“Bad Columns”

Richard Crisp

27 January 2014

rdcrisp@earthlink.net

Preliminary, not released, for Greg only

Bad Columns

- Have a very specific definition in the terminology of Truesense

DEFECT DEFINITIONS FOR TESTING AT 40 °C

Description	Definition	Grade 1	Grade 2 Mono	Grade 2 Color	Notes
Major dark field defective bright pixel	PD_Tint = Mode A → Defect ≥ 565 mV	270	540	540	1
Major bright field defective dark pixel	Defect ≥ 12%				
Minor dark field defective bright pixel	PD_Tint = Mode A → Defect ≥ 282 mV	2700	5400	5400	
Cluster Defect	A group of 2 to 19 contiguous major defective pixels, but no more than 4 adjacent defects horizontally.	20	n/a	n/a	2
Cluster Defect	A group of 2 to 38 contiguous major defective pixels, but no more than 5 adjacent defects horizontally.	n/a	50	50	2
Column defect	A group of more than 10 contiguous major defective pixels along a single column	0	7	27	2

Notes:

1. For the color devices (KAI-29050-CXA and KAI-29050-PXA), a bright field defective pixel deviates by12% with respect to pixels of the same color.
2. Column and cluster defects are separated by no less than two (2) good pixels in any direction (excluding single pixel defects).

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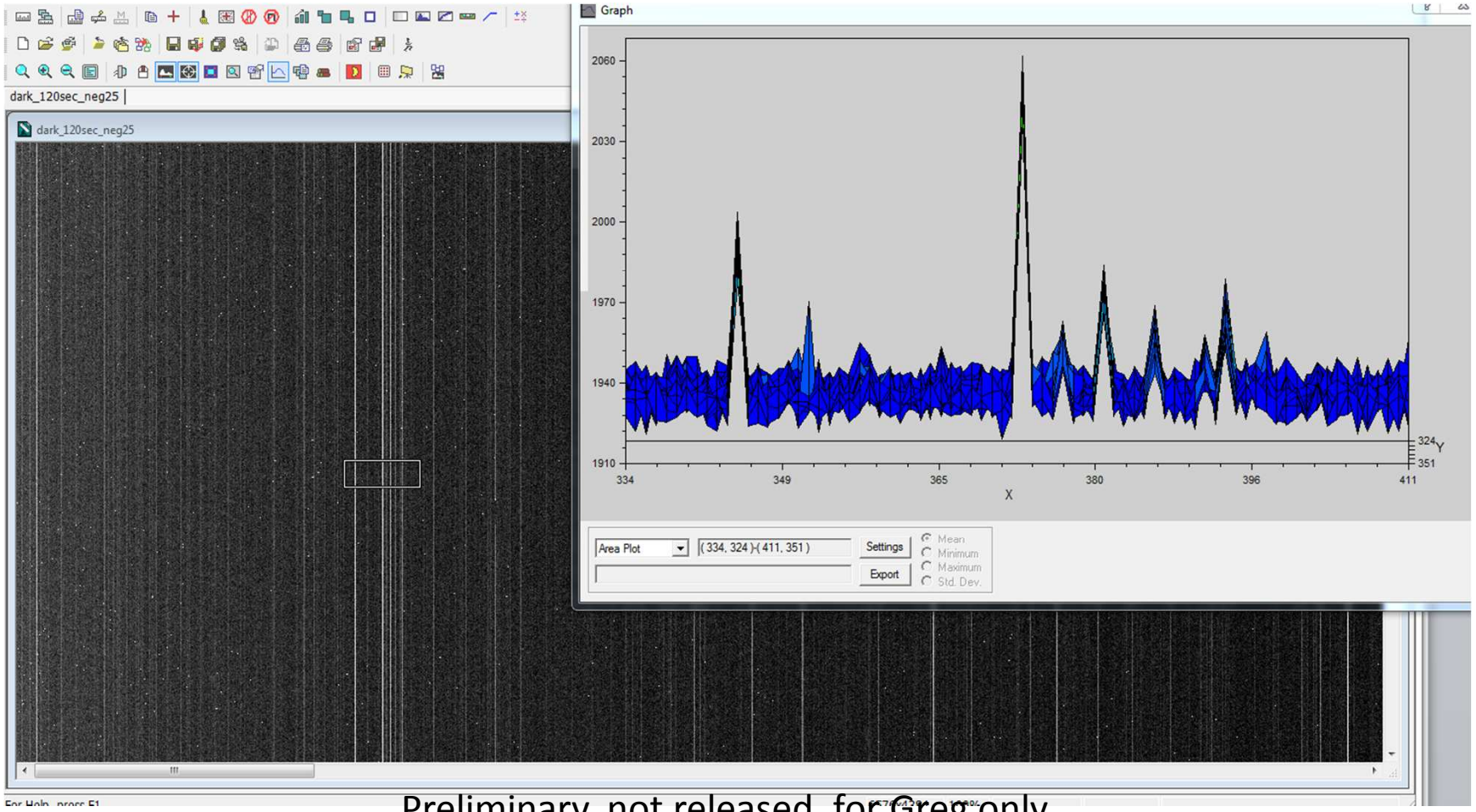
Why is this not a Bad Column?



