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1. Instruction

Congratulations and thank you for buying one of our ASI Cameras! This manual will give you a brief introduction to your ASI camera. Please take the time to read it thoroughly and if you have any other questions, feel free to contact us. info@zwoptical.com

ASI1600 Cameras are designed for astronomical photography. This is the first camera in the world not only suitable for DSO imaging but also planetary imaging. The excellent performance and multifunctional usage will impress you a lot!

For software installation instructions and other technical information please refer to “ASI USB3.0 Cameras software Manual”

https://astronomy-imaging-camera.com/
2. Camera Models and Sensor Type

There are 6 types of ASI1600 models, 2 of them are discontinue:

<table>
<thead>
<tr>
<th>Models</th>
<th>Mono or Color</th>
<th>Regulated TEC Cooling</th>
<th>Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASI1600MM</td>
<td>Mono</td>
<td>No</td>
<td>Panasonic MN34230ALJ</td>
</tr>
<tr>
<td>ASI1600MC</td>
<td>Color</td>
<td>No</td>
<td>Panasonic MN34230PLJ</td>
</tr>
<tr>
<td>ASI1600MM Pro</td>
<td>Mono</td>
<td>Yes</td>
<td>Panasonic MN34230ALJ</td>
</tr>
<tr>
<td>ASI1600MC Pro</td>
<td>Color</td>
<td>Yes</td>
<td>Panasonic MN34230PLJ</td>
</tr>
<tr>
<td>ASI1600MM-Cool</td>
<td>Mono</td>
<td>Yes</td>
<td>Panasonic MN34230ALJ</td>
</tr>
<tr>
<td>discontinue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASI1600MC-Cool</td>
<td>Color</td>
<td>Yes</td>
<td>Panasonic MN34230PLJ</td>
</tr>
<tr>
<td>discontinue</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Which camera to choose:

Monochrome camera sensors are capable of higher detail and sensitivity than is possible with color sensors, but you need additional accessories such as filter wheel and filters. The post-processing is more complicated too, so a color camera is often recommended for the beginner of astrophotographer.

TEC cooling will help to reduce dark current noise for long exposures. For short exposures, such as under one second, the dark current noise is very low, however cooling is recommended for DSO imaging when long exposures are required.
3. What's in the box?

ASI1600MM or ASI1600MC

- ST4 cable
- Camera body
- T2-1.25" adapter
- quick guide
- 1.25" cover
- USB3.0 cable
- 2" cover
- 1.25" nose piece

ASI1600MM Pro or ASI1600MC Pro

- camera bag
- camera body
- T2-1.25" adapter
- quick guide
- 21mm extender
- T2-M48
- 16.5mm extender
- 1.25" nose piece
- 1.25" cover
- M42-M48 adapter
- 0.5m USB 2.0 cable ×2
- USB3.0 cable
- spacer ×2
4. Camera technical specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>4/3” CMOS</td>
</tr>
<tr>
<td>Diagonal</td>
<td>21.9mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>16Mega Pixels 4656x3520</td>
</tr>
<tr>
<td>Pixel Size</td>
<td>3.8μm</td>
</tr>
<tr>
<td>Image area</td>
<td>17.6mm*13.3mm</td>
</tr>
<tr>
<td>Max FPS at full resolution</td>
<td>23FPS(10bitADC) 15FPS(12bitADC)</td>
</tr>
<tr>
<td>Shutter</td>
<td>Rolling shutter</td>
</tr>
<tr>
<td>Exposure Range</td>
<td>32μs-2000s</td>
</tr>
<tr>
<td>Read Noise</td>
<td>1.2e @30db gain</td>
</tr>
<tr>
<td>QE peak</td>
<td>~60%</td>
</tr>
<tr>
<td>Full well</td>
<td>20ke</td>
</tr>
<tr>
<td>ADC</td>
<td>12 bit or 10 bit</td>
</tr>
<tr>
<td>DDR3 buffer</td>
<td>256MB</td>
</tr>
<tr>
<td>Interface</td>
<td>USB3.0/USB2.0</td>
</tr>
<tr>
<td>Adapters</td>
<td>2” / 1.25” / M42X0.75</td>
</tr>
<tr>
<td>Protect window</td>
<td>AR window</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Uncooled 62mm/Cooled 78mm</td>
</tr>
<tr>
<td>Weight</td>
<td>Uncooled 140g/Cooled 410g</td>
</tr>
<tr>
<td>Back Focus Distance</td>
<td>6.5mm</td>
</tr>
<tr>
<td>Cooling:</td>
<td>Regulated Two Stage TEC</td>
</tr>
<tr>
<td>Delta T</td>
<td>40°C -45°C</td>
</tr>
<tr>
<td>(based on 30°C ambient temperature)</td>
<td></td>
</tr>
<tr>
<td>Cooling Power consumption</td>
<td>12V at 2A Max</td>
</tr>
<tr>
<td>Supported OS</td>
<td>Windows, Linux &amp; Mac OSX</td>
</tr>
<tr>
<td>Working Temperature</td>
<td>-5°C—45°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-20°C—60°</td>
</tr>
<tr>
<td>Working Relative Humidity</td>
<td>20%—80%</td>
</tr>
<tr>
<td>Storage Relative Humidity</td>
<td>20%—95%</td>
</tr>
</tbody>
</table>
5. QE Graph & Read Noise

