

# **DSO Camera ASI991/990 MM Pro**

## **Product Manual**



Thank you so much for purchasing ZWO ASI camera! Before using the product, please read this manual carefully. All materials related to this publication are subject to change without notice and its copyright totally belongs to Suzhou ZWO CO.,LTD.

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## 1 Product Introduction



 Sensor IMX991	 1/4" 3.2×2.6mm	 Resolution 656×520	 ADC 12bit
 Read noise 21e	 Cooling Temp 30°C - 35°C	 DDR3 Buffer 256MB	 USB 3.0
 FPS 144	 Full well 127Ke	 QE 80%	 Pixel Size 5μm



 Sensor IMX990	 1/2" 6.4×5.12mm	 Resolution 1280×1024	 ADC 12bit
 Read noise 21e	 Cooling Temp 30°C - 35°C	 DDR3 Buffer 256MB	 USB 3.0
 FPS 31.9	 Full well 127Ke	 QE 80%	 Pixel Size 5μm

### SWIR DSO Cooled Camera

ASI991MM Pro adopts 1/4" Sony-IMX991InGaAs sensor, featuring a wide band from 0.4μm to 1.7μm, it is the first & most powerful SWIR camera of ZWO. The camera has a large full well capacity, high sensitivity with an incredible QE peak value of 80% at 1200nm, and a big pixel size of 5μm.

The great performance in capturing short wave infrared lights makes it applicable for SWIR imaging, photometric measurement, optical communication, laser & optical laboratory and more fields.

Compared to ASI991MM Pro, ASI990MM Pro has a larger resolution which will bring a larger FOV when matching the same telescope.

### The Wide Band (0.4-1.7μm)

ASI991MM Pro can capture high definition images. The wide band (400-1800nm) gets the camera's sensitivity into a higher level, making it capable of capturing beautiful night skies with thin clouds and also allowing you photograph stars even during daytime.

## 2 Notice for Use

Before using the camera, please read this manual carefully.

External power supplies are needed for all ASI cooled cameras. We recommend you use a 12V@3A~5ADCadapter (D5.5x2.1mm, center pole positive) or a lithium battery with 11-14V to power the camera. You can also use ASIAIR to power the cameras. Be aware that using power supply out of this voltage range will probably lead to irreparable damage to the camera.

Note that the camera can only be used and stored under the following conditions. Usages out of the environment limits might lead to damage to the camera.

Storage temperature	-20°C ~ 60°C
Storage humidity	20% ~ 95%
Working temperature	-5°C ~ 50°C
Working humidity	20% ~ 80%

Please do not use corrosive solutions to clean the camera to avoid corroding the oxide layer on the surface and damaging the camera. Meanwhile, please do not keep the camera exposed to the sun for a long time to avoid discoloration of the oxide layer on the camera surface.

### 3 Getting to Know Your Camera

#### 3.1 External View



1. Heat sink
2. M42 11mm ring: Can be screwed off if needed.
3. AR protective window (D32\*2mm)
4. USB 2.0 Hub
5. USB 3.0/USB 2.0 data transmission port
6. Led indicator
7. DC power port: D5.5x2.1mm, center pole positive. 12V@3A power supply is recommended to use.
8. Ultra-quiet magnetic levitation fan: Only runs when cooling is turned on.

The camera can be supported by the ZWO holder ring. There is a 1/4" screw interface at the base of the ring.



