Analysis of a recently purchased SONY A7s (not model 2)

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October 14, 2017

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I recently (Oct, 2017) got a SONY A7s (not a model 2) and I wanted to determine whether or not it also suffered from the "Star-Eater" problem. This was a brand-new "in the box" purchase of an A7s.

The camera Model is ILCE-7S, serial number 3386334, with firmware V3.20 (7/26/2016).

As an astrophotographer, I was concerned about the "Star Eater" problem, and if so, I wanted to determine analytically what was happening to the RAW files. There are differing opinions on the net concerning "whether or not", "BULB versus camera timing", which ISO values etc. and under which conditions it gets applied.

Rather than go outside and take actual sky shots which would be affected by the temperature, the varying sky seeing and transparency, and the accuracy of my computer guided telescope drive which could "smear" some stars if it didn't work perfectly, I decided to try an indoor experiment.

What I decided to do was to take a bunch of "dark images" where the inherent "noise" would generally appear as "simulated" faint stars - i.e. random low RGB values spread across the frame.

So I set up the A7s and a laptop indoors and performed the following test.

1. Setup

- All images were taken with the body cap on, i.e. all were "Dark Images"
- The camera was powered by battery to eliminate any possible AC adapter noise
- The camera was connected to my laptop via USB cable to eliminate any possible A7s WiFi noise

2. Pertinent camera settings:

Image Size (M:5.1M) - JPEG image size - still a 12 M RAW
Aspect Ratio - 3:2
Quality - RAW & JPEG
Exposure Comp. - 0
White Balance - Auto
DRO/AutoHDR - off
Creative Style - Standard
Long Exposure NR (Noise Reduction) - OFF
Hi ISO NR (Noise Reduction) - OFF
Release w/o Lens - Enable
AF w / shutter - off
AEL w / shutter - off
Silent Shooting - off
e-Front Curtain Shut - On
APS-C Size Capture - off

3. Testing:

- A "Dark Image" was taken for every 3rd ISO value from ISO 400 to ISO 409,600 (11 different values)
- Shots were taken for ~3 second, 10 second, and 30 second exposures for each ISO (a set of 33)
- One set taken at "Manual" using Remote Shooting "Camera timing" (3.2, 10, 30 seconds)
- One set taken at "BULB" using Remote Shooting and manually holding the Shoot button (3, 10, 30 seconds). (I didn't see a way to set the BULB exposure time using Remote Shooting and I did not have an "automatic Bulb-mode shutter release", but I'm pretty darn good at following a clock's second hand).

- A total of 11 x 3 x 2 = 66 shots were thus taken (in one sitting) resulting in 66 RAW and 66 JPEG files.

- The RAW files (4240 x 2832 pixels = 12,007,680 pixels i.e. full sized) were converted to 8 bit TIFs so I could process them with my custom program.

- The JPEG files were 2768 x 1848 = 5,115,264 (5.1 Mp) i.e. a size reduction as well.