QE and Read noise are the most important parts to measure the performance of a camera. Higher QE and Lower read noise are needed to improve the SNR of an image.

For the Mono 1600 Sensor, the peak value for QE is around 60%

Relative QE

Color 1600 sensor
Read noise includes pixel diode noise, circuit noise and ADC quantization error noise, and the lower the better.

The Read Noise of the ASI1600 cameras is extremely low when compared with traditional CCD cameras and it is even lower when the camera is used at a higher gain.

Depending on your target, you can set the gain lower for higher dynamic range (longer exposure) or set the gain higher for lower noise (such as short exposure or lucky imaging).

Read noise, full well, gain and dynamic range for ASI1600
6. Getting to know your camera

6.1 External View

The first generation of cooled camera we used a ST4 port instead of USB2.0 hub.

- T2 extender ring: 2” diameters
- T2 screws inside
- 11mm thickness
- Can be removed

- Protect and sealed window
- AR coated D32*2mm

- 1/4” screw
- You can mount to tripod

- ST4 Guide Port

- USB3.0 or USB2.0 IN

- USB2.0 Hub*

- USB3.0 or USB2.0 IN

- Cooler power supply
- 5.5*2.1 DC socket
- 12V 3A AC-DC power supply suggested

- Cooler Maglev fan
- Only on when cooler power supply is there

- Heat Sink

-The first generation of cooled camera we used a ST4 port instead of USB2.0 hub
You can order the holder ring from us or our dealer to mount the cooled camera to tripod. There is 1/4" screw under the holder.

6.2 Power consumption

ASI cameras are designed to have very low power consumption which is around 300ma@5V. You only need the USB cable to power up the camera. However, you will need a separate power supply to activate the cooler. We recommend 12V at 3A or more AC-DC adapter for cooler power supply (2.1mm*5.5mm, center positive). You may also use a battery supply from 11 to 15V to power the cooler.

Here is a test result of the cooler power consumption of our cooled camera. It only needs 0.5A to cool the camera to 30°C below ambient.
6.3 Cooling system

The cooled ASI1600 cameras have a robust, regulated cooling system, which means that the camera sensor can be kept at the desired temperature throughout your imaging session. The super low readout noise, combined with efficient cooling and adjustable gain setting, allows you to do short or lucky DSO imaging unlike the traditional CCD cameras which need very long exposures for each frame. However, keep in mind that cooling won’t help with very short exposures such as less than 100ms. Based on the testing result at 30°C ambient temperature, the Delta T of can be 40°C–45°C. Please note that the Delta T might get down when the cooling system is working for long time. Also, as the ambient temperature falls, the Delta T would also decrease.

Here is a dark current test result of 1600 Cool sensor at various temperatures.

6.4 Back focus distance

When the attached 11mm T2 Extender is removed the optical distance from the sensor to the camera body is reduced to 6.5mm.

6.5 Protect Window

There is a protect window before the sensor of ASI1600 camera.
It’s an AR-AR coated BK7 glass, diameter is 32mm and 2mm thick.

6.6 Analog to Digital Converter (ADC)

The ASI1600 camera records in 12bit ADC and 10bit ADC. You can image at a faster fps rate if you choose to use 10bit ADC (high speed mode). This camera also supports ROI (region of interest) shooting, and this smaller ROI has faster fps. You can uncheck “high speed” and choose 8bit output on software to enable 10bit ADC output, otherwise this camera will use 12bit ADC.

Here is the maximum speed of ASI1600 running at 10bit ADC or 12bit ADC at 8bit mode.