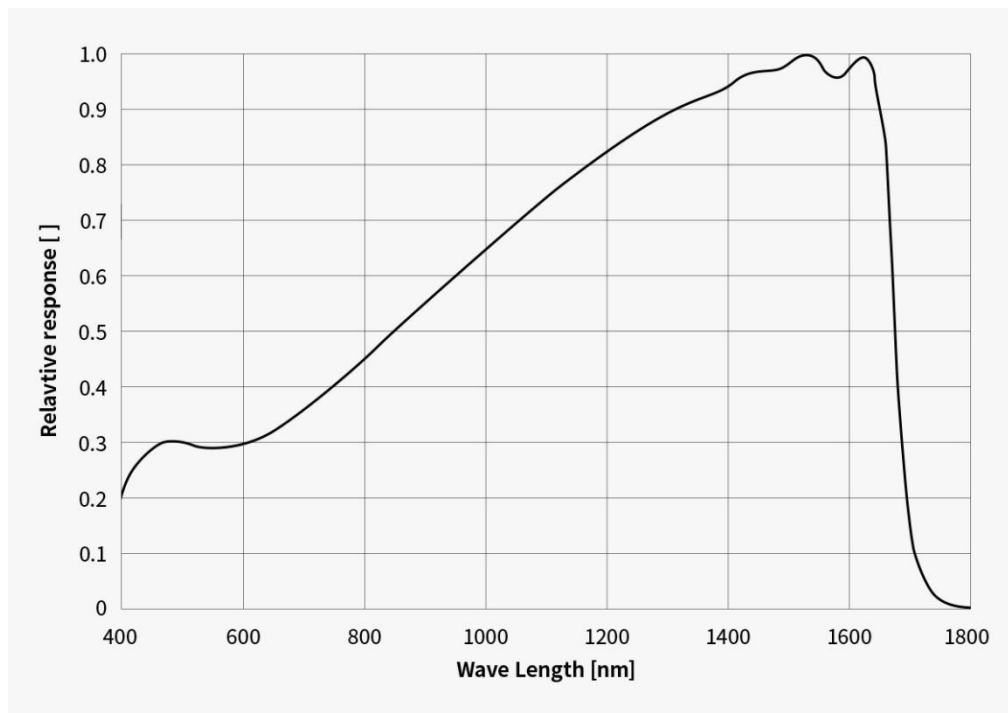
### 3.2 Camera Specifications

Model	ASI991MM Pro	ASI990MM Pro
Sensor	Sony-IMX991	Sony-IMX990
Sensor format	1/4	1/2
Diagonal	4.1mm	8.2mm
Resolution	0.34MP (656 x 520)	1.31MP(1280 x 1024)
Pixel size	5µm	5µm
Sensor size	3.280mm x 2.6mm	6.4mm x 5.12mm
Max frame rate	144FPS	31.9FPS
Shutter	Global Shutter	Global Shutter
Exp range	32µs-2000s	32µs-2000s
Read noise	21-150 e	21-150 e
QE peak	80%	80%
Full well capacity	127k e	127k e
ADC	12bit	12bit
DDR3 buffer	256MB	256MB
USB port	USB 3.0	USB 3.0
Connection adapter	2"/1.25"/M42 x 0.75	2"/1.25"/M42 x 0.75
Protective window	φ32-2 AR	φ32-2 AR
Camera diagonal	78mm	78mm
Net weight	0.465kg	0.465kg
Back focus distance	17.5mm (11mm ring included) /6.5mm	17.5mm (11mm ring included) /6.5mm
Cooling	2-stage TEC cooling	2-stage TEC cooling
Delta-T	30°C~35°C@environmental temperature 30°C	30°C~35°C@environmental temperature 30°C
Power consumption	12V, Max current 3A	12V, Max current 3A
Support OS	Windows, Linux & Mac OSX	Windows, Linux & Mac OSX

