

Optimized Modes for Low Light Imaging in the Grasshopper2 FireWire Camera

Technical Application Note TAN2011002

Revised March 27, 2012

1.1. Subject

Technical Application Note (TAN2011002): Optimized Modes for Low Light Imaging in the *Grasshopper2* FireWire Camera

1.2. Applicable Product(s)

- GS2-FW (all models)

1.3. Application Note Description

This application note describes the optimized modes for low light imaging available in *Grasshopper2* FireWire cameras, including:

- Description and use of optimized modes.
- Comparison of imaging metrics, including full well depth, read noise, dark noise, dark current and temperature, between standard and optimized imaging modes.
- Comparison of images between standard and optimized modes.

1.4. About High-Sensitivity and Reduced Noise Imaging Modes in Grasshopper2

Point Grey *Grasshopper2* FireWire (GS2-FW) models provide vendor-specific Format_7 imaging Mode_3 and Mode_8. In these modes, the CCD pixel gain amplifier is disabled, and the vertical pixel clock shift register is slowed. These features result in reduced read noise, dark noise and dark current. Longer extended shutter times—up to 330 seconds—are also supported in these modes.



To achieve high shutter values the frame rate must be turned off.

When using Format_7 Mode_3 or Format_7 Mode_8 with the *Grasshopper2* FireWire camera, keep in mind the following:

- Image exposure and readout are not overlapped.
- The noise reduction feature of these modes is not available when operating in an asynchronous trigger mode.
- Outputting a region of interest (ROI) is not available.
- Format_7 Mode_3 performs 2X2 pixel binning, and is available only in monochrome pixel formats.

1.5. Imaging Metrics Comparison

Table 1 shows the results of photon transfer curve tests conducted on a *Grasshopper2* 14S5M camera in different Format_7 modes. Testing was conducted under the following conditions:

Gain: 0 dB

Shutter speed: 1.0 ms

Pixel format: Mono16

Resolution: Max

Results indicate that optimized imaging performance modes yield significantly lower read noise and dark noise. Average operating temperature, which is reported by the camera's on-board temperature sensor, is lower in low-noise mode.

Metric	2X2 binning	Low Noise Mode	Full well depth (e-)	Read noise (e-)	Dark noise (e-/s)	Dark current (e-/s)	Gain (e-/ADU)	Average operating temperature (C)
Format_7 Mode_0			19,845	12.06	10.79	204	0.303	41.1
Format_7 Mode_1	✓		14,098	51.71	20.91	815	0.296	41.5
Format_7 Mode_3	✓	✓	15,104	9.63	8.50	739	0.267	34.5
Format_7 Mode_8		✓	19,110	7.51	4.67	202	0.279	35.0

Table 1: Format_7 Imaging Metrics

1.6. Imaging Comparison

The images on the following pages show the reduced noise effects when the *Grasshopper2* FireWire camera operates in modes optimized for low noise imaging. The images, and their corresponding

pixel surface plot diagrams, were taken with a *Grasshopper2* GS2-14S5 at maximum resolution (1384x1036), maximum gain (24 dB), and in total darkness (camera in a darkened environment and lens cap screwed on).

Two sets of images are compared. Both sets compare performance between Format_7 Mode_0 and Format_7 Mode_8 (optimized performance mode), Mono8 pixel format. The images in Figure 1 and Figure 2 are exposed for 100 s; the images in Figure 3 and Figure 4 are exposed for 20 s. Note that, in order to achieve these long exposure times in Format_7 mode_0, the camera operates in bulb-shutter trigger mode (IIDC Trigger_Mode_1). In Format_7 Mode_8, the camera is operating in free-running mode.

