as start. Please note QHY600/268C/411/461 has extend full well mode. In this mode you still need to find out the unit gain position.
Amp Control	Zero Amplifer Glow
Firmware/FPGA remote Upgrade	Supported. Via Camera USB Port
Shutter Type	Electric Rolling Shutter
Computer Interface	USB3.0
Built-in Image Buffer	2GBytes 16Gbit DDR3 memory
Hardware Frame Sequence Number	Supported
Cooling System	<b>Dual Stage TEC cooler:</b> – Long exposures (> 1 second) typically -35C below ambient – Short exposure (< 1second) high FPS, typically -30C below ambient  <b>Water Cooling Version:</b> -45C below ambient with normal temperature water in long exposures up to -60C below ambient with cold liquid
Sensor Chamber Humidity Sensor	Yes. Support both humidity and pressure readout
Optic Window Type	AR+AR High Quality Multi-Layer Anti-Reflection Coating
Anti-Dew Heater	Yes
Telescope Interface	M54/0.75
Back Focal Length	17.5mm (±0.2)
Weigth	PH Version: 850g*
Power	40W/100% 20W/50% 13.8W/0%

- **Different Models**

QHY600 Series have Pro versions and customization for professional astrophotography or scientific uses. They are:

QHY600Pro (Professional Version, mainly for scientific projects);

QHY600SBFL (Short Back Focal Length Customization, for astrographers and scientific projects both, support PH and Pro Versions);

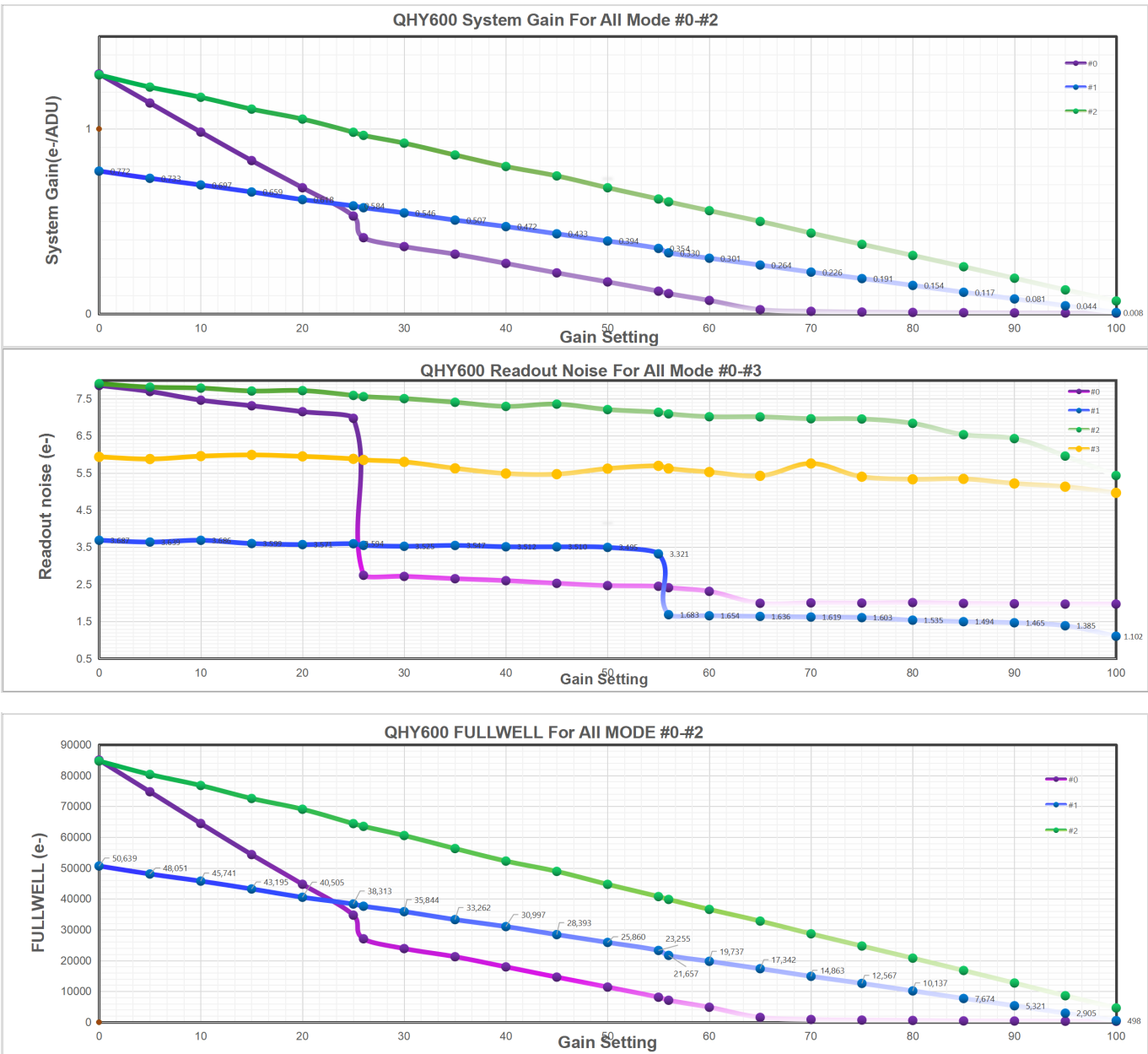
QHY600LQ (Liquid Cooling Customization, mainly for scientific projects, support PH and Pro Versions)

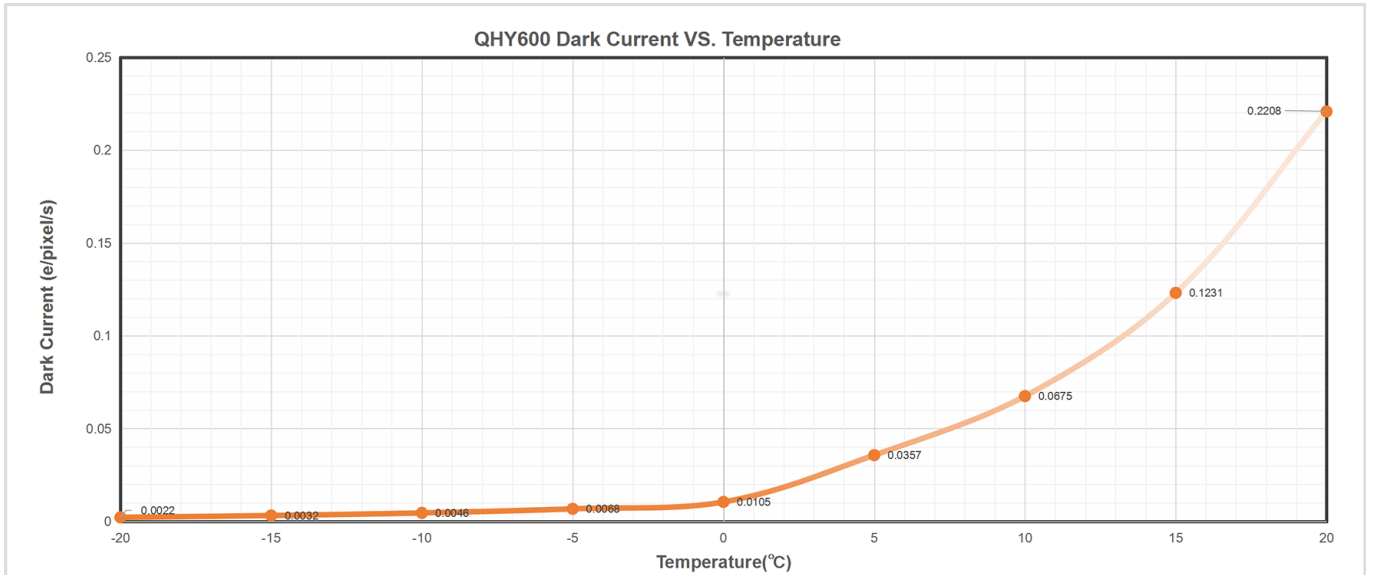
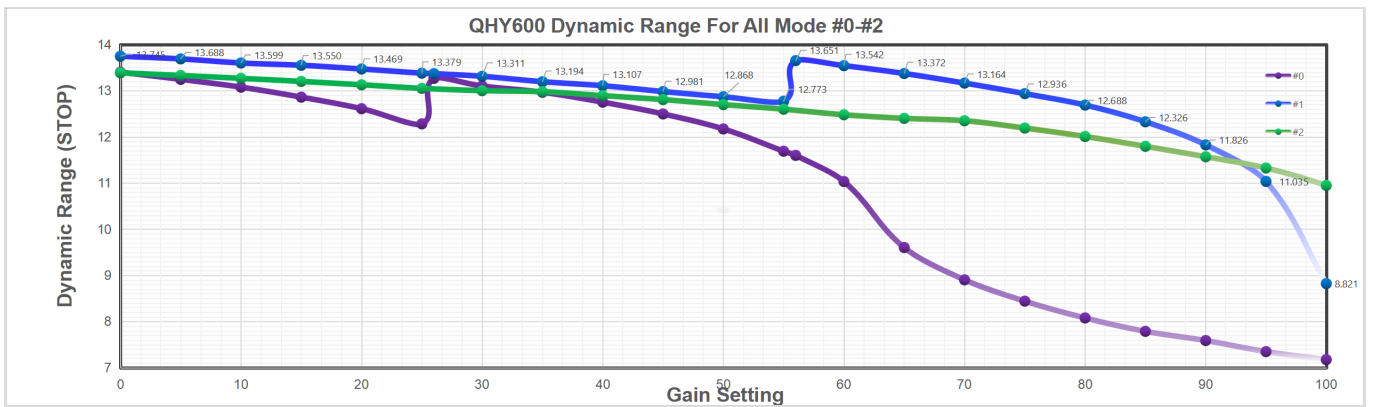
Here we only list different specs due to different models. Please check QHY600 PH Specification list for general information.

Model	QHY600PH	QHY600Pro	QHY600SBFL Short Back Focal Length Version	QHY600LQ Liquid Cooling Version
<b>Frame Rate</b>	USB3.0  Full Frame Size: 4.0FPS (8-bit output)  Full Frame Size: 2.5FPS (16-bit output)  7.2FPS at 9600×3194, 22.5FPS at 9600×1080, 28FPS at 9600×768, 47FPS at 9600×480, 160FPS at 9600×100	USB3.0 & 2*10Gigabit		
<b>Computer Interface</b>	USB3.0	2*10Gigabit  Full Frame Size: 4.0FPS (16-bit output)		
<b>GPIO</b>	N/A	6PIN, high speed with flexible FPGA control.  Can be used as trigger in/out, multiple camera sync capture control, high precision GPS time measurement etc.		
<b>Cooling System</b>	Dual Stage TEC cooler:  – Long exposures (> 1 second) typically -35C below ambient  – Short exposure (< 1second) high FPS, typically -30C below ambient			-45 degrees in continuous mode and single frame mode with an exposure time greater than 1 second.

