University of Arizona
Imaging Technology Laboratory

Detector Characterization Report

Customer	University of Arizona
Device	ITL SN5339 STA0500A Lot run 109468 Wafer 6 Die 1
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1. Introduction

The above detector is part of the University of Arizona Foundry Run. Most tests were performed at or close to -138 C, a typical operating temperature for most scientific CCDs.

2. Description of the ITL Detector Characterization System

Uniform monochromatic illumination for the Device Under Test (DUT) is provided by a system consisting of an Oriel 6255 150-watt xenon arc lamp enclosed in an Oriel 66002 lamp housing, Oriel model 68805 Universal Power Supply, Oriel 68850 Photofeedback Controller, Oriel 76995 Electronic Shutter Controller, Oriel model 76994 Shutter, Oriel 77702 Monochromator, and an 20" diameter Labsphere Integrating Sphere with a UV-enhanced interior diffuse coating.

Diode mode DUT and calibrated diode photocurrents are measured during QE testing by a Keithley Model 6512 Electrometer.

The detector was operated in a liquid-nitrogen-cooled Kadel dewar equipped with a fused quartz window of 137 millimeter aperture. The temperature was regulated at -100C for temperature-critical tests.

The device was tested with a gen1 CCD controller from Astronomical Research Cameras, Inc. The software system used was the ITL AzCam data acquisition system.

3. Diode Mode Quantum Efficiency

The quantum efficiency (QE) of the imaging device was measured by comparison with a silicon photodiode with an NIST-traceable calibrated response. The photodiode is attached to the output of the optical system (where the CCD in its dewar will be placed) and the monochromatic output of the integrating sphere is sampled at each wavelength of interest by scanning the monochromator. This procedure is then repeated with DUT by connecting the electrometer to the CCD SUBSTRATE and RESET DRAIN. QE is computed based upon the ratio of the photocurrents, UV quantum yield, relative light collecting areas and geometric factors involving the particular dewar and window material. The QE is shown in Table 1 and Figure 1.

300	62.7%
320	66.9%
340	69.3%
350	65.8%
360	61.3%
380	65.5%
400	74.5%
450	77.5%
500	80.4%
550	86.2%
600	87.4%
650	85.1%
700	83.7%
750	79.9%
800	70.6%
850	58.9%
900	46.7%
950	29.5%
1000	18.2%
1050	9.6%
1100	1.7%

Table 1. Measured QE at room temperature

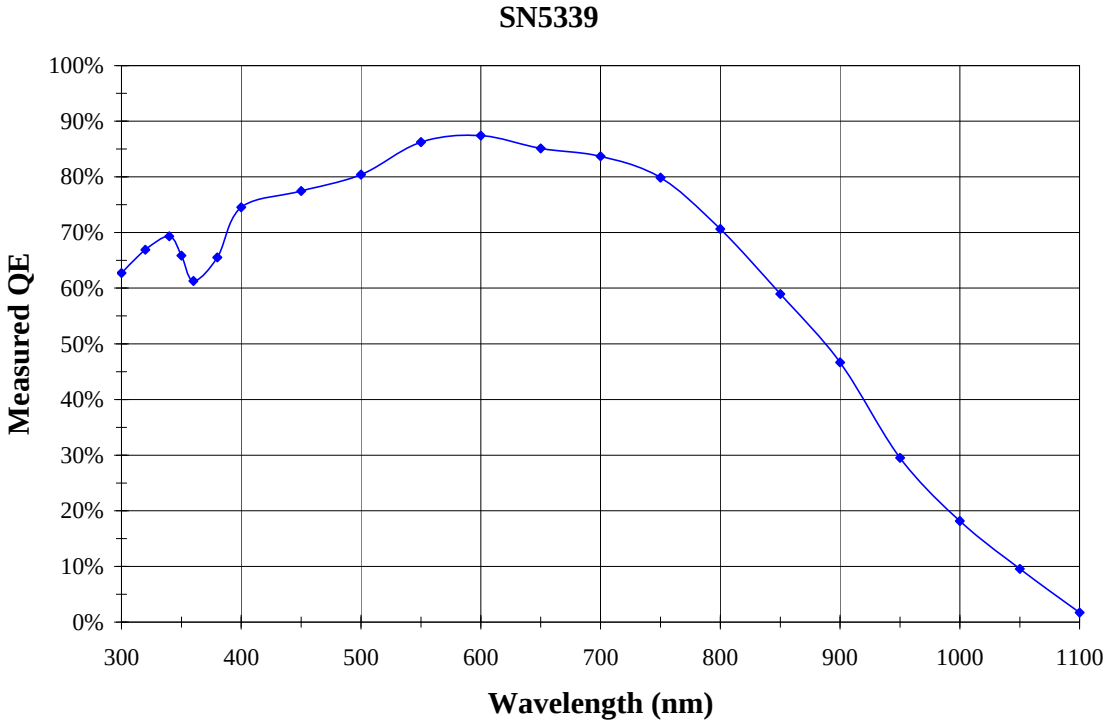

Figure 1. Measured QE at room temperature

4. Detector Cosmetics

Flat field images were obtained with illumination wavelengths of 300, 400, 600, and 900 nanometers. Light of 300 and 400 nanometers wavelength is detected very close to the surface of the device and critically reveals details of the surface charging. At 300 nm, a few faint, wispy features were seen that were essentially not present at 400 nm. A thin scattering of small, round spots and a few irregularly-shaped dark features are present.

600 nanometer light penetrates more deeply into the device and the detected electrons are less influenced by surface charging. The device appears to be very uniform except for the spots noted at 400 nm. There is a bad column.

900 nanometer light penetrates through the imager and the resulting optical interference fringes provides information about the thinning of the device. The ‘topographic map’ pattern of fringes appears to be modulated by an off-center, vaguely concentric ring feature, probably due to variations in how the silicon crystal grew, but inconsequential in the operation of the device.

5. Fe-55 Noise, Gain, and CTE measurements

The CCD was exposed to Fe-55 x-rays to determine gain and charge transfer efficiency.

Operating conditions:

Reset gate	+10/-2 volts
Serial clock	+3/-3 volts
Summing well	+3/-3 volts
Parallel clocks	+3/-8 volts (+4.5/-6.5 P3)
Transfer gate	+3/-8 volts
Vod	+26.0 volts
Vrd	+16.0 volts
Vog	-1.0 volts

Amp	HCTE	VCTE	Noise (e)
UR	0.999997	1.000000	4.06
UL	0.999997	1.000000	3.52
LR	0.999997	1.000000	3.85
LL	0.999997	1.000000	4.62

6. PTC measurements

A series of PTC measurements were made to determine noise and full well.

Amp	Full Well	Noise (e)
UR	103,000	3.76
UL	120,000	5.04
LR	131,000	4.30
LL	124,000	5.24

7. Parallel register full well

A ramp image from the LR amp was obtained showing saturation at about 174,000 electrons in normal mode. In MPP mode, the wells are substantially more shallow at the voltages adopted to reduce spurious charge.

8. Summary

Four amps worked, cosmetics are generally good with one bad column and a scattering of small spots. QE is lower than expected. The device operates better in normal mode because the parallel clock voltages must be lowered to reduce spurious charge. Dark current at -138C was measured as 35.7 electrons/pixel/hour.