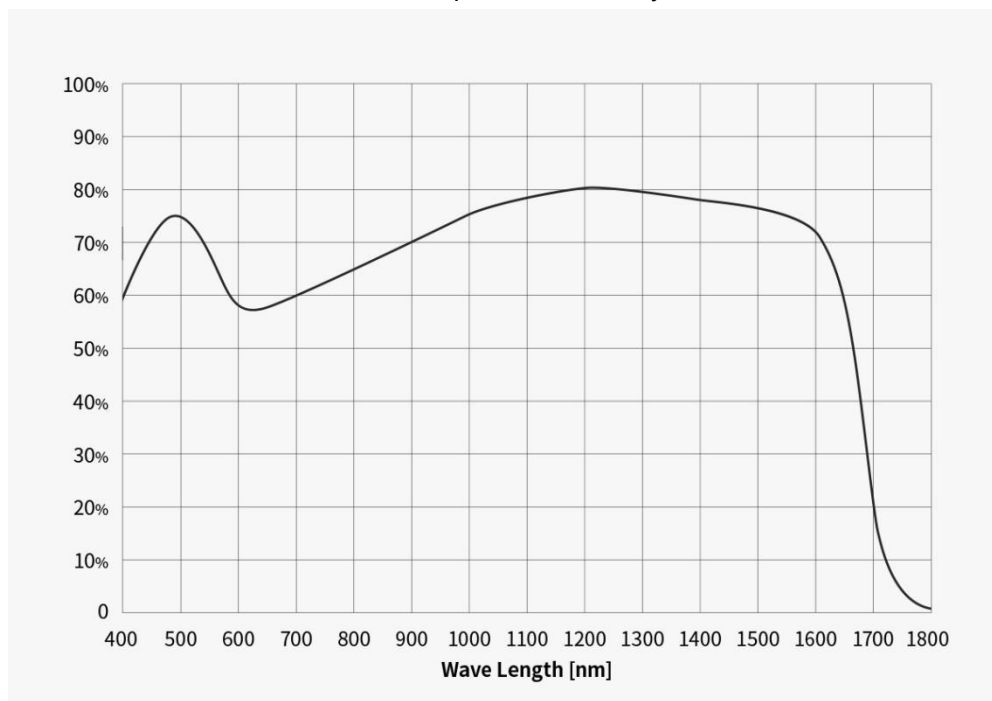
### 3.3 Quantum Efficiency & Read Noise

#### Quantum Efficiency

QE curve and readout noise are two of the most important elements to measure a camera's performance. Based on our calculation, the QE peak value of ASI991/990 MM Pro is over 80% at 1200nm.



