AE676C User Manual

Version 1.0

Mar 2026



All materials related to this publication are subject to change without notice and its copyright totally belongs to ToupTek Photonics.

Please download the latest version from touptek-astro.com.

Contents

AE676C User Manual **1**

1 Description and Features **1**

2 AE676C Specifications and Performance **2**

2.1 Camera Specifications 2
2.2 Sony IMX676 Sensitivity 2
2.3 12bit ADC and ROI 3
2.4 DDR3 Buffer 3
2.5 Binning 3
2.6 Conversion Gain Switch 4
2.7 Power and Cooling System for Precise Temperature Regulation 4
2.8 Camera Performance Analysis 4

3 Product Package and Connections **9**

3.1 Packing List 9
3.2 Camera Dimension and Its Mount 10
3.3 Camera Outline and Interface 11

4 AE676C and Its Software **12**

4.1 Application Installation 12
4.1.1 User-friendly UI Design *12*
4.1.2 Professional Camera Control Panel *13*
4.1.3 Practical Functions with Good Results *13*
4.1.4 Powerful Compatibility *14*
4.1.5 Hardware Requirement *14*
4.2 AE676C and Dshow 14
4.3 AE676C and the 3rd Party Software 14
4.3.1 Support Software *14*
4.3.2 N.I.N.A *14*
4.3.3 INDI *15*
4.3.4 ASCOM Platform *15*
4.3.5 PHD Guiding *15*
4.3.6 Nebulosity *15*
4.3.7 MetaGuide *15*
4.3.8 MAXIMDL *15*
4.3.9 AstroArt *15*
4.3.10 FireCapture *15*
4.3.11 SharpCAP *15*
4.3.12 Registax *15*
4.3.13 AstroStack *15*
4.3.14 DeepSky Stacker *15*

5 Service **16**

1 Description and Features

AE676C camera possesses an exceptionally strong capability to capture infrared light (with a high QE value at 825nm). It also has a large full well capacity, high dynamic range, high sensitivity, and low readout noise among other advantages. This results in outstanding performance in autoguiding, planetary photography, as well as in solar and lunar photography.

The features of AE676C are listed below:

- IMX 676 Colorful CMOS Sensor
- Resolution: 3536 x 3536
- 2.0 um Square Pixels
- 1/1.6-inch Optical Format
- 12-bit ADC
- 512 MB DDR3 Buffer
- Precise Temperature Regulation
- G Sensitivity: 3637mv with 1/30s
- Zero Amp-Glow
- Low Noise: 1.00 to 3.79e-
- Frame Rate: 31 FPS at all pixel readout 8 bit
- SNR Max: 40.6 dB
- Dynamic Range: 69.5 dB
- Under short exposures, with TEC cooling enabled, relying solely on passive heat dissipation, the sensor temperature can be reduced to up to 4°C below ambient; with active cooling via the fan, it can be reduced to up to 15°C below ambient.
  Under long exposures, with TEC cooling enabled, relying solely on passive heat dissipation, the sensor temperature can be reduced to up to 6°C below ambient; with active cooling via the fan, it can be reduced to up to 19°C below ambient.

2 AE676C Specifications and Performance

2.1 Camera Specifications

Table 1 AE676C Technique Specifications.

Sensor	Sony IMX676 back illuminated sensor	
Diagonal	10.0 mm	
Image Resolution	12.50 mega pixels (3536*3536)	
Pixel Size	2.0μm × 2.0μm	
Image Area	7.07mm × 7.07mm	
Max FPS at Resolution (USB 3.0)	12bit	8bit
	16 FPS @ 3536*3536 31 FPS @ 1760*1760	31 FPS @ 3536*3536 61 FPS @ 1760*1760
Max FPS at Resolution (USB 2.0)	12bit	8bit
	1.5 FPS @ 3536*3536 3 FPS @ 1760*1760	3 FPS @ 3536*3536 6 FPS @ 1760*1760
Shutter Type	Rolling shutter	
Exposure Time	0.1ms – 1000s	
Gain	1x – 150x	
SNR	40.6 dB	
Dynamic Range	69.5 dB	
Read Noise	3.79 – 1.00 e-	
QE Peak	>83%	
Full Well	11.536ke-	
ADC	12bit	
DDR3 Buffer	512MB(4Gb)	
Connection Port	USB3.0/USB2.0 Type-C	
Camera Adaptor	Standard CS adapter for industrial lens	
Protect Windows	AR-window	
Spectral Range	380-1100nm (with AR-window)	
Capture/Control SDK	Windows/Linux/macOS/Android Multiple Platform SDK (Native C/C++, C#/VB.NET, Python, Java, DirectShow, Twain, etc.)	
Recording System	Still picture and video mode	
Camera Dimensions	Diameter 63mm * height 49.5mm	
Camera Weight	Main unit: 229g; Magnetic fan module: 69g	
Back Focus Distance	Back Focus Distance is 6.5mm, 17.5mm with M42 female adapter, 12.5 with CS adapter	
Cooling:	Active TEC cooling with passive heat dissipation	
Effective Cooling Temp:	Short Exposures (40ms)	Long Exposures (30s)
	Passive heat dissipation: 4°C	Passive heat dissipation: 5°C
	Active cooling via a fan: 15°C	Active cooling via a fan: 19°C
Supported OS	ToupTek StellaVita Microsoft® Windows® XP / Vista / 7 / 8 /10 /11 (32 & 64 bit) OS x (Mac OS X) Linux	

2.2 Sony IMX676 Sensitivity

The sensor G Sensitivity of AE676C is 3637mv with 1/30s. Its spectral sensitivity is shown in Figure 1. The sensitivity is measured with a purple excitation LED light source with a color temperature of 2850 K, an IR cut filter CM700(t =1.0 mm) is placed between the LED light source and the sensor receiving surface to irradiate substantially parallel light.

