Overview

QHY9701 is a cooled scientific CMOS camera with GSENSE9701 back illuminated sCMOS sensor. The CMOS has a very wide spectral response.

With the characteristics of large pixels, ultra-wide spectrum and low noise, it is suitable for high-end microscopy, micro-optics, biofluorescence and other scientific research fields.

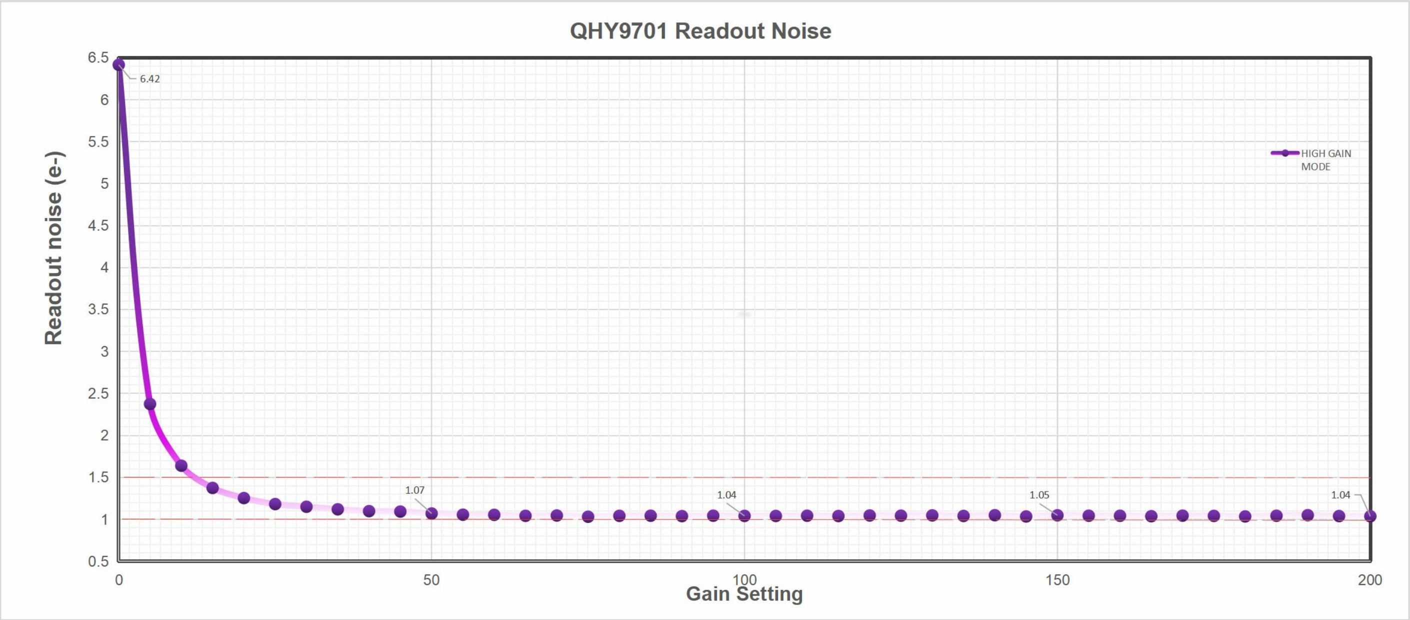
It has 89% peak QE at 610nm. The high, wide response from NIR to UV makes the QHY9701 a perfect camera for spectrum analysis and spectrum imaging systems. The QHY9701 is also an ideal scientific CMOS camera for Fluorescence imaging.

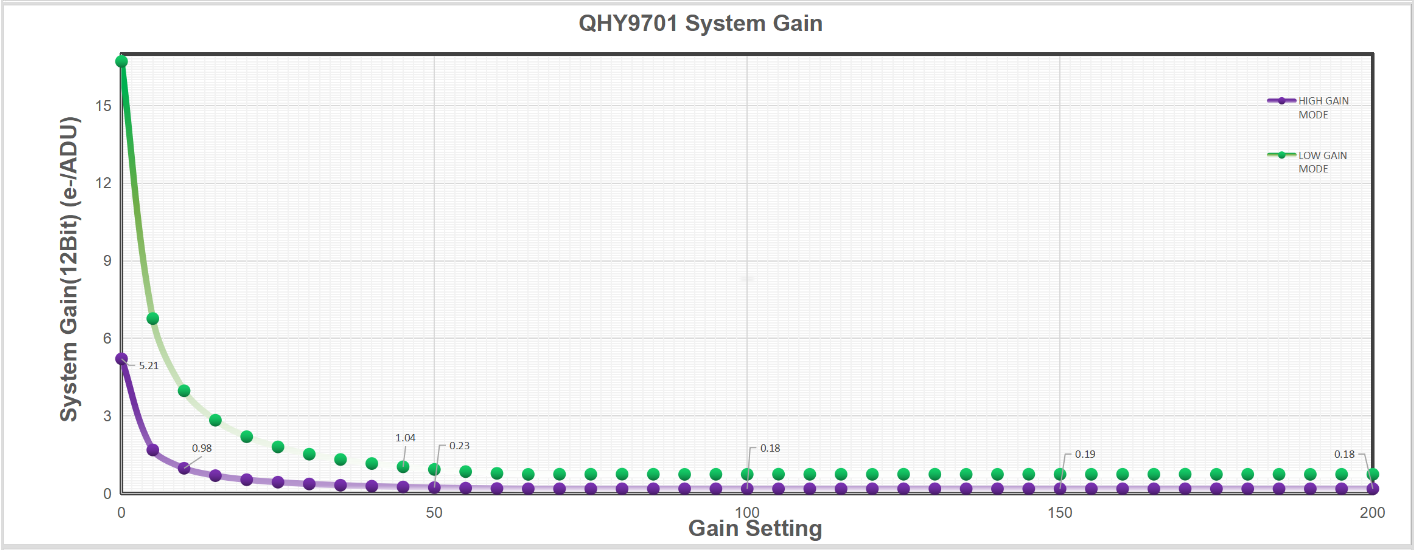
With read noise as low as 0.85e-, this camera can capture photons from very dim objects.