Relative quantum efficiency

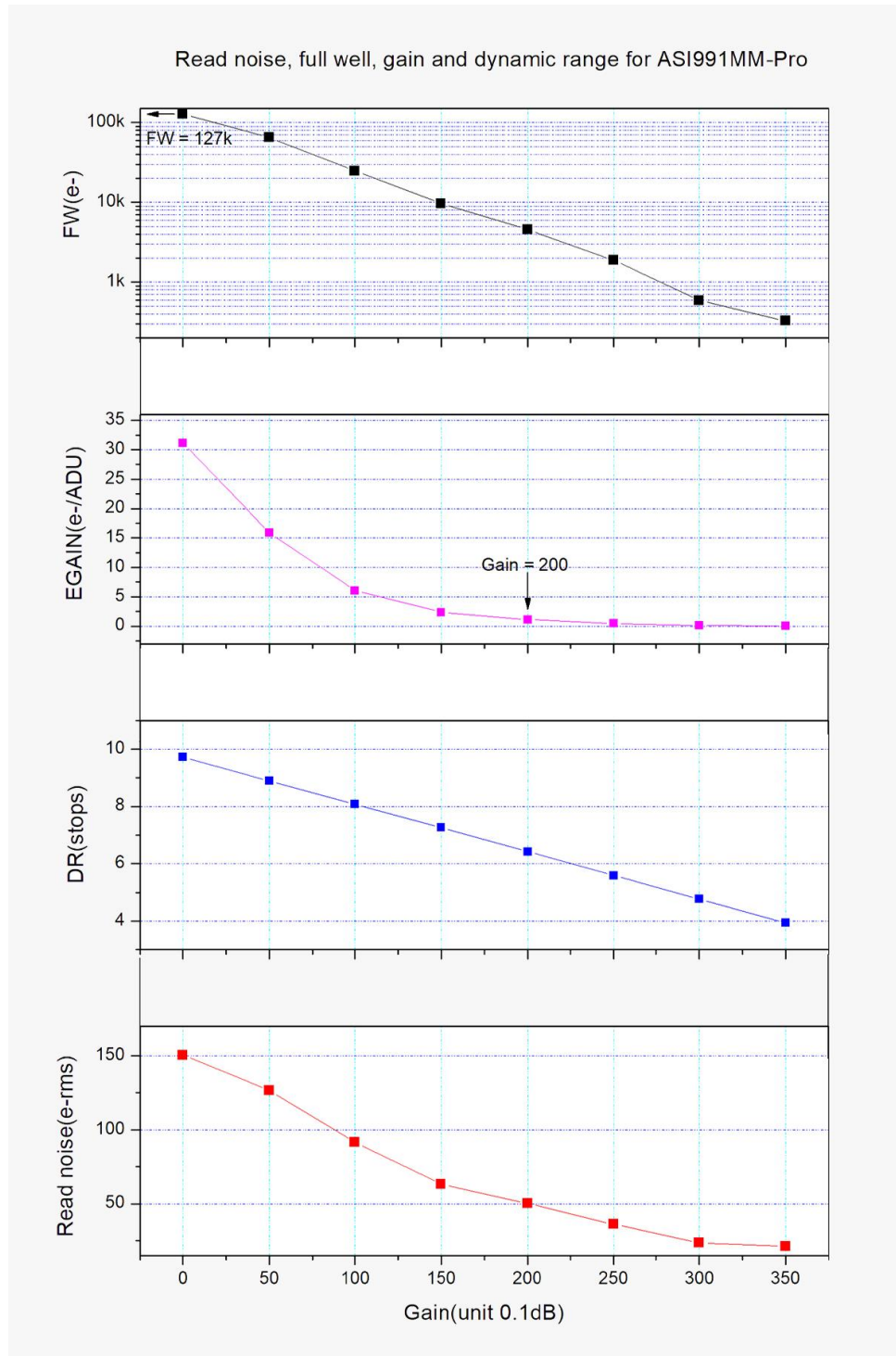


Absolute quantum efficiency



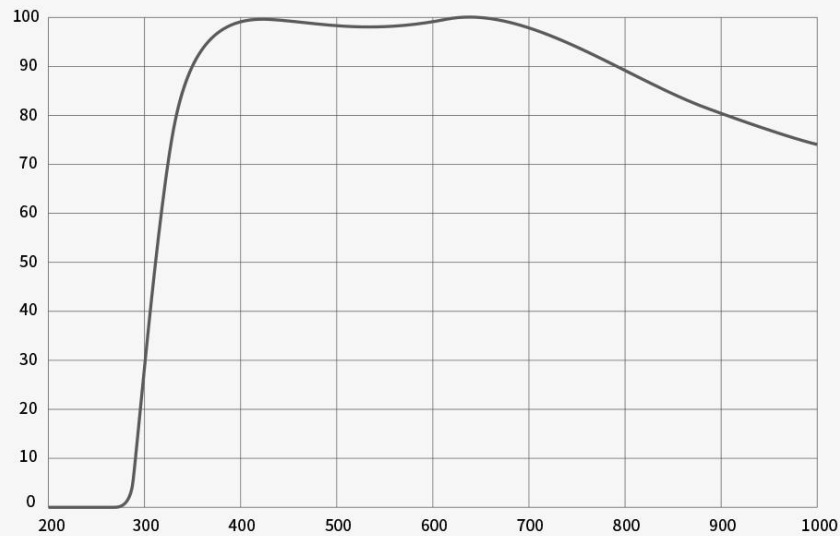
## Read Noise

Read noise includes pixel noise, circuit noise, and ADC quantization noise. The lower the readout noise is, the better the image SNR we'll get. Compared to traditional CCD SWIR cameras, ASI991/990MM Pro keeps its readout noise at a really low level.



### 3.4 Protective Window (AR-Coated Anti-Reflection Filter)

The ASI991/990MM Pro camera is equipped with a 32mm diameter, 2mm thick AR-coated anti-reflective filter as a protective window. This filter safeguards the sensor from external damage while enhancing light transmission across the near-ultraviolet to near-infrared spectrum.



### 3.5 Analog to Digital Converter (ADC)

ASI991/990MM Pro records in 12bit ADC. It also supports a customizable ROI readout mode, enabling faster frame rates at smaller ROI resolutions.

Below are the maximum speeds of ASI991MM Pro running at different USB transmission modes.

Resolution	USB 3.0		USB 2.0	
	Normal Mode: 12BIT ADC		Normal Mode: 12BIT ADC	
	RAW16	RAW8	RAW16	RAW8
656 x 520	144	144	89	89
640 x 480	155	155	113	113
320 x 240	289	289	226	226