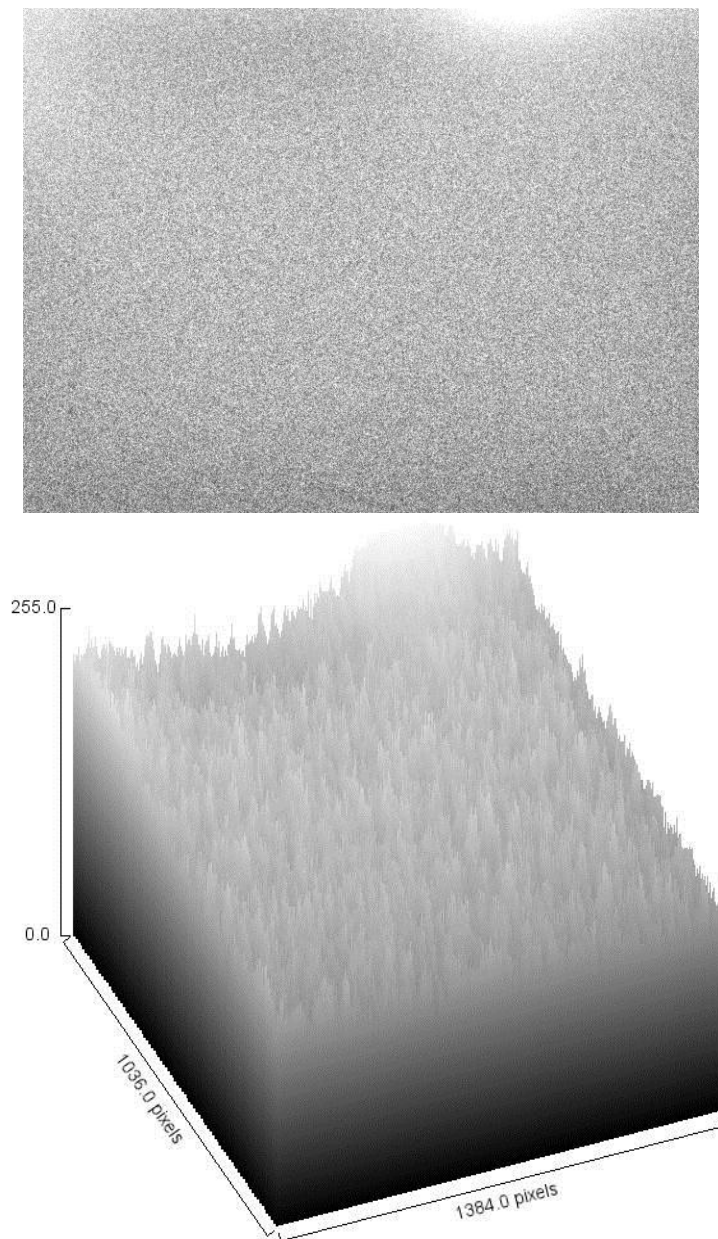


Figure 1: Image and Corresponding Surface Plot Diagram: Format_7 Mode_0, Exposure 100 s

