- Overview

With the advantage of low readout noise and high-speed readout, CMOS technology has revolutionized astronomical imaging. A monochrome, back-illuminated, high-sensitivity, astronomical imaging camera is the ideal choice for astro-imagers. The QHY600 Series uses SONY IMX455, a BSI full frame (35mm format) sensor with 3.76um pixels and native 16-bit A/D. This sensor is available in both monochrome and color versions. The QHY600 Series ends the days of non-16bit cooling CMOS cameras and it ends the days non-full frame (and larger) monochrome cooling CMOS cameras.

- Extremely low dark current (0.002e/p/s@-20C) using SONY's Exmor BSI CMOS technology.
- Zero amplifer glow.
- Only one electron of read noise at high gain and full resolution and 4FPS readout speed. One electron of read noise means the camera can achieve a SNR>3 at only 4 to 6 photons. This is perfect performance when conditions are photon limited, i.e., short exposures, narrow band imaging, etc., making this large area sensor ideal for sky surveys, time domain astronomy, fluorescence imaging, DNA sequencing and microscopy.

In order to provide smooth uninterrupted data transfer of the entire 60MP sensor at high speed, the QHY600 Series (except QHY600M-PH L) have 2GB DDR3 image buffer. The pixel count of the latest generation of CMOS sensors is very high resulting in greater memory requirements for temporary and permanent storage. When using some computers that do not have fast processors or have poor support for USB 3.0, the computer can't transfer high-speed data well, and the data is often lost. The DDR can buffer a lot of image data and send it to the computer. Even if the USB 3.0 transmission frequently gets suspended, it will ensure that data is not lost.

For example, the QHY600 sensor produces about 120MB of data per frame. The data band-width is also increased from the original 16-bits to the current 32-bits. Transferring such a large file sizes necessarily requires the camera to have sufficient memory. This large image buffer meets the needs of high-speed image acquisition and transmission of the new generation of CMOS, making shooting of multiple frames smoother and less stuttered, further reducing the pressure on the computer CPU.

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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 amplifer 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.

- QHY600Series Naming Rules and Introduction

- QHY600 Naming Rules

PH–Photographic Grade. Mainly for astrographers.

Pro–Scientific Grade. Mainly for scientific instituations. Since 2023, the Pro series have been devided to Pro I and Pro II series, the original "Pro" models will be replaced by "Pro I" models.

Pro I–Upgraded from the previous Pro series, it has 2*10G fiber interface with shorter body length.

Pro II–Based on Pro I models, it provides another two CameraLink interfaces.

M–Monochrome.

C–Colored.

L–Lite version is only available in PH Grade. Its body length becomes shorter and the built-in memory storage is 1GB instead of 2GB. Mono only.

SBFL–has a shorter back focal length.

LQ–supports liquid cooling.

	Grade	Body Length	Back Focal Length	Cooling Method	Buffer	2*10g	CameraLink	Note
QHY600PH	Photographic	142mm	17.5+6mm CAA	Air Cooling	2GB DDR3	–	–	
QHY600PH SBFL	Photographic	138mm	14.5mm	Air Cooling	2GB DDR3	–	–	
QHY600PH L	Photographic	123mm	17.5+6mm CAA	Air Cooling	1GB DDR3	–	–	
QHY600PH EB	Photographic	185mm	17.5+6mm CAA	Air Cooling	2GB DDR3	–	–	Discontinued
QHY600Pro	Scientific	185mm	17.5+6mm CAA	Air Cooling	2GB DDR3	Yes	–	Replaced by Pro I
QHY600Pro SBFL	Scientific	181mm	14.5mm	Air Cooling	2GB DDR3	Yes	–	Replaced by Pro I
QHY600Pro LQ	Scientific	185mm	17.5+6mm CAA	Liquid Cooling	2GB DDR3	Yes	–	Replaced by Pro I
QHY600Pro SBFL LQ	Scientific	181mm	14.5mm	Liquid Cooling	2GB DDR3	Yes	–	Replaced by Pro I
QHY600Pro I	Scientific	142mm	17.5+6mm CAA	Air Cooling	2GB DDR3	Yes	–	

QHY600Pro I LQ	Scientific	142mm	17.5+6mm CAA	Liquid Cooling	2GB DDR3	Yes	–	
QHY600Pro I SBFL	Scientific	138mm	14.5mm	Air Cooling	2GB DDR3	Yes	–	
QHY600Pro I SBFL LQ	Scientific	138mm	14.5mm	Liquid Cooling	2GB DDR3	Yes	–	
QHY600Pro II	Scientific	142mm	17.5+6mm CAA	Air Cooling	2GB DDR3	Yes	Yes	
QHY600Pro II LQ	Scientific	142mm	17.5+6mm CAA	Liquid Cooling	2GB DDR3	Yes	Yes	
QHY600Pro II SBFL	Scientific	138mm	14.5mm	Air Cooling	2GB DDR3	Yes	Yes	
QHY600Pro II SBFL LQ	Scientific	138mm	14.5mm	Liquid Cooling	2GB DDR3	Yes	Yes	

- Introduction of "SBFL" Version

SBFL (Short back-focal length version) models are specially designed for DSLR lens users or those who has special requirment of short back focal length. This version has a special front part version which has 14.5mm B.F.L only (The B.F.L consumed equals 12.5mm when connecting QHYCFW. About the defination of “BFL Comsumed” and our adapter system please view: https://www.qhyccd.com/astronomical-camera-adapter-bfl-solution/). A model with “SBFL” suffix can easily match Canon/Nikon lens even with filter wheel. 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.

- Introduction of "LQ" Version

A model with “LQ” suffix supports Liqiud cooling. Since LQ models need customization, please contact the QHYCCD sales department. Compared to air cooling, liquid cooling offers the following advantages:

More efficient cooling. When using ambient temperature pure water for water cooling, the maximum cooling temperature is about 10 degrees Celsius lower than that of air cooling. QHYCCD is improving its support for ultra-low temperature liquid cooling.

No vibration. No matter how high-quality the fan is, it is inevitable to generate some image jitter. The water-cooling version does not have moving mechanical parts that cause camera vibration, thus avoiding negative effects on the image.

No turbulent hot air. For certain cameras that need to be installed in front of the optical system, such as Schmidt-Cassegrain telescopes, the hot air generated by air cooling systems may cause slight interference with the optical path. Water cooling does not produce this kind of impact.

- 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

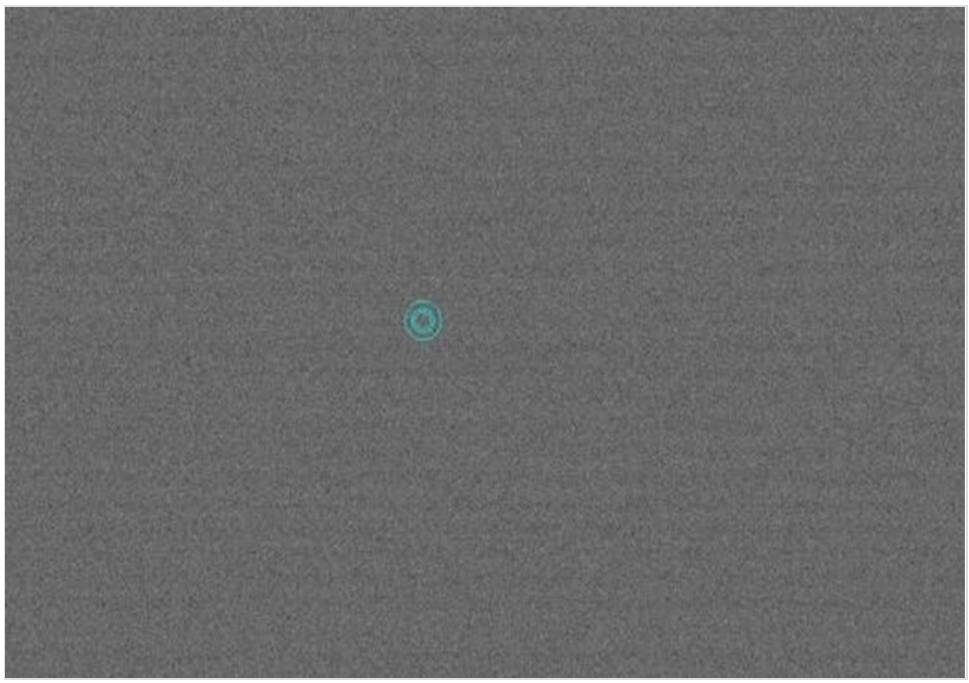
UVLO Under Voltage Locking) is to protect the electronic device from damage caused by abnormally low voltages.

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.