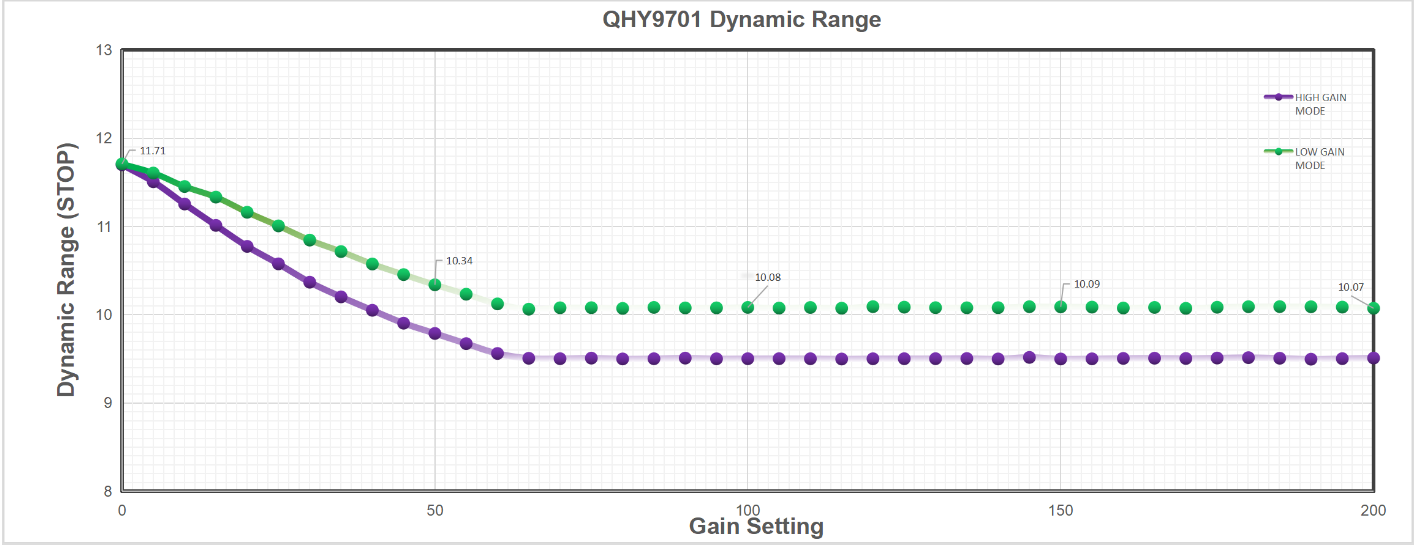
Specifications

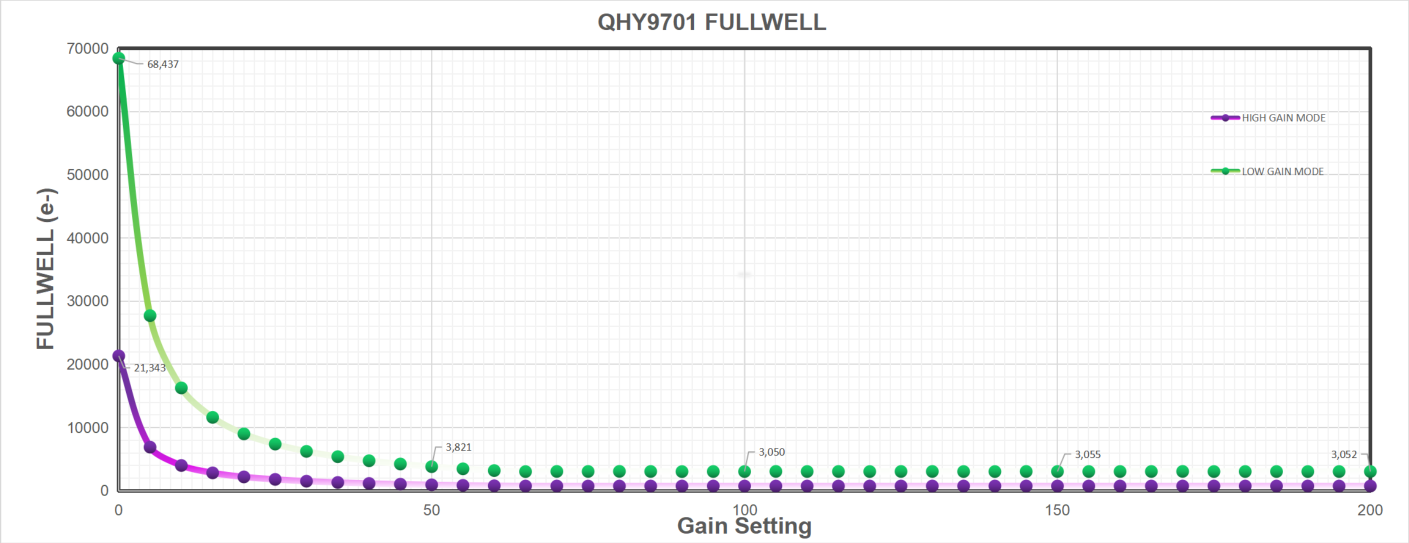
Model	QHY9701
Sensor	Gsense9701
FSI/BSI	BSI
Mono/Color	Mono Only
Sensor Size	12.493mm x 9.994mm
Effective Pixels	1.3MP
Pixel Sizes	9.76um x 9.76um
Resolution	1280 (H) x 1024 (V) Effective 1344 (H) x 1054 (V) Readable
Shutter Type	Eletric Rolling Shutter
Full Well*	48Ke-
Readout Noise*	1.6e- @ HDR mode 0.85e- @ Low Noise mode
Dynamic Range	89.5dB @ HDR
Dark Current*	40/s/p @ 31 oC 0.08e-/s/p @ -28 oC
Peak QE	89% @ 610nm
Max Fps	21fps @ Low noise
	445.5Mbps per lane (Sub-LVDS) 445.5Mbps per lane (MIPI)

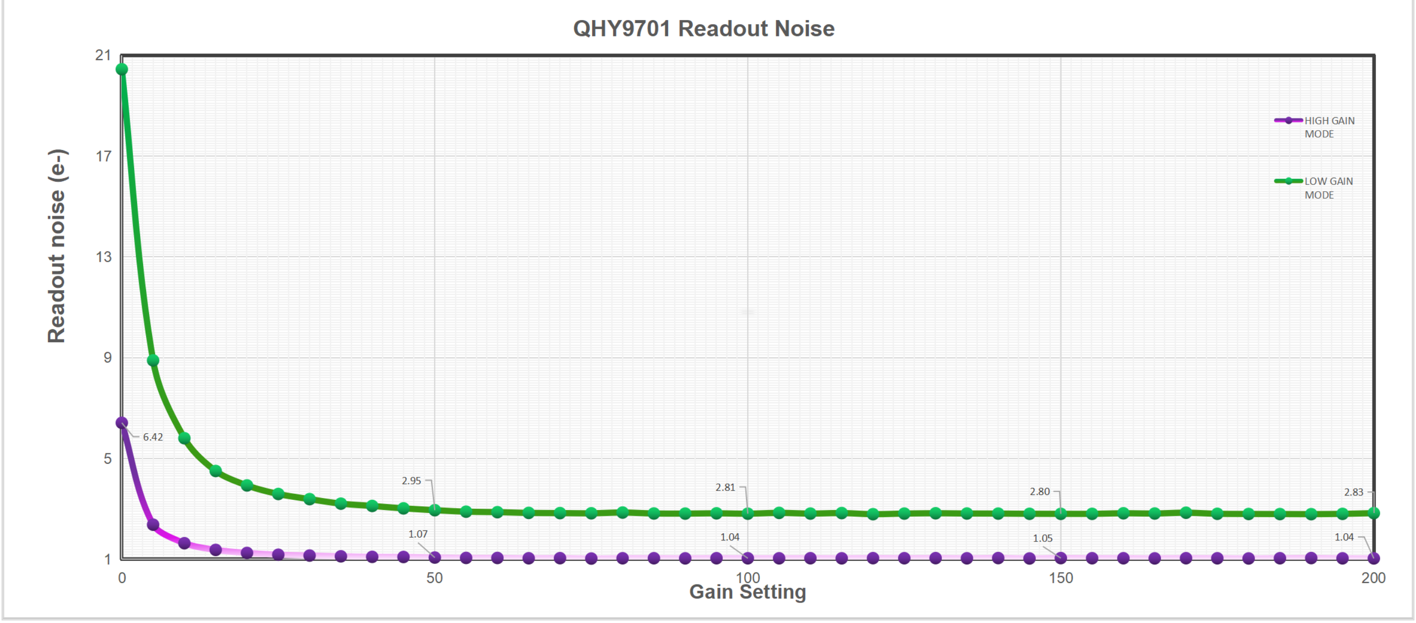
Curves


QHY9701 Readout Noise
Readout noise (e-)
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
50
100
150
200
Gain Setting
6.42
1.07
1.04
1.05
1.04
HIGH GAIN MODE