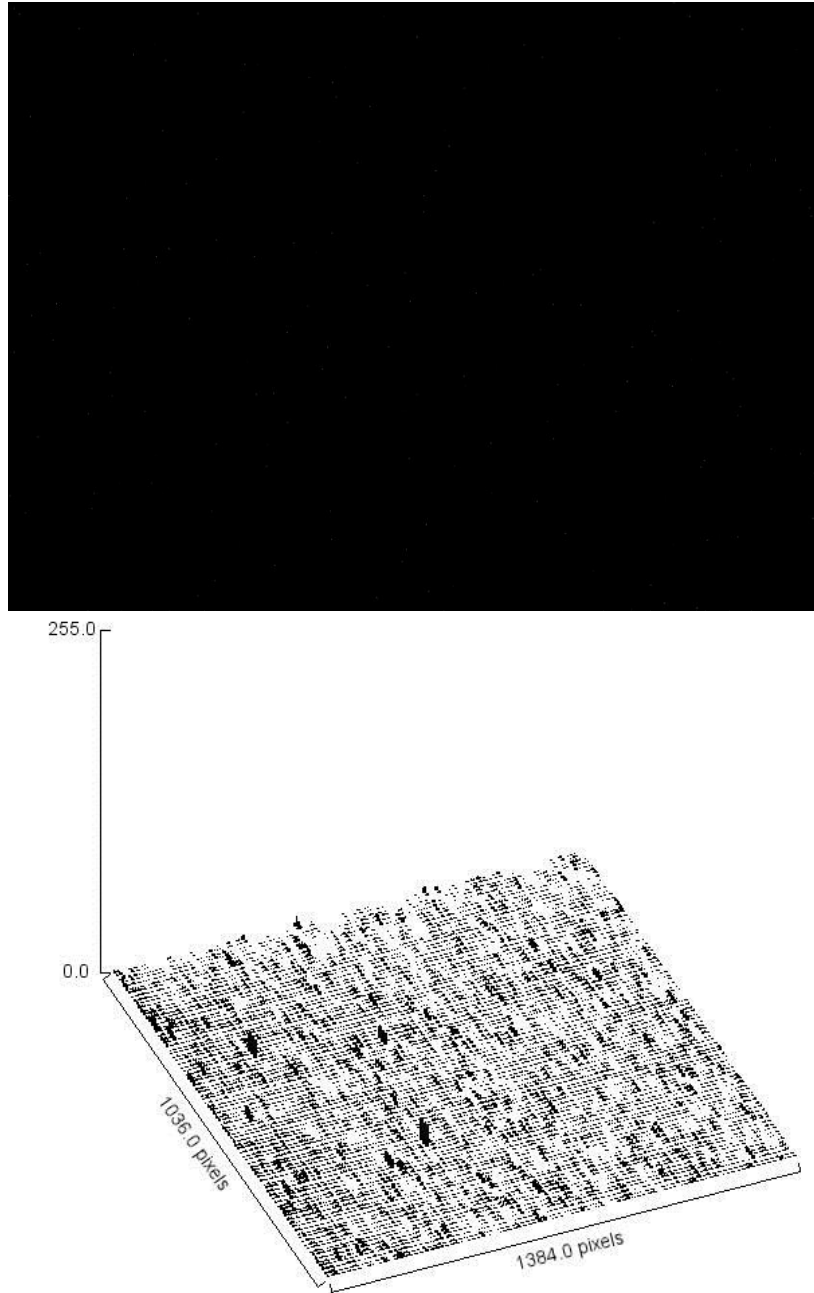


Figure 2: Image and Corresponding Surface Plot Diagram: Format_7 Mode_8 (Optimized Imaging Performance Mode), Exposure 100 s