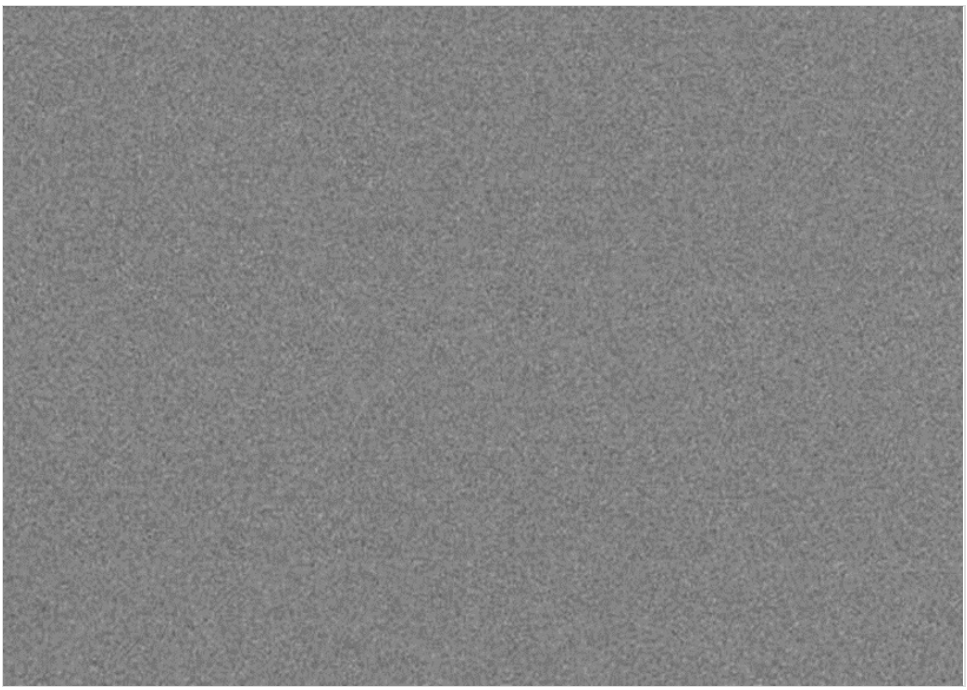
- Optimizing USB Traffic to Minimize Horizontal Banding

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.

- User Images

Contrasted and colorful M78 area Photographer: Patrick Dufour Imaging telescopes or lenses: AG Optical 12.5" iHW Imaging cameras: QHYCCD QHY600 Mounts: iOptron CEM120 EC2 Integration: 33.3 hours

Horse Head Nebula in H-alpha wavelength. Author: Wu Zhen Imaging camera: QHYCCD QHY600 with RASA11

- Specifications

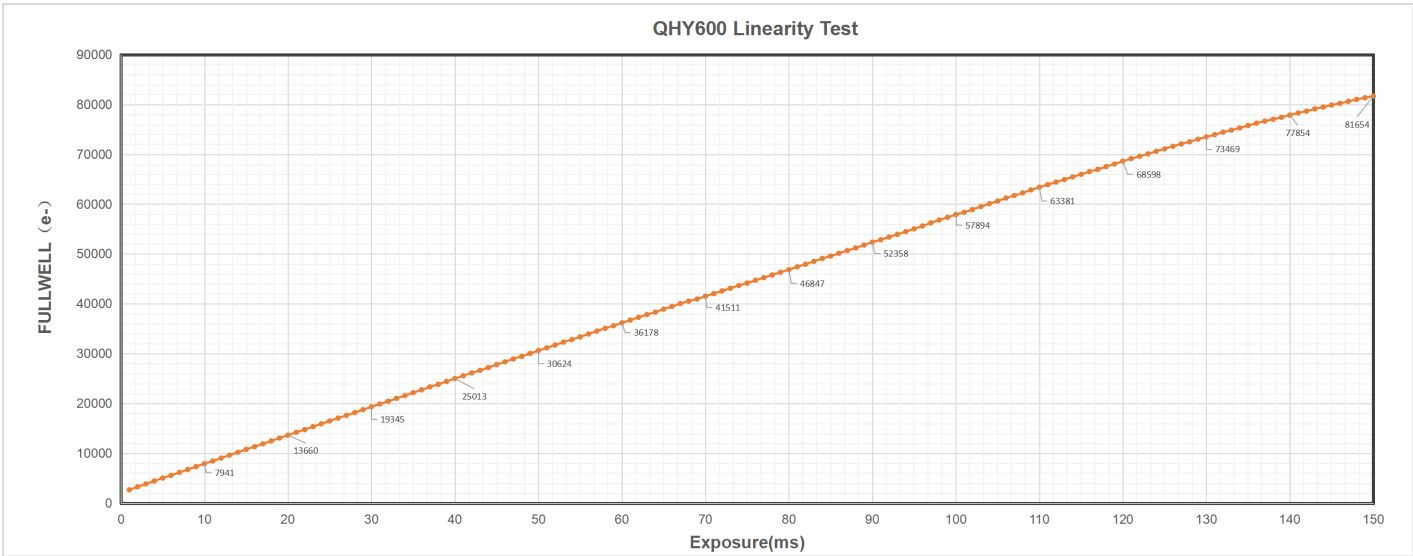
Model	**QHY600PH (Photographic Ver.)** **QHY600PH SBFL (Short Back Focal Length Ver.)** **QHY600PH L (Lite Ver.)**
CMOS Sensor	SONY IMX455
Mono/Color	Both Available (while Mono only with QHY600PH-L)
FSI/BSI	BSI
Pixel Size	3.76um x 3.76um
Effective Pixel Area	9576*6388 9600*6422 with overscan and optically black area)
Effective Pixels	61.17 Megapixels
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 (1×1, 2×2, 3×3)	Standard Mode >51ke- / >204ke- / >408ke- Super Full Well Mode >80ke- / >320ke- / >720ke-
Frame Rate	Full Resolution 4.0FPS (8-bit output) ; 2.5FPS (16-bit output) ROI 7.2FPS at 9600×3194, 22.5FPS at 9600×1080, 28FPS at 9600×768, 47FPS at 9600×480, 160FPS at 9600×100
Readout Noise	1.0e- to 3.7e- (Standard Mode)
Dark Current	0.0022e-/p/s @ -20 0.0046e-/p/s @ -10
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 gain 0 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	PH & PH SBFL Ver.: 2GB DDR3 PH L Ver. : 1GB DDR3
Hardware Frame Sequence Number	Supported
Cooling System	Dual Stage TEC cooler: – Long exposures (> 1 second) typically -35 below ambient – Short exposure (< 1second) high FPS, typically -30 below ambient Test temperature +20
Optic Window Type	AR+AR High Quality Multi-Layer Anti-Reflection Coating
Anti-Dew Heater	Yes

Telescope Interface	M54/0.75
Back Focal Length	QHY600PH&QHY PH-L: 17.5mm+6mm (CAA) QHY600SBFL: 14.5mm* *The BFL Consumed equals 12.5mm when connecting QHYCFW. About the defination of “BFL Comsumed” and our adapter system please view: https://www.qhyccd.com/adapters/
Weigth	PH & PH SBFL Ver.: 850g PH L Ver. : 790g
Power	40W/100% 20W/50% 13.8W/0%