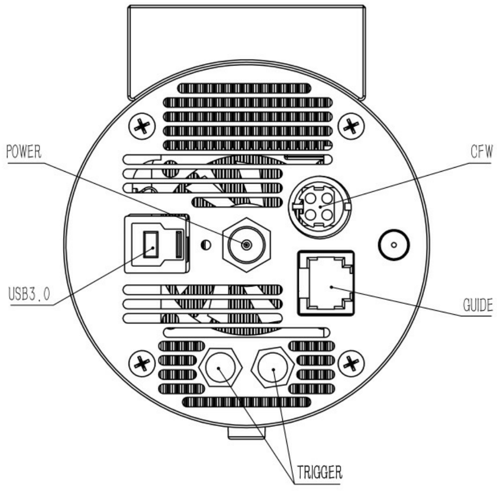

QHY9701 System Gain
System Gain(12Bit) (e-/ADU)
15
12
9
6
3
0
0
50
100
150
200
Gain Setting
5.21
0.98
1.04
0.23
0.18
0.19
0.18
HIGH GAIN MODE
LOW GAIN MODE

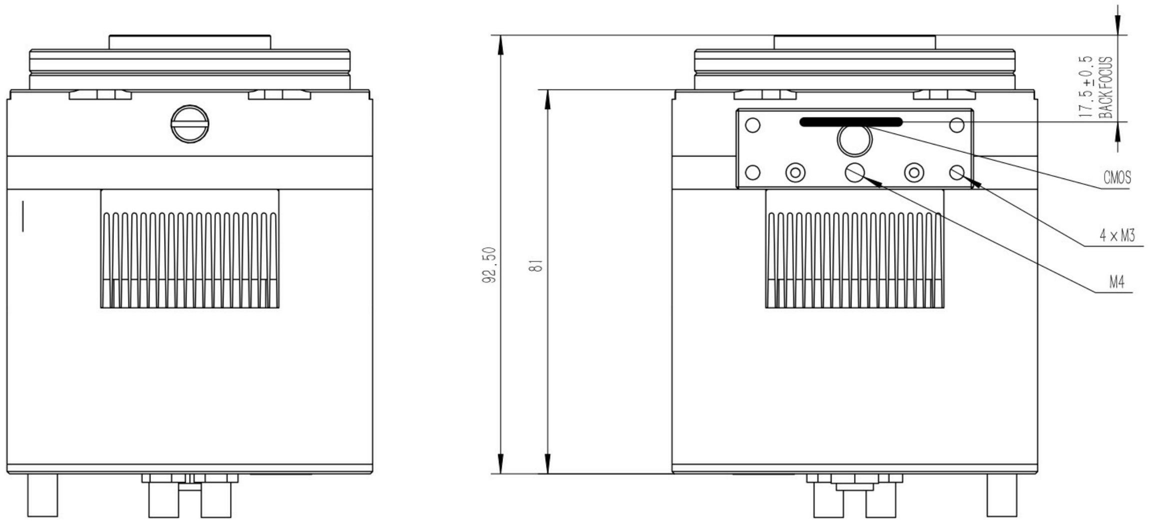

QHY9701 Dynamic Range
Dynamic Range (STOP)
13
12
11
10
9
8
0
50
100
150
200
Gain Setting
11.71
10.34
10.08
10.09
10.07
HIGH GAIN MODE
LOW GAIN MODE

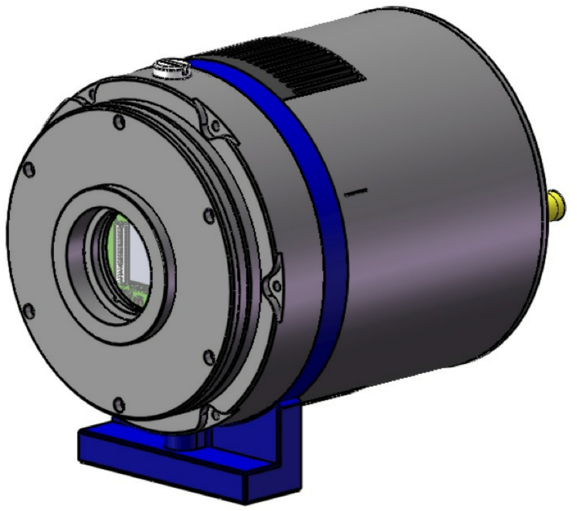


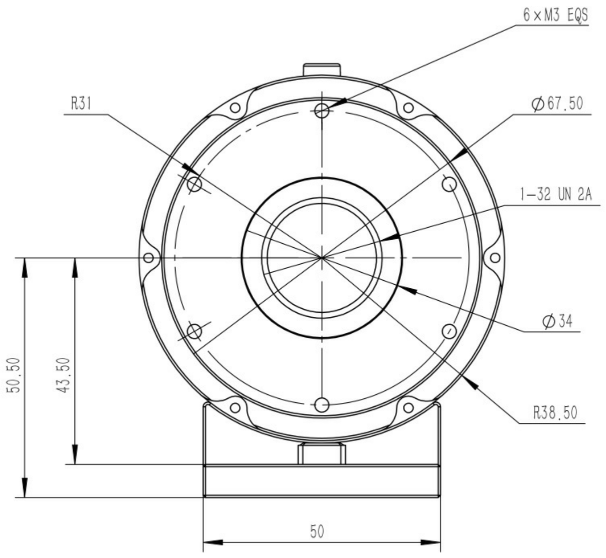


- Machanical Dimensions


POWER
CFW
USB3.0
GUIDE
TRIGGER


92.50
81
17.5±0.5
BACKFOCUS
CMOS
4×M3
M4




6×M3 EQS
R31
Ø67.50
1-32 UN 2A
Ø34
R38.50
50.50
43.50
50

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(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 opeing 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 controling 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 controling 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 exeuate 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

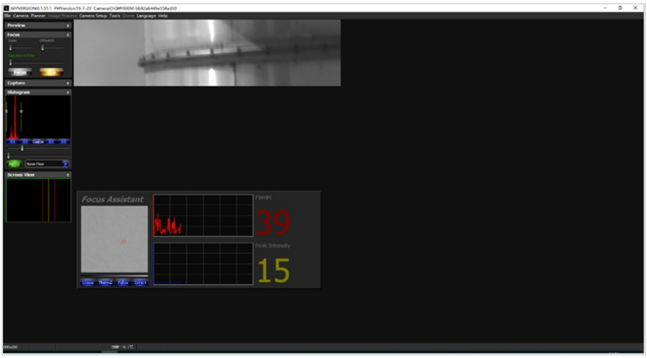
Before using software, make sure you have connected the cooling camera to the 12V power supply and connected it to the computer with a USB3.0 data cable. If it's an uncooled camera, 12V power is not needed.

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

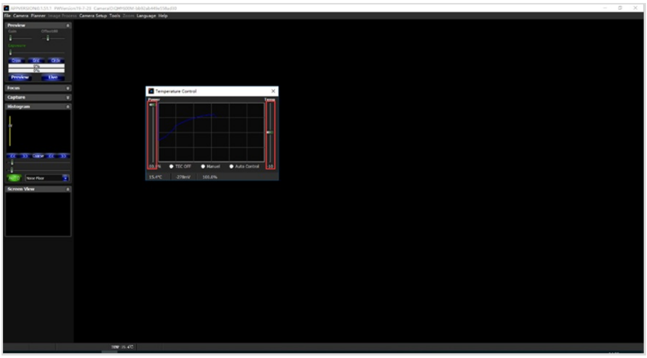
EZCAP_QT is software developed by QHYCCD. This software has basic capture functions for QHYCCD deep sky cameras.