<table>
<thead>
<tr>
<th>Resolution</th>
<th>USB3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10Bit ADC</td>
</tr>
<tr>
<td>4656x3520</td>
<td>23fps</td>
</tr>
<tr>
<td>3840x2160</td>
<td>36.2fps</td>
</tr>
<tr>
<td>1920x1680</td>
<td>57.7fps</td>
</tr>
<tr>
<td>1280x960</td>
<td>73.6fps</td>
</tr>
<tr>
<td>640x480</td>
<td>125.7fps</td>
</tr>
<tr>
<td>320x240</td>
<td>192.4fps</td>
</tr>
</tbody>
</table>

6.7 Binning

The ASI1600 camera supports hardware and software bin2, bin3 and bin4 mode. Hardware binning is supported by sensor but is done in digital domain like software binning and use 10bit ADC. The only advantage of hardware binning is faster fps. We recommend customer to use software binning if you don’t care speed.

6.8 DDR Buffer

ASI1600 Pro camera includes one 256MB DDR3 memory buffer to help data transfer more stable and no amp-glow issue which is caused by the slow speed data transfer during reading out under USB2.0 Port.

DDR memory buffer is the main difference between ASI “Cool” and “Pro” cameras.
7. How to use your camera

There are many adapters available for this camera for connecting to your scope or lens. Some are included with the camera and others you can order from our site:

Color camera connecting drawing:

1. 1.25” T-Mount
2. 1.25” filter (optional)

1. M43-T2 adapter
2. EOS-T2 adapter
3. 2” Filter (optional)
4. 1.25” T-Mount
5. 1.25” Filter (optional)
6. M42-1.25” Filter (optional)
7. T2 extender 11mm
Mono camera connecting drawing:

1. 1.25” T-Mount
2. 1.25” filter (optional)
3. M42-1.25” adapter
4. M42-M42 (Male screw thread)

1. M43-T2 adapter
2. EOS-T2 adapter
3. 2”Filter (optional)
4. 1.25” T-Mount
5. 1.25” Filter (optional)
6. M42-1.25” Filter (optional)
7. T2 extender 11mm
8. M42-M48 extender 16.5mm
9. T2-T2 adapter
10. EFW mini
11. EOS adapter for EFW
Here are the steps to show you how to connect mono 1600 and our EFW mini to your scopes.

Benefiting from the short back focus design, 1.25” filter can support up to F5 scope without vignetting and 31mm filter can support up to F2 scope without vignetting. 36mm filter can support all F-radio telescopes.

EFW Mini & ASI1600MM cooled camera

Unscrew the six screws.

Take the back cover off.

Screw all the filters to the right position.

Tighten back the screws.

Screw off the T2-1.25” holder on the EFW, screw off the T2 ring on the 1600 camera.
Attached the camera to the EFW as shown. 

Take out the 1.25” T-Mount form the T2-1.25” holder.

Install the T-mount to the back of the EFW. 

Attach it to your telescope.

Here is the sideways view. 

T2 extender can be used for attaching the telescope with 2” interface.
Here is an example of the whole setup including an OAG and guider camera.
8. Cleaning

The camera comes with an AR protect window, which can protect the sensor from dust and humidity. Should you need to clean the sensor, it’s better to do so during the daytime. To see the dust, you just need to setup your telescope and point it to a bright place. A Barlow is required to see these dusts clear. Then attach the camera and adjust the exposure to make sure not over exposed. You can see an image like below if it’s dirty.

![Dusts on sensor and protect window](image)

The big dim spot on the image (at right) are the shadows of dust on the protect window. The very small but very dark spot in the image (at left) are the shadows of the dusts on the sensor.

The suggested way to clean them is try to blow them away with a manual air pump. To clean the dust on the sensor you will need to open the camera chamber.

We have a very detailed instruction on our website: [https://astronomy-imaging-camera.com/manuals/](https://astronomy-imaging-camera.com/manuals/)
9. Mechanical drawing

ASI1600MM/ASI1600MC

ASl1600MM Pro /ASI1600MC Pro

Unit:mm
单位: 毫米
10. Servicing

Repairs, servicing and upgrades are available by emailing info@zwoptical.com

For customers who bought the camera from your local dealer, dealer is responsible for the customer service.

11. Warranty

We provide 2-year warranty for our products, we will offer repair service for free or replace for free if the camera doesn’t work within warranty period.

After the warranty period, we will continue to provide repair support and service on a charged basis.

This warranty does not apply to damage that occurred as a result of abuse or misuse, or caused by a fall or any other transportation failures after purchase.

Customer must pay for shipping when shipping the camera back for repair or replacement.