

- Overview

QHY268M Pro I has SONY IMX571 APS-C format CMOS sensor inside. 26mega pixels, Back-illuminated, native 16BIT ADC. QE is up to 91% and readout noise is as low as 1.1e. Even with a 3.76um pixel size, it has a big full-well up to 75ke. It has extremely low thermal noise 0.0005e/pixel/sec @ -20C, ZERO amplifier-glow performance, It has a maximum frame rate of 6.8FPS@16bit full resolution.

*PCIE Card Kit is NOT included in QHY268Pro product.

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Native 16 bit A/D: The new Sony sensor has native 16-bit A/D on-chip. The output is real 16-bits with **65536 levels**. Compared to 12-bit and 14-bit A/D, a 16-bit A/D yields higher sample resolution and the system gain will be less than 1e-/ADU with no sample error noise and very low read noise.



BSI: One benefit of the back-illuminated CMOS structure is improved full well capacity. In the back-illuminated sensor the light is allowed to enter the photosensitive surface from the reverse side. In this case the sensor's embedded wiring structure is below the photosensitive layer. As a result, more incoming photons strike the photosensitive layer and more electrons are generated and captured in the pixel well. This ratio of photon to electron production is called quantum efficiency. The higher the quantum efficiency the more efficient the sensor is at converting photons to electrons and hence the more sensitive the sensor is to capturing an image of something dim.



TRUE RAW Data: In the DSLR implementation there is a RAW image output, but typically it is not completely RAW. Some evidence of noise reduction and hot pixel removal is still visible on close inspection. This can have a negative effect on the image for astronomy such as the "star eater" effect. However, QHY Cameras offer TRUE RAW IMAGE OUTPUT and produces an image comprised of the original signal only, thereby maintaining the maximum flexibility for post-acquisition astronomical image processing programs and other scientific imaging applications.



Zero Amplify Glow: This is also a zero amplifier glow camera.



Cooling & Anti-dew Control: In addition to dual stage TE cooling, QHYCCD implements proprietary technology in hardware to control the dark current noise. The optic window has built-in dew heater and the chamber is protected from internal humidity condensation. An electric heating board for the chamber window can prevent the formation of dew.



Sealing Technology: Based on almost 20-year cooled camera design experience, The QHY cooled camera has implemented the sealing control solutions. The sensor itself is kept dry with our silicon gel tube socket design for control of humidity within the sensor chamber. By the way, there's no oil leaking.

- General Introduction of Pro-grade Scientific Cameras

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Compared to astrophotographic products, the scientific grade "Pro" grade version has more interfaces, more functions, and higher quality to cater for the complicated needs including but not limited to: Sky Survey, Astronomical Photometric, high-resolution LCD/OLED screen inspector/color calibration. All-sky camera. Scientific Measurement, DNA sequencer, Spectrum Instrument.

A Pro grade scientific grade camera has the following interfaces or functions.

- USB3.0



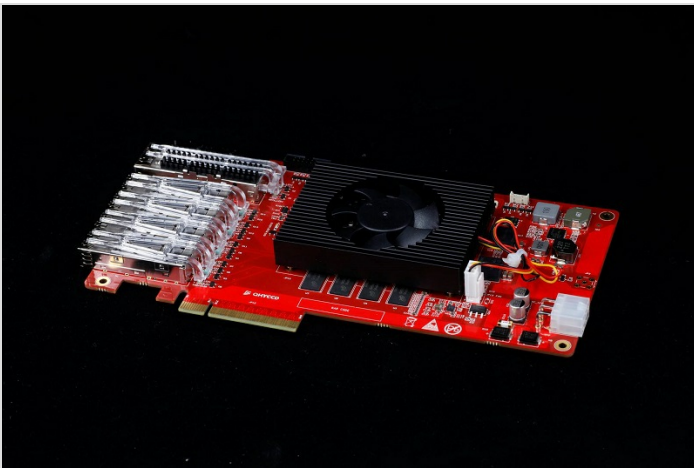
USB3.0 is a very popular interface and very easy to use. USB3.0 can not support a transfer distance of more than 3meter. If you want to get a long-distance under USB3.0, QHYCCD supplies the optional 5meter and 10meter USB3.0 extender cable with a built-in amplifier.

- 2*10Gbps Fiber Interface



The built-in 2*10Gbps fiber socket can work with the QHYCCD PCIE2.0x8 data grabber card. The fiber interface is for the requirement of the professional obs. It will give the following advantages than the USB3.0 interface. Then what is the benefit of the Fiber 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.
- **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; 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.



- GPIO



There is a 6pin GPIO socket on the camera backside. It can be configured into different modes, or customized as the user requests to meeting more complex timing by re-programming the FPGA.

- Liquid Cooling (Customization)



Compared with air cooling, liquid cooling has the following important advantages. If any interest, please **contact QHYCCD in advance** for customization.

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).

- **Advanced Functions**

- **Multiple Readout Modes**

Multiple Readout Modes are special for QHY 16-bit Cameras (QHY600/268/461/411). Different readout modes have different driver timing, etc., and result in different performance. See details at “Multiple Readout Modes and Curves” Part.

- **Random change thermal noise suppression function**

You may find some types of thermal noise can change with time in some back-illuminated CMOS cameras. This thermal noises has the characteristic of the fixed position of typical thermal noise, but the value is not related to the exposure time. Instead, each frame appears to have its own characteristics. The QHY600/268/461/411 use an innovative suppression technology that can significantly reduce the apparent level of such noise.

- **UVLO Protection**

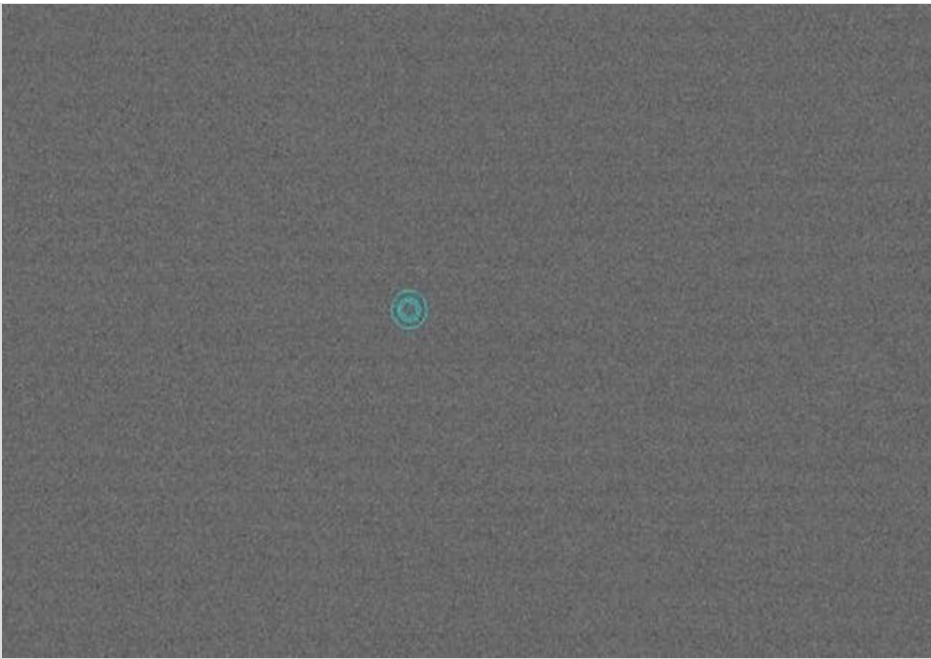
UVLO (Under Voltage Locking) is to protect the electronic device from damage caused by abnormally low voltages.

Our daily life experience tells us that the actual operational voltage of an electrical device must not significantly exceed the rated voltage, otherwise it will be damaged. For such precision equipment as cameras, long-term work at too low input voltage can also be detrimental to the working life of the camera, and may even make some devices, such as power manager, burn up due to long-term overload. In the all-in-one driver and SDK after 2021.10.23 stable version, the camera will give a warning when the input voltage of the camera is below 11V.

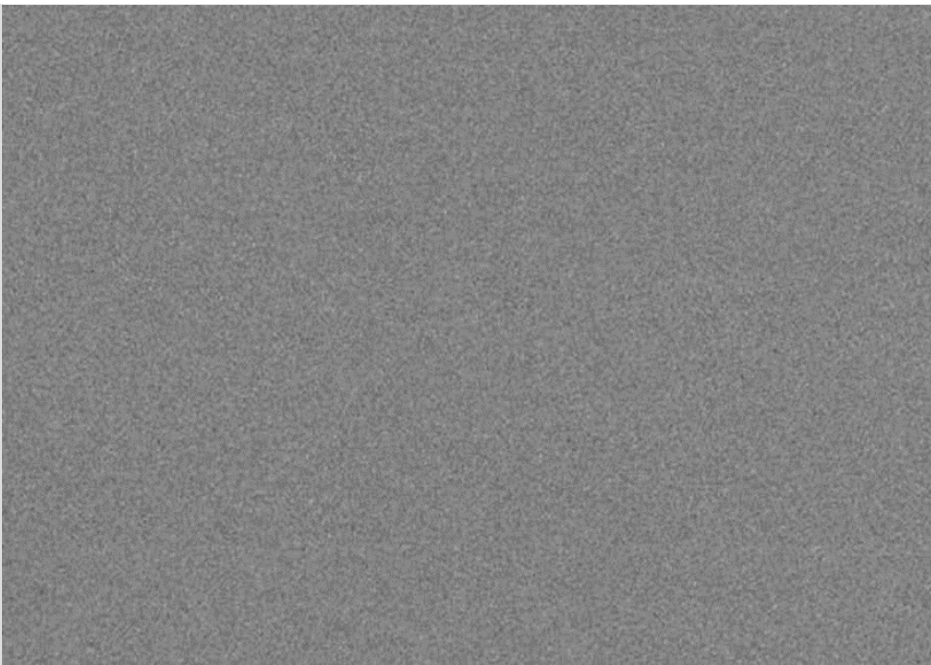
- **Optimizing USB Traffic to Minimize Horizontal Banding**

It is common behavior for a CMOS sensor to contain some horizontal banding. Normally, random horizontal banding can be removed with multiple frame stacking so it does not affect the final image. However, periodic horizontal banding is not removed with stacking so it may appear in the final image. By adjust the USB traffic in Single Frame mode or Live Frame mode, you can adjust the frequency of the CMOS sensor driver and it can optimize the horizontal banding appeared on the image. This optimized is very effective to remove the periodic banding in some conditions.

A typical Periodic Horizontal Noise under certain USB_TRAFFIC values.