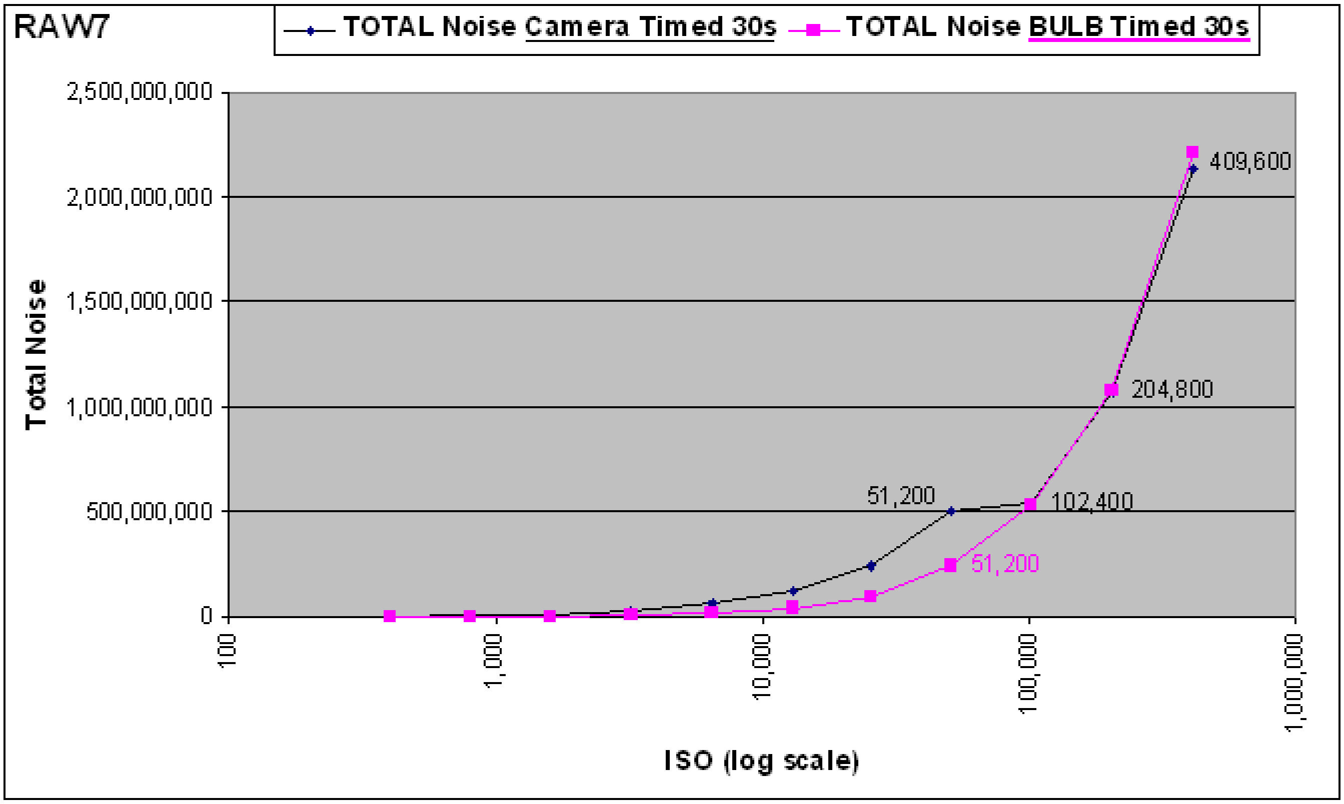
- For every TIF file, a custom made program I wrote looked at every one of the 12 million RGB pixels and calculated the sum of all Red, the sum of all Green, and the sum of all Blue values for that TIF i.e. the noise profile for that image.

- The data (3 values for each of the 66 TIF files) was plugged into an Excel spreadsheet and an analysis of the data was done in graph form to see whether the "star-eater" problem was evident on these "simulated stars".

(The program was then run on the JPEG files to see what effect the JPEG algorithm had on the pixels)

RAW Image Results:

Here is one of the graphs that shows all of the effects that I will explain below.



1. The R,G,B noise counts increased with increasing ISO (as expected - graphs RAW1-RAW9)

2. The R,G,B noise counts increased with exposure time (as expected - graphs RAW1-RAW9)

3. The R,G,B values were similar to each other for all the tests (as expected given random noise)

4. The RAW BULB Timed noise values (all of them) followed a simple curve (graphs RAW2, RAW4, RAW6, RAW7-9, RAW10)

5. The RAW "Camera Timed" noise level curve (black line) has a discontinuity starting after ISO 51,200 where the noise curve suddenly jumped to the "BULB Timed" curve and followed that curve for ISO 102,400 204,800 and 409,600. (graphs RAW1, RAW3, RAW5, RAW7, RAW8, RAW9). Although I did not test every possible ISO value, it appears that the jump is immediately after 51,200 and applies to all ISO values after that.