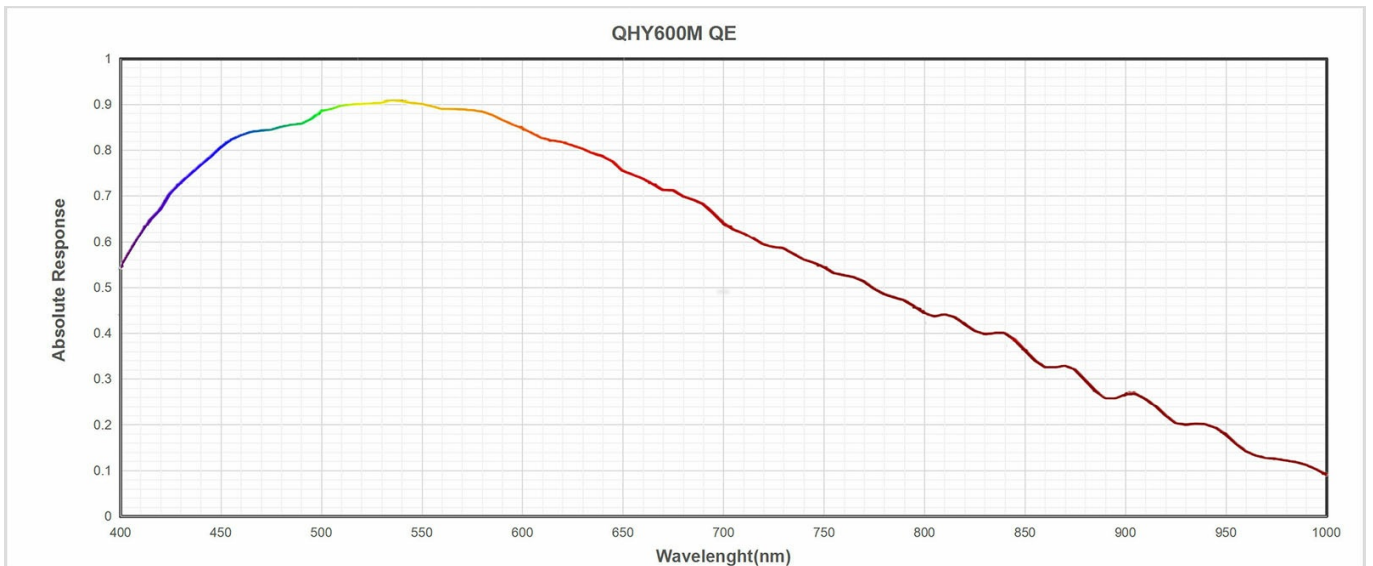
<b>Back Focal Length</b>  (Intercept from the CMOS chip to the top of the camera)	17.5mm (without CAA)		12.5mm when connected with QHYCFW.	
	This intercept does not include CAA. If CAA is used, it increases by 6mm (23.5mm total).		The actual BFL is 14.5mm. Since most uses will match CFW with monochrome cams, please take 12.5mm as major reference.	
<b>Weight</b>	850g	965g	870g	TBD

- Curves





Absolutely Response Curve. This curve is based on the Relativity QE curve on the sony datasheet and QHYCCD measured two-wavelength to compare with a known QE sensor and get this. This curve is just for reference. QHYCCD does not guarantee accuracy. [The test data can be found at the link](#)



## - Advanced Functions

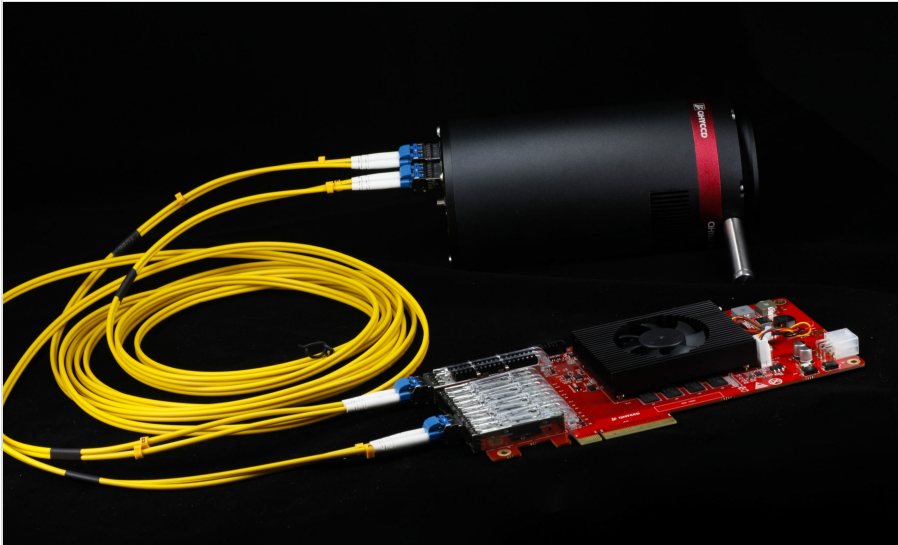
The QHY600PRO supports the Trig in/out function and GPS function. There is a 6pin GPIO socket on the camera backside. It can be configured into different modes. QHY600PRO also can be customized as the user requests to meeting more complex timing by re-programming the FPGA.

## - High Speed Interface

QHY600PRO has two data interfaces: USB3.0 interface and 2\*10Gbps fiber interface.

## - 2\*10Gbps Optical Fiber

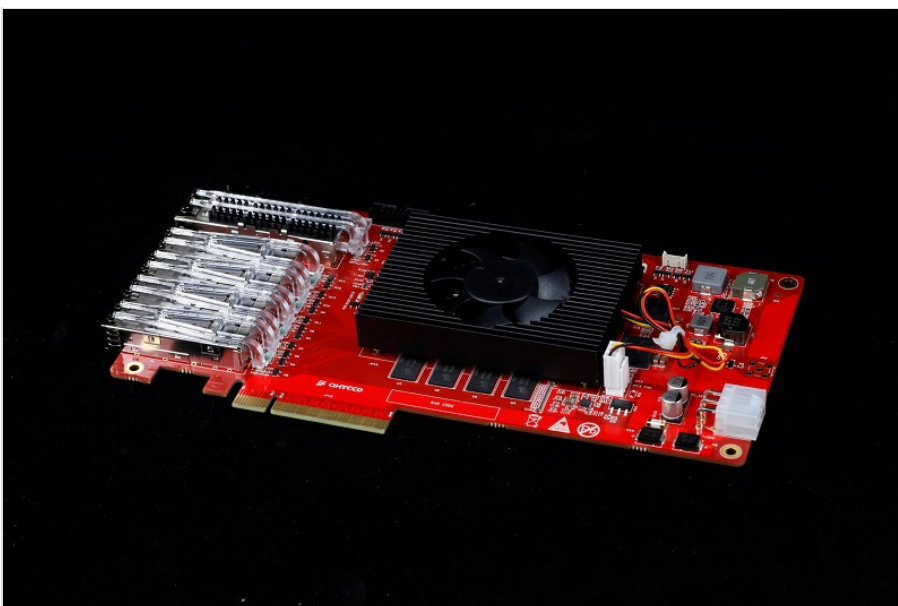
QHY600PRO has a built-in 2\*10Gbps fiber socket. It can work with the QHYCCD PCIE2.0x8 data grabber card (not includes the standard package of QHY600PRO). It can get 4FPS @ 16bit full resolution and 10FPS @ 14bit full resolution frame rate under live streaming mode.



### What is the benefit of the Fiber Interface?

The fiber interface is for the requirement of the professional obs. It will give the following advantages than the USB3.0 interface.

- **Higher data rate.** One 10Gigabit Fiber can transfer maximum 10Gbps data. The actual data rate can get about 800MBytes/s. While the USB3.0 is 5Gbps and the actual data rate is about 350MByte/sec. Use the two 10Gigabit fiber can get about 1.6GBytes/s speed. The IMX455 sensor has the high-speed mode like the 10FPS 14bit full resolution mode and 30FPS 8K VIDEO mode. The data rate of these modes is much more than USB3.0. This mode can be well supported by QHY600's 2\*10Gigabit fiber solution.
- **Very long transfer distance.** The fiber is hundreds of times longer than USB3.0. USB3.0 can only transfer 3meter to 5meter. For longer distances, it needs the extender cable but can just get 10meter to 15meter. While the Fiber can transfer 300meter directly by default optic module comes with the QHY600. And if with the long-distance optic module, it can transfer up to 40km.
- **Solid stable and no affected by EMI.** One major factor that causes the camera to hang is the EMI issue. The USB3.0 transfer maybe gets effect by the EMI in the transfer patch. Like the static and other high-power device emitted. The EMI will cause the transfer data packet to get a CRC error and cause the image loss. A long USB cable is easier to get this problem. Light can not be affected by the EMI. So with the fiber transfer, it will get everything very stable.



## - USB3.0

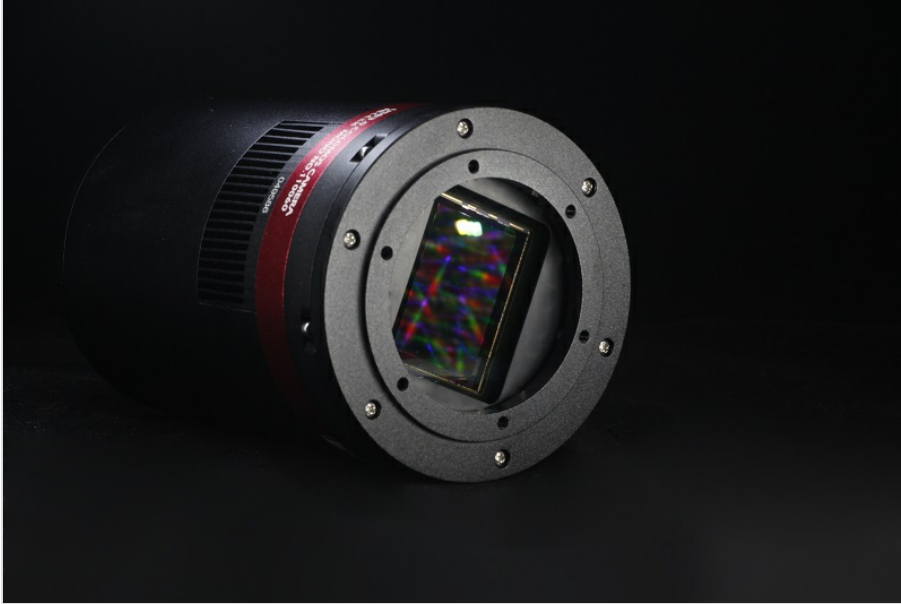
USB3.0 is a very popular interface and very easy to use. QHY600 comes with a 1.8meter USB3.0 cable. Under USB3.0 the

maximum frame rate is 2.5FPS @ 16bit full resolution, 4.0FPS @ 8bit full resolution in live stream mode. USB3.0 can not support a transfer distance of more than 3meter. If you want to get a long-distance under USB3.0, QHYCCD supplies the optional 5meter and 10meter USB3.0 extender cable with a built-in amplifier.

