ANDOR

an **Oxford Instruments** company

System Performance Booklet

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CCD PERFORMANCE

System Overview

Description	Model				Serial Number			
CCD Head ▽	D	Z	9	36N	- BEX2-DD		CCD-21490	
TE Cooler performance (✓)					High		Ultra-high	✓
Power Supply Units					PS -29		PS -40	
					✓		✓	
Accessories					LM-		MFL-	
Serial/Batch Number								
Other					XW-CHIL-160			

▽   Sensor types are defined in Table 1 using the last two letters in box Model Number.

CCD Details

Manufacturer / Model No.		Pixels	Serial Number
E2V	CCD42-40	2048x2048, 13.5µm x 13.5µm	15233-12-02

Special Features	(✓)		(✓)
NIMO		Nikon F-mount with Shutter	✓
Fringe Suppression		Custom Cables	
Shielded Anti-Blooming			

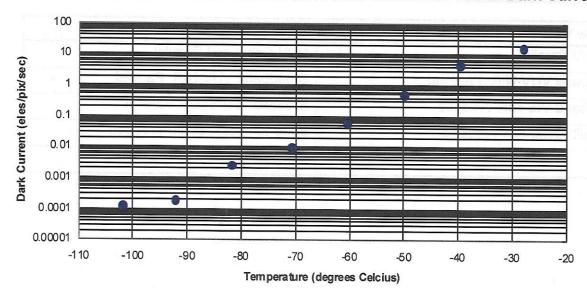| Window Variant	(✓)		(✓)
VUV-UV Parallel		NUV-Enhanced Parallel	
Broadband VUV-NIR Wedged		Broadband VUV-NIR Parallel	✓
Broadband VIS-NIR Wedged		Broadband VIS-NIR Parallel	
VIS-NIR Enhanced Wedged		Bose-Einstein 780nm Wedged	
None		Other	

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Summary of System Test Data

Readout Noise ♦1 and Base Mean Level ♦2

A/D Rate MHz - all 16 bit	Preamp setting	CCD Sensitivity ♦3 e- per A/D count		Single Pixel Noise electrons rms		Base Mean Level A/D counts	
		High Sensitivity Mode	High Capacity Mode	High Sensitivity Mode	High Capacity Mode	High Sensitivity Mode	High Capacity Mode
5.0	x1	6.4	24.2	39.1	130.3	2517	988
5.0	x2	3.3	12.4	31.1	91.2	3954	1013
5.0	x4	1.6	6.2	23.7	64.5	4806	962
3.0	x1	4.3	19.4	19.7	94.0	1064	905
3.0	x2	2.4	10.3	14.0	56.9	1880	1562
3.0	x4	1.1	5.6	10.5	46.4	2734	2862
1.0	x1	3.9	20.2	9.5	47.1	923	1180
1.0	x2	2.1	9.7	8.1	29.7	1469	1945
1.0	x4	1.1	5.4	6.6	28.6	2471	3365
0.05	x1	4.1	19.7	5.4	18.9	913	1162
0.05	x2	2.2	10.2	4.7	14.1	1442	1910
0.05	x4	1.1	5.3	4.1	12.5	2424	3299
Saturation Signal per pixel ♦14				102291		electrons	

CCD Dark Current

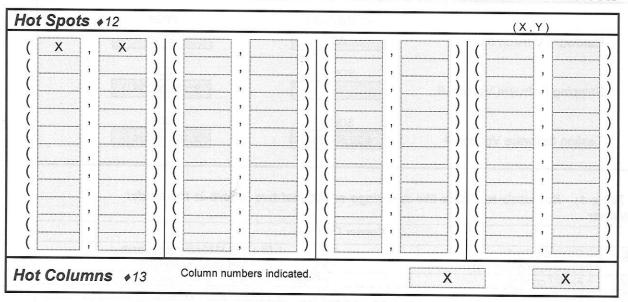| Minimum Dark Current Achievable ♦4	0.000126	electrons/pixel/sec		
@ Sensor Temperature of ♦5	-101.96	°C	16.0	°C cooling water
CCD Dark Current Uniformity better than ♦6	0.685	electrons/pixel/sec		

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Linearity and Uniformity

Linearity better than ◆7	1	% over 16 bits
Response Uniformity better than ◆8	1.86	%

Response Defects

White/Black Spots ◆9

(X , Y) Number of Pixels

X	,	Y	Number of Pixels	X	,	Y	Number of Pixels
(1485	,	1929)	1	(	,	)	
(71	,	284)	1	(	,	)	
(X	,	X)	X	(	,	)	
(	,	)		(	,	)	
(	,	)		(	,	)	
(	,	)		(	,	)	
(	,	)		(	,	)	
(	,	)		(	,	)	
(	,	)		(	,	)	
(	,	)		(	,	)	
(	,	)		(	,	)	

White/Black Columns ◆10

Column numbers indicated.