After Adjusting the USB Traffic to avoid the periodic horizontal noise.

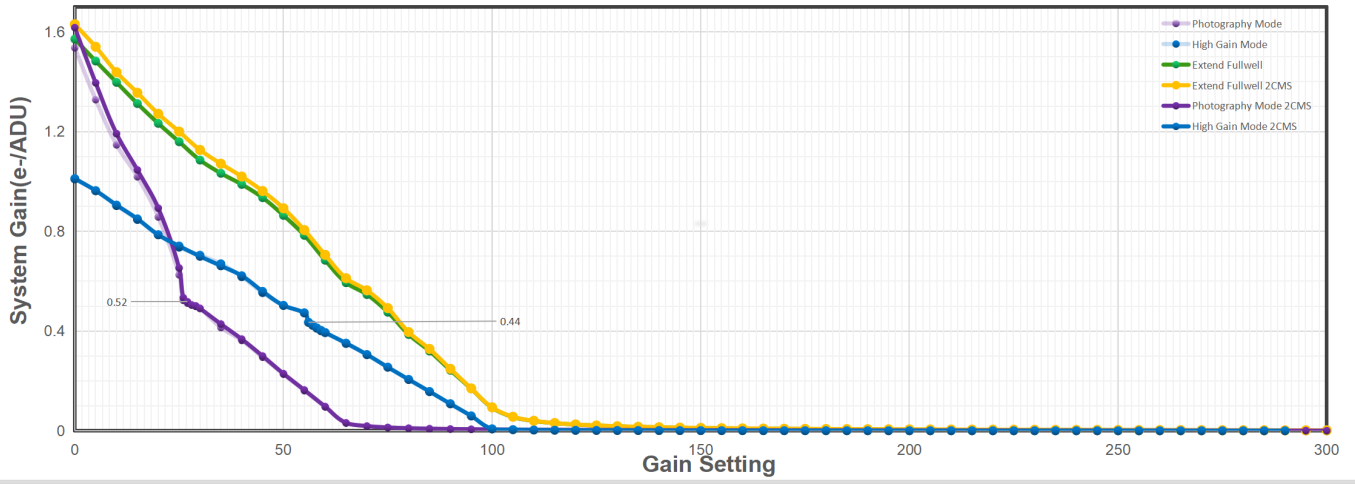


- **Reboot the camera by power off and on**

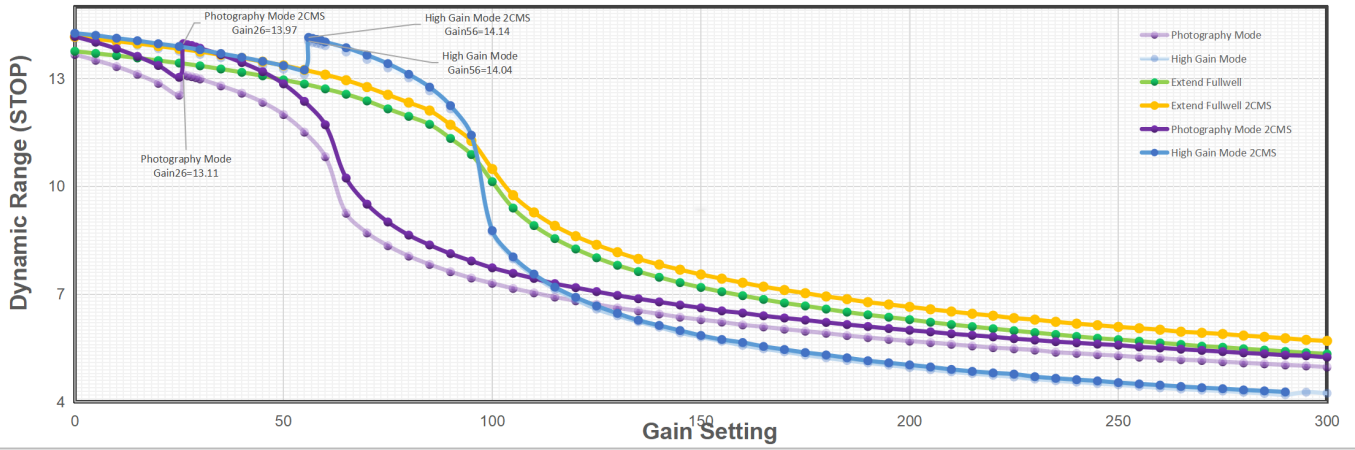
The camera is designed to use the +12V to reboot the camera without disconnecting and reconnecting the USB interface. This means that you can reboot the camera simply by shutting down the +12V and then powering it back on. This feature is very handy for remote controlling the camera in an observatory. You can use a remotely controlled power supply to reboot the camera. There is no need to consider how to reconnect the USB in the case of remote control.

- **Multiple Readout Modes and Curves**

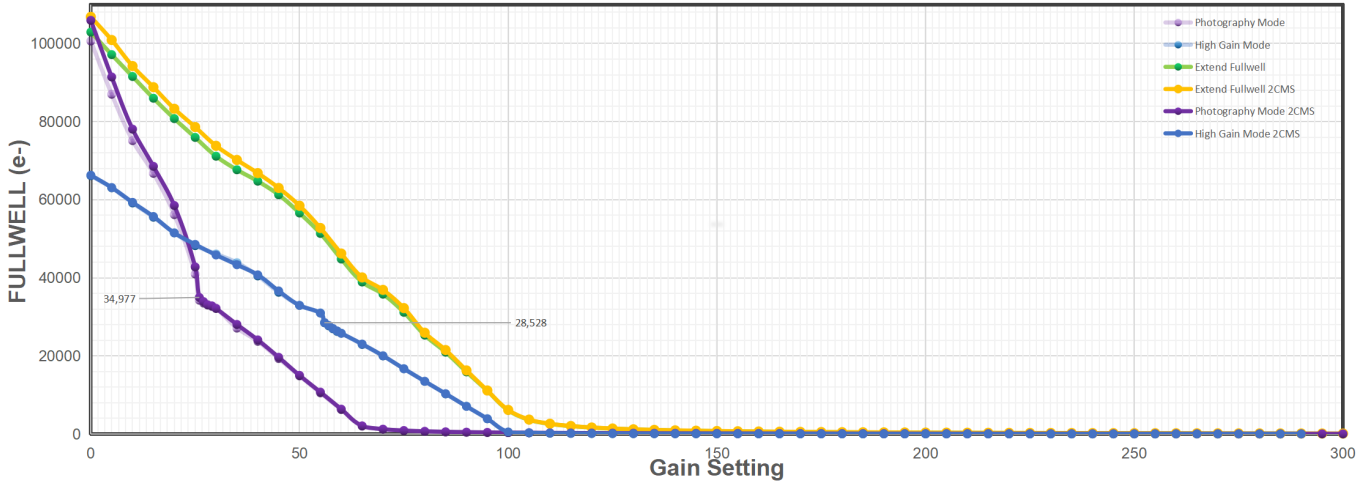
QHY268M/C System Gain For All Mode #0-#5



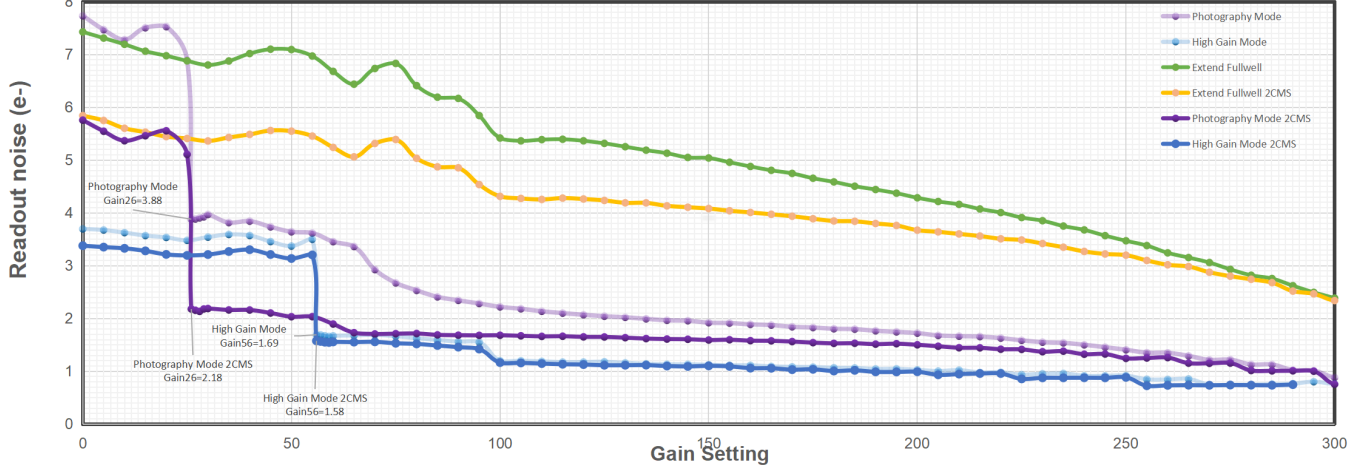
QHY268M/C Dynamic Range For All Mode #0-#5