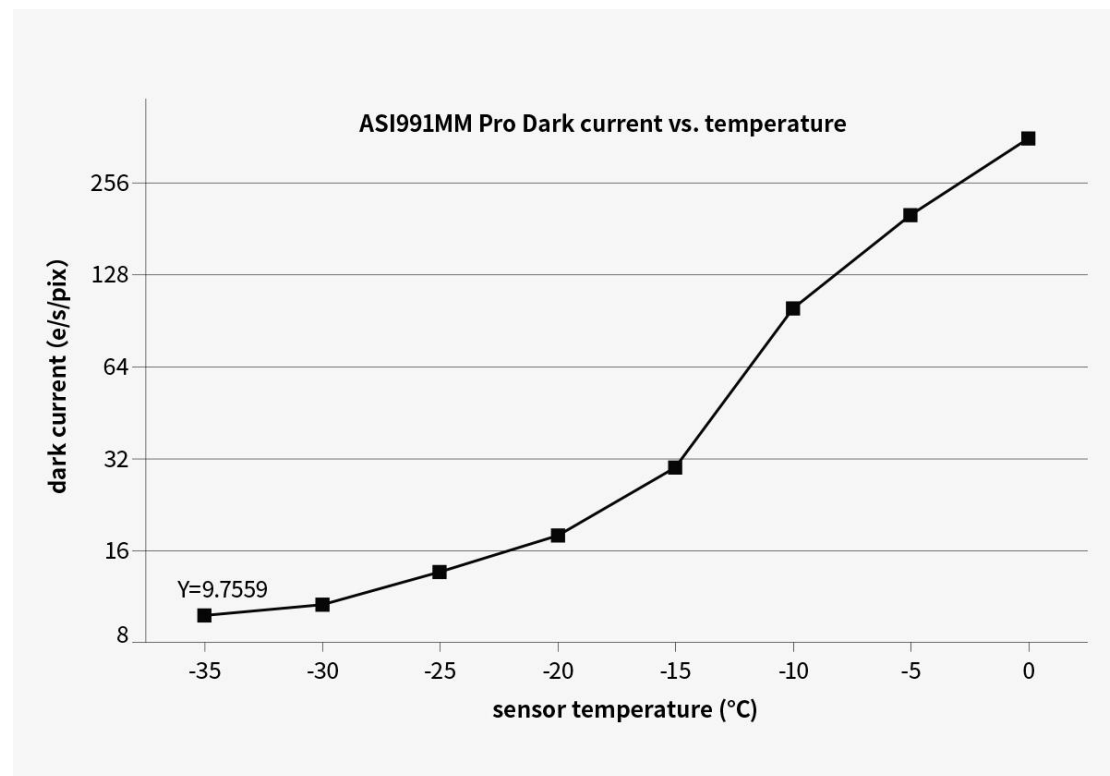
Below are the maximum speeds of ASI990MM Pro running at different USB transmission modes.

Resolution	USB 3.0		USB 2.0	
	Normal Mode: 12BIT ADC		Normal Mode: 12BIT ADC	
	RAW16	RAW8	RAW16	RAW8
1280 x 1024	31.9	31.9	16.5	31.9
640 x 480	66.8	66.8	66.8	66.8
320 x 240	128.9	128.9	128.9	128.9

### 3.6 Two-stage TEC Cooling

The two-stage TEC cooling system can precisely control the temperature of the sensor, and lower it to 30~35 degrees celsius below ambient temperature. Powerful cooling effectively suppresses dark current generation, keeping noise levels low even during exposures of several hundred seconds.

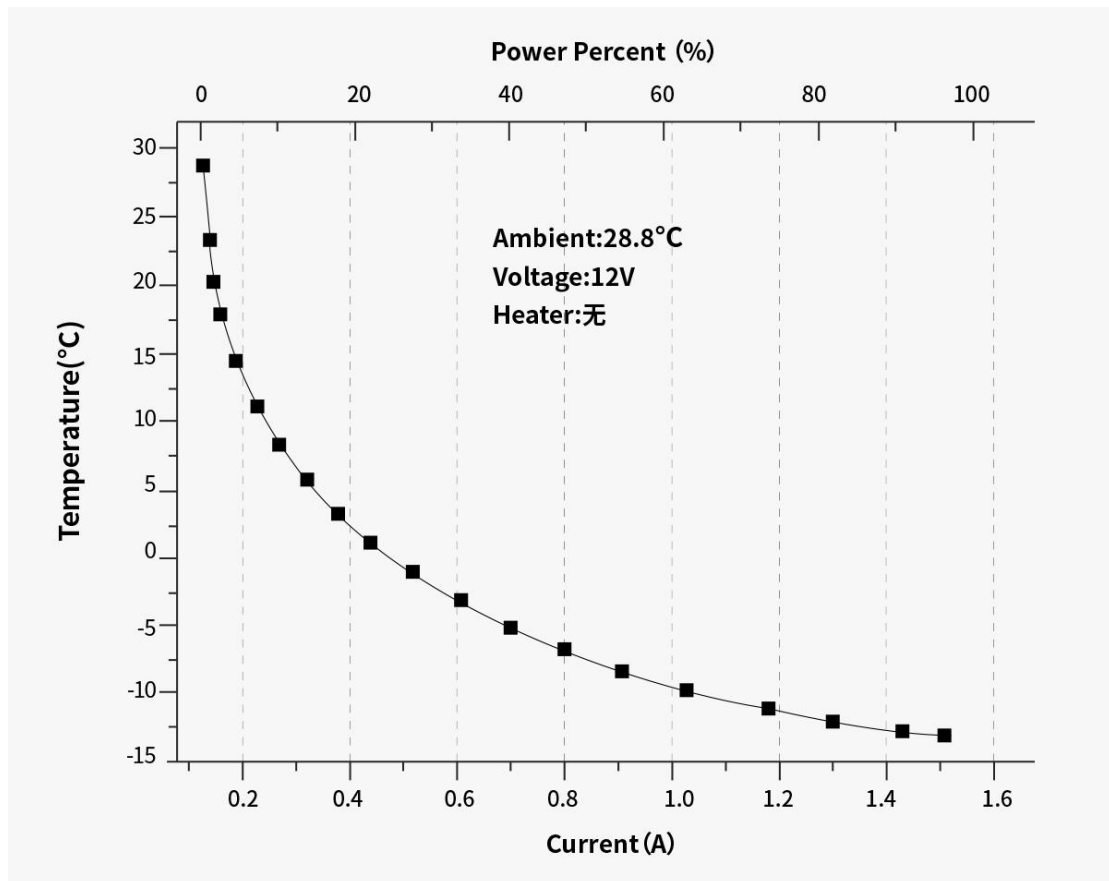
\*The Delta T 30°C~35°C is tested at 30°C ambient temperature. It might get down when the cooling system is working for a long time. It is recommended to use the infrared camera in low-temperature environments. However, it is not advised to operate the sensor at temperatures below -35°C.