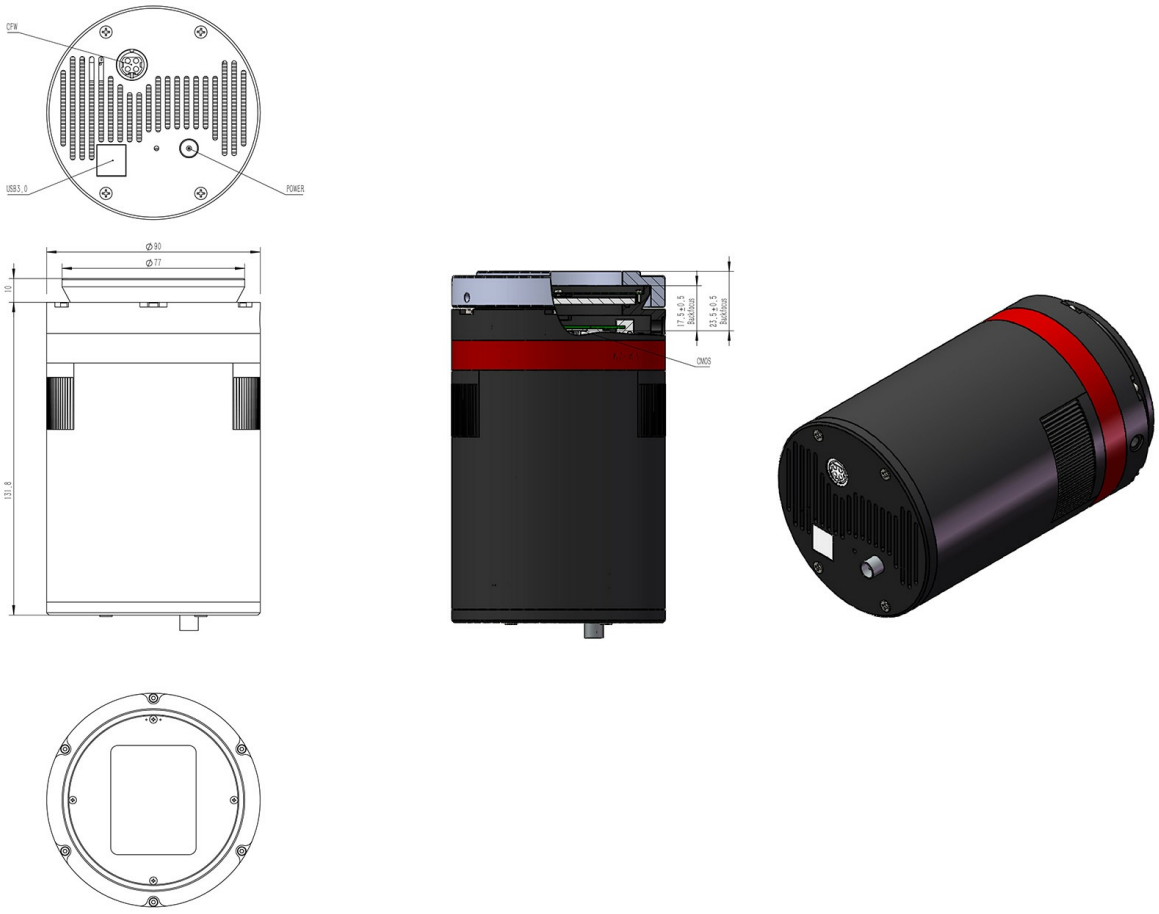
- Linearity Test

We did a test for the QHY600 under the ultra high fullwell mode. The results is quite good to show a good linearity response range up to 73ke-. The results can be found here:
https://www.qhyccd.com/qhy600-linearity-test/
QHY600 linear test results show good linearity up to 73000e-. This is in readout modes # 0 and # 2. Gain = 0. In the linear fit graph we deleted the data above 73000e- and got R ^ 2 = 0.9998.
At very short exposure times below 20ms the value is quite small and may be flicker induced by the tablet.

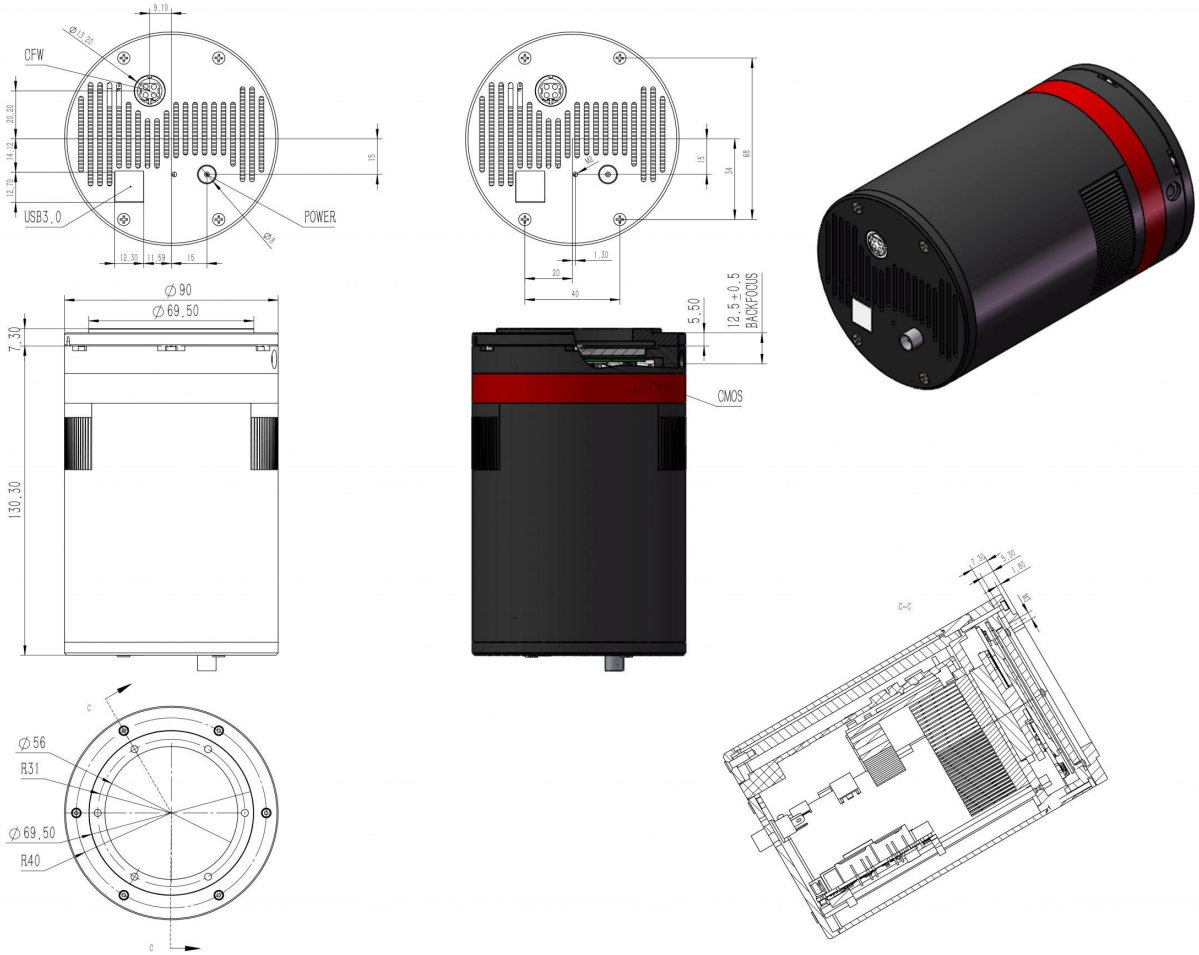


- Mechanical Dimensions

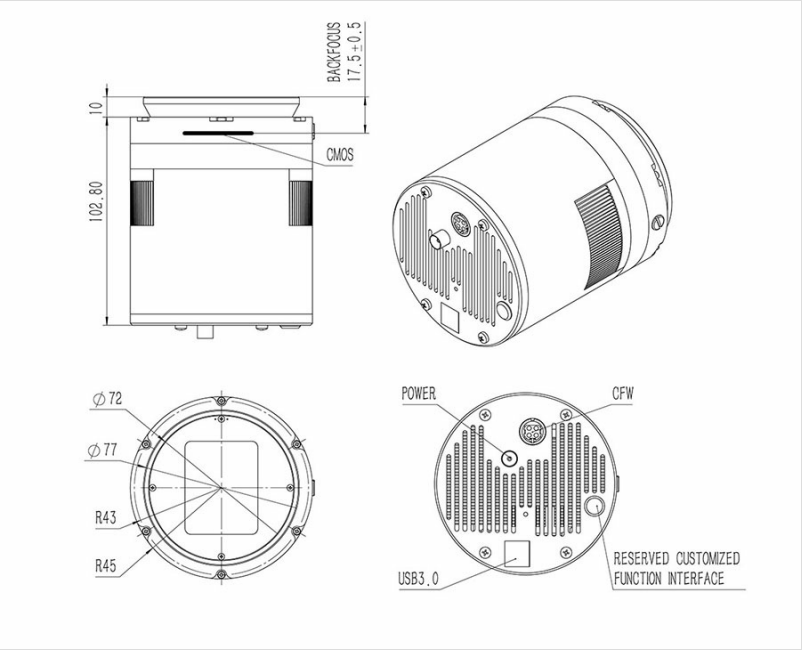
QHY600 PH



QHY600PH-SBFL



QHY600PH-L



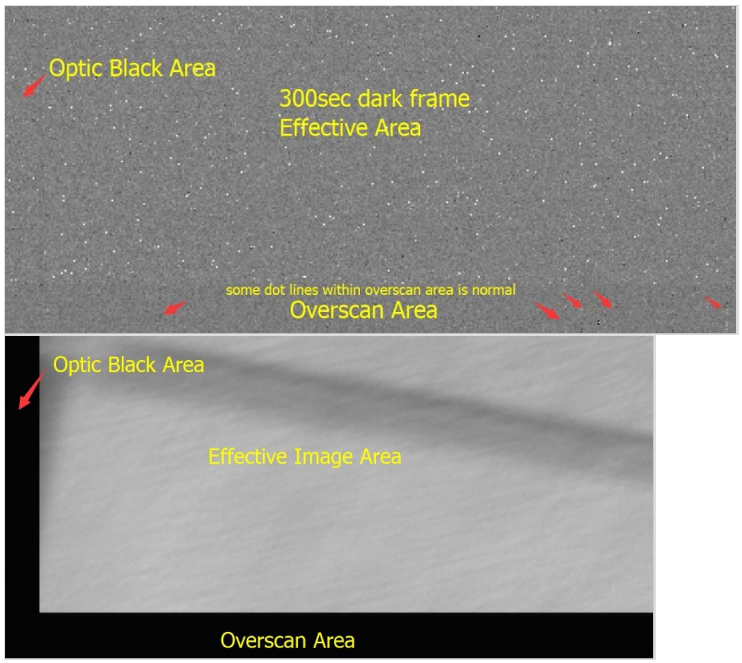
- Image Area Layout

The QHY600 can output the whole active area of the sensor, including the optically black pixels and the overscan area. The total image size including the optically black area area is 9600 x 6422 pixels. The optically black area is on the left of the image and the overscan area is on bottom of the image.

The difference of optically black area and overscan area is that the optically black area includes the dark current during a long exposure while the overscan area does not include the dark current during an exposure. Neither the optically black area nor the overscan area respond to light, so they are regarded as the “non-effective” area of the sensor.