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Read and Interpret the Specs

TRUESENSE imaging, inc.

KAI-29050 Image Sensor

Summary Specification

KAI-29050 Image Sensor

Description

The KAI-29050 Image Sensor is a 29-megapixel CCD in a 35 mm optical format. Based on the TRUESENSE 5.5 micron Interline Transfer CCD Platform, the sensor features broad dynamic range, excellent imaging performance, and a flexible readout architecture that enables use of 1, 2, or 4 outputs for full resolution readout up to 4 frames per second. A vertical overflow drain structure suppresses image blooming and enables electronic shuttering for precise exposure control.

The sensor is available with the TRUESENSE Sparse Color Filter Pattern, a technology which provides a 2x improvement in light sensitivity compared to a standard color Bayer part.

The sensor shares common PGA pin-out and electrical configurations with other devices based on the TRUESENSE 5.5 micron Interline Transfer CCD Platform, allowing a single camera design to be leveraged to support multiple members of this sensor family.

Features

- Bayer Color Pattern, TRUESENSE Sparse Color Filter Pattern, and Monochrome configurations
- Progressive scan readout
- Flexible readout architecture
- High frame rate
- High sensitivity
- Low noise architecture
- Excellent smear performance
- Package pin reserved for device identification

Applications

- Industrial Imaging and Inspection
- Medical Imaging
- Security

Parameter	Typical Value
Architecture	Interline CCD; Progressive Scan
Total Number of Pixels	6644 (H) x 4452 (V)
Number of Effective Pixels	6600 (H) x 4408 (V)
Number of Active Pixels	6576 (H) x 4384 (V)
Pixel Size	5.5 µm (H) x 5.5 µm (V)
Active Image Size	36.17 mm (H) x 24.11 mm (V) 43.47 mm (diag) 35 mm optical format
Aspect Ratio	3:2
Number of Outputs	1, 2, or 4
Charge Capacity	20,000 electrons
Output Sensitivity	34 µV/e⁻
Quantum Efficiency KAI-29050-AXA KAI-29050-CXA	 46% (500 nm) 31%, 43%, 42% (620, 540, and 470 nm)
Read Noise (f= 32MHz)	12 electrons rms
Dark Current Photodiode VCCD	 7 electrons/s 140 electrons/s
Dark Current Doubling Temp Photodiode VCCD	 7 °C 9 °C
Dynamic Range	64 dB
Charge Transfer Efficiency	0.999999
Blooming Suppression	> 300 X
Smear	Estimated -100 dB
Image Lag	< 10 electrons
Maximum Pixel Clock Speed	40 MHz
Maximum Frame Rates Quad Output Dual Output Single Output	 4 fps 2 fps 1 fps
Package	72 pin PGA
Cover Glass	AR Coated, 2 Sides

All parameters are specified at T = 40 °C unless otherwise noted.