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.


APPVERSION0.1.51.1 FWVersion19-7-23 CameraID:QHY600M-bb92ab449e558ad30
File Camera Planner Image Process Camera Setup Tools Zoom Language Help
Preview
Focus
Capture
Histogram
Screen View
Focus Assistant
FWHM
39
Peak Intensity
15

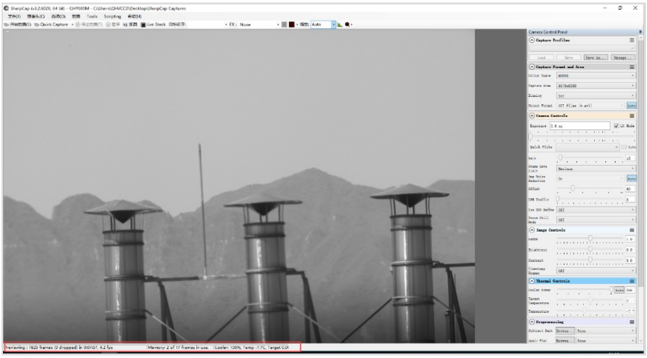
Click "Temperature Control" in "Camera Settings" to set the temperature of the CMOS sensor. You can turn on "Auto" to set the target temperature. For example, here we set the target temperature to -10C. The temperature of the CMOS sensor will drop quickly to this temperature (approximately 2-3 minutes). 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

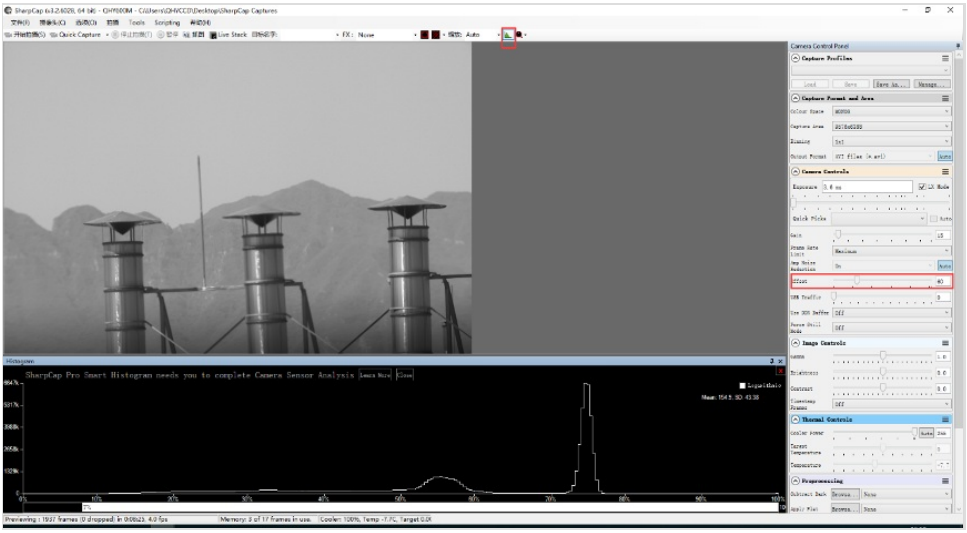
Launch SharpCap. If the software and drivers mentioned above are installed successfully, the video image will appear automatically about 3 seconds after the software loads. You will also see the frame rate in the lower left corner of the software window as shown below.



Previewing : 1825 frames (0 dropped) in 0:07:57, 4.2 fps | Memory: 2 of 17 frames in use. | Cooler: 100%, Temp -7.7C, Target 0.0C

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.



SharpCap Pro Smart Histogram needs you to complete Camera Sensor Analysis

Camera Control Panel

Capture Profiles

Capture Format and Area

Camera Controls

Exposure 3.6 ms ☑ LX Mode

Offset 40

Image Controls

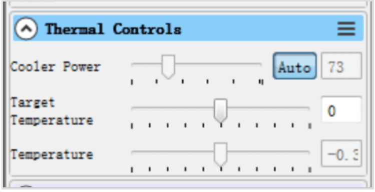
Thermal Controls

Preprocessing

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.



Thermal Controls

Cooler Power Auto 73

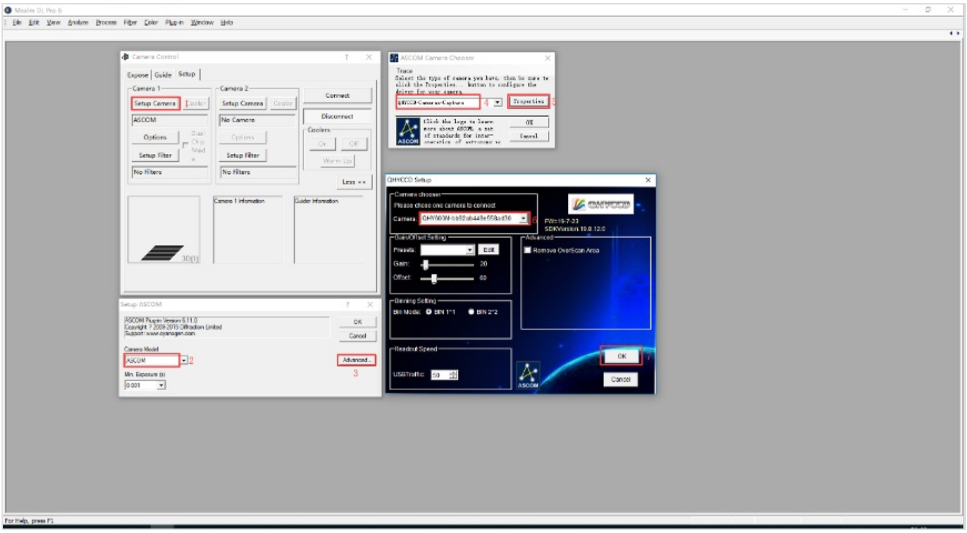
Target Temperature 0

Temperature -0.5

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.



Camera Control

Camera 1: ASCOM

Camera 2: No Camera

Setup ASCOM

ASCOM Plugin Version 6.11.0

Copyright ? 2009-2015 Diffraction Limited

Support: www.cyanogen.com

Camera Model: ASCOM

Min. Exposure (s): 0.001

ASCOM Camera Chooser

Select the type of camera you have, then be sure to click the Properties... button to configure the driver for your camera.

