

**Application Note**  
**Dark Frames and Column Defects**  
**May 25, 2005**

Over the past few years Kodak has improved the classification specification for most of its CCDs to eliminate column defects in Class 2 or better cosmetic grades. The two exceptions to cameras currently offered by SBIG are the Class 2 STL-1001E and Class 2 STL-11000CM (This applies to the color CCD only - the monochrome CCD is available only in Class 1). In these two specific cases a Class 2 CCD may have a certain number of column defects, while the Class 1 versions do not. In all other cases for SBIG cameras, Class 2 CCDs have a zero column defect specification.

Since most of our cameras use Class 2 or Class 1 CCDs with no column defects, the issues we often have to address are whether a line that is visible in a dark frame is actually a column defect or something else, and what effect it has on an image. To illustrate, a typical looking raw dark frame is shown in Figure 1. Several bright lines can be seen.

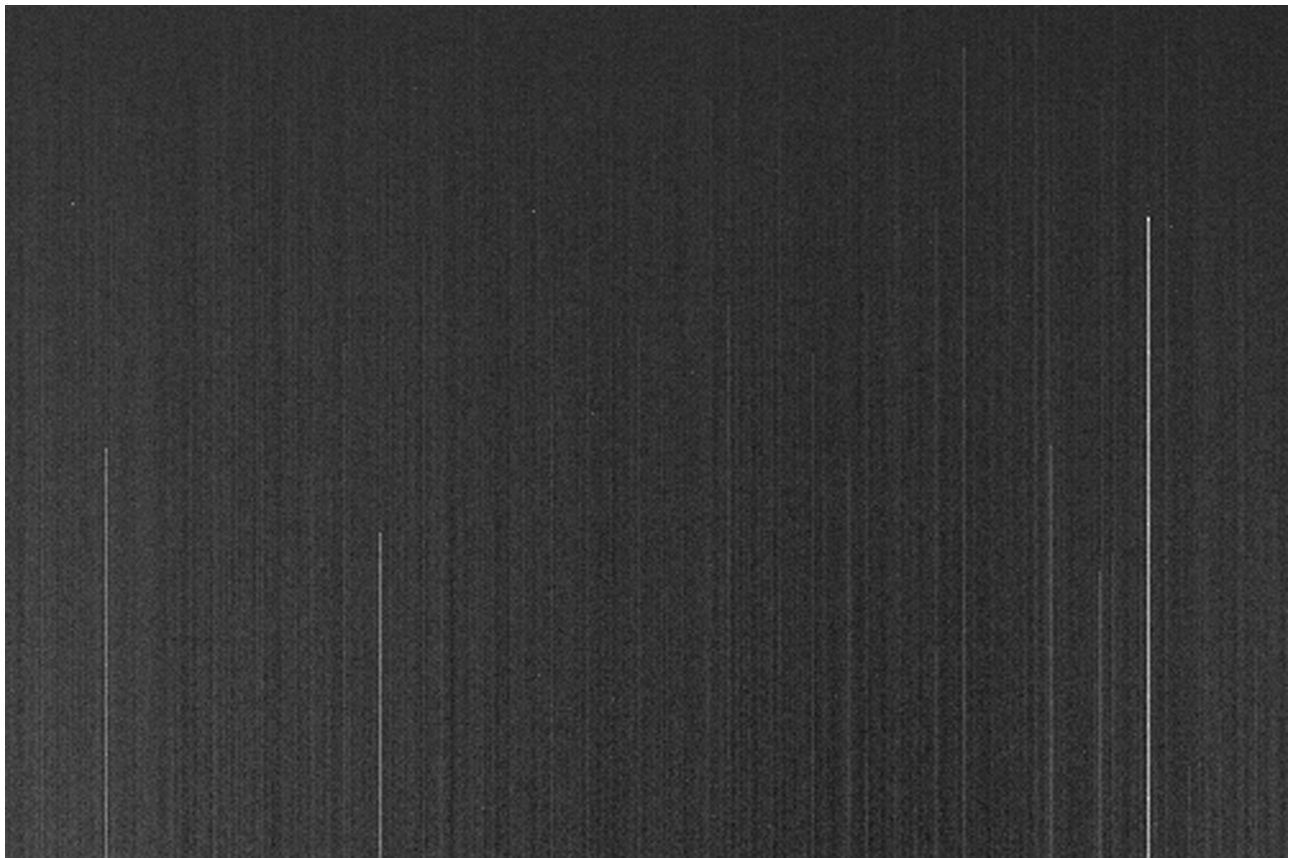


Figure 1

While the lines seen in Figure 1 look like bright columns they are actually just artifacts of the read out process and not CCD defects. There are defects present in the form of hot pixels at the top of each of these lines, but hot pixels are normal occurrences in both Class 2 and Class 1 CCDs. The readout process shifts each one of these hot pixels down the CCD, line by line as it is read out and the resulting raw dark frame looks like it contains bad columns. But the effect is completely repeatable and is removed when the dark frame is subtracted from the light frame as the sequence in Figure 2 demonstrates:

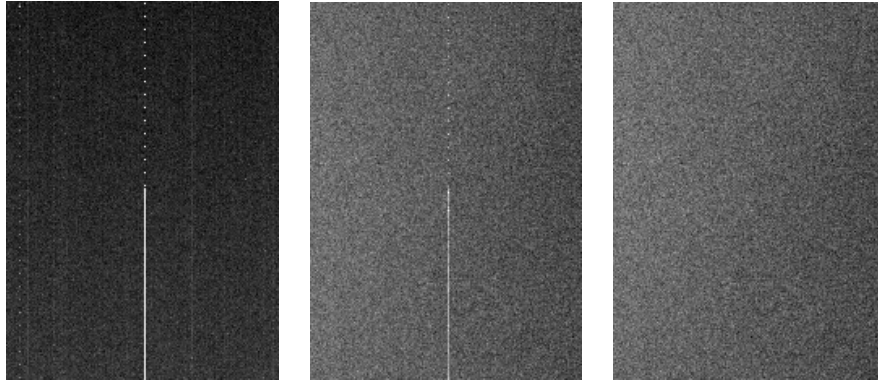


Figure 2

The leftmost frame in Figure 2 is a cropped portion of the raw dark frame from Figure 1 showing the bright line originating from a hot pixel. Note that there is also a dotted line above the hot pixel. The center frame in Figure 2 is a raw light frame showing the same artifact. The final frame on the right is the light minus the dark frame.

There are various reference works and software available to help owners test and evaluate the performance of their CCD camera. Often, a new owner will put the camera through some paces on the bench before using it at night at the scope. These are good practices, but it is also important for new users to know that it is normal for raw dark frames to contain a variety of bright points and lines. With the development of much larger CCDs such as the 11 Megapixel KAI-11000M, the odds of seeing these kinds of things have increased. After all, with 11,000,000 pixels, one can expect a few odd ones. So long as these things disappear when subtracted from a light frame, leaving only the allowed number of warm or cool pixels per the Kodak specification, then the CCD is operating normally and the camera need not be returned for inspection or repair.

A very simple test any user can do to determine if there is a problem or not is to take a single light frame of several hundred counts or more and subtract a single dark frame taken at the same time and of the same duration and temperature and examine the result. Most of the time any bright lines otherwise seen in the dark frame will disappear after the reduction.