ST10XME Power Extension Cable Test

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1. **Mechanical**
   Very stable cable. The connection to the Camera and to the power supply cable is very snug. There is no indication that slight motion of the cable during slewing of the telescope will result in disconnects.

2. **Electrical**
   Measured resistance for the individual leads in the cable. Resolution of my Ohm-meter is only 0.1Ohm, so resistance is below accurate measurement capability.

Lead	Resistance [ohm]
1	0.1
2	0.1
3	open
4	0.1
5	0.1

Assuming 0.1Ohm resistance for each lead and the rated power consumption (SBIG webpage) yield the following estimate for cable IR-drop loss.

Supply [V]	Rated Current [A]	Loss @ 2 x 0.1Ohms	Reduced Supply
5	1.5	0.3	4.7
12	0.5	0.1	11.9

3. **Imaging**
   I used CCDSoft version 5.00.153 to acquire test frames.

Camera	ST10XME
Target	flat light screen

Using the power supply, only the following exposures were made:

Target	#	Exp. [sec]	Binning	Temp. [C]	Cooler [%]
light	10	30	1x1	-20	98
dark	10	30	1x1	-20	98
bias	10	30	1x1	-20	98

Using the power supply plus extension cable the following exposures were made:

Target	#	Exp. [sec]	Binning	Temp. [C]	Cooler [%]
light	10	30	1x1	-20	98
dark	10	30	1x1	-20	96

bias	10	30	1x1	-20	96

The cooling was purposely set very aggressive to put maximum stress on the power supply for the peltier cooling.

3.1 Imaging camera characteristics

I used Richard Berry's AIP4WIN version 1.4.25 for some image statistics. First I used the camera characterization function to determine camera gain and readout noise for the camera when operated with the power supply, only and the camera operated with the power supply and extension cable. The characterization function uses 1 dark, 1 bias and 2 light frames. I used 3 sets of frames from the middle of the run of 10 frames for each setup. The switching to the power supply with the extension cable was made a quickly as possible.

	Power supply, only	
Image set	Conversion Factor e/ADU	Readout Noise e-RMS
bias2, dark2, light2, light3	1.40	11.45
bias5, dark5, light5, light6	1.27	11.01
bias8, dark8, light8, light9	1.35	11.54
Average	**1.34**	**11.33**

