ZWO ASI294MC Pro Versus Mallincam SkyRaider DS10C-TEC Comparison
Part 1 - Physical
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Test Report - November 13th, 2018

Introduction:
The Sony IMX294CJK CMOS sensor has shown itself to be a strong performer in the application of Electronically Assisted Astronomy (EAA). There are presently cameras available using this sensor from five different amateur astronomy companies:

- ZWO ASI294MC Pro ($1080USD)
- Mallincam SkyRaider DS10C ($929.00USD) & DS10C-TEC ($1399.99)
- RisingCam G3-10300KPA ($725USD) & ATR3CMOS ($900USD)
- Orion StarShoot G10 ($1099.99USD)
- QHYCCD QHY294C ($999USD)

The obvious question that is raised is: which camera performs the best? There is a range of prices for the available models, and certainly a large portion of the perceived value can be associated with things like customer support, etc., but eventually the question "how do they perform" needs to be answered. I have owned an ASI294MC Pro for a while now, and I was able to borrow a DS10C-TEC from someone here in town, so I can at least compare two of the cameras from the above list.

Objectives:
In this first part of my comparison testing I will survey the physical attributes of each camera. The objective is to compare the performance of the cameras on aspects other than the image quality itself. Things like thermal electric cooling (TEC) system effectiveness and frame rate will be assessed. In a later test report I will present a comparison of image quality related performance, specifically: dark frame comparisons, and signal-to-noise ratio (SNR) comparisons.

Methodology:
The physical parameters of each camera that I plan to report on can be directly measured by hand (dimensions, weight, outer casing temperature), or read out from each camera's software (frame rate, resolution, sensor temperature). The most likely usage scenario is that each camera is used with the software they are distributed with. Thus, in the case of the ASI294 I used Sharpcap v3.2, and with the DS10C-TEC I used the latest version of MallincamSky.

To measure frame rate I connected each camera to the same computer, first via a USB2 port, and then by a USB3 port. Within each camera software I selected a variety of different output resolutions and noted the frame rate reported by the software. For frame rates below 15 fps I manually counted how long it took for 100 frames to be captured and worked the fps out from that. For all the frame rate measurements I set the cameras to their minimum exposure time. Based on the exposure time alone, the theoretical max frame rate for each camera is 31,250fps for the ASI294, and 10,000fps for the DS10C-TEC, so my recorded frame rates are not expected to be exposure limited.

To measure the TEC cooling performance I set both cameras to maximum gain and 20 sec exposure per frame. I then let each camera operate continuously for 30 minutes before measuring the external casing temperature, and recording the sensor temperature reported by the camera software. During this test I monitored the ambient air temperature, which was fairly stable at 23.6°C ± 0.5°C.

Results:
A summary of the physical parameter comparison is provided in the table below. Also provided at the end of this report are photographs I took of each camera as it was unpacked from its packaging. Note that I have been using the ASI294MC Pro for a while but still had all the packaging material on hand, so I was able to return it to an "as received" condition for the purpose of the photographs.

Physical - The DS10C camera is roughly the same diameter but slightly longer than the ASI294, and is heavier by 75g. They both have the same interfaces for USB3, USB2, and 12VDC power. The ASI294 has a single red LED on the back to indicate the cooler is being powered. The DS10C-TEC has a series of four blue indicator LED's on the back that provide status information on: supply power, TEC, fan, and system communications. It is my understanding that blue is the preferred colour for indicator lights since camera sensors are least sensitive to that colour.

Cooling Performance - There was a definite difference in the sensor and casing temperatures between these two cameras, confirming there are physical differences in the design of the two sensor chambers. With TEC off the sensor temp in the DS10C-TEC was 7.3°C warmer than the ASI294MC, suggesting that the sensor in the DS10C-TEC is more isolated from the rest of the camera than it is in the ASI294MC. This is further supported when comparing the TEC on temps. The absolute sensor temp for the DS10C-TEC with TEC on was 3.3°C cooler than for the ASI294MC. In terms of the change in sensor temp achieved by using the TEC, the DS10C-TEC dropped the sensor by 50.6°C (no TEC vs. TEC), but the ASI294MC TEC only dropped the sensor temp by 40.0°C. The DS10C showed there was also a benefit to running the fan alone versus no fan/no TEC. With the fan on the sensor temp was reduced by 6.3°C. The ASI294MC is not able to operate the fan independent of the TEC. Before leaving the discussion of sensor cooling it is important to note that my results are impacted by the ambient conditions during my test (ie. the air temperature) as well as the load that the camera was under at the time. If I were using a shorter exposure time the camera would be working harder and generating more heat, resulting in a higher absolute sensor temperature. Conversely if I were using a longer exposure time the camera would not be working as hard, and the absolute sensor temps would likely have measured to be lower.