### - Special Version

QHY600PRO has two special versions. The water cooling version and the ultra-short back focal length version.

### - Short B.F.L Version



QHY600 Short back-focus version (QHY600 SBFL) is specially designed for DSLR lens users or those who has special requirement of short back focal length. This version has a special front part version which has 7mm B.F.L only. The front part includes six M2.5 screw holes arranged on a 80mm diameter roundness.

A special adapter is provided to connect the filter wheel. The B.F.L equals 12.5mm when connecting QHYCFW with the adapter. Plus the QHYCFW3L, the total B.F.L is  $12.5+21.5=34\text{mm}$ .



On the side of this adapter there is a 4mm hole to connect air pump through plastic pipe in case of the dewing glass when necessary.



QHY600 SBFL can easily match Canon/Nikon lens, even with filter wheel.

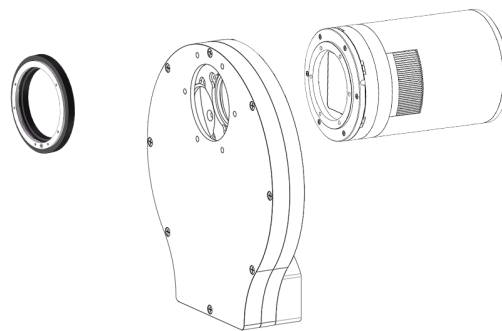


44.1mm = Canon Adapter 10mm CFW3L 21.5mm 12.5mm

COMBO B2

QHY 600M<sub>(Short BFL Ver.)</sub>/268M

For Canon EF Lens (BFL=44.1mm)





**QHYCCD**

46.5mm =      Nikon Adapter (SP)      CFW3L  
                                          12mm    0.5mm      21.5mm      12.5mm

**COMBO B3**

**QHY 600M**(Shor BFL Ver.)/**268M**

For Nikon F Lens (BFL=46.5mm)

If you need filterwheel and OAG to connect 55mm MPCC at the same time, then the SBFL version is the best choice. Notice: If it's not necessary to use an OAG, you can also choose standard QHY600 PH version to match filter wheel.

**QHYCCD**

55mm =      M48 Output    OAGM      CFW3L  
                                          5mm    10mm    3mm    3mm      21.5mm      12.5mm

**COMBO B1-1**

**QHY 600M**(Short BFL Ver.)/**268M**

For MPCC (M48, BFL=55mm)

Note: Put OAG at the position next to the M48 Output to make both main cam and guiding cam focused.

Or

10mm      [24mm M3 Screws\*6 to fix adapters ]

(If OAG is not used)

QHY600 Short Back-focus version supports CAA function, too. However, each QHY camera guarantees the right center angle with professional devices before the sale. So please do not adjust CAA unless there's a problem at the front of the cam, like telescope adapters.





Compared with air cooling, QHY600LQ (Liquid Cooling Customization) has the following important advantages:



**No vibration.** Air-cooling requires the use of a fan inside the camera that may induce small vibrations. Even the highest quality fan cannot avoid some effect on the FWHM (full width at half maximum) of stellar images on certain telescopes. Long focal length optical systems are more sensitive to this effect. However, water cooling achieves temperature reduction through the slow flow of water. There is no moving mechanical component to cause vibration of the camera, eliminating any negative effect on the image.

**No hot air turbulence.** For optical systems like RASA and Hyperstar where the camera is placed at the secondary position, air

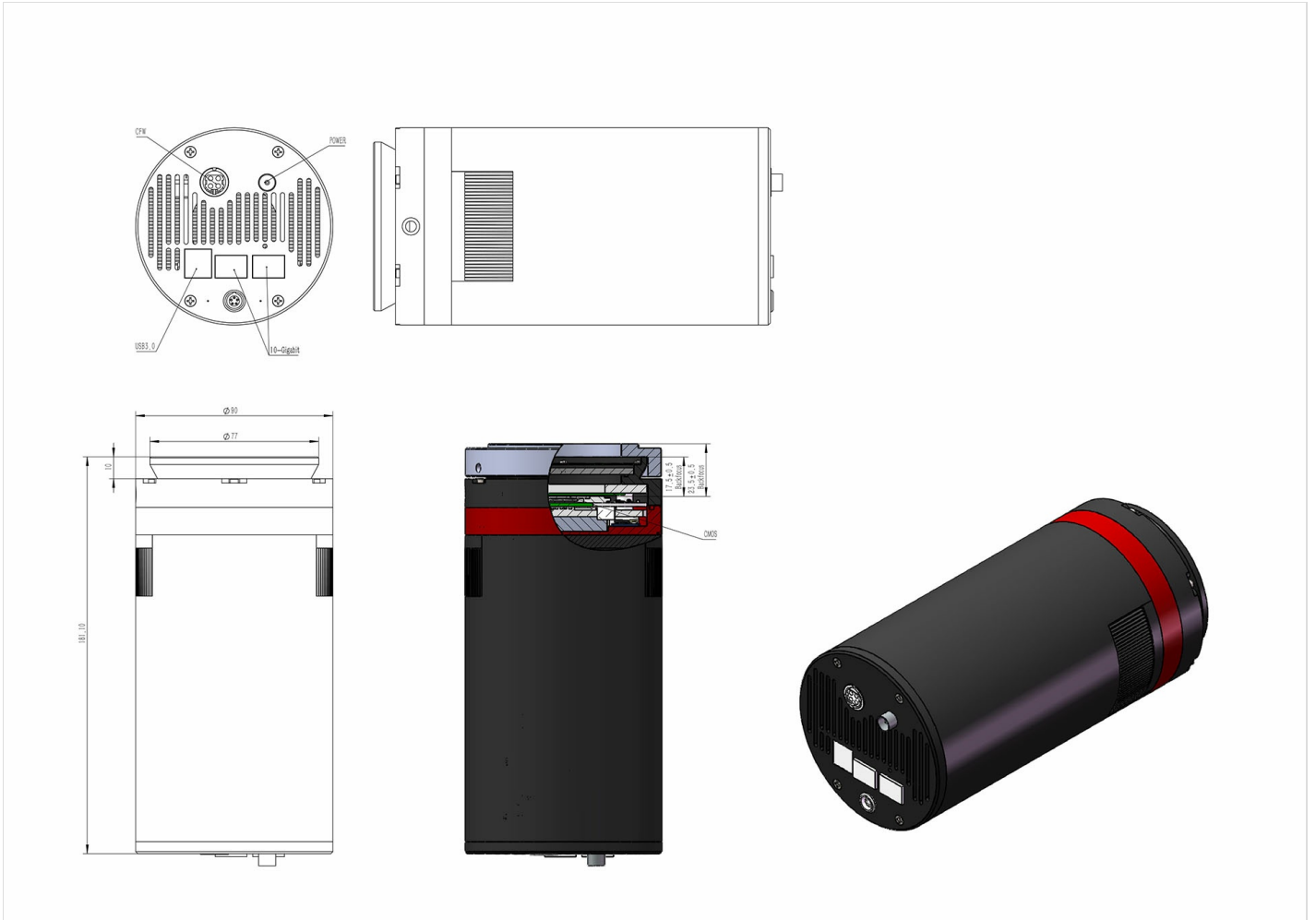
turbulence is not generated. When an air-cooled camera is installed in front of the optics, the hot air generated by the air-cooled system passes through the optical path and can generate seeing effects. Water cooling does not produce hot air discharge. The heat is carried away by the liquid so there is no such effect.

**Greater Cooling Delta T.** With water cooling, the maximum cooling temperature is about 10 degrees Celsius lower than the maximum temperature achieved with air only (About 45 degree below ambient).

QHY600 Liquid-cooling version requires reservation, please contact QHYCCD before the order.

## - Mechanical Dimensions

### QHY600 PRO



### QHY600 Ultra Short B.F.L Version



## + User Guide

### - 1. Before Start: Input Voltage Requirements

The camera requires an input voltage between 11V and 13.8V. If the input voltage is too low the camera will stop functioning or it may reboot when the TEC power percent is high, causing a drain on the power. Therefore, please make sure the input voltage arrived to the camera is adequate. 12V is the best but please note that a 12V cable that is very long or a cable with small conductor wire may exhibit enough resistance to cause a voltage drop between the power supply and the camera. The formula is:  $V(\text{drop}) = I * R$  (cable). It is advised that a very long 12V power cable not be used. It is better to place the 12V AC adapter closer to the camera.

First connect the 12V power supply, then connect the camera to your computer via the USB3.0 cable. Make sure the camera is plugged in before connecting the camera to the computer, otherwise the camera will not be recognized. When you connect the camera for the first time, the system discovers the new device and looks for drivers for it. You can skip the online search step by clicking "Skip obtaining the driver software from Windows Update" and the computer will automatically find the driver locally and install it. If we take the 5IIISeries driver as an example (shown below), after the driver software is successfully installed, you will see QHY5IIISeries\_IO in the device manager.

Please note that the input voltage cannot be lower than 11.5v, otherwise the device will be unable to work normally.

### - 2. Install "All-In-One" System Pack

All-in-one Pack (Windows) is for all QHYCCD USB3.0 devices, including all Cooling CMOS cameras, QHY5III and QHY 5II series, QHYCFW3. We recommend you choose "Stable Version" as usual.