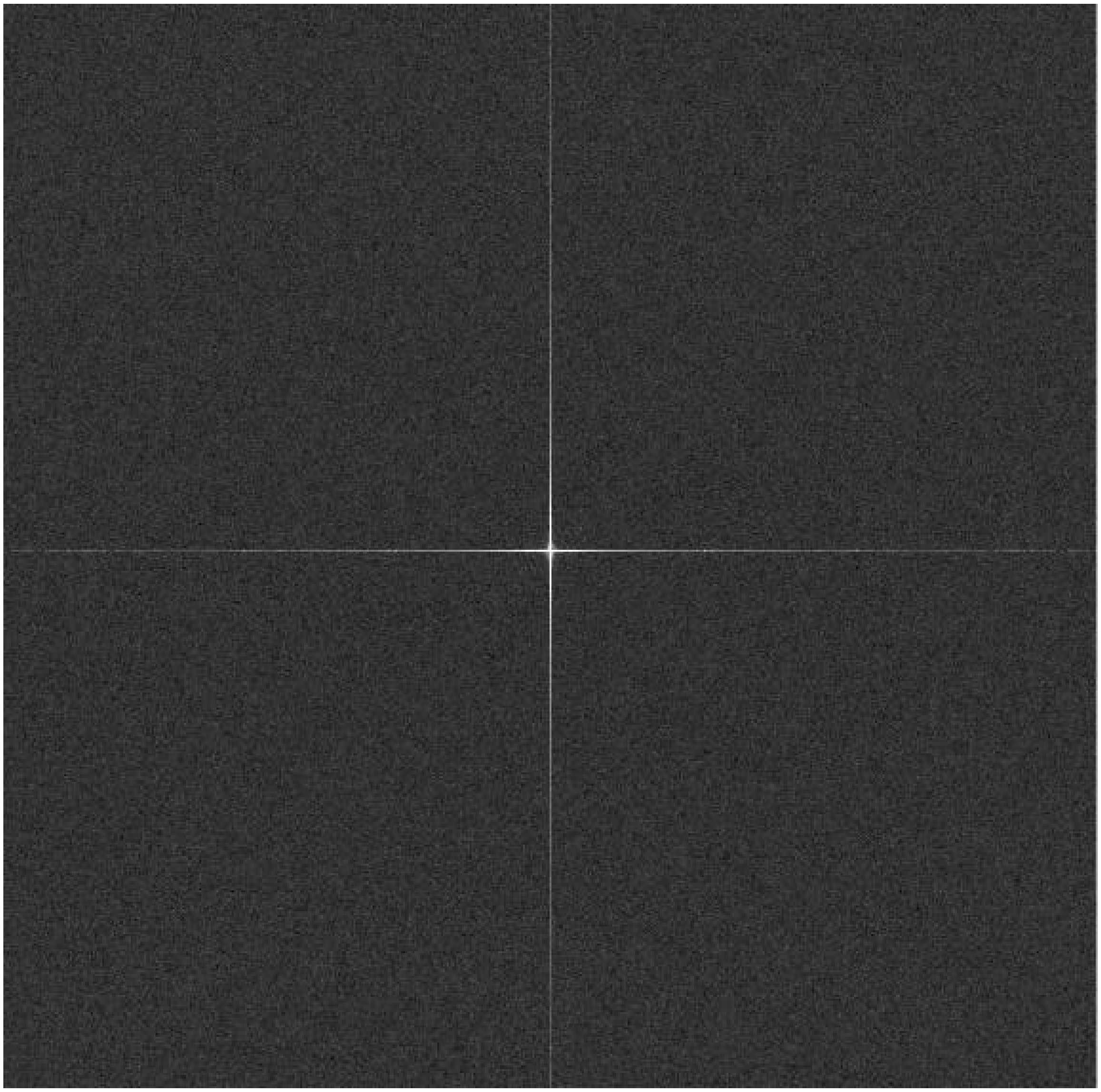
	Power supply with extension cable	
Image set	Conversion Factor e/ADU	Readout Noise e-RMS
bias2, dark2, light2, light3	1.36	10.81
bias5, dark5, light5, light6	1.50	12.33
bias8, dark8, light8, light9	1.38	11.55
Average	**1.41**	**11.56**

The increase in readout noise seems statistically insignificant. The best overall value occurs in the series with the use of the extension cable.