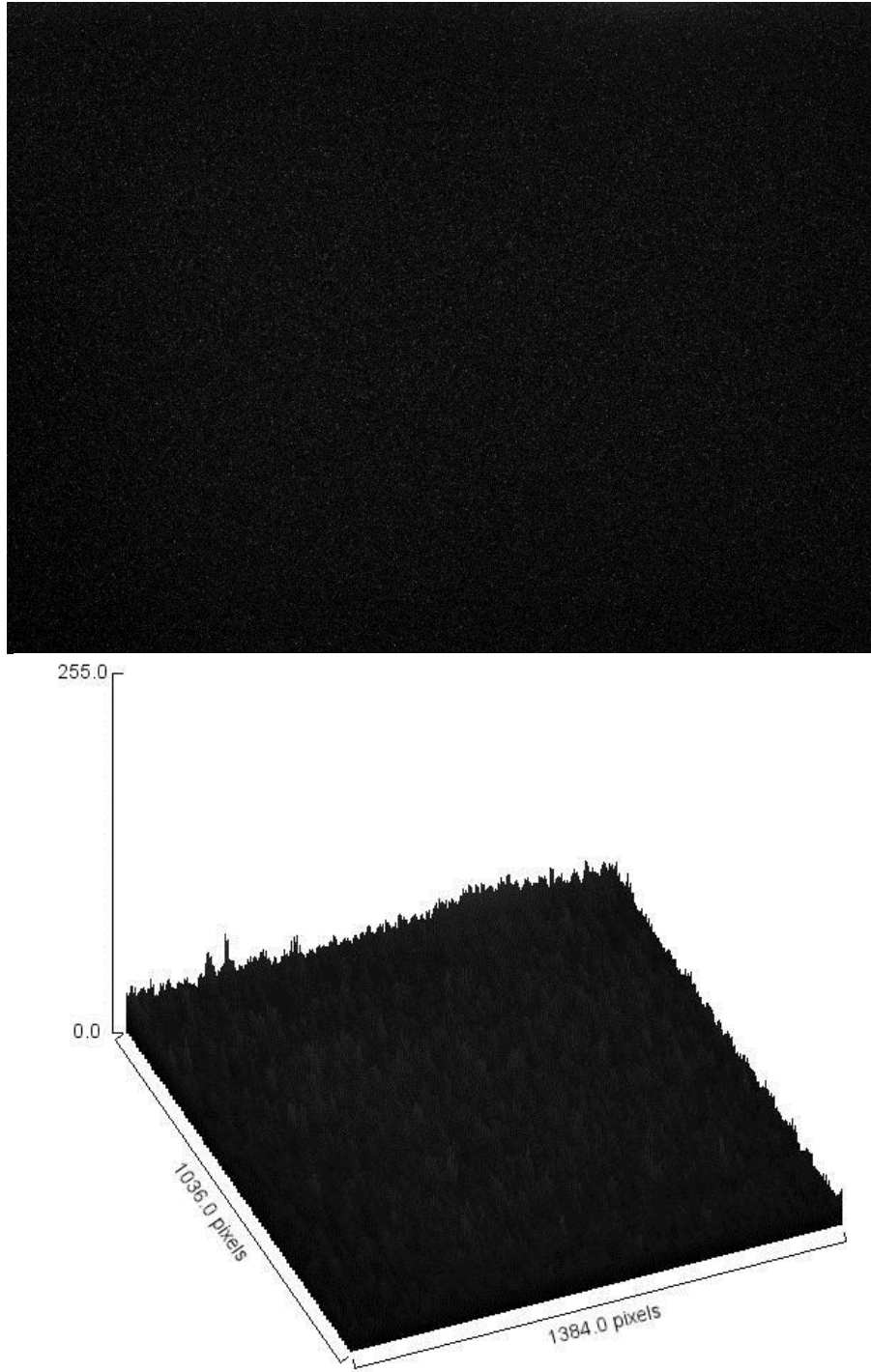


Figure 3: Image and Corresponding Surface Plot Diagram: Format_7 Mode_0, Exposure 20 s