6. Prior to the "jump" at ISO 51,200 the "Camera Timed" noise levels were higher than the "BULB Timed" values (graphs RAW7, RAW8, RAW9)

Note: *Do not be dismayed by the amount of noise shown in the graph above (with a "Y-axis" up to a count of 2.5 billion). If I took a pure-white image, the 12 million pixels, each with a red and blue and green value of 255, it would total a count = (255+255+255) times 12 million, or more than 9 billion (9,185,875,200 to be exact). So a noise count of 500,000,000 (at ISO 51,200) equals about 5% of the white value. This is considered "very low noise" for a 30 second time-exposure at such a high ISO value.*

7. Although there have been speculations about a problem with exposures going beyond 3.2 seconds, I did not see any unexpected change between 3.2 seconds and 10 seconds in the results.

Conclusion 1

Using ISOs up to 51,200 and using the built in camera exposure timer (up to 30 seconds max) seems to produce the correct response curve to accumulated random noise.

Conclusion 2

Using a BULB setting at any ISO and any exposure time produces images with less "noise" and which always follow a simple mathematical curve. This, I believe, is the primary effect of the "Star-Eater" code which affects ALL BULB settings.

Conclusion 3

Exceeding ISO 51,200 for any internally camera-timed exposures (30 seconds max) apparently invokes the "Star-Eater" code. This, I believe, is the second effect.

Conclusion 4

For normal daytime photography use, people usually use the internal exposure timer (manually or automatically) and seldom use ISO above 51,200. To them the problem does not appear and they assume the Star-Eater issue is not present.

For astrophotographers, using BULB at any value (but mainly to exceed the 30 second limit) - causes the problem. AND using any ISO above 51,200 causes the problem.

However - if an astrophotographer does NOT use a carefully aligned and computerized auto-guided telescope, then all stars (including the faint ones) "trail" across more than one pixel. These elongated star trails (however small) do NOT appear as "noise" to the camera software (which I believe is looking for a single or small group of isolated pixels). Therefore, a slightly "trailed" image will appear "normal" causing them to believe the Star-Eater software is NOT in place. However a "perfect" star image WILL trigger the reduction of these faint pixels.