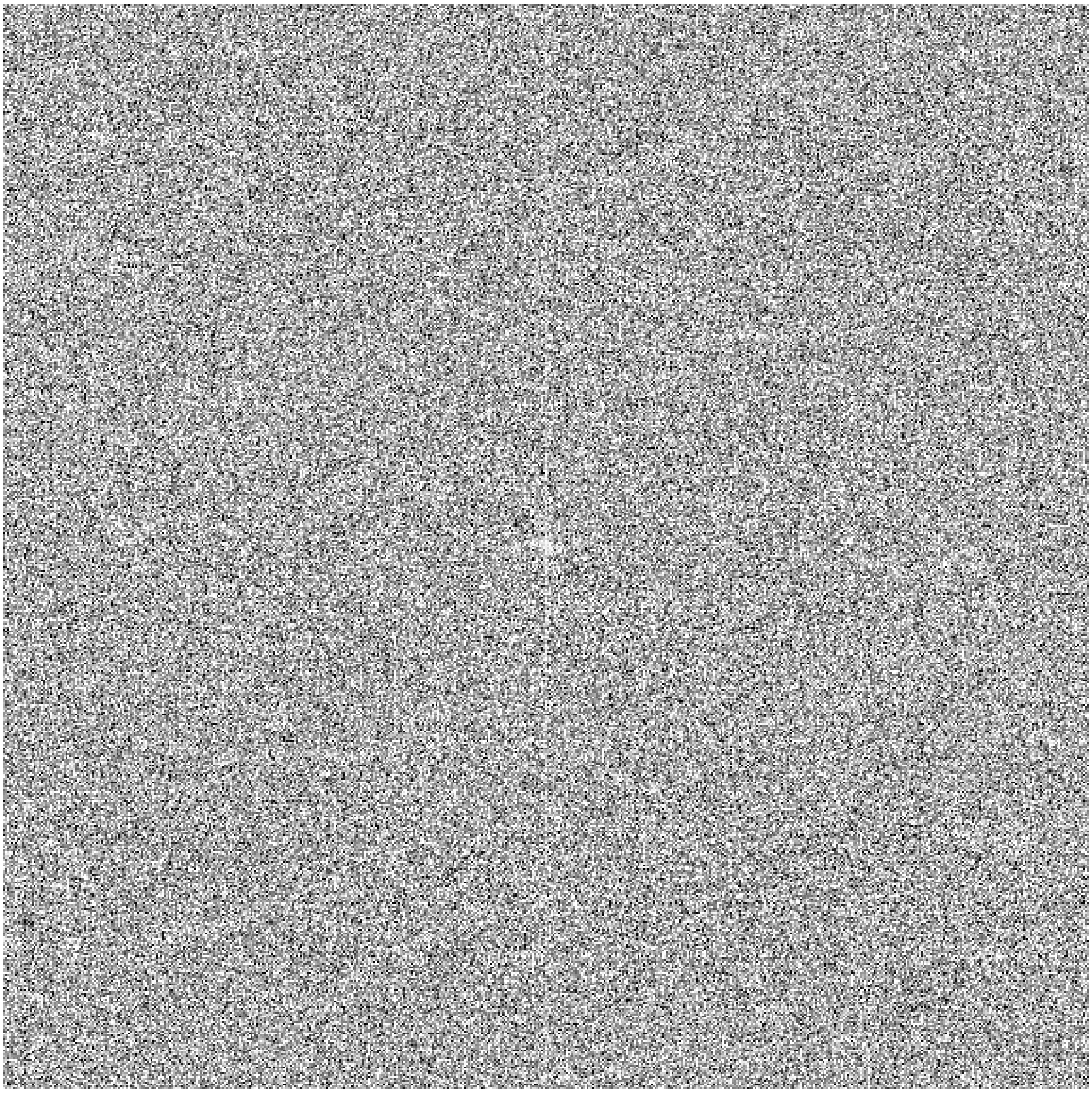
3.2 Image noise periodicity

Interference due to cable cross talk and RF pickup would manifest itself as spikes in the Fourier transform of the image. In the presence of stronger interference to spikes in the Fourier image would be more pronounced. To measure this I cropped a 1024x1024 area from the center of exposures without and with the extension cable, applied the FFT and computed the ratio and difference of the two special frequency images.

This is a typical FFT image (light #5 without extension)