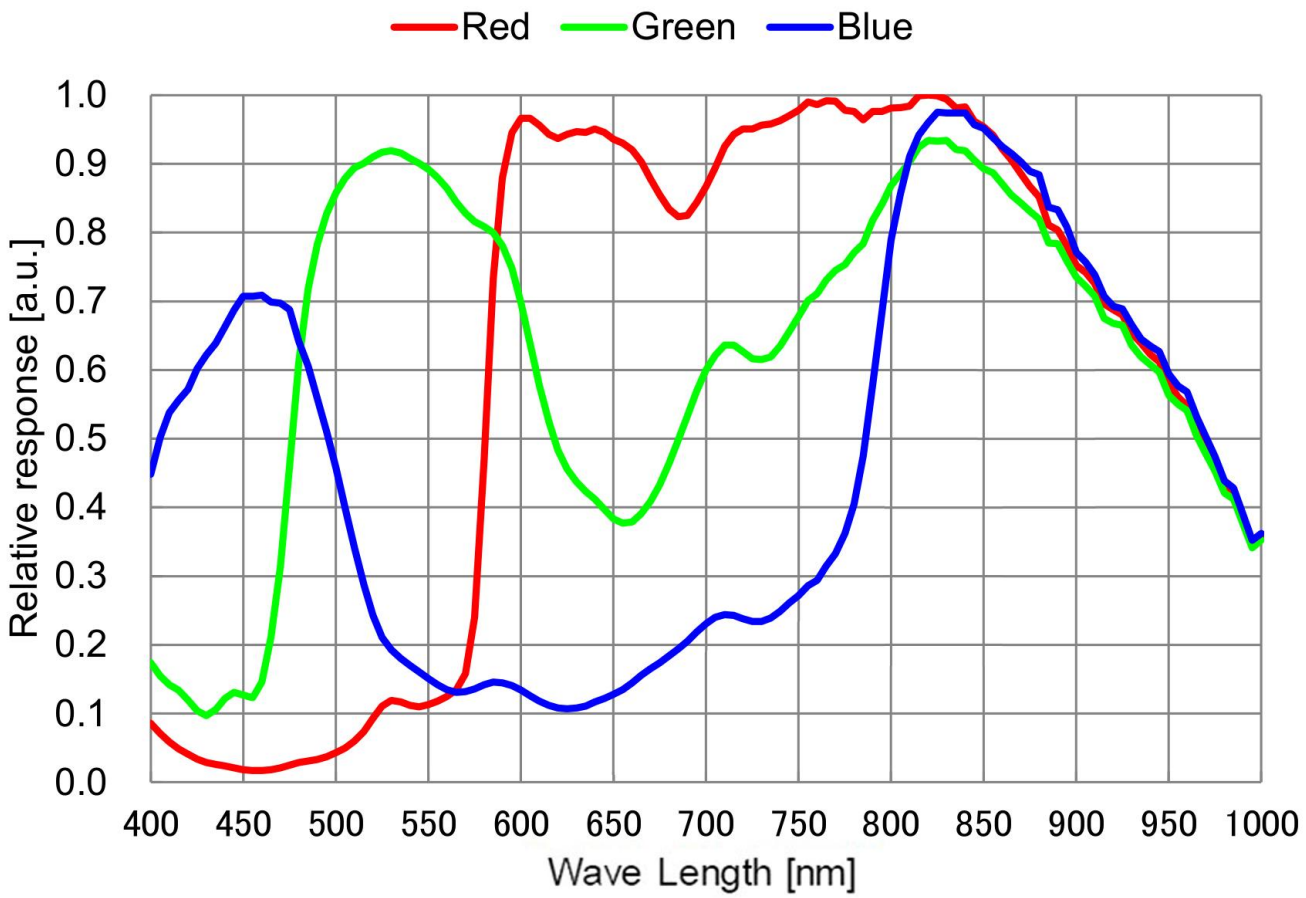


Figure 1 IMX676 Spectral Sensitivity Characteristic

2.3 12bit ADC and ROI

AE676C has built in 12bit ADC. It also has 12bit output mode for software binning and smaller resolution. The camera also supports hardware ROI, and the smaller the ROI size is, the higher the frame rate is.

Table 2 shows the frame rate of the AE676C in 12/8bit mode, USB3.0 / USB2.0 data transfer interface at different resolutions:

Table 2 AE676C Frame Rate at Different Resolution/Data Bit/Data Transfer (USB3.0/ USB2.0)

Bit & Interface / FPS / Resolution	12bit ADC		8bit ADC	
	USB3.0	USB2.0	USB 3.0	USB 2.0
3536 * 3536	16	1.5	31	3
1760 * 1760	31	3	61	6

2.4 DDR3 Buffer

AE676C camera has a 512MB DDR3 buffer, which helps maintain the stability of data transmission, and effectively reduce the amp-glow caused because image data can be temporarily buffered without being sent hastily to the receiver. Ensure that each camera can still achieve its maximum frame rate when multiple cameras are operating simultaneously.

2.5 Binning

The AE676C supports digital binning from 1×1 to 8×8 in either stacking or averaging method, and hardware binning

from 1×1 to 2×2 in stacking method. Hardware pixel binning is much faster than software binning.