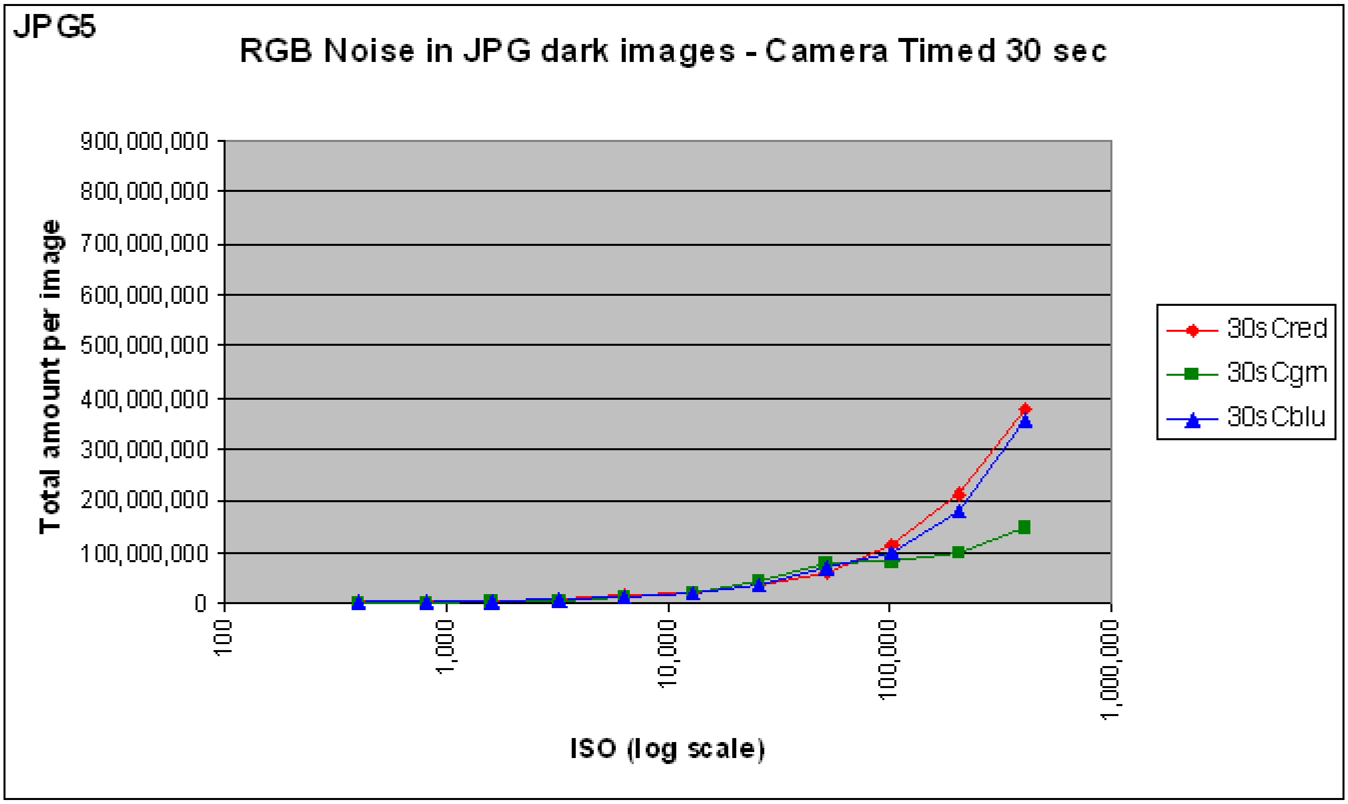
JPEG Image Results:

Professionals usually shoot raw, but those that do not have the time, patience, inclination, disk space, or technology to process RAW images shoot JPEG. They may still may want an A7s for things like low-light movies (not tested here) or the occasional dimly-lighted room exposure.

So, I ran my program on the 66 JPEG images and charted the data in the same manner as for the RAW files. I specifically chose a size reduction as well since a huge number of these JPEG images will be posted on the web, or sent via e-mail where 12 megapixel images just waste bandwidth.