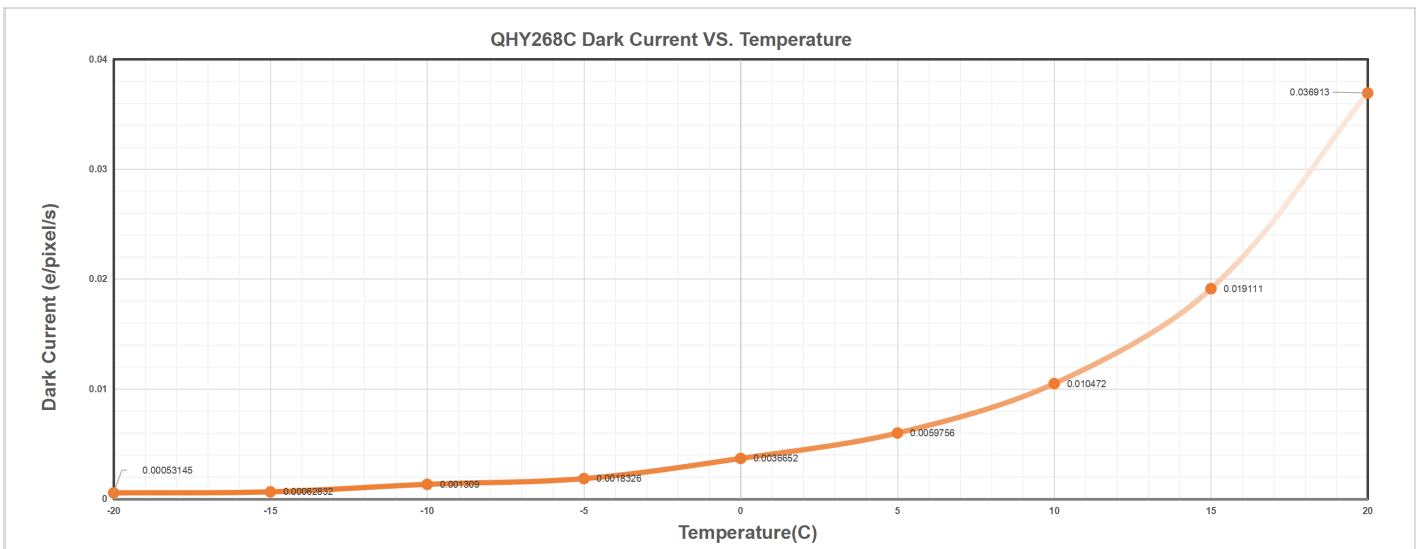


QHY268M/C FULLWELL For All MODE #0-#5

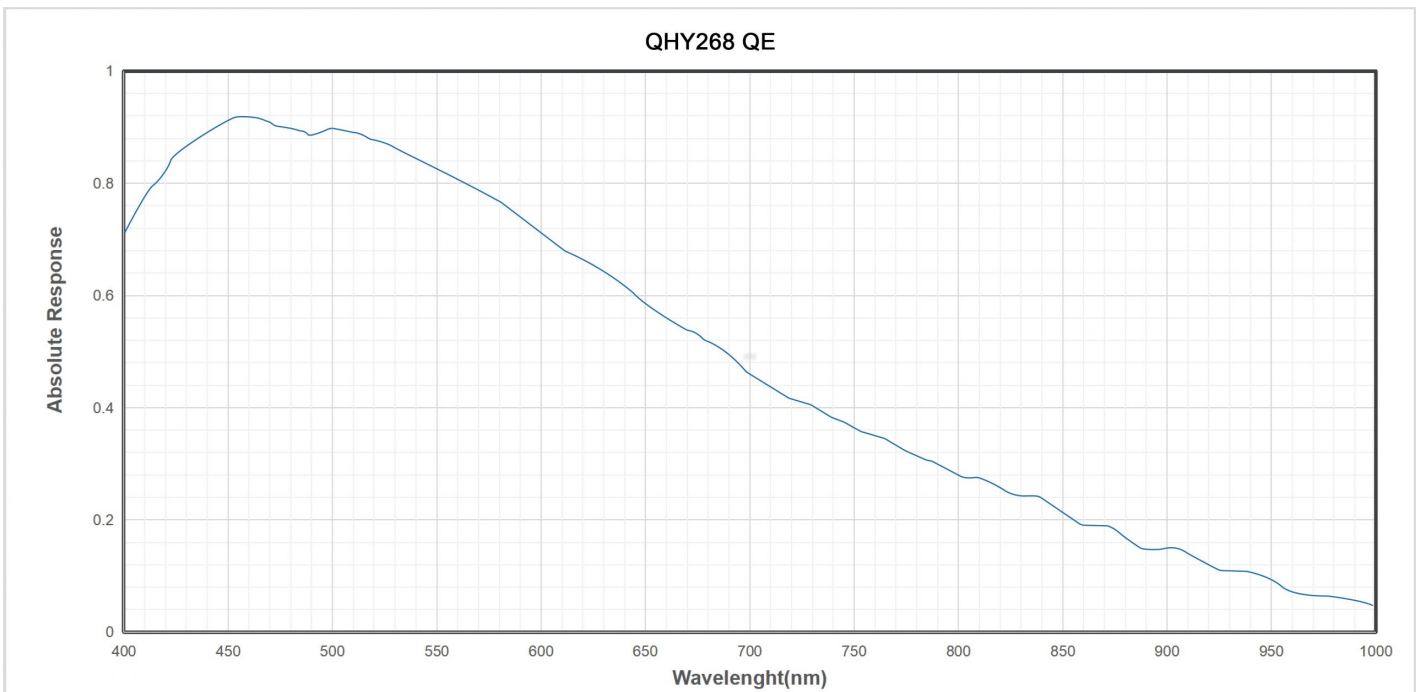


QHY268M/C Readout Noise For All Mode #0-#5





Monochrom's Spectrum Response Curve. The curve is based on SONY's datasheet. In the datasheet, it is the normalized curve QHYCCD test it by comparing with a known QE CCD sensor. And get this curve. This curve is only a reference. QHYCCD does not guarantee this curve is correct.



Color version (Normalized Response Curve from SONY datasheet).



Multiple Readout Modes are special for QHY 16-bit Cameras (QHY600/268/461/411). Different readout modes result in different performance. These readout modes are currently supported in the QHYCCD ASCOM Camera Driver, SharpCap and N.I.N.A.

Readout Mode #0 (Photographic DSO Mode). This mode is suitable for most DSO imaging situations. Since there is a drop in the noise between Gain 25 and Gain 26 (unity gain), we recommend it as default gain setting; however, gain0 is also good enough for a 16-bit sensor.

Readout Mode #1 (High Gain Mode). This mode is something like double native iso of some new digital cameras, whose dynamic range can greatly increase at the very high iso value, like iso800, iso3200, etc. The high gain mode provides such improvement for QHYCCD 16-bit cameras. We recommend you choose this mode when you have to capture at high gain, for example, a very dark object. **Please note the switch point of HGC/LGC of QHY600/268/461 is 56. That means you must set Gain 56 to make the best of it.**

Readout Mode #2 (Extended Fullwell Mode). With a pixel size of 3.76µm, these sensors already have an impressive full well capacity of 51ke. Nevertheless, QHYCCD has implemented a unique approach to achieve a full well capacity higher than 51ke- through innovative user controllable read mode settings. In Extended Fullwell Mode, the QHY600 can achieve an

extremely large full-well charge value of nearly 80ke- and the QHY268 can achieve nearly 75ke-. Greater full-well capacity provides greater dynamic range and large variations in magnitude of brightness are less likely to saturate.

Mode-2CMS

Based on the three basic modes above, 2CMS mode can greatly reduce readout noise by secondary sampling while keeping the same full well value and system gain. We prefer 2CMS modes than basic modes in astrophotography. By the way, the recommend gain values are the same as their basic modes.

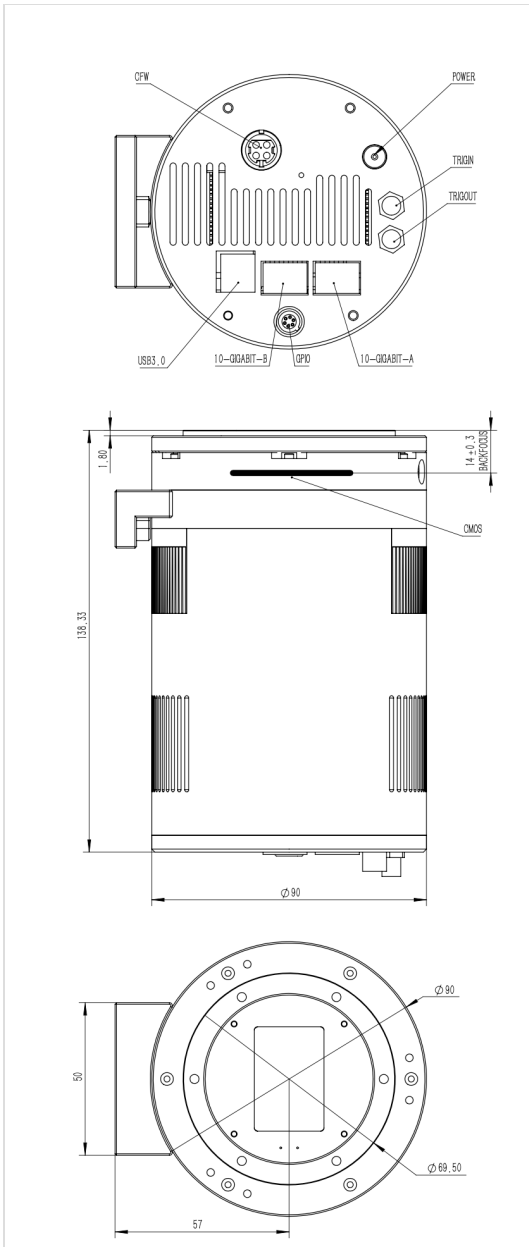
Currently QHY600 and QHY461 Series support **Extended Fullwell Mode-2CMS (Mode#3), and QHY268 Series support Photographic DSO Mode-2CMS (Mode#4) and High Gain Mode-2CMS (Mode#5)**. Mode#4 and Mode#5 require Allinone version 20230412 or higher.

- Specifications

Model	QHY268M PRO I
COMS Sensor	SONY IMX571 M
Mono/Color	Mono Only
FSI/BSI	BSI
Pixel Size	3.76um x 3.76um
Effective Pixel Area	6280*4210 (includes the optically black area and overscan area)
Effective Pixels	26MP
Sensor Size	APS-C
A/D Sample Depth	Native 16-bit (0-65535 greyscale) A/D
Full Well Capacity (1x1, 2x2, 3x3)	51ke- 75ke- or above in extended full well mode
Full Frame Rate	USB3.0 Mode 6.7FPS@6280*4210 8Bit 6.5FPS@6280*4210 16Bit 13.6FPS@2048*2048 8Bit 12.7FPS@2048*2048 16Bit 25.4FPS@1080*1080 8Bit 21.8FPS@1080*1080 16Bit 12BIT High Speed Mode 14.5FPS@6280*4210 8Bit 29FPS@2048*2048 8Bit 52.5FPS@1080*1080 8Bit PCIE Mode 6.7FPS@6280*4210 8Bit 6.7FPS@6280*4210 16Bit 14FPS@2048*2048 8Bit 14FPS@2048*2048 16Bit 25.4FPS@1080*1080 8Bit 25.4FPS@1080*1080 16Bit

Readout Noise	1.1e- High Gain, 3.5e- Low Gain (5.3e- to 7.4e- in extended full well mode)
Dark Current	-20C 0.0005e /pixel/sec -10C 0.001e /pixel/sec
Exposure Time Range	30us-3600sec
Unity Gain*	0* PH Mode 30 Extended Fullwell 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	Fully support via Camera USB port
Shutter Type	Electronic Shutter
Computer Interface	USB3.0 and 2*10Gbps Fiber interface
Built-in Image Buffer	2GB DDR3 Memory
Cooling System	Two-stage TEC cooler Air Cooling Version Typical -30C below ambient in short exposure time (exposure time < 10sec) Typical -35C below ambient in long exposure time (exposure time > 30sec) Test temperature +20° Water Cooling Version Typical -45C below ambient in long exposure time (exposure time > 30sec)
Recommended flow rates for water-cooled versions	1.6ml/s
Optic Window Type	AR+AR High Quality Multi-Layer Anti-Reflection Coating
Anti-Dew Heater	Yes
Humidity Sensor*	Yes
Telescope Interface	Support M54 and M48 (with standard adapters)
Back Focal Length	14.5mm*

- Mechanical Drawing



+ User Guide

- Before Start: Install "All-In-One" Pack

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 formular 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.