In the bottom of the overscan area you may find some vertical series of dots in single frame that can become vertical lines after stacking. One of the reasons for this is that the FPN calibration results represented in the overscan area can’t be found in the effective image area.

The following picture is the left bottom corner of a 300 second dark image. You can see these dots in the overscan area. The optically black level area and overscan area are usually used for precise calibration of an image and for calibration of an image without using a bias frame or dark frame, or for some scientific applications. Because the optically black and overscan areas are not part of the effective image area, QHYCCD does not guarantee the signal quality in these areas. If you do not use these areas, you can select the option “Ignore overscan area” in the ASCOM driver or select a ROI of effective area in SharpCAP.



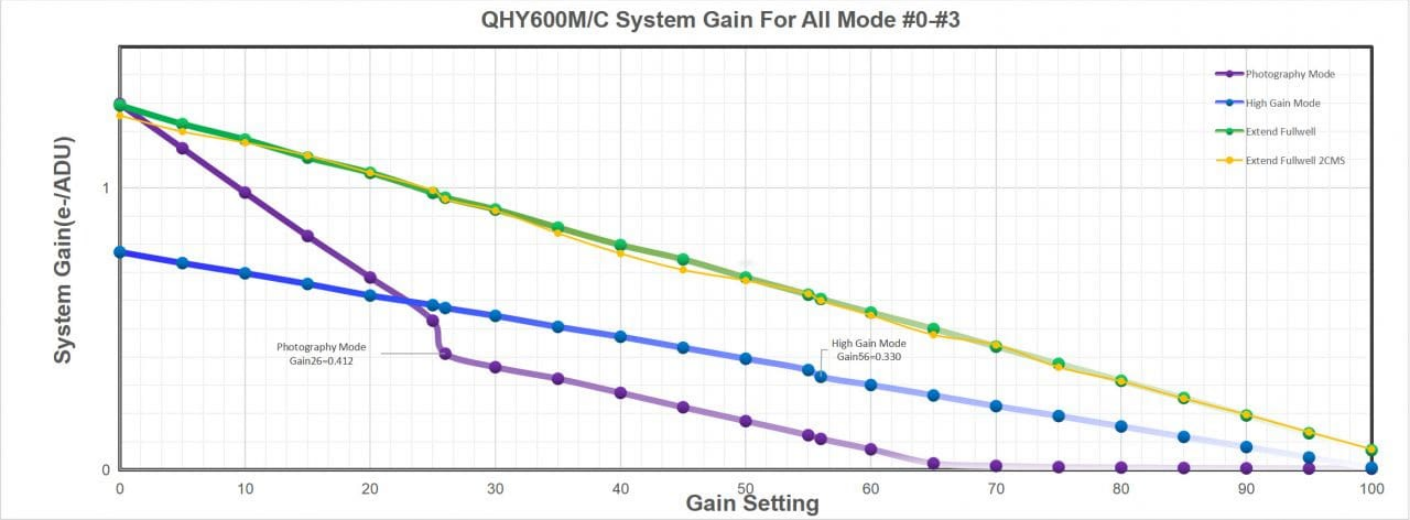
- Multiple Readout Modes and Curves

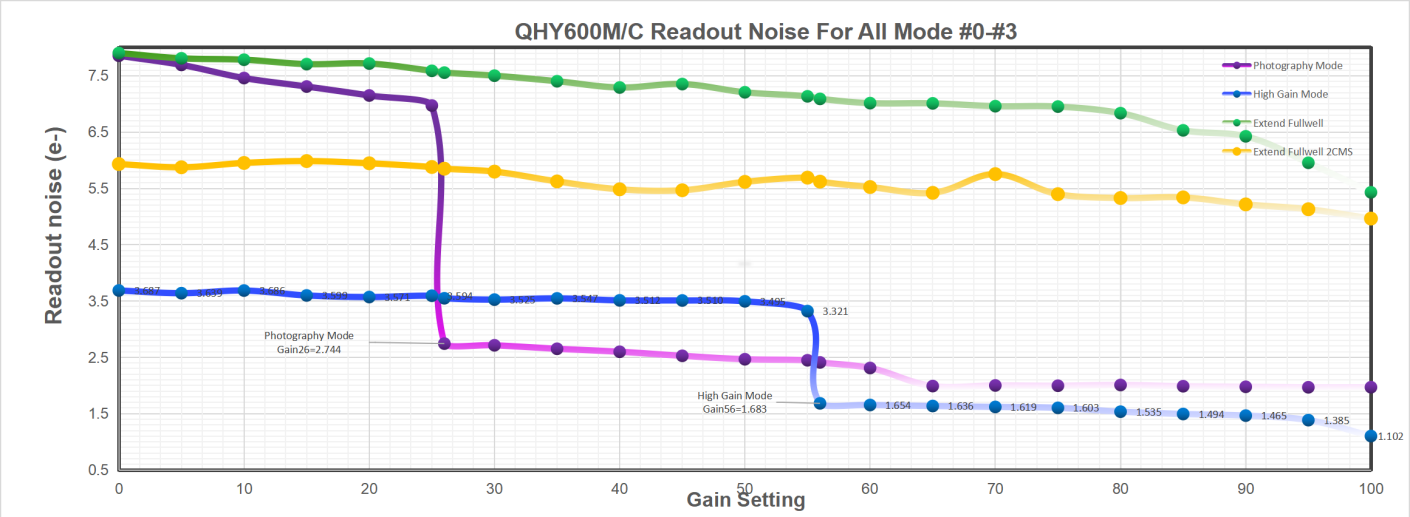
Readout Mode #0 (Photographic Mode)

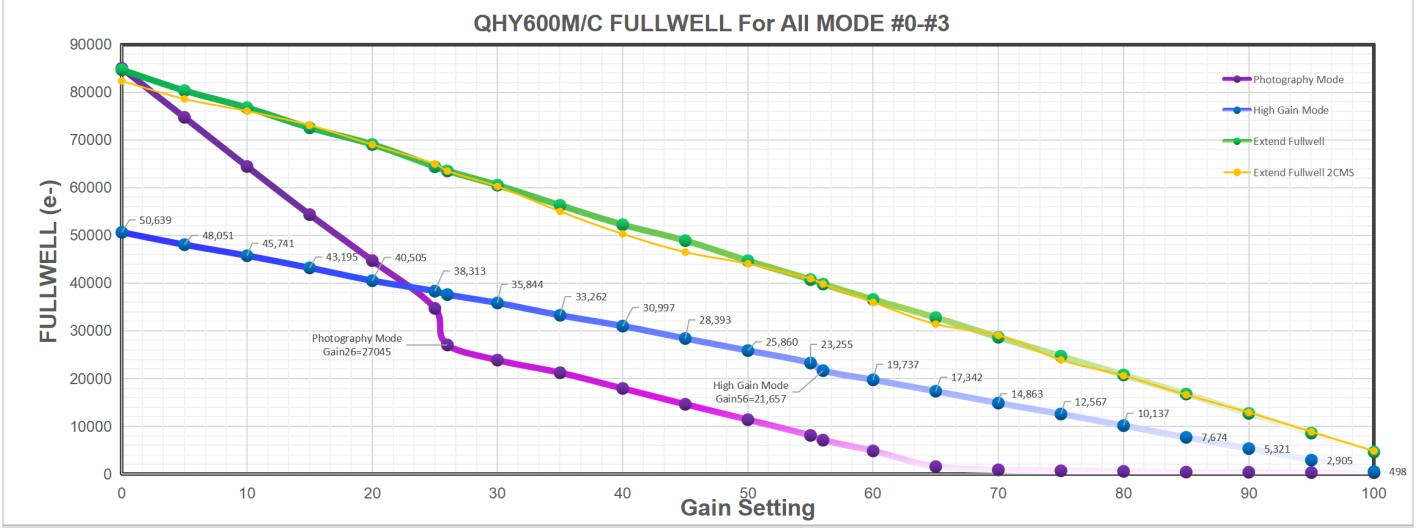
Readout Mode #1 (High Gain Mode)

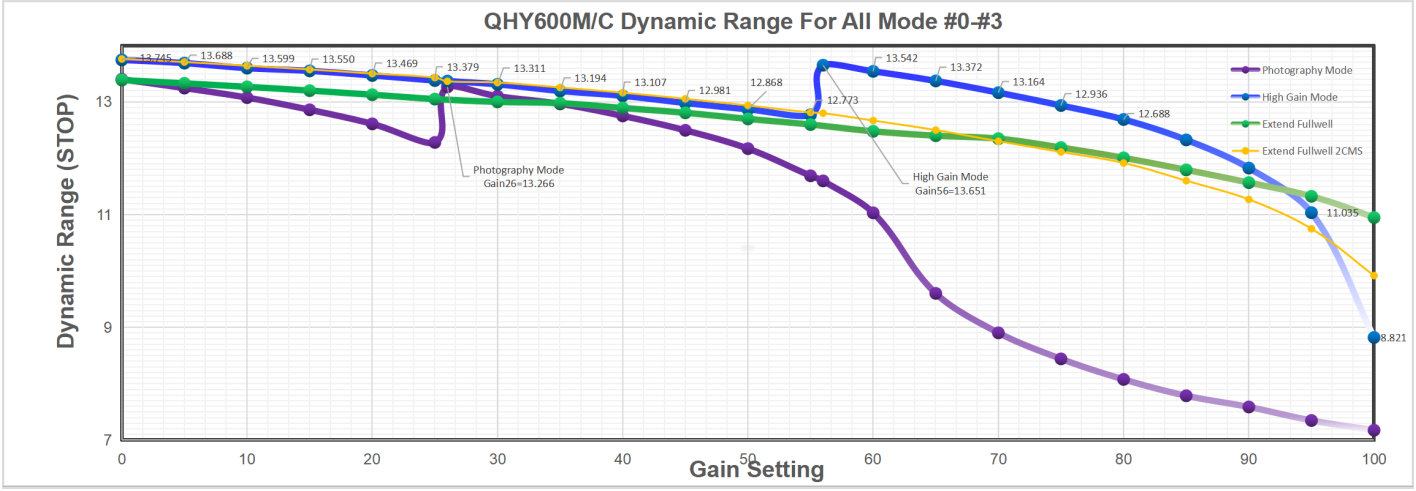
Readout Mode #2 (Super Fullwell Mode)