QHYCCD-Cameras-Capture

QHYCCD Setup

Please chose one camera to connect

Camera: QHY600M-bb92ab449e558ad36

FW:19-7-23

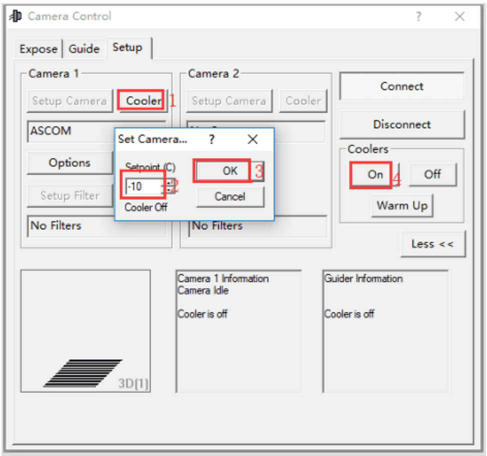
SDKVersion:19.8.12.0

Gain: 20

Offset: 60

Bin Mode: ● BIN 1*1 ○ BIN 2*2

USBTraffic: 50



ASCOM

-10

No Filters

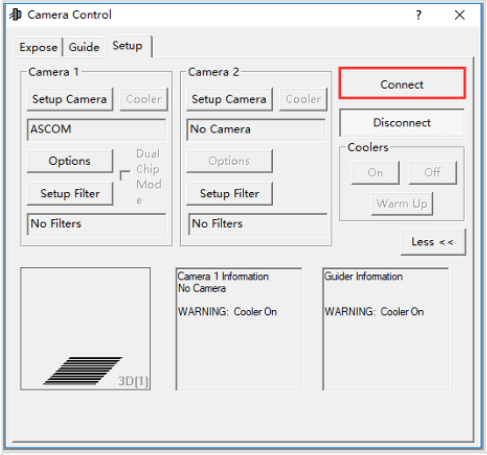
No Filters

Camera 1 Information
Camera Idle

Cooler is off

Guider Information

Cooler is off



ASCOM

No Camera

No Filters

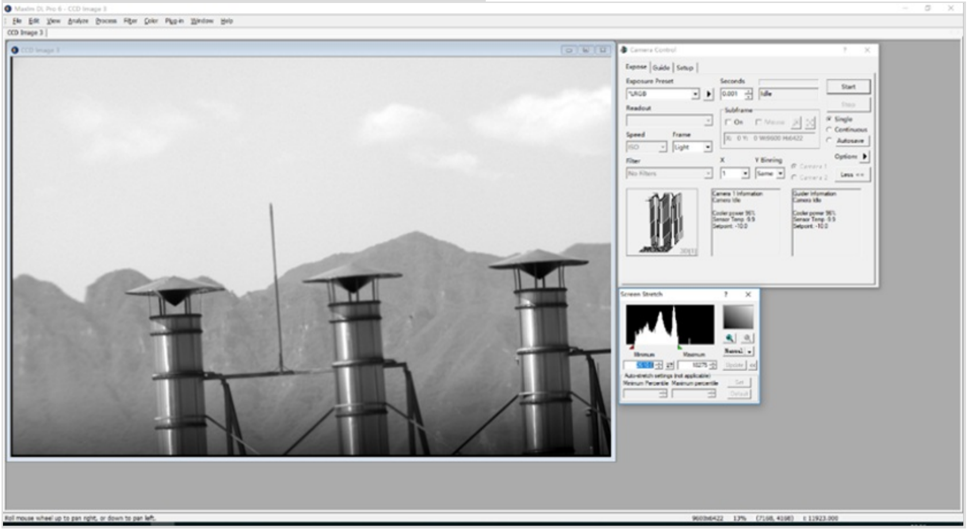
No Filters

Camera 1 Information
No Camera

WARNING: Cooler On

Guider Information

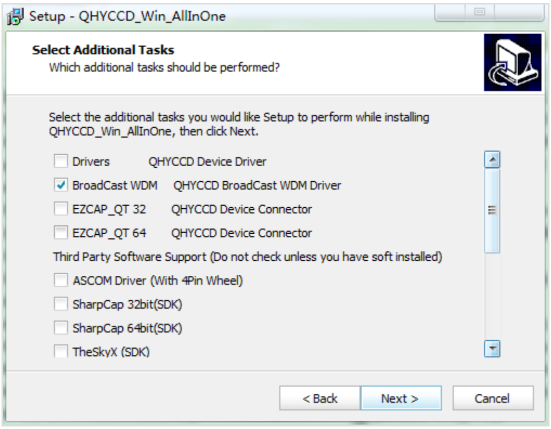
WARNING: Cooler On



- 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.



Setup - QHYCCD_Win_AllInOne

Select Additional Tasks
Which additional tasks should be performed?

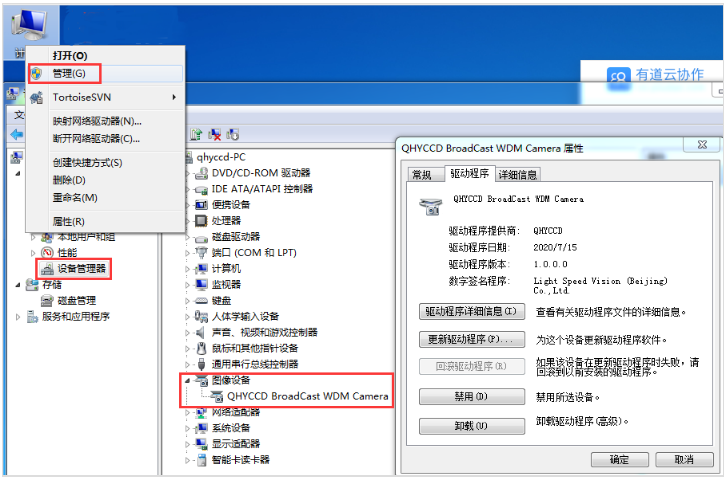
Select the additional tasks you would like Setup to perform while installing QHYCCD_Win_AllInOne, then click Next.

- □ Drivers QHYCCD Device Driver
- ☑ BroadCast WDM QHYCCD BroadCast WDM Driver
- □ EZCAP_QT 32 QHYCCD Device Connector
- □ EZCAP_QT 64 QHYCCD Device Connector

Third Party Software Support (Do not check unless you have soft installed)

- □ ASCOM Driver (With 4Pin Wheel)
- □ SharpCap 32bit(SDK)
- □ SharpCap 64bit(SDK)
- □ TheSkyX (SDK)

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.



QHYCCD BroadCast WDM Camera 属性

常规 驱动程序 详细信息

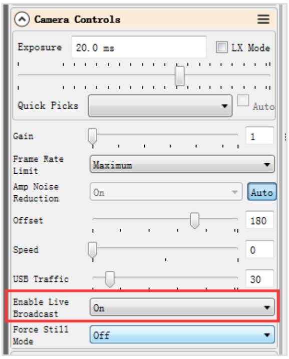
QHYCCD BroadCast WDM Camera

驱动程序提供商: QHYCCD
驱动程序日期: 2020/7/15
驱动程序版本: 1.0.0.0
数字签名程序: Light Speed Vision (Beijing) Co., Ltd.

驱动程序详细信息(I) 查看有关驱动程序文件的详细信息。
更新驱动程序(P)... 为这个设备更新驱动程序软件。
回滚驱动程序(R) 如果该设备在更新驱动程序时失败，请回滚到以前安装的驱动程序。
禁用(D) 禁用所选设备。
卸载(U) 卸载驱动程序(高级)。

Activate the function:

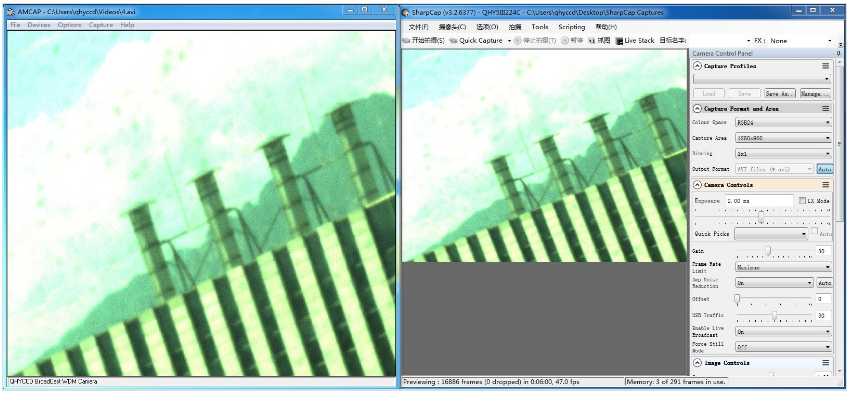
Usually sharpcap is used to connect the camera as the broadcasting terminal. After connecting the camera, you need to turn on the Enable Live Broadcast switch to broadcast.



