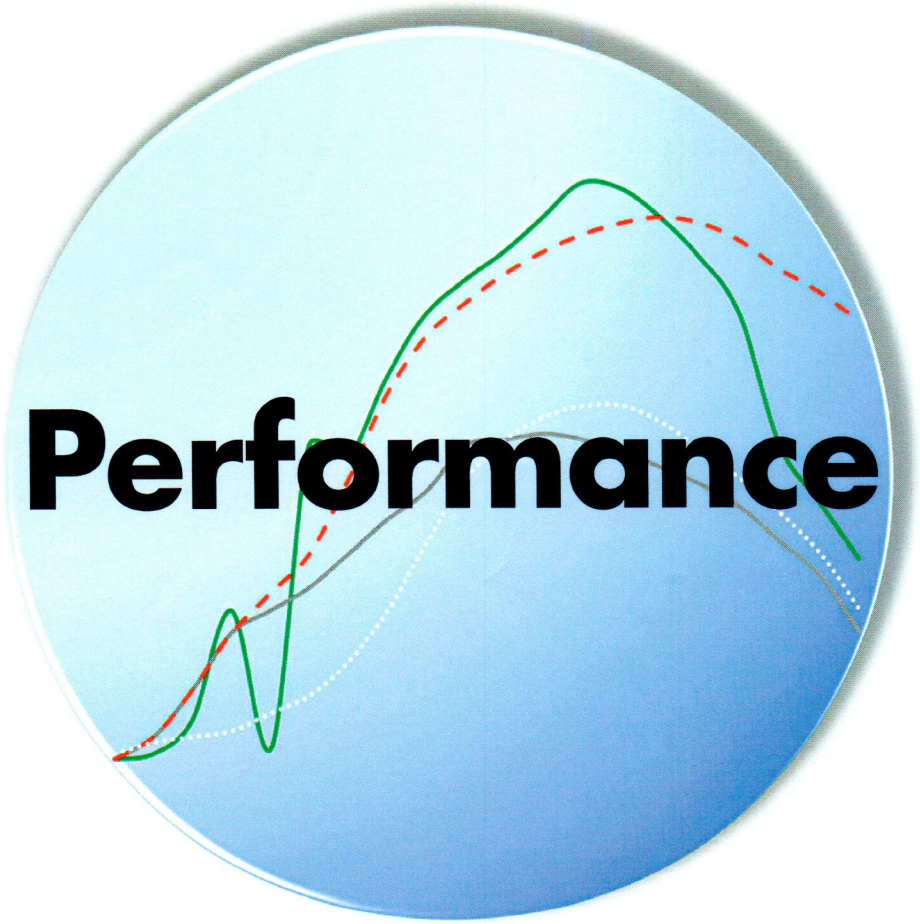

System Performance

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CCD PERFORMANCE

System Overview

Description	Model						Serial Number		
CCD Head ▽	D	U	9	40P	-	BU	CCD-21061		
TE Cooler performance (✔)							High	Ultra-high	✔
Accessories	Power Supply Unit						PS -24	PS -25	✔
	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	CCD207-10	1600x400, 16µm x 16µm	
E2V	CCD207-00	1600x200, 16µm x 16µm	
E2V	CCD42-10	2048x512, 13.5µm x 13.5µm	14292-18-06
E2V	CCD30-11	1024x256, 26µm x 26µm	

Special Feature	(✔)		(✔)
NIMO		Other (specify)	
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	