In this pack there are:

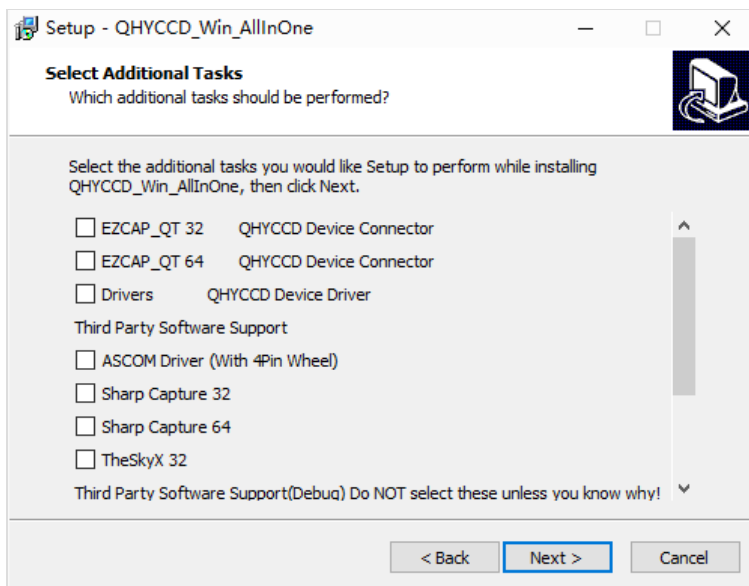
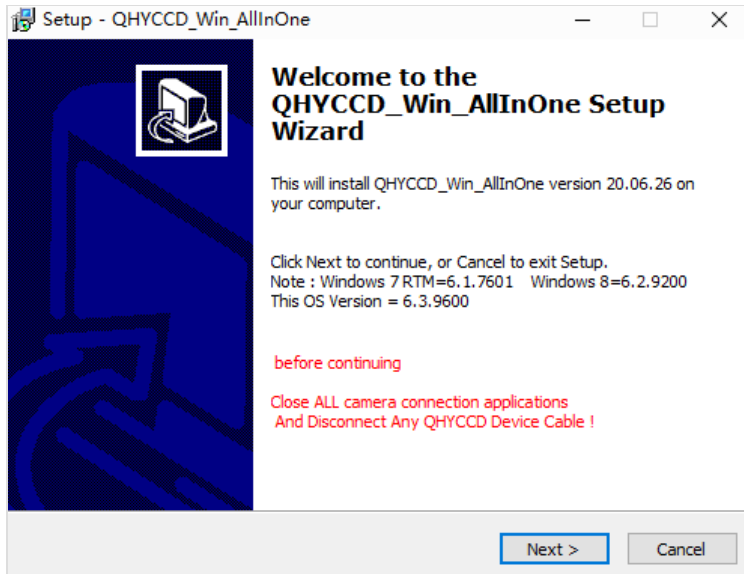
1. System driver. It must be installed to make devices work.
2. EZCAP\_QT: it's developed by QHYCCD which could be used in QHY devices tests, simple capture tasks, and above all, the management of updates. So even if you won't use EZCAP\_QT as your main capture software, we suggest you install it to get the latest information of QHY drivers/SDK updates.
3. Ascom driver: Ascom Platform is supported by most astronomy devices which connect to Windows.

4. SDK: SDK is the file of “.dll” format. With this the device can be identified in other capture software.
5. SkyX Plugin: special support for SkyX.
6. QHYCCD BroadCast WDM Driver: It is a broadcast driver that supports QHYCCD cameras with video broadcast function, which can meet the needs of customers to send video images to other target software.

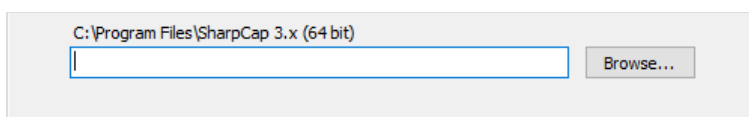
### How to install it?

Take SharpCap (x64) for example:

Before the installation, make sure you’ve already installed SharpCap (X64) on your PC;



Then click "Third Party Software Support" – "SharpCap 64", the pack will detect the location of SharpCap files and install automatically; if not, please manually select root directory of SharpCap where you installed it, like:  
C:\Program Files\SharpCap 3.2 (64 bit)



## 3. Connect with Software

Before using software, make sure you have connected the cooling camera to the 12V power supply and connected it to the computer with a USB3.0 data cable. If it’s a planetary/guiding camera, 12V power is not needed.

**Note:** We recommend 64-bit Software when you’re using cameras with a large sensor, such as QHY600. A full resolution image from the QHY600 is 120MBytes. It takes a significant amount of processing power and memory to capture, buffer,

display and process. We therefore suggest using 64-bit software with the QHY600, for example, SharpCAP x64 , N.I.N.A x64. etc. Although the camera has 4GB of internal memory, 32-bit software will run within this memory area and the remaining memory may be not sufficient for normal operation.

### 3.1 EZCAP\_QT

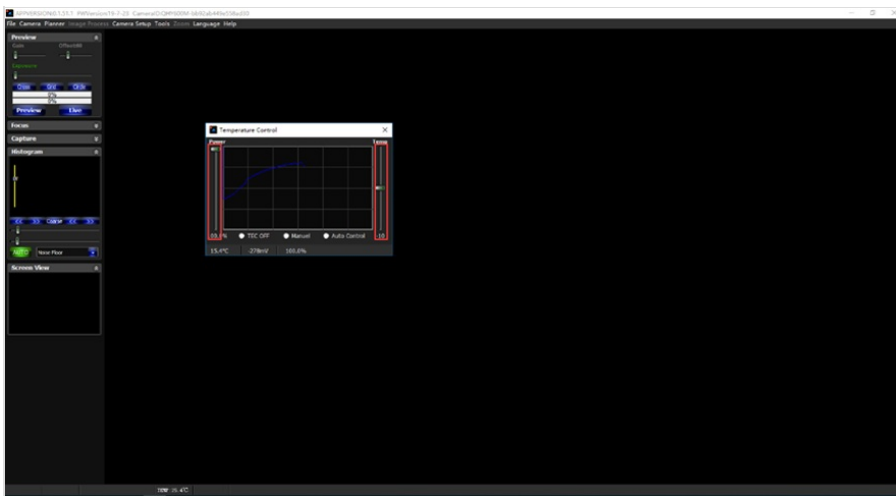
EZCAP\_QT is software developed by QHYCCD. This software has basic capture functions for QHYCCD deep sky cameras.

Run EZCAP\_QT. Click “Connect” in Menu -> Camera. If the camera is successfully connected, the title line of EZCAP\_QT will display the camera firmware version and the camera ID as shown below.



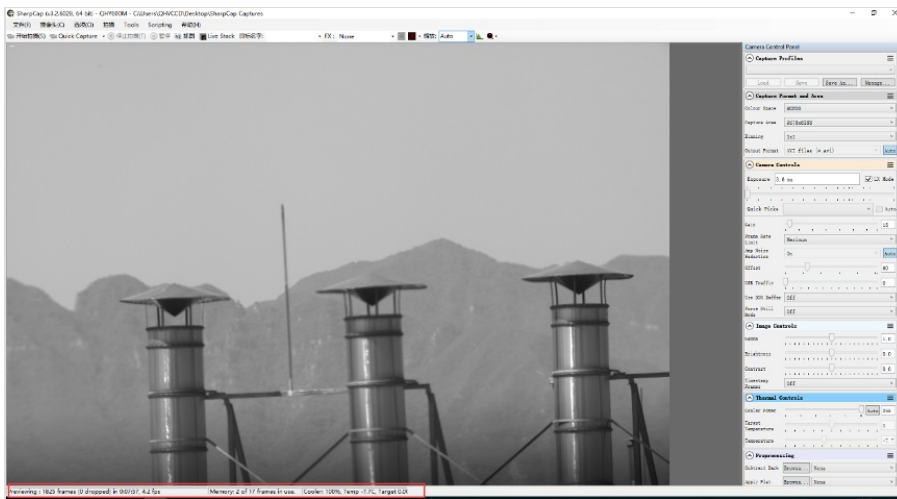
Click “Temperature Control” in “Camera Settings” to set the temperature of the CMOS sensor. You can turn on “Auto” to set the target temperature. For example, here we set the target temperature to -10C. The temperature of the CMOS sensor will drop quickly to this temperature (approximately 2-3 minutes). If you want to turn off cooling, you can choose Stop. If you just want to set the TEC power but not the temperature. You can select “Manual” and then set the percentage of the TEC power.

You can use the “preview tab” to preview and use the focus tool to focus. Then use the “capture tab” to capture the image.



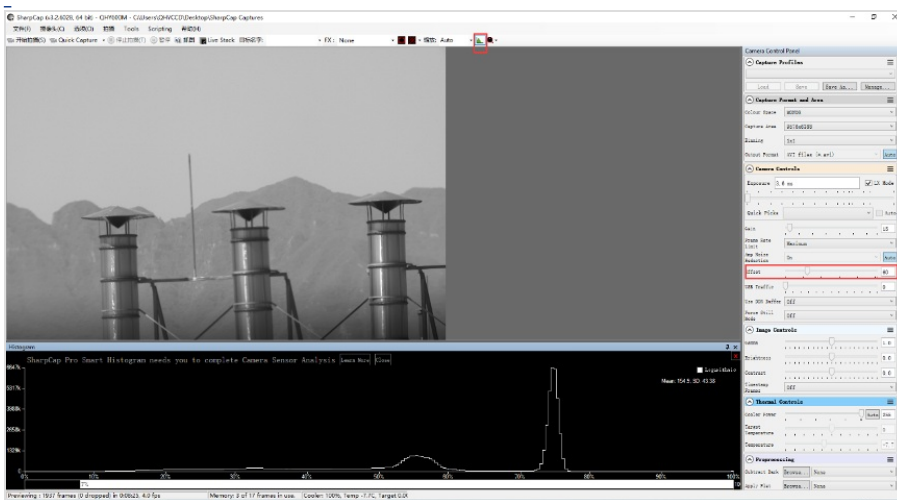
### 3.2 SharpCap

Launch SharpCap. If the software and drivers mentioned above are installed successfully, the video image will appear automatically about 3 seconds after the software loads. You will also see the frame rate in the lower left corner of the software window as shown below.



If you have already started the SharpCap software before connecting the camera, in order to open the camera, click on the “camera” in the menu bar and then select the device.

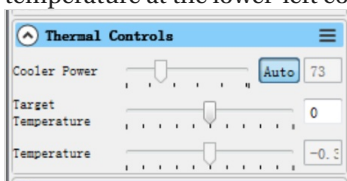
Offset adjustment. When you completely block the camera (i.e., like taking a dark frame) you may find that the image is not really zero. Sometimes this will reduce the quality of the image contrast. You can get a better dark field by adjusting the offset. You can confirm this by opening the histogram as indicated in the figure below.



If you want to enter the 16-bit image mode, select the “RAW16” mode.

By selecting the “LX” mode you can expand the exposure setting range and take long exposures.