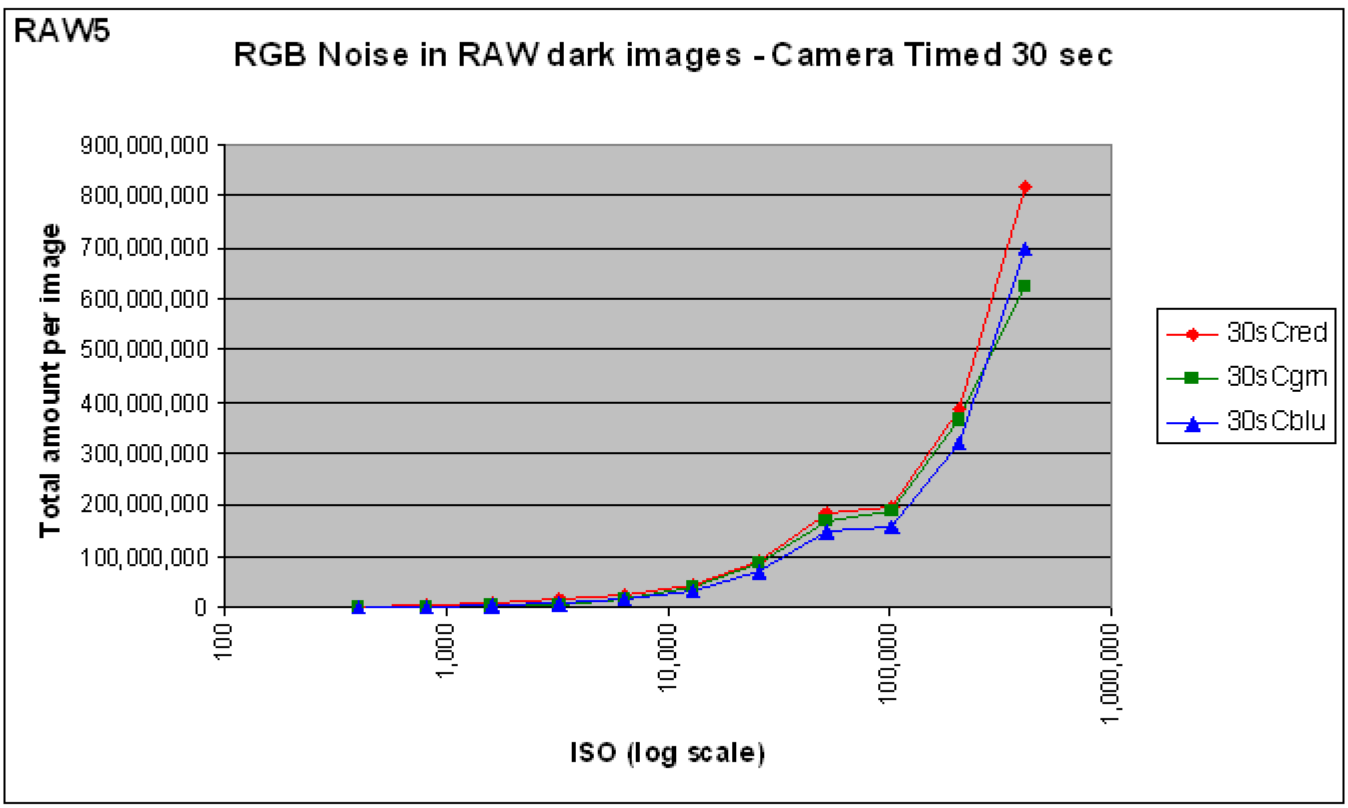
The results were a combination of what I expected and something not expected.

JPEG Observation 1



1. The individual JPEG R,G,B counts tracked together well up to ISO 51,200 after which the amount of "green noise" in the JPEG image is drastically altered (reduced) for both Camera-timed and BULB exposures.

2. Compare this with the same graph for the RAW images:



3. The reduction in JPEG "green noise" is NOT as apparent in the source RAW file itself. It is apparently due to the JPEG conversion algorithm.