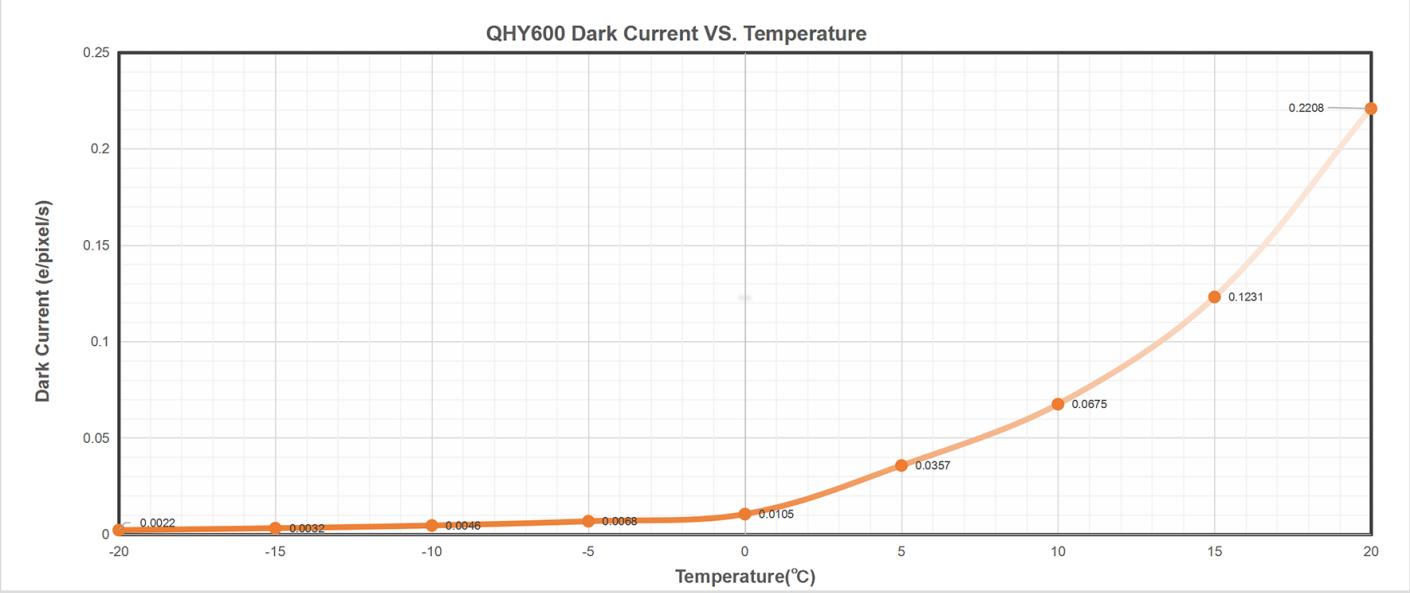
Readout Mode #3 (Extend Fullwell Mode-2CMS)



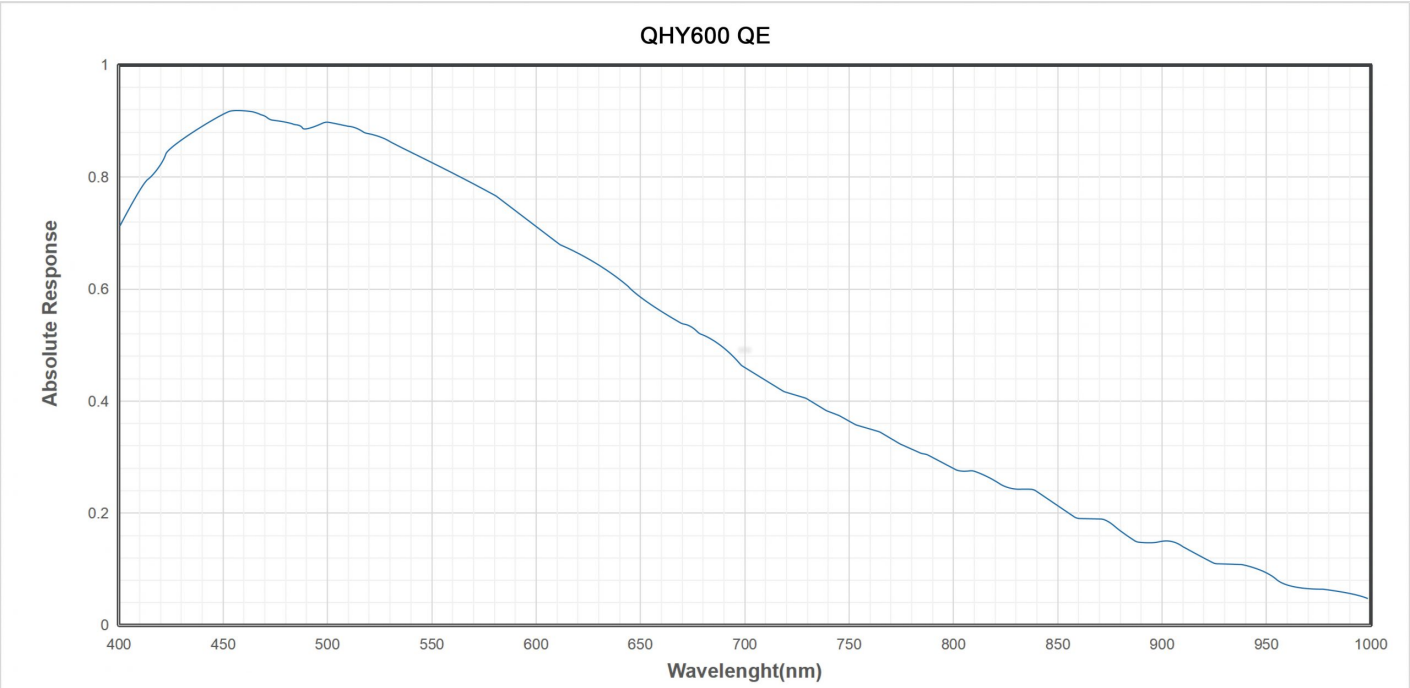








The curve shows absolute QE



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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 ASCOM, SharpCap and N.I.N.A.

Photographic DSO Mode (Mode #0)

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.

High Gain Mode (Mode #1)

This mode is something like double native iso of some new digital cameras, whose danamic range can greatly incerase at the vary high iso value, like iso800, iso3200, etc. The high gain mode provide such improvement for QHYCCD 16bit cameras. We recommend you choose this mode when you have to capture at high gain, for example, a vary 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.**

Extended Fullwell Mode (Mode#2)

With a pixel size of 3.76um, 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.

2CMS Modes

Extended Fullwell Mode-2CMS (Mode#3)

Photographic DSO Mode-2CMS (Mode#4)

High Gain Mode-2CMS (Mode#5)

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.

- Accessories

QHY6OOPH-M:

What's in the box?

QHY600PH-M *1

Locking Power Cable *1

CAA (Dovetail Ring to M54) *1

USB 3.0 Cable (2m) *1

12V Power Adapter *1

AV Power Cable *1

Desiccant Tube *1

M54 to 2-Inch Nosepiece *1

Adapter Kit C1 *1

Adapter Kit Instructions Card *1

Driver Download Instructions Card *1

Adapter Kit C1 is for connecting an MPCC that typically requires 55mm BFL and M48 interface to the QHY600PH-M camera with QHYCFW3L. You can use the M54 adapter and M54 to 2-inch nosepiece if you have no special re-quiremnets for back focus distance.

QHY600PH-C:

What's in the box?

QHY600PH-C *1

Locking Power Cable *1

M54 to 2-Inch Nosepiece *1

USB 3.0 Cable (2m) *1

12V Power Adapter *1

CAA (Dovetail Ring to M54) *1

Adapter Kit D1 *1

AV Power Cable *1

Adapter Kit Instructions Card *1

Desiccant Tube *1

Driver Download Instructions Card *1

Adapter Kit D1 is for connecting an MPCC that typically requires 55mm BFL and M48 interface to the QHY410C camera, which can be embedded with a 2" mounted filter. You can use the M42 to 2-inch nosepiece if you have no special requiremnets for back focus distance.

