

# The ASI 1600MC Cooled Camera

*This 16-megapixel camera is as effective shooting the Moon and planets as it is deep-sky targets, and at a price that's tough to beat.*



## ASI 1600MC-Cool

U.S. Price: \$999  
Astronomy-imaging-camera.com

**What We Like:**  
Affordable and versatile  
Very low-noise images

**What We Don't Like:**  
Poor documentation  
Cooler power supply  
not included

**ASTROPHOTOGRAPHERS** today generally choose between two different types of cameras, depending on the objects they're interested in recording. The highest quality shots of the Sun, Moon, and planets come from the "lucky imaging" technique using high-speed digital video cameras to capture short video clips that are later processed into a finished still image by stacking and sharpening the highest-quality frames.

Deep-sky imagers in pursuit of the faintest objects usually turn to cooled CCD cameras that can capture long exposures often tens of minutes in duration. Like the lunar and planetary shots, multiple frames are stacked to improve the signal-to-noise ratio for better pictures.

But the line separating these two types of cameras is blurring. ZWOptical's ASI 1600MC-Cool camera is a versatile, 16-megapixel, one-shot-color

◀ The ASI 1600MC-Cool from ZWOptical is a 16-megapixel cooled CMOS camera capable of operating in either high-speed video mode or as a long-exposure, deep-sky camera.

camera that is as comfortable shooting the Moon as it is the faintest nebulae. Its Panasonic MN34230PLJ CMOS detector features a generous array of  $4,656 \times 3,520$ , 3.8-micron pixels forming an active imaging area measuring  $17.6 \times 13.3$  mm. A monochrome version of the camera is also available for \$1,280.

Housed in a compact, red-anodized cylinder, the camera has male T-threads (often called M42 threads) at the front and jacks for a USB cable, a 12-VDC power cable (that's only needed for the cooler), and an industry-standard autoguider port on the back end. Surprisingly, no AC adapter or even a power cord is supplied for the camera's regulated two-stage cooler. I contacted the manufacturer and was told that the 12-VDC input plug on the camera is center-positive and that the cooler draws about 2 amps of power. Suitable AC adapters are readily available online, and I was able to use one that I already had on hand.

The camera comes with 1¼- and 2-inch nosepieces as well as a short extension tube that has female T-threads on one end and slightly larger female M48 threads on the other end. This would come in handy for connecting the camera to telescopes and accessories that use M48 threads. The camera is light, weighing just 14.5 ounces.

When the cooler is operating, a small fan on the back circulates air through the camera body and out through two louvered vents on the side. Using the supplied software, you can enable a wide range of region-of-interest (ROI) sub-fields on the chip. The camera's tiny pixels produce high-resolution

lunar and planetary images with large-aperture telescopes, and work well on deep-sky objects using small-aperture instruments and camera lenses.

An optional camera-lens adapter is available, as is a mounting collar with a 1/4-20 tripod socket that fits around the camera body. The camera's imaging chip is located just 6.5 mm back from the front face of the camera body. This allowed me to use a low-profile, off-axis guider while still maintaining the optimum distance between the sensor and the field flattener and coma correctors used when recording many of my deep-sky test exposures. The camera's detector chamber is sealed with an anti-reflection coated window that also blocks infrared light, and a 1 1/4-inch filter adapter is mounted just ahead of the window. This allows 1 1/4-inch filters to be used on the camera without vignetting the chip.

Although the ASI 1600MC-Cool is capable of capturing up to 23 full-resolution frames per second, the actual maximum frame rate may be lower depending on the speed of the USB port on your host computer and the write speed of your computer's hard drive. Although my relatively new laptop features USB 3.0 ports, the hard

▼ The camera comes with a 2-meter USB 3.0 cable, 6-pin autoguider cable, M42 extension adapter, and a CD-ROM disk containing the camera drivers and control software.

drive speed of 5,600 r.p.m. significantly limited the actual rate at which I could record frames when shooting lunar clips. Frame rates were much faster when I was using smaller ROIs for shooting the planets, since these didn't require the camera's entire 16-megapixel detector. Deep-sky exposures of several minutes were no problem using either the USB 3.0 on my laptop or the older USB 2.0 port on my desktop computer.