Install "All-In-One" System Pack

All-in-one Pack supports most QHYCCD models only except PoleMaster and several discontinued CCD cameras.

Download Page: <https://www.qhyccd.com/download/>

Video Tutorial: <https://www.youtube.com/embed/mZDxIK0GZRc?start=1>

- Since most of the contents of All-in-one package are plug-ins that support third-party software, **the third-party capturing software that you want to use must be installed before the All-in-one package.** Otherwise the program will report an error.
- **ALL-IN-ONE Pack contains:**
 - **System Driver**, which is necessary for the camera operation and must be installed.
 - **WDM Broadcast Driver**, which can provide a live signal to Obs and other live software, you can install it if you have such needs like opening a live show.
 - **EZCAP_QT**, which is developed by QHYCCD and can be used in QHY devices tests, and management of updates. So even if you won't use EZCAP_QT for capturing, we suggest you install it.
 - **Ascom driver**, which is necessary for the camera used in Ascom (the latest version of Ascom is 6.6).
 - **The two sorts of Ascom CFW Drivers** correspond to two methods of controlling the filter wheel: USB control and camera serial control. It is recommended that both drivers should be installed if you have a filter wheel.
 - **CP210X_VCP** is a serial driver. Some computers come with the driver, but the computer without the driver may be failed of controlling the filter wheel.
 - **SDKs for Third-party Software:** Just pick and install the corresponding SDK according to the software you want to use. Don't forget to check whether the software you are using is 32-bit or 64-bit and select the right SDKs.
 - **SHARPCAP** is also included in the pack, you can choose 32-bit or 64-bit to install. This is authorized by SHARPCAP.
 - **QT LIB** is a plug-in to ensure that 64-bit software can execute normally on some computers with poor compatibility.
- **Difference between Stable version and Beta Version:** Beta version is the latest version, which gives priority to support for the latest products (the stable version may not be compatible with those yet), and has some of the latest optimized ,but experimental features. The stable version is older than the beta version but more stable, so it is recommended for beginners who are not using the latest products.
- **Don't let the camera connect to the computer during the All-in-one pack installation process** connect it to the computer after all the installation is complete.

- Connect Software

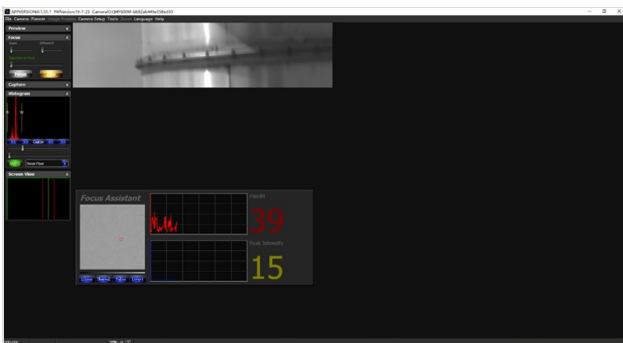
Before using software, make sure you have connected the cooling camera to the 12V power supply and connected it to the computer with a USB3.0 data cable. If it's an uncooled camera, 12V power is not needed.

Note: We recommend 64-bit Software if possible, like SharpCAP x64 , N.I.N.A x64. etc., especially when you're using 16bit cameras.

EZCAP_QT

EZCAP_QT is software developed by QHYCCD. This software has basic capture functions for QHYCCD deep sky cameras.

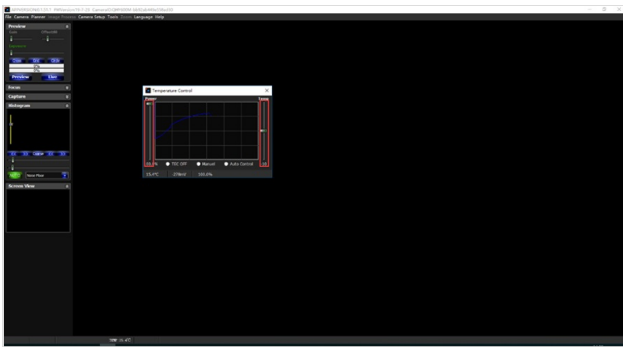
Run EZCAP_QT. Click “Connect” in Menu -> Camera. If the camera is successfully connected, the title line of EZCAP_QT will display the camera firmware version and the camera ID as shown below.



Click “Temperature Control” in “Camera Settings” to set the temperature of the CMOS sensor. You can turn on “Auto” to set

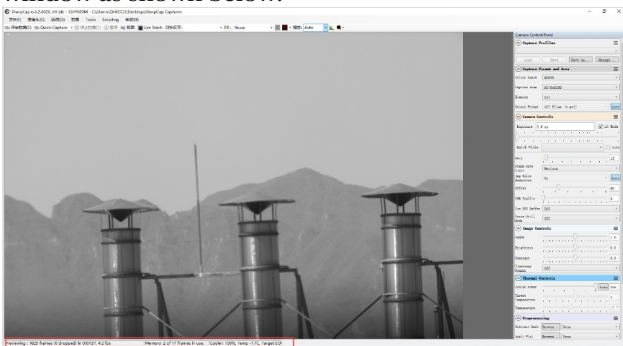
the target temperature. For example, here we set the target temperature to -10C. The temperature of the CMOS sensor will drop quickly to this temperature (approximately 2-3 minutes). If you want to turn off cooling, you can choose Stop. If you just want to set the TEC power but not the temperature. You 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.



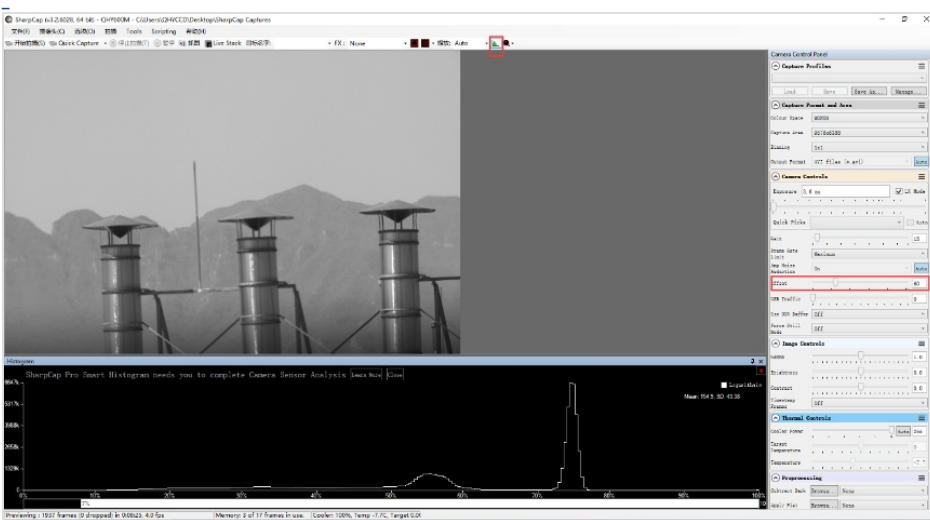
SharpCap

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.

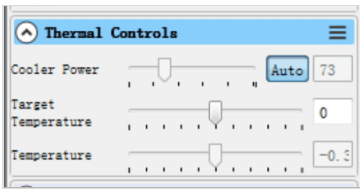
Offset adjustment. When you completely block the camera (i.e., like taking a dark frame) you may find that the image is not really zero. Sometimes this will reduce the quality of the image contrast. You can get a better dark field by adjusting the offset. You can confirm this by opening the histogram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

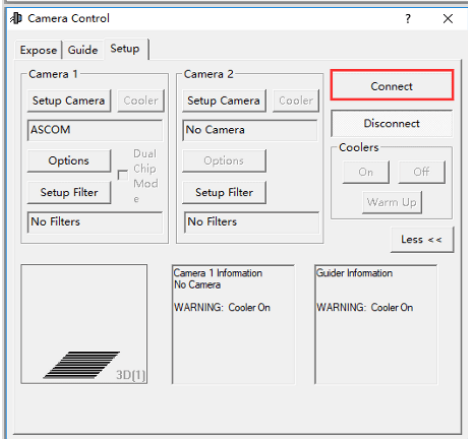
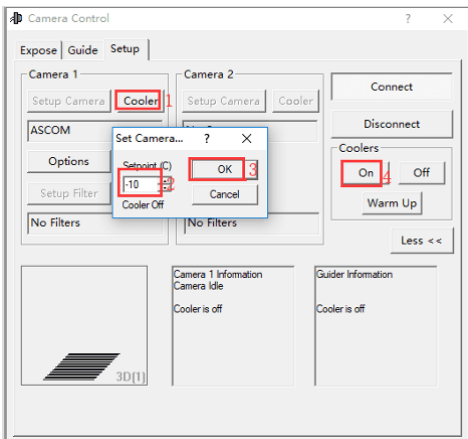
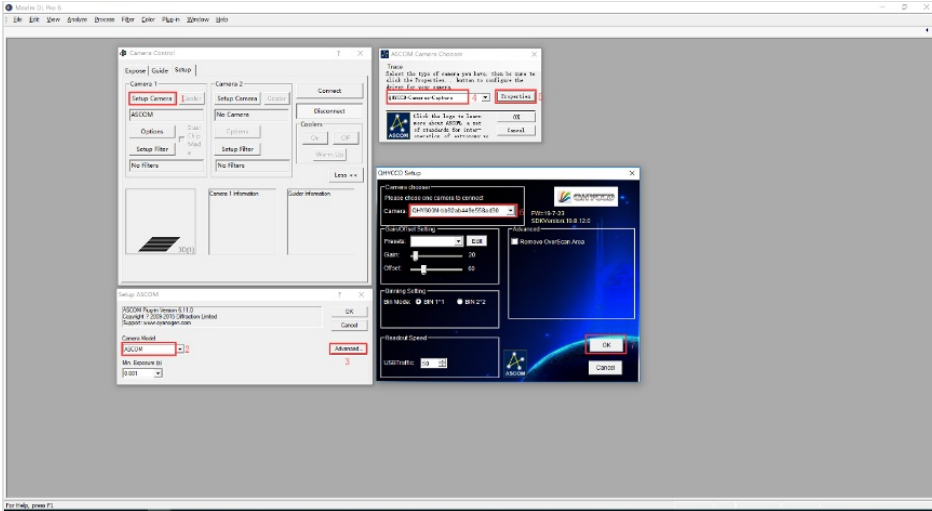
After cooling devices connected to the 12V power supply, the temperature control circuit will be activated. You can control the CMOS temperature by adjusting the settings in the figure below. Basically, you can control the temperature of CMOS by either adjusting “Cooler Power” or clicking “Auto” and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