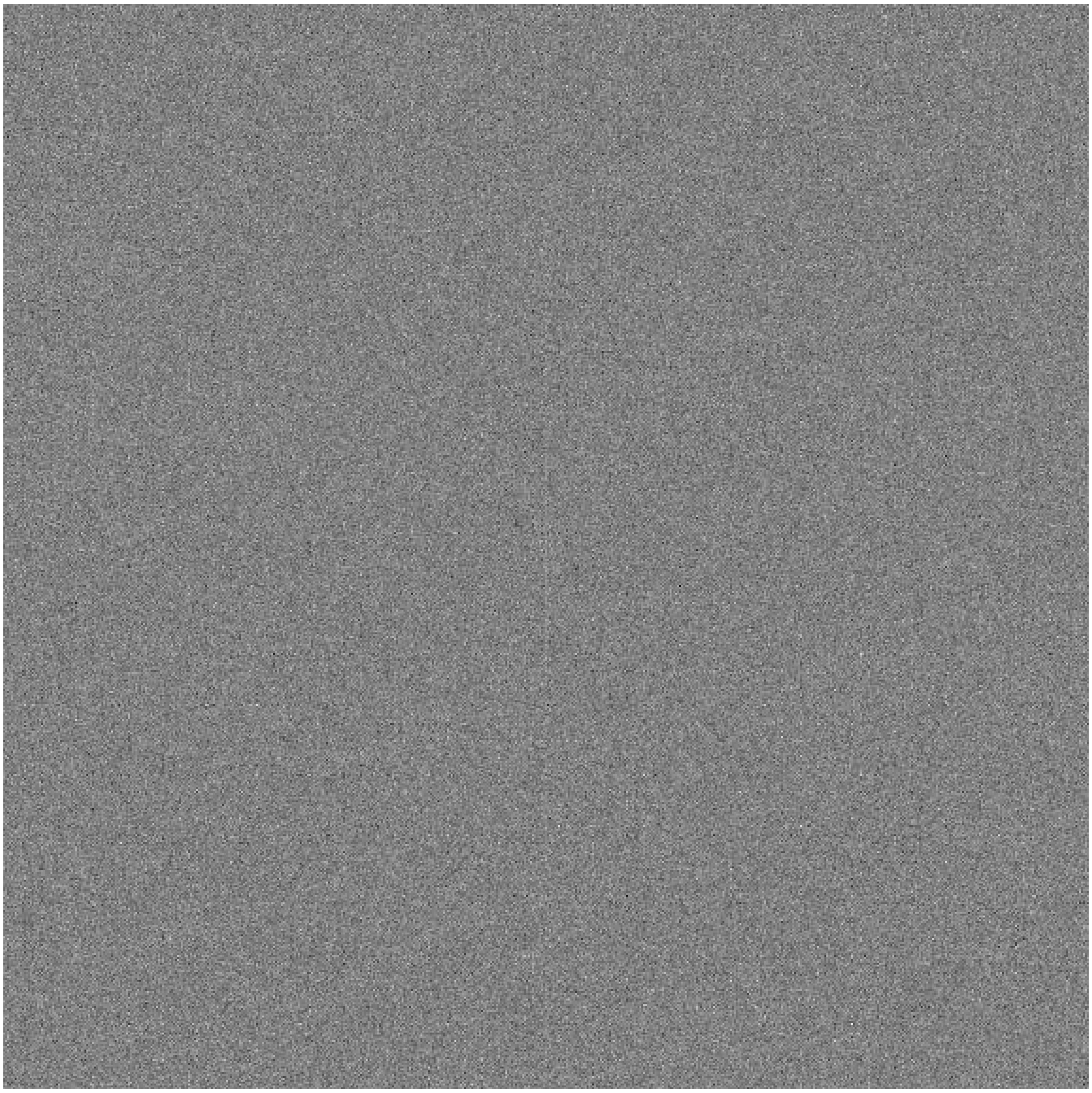


This is the ratio for the light images (#5 each)



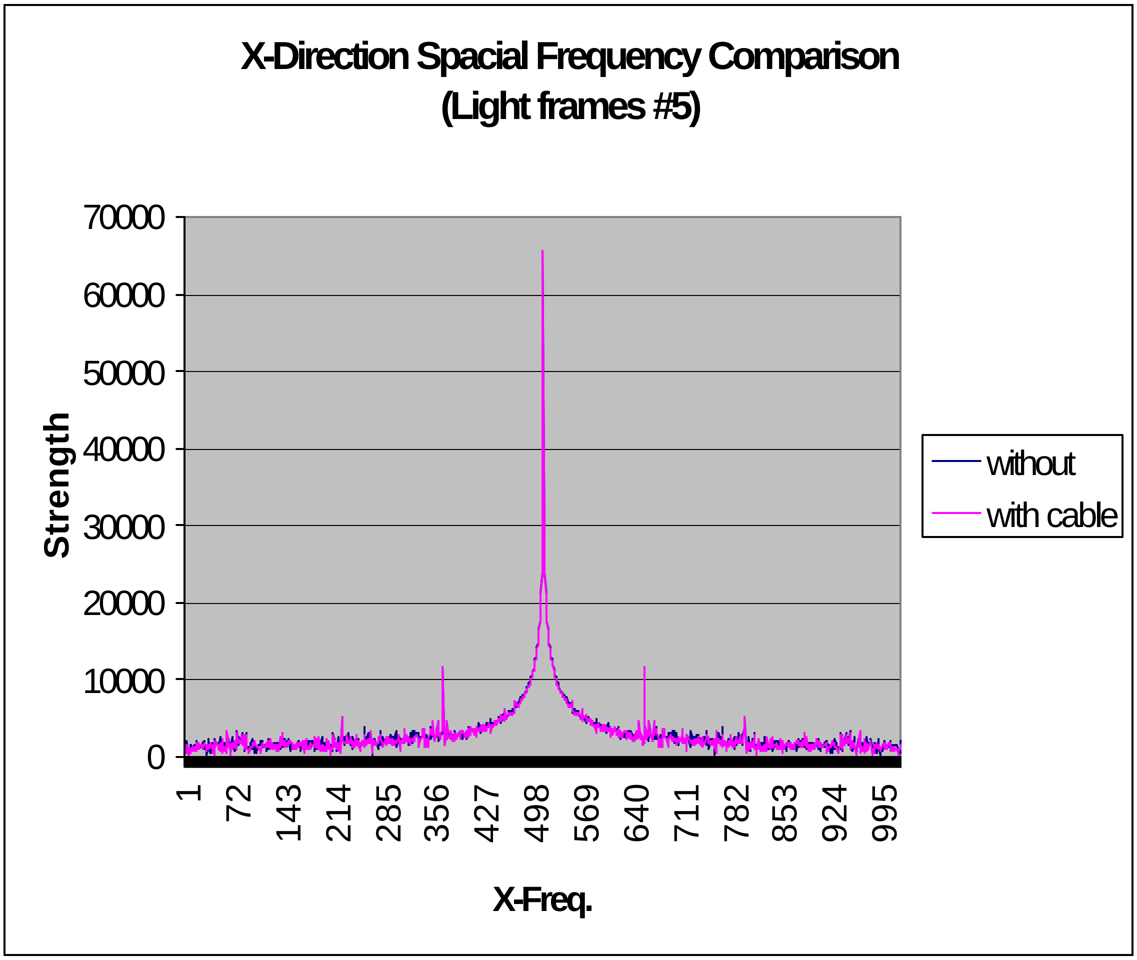
The contrast has been extremely stretched to show the FFT data at all. Otherwise they are negligible. This shows no detectable interference from the use of the extension cable.