I tested the camera on several instruments ranging from a 12 1/2-inch Newtonian/Classical Cassegrain reflector down to a telephoto camera lens.

### Control Software

The ASI 1600MC-Cool camera includes three software programs on a CD that can control the camera. The simplest is titled *USB3\_cameras*. The other two, named *SharpCap* and *FireCapture*, offer more features including control of the camera's two-stage thermoelectric cooling, which decreases noise in long-exposure images. Regulated cooling also allows you to record accurate dark and bias calibration frames in advance of an imaging session, which saves valuable shooting time under a dark sky. The popular planetary stacking program *Autostakkert!2* (*S&T*: Sept. 2016, p.68) and the autoguiding software *PHD2* are also included on the same CD, as are the camera and ASCOM drivers to allow



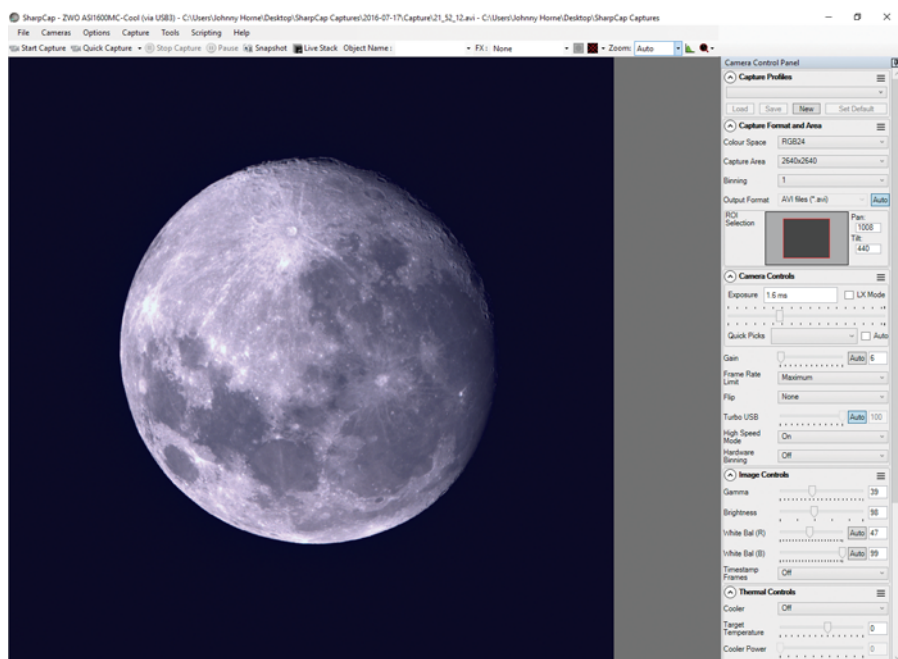
▲ The rear of the camera's housing includes an autoguider port, the USB 3.0 port (which also powers the camera) and a 12VDC jack that powers the dual-stage cooling. New models also have a built-in, dual-port USB 2.0 hub to connect a filter wheel and electronic focuser.

control of the camera with other third-party programs. All of the software as well as the camera drivers were easily installed without issues.

One feature of the camera that took me by surprise with all three of the included camera-control programs was that the camera starts exposing as soon as the control software detects it. A readout of the number of frames-per-second indicates the camera is active from the get-go. However, this doesn't mean that the frames are being saved. That only happens after you designate a folder for the images and enable the "start capture."

When the camera is capturing a series of images, it shows the actual frame rate recorded and displays the number of "dropped" frames, if any. The number of recorded frames depends on the set frame rate, the resolution of the frames, the gain setting and exposure duration, and the speed of the computer's hard drive. Both *SharpCap* and *FireCapture* include settings to monitor USB traffic on your computer and figure into how fast frames can be ultimately recorded. All of these factors can make the difference between having smooth video clips or a set of consecutive still frames, versus having many dropped frames or even having the camera lock up during an imaging session.





▲ *SharpCap*, one of the camera-control programs that comes with the ASI 1600MC-Cool, runs the camera in video mode while imaging the Moon and planets. It also provides live stacking of longer exposures when using the unit for public outreach.

