

Review: Mallincam SkyRaider DS2.3+ The "All-In-One" Video Astronomy Camera

by: Jim Thompson

I can recall precisely the date that I fell in love with using a video camera for astronomical viewing. It was August 26th, 2010, the first night I looked at the Moon through an old Toshiba-brand security camera that I had jury-rigged to my 8" LX10. At the time I had no idea the extent to which a simple video camera could be used to enhance my observing experience. Back in 2010 there were few commercially available astro-video camera choices, but as with all things high-tech that situation has quickly changed in the last couple of years. There is a large assortment of camera types and brands available today, for observing both nearby objects like the Sun or Moon and for deep sky objects. In general astro-video cameras are designed to fill a specific roll, for example: high resolution and high frame rate for solar system viewing/imaging, or high sensitivity and low noise for deep sky viewing. There has been a lack of camera offerings that are able to provide good performance at both, that is until now.

A large part of my fascination with video astronomy, also referred to as Electronically Assisted Astronomy (EAA), is with the cameras themselves. I have spent many nights trying out different styles and brands of cameras, either purchased by myself or borrowed from friends. This past spring/summer I had an opportunity to try out the Mallincam SkyRaider DS2.3+. Over the course of the 6 months that I had the camera I was able to test it on a wide variety of celestial targets, on a range of telescopes, under both light polluted and dark skies. The rest of this article presents my results from that testing.

What's In The box:

The camera comes from the retailer shipped in a sturdy cardboard box with neatly cut closed-cell foam inside to firmly hold each of the components (Figure 1). The package includes the camera itself plus: rubber dust cap, 1.25" nosepiece, 15' long USB3 cable, 10' long ST4 guider cable, and a software installation disk. The DS2.3+ is a 2.3MP one-shot-colour camera based on the Sony IMX302 Exmor CMOS sensor. The sensor diagonal size is 13.4mm and has pixel dimensions of 5.86 x 5.86 μm . The camera is capable of exposure times ranging from 25 μs up to just over 16 minutes, and has a maximum frame rate of 30 fps. The camera body is 80mm in diameter and 85mm long, and has an integrated fan-cooled heat sink for regulating camera temperature. The camera has a standard T-mount interface but also

comes with an adapter to allow connection to C-mount accessories. There are two cable connections on the camera (Figure 2), the main USB3 connection and a standard ST4 guider port in case the user wants to use the camera for guiding. The camera body with C-mount adapter weighs approximately 430g.



Figure 1: Contents of camera package as received from retailer. (photo credit: J. Thompson)

My impression of the camera is that it is a very solid well built unit. The machining and finishing of the all metal casing looks to be of high quality, and the little details such as: a sealed sensor chamber, robust USB3-B type connector, and whisper-quiet maglev cooling fan, all combine to make a top notch product.



Figure 2: Close-up view of camera back panel, showing cooling fan and cable connections. (photo credit: mallincam.net)

Getting Started:

The first step before using the camera was to install the correct drivers and software on my computer. All the files necessary were on the provided disk, or optionally I could have downloaded the very latest software from the Mallincam website. Once the software was installed I simply had to start it up and plug the camera into my computer's USB port to be on my way. I found the camera software Mallincam Sky to be very stable and smooth on my Windows 8.1 computer, having no problems with it even when I purposely unplugged and re-plugged the camera to my computer several times. I also found the software relatively easy to use, with all the camera functions organised in expandable tool boxes along the left-hand side of the screen (Figure 3). The software itself comes with a large assortment of features including: gain and exposure control, colour and gamma adjustments, histogram with adjustable black and white points, flip horizontal/vertical, colour/greyscale, region of interest, crosshairs, live stacking with star alignment, and dark field correction. The dark field correction (DFC) feature allows the user to record a number of frames with the telescope covered and then subtract them from the live image afterwards. This tool works well to reduce the appearance of hot/warm pixels and amp glow. Newer versions of the Mallincam Sky software are released every 3-4 months, so new features and bug fixes are added regularly.