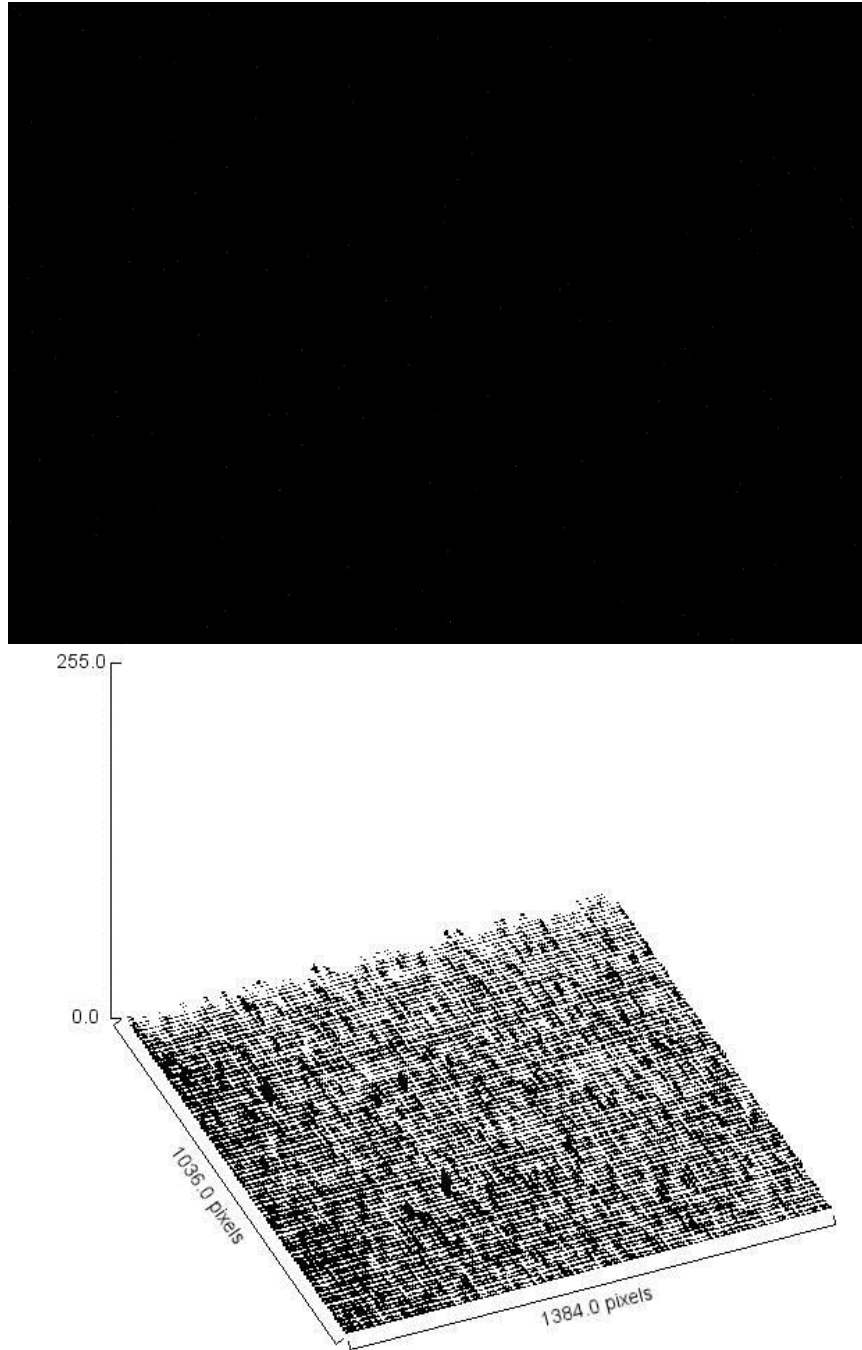


Figure 4: Image and Corresponding Surface Plot Diagram: Format_7 Mode_8 (Optimized Imaging Performance Mode), Exposure 20 s

1.7. Additional Downloads and Support

Access more Technical Application Notes on the web at www.ptgrey.com/support/downloads.

Point Grey Research Inc. endeavors to provide the highest level of technical support possible to our customers. Most support resources can be accessed through the Product Support section of our website: www.ptgrey.com/support.

Creating a Customer Login Account

The first step in accessing our technical support resources is to obtain a Customer Login Account. This requires a valid name, e-mail address, and camera serial number. To apply for a Customer Login Account go to www.ptgrey.com/support/downloads/.

Knowledge Base

Our on-line knowledge base at www.ptgrey.com/support/kb/ contains answers to some of the most common support questions. It is constantly updated, expanded, and refined to ensure that our customers have access to the latest information.

Product Downloads

Customers with a Customer Login Account can access the latest software and firmware for their cameras from our downloads site at www.ptgrey.com/support/downloads. We encourage our customers to keep their software and firmware up-to-date by downloading and installing the latest versions.

Contacting Technical Support

Before contacting Technical Support, have you:

1. *Read the product documentation and user manual?*
2. *Searched the Knowledge Base?*
3. *Downloaded and installed the latest version of software and/or firmware?*

If you have done all the above and still can't find an answer to your question, contact our Technical Support team at www.ptgrey.com/support/contact/.