Frame Rate - When connected to the computer via USB2, the ASI294MC camera gave slightly faster frame rates than the DS10C-TEC. Interestingly I found that when you compare the total megapixels transferred per second (Mpps), the rates are relatively constant for the two cameras regardless of the resolution setting. When connected to the computer via USB3, the ASI294MC camera still showed slightly higher frame rates than the DS10C-TEC for larger resolutions. Below 4000 x 2000 pixel frame size the ASI294MC for some reason gradually slowed down with decreasing frame size. The DS10C-TEC also slowed down with decreasing frame size but not to the same extent. For example at 1080p and 720p HD resolutions the DS10C-TEC gave frame rates twice as fast as the ASI294MC. Not shown in the summary table was the finding that the DS10C-TEC does not produce the same increase in frame rate using region-of-interest (ROI) in the software as the ASI294MC does. The ASI294MC frame rate scales roughly with the change in frame resolution (1/2 number of pixels, double the frame rate), but the DS10C-TEC never seems to increase in speed by more than a factor of two over the full resolution frame rate. I am guessing this is a software issue.

A final note on prices. I urge caution when comparing the MSRP I listed at the top of this report. There may be other hidden costs such as shipping charges and import fees that need to be included when looking at the landed cost of each camera. Also to be considered is the cost in time and money of support, should it be necessary down the road. There is value there that also needs to be considered.