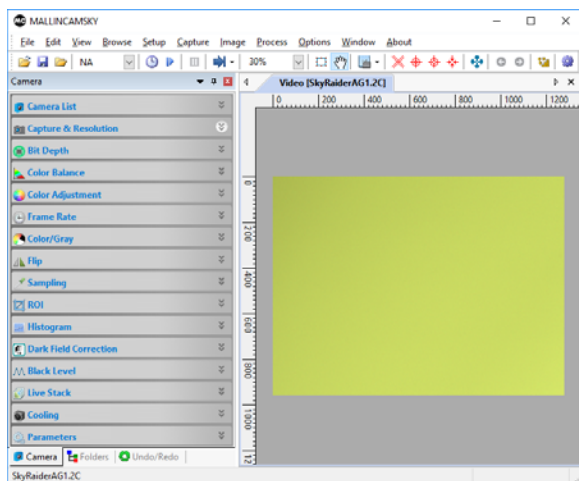


Figure 3: Screen capture of Mallincam Sky software user interface. (photo credit: J. Thompson)

Installing the camera on my telescope was as easy as slipping an eyepiece into the focuser, literally! The 1.25" nosepiece that comes with the kit screws onto the front of the camera, making it into essentially a big fancy eyepiece. For those unfamiliar with video astronomy scope alignment and focusing using a

camera is normally a breeze, with the same being true using the DS2.3+. I set the camera exposure to 1 second and gain at maximum, which gave me a view with plenty of stars visible and a fast refresh rate. This made it very easy to focus the scope and to navigate around the sky to perform my mount's star alignment routine. Focusing was simplified even more by using a Bahtinov mask. Once focusing and mount alignment was completed I was off to my first target.

Solar System Imaging:

I find a lot of enjoyment observing and imaging the Sun and Moon, and to a lesser extent planets. The seeing conditions where I live in central Ottawa, Canada however are typically poor, so I am heavily dependent on the "lucky imaging" technique. The DS2.3+ is not marketed specifically as a solar system imager, but I decided to try it in that role nonetheless. The first object I tried the camera on was the Moon. I had some concerns starting out that the moderately sized sensor pixels of the DS2.3+ would hurt this camera's ability to capture fine detail. In effect more magnification via Barlow/teleXtender would be required to achieve the same angular resolution that a camera with smaller pixels would provide. Typically more magnification means longer exposure times which in turn allows more atmospheric distortion. In the end I found that the high sensitivity of the IMX302 sensor allowed for lower exposure times in general, thus reducing the impact of having to use a longer focal length to get nice zoomed in shots. This sensitivity extends well into the IR band, allowing for the use of an IR pass filter to further improve the image quality. I was very pleased with the f/20 images I captured with my 10" RC, both in the IR band (Figure 4) and visual band (Figure 5).



Figure 4: Theophilus region of Moon around sunset on 12 Apr 2016 (10" RC @ f/20, Baader IR Pass, 50% gain, 15ms exp.) (photo credit: J. Thompson)



Figure 5: Tycho-Clavius region of Moon on 16 Apr 2016 (10" RC @ f/20, Baader Moon & Skyglow, 25% gain, 20ms exp.) (photo credit: J. Thompson)

While I was trying out the DS2.3+ on the Moon it made sense to also try it on any planets that were up at the same time. On the first evening when I was imaging with the IR pass filter I also had a look at Jupiter (Figure 6a). Imaging Jupiter in IR can reveal some very interesting details in the surface features that you cannot discern in the visual band. Later in the month I imaged Jupiter again (6b) but in the visual band, along with Mars (6c) and Saturn (6d). Saturn was very low on the horizon, so I am surprised I was able to get any sort of useful image. My image of Mars however is probably the best I have ever captured from my location.