Much of my initial time with the camera involved making sure these settings were optimized. If they weren't, camera hang-ups and many dropped frames were the rule rather than the exception. Downloading the latest beta version of *FireCapture* at [firecapture.de](http://firecapture.de) helped with some hang-up issues I had when recording videos.

The manual warns against using any type of USB extension cable or connecting the camera through a USB hub. These could significantly decrease the frame rate. I made sure my computer was quite close to the camera at all times in order to use the supplied 2-meter-long USB 3.0 cable, though longer cables are available online.

Additionally, the sparse documentation provided with the camera, especially the absence of any "quick start" guide, made my initial tests challenging. Both the camera user's guide and the trouble-shooting guide that are supplied as PDFs on the CD covered only earlier ASI camera models and not the ASI 1600MC-Cool specifically, though the manufacturer's website now offers a downloadable manual for the new ASI 1600 cameras.

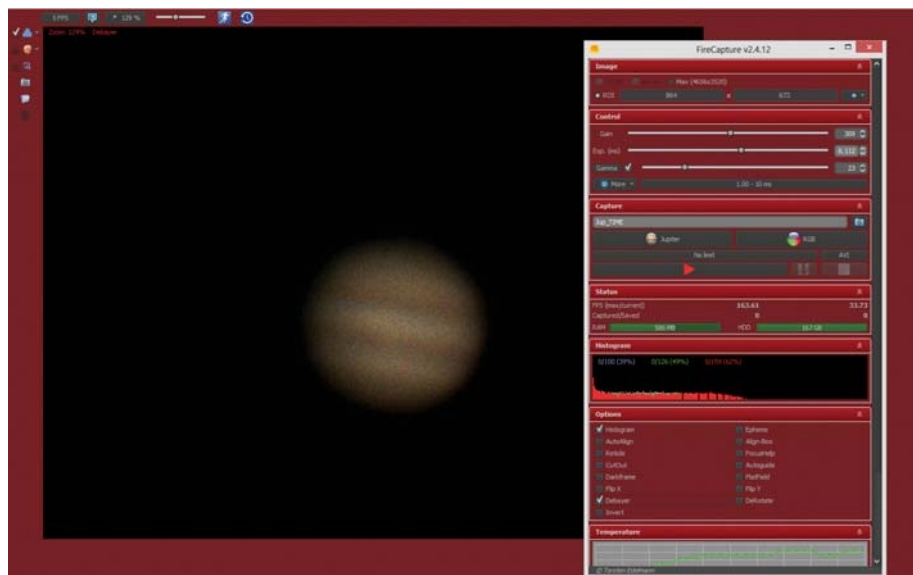
## High-speed Video

When using the ASI 1600MC-Cool for lunar imaging, the camera's large 16-megapixel chip allowed me to shoot the entire first quarter Moon at the native focus of my 12½-inch f/4 Newtonian reflector in a single video. However, the limited write speed of my

laptop's hard drive resulted in a frame rate of 10 to 15 FPS — not terrible, but only around half of the full potential that the camera can achieve. Stacking the result was easy using *AutoStakkert!2*.

Both *SharpCap* and *FireCapture* enable the selection of various ROIs on the chip to achieve higher frame rates when shooting the planets at long focal lengths. These smaller ROIs eliminate the need to download the empty black sky in the field around the planets, which equates to unnecessary baggage in the video or image stream. The small ROIs result in less data that can be read off the chip quickly.

During my time with the camera, Saturn was well placed in the early-evening sky, so I used *FireCapture* to make several AVI video clips of the planet with my Celestron C11 at about f/20. Saturn has a low surface brightness and requires longer exposures than, say, Jupiter or Mars, but I was able to achieve a frame rate of 38 FPS with an ROI of 488 × 388 pixels. The software includes extensive exposure and gain settings that allow satisfactory results regardless of the optical system's effective f/ratio. In fact, *FireCapture* includes many useful features for planetary imagers that are worth exploring for owners of most high-speed planetary video cameras.



▲ Another program included with the camera is *FireCapture*, which provides extensive controls for imaging solar system objects as well as deep-sky targets, with additional support for filter wheels and autoguiding features.