QHY600PH-M SBFL:

What's in the box?

QHY600PH-M SBFL *1

Locking Power Cable *1

Adapter Kit B1 *1

USB 3.0 Cable (2m) *1

12V Power Adapter *1

AV Power Cable *1

Desiccant Tube *1

M54 Adapter(020070) *1

M54 to 2-Inch Nosepiece *1

Adapter Kit Instructions Card *1

Driver Download Instructions Card *1

Adapter Kit B1 is for connecting an MPCC that typically requires 55mm BFL and M48 interface to the QHY600PH-M SBFL camera with QHYCFW3M/L. You can use the M54 adapter(020070) and the M54 to 2-inch nosepiece if you have no special requiremnets for back focus distance.

QHY600PH-C SBFL:

What's in the box?

QHY600PH-C SBFL *1

USB 3.0 Cable (2m) *1

Locking Power Cable *1

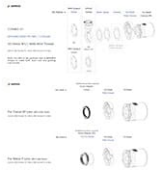
AV Power Cable *1

12V Power Adapter *1

Adapter Kit G1 *1

M54 to 2-Inch Nosepiece *1

Desiccant Tube *1



Adapter Kit Instructions Card *1

Driver Download Instructions Card *1

+ Combos & Adapters

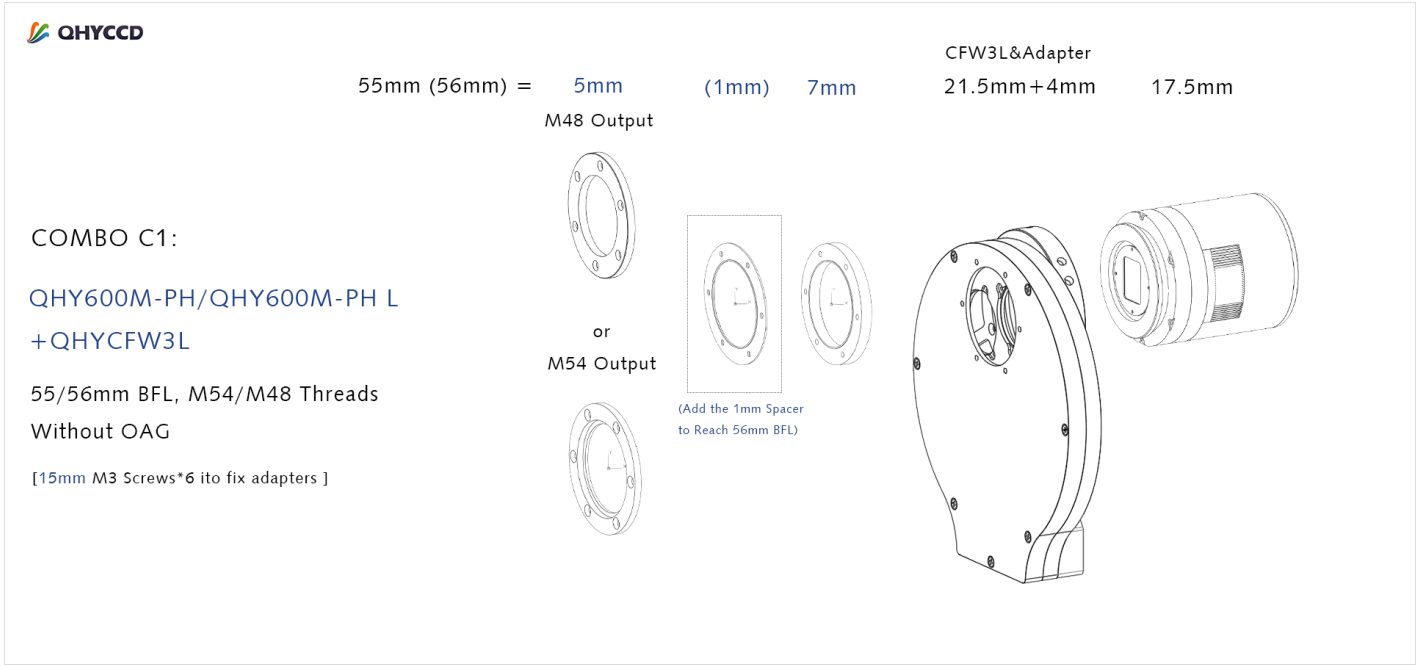
For QHY600PH Series, the match we recommend is CFW3L + OAGM or CFW3XL+OAGL Pro combo.

If you have special requirement for short back focal length, like using Canon EF Lens (44.1mm BFL), Nikon F Lens (46.5mm), or using 55mm MPCC with both CFW and OAG, we recommend SBFL version as the only choice.

Here we only display the adapter combos of mono cameras. Solution of colored cameras please refer to: https://www.qhyccd.com/astronomical-camera-adapter-bfl-solution/

- QHY600M-PH+CFW3L+(OAGM)

Since June 2023, we are adding a 5mm spacer with M54 threads into Adapter kit C1. This addition gives the user a choice of terminating the output in either M48 or M54 threads. Since C1 are standard accessories included with the camera, this addition has no affect on the price list.



Note:

Combo C1 is the solution without OAG. The QHY600M-PH or QHY600M-L with CFW3L and OAG result in a backfocus greater than 55mm. Therefore, if you must limit this BF distance to 55mm due to a corrector lens or DSLR lens, we recommend the QHY600M-PH SBFL.

If you need more than 7 x 50mm filter positions for the QHY600, you can use the CFW3XL filter wheel with 9 x 50mm filter carousel.

- QHY600M-PH SBFL+CFW3L+(OAGM

The New Combo B1 is designed to be more flexible to achieve multiple output specifications. Since June 2023, we are adding a 5mm spacer with M54 threads into Adapter kit B1. This addition gives the user a choice of terminating the output in either M48 or M54 threads. You can get 55/56mm BFL with M48/M54 threads according to your needs. Since are standard accessories included with the camera, this addition has no affect on the price. 55mm M48/M54 are suitable for standard flatteners and multiple purpose coma correctors (MPCC), while 56mm M54 threads are common for Takahashi reflectors.

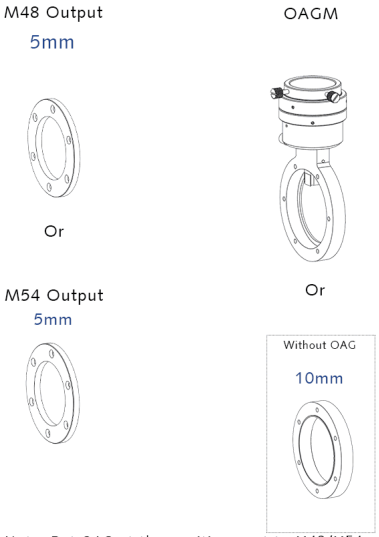
Note: Please position the OAG as far forward as possible (for example, placing it under the M48 thread), and extend the OAG prism slightly outward to ensure simultaneous focus for both the main camera and the guiding camera.

QHYCCD

COMBO B1-2

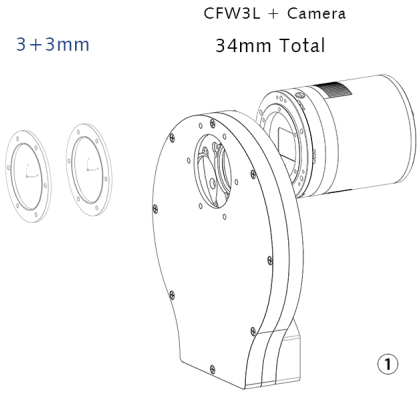
QHY268M/QHY600M-PH SBFL Combos

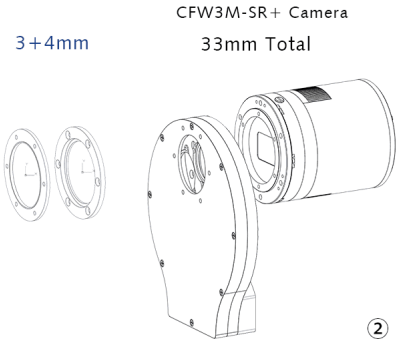
55mm/56mm BFL, M48/M54 Threads

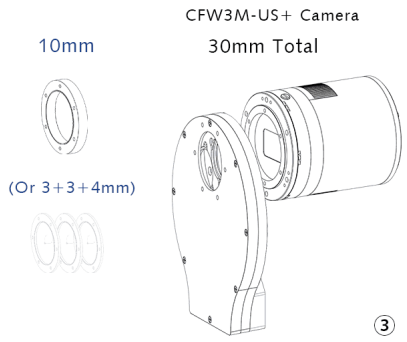


Note: Put OAG at the position next to M48/M54 Output to make both main cam and guiding cam foused.

+



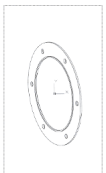




55mm = | 15mm | + | 40mm |

B1 Kit Include:
5mm M54-M48 Threads Adapter*1
5mm M54-M54 Threads Adapter*1
4mm Spacer*1
3mm Spacer*2
1mm Spacer*1
10mm Spacer*1
24mm M3 Screws*8 (Used in ① & ②)
28mm M3 Screws*8 (Used in ③)
Just pick up what you need.