### 3.7 Power Consumption

All ASI cameras have low power consumption.

ASI991/990MM\_Pro is no exception. When it's at non-cooling status, the max power consumption is only 1.85W. When it's at cooling status, the max power consumption is 21.36W.



### 3.8 High Transmission Speed

The ASI991/990MM Pro cameras are equipped with 256MB (2Gb) of high-speed DDR3 memory to buffer image data, ensuring stable data transmission.

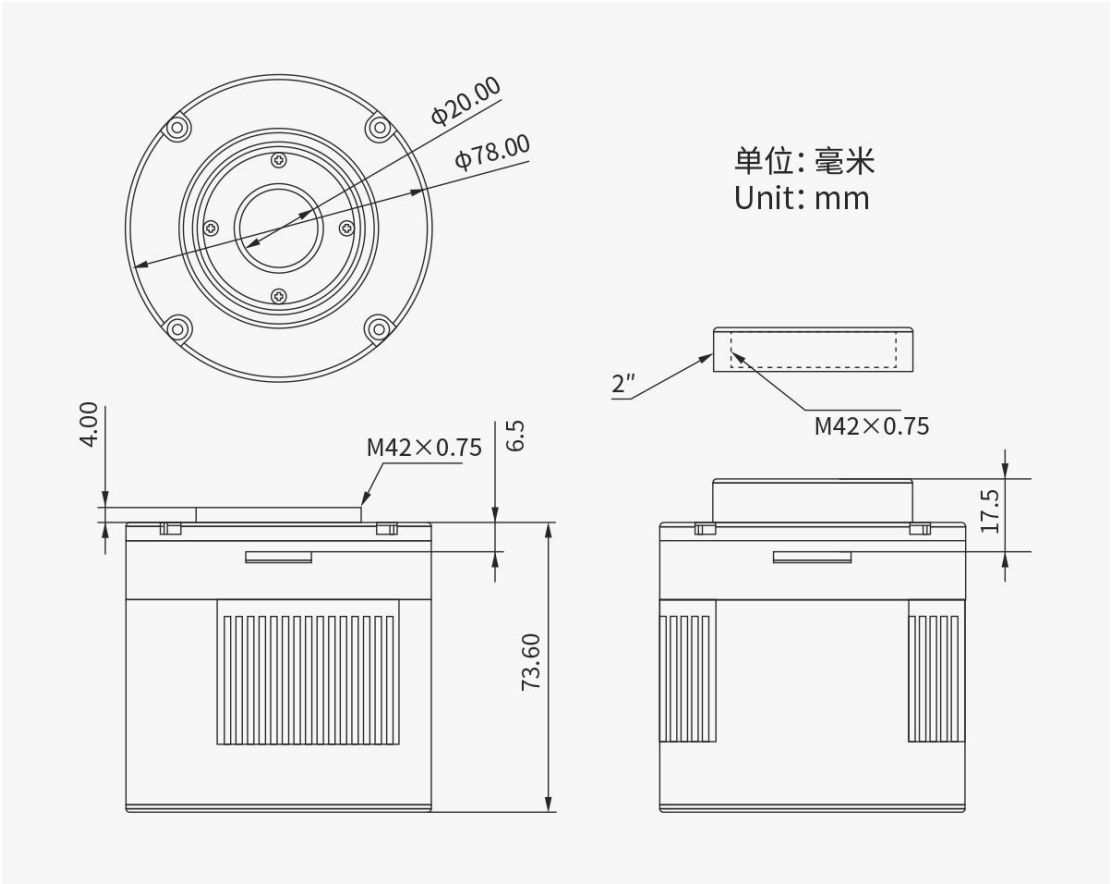
#### 4 What is in the Box?