2.6 Conversion Gain Switch

AE676C supports HCG 、LCG 、HDR mode switch.

2.7 Power and Cooling System for Precise Temperature Regulation

The camera is powered and transmits data solely through its USB 3.0 Type-C interface. Once connected to the host system via a USB 3.0 cable, the camera can be fully controlled. When the magnetic fan module is attached and operating at maximum cooling power, power consumption is approximately 5V 0.8A (4W).

The cooling system of the AE676C camera body is a single-stage Thermoelectric Cooling (TEC) without an integrated fan, relying solely on passive heat dissipation through its housing. During short exposures (exposure time = 40ms), the TEC can precisely regulate the sensor temperature to a target of up to 4°C below ambient. During long exposures (exposure time = 30s), it can maintain the sensor at a target of up to 6°C below ambient.

The AE676C can also be equipped with the included magnetic fan module for active cooling. With the fan module attached, the TEC can regulate the sensor temperature to a target of up to 15°C below ambient during short exposures (40ms), and up to 19°C below ambient during long exposures (30s).

The TEC system is controlled by a PID algorithm, allowing it to maintain the target temperature with a deviation of just 0.1°C. This efficient and precise cooling system ensures lower noise and stable image quality, enabling users to perform accurate calibration frame processing.

2.8 Camera Performance Analysis

Camera performance can be evaluated with e-/ADU, Read Noise, Full Well and Dynamic Range.

e-/ADU: The sensors found in cameras used for vision applications have pixels that convert incoming photons into electrons. Gain on a CCD /CMOS camera represents the conversion factor from electrons (e-) into digital counts, or Analog-Digital Units (ADUs). Gain is expressed as the number of electrons that get converted into a digital number, or electrons per ADU (e-/ADU).

Read Noise: Read Noise is the most important reference to measure the performance of a camera. Lower read noise usually means better SNR and better quality of image. Read Noise is created within the camera electronics during the readout process as the electrons are subjected to the analog to digital conversion, amplification and processing steps that enable an image to be produced.

Full Well: The electrons are held in each pixel and are converted into electrical charge which can be measured to show the amount of light that has fallen on each pixel. The maximum electrical charge possible is termed "full well capacity". Under the same conditions such as noise and A/D converter quality, the greater full well capacity a sensor has, the wider dynamic range the sensor has. As there is a limit to the depth to which pixels can be made, the full well capacity is often proportional to the frontal area of the light gathering element of the pixel.

Dynamic Range is the ratio between the maximum output signal level and the noise floor at minimum signal amplification (noise floor which is the RMS (root mean square) noise level in a black image). The noise floor of the camera contains sensor readout noise, camera processing noise and the dark current shot noise. Dynamic range represents the camera's ability to display/reproduce the brightest and darkest portions of the image and how many variations in between. This is technically intra-scene dynamic range. Within one image there may be a portion that is in complete black and a portion that is completely saturated.

For the AE series camera, the Gain Value is in xxx% mode. Here xxx is used as the x axis (Gain Value) for the description of the camera performance

$$Rel\ Gain(dB) = 20 * log_{10}[xxx(Gain\ Value)/100]$$

$$xxx(Gain\ Value) = 100 \times 10^{(Rel\ Gain(dB)/20}$$

Camera setting used for performance analysis is shown below:

- HCG
- Full resolution
- RAW 12-bit mode
- Temperature: 10°C

Figure 2 shows the curves of the camera analysis data in Table 3

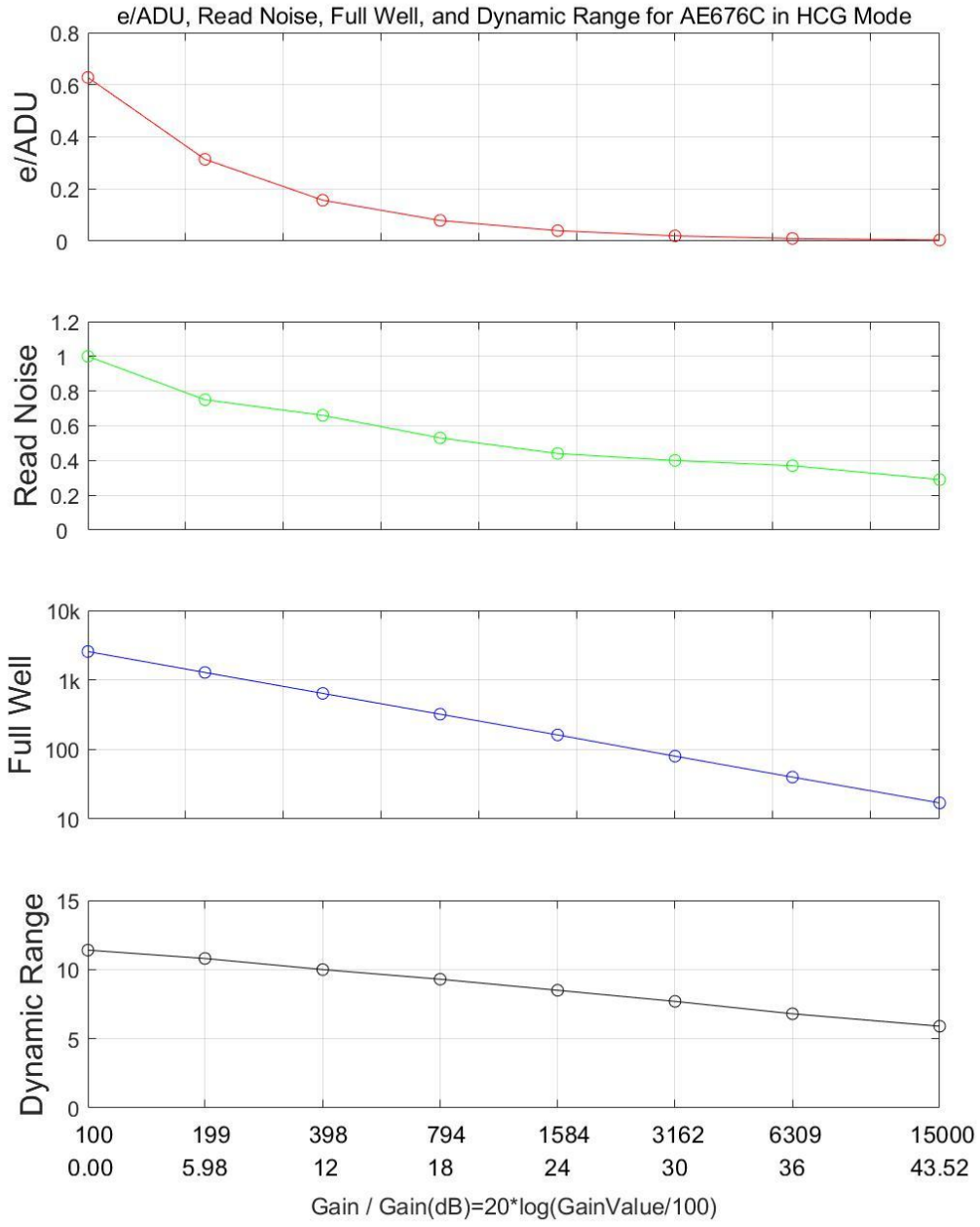


Figure 2 e/ADU, Read Noise, Full Well and Dynamic Range for AE676C

The camera analysis data is shown in Table 3:

Table 3 Camera Analysis Data

Sensor Analysis Data								
Gain Value	100	199	398	794	1584	3162	6309	15000
Rel Gain (dB)	0.0	5.98	12	18	24	30	36	43.52
e-/ADU	0.628	0.314	0.157	0.079	0.04	0.02	0.01	0.004
Read Noise (e-)	1.00	0.75	0.66	0.53	0.44	0.40	0.37	0.29
Full Well (ke-)	2.565	1.282	0.641	0.322	0.162	0.080	0.04	0.017
Dynamic Range (stop)	11.4	10.8	10.0	9.3	8.5	7.7	6.8	5.9

Camera setting used for performance analysis is shown below:

- LCG
- Full resolution
- RAW 12-bit mode
- Temperature: 10°C

Figure 3 shows the curves of the camera analysis data in Table 4

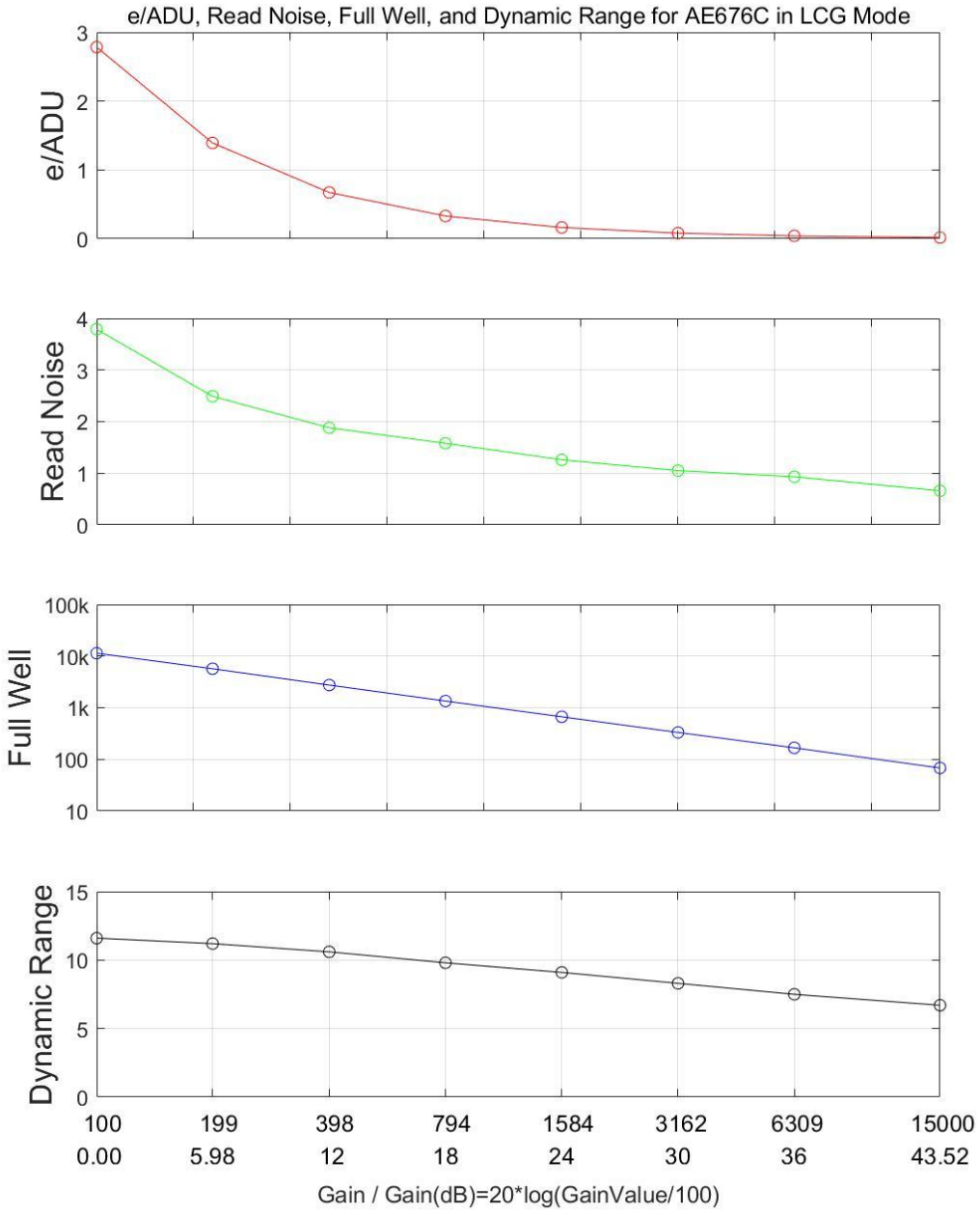


Figure 3 e/ADU, Read Noise, Full Well and Dynamic Range for AE676C

The camera analysis data is shown in Table 4:

Table 4 Camera Analysis Data

Sensor Analysis Data								
Gain Value	100	199	398	794	1584	3162	6309	15000
Rel Gain (dB)	0.0	5.98	12	18	24	30	36	43.52
e-/ADU	2.784	1.392	0.672	0.330	0.163	0.081	0.041	0.017
Read Noise (e-)	3.79	2.49	1.88	1.58	1.26	1.05	0.93	0.66
Full Well (ke-)	11.378	5.688	2.748	1.348	0.667	0.332	0.167	0.068
Dynamic Range (stop)	11.6	11.2	10.6	9.8	9.1	8.3	7.5	6.7

3 Product Package and Connections

3.1 Packing List



Figure 4 Packing Information of AE676C

Table 5 AE676C Packing List

Standard Camera Packing List	
A	Carton L:50cm W:30cm H:30cm (20pcs, 12~17Kg/ carton, 0.045m3), not shown in the photo
B	Packaging box: L:13.4cm W:13.4cm H:8.85cm (approx. 0.676kg per finished package)
C	AE series camera (body features a 6.5 mm back focus M42M threaded mount, comes with a standard CS-mount adapter)
D	Magnetic fan module
E	11mm M42F-M42F adapter ring (enables a standard 17.5 mm back focus M42F threaded mount)
F	1.25-inch extension tube
G	C-mount rubber plug
H	Fisheye lens (standard CS-mount, 2.8mm focal length, F/2.0 f-ratio, approx. 126° FOV, IR-corrected)
I	5mm CS-to-C adapter ring (converts a standard CS-mount to a standard C-mount)
J	LP825 Long Pass IR filter cap
K	1.5m USB 3.0 high-speed cable (A male to C male)