The New Combo B1 is designed to be more flexible to achieve multiple output specifications. You can get 55/56mm BFL with M48/M54 threads according to your needs. 55mm M48/M54 are suitable for common flatteners and multiple purpose coma correctors (MPCC), while 56mm M54 threads are common for Takahashi Epsilon Reflector Series.



(Add an extra 1mm Spacer to reach 56mm BFL)

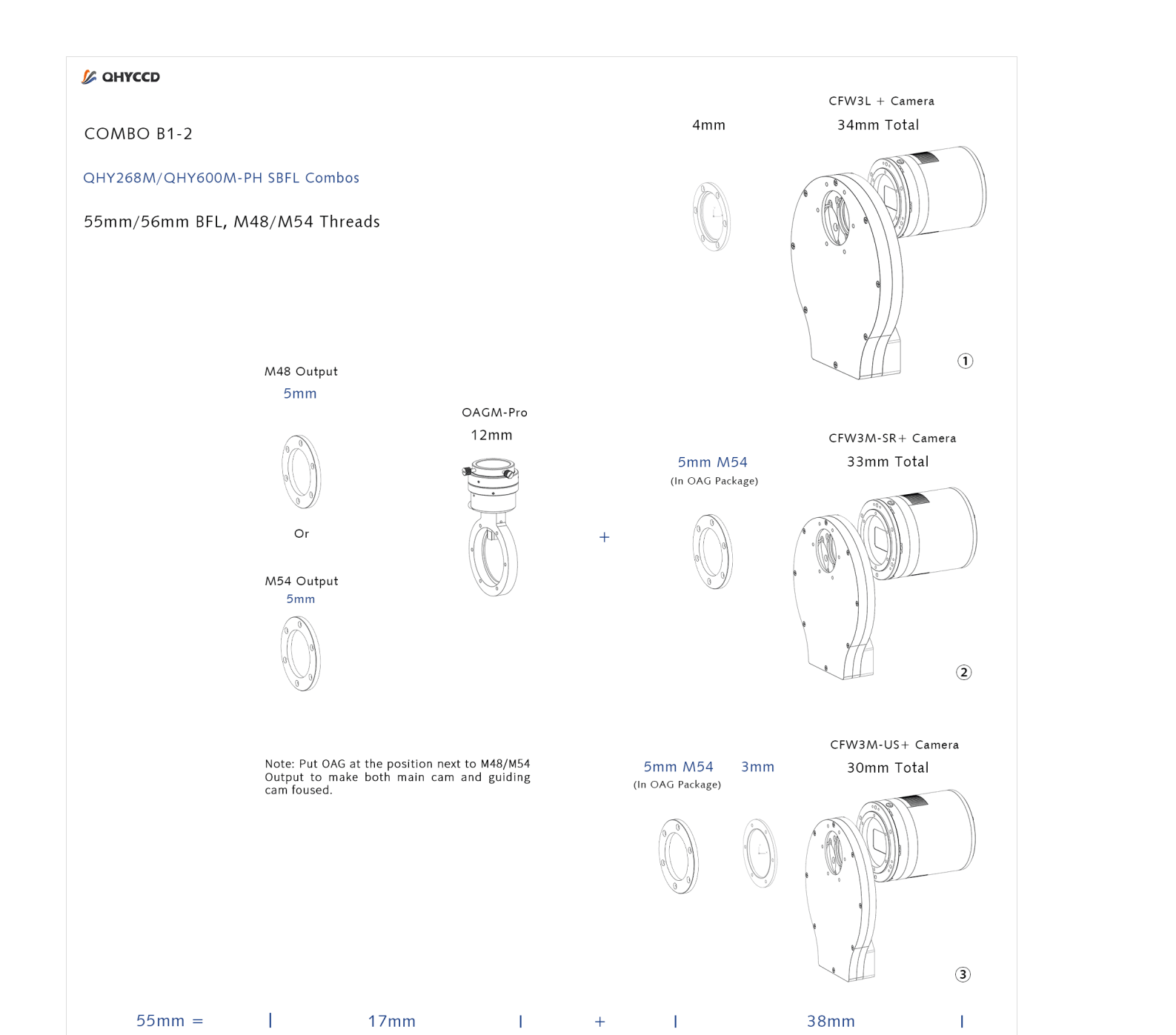
In 2023, we launched the new version of the QHYOAGM-Pro with a larger prism. Its thickness is 12mm, so it is necessary to reduce the spacer thickness by 2mm in the COMBO above while keeping the rest part unchanged.

QHYCCD

COMBO B1-2

QHY268M/QHY600M-PH SBFL Combos

55mm/56mm BFL, M48/M54 Threads



B1 Kit Include:

5mm M54-M48 Threads Adapter*1

5mm M54-M54 Threads Adapter*1

4mm Spacer*1

3mm Spacer*2

1mm Spacer*1

10mm Spacer*1

24mm M3 Screws*8 (Used in ① & ②)

28mm M3 Screws*8 (Used in ③)

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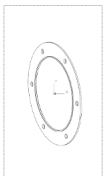
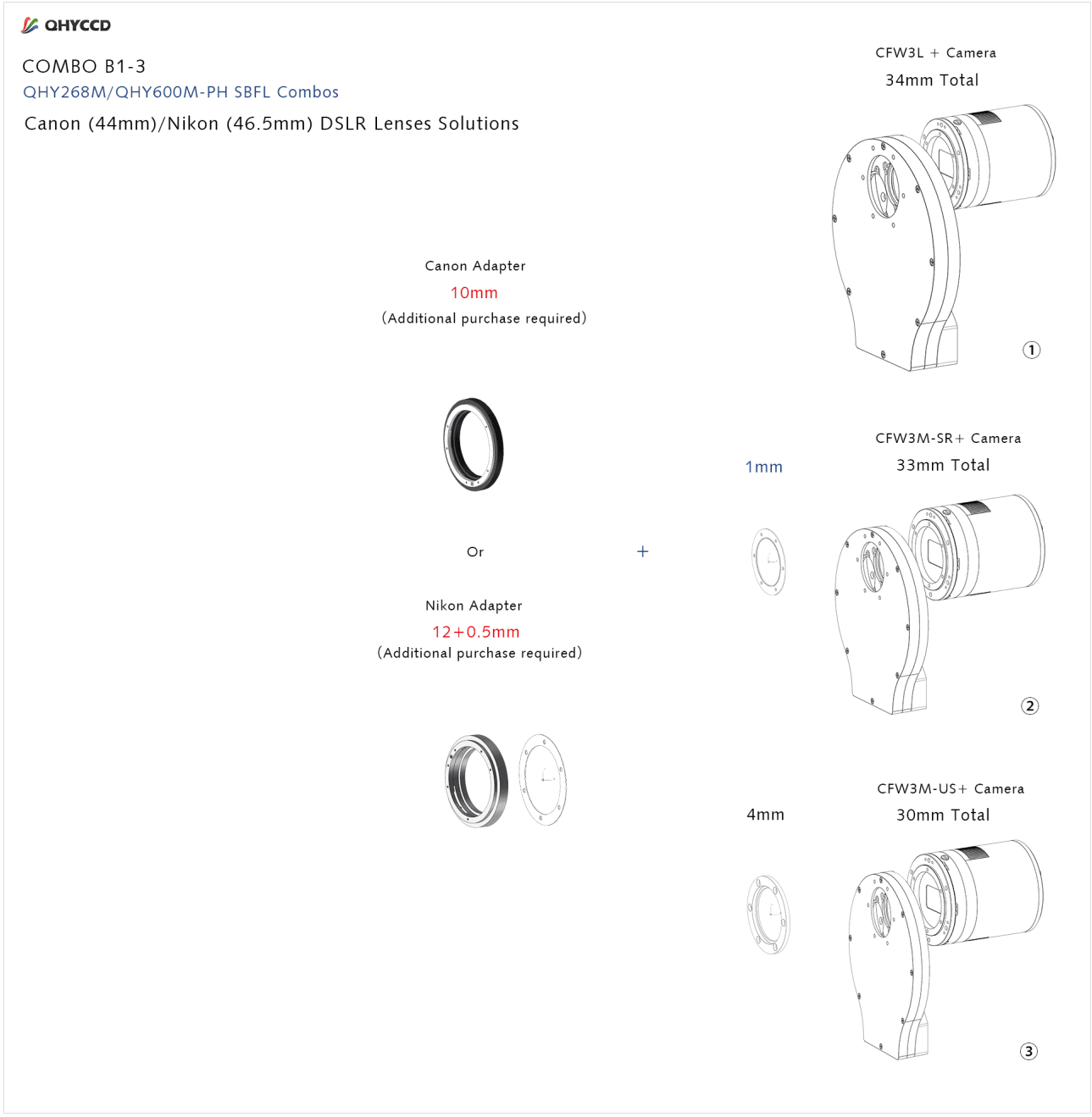


(Add an extra 1mm Spacer to reach 56mm BFL)

The QHY600M-PH SBFL and QHY268M with CFW3L filter wheel can fit an optional Canon EF or Nikon F Lens Adapter without additional spacers. Smaller filter wheels may require additional spacers.