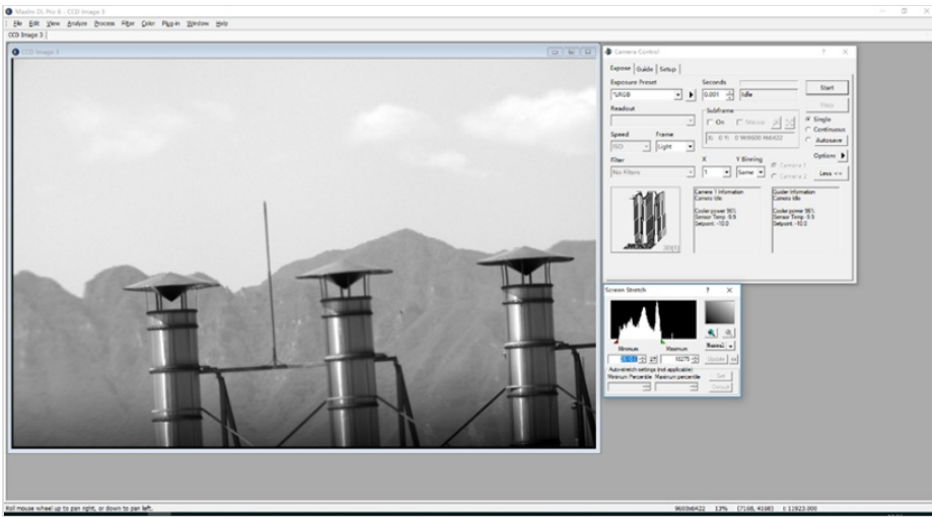


ASCOM supported software (e.g. MDL)

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.



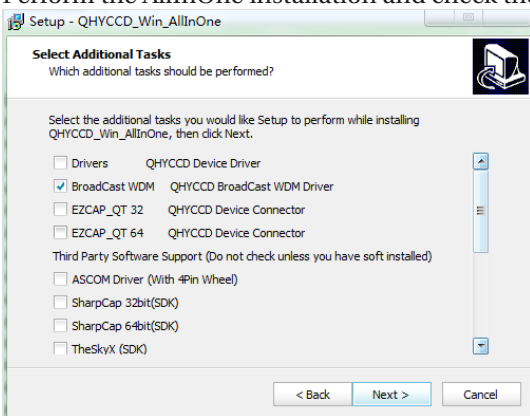


- Broadcast WDM Camera Driver

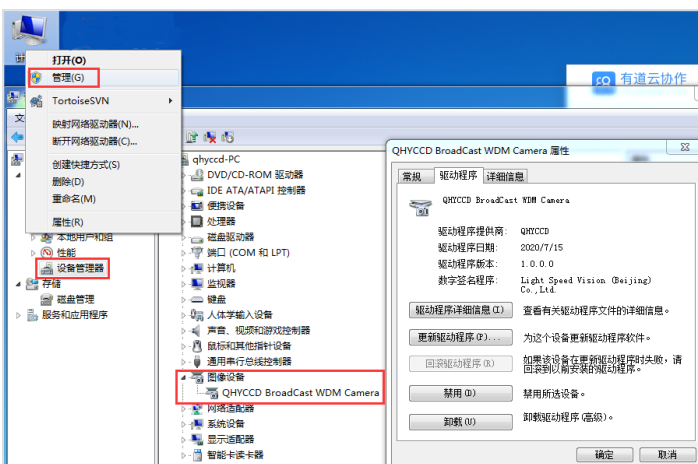
QHYCCD BroadCast WDM Camera is a broadcast driver that supports QHYCCD cameras with video broadcast function, which can meet the needs of customers to send video images to other target software. For example, use sharpcap to connect a WDM-enabled camera, and the sharpcap display video image can be sent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

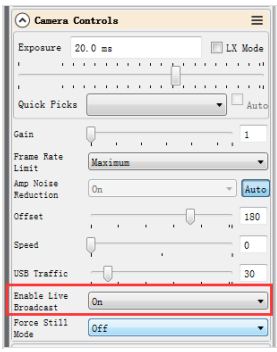


The installation process is over, right-click the computer to find the device manager, and check that the image device name is QHYCCD BroadCast WDM Camera, which means the installation is successful.

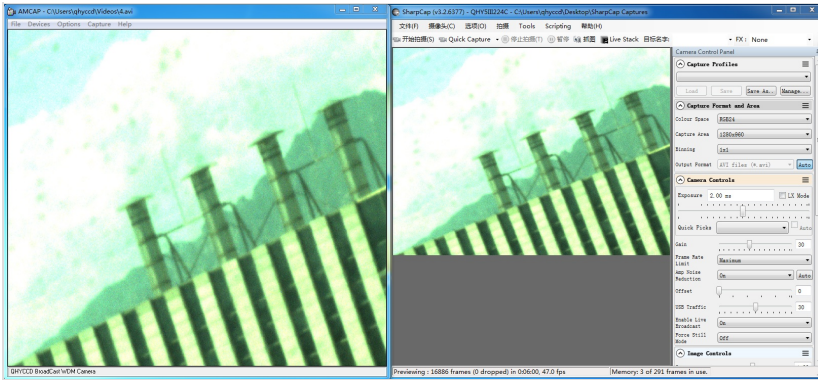


Activate the function:

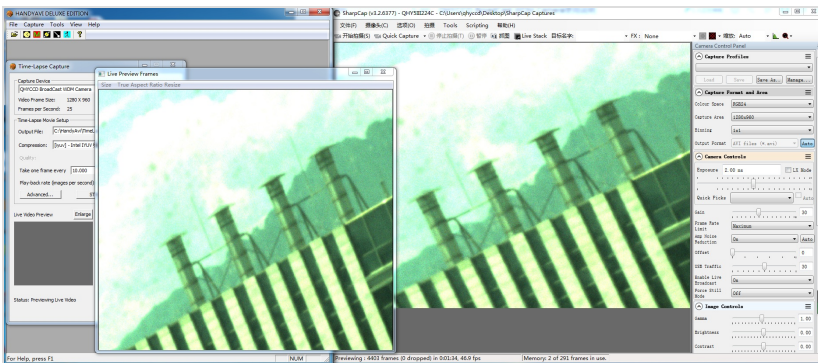
Usually sharpcap is used to connect the camera as the broadcasting terminal. After connecting the camera, you need to turn on the Enable Live Broadcast switch to broadcast.



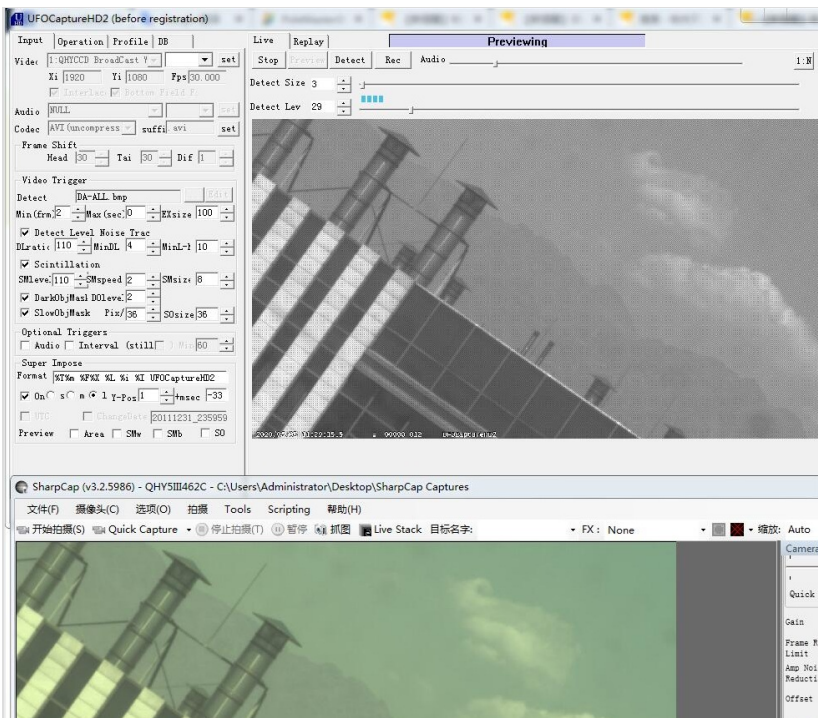
Common supporting software (ie, broadcast receiver) includes: UFOCAPTURE, HANDYAVI, QQ video functions, etc. AMcap test effect chart:



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

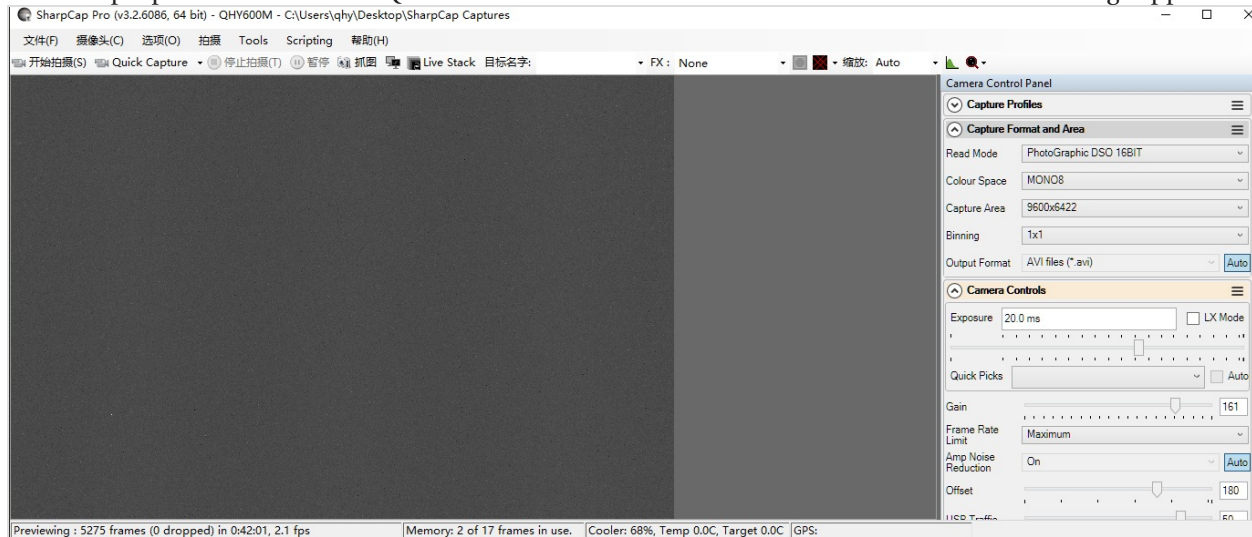
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Click to download 2021.1.2