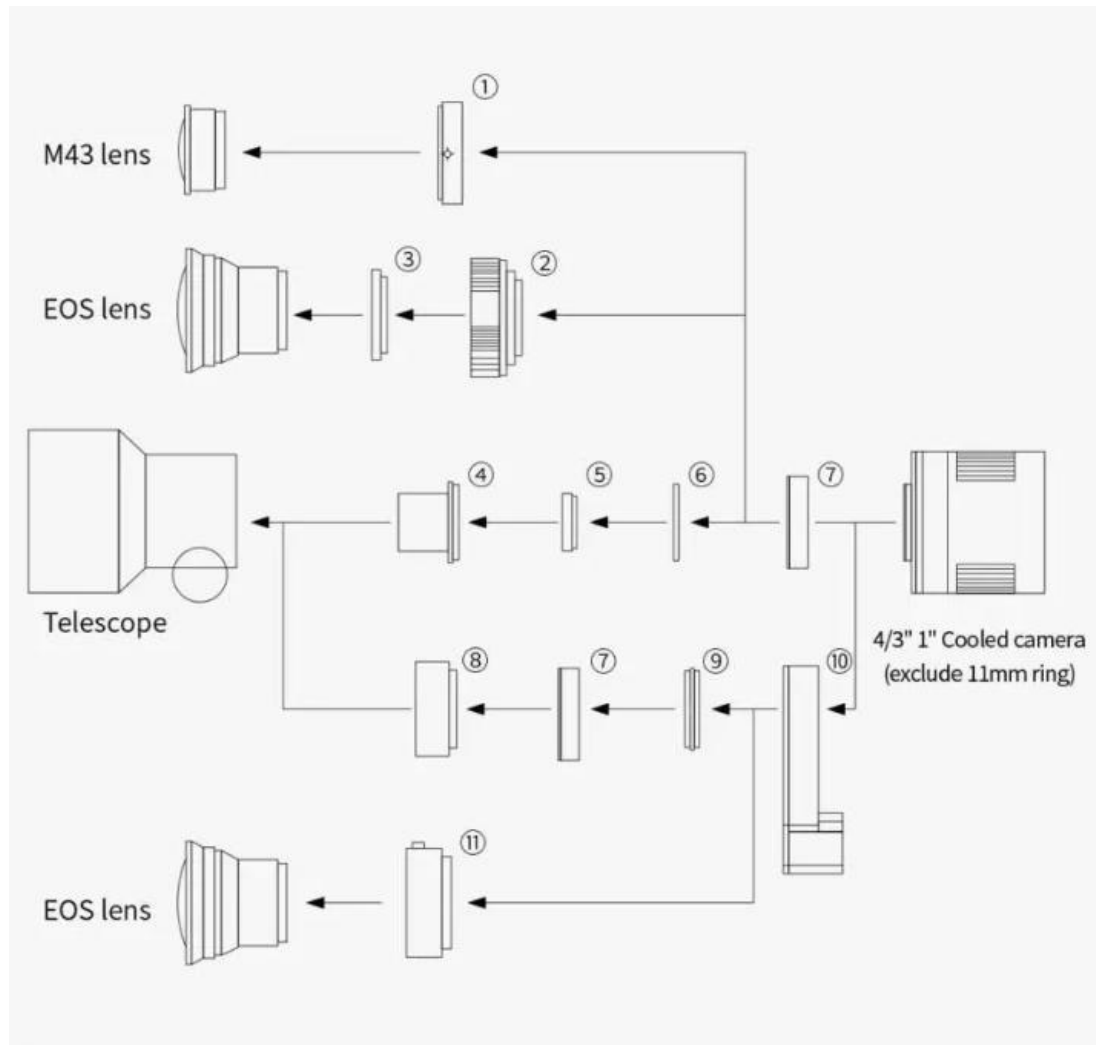
It comes standard with one long USB cable and two short ones, making it convenient for different use scenarios — for example, using the long cable for guiding with a PC, and the short ones for guiding with ASIAIR or connecting to the EAF.