+ User Guide: How to Start the Camera

- Install "All-In-One" Driver&SDK 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 DSO Imaging Software (e.g. NINA)

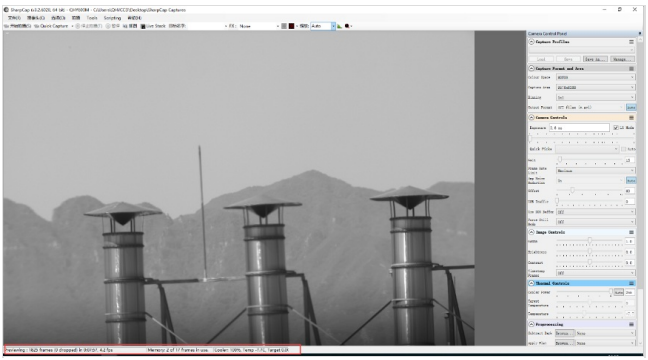
Before using software, make sure you have connected the cooling camera to the 12V power supply and connected it to the computer with a USB3.0 data cable. If it's an uncooled camera, 12V power is not needed. We recommend 64-bit Software, like SharpCAP x64 , N.I.N.A x64. etc., especially when you're using 16bit cameras.

In NINA, you can select the device to connect to QHY Camera directly without ASCOM driver.

If connecting to the camera via ASCOM is desired, first make sure you have installed both the QHYCCD ASCOM Drivers and ASCOM Platform. Then you would select the appropriate camera driver under the ASCOM section. Then click the Connect icon. Here we take NINA as an example, but it's similar to other software packages supporting ASCOM, like MaxDL, The SkyX, etc.

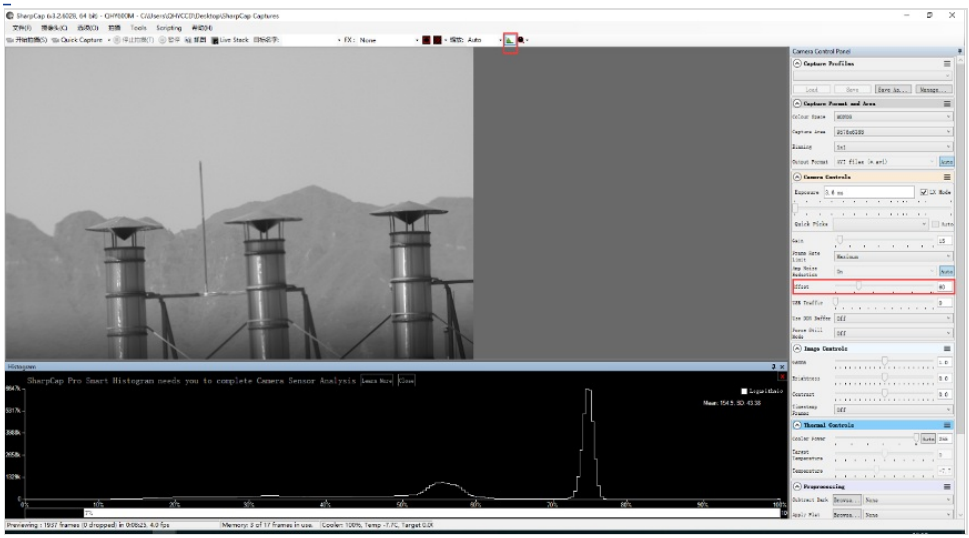
- Connect Planetary Imaging Software (e.g. SharpCap)

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.

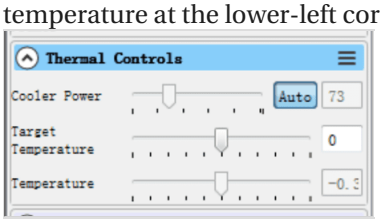
Offset adjustment. When you completely block the camera (i.e., like taking a dark frame) you may find that the image is not really zero. Sometimes this will reduce the quality of the image contrast. You can get a better dark field by adjusting the offset. You can confirm this by opening the histogram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



+ User Guide: How to Set Gain and Offset

- Unity Gain of Some 16bit Models

Model	Unity Gain
QHY600M/C	25
QHY268M/C	30
QHY461PH	26

Now with the improvement of the CMOS technology, the 16bit CMOS cameras like QHY600/268/411/461, can be directly set gain 0 under default Photographic DSO mode. Even in lowest gain zero they're beyond the requirement (less than 1e/ADU due to sufficient samples).

However, when you use QHY600/268/411/461 under Extended Fullwell Mode, we recommend their unit gain as default.

- OFFSET Setting

There is no fixed "best value" for OFFSET. To set OFFSET, you should take the bias frame and dark frame at a certain GAIN value, then check the histogram of the frames.

The histogram distribution is a peak-like curve. While changing the OFFSET value, the histogram will move left or right. We need to guarantee the range of the whole curve won't be chopped off at the end. At the same time, we need to keep a little residue on the left side, just over 0 a bit.

Pay attention that under different GAIN values, the width of this peak varies. The higher the GAIN is, the wider the distribution will be. So OFFSET value at low GAIN is not suitable for high GAIN because the curve is easily to be chopped off.

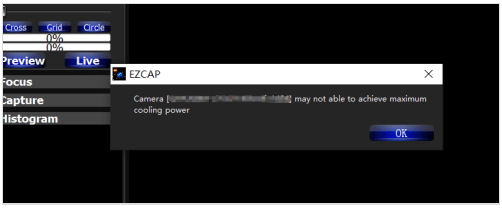
+ Appendix: UVLO Introduction and How to Improve the Power Supply

-

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 ezcap 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.

+ Appendix: Bayer Sequences of Some Colored Cameras

-

Cooled CMOS Camera	Bayer
QHY600C/QHY268C/QHY410C/ QHY367Pro/QHY128Pro/QHY294C/ QHY247C/QHY168C/QHY165C/QHY183C/QHY174C	RGGB
QHY533C/QHY178C/QHY290C/QHY224C	GBRG
QHY163C	GRBG
QHY1920C	BGGR

Cooled CCD Camera	Bayer
QHY8L-C	GBRG
QHY10-C	RGGB

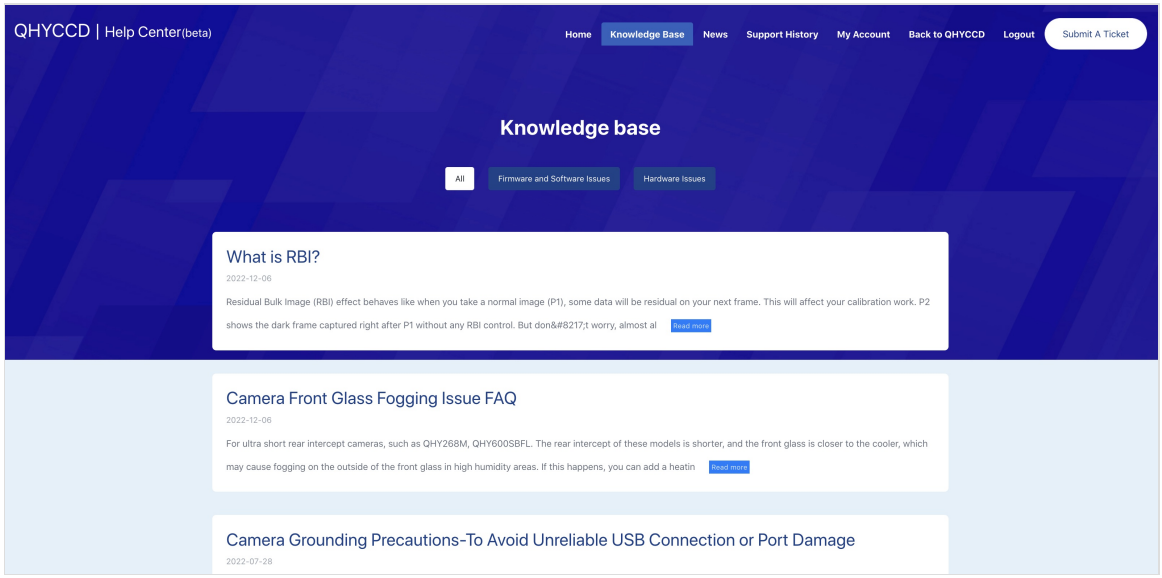
QHY12-C	BGGR
Planetary and Guiding	Bayer
QHY5III174C	RGGB
QHY5III178C	GBRG
QHY5III224C	GBRG
QHY5III290C	GBRG
QHY5III462C	GBRG
QHY5III485C	RGGB
QHY5L-II-C	GRBG
QHY5P-II-C	GBRG
QHY5III585C	RGGB
QHY5III678C	RGGB
QHY5III715C	GBRG

+ Camera Maintenance

- FAQs

-

Now the FAQ part has been intergrated into " QHYCCD Help Center"–Knowledge base



This is QHYCCD Help Center. Here you can:

Submit a Ticket: Describe the issue you met while you're using them. Our technicans will reply you in 48 hours during working days. You don't have to check the Ticket update everyday—they can receive email notifications and know if there's any update.

Knowledge Base: Here lists some tips for using your gears, or solutions to issues that you may met. Help your self!

Support History: Check your ticket's status.