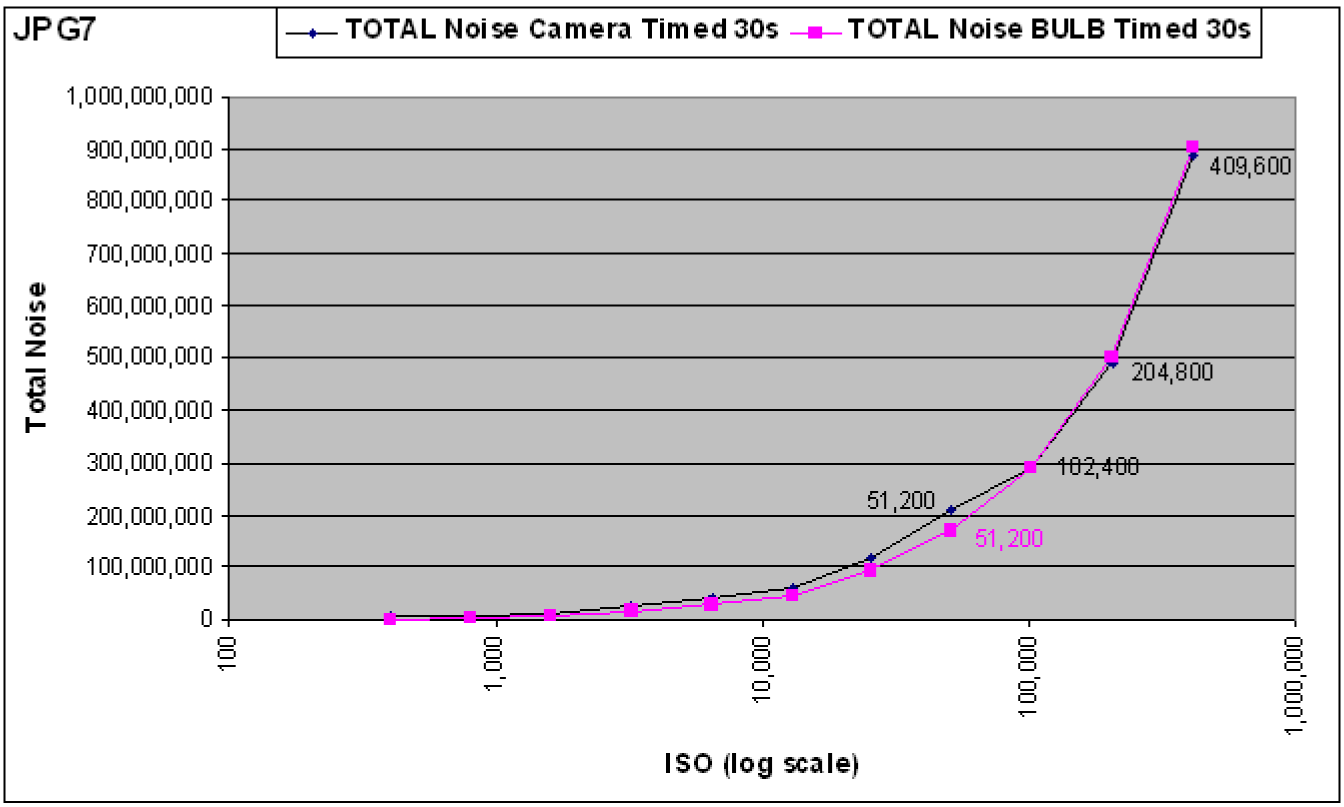
The two images below show what happens when you reduce the green component of a picture by 50%. It turns magenta - just like what you see on the SONY A7s picture review screen on the back of the camera when taking very high ISO images. **Note:** *These images are NOT from my SONY A7s - they are for illustration only. But the JPEG images from this test DO show a definite magenta bias of the noise at high ISO values.*

Conclusion 5

A7s JPEG images at very high ISO values may suffer from a loss of green information regardless of whether they are Camera-timed or BULB timed. A7s RAW images which are later converted to JPEG by image-processing software would NOT incur this effect. This is the third A7s software problem.

JPEG Observation 2

The TOTAL amount of noise in my Camera-timed JPG images is close to the BULB-timed images but it still looks like the JPG smoothed noise in the Camera-Timed images would have exceeded the noise in the BULB timed images until it jumps to the BULB curve after ISO 51,200.



Conclusion 6

The SONY A7s JPEG images are a result of the Star-Eater algorithm AND something that suppresses green at high ISO values.

Summary

A newly purchased SONY A7s with the V3.20 firmware definitely has the "Star-Eater" problem as well as a "greening of JPEGs" problem..

To avoid the problem until it is fixed:

- Shoot at any ISO up to and including 51,200 AND use the camera (or Remote Shooting) internal "Manual" exposure time setting NOT BULB for shots up to 30 seconds.

- Although this seems limiting, an ISO 51,200 image captures what my Canon 60D does at ISO 3200 in a 10 minute exposure - and the SONY does it in 30 seconds!

Appendix A

A shot of the Orion Nebula taken with a different SONY A7s at the prime focus of my 8 inch Celestron NexStar telescope on the night of 2014 December 23. A combination of a 15 second exposure at ISO 120,400 and a 2 second exposure at ISO 51,200 processed in Photoshop.

Appendix B

A screen shot of one of the Excel spreadsheets