To be a Saturated Column by Kodak Definition: Column must be 282mV above adjacent columns with a 0.25second exposure at +40C

34 microvolts/electron (output node sensitivity)

Saturated Column definition (dark, 0.25sec @ +40C)

282millivolts / (34 microvolts/e-) ~= 7235 e-

The camera gain for this camera is 0.5e-/ADU

The definition of a saturated column (not illuminated) at 120second dark exposure at -25C therefore is:

5564 e- / (0.5 e-/ADU) =11129 ADU (above adjacent pixels when not illuminated with a 0.25 second illumination at -25C

+40C:	
246000	mv (for saturated pixel)
34	microvolts/e-
7235.294	e- in 0.25seconds at +40C for a saturated pixel)
14470.59	DN
9.285714	doublings: -25 to +40C @ 7C/doubling
7235.294	e- in 0.25 sec at +40C
0.5	e-/adu (camera gain)
-25C:	
0.001602	current multiplication factor: slewing from +40C to -25C (9.25 doublings)
11.59251	e- in 0.25 sec at -25C
5564.407	e- in 120sec at -25C
11128.81	ADU delta needed to qualify as a Saturated Column

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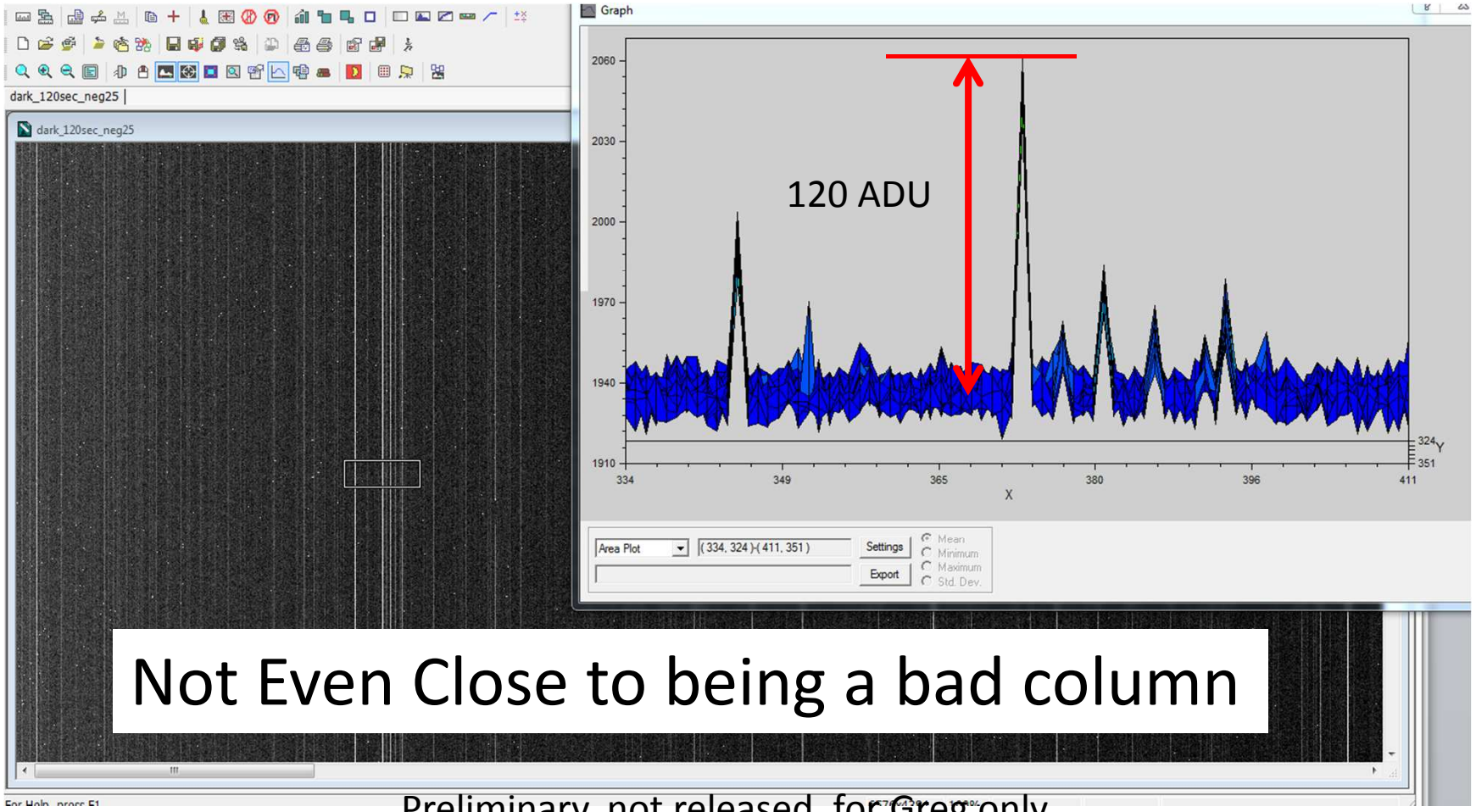
What about this Sensor?



