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## System Performance Booklet



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## System Overview

Description	Model	Serial Number
CCD Head <input checked="" type="checkbox"/>	D U 9 34P - BR-DD	CCD-16343
TE Cooler performance ( <input checked="" type="checkbox"/> )	High	Ultra-high <input checked="" type="checkbox"/>
Accessories	Power Supply Unit (PS -24)	PS -25
	--	<input checked="" type="checkbox"/>
	SO-	LM- MFL-
Serial/Batch Number		
Other		

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

## CCD Details

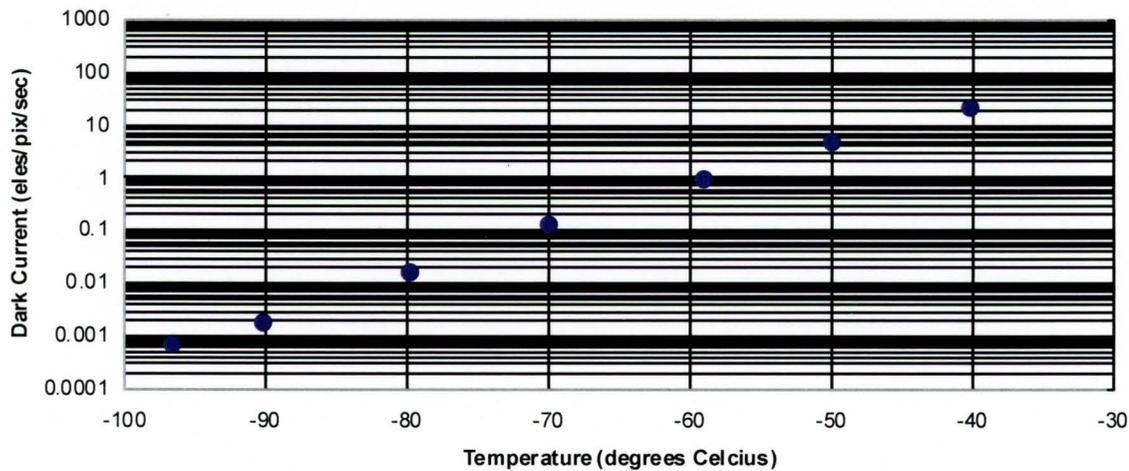
Manufacturer / Model No.	Pixels	Serial Number
E2V CCD47-10	1024x1024, 13 $\mu$ m x 13 $\mu$ m	10141-09-13
E2V CCD57-10	512x512, (FT), 13 $\mu$ m x 13 $\mu$ m	
E2V CCD77-00	512x512, 24 $\mu$ m x 24 $\mu$ m	

Special Feature	( <input checked="" type="checkbox"/> )	( <input checked="" type="checkbox"/> )
NIMO	<input checked="" type="checkbox"/>	AR coated Window ( $\frac{1}{2}^\circ$ wedge)
Fringe Suppression	<input checked="" type="checkbox"/>	Custom Cables
Shielded Anti-Blooming		Custom Mounting Flange
MgF <sub>2</sub> Input		

**Summary of System Test Data**  
**Readout Noise  $\blacklozenge$ 1 and Base Mean Level**

A/D Rate (MHz All 16 bit)	Preamp setting	CCD	Single Pixel	Full Vert Bin	Base Level $\blacklozenge$ 2
		Sensitivity $\blacklozenge$ 3 eles per A/D count	Noise electrons	Noise electrons	(Counts)
5	x1	6.5	34.3	35.8	1059
5	x2	3.1	18.3	19.0	1642
5	x4	1.6	13.9	14.4	2911
3	x1	5.8	19.2	19.5	1098
3	x2	2.9	12.7	13.2	2070
3	x4	1.3	10.3	11.0	3697
1	x1	5.3	11.4	11.1	902
1	x2	2.7	8.1	8.0	1818
1	x4	1.2	6.8	6.8	3697
0.05	x1	5.2	5.3	5.3	526
0.05	x2	2.7	4.4	4.5	1429
0.05	x4	1.2	3.7	3.8	3280
<b>Saturation Signal per pixel</b>			129050	Electrons/pixel	

**CCD Dark Current**



<b>Minimum Dark Current Achievable <math>\blacklozenge</math>4</b>	0.000717	electrons/pixel/sec		
<b>@ Sensor Temperature of <math>\blacklozenge</math>5</b>	-96.77	°C	16	°C cooling Water
		With PS-25		
<b>CCD Dark Current Uniformity better than <math>\blacklozenge</math>6</b>	0.43803	electrons/pixel/sec		

**Linearity and Uniformity**

Linearity better than $\blacklozenge 7$	1	% over 16 bits
Response Uniformity better than $\blacklozenge 8$	2.18	%

**Response Defects**

<b>White/Black Spots <math>\blacklozenge 9</math></b>				(X, Y)
<b>Centroid</b>	<b>Number of Pixels</b>	<b>Centroid</b>	<b>Number of Pixels</b>	
( X , X )	X	( , )		
( X , X )	X	( , )		
( , )		( , )		
( , )		( , )		
( , )		( , )		
( , )		( , )		
<b>White/Black Columns <math>\blacklozenge 10</math></b>		Column numbers indicated	X	X
			X	X
<b>Trap <math>\blacklozenge 11</math></b>		(X, Y)	( X , X )	

**Dark Current Defects**

<b>Hot Spots <math>\blacklozenge 12</math></b>				(X, Y)
<b>Centroid</b>	<b>Number of Pixels</b>	<b>Centroid</b>	<b>Number of Pixels</b>	
( X , X )	X	( , )		
( X , X )	X	( , )		
( , )		( , )		
( , )		( , )		
( , )		( , )		
( , )		( , )		
<b>Hot Columns <math>\blacklozenge 13</math></b>		Column numbers indicated	X	X

## Test Conditions

Readout Noise tested at	-80	°C with	16	°C water
Base Mean Level measured at	-80	°C with	16	°C water
Dark Current Uniformity tested at	-65	°C with	16	°C water
Blemishes tested at	-65	°C with	16	°C water

## Custom Testing

## System Passed for Shipping

Signed

Date

**G. McCULLOUGH**

**27<sup>TH</sup> JANUARY 2014**

Hardware	HEADBOARD	FPGA
Version #	AB	20.24
Shipping Software	SOLIS	SDK
Version #	--	2.96.30004.0
Testing Software	SOLIS	SDK
Version #	4.24..30004.0	2.96.30004.0

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

Sensor Options			
OE	Open electrode	BU2	Back Illuminated (BI) + 250nm UV optimised
FI	Front illuminated (FI)	BU	BI + UV (350nm) optimised
UV	FI+UV coating	BV	BI + VIS (550nm) optimised
FO	FI + Fibre optic	BR-DD	BI + NIR +deepdepletion
FI-DD	FI + deep depletion	BN	BI with no AR coating

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**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 Curve.
- ◆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 full resolution image for imaging cameras, illuminated with uniform white light (defects not included).
- ◆9 White/black pixels have signals >25% above/below the average (25% contrast) with uniform illumination across the sensor.
- ◆10 A black column is defined as having  $\geq 10$  black pixels 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 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.