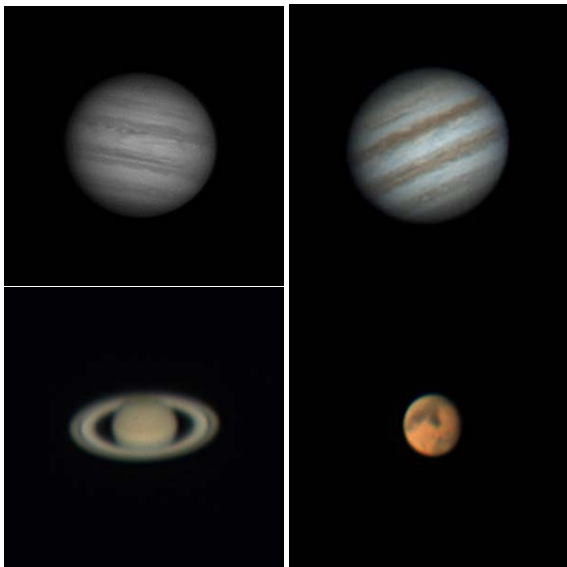


Figure 6: a) Jupiter on 12 Apr 2016 w/ Baader IR Pass; b) Jupiter, c) Saturn, & d) Mars all captured on 16 Apr 2016 w/ Baader Moon & Skyglow; all using 10" RC @ f/20, various gains & exposures. (photo credit: J. Thompson)

Finally I tried using the DS2.3+ to observe the Sun. I used it with white light and Calcium-K via my 98mm

refractor and Baader Herschel Prism (plus appropriate filters), and in H-alpha using a 50mm aperture tilt-tuned etalon from the UK company Solarscope. I also tried white light through my 10" RC scope using a 1000 Oaks part-aperture solar filter. With the later setup I was fortunate to capture a nice close-up of the large sunspot AR2529, including some well defined structure within the umbra itself (Figure 7a). I also had a rare opportunity to use the DS2.3+ to observe the May 9th Mercury Transit from the lawn in front of the Canadian Parliament buildings (Figure 7b). It was quite an experience sharing my live view of the event (Figure 7c) on a screen with the public and a number of famous dignitaries including retired Canadian astronaut Marc Garneau. In all cases I found the camera worked very well for solar imaging, again due to the high sensitivity providing for short exposure times. I also found that the camera's sensor size worked well with my main solar scope, a William Optics FLT98, to give me a well framed view of the entire solar disk.

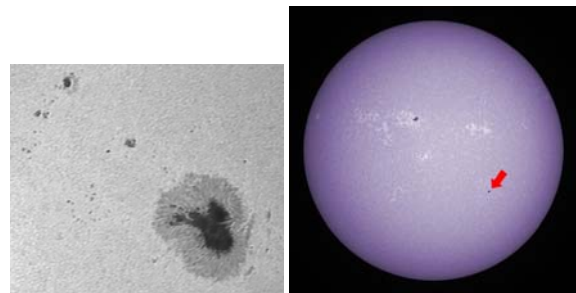


Figure 7: a) Large sunspot AR2529 on 16 April 2016 in white light (10" RC @ f/20, Baader UV/IR Cut, 0% gain, 20ms exp.); b) Photo of my setup on Parliament Hill during Mercury Transit; c) Sun in CaK during 09 May 2016 Mercury transit (FLT98 @ f/6.3, Omega CaK, 0% gain, 4ms exp). (photo credit: J. Thompson)

Deep Sky Video Observing:

For many the main attraction to the DS2.3+ is its ability to provide a "live" view of deep-sky objects. Over the six months that I had the camera I was able to test it on DSO's from both my light polluted backyard (Mv+3.5) and from the relatively dark skies at the family cottage (Mv+5.5). I was able to test it on a variety of telescopes including: Computer 50mm achromat, WO 67mm ED doublet, WO 98mm APO triplet, Meade SCT 6" ACF, and Mallincam 10" RC. The majority of my testing however was performed from my backyard with the 10" RC at f/4.

Most of my EAA experience has been with an analog video camera that produces a standard definition signal (0.3MP) with an 8mm sensor. Stepping up to the DS2.3+ gave me 7.5x the resolution plus a 68% increase in field of view for the same scope and focal ratio. The result was a big improvement in the quality of the image generated from what I am used to. One challenge presented by the larger sensor however was that it is more difficult to achieve fast focal ratios using focal reducers without incurring excessive aberrations. I can easily achieve f/3 with an 8mm sensor camera, but with the DS2.3+ I have not been able to get much below f/4 on the scopes listed above. To get faster than that one would need to move to a Hyperstar system or an astrograph that natively has a fast focal ratio.