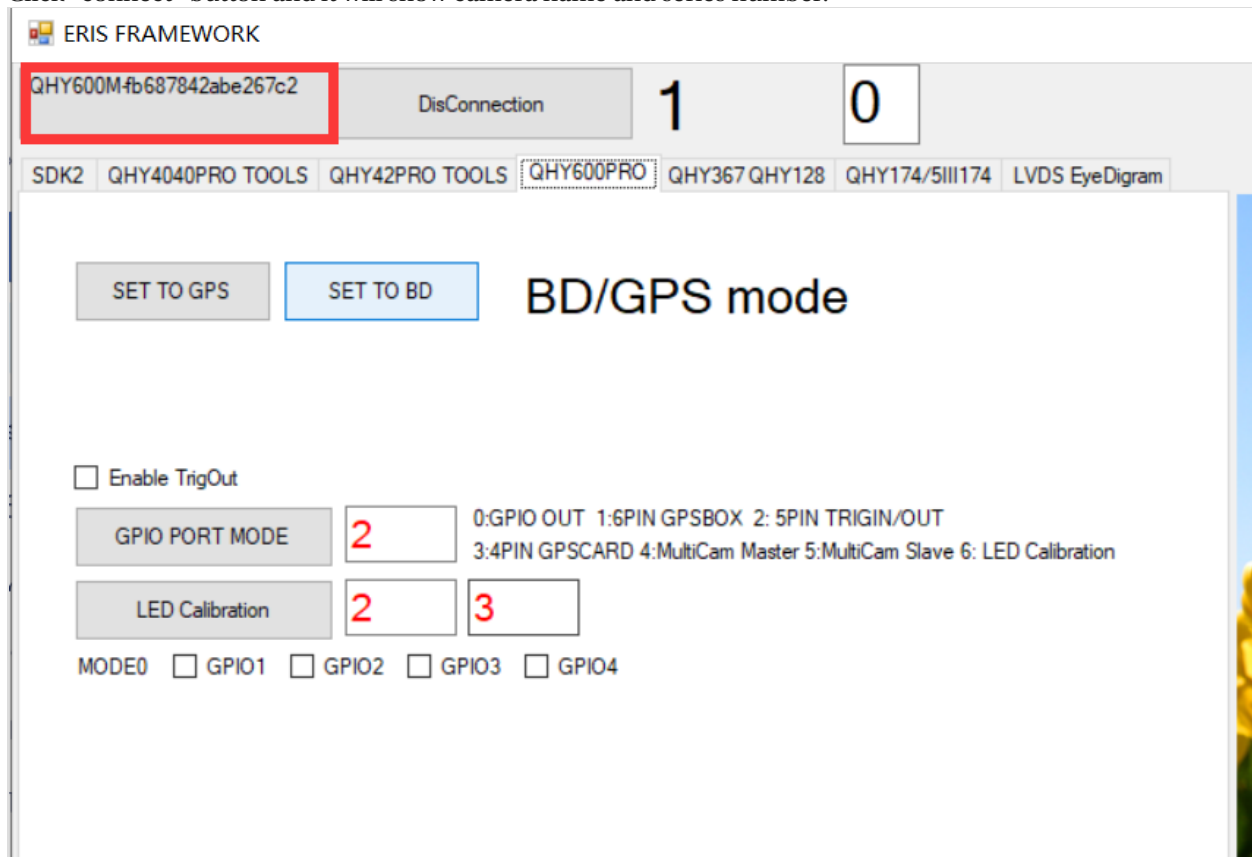
[Debug TOOL](#)

[Release TOOL](#)

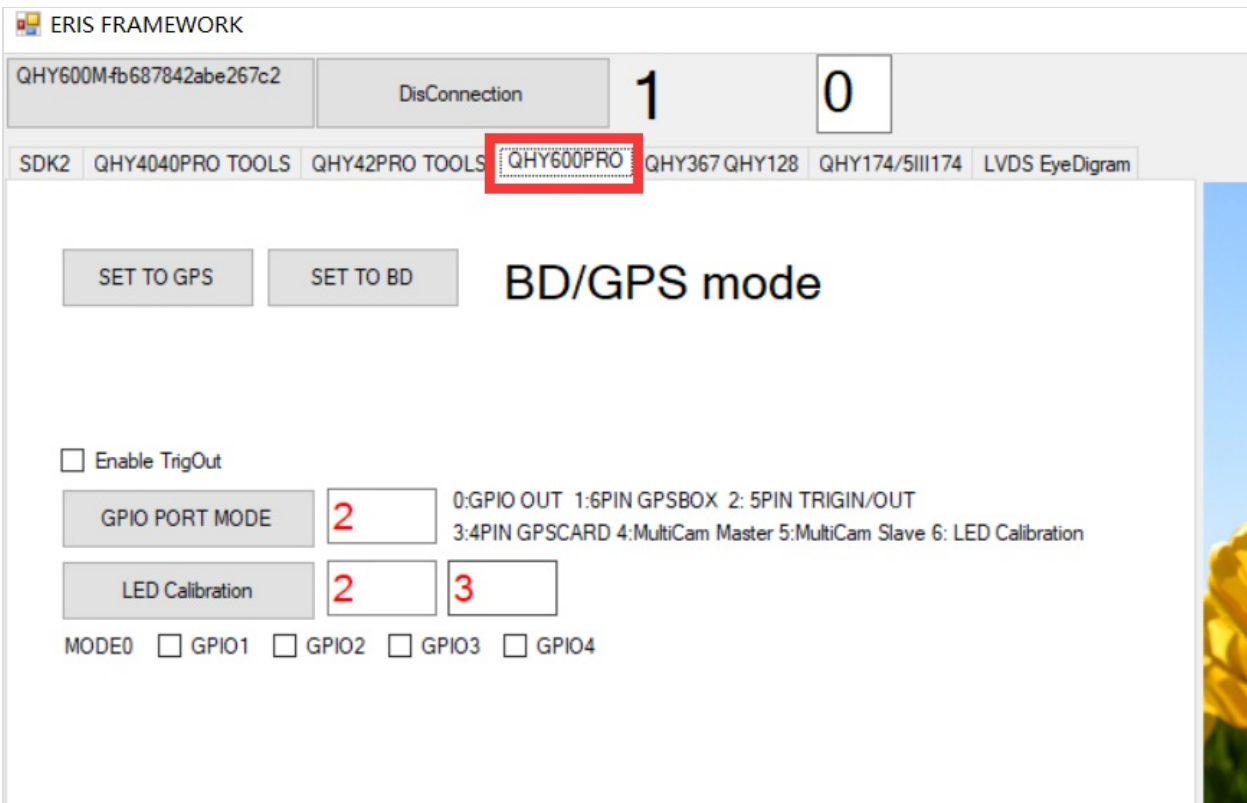
Run Sharpcap and make sure the QHY Camera works well under it. You will see the continous image appears.



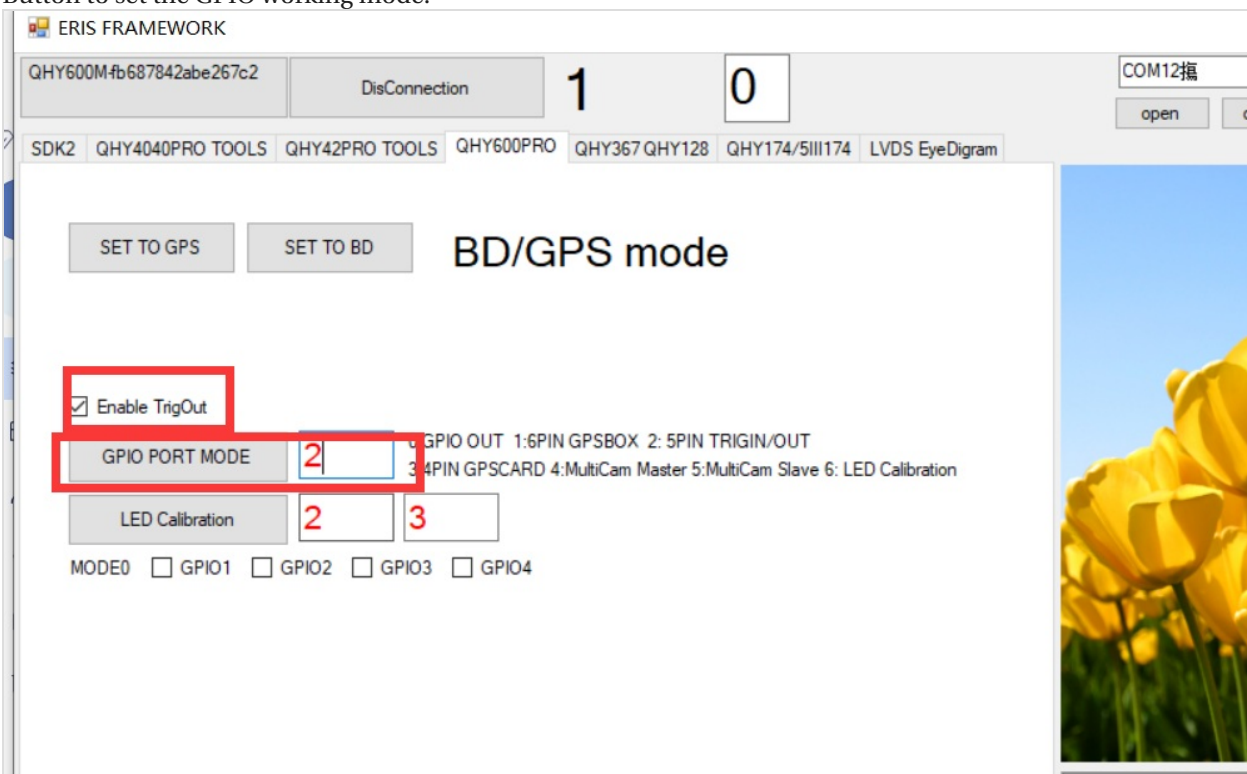
Click "connect" button and it will show camera name and series number.