3.2 Camera Dimension and Its Mount

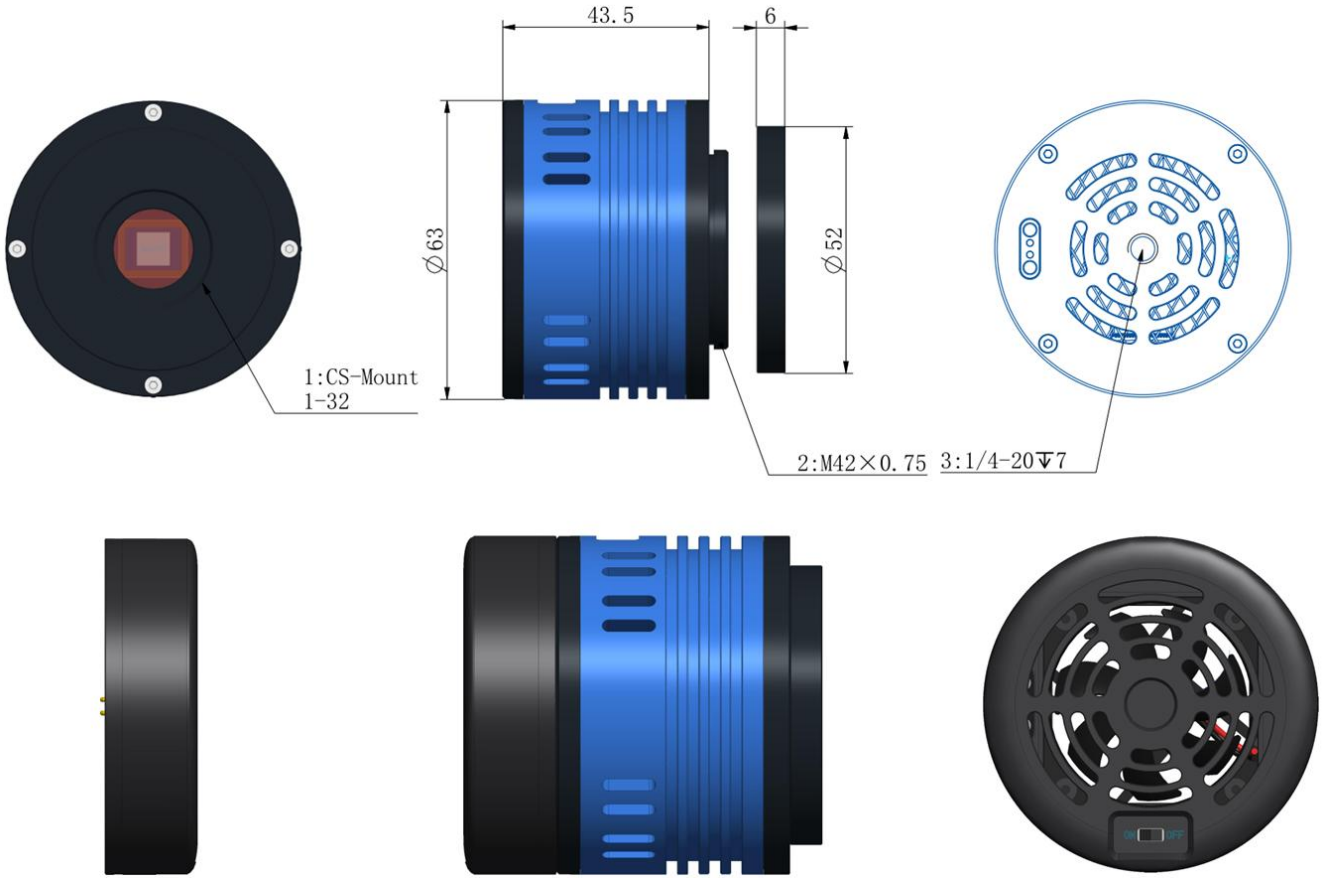


Figure 5 Dimension and Mount of AE676C

The AE series cameras feature a robust alloy body, ensuring a solid and durable structure. They are equipped with an AR anti-reflective coating to protect the sensor and minimize reflections. With no moving parts inside, these design choices make the cameras more rugged and reliable compared to other industrial camera solutions, thereby extending their operational lifespan. The CS mount of the AE series camera is realized through the M42×0.75 external thread on the front of the camera combined with a 6 mm thick M42-to-CS adapter ring. When this adapter ring is removed and the M42×0.75 thread is used directly, the camera flange focal distance is 6.5 mm.

The magnetic fan module included with the AE camera attaches to the camera body via multiple pairs of strong magnets, and its power is supplied through a pair of magnetic contacts on the module that connect to the camera body. The fan can only be manually controlled using the switch on the module.

When the magnetic fan module is not in use, ensure that the magnetic contacts on both the camera body and the module remain dry, clean, and properly insulated.

Table 6 Adapter of AE676C

Item	Specification
1	The standard CS adapter ring is directly compatible with industrial CS-mount lenses (the CS-mount is implemented via an adapter ring)
2	M42M×0.75 thread, 6.5 mm flange distance; convertible to M42F×0.75 interface with 17.5 mm flange distance via an 11 mm extension ring
3	1/4"-20 UNC threaded hole (Imperial standard), 7 mm thread depth, directly compatible with photographic tripods and similar supports

3.3 Camera Outline and Interface



Figure 6 Camera Outline and Interface.

Table 7 Camera Outline and Interface List

Item	Specification
1	USB 3.0 Type-C female port

4 AE676C and Its Software

4.1 Application Installation

For software, customers are welcomed to go to our software website: https://touptek-astro.com/downloads/, to download the latest ToupSky. The AE can also be used with ASCOM, DirectShow SDK. If the third-party software is compatible with these SDK, customers can also download the software driver from our website and install the drivers into the third-party software.

ToupSky is ToupTek astronomy camera's Windows application. ToupSky is a professional software integrated with camera control, image capture & process, image browse, and analysis functions. ToupSky is born with the following features:

Windows:

- x86: XP SP3 or above; CPU supports SSE2 instruction set or above
- x64: Win7 or above

Features

- Full control of the camera
- Trigger mode and video mode support (raw format or RGB format)
- Automatic capture and quick record function
- Multi-language support
- Hardware ROI and digital binning function
- Extensive image processing functions, like image stitching, live stacking, flat field correction, dark field correction, etc.

Supported Camera:

- All ToupTek astronomy cameras

4.1.1 User-friendly UI Design

- Well-arranged menus and toolbars ensure quick operating;
- The unique design of 3 sidebars -- Camera, Folders, Undo/Redo are orderly classified;
- Convenient operating method (Double click or right-click context menu) as much as possible;
- Detailed help manual;

