

Application Note

What are all these white spots?



Pixel Defects

Goodrich's SUI (Sensors Unlimited, Inc.) team is a world-leading manufacturer of Indium Gallium Arsenide (InGaAs) focal plane array technology. Many customers are accustomed to working with silicon focal plane arrays, which are manufactured with near perfect pixel yields. InGaAs involves three compounds, therefore, manufacturing these devices is orders of magnitude more complicated than silicon devices. These complications inevitably lead to a higher percentage of pixel defects or bad pixels. With rare exception, every InGaAs focal plane array (FPA) has pixel defects in the active area. These defects occur in both the material fabrication and device processing stages and are a direct result of the difficult processes required to make high resolution InGaAs FPAs. The key to determining whether the defects are acceptable for each application depends on the type of defect, and the application itself. A bad pixel can be classified as a bright pixel (shorted), an open pixel (dark), or a non-uniform pixel. Each of these bad pixels will appear differently on the focal plane.

Bright Pixel

A bright pixel is an element on the focal plane array that appears bright white, regardless of the amount of light impinging on it (Figure 1). These pixels are always saturated due to localized defects in the InGaAs material or a short circuit from the InGaAs to the readout multiplexer. It is

important to note that if an InGaAs camera has variable exposure times, bright pixels can appear and disappear. More signals are collected by the photodetector at longer exposure times (e.g. 16 ms). Therefore, it is more likely that pixels with defects will saturate. Since a smaller amount of signal is collected at shorter exposure settings, these previously saturated pixels may actually disappear.

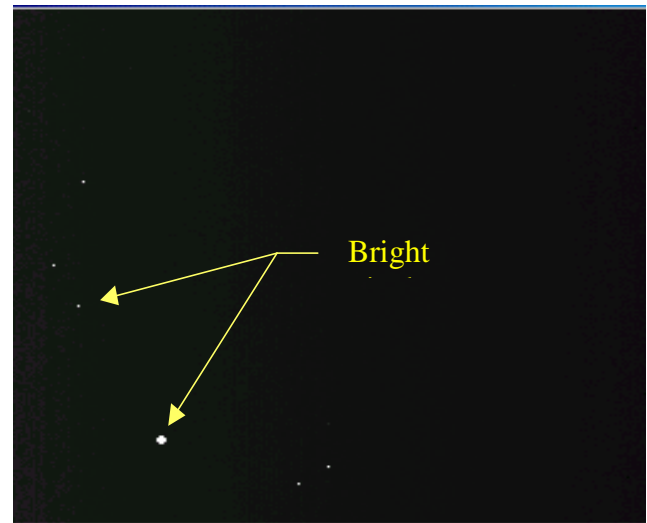


Figure 1. Bright Pixels on the SU320 FPA (shown in complete darkness)

Open Pixel

An open pixel is an element on the focal plane array that appears black. Most open pixels have no response to light and are caused by a bad connection from the InGaAs element to the CMOS readout. Normally, the neighboring pixels will accumulate the signal from an open pixel and will appear more sensitive to light (Figure 2).

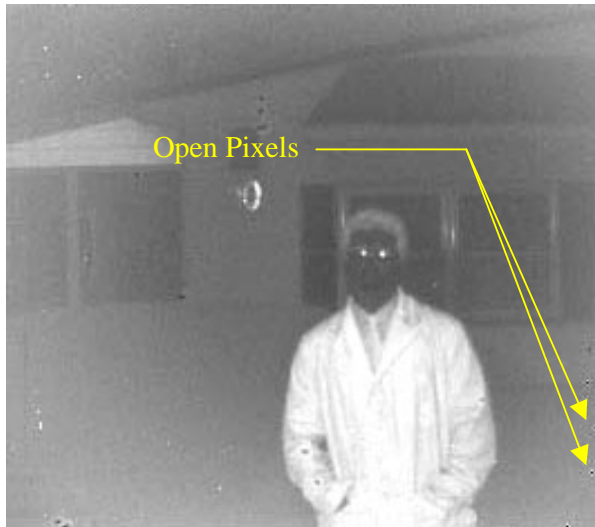


Figure 2. Open Pixels on the SU320 FPA

Non-Uniform Pixel

A non-uniform pixel is a picture element with response that is different from the surrounding pixels. This could be a pixel that is either more sensitive or less sensitive than the average of the rest of the array.

The SUI Specification

SUI is constantly refining device-processing techniques and focal plane arrays are emerging with better pixel yields. The awareness of the different types of bad pixels has enabled Sensors Unlimited to put quality assurance specifications in place to minimize the number of defects, which may appear. Defects of up to 2% are usually acceptable for applications requiring only a video output. This is especially true if defect correction techniques are applied. However, if the application requires metrology, defect correction may not be appropriate. Customers should contact their local sales representative for assistance with determining which method is best for them.

If you need further technical support, please contact our sales department via email sui_support@goodrich.com or call us at 609-520-0610.

About Goodrich's SUI Team: Founded in 1991, SUI (Sensors Unlimited, Inc.) is the leading manufacturer of indium gallium arsenide (InGaAs) PIN and avalanche photodiode arrays that are used in shortwave and near infrared imaging for military, industrial, spectroscopic, machine vision, and telecommunications applications. SUI provides InGaAs photodiode array processing as a foundry service and designs custom readout integrated circuits for unique imaging applications within its ISO 9001 certified facility. For more information, visit www.oss.goodrich.com/sui.