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120 ADU above neighbors: 120 seconds @ -25C

Calculations

- Must transform the data from the dark to the Kodak specified condition:
- From Spec: dark doubling temperature: 7C

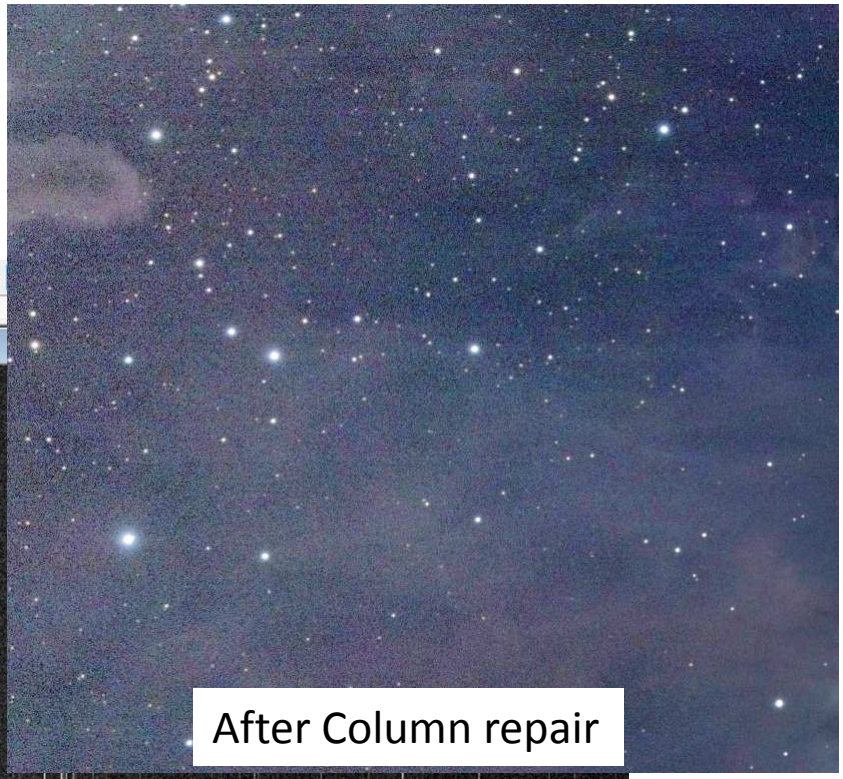
+40C to -25C is a 65C deviation

50C/(7C/doubling): 9.29 doublings: means the current is 624.1 times larger at +40C vs -25C for same exposure interval

120 seconds contains 480 quarter second intervals

Image using the dark shown

Before Column repair



After Column repair

Dark: these are not “BAD COLUMNS” as defined by Truesense

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