Figure 8: Images of bright DSO's captured from my backyard: a) M27 Dumbbell Nebula, 10x30sec; b) M17 Swan Nebula, 10x30sec; c) M8 Lagoon Nebula, 10x30sec; d) M42 Orion Nebula, 1x16sec. (photo credit: J. Thompson)

From my backyard I found that the DS2.3+ performed well on bright DSO's such as the Messier objects (Figure 8). I had quite an enjoyable time revisiting my old favourites at the much higher resolution. Faint details were easier to see when I used the built-in live stacking function, and colour was easy to adjust using the push-button white balance tool. The histogram tool made it simple to fine tune the tone of the image, and the gamma setting allowed me to bump up fainter regions if I needed to. I also found that the DFC feature worked well to reduce the appearance of amp glow and warm pixels (Figure 9). I found it most convenient to record a library of dark frames at different exposures and gains beforehand that I was able to call up later during my observing session.

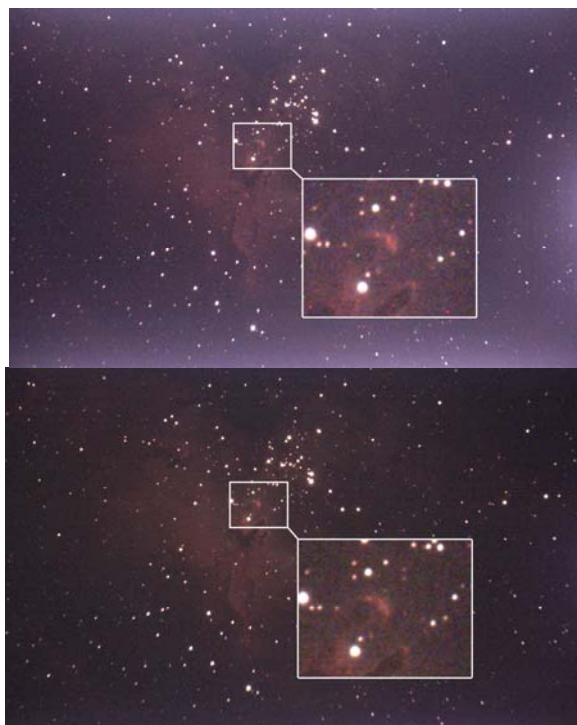


Figure 9: Examples of images captured without (a) and with (b) DFC engaged, showing how amp glow and warm pixels are effectively removed.

I also tried for a few dimmer DSO's (Figure 10) but found them to be quite a bit more challenging with this camera, even when using a light pollution filter. The camera performed much better on dim objects when under darker skies. At a star party in July I also witnessed the camera being used on an f/2 Hyperstar system, and it seemed to work very well in that situation. Perhaps my only dislike of this camera is that there is a delay after you change settings in the software before you see the effect. The way the camera and software work together results in user

setting changes not being implemented until the next frame refresh. Thus if your exposure time is 60 seconds, you will be waiting that long to see the impact of your setting change. This slows down the whole observing experience, more so when under light polluted skies with a moderate focal ratio and thus using generally longer exposure times.



Figure 10: Images of dim DSO's captured from my backyard: a) NGC7293 Helix Nebula, 5x30sec; b) NGC7380 Wizard Nebula, 5x30sec; c) NGC281 Pacman Nebula, 5x30sec; d) NGC2359 Thor's Helmet Nebula, 1x60sec.

Conclusions:

I am happy to have had an opportunity to thoroughly test this camera out. All things considered I think it is a very capable camera. I did not try the camera specifically in a traditional astrophotography role, but there is no reason why it could not be used for that purpose as well. It may be that a better performing camera can be found for doing only solar system imaging or only deep-sky observing, but if you are looking for a camera that gives good results at everything, the DS2.3+ is the camera for you.