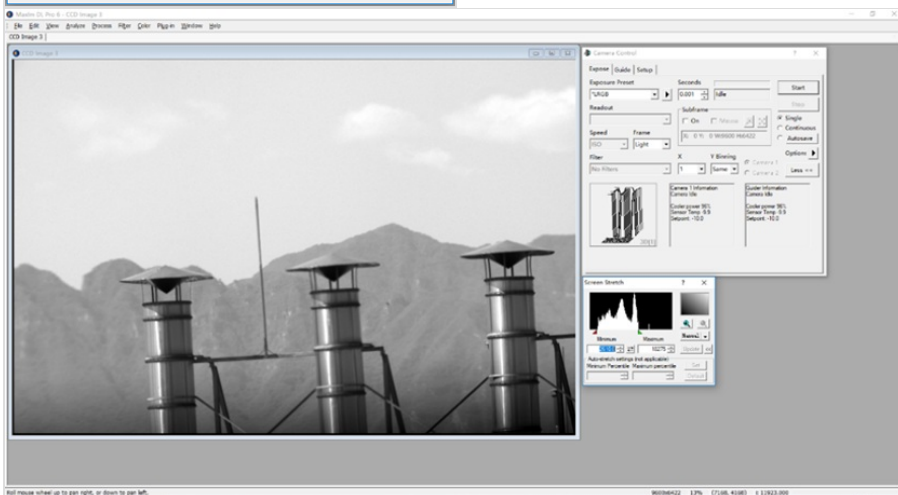
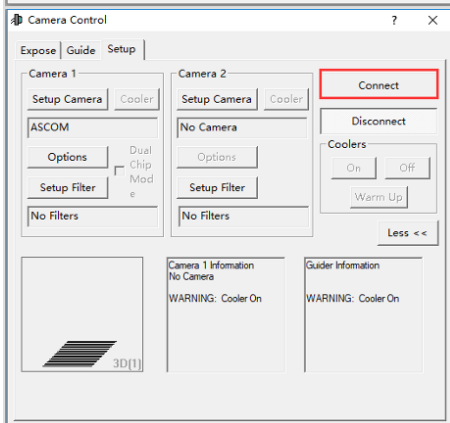
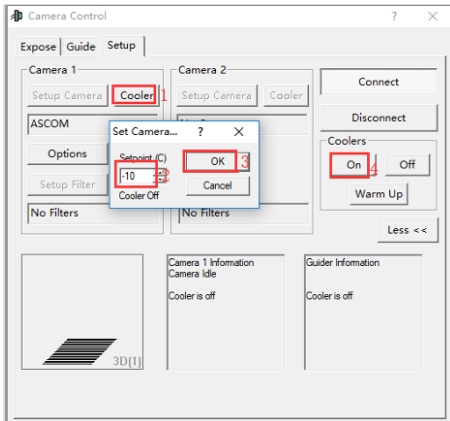
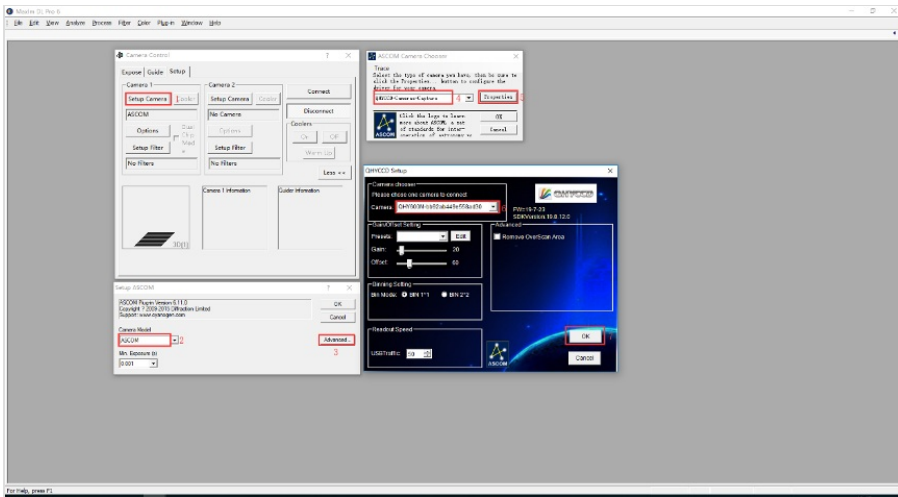
After cooling devices connected to the 12V power supply, the temperature control circuit will be activated. You can control the CMOS temperature by adjusting the settings in the figure below. Basically, you can control the temperature of CMOS by either adjusting “Cooler Power” or clicking “Auto” and setting “Target Temperature”. You can also see the CMOS temperature at the lower-left corner of the software window.



### 3.3 ASCOM supported software (e.g. MDL)

With ASCOM drivers, you can use the device with many software packages that support the ASCOM standard. We will use **Maxim DL** below as an example, but a similar procedure is used for The SkyX and other software packages supporting ASCOM.

First make sure you have not only loaded the ASCOM drivers but that you have also downloaded and installed the ASCOM platform from ASCOM. After both the drivers and platform are installed, start MAXIMDL. Follow the instructions shown below to finish the setup. Then Click Connect in and enter the software.



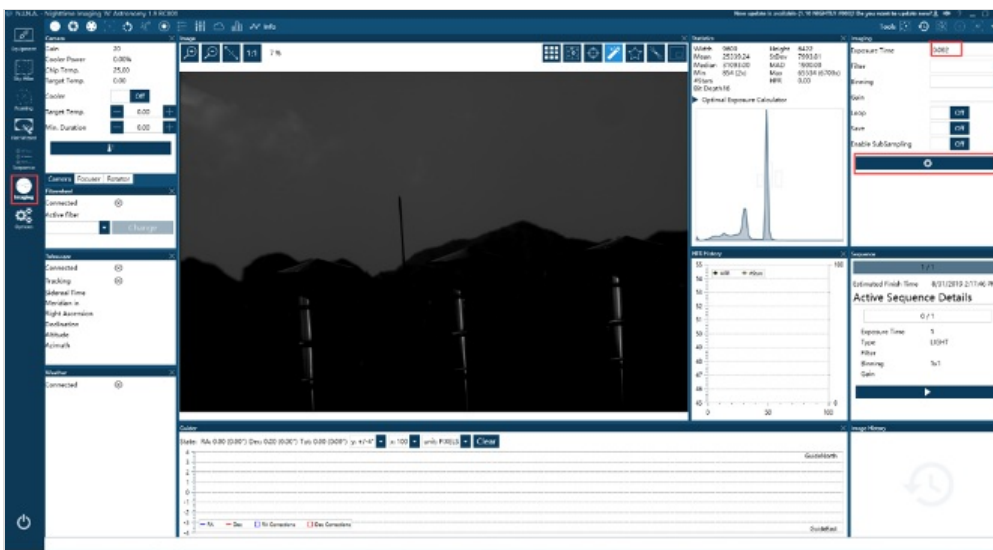
3.4 N.I.N.A

Open N.I.N.A. – Nighttime Imaging ‘N’ Astronomy. Drive connections via ASCOM.





Turn on the TE cooler to set temperature. Then set the exposure time to capture the image.

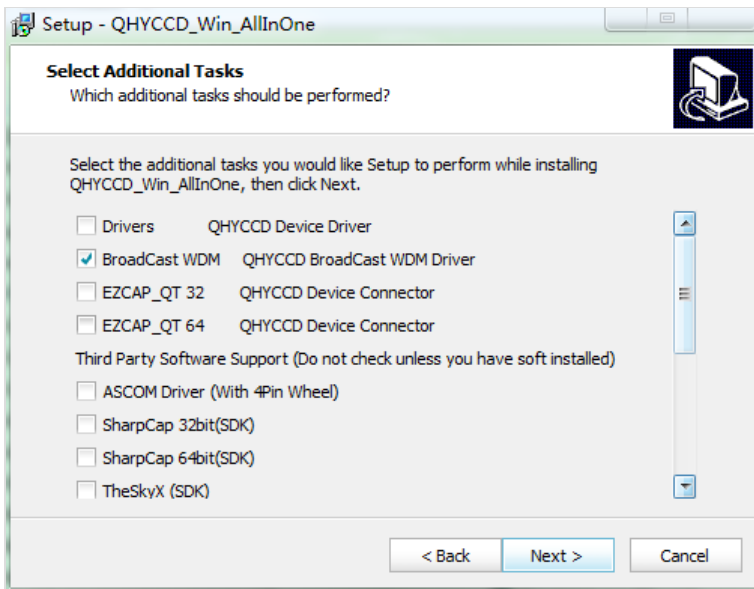


#### 4. BroadCast WDM Camera Driver

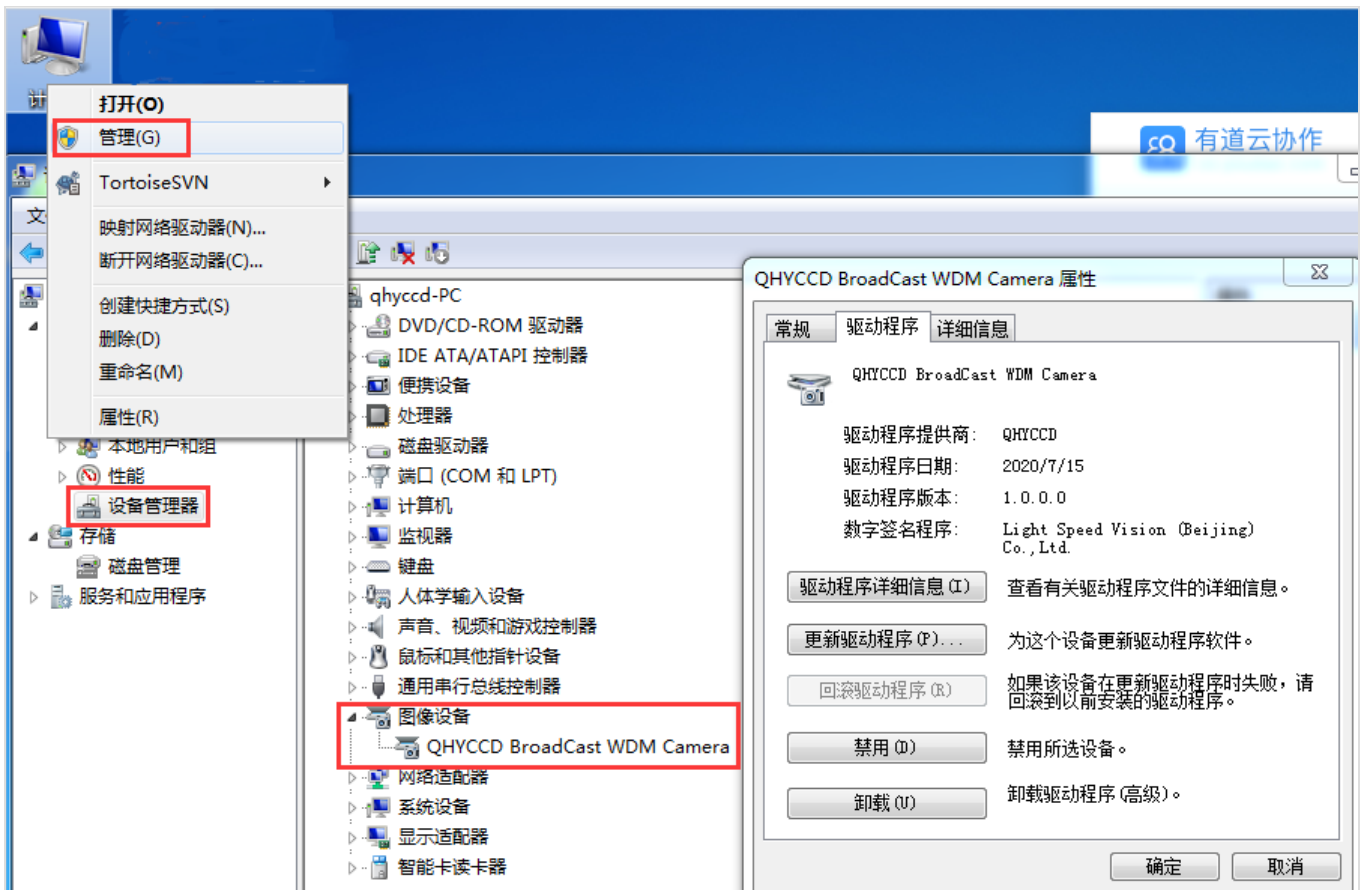
QHYCCD BroadCast WDM Camera is a broadcast driver that supports QHYCCD cameras with video broadcast function, which can meet the needs of customers to send video images to other target software. For example, use sharpcap to connect a WDM-enabled camera, and the sharpcap display video image can be sent to other WDM-supported software for display, which is suitable for video online broadcast applications.