This is the difference of two light frames. (#5 each)

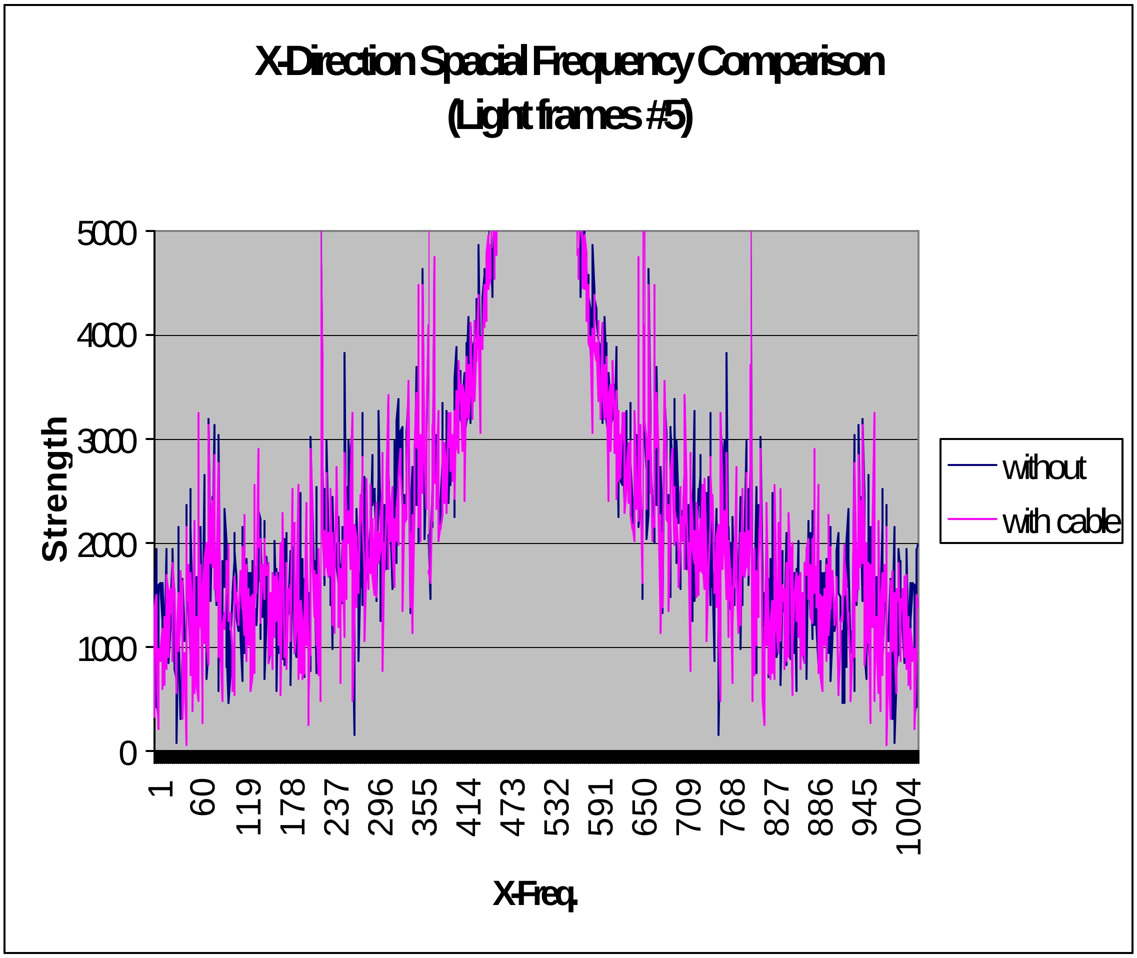


Again, almost no detectable artifacts are visible.