▲ Images produced with the ASI 1600MC-Cool were smooth and noise-free; few hot pixels were noted on uncalibrated files. This colorful shot of M8, the Lagoon Nebula, consists of ten 5-minute exposures recorded through a 102-mm refractor.

## Deep-sky Performance

Although *SharpCap* and *FireCapture* enable you to record exposures up to 20 minutes long, I used *MaximDL* via an ASCOM link to operate the camera for deep-sky exposures. In this configuration the ASI 1600MC-Cool performed like most CCD cameras I've used in the past. I also operated the camera successfully using *Nebulosity 4.0*, again through the ASCOM link. The camera has no mechanic shutter, so you'll need to cover the telescope's objective when shooting dark and bias calibration frames.

In spite of the camera's small pixels, it is very sensitive for long exposures. I often used  $4 \times 4$  pixel binning to boost sensitivity further when aiming and

composing deep-sky shots. This allowed fast readout of low-resolution images before switching to full resolution for the actual exposure sequence.

One limitation of the ASI 1600MC-Cool is its notably shallow dynamic range compared to other deep-sky cameras used by today's amateurs. The camera outputs 8-, 10-, and 12-bit capture modes, while 16-bit data is the standard for deep-sky imaging. The limited dynamic range was evident when shooting deep-sky objects with a wide range of brightness. One way around this is to record short exposures that capture detail in the brighter parts of an object and then shoot longer exposures that record fainter detail in a nebula or



▲ The CMOS detector in the ASI 1600MC-Cool is located just 6.5 mm from the front flange of the camera body, allowing users to include additional accessories between the unit and any field correctors while preserving any critical spacing requirements.



galaxy. The two sets of exposures can be combined in most astronomical image-processing programs.

Early in my testing, I experienced an intermittent-connection problem with the camera. I traced this to the USB connection at the camera. Fortunately, a shot of electronics cleaner on both the cable plug and into the USB socket on the camera solved the issue.

Among the most enjoyable evenings I spent with the camera involved

no recorded images at all. Using the optional lens adapter, I installed an 85-mm f/1.4 lens on the camera and pointed it toward the Milky Way. Immediately, a near-real-time video experience began playing out on my laptop screen as the camera produced detailed, wide-field views of star fields and nebulae in full color with exposures of only a few seconds! Pinkish nebulosity as well as dark nebulae appeared against the rich, golden star fields of our home galaxy.

There were also occasional faint satellites passing through the field that were well below the naked-eye limit but easily seen on the computer screen. Besides the ASI 1600MC-Cool's considerable imaging capabilities, using the camera in such a configuration would be a great public outreach device, which can operate in HD quality or better with the appropriate computer monitor.

## The Bottom Line

The ASI 1600MC-Cool camera is a solid competitor in the field of today's astro cameras, particularly for those of us who do a wide variety of astrophotography. The camera's ability to record high-resolution video of the Moon and planets, as well as its 16-megapixel detector capable of producing vivid color images of deep-sky objects at an extremely affordable price, make it an attractive option for beginners and experienced imagers alike.

Be aware that users looking at purchasing the camera and expecting it to perform at its best should also have a computer with USB 3.0 ports and a very large hard drive with fast write speeds (preferably a solid-state drive), or else they won't be able to achieve the camera's full video potential.

Deep-sky imagers aren't completely off the hook in computer power either. Given that the camera's 16-megapixel detector at full resolution produces a 32-megabyte image, a computer with considerable horsepower is necessary to process these files.

The sparse documentation may be frustrating to first-time users or for astrophotographers moving from a DSLR to a regulated, cooled camera with many settings and wide-ranging capabilities. But once you become familiar with the camera and software, the result will be high-quality images that can show fine lunar and planetary detail as well as dramatic color in nebulous fields throughout the Milky Way.

■ **JOHNNY HORNE**, a veteran newspaper photographer, has spent plenty of all-nighters in his backyard observatory since retiring in April 2016.



The camera's 16-megapixel detector with its small pixels easily fit large targets comfortably on the chip with moderate focal lengths. This image of the first-quarter Moon was recorded in video mode at the Newtonian focus through the author's 12½-inch telescope at f/4.