##### Installation:

Perform the AllInOne installation and check the BroadCast WDM Camera option.

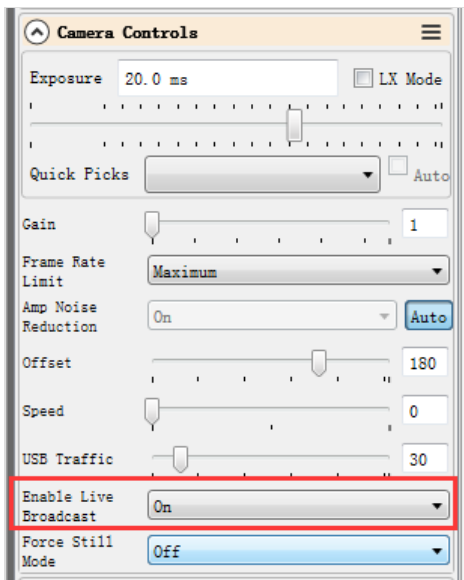


The installation process is over, right-click the computer to find the device manager, and check that the image device name is QHYCCD BroadCast WDM Camera, which means the installation is successful.

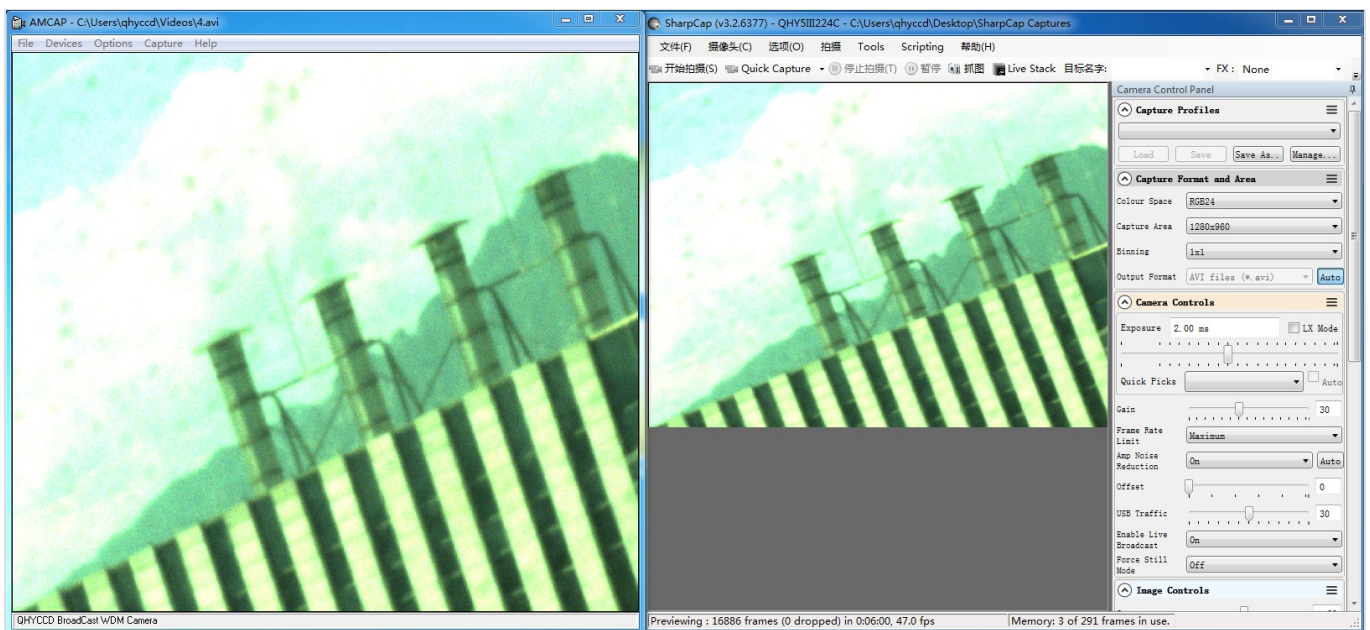


**Activate the function:**

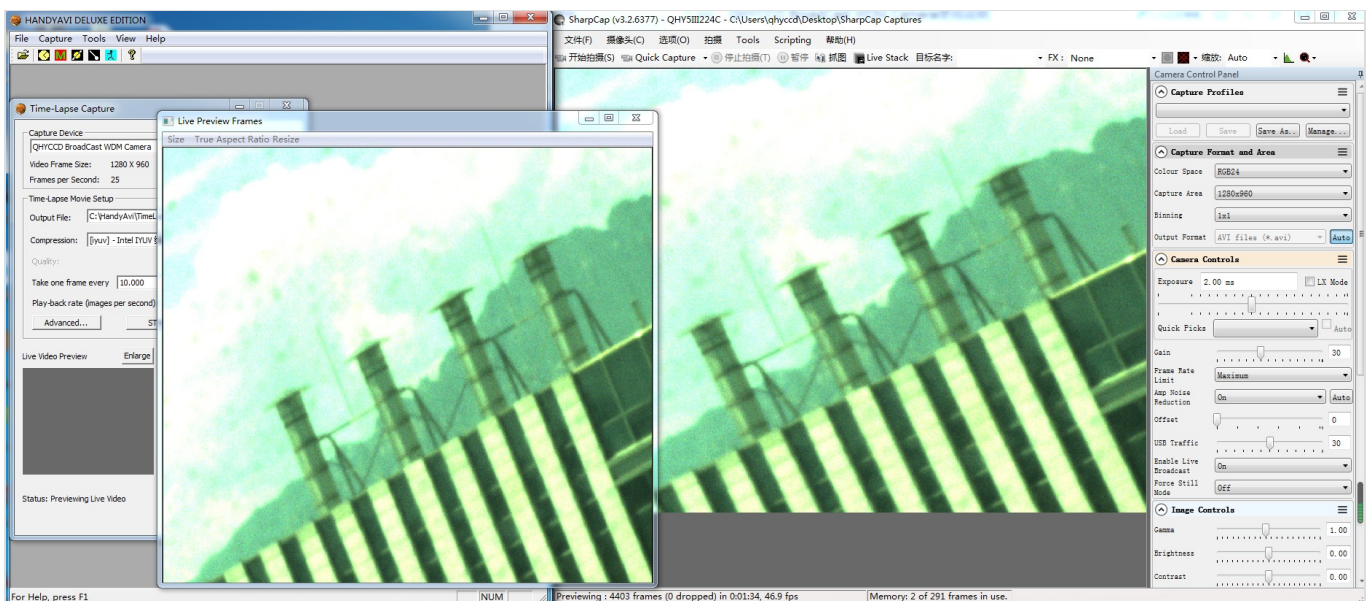
Usually sharpcap is used to connect the camera as the broadcasting terminal. After connecting the camera, you need to turn on the Enable Live Broadcast switch to broadcast.



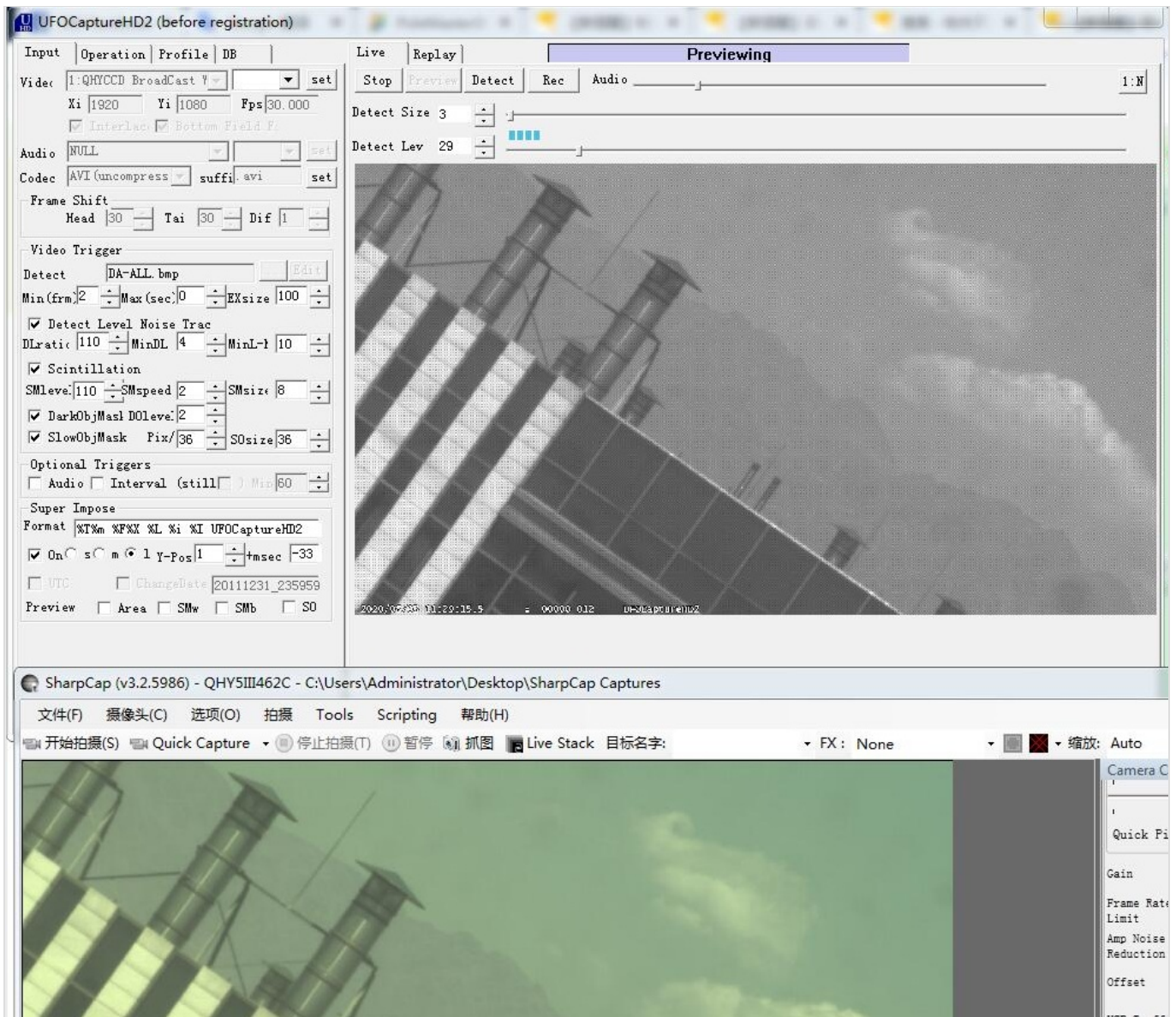
Common supporting software (ie, broadcast receiver) includes: UFOCAPTURE, HANDYAVI, QQ video functions, etc.  
AMcap test effect chart:



HANDYAVI test effect chart:



UFOCAPTURE test renderings:



**Precautions:**

Currently only supports Windows system.