This is the comparison for the x-axis Fourier space. (y=0, x=0…1024). Both curves fit perfectly on top of each other.

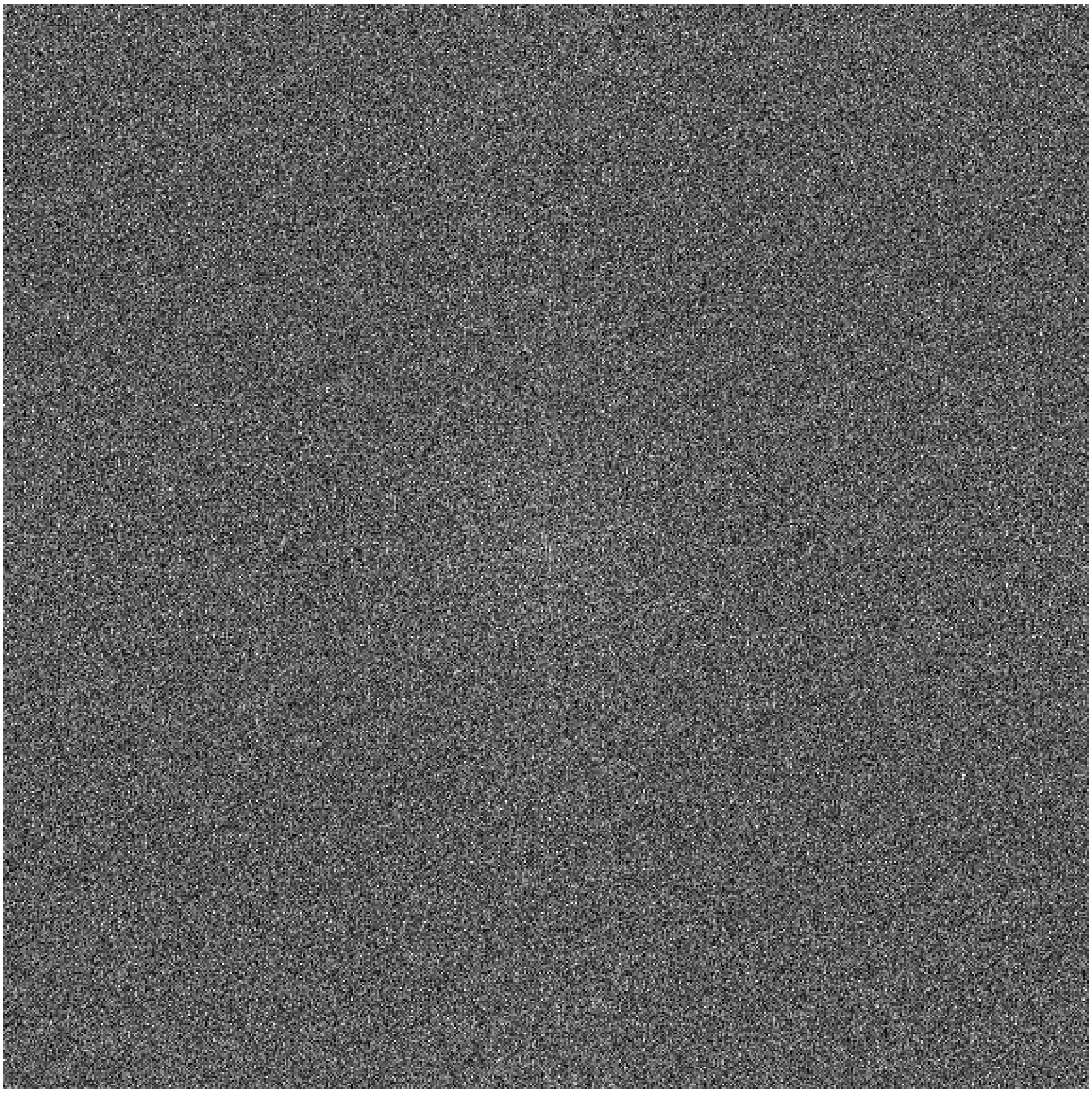


The above was rescaled to show the slightest differences.