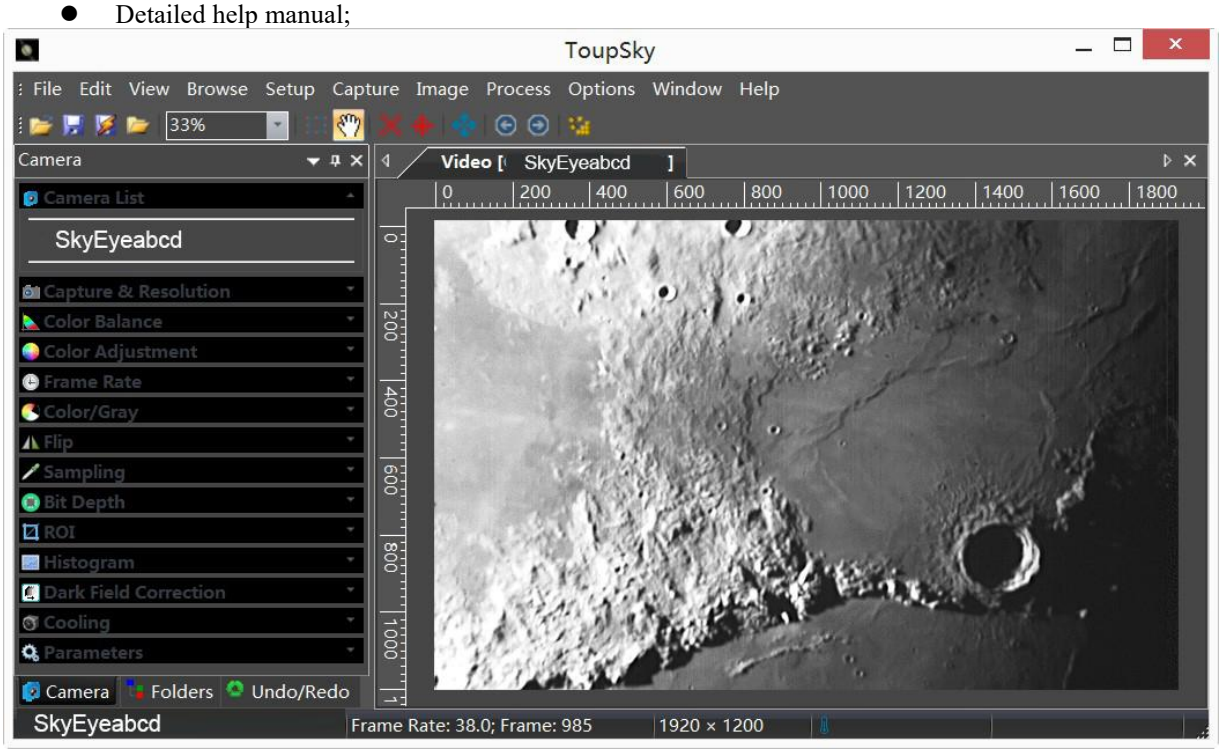


Figure 7 ToupSky and Its Video Window

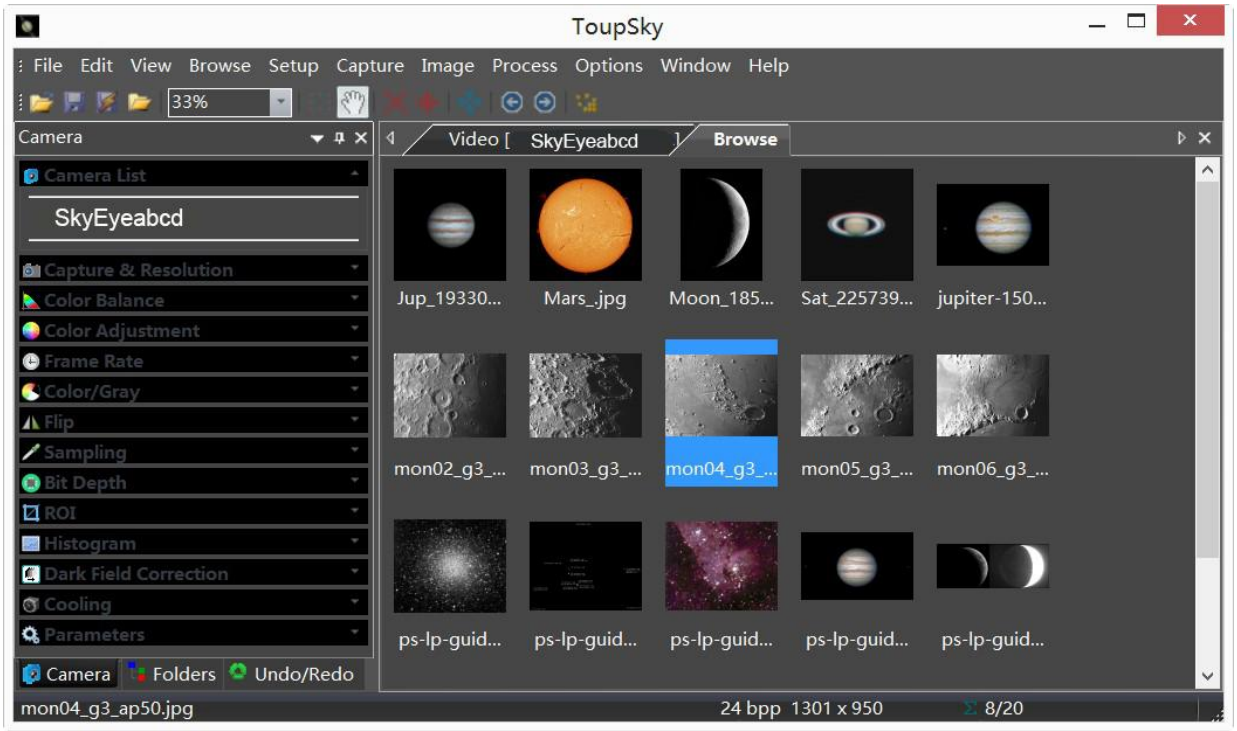


Figure 8 ToupSky and Its Browse Window

4.1.2 Professional Camera Control Panel

Capture & Resolution	Set the live and snap resolution and snap the image or record video;
Exposure & Gain	Auto exposure (exposure target preset) and manual exposure (exposure time can be inputted manually); Up to 5 times gain;
Color Balance	Advanced single-click intelligent white balance setting, temperature and tint can be manually adjusted;
Color Adjustment	Hue, saturation, brightness, contrast, gamma initialization adjustment;
Frame Rate	Adjustment of frame rate available for different computer configurations;
Flip	Check the “horizontal” or “vertical” option to correct the sample direction;
Sampling	Bin mode can obtain low noise video stream; Skip mode obtains sharper and smoother video stream. Support video stream histogram extension, Negative and positive switching, Gray calibration, Clarity factor for focusing etc.
Bit Depth	Switch between 8 bits and 12 bits. 8 bits is the basic Windows image format. 12bits will have higher image quality but moderate FPS.
ROI	ROI, Region of interest. This function can set the ROI on the video window. When the ROI group was expanded, a dotted rectangle with "Handles" will appear around the video window that will let you alter the ROI. Use mouse button to adjust the ROI size. If ROI is ok, click Apply will set the video to ROI size, Defaults will return to the original size.
Dark Field Correction	To Enable the Dark Field Correction, one should capture the dark field image first. After the images are captured, the Enable button will be clickable. Checking the Enable button will enable the Dark Field correction. Unchecking it will disable the Dark Field Correction.
Cooling	Set the TE-Cooling target temperature and set the fan On/Off;
Parameters	Load, save, overwrite, import, export self-defined parameters of camera control panel (including calibration information, exposure and color setting information);

4.1.3 Practical Functions with Good Results

Video functions	Various professional functions: Video broadcast; Time lapse capture; Video record; Video stream grid; Image stitch; Video scale bar, date etc.
Image Processing and Enhancement	Control and adjust image by denoise, sharpen, color toning deinterlace, all kinds of filtering algorithm and mathematical morphology algorithm, range, binary, pseudo color, surface plot and line profile ital..
Image Stacking	Image stacking adopts advanced image matching technology. With the recorded video, regardless of shifting, rotation, scaling, the high-fidelity image can be stacked to decrease the image noise.

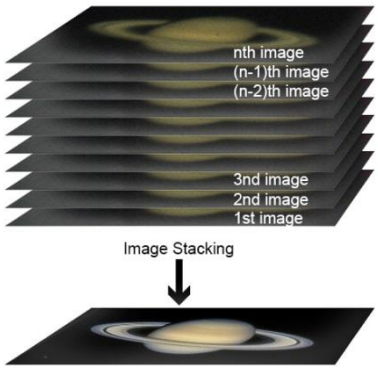


Figure 9 Image Stacking

4.1.4 Powerful Compatibility

Video Interface	Support Twain, DirectShow, SDK Package（Native C++、C#/VB.NET）