Currently, the SDK does not support 16 bits for the time being.

RGB24 mode must be selected for color images, otherwise the image will appear gridded.

**+ Advanced Control Tools**

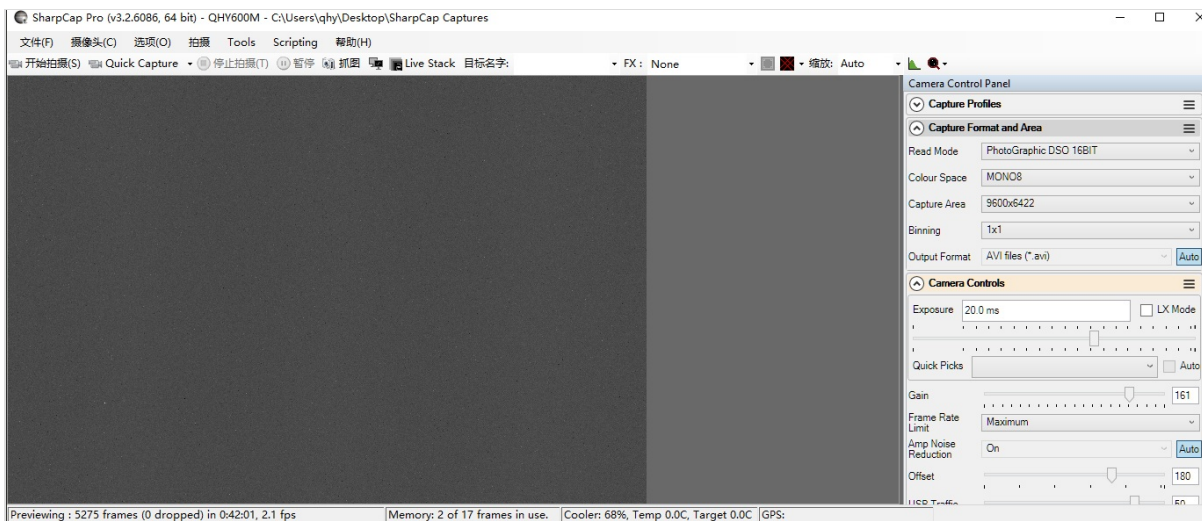


Click to download 2021.1.2

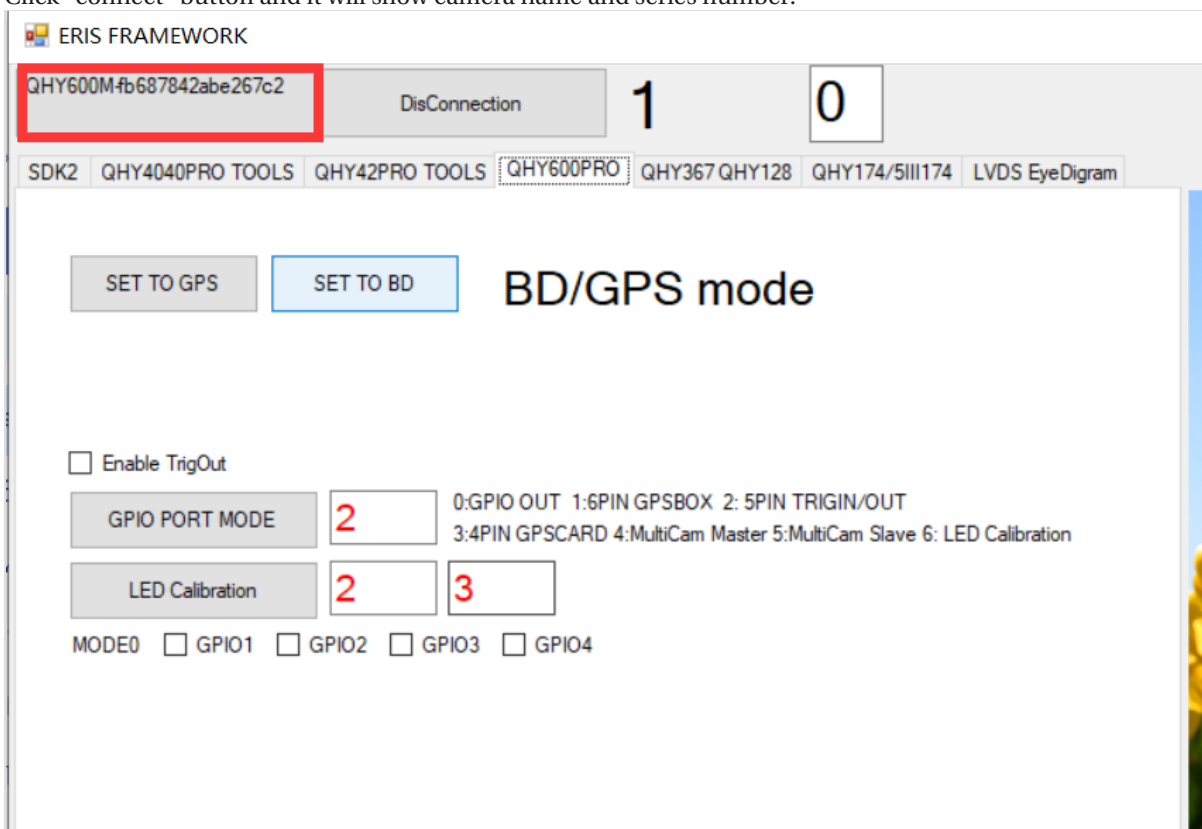
[Debug TOOL](#)

[Release TOOL](#)

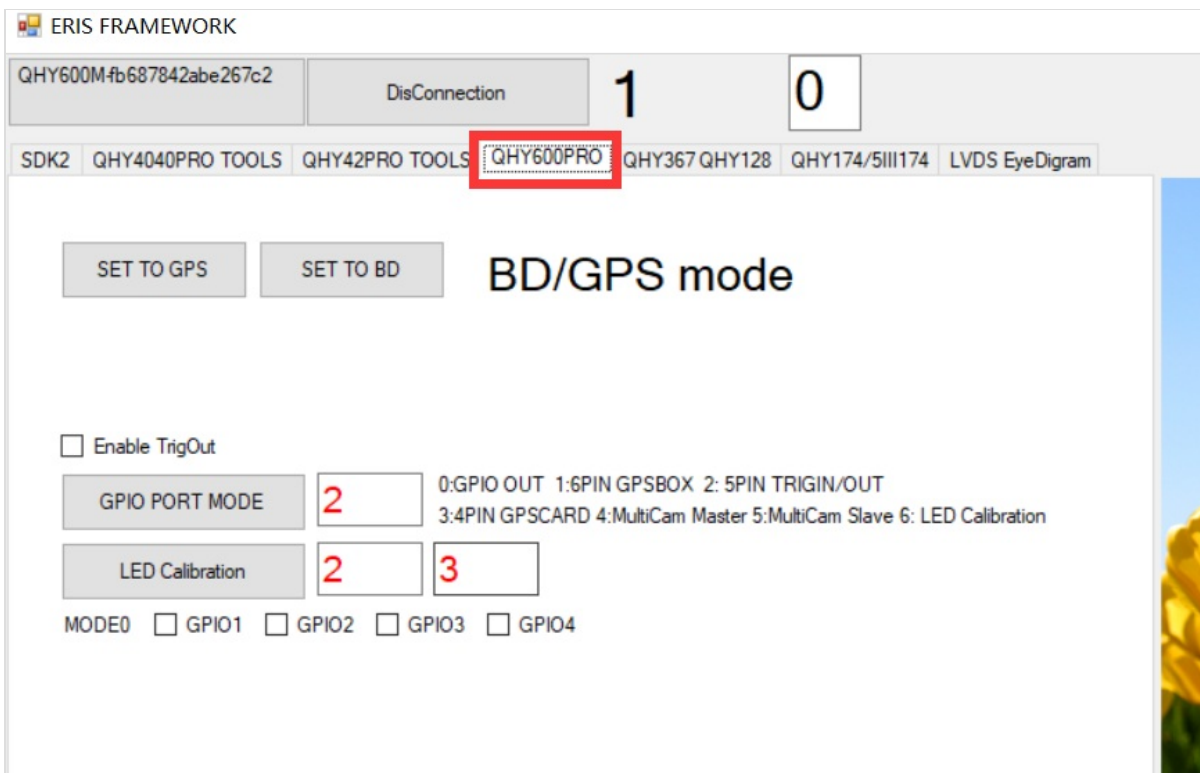
Run Sharpcap and make sure the QHY Camera works well under it. You will see the continous image appears.



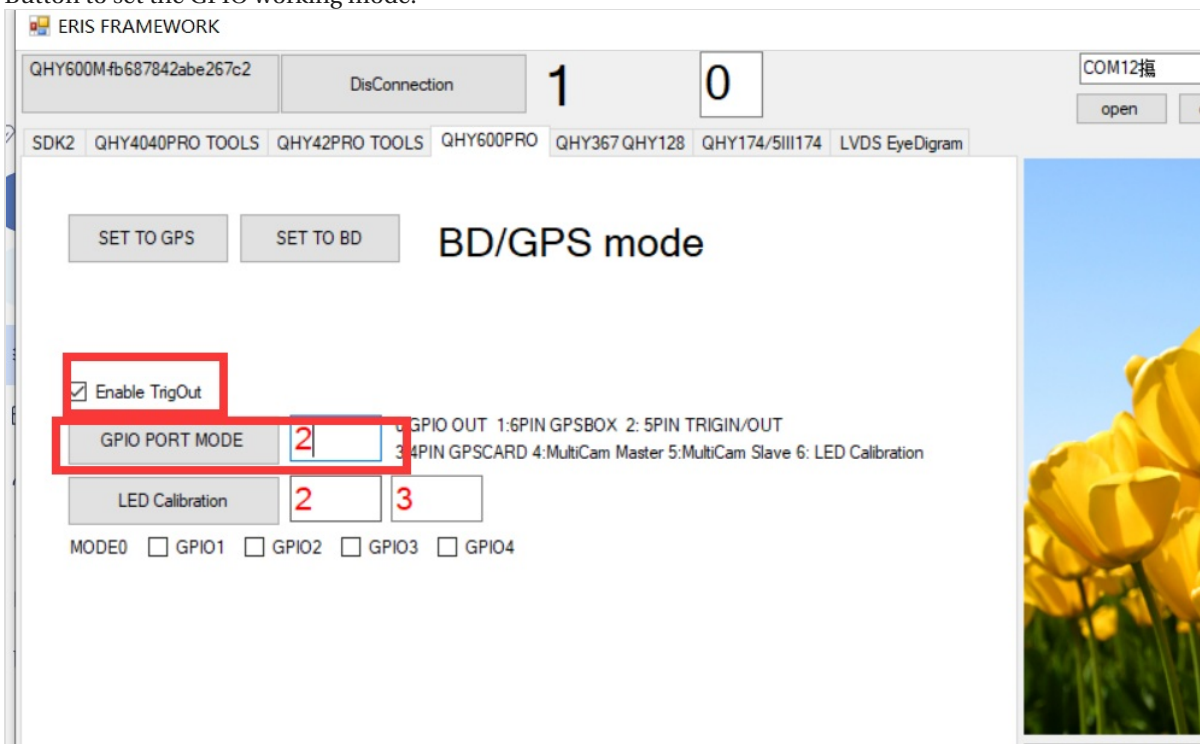
Click "connect" button and it will show camera name and series number.



select QHY Camera tabl.



check on the “Enable TrigOut” Input 2 to the textbox near to the “GPIO PORT MODE”. Then click the “GPIO PORT MODE” Button to set the GPIO working mode.