Camera Controls

Exposure 20.0 ms □ LX Mode
Quick Picks □ Auto
Gain 1
Frame Rate Limit Maximum
Amp Noise Reduction On Auto
Offset 180
Speed 0
USB Traffic 30
Enable Live Broadcast On
Force Still Mode Off

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



AMCAP - C:\Users\qhyccd\Videos\4.avi

File Devices Options Capture Help

QHYCCD BroadCast WDM Camera

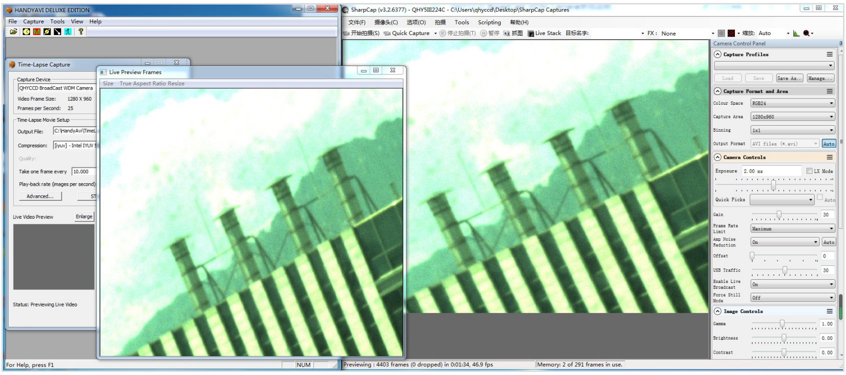
SharpCap (v3.2.6377) - QHY5III224C - C:\Users\qhyccd\Desktop\SharpCap Captures

文件(F) 摄像头(C) 选项(O) 拍摄 Tools Scripting 帮助(H)
开始拍摄(S) Quick Capture 停止拍摄(T) 暂停 抓图 Live Stack 目标名字:
Camera Control Panel
Capture Profiles
Load Save Save As.. Manage...
Capture Format and Area
Camera Controls
Image Controls

FX: None
Colour Space RGB24
Capture Area 1280x960
Binning 1x1
Output Format AVI files (*.avi) Auto
Exposure 2.00 ms □ LX Mode
Quick Picks □ Auto
Gain 30
Frame Rate Limit Maximum
Amp Noise Reduction On Auto
Offset 0
USB Traffic 30
Enable Live Broadcast On
Force Still Mode Off

Previewing : 16886 frames (0 dropped) in 0:06:00, 47.0 fps
Memory: 3 of 291 frames in use.

HANDYAVI test effect chart:



HANDYAVI DELUXE EDITION

Time-Lapse Capture

Capture Device: QHYCCD BroadCast WDM Camera

Video Frame Size: 1280 X 960

Frames per Second: 25

Time-Lapse Movie Setup

Output File: C:\HandyAvi\TimeL

Compression: [iyuv] - Intel IYUV

Take one frame every 10.000

Status: Previewing Live Video

SharpCap (v3.2.6377) - QHY5III224C - C:\Users\qhyccd\Desktop\SharpCap Captures

Capture Format and Area

Colour Space: RGB24

Capture Area: 1280x960

Binning: 1x1

Output Format: AVI files (*.avi)

Camera Controls

Exposure: 2.00 ms

Gain: 30

Frame Rate Limit: Maximum

Amp Noise Reduction: On

Offset: 0

USB Traffic: 30

Enable Live Broadcast: On

Force Still Mode: Off

Image Controls

Gamma: 1.00

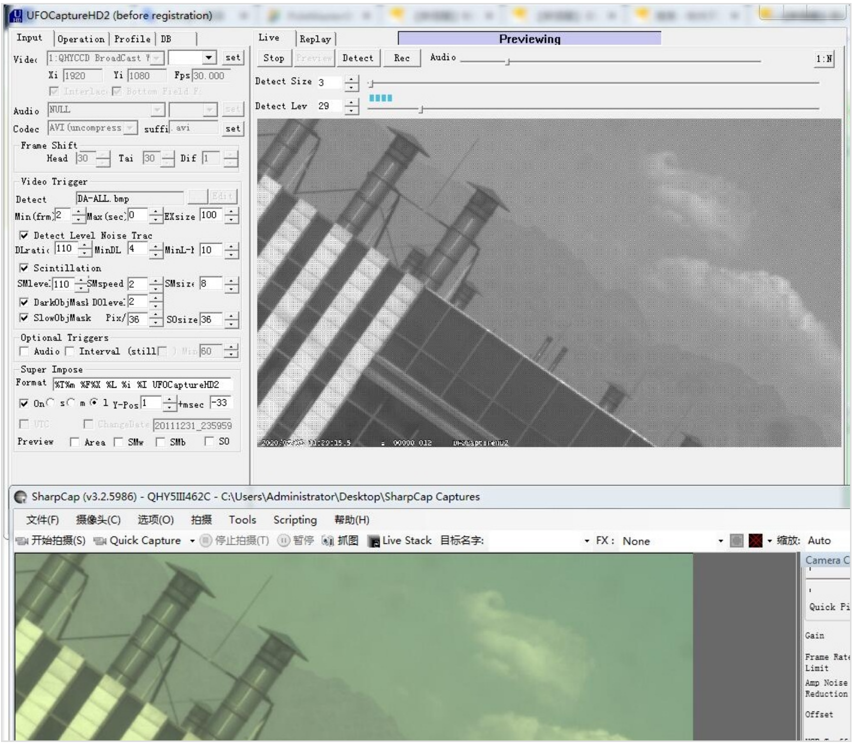
Brightness: 0.00

Contrast: 0.00

Previewing : 4403 frames (0 dropped) in 0:01:34, 46.9 fps

Memory: 2 of 291 frames in use.

UFOCAPTURE test renderings:



UFOCaptureHD2 (before registration)

Video: 1:QHYCCD BroadCast

Xi 1920 Yi 1080 Fps 30.000

Audio: NULL

Codec: AVI (uncompress suffix .avi

Frame Shift: Head 30 Tai 30 Dif 1

Video Trigger

Detect: DA-ALL.bmp

Min(frm) 2 Max(sec) 0 EXsize 100

☑ Detect Level Noise Trac

DLratio 110 MinDL 4 MinL-1 10

☑ Scintillation

SMlevel 110 SMspeed 2 SMsize 8

☑ DarkObjMask DOlevel 2

☑ SlowObjMask Pix/ 36 SOsize 36

Optional Triggers

□ Audio □ Interval (still) Min 60

Super Impose

Format: %T%m %F%X %L %i %I UFOCaptureHD2

☑ On ○ s ○ m ● l Y-Pos 1 +msec -33

□ UTC □ ChangeDate 20111231_235959

Preview □ Area □ SMw □ SMb □ SO

Detect Size 3

Detect Lev 29

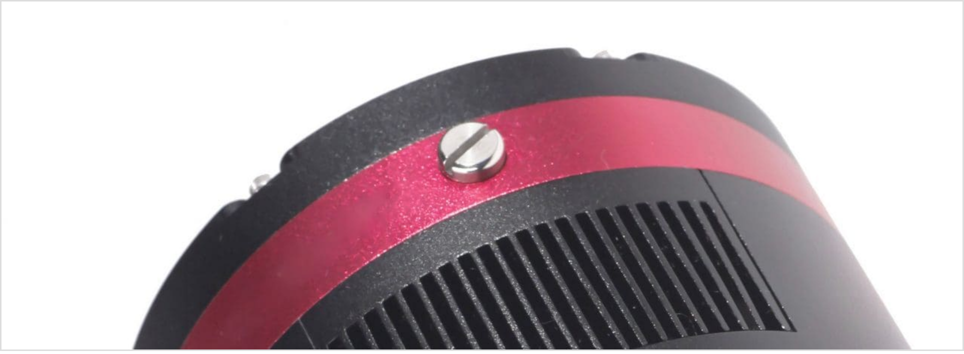
SharpCap (v3.2.5986) - QHY5III462C - C:\Users\Administrator\Desktop\SharpCap Captures

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.