X	X
X	X

Traps ◆11

Column numbers indicated.

1980	X

Dark Current Defects

Hot Spots ◆12

(X , Y)

(X	,	X)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)
(	,	)	(	,	)	(	,	)	(	,	)

Hot Columns ◆13

Column numbers indicated.

X	X

Test Conditions

Readout Noise tested at	-90	°C with	16	°C water
Base Mean Level measured at	-90	°C with	16	°C water
Dark Current Uniformity tested at	-50	°C with	16	°C water
Blemishes tested at	-50	°C with	16	°C water

Custom Testing

System Passed for Shipping

Signed	Date
P. SCOTT	23RD FEBRUARY 2018

	HEADBOARD	FPGA
Hardware Version #	AF	20.12
	SOLIS	SDK
Shipping Software Version #	--	2.102.30034.0
	SOLIS	SDK
Testing Software Version #	4.30.30034.0	2.102.33034.0

▽ Table 1; Key code to define the meanings of the last two letters in the Model Number

Sensor Options			
OE	Open electrode	BV	BI + VIS (550nm) optimised
FI	Front illuminated (FI)	BR	BI + NIR (850) optimised
UV	FI+UV coating	BR-DD	BI + NIR +deepdepletion
FO	FI + Fibre optic	BN	BI with no AR coating
FI-DD	FI + deep depletion	FK	Fast Kinetics (masked; 3011 only)
BU2	Back Illuminated (BI) + 250nm UV optimised	KT	Kodak FI coating
BU	BI + UV (350nm) optimised		

Performance Notes

♦1   Readout Noise is measured for both single pixel (SP) and fully vertically binned (FVB) with the CCD in darkness at temperature indicated and minimum exposure time. Noise values will change with pre-amplifier gain selection [PAG].

♦2   Average electronic DC offset for CCD in darkness at temperature indicated and minimum exposure time under dark conditions measured by single pixel (SP) for imaging systems and by (FVB) for spectroscopic systems.

♦3   Sensitivity is calculated in photoelectrons per A/D count from measurements of the Photon Transfer Curves.

♦4   Dark current falls exponentially with temperature. However, for a given temperature the actual dark current can vary by more than an order of magnitude from device to device. The devices are specified in terms of minimum dark current achievable rather than minimum temperature.

♦5   Minimum temperature achieved for thermoelectric (TE) cooler set to maximum value with water cooling

♦6   RMS (root mean square) deviation of dark current for fully binned operation for spectroscopic cameras, or full resolution image for imaging cameras, under dark conditions at temperature indicated (pixel/column defects not included). This variation is mainly cosmetic since it is fully subtractable without significant loss of performance.

♦7   Linearity is measured from a plot of Counts vs. Signal over the 16 bit dynamic range. Linearity is expressed as a %age deviation from a straight line fit. This quantity is not measured on individual systems.

♦8   RMS (root mean square) deviation from the average response of the CCD in fully binned operation for spectroscopic cameras, or full resolution image for imaging cameras, illuminated with uniform white light (defects not included).

♦9   White/black spots have signals >25% above/below the average (i.e >25% contrast) with uniform illumination across the sensor.

♦10   Columns whose signals have >10% contrast in binned operation with uniform illumination across the sensor for spectroscopic cameras, ≥ 10 black spots per column for imaging cameras.

♦11   Pixels which absorb charge as it is clocked through the defective area. When the light source is switched off, the signal from the trap appears to drop off more slowly than the signal from the surrounding pixels.

♦12   A spot can be up to 3 pixels in size. For Grade A devices, hot spots are counted if they exhibit >50 times the maximum specified dark current at the test temperature indicated.

♦13   A column is considered defective if >10 pixels are affected, or if the column exhibits >2 times the maximum specified dark current at the test temperature indicated.

♦14   Saturation Signal per pixel is measured at 1MHz PreAmp x1 High Sensitivity mode