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

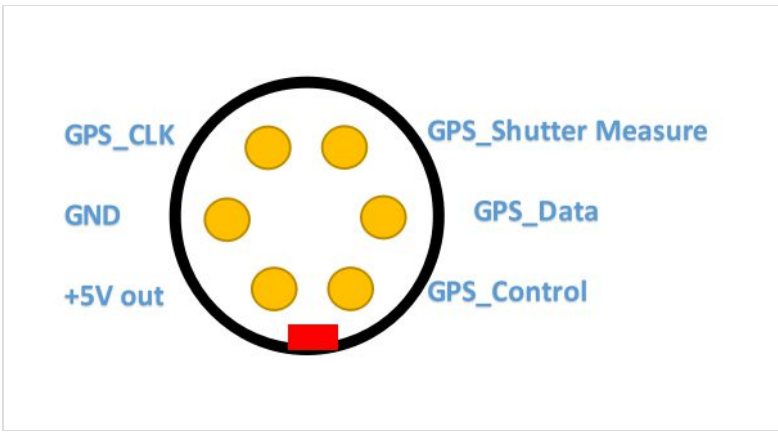
MODE0: Generic GPIO output mode / Auto Guide Port

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

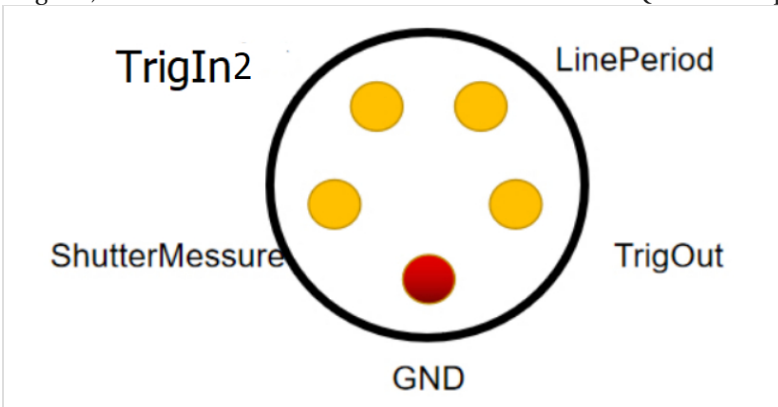
In this mode, Four GPIO port is configed as gps_clock, gps_data, shuttermeassure,gps_control. You can connect with QHYCCD-GPSBOX. The camera will output the shuttermeassure signal to GPSBOX and GPSBOX will send the data to camera. Camera will replace the first some pixel to the gps data .



MODE2: 5PIN Generic TrigOut / TrigIn mode

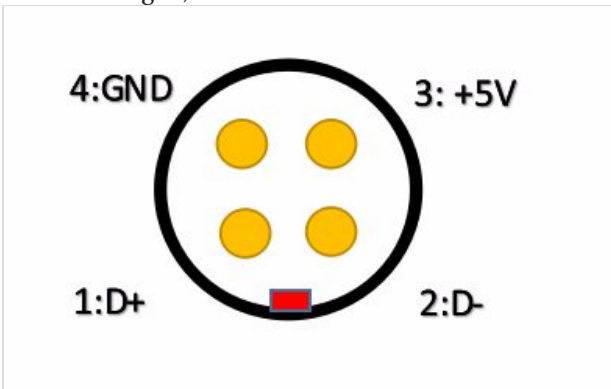
In this mode, Four GPIO port is configed as TrigOut, ShutterMeassure, TrigIn, LinePeriod . Only TrigIn pin is input direction and other three pin is output direction.

In some camera, like QHY4040,QHY2020,QHY42PRO,QHY6060, The shuttermeasure 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 shuttermeasure 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 shuttermeasure 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 ShutterMeassure 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/ShutterMeassure can be set by APIs. By check if the camera captured this pulse. You will get the delta time of the TrigOut/ShutterMeassure 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

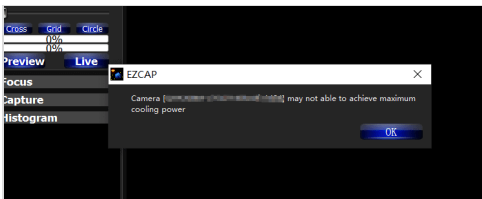
+ UVLO Function

-

UVLO (Under Voltage Locking), is primarily intended to protect the electronic device from damage caused by abnormally low voltages. **Now only QHY600, QHY268, QHY410, QHY411, QHY461, QHY533 cameras have UVLO Protection.**

UVLO warning execution

After a warning is given, the camera firmware will automatically turn off the cooler and will turn on the camera's TEC protection mode. After the camera is reconnected, it will always work in TEC protection mode (maximum power cooler power will be limited to 70%). Since many times the voltage shortage is caused by the high resistance of the power supply cable itself, resulting in a large voltage drop at high currents, the voltage will usually rise after the power is limited. But limiting the power will affect the cooling temperature difference. Therefore, it is recommended that users first check the power supply cable to solve the problem of excessive resistance of the power supply cable.



If the user has solved the problem of insufficient supply voltage, the TEC protection mode can be removed through the menu of EZCAP_QT.

How to improve the power supply?

1. Make sure the output voltage of the AC adapter is not less than 12V and the maximum output current can reach 4A or more. Otherwise, the AC adapter itself will not meet the power demand of the camera and it may cause a low voltage problem.
2. Make sure that the 12V power supply cable connecting the AC adapter to the camera has a low impedance. The impedance of the positive and negative paths should not exceed 0.1 ohms each. Or the total impedance (positive + negative) should not exceed 0.2 ohms. Otherwise, the power supply cable should be thickened.
3. When using battery power, it is recommended to add a 12V output voltage regulator. If the battery is connected directly, usually the battery voltage reaches 13.8V when fully charged, and will gradually drop during use. It is easy to cause the camera to reach the low-voltage detection threshold.

How to clear the TEC protection status triggered by UVLO?

Once a UVLO event occurs, the camera will automatically memorize it and will work in a protected mode at a maximum of 70% power after reconnection. This memory can be erased as follows:

After you find the system error, you need to turn off the device and check the power supply. After inspecting the problem, open the ezcapp software and select "Camera Settings" – "Preferences" – "Reset Flash Code" to reset the error status.



Why does the warning appear even though the power supply voltage is 12 V?

1. The voltage measured inside the camera is the voltage reaching the camera, not the voltage at the power adapter end.

Therefore, the voltage measured at the power adapter end does not reflect the voltage received at the camera end. This is because the power cable has its own resistance. If the resistance is large, it will cause a large voltage drop. The voltage drop can be calculated by $U = I * R$. So if the power cable has a resistance of 0.2 ohms, it will produce a voltage drop of $3.3 * 0.2 = 0.66V$. If the power adapter output is 12 V, the voltage reaching the camera is $12 - 0.66 = 11.34 V$. To actually measure the input voltage at the camera end, you can refer to the photo below.



2. For cameras produced after September 2021, the UVLO is detected by communicating directly with the power manager, and the UVLO code that appears is 9, while for cameras produced before, the indirect detection method is used, and the UVLO code that appears is 3. The indirect detection method will detect UVLO except for the low voltage problem, and any other accident that causes CMOS not to work will also trigger the UVLO=3 alarm, for example, the camera is subject to severe electromagnetic interference, causing registers inside the CMOS not to work. Therefore, if UVLO=3 occurs, it is recommended to contact QHYCCD technical support for further judgment.
3. Using older versions of drivers and firmware may cause false positives (UVLO=9). Please make sure that ALL-in-one SDK version is out of stable version 2021.10.23 or higher. Please disconnect the 12V power supply during the driver installation.

+ QHYCCD BURST Mode

- QHYCCD BURST Mode

Added functions related to BURST mode in SDK. Currently, cameras that support Burst function include QHY600, QHY411, QHY461, QHY268, QHY6060, QHY4040, QHY4040PRO, QHY2020, QHY42PRO, QHY183A

This mode is a sub-mode of continuous mode. This function can only be used in continuous mode. When this function is enabled, the camera will stop outputting image data, and the software frame rate will be reduced to 0. At this time, send relevant commands to the camera, and the camera will Output the image data with the specified frame number according to the settings, for example, set Start End to 1 6, the camera will output the image data with the frame number 2 3 4 5 when receiving the command.

Note:

1. When using Burst mode in fiber mode, the first Burst shot will be one less. For example, if the start end is set to 1 6, the output of 2 3 4 5 is normal, but in fact, only 3 4 will be output during the first burst shot. 5, 2 will not be received, the second and subsequent shots can normally obtain Burst images 2 3 4 5. This problem will be fixed later.
2. QHY2020, QHY4040 found that the frame number that came out when the exposure time was short is [start+1,end-1] but the one that came out under long exposure was [start+2,end]
3. When the camera is just connected, if the set end value is relatively large, the camera will directly output the picture after entering the burst mode. Therefore, it is necessary to set the camera to enter the IDLE state and then set the start end and related burst operations.