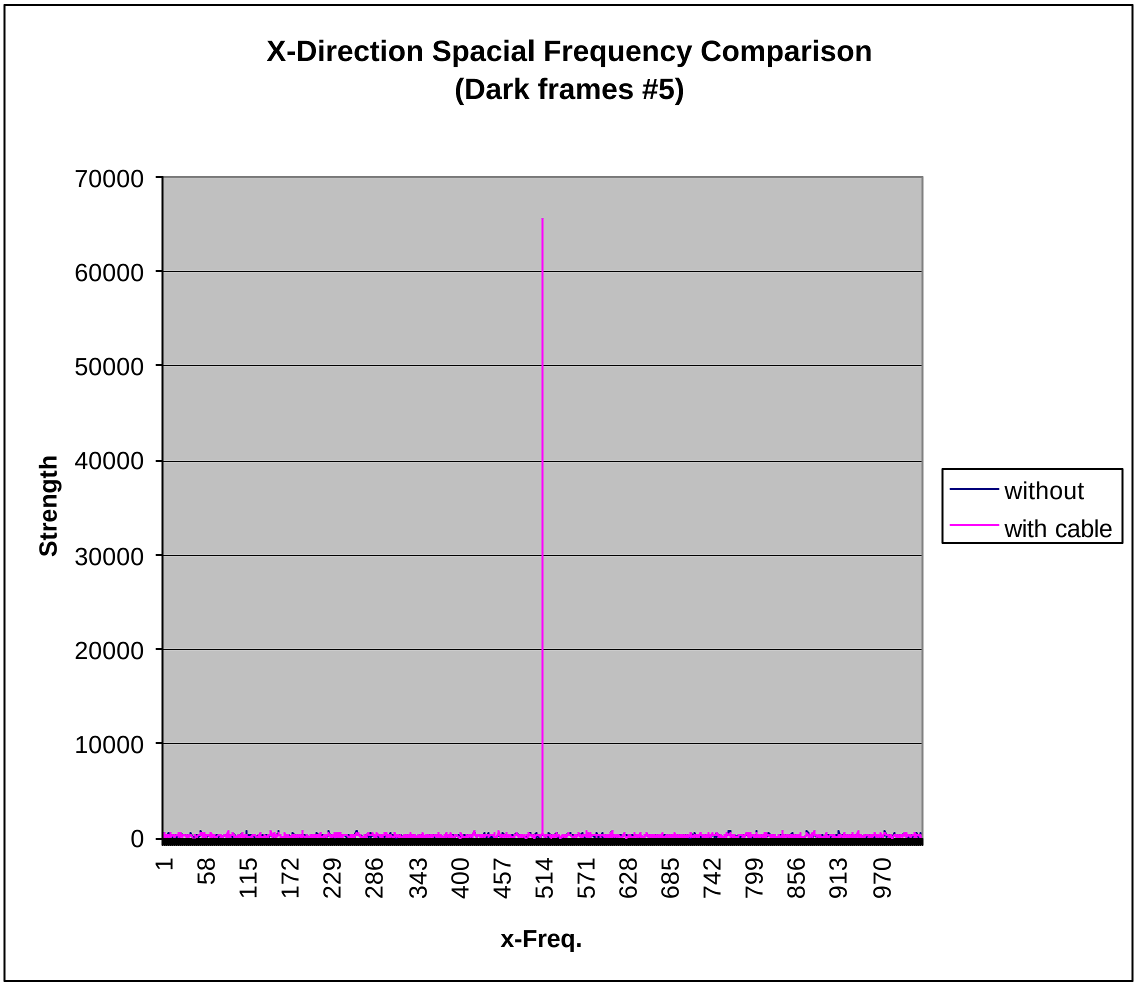


No significant deviation of the two curves can be detected.