Camera Maintenance

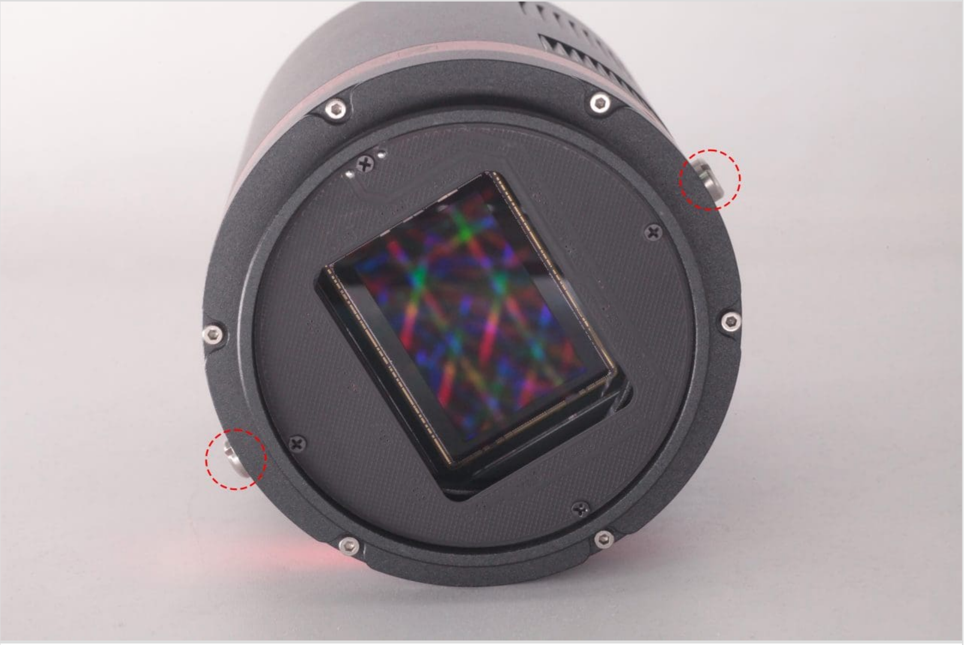
Drying the camera CMOS chamber

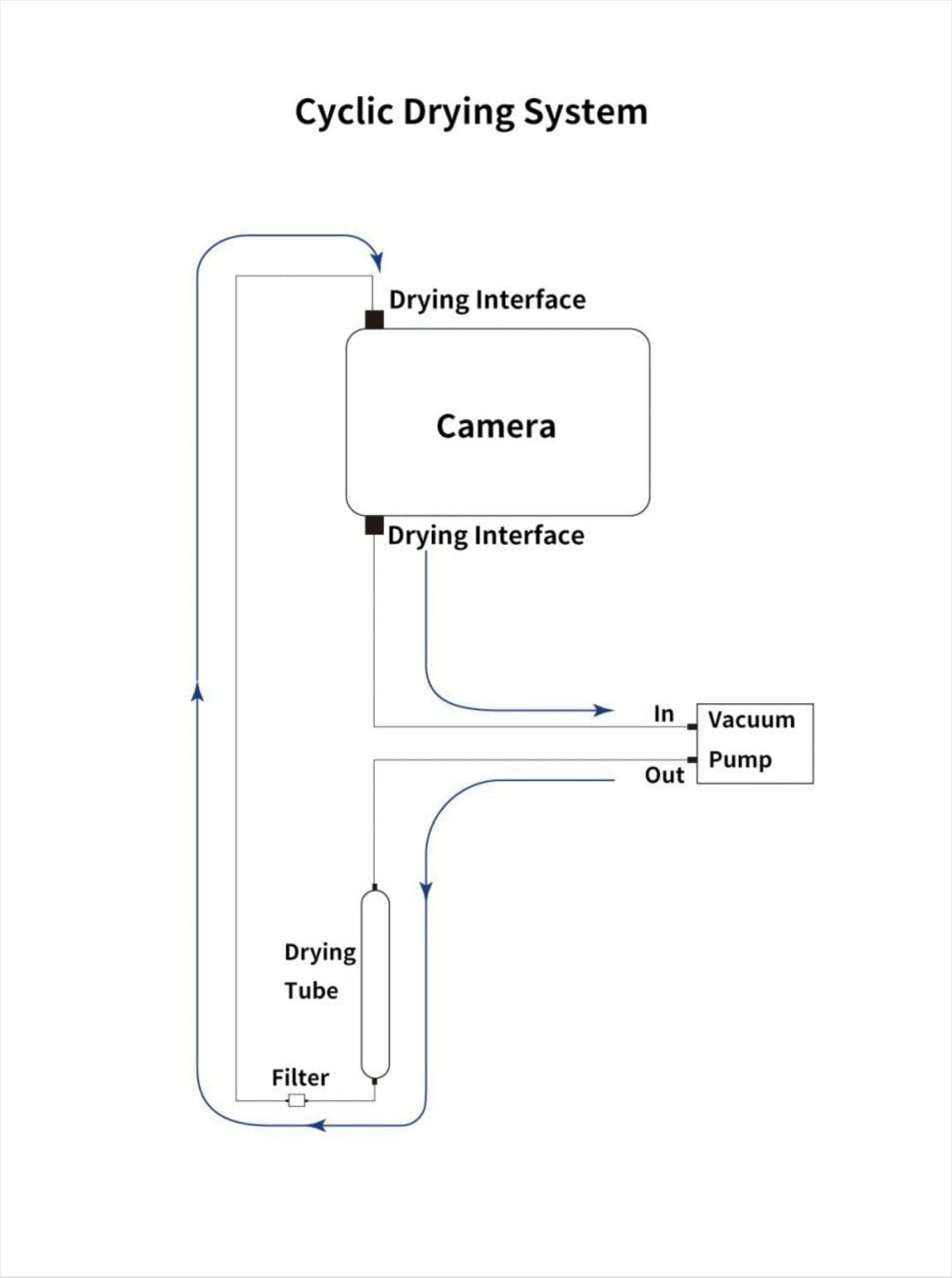
1. There are holes in the two sides of the camera near the front plate that is normally plugged by a screw with an o-ring. If there’s moisture in the CMOS chamber that causes fog, you can connect the desiccant tube to this hole for drying. There would better be some cotton inside to prevent the desiccants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





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:1.Do not reverse the order of the intake and exhaust ports

2.Before circulating drying, it is necessary to turn off the refrigerator, and then turn on circulating drying after the temperature returns to normal temperature. Only by following this step can the water vapor in the sealed chamber be effectively removed. If the cooler is turned on, the cooler inside the camera will absorb water vapor, causing more water vapor to condense inside the camera instead of being absorbed by the desiccant.