The following is the usage of Burst mode related functions:

- 1.EnableQHYCCDBurstMode

```

1 /**
2  @fn uint32_t EnableQHYCCDBurstMode(qhyccd_handle *h,bool i)
3  @brief Set camera enable or disable burst mode
4  @param h Camera control handle
5  @param i Enable or disable burst mode \n
6  true:enable burst mode \n
7  false:disable burst mode \n
8  @return
9  On success,return QHYCCD_SUCCESS \n
10 another QHYCCD_ERROR code on other failures
11 */
12 uint32_t STDCALL EnableQHYCCDBurstMode(qhyccd_handle *h,bool i);
13
14 /*
15  * Note:
16  * This function only works in LiveVideo mode. When enabled,
17  * the video stream will pause and wait the burst mode start capture command.
18  * When disabled the camera will return the live video streaming mode.
19  * In Burst Mode, you can set the camera into IDLE status at first,
20  * and then release the IDLE status, this execution will make camera output a series of frames.
21  * You can define the start and end frame number and camera will only output the limited frames.
22  *
23  * About set IDLE status, please check SetQHYCCDBurstIDLE function,
24  * about release IDLE status, please check ReleaseQHYCCDBurstIDLE function,
25  * about set start and end frame,please check SetQHYCCDBurstModeStartEnd function.
26  */

```

2.SetQHYCCDBurstModeStartEnd

```

1 /**
2  @fn uint32_t SetQHYCCDBurstModeStartEnd(qhyccd_handle *h,unsigned short start,unsigned short end)
3  @brief Set start and end frame,camera will output middle frames
4  @param h Camera control handle
5  @param start The start of frame number
6  @param end The end of frame number
7  @return
8  On success,return QHYCCD_SUCCESS \n
9  another QHYCCD_ERROR code on other failures
10 */
11 uint32_t STDCALL SetQHYCCDBurstModeStartEnd(qhyccd_handle *h,unsigned short start,unsigned short end);
12
13 /*
14  * Note:
15  * Burst mode is to output a series of frames.This function is used to define the start and the end frame.
16  * For QHY411, QHY600, QHY268, QHY410, QHY533, the minumu value is 1 max value is 65535.
17  * The frame account that output frmae is from (start+1) to (end-1). For example, start=1, end =10,
18  * the output frame is #2,#3.....#9. The #2 is the first effective image after release IDLE.
19  * For QHY2020, QHY42PRO, QHY4040, QHY6060, the minum value is 0, max value is 65535.
20  * The frame account that output frmae is from (start+1) to (end-1). For example, start=0, end =9,
21  * the output frame is #1,#2.....#8. The #1 is the first effective image after release IDLE.
22  */

```

3.SetQHYCCDBurstIDLE

```

1 /**
2  @fn uint32_t SetQHYCCDBurstIDLE(qhyccd_handle *h)
3  @brief Set camera enter IDLE status
4  @param h Camera control handle
5  @return
6  On success, return QHYCCD_SUCCESS \n
7  another QHYCCD_ERROR code on other failures
8  */
9  uint32_t STDCALL SetQHYCCDBurstIDLE(qhyccd_handle *h);
10
11 /**
12  * Note:
13  * Let the camera enter the IDLE status. When camera is in IDLE status, it will do nothing and not output any frames.
14  * This API need work with ReleaseQHYCCDBurstIDLE,and need setup a delay between these two functions,time is 20ms normally.
15  */

```

4.ReleaseQHYCCDBurstIDLE

```

1 /**
2  @fn uint32_t ReleaseQHYCCDBurstIDLE(qhyccd_handle *h)
3  @brief Set camera exit IDLE status
4  @param h Camera control handle
5  @return
6  On success, return QHYCCD_SUCCESS\n
7  another QHYCCD_ERROR code on other failures
8  */
9  uint32_t STDCALL ReleaseQHYCCDBurstIDLE(qhyccd_handle *h);
10
11 /**
12  * Note:
13  * Let the camera exit the IDLE status. After run this API, the camera will begin to output a series of the frames.
14  * This API need work with SetQHYCCDBurstIDLE,and need setup a delay between these two functions,time is 20ms normally.
15  */

```

5.SetQHYCCDBurstModePatchNumber

```

1 /**
2  @fn uint32_t SetQHYCCDBurstModePatchNumber(qhyccd_handle *h, uint32_t value)
3  @brief Setup a data patch in DDR to avoid camera can't output frames normally
4  @param h Camera control handle
5  @param Value the number of data patch,normally is 32001
6  @return
7  On success, return QHYCCD_SUCCESS\n
8  another QHYCCD_ERROR code on other failures
9  */
10 uint32_t STDCALL SetQHYCCDBurstModePatchNumber(qhyccd_handle *h,uint32_t value);
11
12 /**
13  * Note:
14  * It is best to enable DDR in the burst mode to avoid the image lost caused by the host cpu busy.
15  * The function of enable DDR is SetQHYCCDParam(camhandle, CONTROL_DDR, 1.0);
16  * The DDR will buffer the image streaming. But DDR will remain some data in its buffer,
17  * and it will cause some of the last bye can not come out from it.
18  * This function will cause the last frame in a burst series may not come out.
19  * This API can add some patch number in the end of a frame to allow all frame come out.
20  */

```

6.ReseQHYCCDtFrameCounter

```

1 /**
2  @fn uint32_t ReleaseQHYCCDFrameCounter(qhyccd_handle *h)
3  @brief Reset the hardware frame counter to 0
4  @param h Camera control handle
5  @return
6  On success, return QHYCCD_SUCCESS\n
7  another QHYCCD_ERROR code on other failures
8  */
9  uint32_t STDCALL ReseQHYCCDtFrameCounter(qhyccd_handle *h);
10
11 /*
12  * Note:
13  * Reset the hardware frame counter to 0. In fact, each time when release the IDLE will clear the frame counter,
14  * so this API is not need to call in burst mode, you can ignore this function.
15  */

```

7.SetQHYCCDEnableLiveModeAntiRBI

```

1 /**
2  @fn uint32_t SetQHYCCDEnableLiveModeAntiRBI(qhyccd_handle *h, uint32_t value)
3  @brief Set camera enter AntiRBI mode
4  @param h Camera control handle
5  @param value The number of enable function
6  @return
7  On success, return QHYCCD_SUCCESS\n
8  another QHYCCD_ERROR code on other failures
9  */
10 uint32_t STDCALL SetQHYCCDEnableLiveModeAntiRBI(qhyccd_handle *h,uint32_t value);
11
12 /*
13  * Note:
14  * QHY600, QHY411, QHY461 support this function, and different cameras need setup different value.
15  * Disable : value = 0
16  * Enable  : for QHY600, value = 0x1C00
17  *          for QHY411, value = 0x2A94
18  *          for QHY461, value = 0x2300
19  */

```

8.EnableQHYCCDImageOSD

```

1 /**
2  @fn uint32_t EnableQHYCCDImageOSD(qhyccd_handle *h, uint32_t i)
3  @brief Setup some information display on image
4  @param h Camera control handle
5  @param i Display switch
6  @return
7  On success, return QHYCCD_SUCCESS\n
8  another QHYCCD_ERROR code on other failures
9  */
10 uint32_t STDCALL EnableQHYCCDImageOSD(qhyccd_handle *h,uint32_t i);
11
12 /*
13  * Note:
14  * Some information text, eg, the hardware frame sequence number, or the GPS information etc,
15  * can be add on the left top side of the image.
16  * disable : i=0
17  * enable  : i=1
18  */

```

Sample Code

```

1 ret = SetQHYCCDParam(camhandle, CONTROL_DDR, 1.0);
2 ret = BeginQHYCCDLive(camhandle);
3 ret = SetQHYCCDBurstModeIDLE(camhandle);
4 ret = SetQHYCCDBurstModeStartEnd(camhandle, 1, 3);
5 ret = SetQHYCCDBurstModePatchNumber(camhandle, 32001);
6 ret = EnableQHYCCDBurstMode(camhandle, true);
7
8 while(true)
9 {
10     ret = SetQHYCCDBurstModeIDLE(camhandle);
11     sleep(20);
12     ret = ReleaseQHYCCDBurstModeIDLE(camhandle);
13
14     ret = QHYCCD_ERROR;
15     while(ret == QHYCCD_ERROR)
16     {
17         ret = GetQHYCCDLiveFrame(camhandle, &w, &h, &b, &c, ImgData);
18     }
19 }

```

+ Maintenance

- Drying the camera CMOS chamber

1. There are holes in the two sides of the camera near the front plate that is normally plugged by a screw with an o-ring. If there's moisture in the CMOS chamber that causes fog, you can connect the desiccant tube to this hole for drying. There would better be some cotton inside to prevent the desiccants from entering the CMOS chamber.

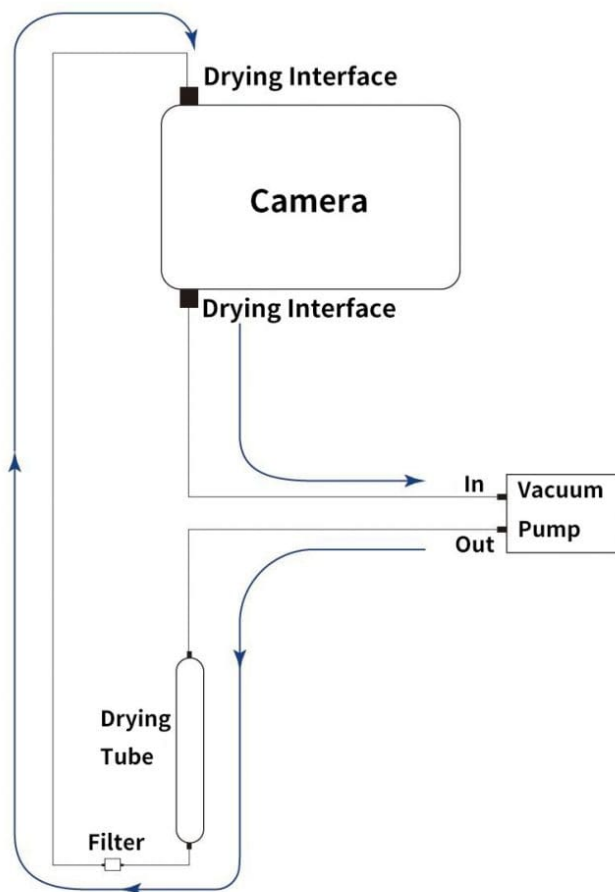


Please note that you may need to prepare desiccants yourself because for most countries and regions desiccants are prohibited by air transport. Since QHY always deliver your goods by air, sorry that we can't provide desiccants for you directly.

2. **Cyclic Drying:** The front end of the camera body is equipped with two drying interfaces with M5 threads, which are used in conjunction with drying tubes and circulation pumps for drying treatment inside the sensor chamber. The position of the drying interface is indicated by the red circle in the figure below (take the QHY600 as an example):



Cyclic Drying System



Under the vacuum pump, the gas inside the sensor chamber is drawn out through one drying interface, enters the drying tube, and then undergoes filtration. It is then reintroduced into the camera through the other drying interface, circulating back and forth for drying.

Note: Do not reverse the order of the intake and exhaust ports

- **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.

- **Preventing fogging of the CMOS chamber**

All QHY cooling cameras have built-in heating plates to prevent fogging. However, If the ambient humidity is very high, the optical window of the CMOS chamber may have condensation issues. Then try the following:

1. Avoid directing the camera towards the ground. The density of cold air is greater than 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. Slightly increase the temperature of the CMOS sensor .
3. Check if the heating plate is normally working. If the heating plate is not working, the glass will be very easy to fog, the temperature of the heating plate can reach 65-70 °C in the environment of 25 °C. If it does not reach this, the heating plate may be damaged. Please contact us for maintenance.

- **TE Cooler Maintenance**

Please 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.

+ **Appendix: Test for QHY268M for Science Observations by Alto-observatory**

<https://www.qhyccd.com/testing-the-qhy-268-mono-for-science-observations/>