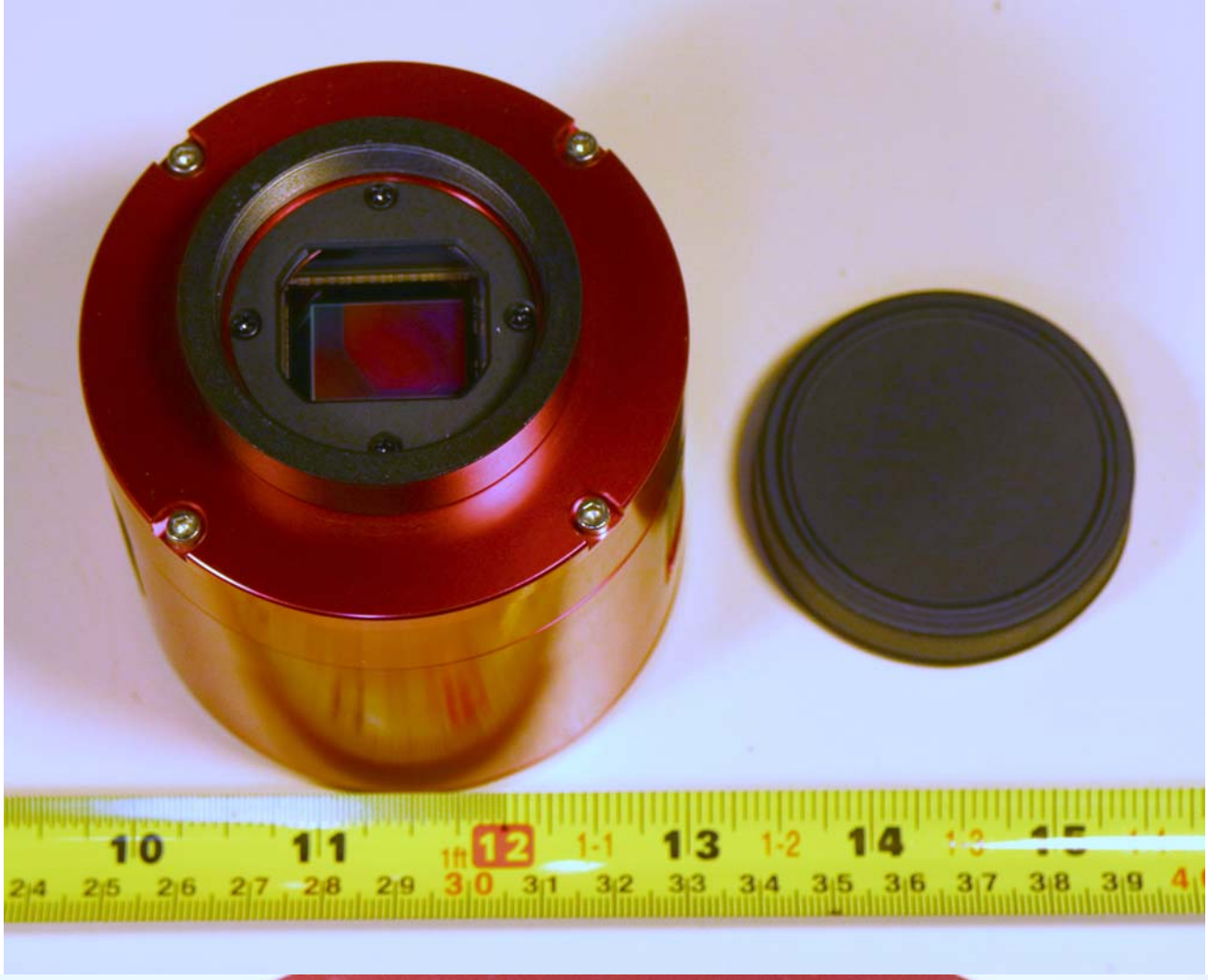
Parameter	ASI294MC Pro	DS10C-TEC
camera body length	74 mm	100 mm
camera body diameter	78 mm	79 mm
mass (+/- 10g)	450 g	525 g
min exposure	0.032 ms	0.100 ms
max exposure	2000 s	1000 s
gain range	0-570	1-160
Tsensor no TEC	27.7 degC	35.0 degC
Tcamera body no TEC	27.1 degC	30.0 degC
Tsensor no TEC but fan on	n/a (can't run fan separately)	28.7 degC
Tcamera body no TEC but fan on	n/a	25.1 degC
Tsensor w/ TEC 100%	-12.3 degC	-15.6 degC
Tcamera body w/TEC 100%	36.7 degC	32.1 degC
Bit Depth	8 or 14 bit	8 or 14 bit
Output Max Resolution	4144x2822	3704x2778, 4096x2160
Binning Options	1x1, 2x2, 3x3, 4x4	1x1, 2x2, 3x3, 4x4
Frame Rate @ Res (USB2)	3.0 fps (4144x2822) - 35.1 Mpps	3.2 fps (3704x2778) - 32.9 Mpps
	3.9 fps (4144x2116) - 34.2 Mpps	3.6 fps (4096x2160) - 31.9 Mpps
	16.6 fps (1920x1080) - 34.4 Mpps	15.2 fps (2048x1080) - 33.6 Mpps
	26.3 fps (1280x1024) - 34.5 Mpps	33.3 fps (1360x720) - 32.6 Mpps
	86.0 fps (640x480) - 26.4 Mpps	n/a (no drop down setting for 640x480 in software)
Frame Rate @ Res (USB3)	16.2 fps (4144x2822) - 189.4 Mpps	16.8 fps (3704x2778) - 172.9 Mpps
	21.6 fps (4144x2116) - 189.4 Mpps	19.2 fps (4096x2160) - 169.9 Mpps
	41.0 fps (1920x1080) - 71.3 Mpps	69.4 fps (2048x1080) - 153.5 Mpps
	43.1 fps (1280x1024) - 45.2 Mpps	96.2 fps (1360x720) - 94.2 Mpps
	85.9 fps (640x480) - 26.4 Mpps	n/a
Comes with	camera body w/2" dust cap, padded camera bag, 2m USB3 cable, quick guide, T2 21mm ext., T2-M48 16.5mm ext., 1.25" nosepiece, 1.25" dust cover, M42-M48 adapter ring, 0.5m USB2 cable x2, T2-1.25" adapter ring, plastic spacer ring x2, software disc	camera body w/T2 threaded dust cap, foam lined water proof carry case, 5m USB3 cable, T2-M48 nosepiece, 12VDC power supply, software disc, spare dessicant tube
Footnotes:		
1. Temperatures recorded after camera at max gain + 20 sec exposure for 30 minutes		
2. With TEC on used same 12VDC 3.34A power supply for both cameras		
3. Ambient air temperature during testing averaged 23.6degC		
4. "Mpps" stands for Mega-pixels per second		


ZWO
ASI224MC-Cool
ASI178MC-Cool
ASI
ASI
ASI
ASI294MC-P
ZWO ASI294MC Pro Color USB3.0 Camera
Made In China