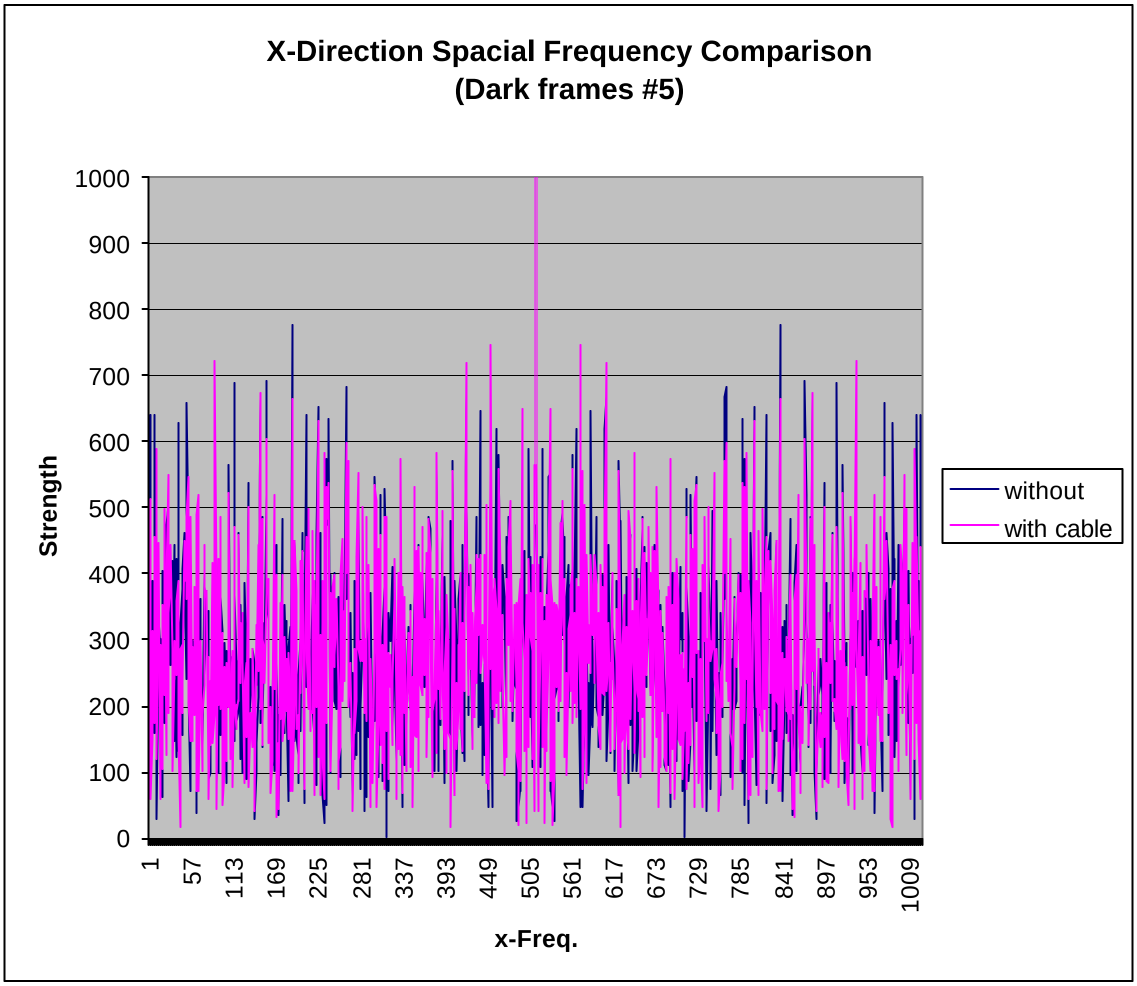
FFT image (dark #5 with cable extension)



Again the comparison for the x-axis Fourier space for the dark frames #5. (y=0, x=0…1024). Both curves fit perfectly on top of each other.



The above was rescaled to show the slightest differences.



Again, no significant deviation of the two curves can be detected.

Summary

A series of images was taken with and without the cable extension. The power supply was put under stress by setting aggressive temperature targets to have maximum current flow through the cable.

The small measured cable resistance (close to resolution limit) will cause a small IR drop in the voltage supplied to the camera. It seems the camera operates fine with the reduced voltage.

The was no significant deterioration of the camera characteristics read noise and ADU conversion factor.

Test images were analyzed for increased interference patterns due to RF or signal interference. In light and dark exposures of 30sec. No measureable artifacts could be documented.

The cable does not negatively impact any camera or imaging performance parameters.