Check the waveform output from the TrigPort.

The introduction of different GPIO PORT MODE

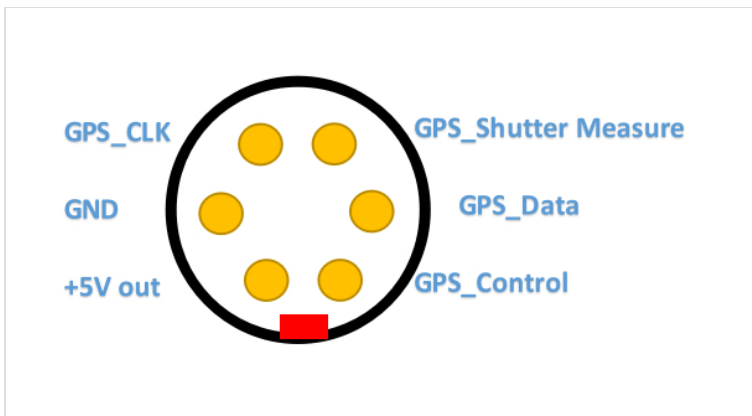
**MODE0:** Generic GPIO output mode / Auto Guide Port

In this mode. Four GPIO port is all output . You can control each port to output high or output low with the API. This mode does not controlled by Enable TrigOut.

You can select the check box of MODE0, GPIO1,GPIO2,GPIO3,GPIO4 to test this mode. This mode is also been used to test if the socket io port working well.

**MODE1:** 6PIN QHY-GPSBOX mode

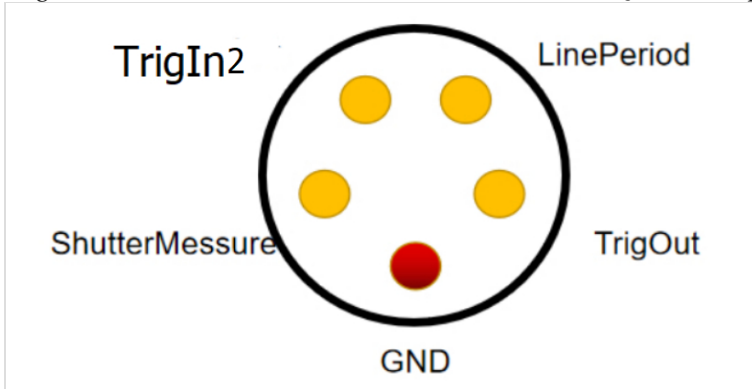
In this mode, Four GPIO port is configured as gps\_clock, gps\_data, shuttermeasure,gps\_control. You can connect with QHYCCD-GPSBOX. The camera will output the shuttermeasure signal to GPSBOX and GPSBOX will send the data to camera. Camera will replace the first some pixel to the gps data .



**MODE2:** 5PIN Generic TrigOut / TrigIn mode

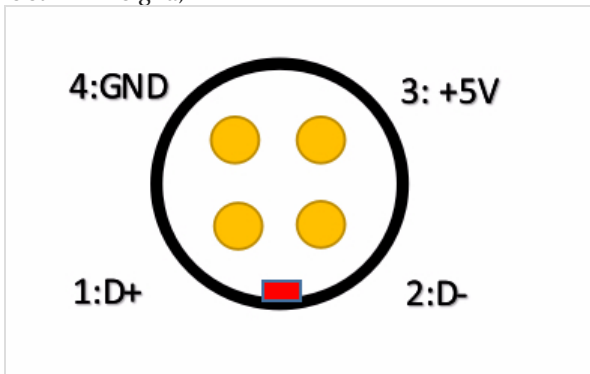
In this mode, Four GPIO port is configed as TrigOut, ShutterMeasure, TrigIn, LinePeriod . Only TrigIn pin is input direction and other three pin is output direction.

In some camera, like QHY4040,QHY2020,QHY42PRO,QHY6060, The shuttermeassure waveform rising edge is the start exposure time and falling edge is the end exposure time in other camera like QHY600,QHY268, QHY411,QHY461 etc, The shuttermeassure waveform is the vsync signal . It is near to the end of exposure time of the first row. For more information of TrigOut,LinePeriod. Please see some other document of QHYCCD supplied.



**MODE3:** 4PIN GPS Card TrigIn mode

In this mode. there is two pin is configured as ouput . Both of the two pins is the shuttermeassure signal but one of it is inverted. This is suitbale for some GPS card which need such a “differential signal”. But please note this is not LVDS signal. It is still TTL signa,



**MODE4:** Multi-Camera Master Mode

TO BE ADDED

**MODE5:** Multi-Camera Slave Mode

TO BE ADDED

**MODE6:** LED Calibration Mode

By using the controlled LED pulse, we can calibrate the distance from the TrigOut or ShutterMeasure signal to the real pixel/row start/end exposure time. To use this mode. You need to connect a LED to one GPIO pin and let the camera capture the flash that output from the camera. The start time and end time relative with the TrigOut/ShutterMeasure can be set by APIs. By check if the camera captured this pulse. You will get the delta time of the TrigOut/ShutterMeasure signal and use it to calibrate the messured GPS time.

mode 0	mode 1	mode 2	mode 3	mode 4	mode5	mode6
GPIO1	GPSBOX_Control	ShutterMessure+	ShutterMessure+	n.a	n.a	ShutterMessure+
GPIO2	GPSBOX_Data (IN	TrigIn2	ShutterMessure-	n.a	n.a	TrigIn2
GPIO3	GPSBOX_ShutterMessure	LinePeriod	n.a	HSYNC(OUT	HSYNC IN)	LinePeriod
GPIO4	GPSBOX_CLK	TrigOut	n.a	VSYNC(OUT	VSYNC(IN)	LED(OUTPUT)

GND	GND	GND	GND	GND	GND	GND
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## + Maintenance

### - 1. Camera grounding precautions

#### **To avoid the problem of unreliable USB connection or port damage caused by leakage of computer or 220V to 12V adapter**

Some computers or 220V to 12V adapters have leakage currents. If they are not well grounded, a high voltage is formed between the ground (metal case) of the USB interface and the ground (metal case) of the power supply line. If the USB and power supply wires are in good contact with the camera, the device can operate normally due to the formation of a common ground at the camera.

However, the common ground formed at the camera is very dangerous. On the one hand, it is easy to cause the USB connection to be unreliable, and the USB connection is often lost during use, and on the other hand, there is a risk of potentially damaging the port. Therefore, make sure the computer and adapter are well grounded before putting the device into service.

You can use the multimeter's AC voltage file to detect if there is any leakage between the computer and the adapter. The method is not to connect the camera first, one meter is connected to the metal case of the USB plug, and the other meter is connected to the negative pole of the DC output plug of the power adapter (generally inside and outside negative). If the voltage between the two is small, there is no leakage or a good ground has been achieved through the ground of the power plug. If there is a voltage of several V to several tens of V, there is leakage and there is no good grounding. Need to check if the 220V power plug can provide a good ground.

Another way is to use a test pencil. Test the negative pole of each power adapter, the metal part of the computer, and the metal part of the equatorial mount for leakage.

If there is no way to avoid it, you need to use a separate wire to connect the ground of the computer (usually connected to the metal case) and the negative pole of the 220V to 12V adapter to achieve common ground.

Commonly because the computer or power adapter leaks to cause USB instability or port damage:

A camera with a 9-pin socket and a USB socket is common at the camera.

A camera with a USB socket and a metal case. After connecting the telescope to the equatorial mount, the ground of the equatorial mount and the ground of the computer are at the camera.

After the QHY9 is connected to the color wheel through the camera's color wheel interface, it is common at the color wheel interface.

The above may cause the USB connection to be unstable, the connection is often lost, the USB port is burned, the color wheel interface is burned, etc.

### - 2. Drying the camera CMOS chamber

The CMOS sensor is located in the CMOS chamber. There is a hole in the side of the camera near the front plate that is normally plugged by a screw with an o-ring. If there is moisture in the CMOS chamber that causes the sensor glass to fog, you can connect the silica gel tube to this hole for drying the chamber.

Place an effective silica gel desiccant in the silica tube make sure there is some cotton inside to prevent the silica gel from entering the CMOS chamber.

### - 3. Cleaning the CMOS sensor and optical window

If you find dust on the CMOS sensor, you can first unscrew the front plate of the cam and then clean the CMOS sensor with a cleaning kit for SLR camera sensors. Because the CMOS sensor has an AR (or AR/IR) coating, you need to be careful when cleaning. This coating can scratch easily so you should not use excessive force when cleaning dust from its surface.

### - 4. Preventing fogging of the CMOS chamber

If the ambient humidity is very high, the optical window of the CMOS chamber may have condensation problems. The QHY600 has a built-in heating plate to heat it to prevent fogging. In most cases, it is very effective. However, If fogging still persists, try the following:

1. Avoid directing the camera towards the ground. The density of cold air is greater than the density of hot air. If the camera is facing down, cold air will be more accessible to the glass, causing it to cool down and fog.

2. Increase the temperature of the CMOS sensor. You can increase the temperature of the CMOS sensor slightly to prevent fogging of the glass.

3. Check if the heating plate is working. If the heating plate is not working, the glass will be very easy to fog. Normally, the



temperature of the heating plate can reach 65-70 °C in the environment of 25 °C. If it does not reach this heat, it may be because the heating plate is damaged, you can contact us to replace the heating plate.

## - **5. Protecting the TE Cooler**

You should avoid thermal shock during use. Thermal shock refers to the internal stress that the TE cooler has to withstand due to the thermal expansion and contraction when the temperature of the TEC suddenly rises or falls. Thermal shock may shorten the life of the TEC or even damage it.

Therefore, when you start using the TEC to adjust the CMOS temperature, you should gradually increase the TEC power rather than turning the TEC to maximum power. If the power of the TEC is high before disconnecting the power supply, you should also gradually reduce the power of the TEC and then disconnect the power supply.