ZWO
ASI Cooled Camera
Quick Guide
21mm
16.5mm


USB2.0 OUT


USB2.0 OUT
USB3.0 IN
DC 12V 3A
ZWO
ASI294MC Pro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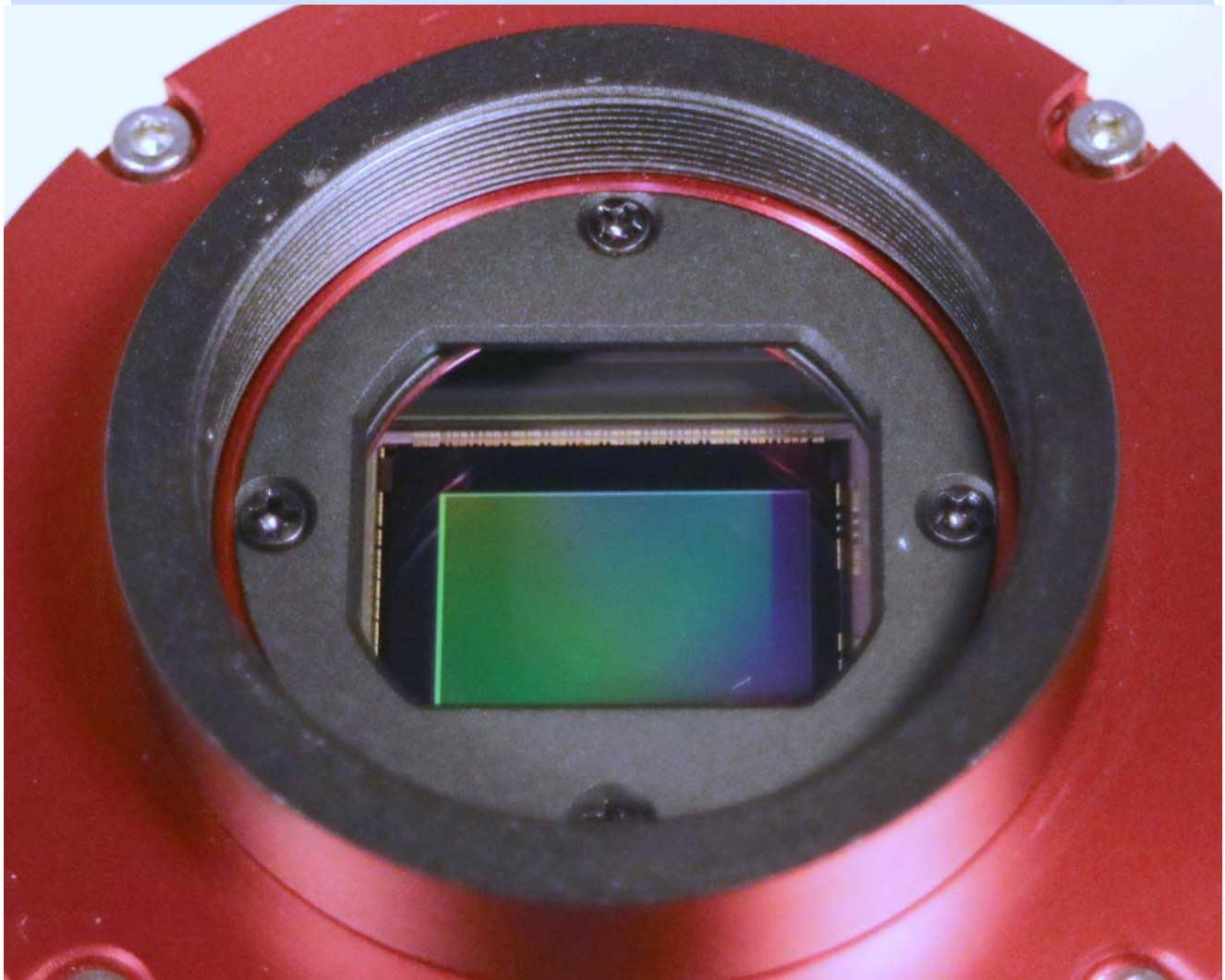


MALLINCAM
PRODUCT NAME: ASTRONOMICAL CAMERA
MODEL NUMBER: SkyRaiderDS10CTEC
USB3.0 /T-Mount
Manufactured Date : 09/19/2018


MALLINCAM
Digital Camera Solution Dis
Microsoft Windows Version
Support Windows XP / Vista / 7 / 8 / 10
32-bit & 64-bit
Mac OSX / Linux


MALLINCAM
Digital Camera Solution Dis


MALLINCAM
SkyRaider DS 10CTEC
USB2.0
USB3.0
PWR
SYS
TEC
FAN
DC 12V


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SkyRaiderDS10CTEC