- 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.

+ 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

```
/**
 @fn uint32_t EnableQHYCCDBurstMode(qhyccd_handle *h,bool i)
 @brief Set camera enable or disable burst mode
 @param h Camera control handle
 @param i Enable or disable burst mode \n
 true:enable burst mode \n
 false:disable burst mode \n
 @return
 On success,return QHYCCD_SUCCESS \n
another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL EnableQHYCCDBurstMode(qhyccd_handle *h,bool i);

/*
 * Note:
 * This function only works in LiveVideo mode. When enabled,
 * the video stream will pause and wait the burst mode start capture command.
 * When disabled the camera will return the live video streaming mode.
 * In Burst Mode, you can set the camera into IDLE status at first,
 * and then release the IDLE status, this execution will make camera output a series of frames.
 * You can define the start and end frame number and camera will only output the limited frames.
 *
 * About set IDLE status, please check SetQHYCCDBurstIDLE function,
 * about release IDLE status, please check ReleaseQHYCCDBurstIDLE function,
 * about set start and end frame,please check SetQHYCCDBurstModeStartEnd function.
 */
```

2.SetQHYCCDBurstModeStartEnd

```
/**
 @fn uint32_t SetQHYCCDBurstModeStartEnd(qhyccd_handle *h,unsigned short start,unsigned short end)
 @brief Set start and end frame,camera will output middle frames
 @param h Camera control handle
 @param start The start of frame number
 @param end The end of frame number
 @return
 On success,return QHYCCD_SUCCESS \n
 another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL SetQHYCCDBurstModeStartEnd(qhyccd_handle *h,unsigned short start,unsigned short end);

/*
 * Note:
 * Burst mode is to output a series of frames.This function is used to define the start and the end frame.
 * For QHY411, QHY600, QHY268, QHY410, QHY533, the minumu value is 1 max value is 65535.
 * The frame account that output frmae is from (start+1) to (end-1). For example, start=1, end =10,
 * the output frame is #2,#3......#9. The #2 is the first effective image after release IDLE.
 * For QHY2020, QHY42PRO, QHY4040, QHY6060, the minum value is 0, max value is 65535.
 * The frame account that output frmae is from  (start+1) to (end-1). For example, start=0, end =9,
 * the output frame is #1,#2......#8. The #1 is the first effective image after release IDLE.
 */
```

3.SetQHYCCDBurstIDLE

```
/**
 @fn uint32_t SetQHYCCDBurstIDLE(qhyccd_handle *h)
 @brief Set camera enter IDLE status
 @param h Camera control handle
 @return
 On success, return QHYCCD_SUCCESS \n
 another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL SetQHYCCDBurstIDLE(qhyccd_handle *h);

/*
 * Note:
 * Let the camera enter the IDLE status. When camera is in IDLE status, it will do nothing and not output any frames.
 * This API need work with ReleaseQHYCCDBurstIDLE,and need setup a delay between these two functions,time is 20ms normally.
 */
```

4.ReleaseQHYCCDBurstIDLE

```
/**
 @fn uint32_t ReleaseQHYCCDBurstIDLE(qhyccd_handle *h)
 @brief Set camera exit IDLE status
 @param h Camera control handle
 @return
 On success, return QHYCCD_SUCCESS\n
 another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL ReleaseQHYCCDBurstIDLE(qhyccd_handle *h);

/*
 * Note:
 * Let the camera exit the IDLE status. After run this API, the camera will begin to output a series of the frames.
 * This API need work with SetQHYCCDBurstIDLE,and need setup a delay between these two functions,time is 20ms normally.
 */
```

5.SetQHYCCDBurstModePatchNumber

```
/**
 @fn uint32_t SetQHYCCDBurstModePatchNumber(qhyccd_handle *h, uint32_t value)
 @brief Setup a data patch in DDR to avoid camera can't output frames normally
 @param h Camera control handle
 @param Value the number of data patch,normally is 32001
 @return
 On success, return QHYCCD_SUCCESS\n
 another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL SetQHYCCDBurstModePatchNumber(qhyccd_handle *h,uint32_t value);

/*
 * Note:
 * It is best to enable DDR in the burst mode to avoid the image lost caused by the host cpu busy.
 * The function of enable DDR is SetQHYCCDParam(camhandle, CONTROL_DDR, 1.0);
 * The DDR will buffer the image streaming. But DDR will remain some data in its buffer,
 * and it will cause some of the last bye can not come out from it.
 * This function will cause the last frame in a burst series may not come out.
 * This API can add some patch number in the end of a frame to allow all frame come out.
 */
```

6.ReseQHYCCDtFrameCounter

```
/**
 @fn uint32_t ReleaseQHYCCDFrameCounter(qhyccd_handle *h)
 @brief Reset the hardware frame conuter to 0
 @param h Camera control handle
 @return
 On success, return QHYCCD_SUCCESS\n
 another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL  ReseQHYCCDtFrameCounter(qhyccd_handle *h);

/*
 * Note:
 * Reset the hardware frame counter to 0. In fact, each time when release the IDLE will clear the frame counter,
 * so this API is not need to call in burst mode, you can ignore this function.
 */
```

7.SetQHYCCDEnableLiveModeAntiRBI

```
/**
 @fn uint32_t SetQHYCCDEnableLiveModeAntiRBI(qhyccd_handle *h, uint32_t value)
 @brief Set camera enter AntiRBI mode
 @param h Camera control handle
 @param value The number of enable function
 @return
 On success, return QHYCCD_SUCCESS\n
 another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL SetQHYCCDEnableLiveModeAntiRBI(qhyccd_handle *h,uint32_t value);

/*
 * Note:
 * QHY600, QHY411, QHY461 support this function, and different cameras need setup different value.
 * Disable : value = 0
 * Enable  : for QHY600, value = 0x1C00
 *           for QHY411, value = 0x2A94
 *           for QHY461, value = 0x2300
 */
```

8.EnableQHYCCDImageOSD

```
/**
 @fn uint32_t EnableQHYCCDImageOSD(qhyccd_handle *h, uint32_t i)
 @brief Setup some information display on image
 @param h Camera control handle
 @param i Display switch
 @return
 On success, return QHYCCD_SUCCESS\n
 another QHYCCD_ERROR code on other failures
*/
uint32_t STDCALL EnableQHYCCDImageOSD(qhyccd_handle *h,uint32_t i);

/*
 * Note:
 * Some information text, eg, the hardware frame sequence number, or the GPS information etc,
 * can be add on the left top side of the image.
 * disable : i=0
 * enable  : i=1
 */
```

Sample Code

```
ret = SetQHYCCDParam(camhandle, CONTROL_DDR, 1.0);
ret = BeginQHYCCDLive(camhandle);
ret = SetQHYCCDBurstModeIDLE(camhandle);
ret = SetQHYCCDBurstModeStartEnd(camhadnle, 1, 3);
ret = SetQHYCCDBurstModePatchNumber(camhandle, 32001);
ret = EnableQHYCCDBurstMode(camhandle, true);

while(true)
{
    ret = SetQHYCCDBurstModeIDLE(camhandle);
    sleep(20);
   ret = ReleaseQHYCCDBurstModeIDLE(camhandle);

   ret = QHYCCD_ERROR;
   while(ret == QHYCCD_ERROR)
   {
       ret = GetQHYCCDLiveFrame(camhadnle, &w, &h, &b, &c, ImgData);
   }
}
```