Operating System	Compatible with Microsoft® Windows® XP / Vista / 7 / 8 /10/11 (32 & 64 bit), Mac OSX, Linux
Language Support	Unlimited language support, currently available in Simplified Chinese, Traditional Chinese, English, Russian, German, French, Polish and Turkish

4.1.5 Hardware Requirement

PC Requirements	CPU: Intel Core 2 2.8GHz or higher
	Memory:2GB or more
	USB port: USB3.0/USB2.0 port
	Display:17" or larger
	CD-ROM

4.2 AE676C and Dshow

ToupTekDshowAstroSetup (Click the left blue link to download)

DshowAstro is an interface driver providing Dshow standard support for ToupTek USB astronomy camera

Supported OS: Windows:

- x86: XP SP3 or above; CPU supports SSE2 instruction set or above
- x64: Win7 or above

Supported Camera:

- All ToupTek astronomy cameras

4.3 AE676C and the 3rd Party Software

4.3.1 Support Software

No.	Software	Version	WDM	ASCOM	Native
1	PHD Guiding	2.3.0(2014)	√	√	√
2	Nebulosity	3.2.2(2014)	√	×	/
3	MaxIm DL	5.23(2013)	√	×	/
4	SharpCap	2.1(2014)	√	×	/
5	MetaGuide	5.2.0(2014)	√	/	/
6	FireCapture	2.4.05(2014)	√	/	/
7	Astroart	5.0(2014)	√	×	/

4.3.2 N.I.N.A

Powerful open source astronomy equipment management system for deep sky photo shooting, free.

4.3.3 INDI
A popular third-party driver software for astronomy devices, often used on Linux and MacOS.

4.3.4 ASCOM Platform
All AstroCam telescope camera drivers request to install ASCOM platform, free.

http://www.ascom-standards.org/index.htm

You can download the ASCOM package from : http://ascom-standards.org/Downloads/Index.htm

4.3.5 PHD Guiding
A popular free guide software: http://openphdguiding.org/

ToupTek's telescope camera support Native/ASCOM/WDM driver to run the video.

4.3.6 Nebulosity
A popular cooled camera control/image process software directly supported via ASCOM.

4.3.7 MetaGuide
Autoguiding software with novel method to avoid the atmospheric agitation. The latest version support GCMOS01200KPB and the guide port: http://www.astrogeeks.com/Bliss/MetaGuide/

4.3.8 MAXIMDL
Famous full functional CCD Control/Image Process software. Popular used in US.

4.3.9 AstroArt
Famous full functional CCD Control/Image Process software. Popular used in Europe.

4.3.10 FireCapture
Great free planetary capture software. Support part of AstroCam series telescope camera.

4.3.11 SharpCAP
A nice free planetary capture software support WDM cameras includes AstroCam series telescope camera.

4.3.12 Registax
A popular free planetary stacking and processing software.

4.3.13 AstroStack
A planetary stacking and process software.

4.3.14 DeepSky Stacker
A free deep sky image stack and process software.

5 Service

For software upgrades, please refer to “Download” on our official website: https://touptek-astro.com//

For customers who purchase the cameras from local dealer, please contact your dealer for more inquiry.

For technical support, please contact e-mail address: tpa-support@touptek.com .