Spacer: 0.5mm x1, 0.2mm x 2, 0.1mm x1. Can be arbitrarily combined out of any thickness within 1mm

5 Structural Dimension Diagram



## 6 Connection Methods



1. M43-T2 adapter (optional)
2. EOS-T2 adapter (optional)
3. 2" filter (optional)
4. 1.25" T-mount
5. 1.25" filter (optional)
6. M42-1.25" adapter
7. 11mm T2 extender
8. 16.5mm M42-M48 extender
9. T2-T2 adapter
10. 1.25" /36mm/31mm EFW
11. EOS lens adapter for EFW





#A 12v power supply must be used.

## 7 Warranty

1. ZWO provides Users with a warranty period of 2 years for ZWO branded products. The warranty starts from the second day when the customer gets the product.

2. If a User encounters the following Dead on Arrival (DOA) and contacts ZWO within the corresponding time limit to issue the Product purchase invoice and relevant evidence, ZWO will provide door-to-door pick-up service and, as appropriate, after-sale replacement (or partial replacement), repair or return (or partial return) service for the following Products:

1) Product quality problem

Provided that a User detects a quality problem and contacts ZWO within 180 days after receipt of the Products, and ZWO support team confirms that the Products indeed have a quality problem or defect after their inspection, ZWO will provide free replacement service towards such Products;

2) Product transportation problem

Provided that a User finds obvious signs of bubbling, serious overstocking, or deformation on the outer package of the Products upon receipt of the Products, and provides ZWO with pictures of the outer package and proof of receipt within 3 days after receipt of such Products, ZWO support team will verify the actual shipper and determine the responsible party for such transportation problem. In the event that ZWO is the actual shipper, ZWO will be responsible for providing the relevant return or replacement service, however, if the Products are directly sold or transported to the User by an agent of ZWO, the agent will be responsible for providing the relevant return or replacement service.

3. If the Products are under the following circumstances, they are not within the scope of warranty service, ZWO may provide maintenance services to the Users:

1) The Warranty Period of the Products has expired; or

2) The Products are injected into liquid or affected by moisture or corrosion; or

3) The Products are damaged by an external force (such as the broken of the camera protection window glass, the deformation of the product shell, the broken of the USB port, etc.); or

4) Disassembling, repairing by a third party, refurbishment of the Products (such as downloading erroneous firmware) without the written authorization of ZWO; or

5) The product system is modified, or the maintenance notice is lost or changed; or

6) Product quality problem caused by installation not following the requirements or instructions for the Products; or

7) Physical damage or failure of the Products caused by the force majeure (such as strong vibration or extrusion such as flood, fire, earthquake, or thunder stroke); or

8) Damage caused by the improper Customer operation during the period of shooting or use, such as using without the equipment protection or direct shooting of the sun; or

9) No valid purchase invoice or warranty certificate; or

10) The Products are second-hand products.

## 8 Servicing

For software upgrades, please refer to "Guide & Manuals" on our official website.

<https://www.zwoastro.com/guides-and-manuals/>

For repairs and consultation, you can visit here:

<https://support.astronomy-imaging-camera.com/>

Email: [info@zwoptical.com](mailto:info@zwoptical.com)

Phone: 0512-65923102

1. For the normal repair or replacement of the Products during the Warranty Period, the User will bear the return cost. When returning the Products, Users shall specify the actual reasons for the damage to the Products, and shall provide the corresponding valid certificates, such as pictures or videos, etc.

For the Products that need to be replaced after being confirmed by ZWO in writing, the User shall return the Products with the complete package, together with all accessories, manuals, etc., to the address designated by ZWO.

By sending back the product to ZWO, the User agrees to pay out-of-warranty fees that may arise during the repair process of the product. ZWO will send back the product after charging.

2. For the Products that need to be returned for after-sales service, ZWO will provide the corresponding RMA code for reference. ZWO will not accept any products having no RMA code that have been returned privately without ZWO written confirmation.

3. If a User purchases the ZWO Products from a ZWO agent, the User may contact the ZWO agent directly for the relevant after-sales service.