System Sensitivity *1

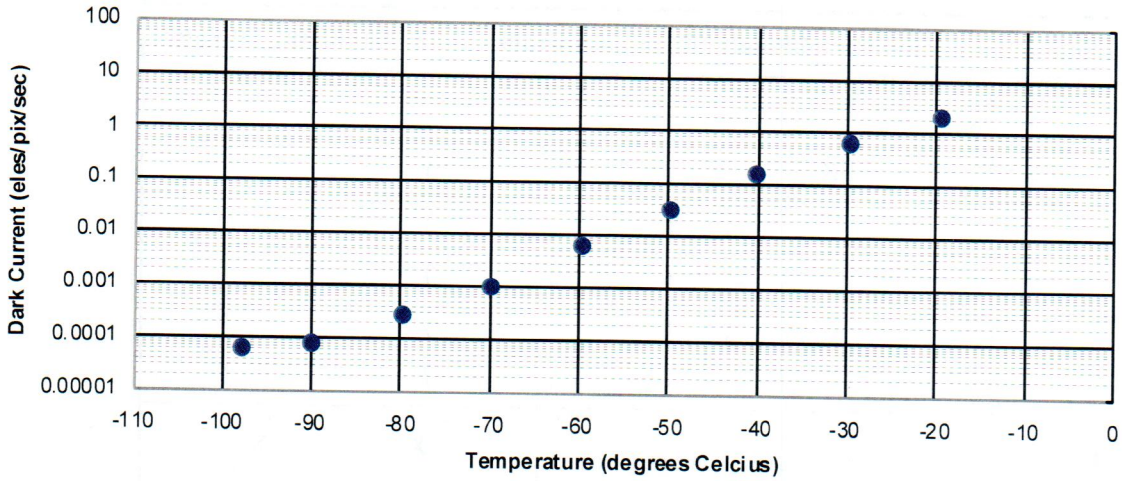
A/D Rate (MHz All 16 bit)	Preamp setting	High Sensitivity (HS) Output eles per A/D count	High Capacity (HC) Output eles per A/D count
3	x1	4.0	18.7
3	x2	2.1	9.4
3	x4	1.0	4.7
1.0	x1	4.3	19.1
1.0	x2	2.2	9.4
1.0	x4	1.0	4.7
0.05	x1	4.1	18.6
0.05	x2	2.2	9.5
0.05	x4	1.0	4.6

Summary of System Test Data

Readout Noise *2 and Base Mean Level

A/D Rate (MHz All 16 bit)	Output Amplifier	Single Pixel Noise electrons	Full Vert Bin Noise electrons	Base Level *3 (Counts)
3	HS	10.2	9.6	2056
3	HC	37.4	36.3	780
1.0	HS	7.0	6.9	831
1.0	HC	26.7	25.7	696
0.05	HS	3.3	3.4	573
0.05	HC	9.3	9.1	602
Saturation Signal per pixel		73900	Electrons/pixel	

CCD Dark Current



Minimum Dark Current Achievable *♦4*	0.000064	electrons/pixel/sec		
@ Sensor Temperature of *♦5*	-98.07	°C With PS-25	16.0	°C cooling water
CCD Dark Current Uniformity better than *♦6*	0.003665	electrons/pixel/sec		

Linearity and Uniformity

Linearity better than *♦7*	1	% over 16 bits
Response Uniformity better than *♦8*	1.54	%

Response Defects

White/Black Spots ♦9				(X, Y)
Centroid		Number of Pixels	Centroid	Number of Pixels
(X , X)		X	(,)	
(X , X)		X	(,)	
(,)			(,)	
(,)			(,)	
(,)			(,)	
(,)			(,)	
White/Black Columns ♦10	Column numbers indicated		X	X
			X	X
Trap ♦11	(X, Y)		(X , X)	

Dark Current Defects

Hot Spots ♦12				(X, Y)
Centroid		Number of Pixels	Centroid	Number of Pixels
(1180 , 490)		1	(,)	
(X , X)		X	(,)	
(,)			(,)	
(,)			(,)	
(,)			(,)	
(,)			(,)	
Hot Columns ♦13	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	-20	°C with	16	°C water
Blemishes tested at	-50	°C with	16	°C water

CCD PERFORMANCE

Additional Comments

System Passed for Shipping

Signed R. CREIGHTON

Date 7TH SEPTEMBER 2017

	System Configuration	FPGA
Hardware Version #	AC	20.24
	Solis	SDK
Shipping Software Version #	--	2.102.30034.0
	Solis	SDK
Testing Software Version #	4.30.30024.0	2.102.33024.0

▽ 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

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 fully binned operation for spectroscopic 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 Columns whose signals have >10% contrast in binned operation with uniform illumination across the sensor for spectroscopic cameras.

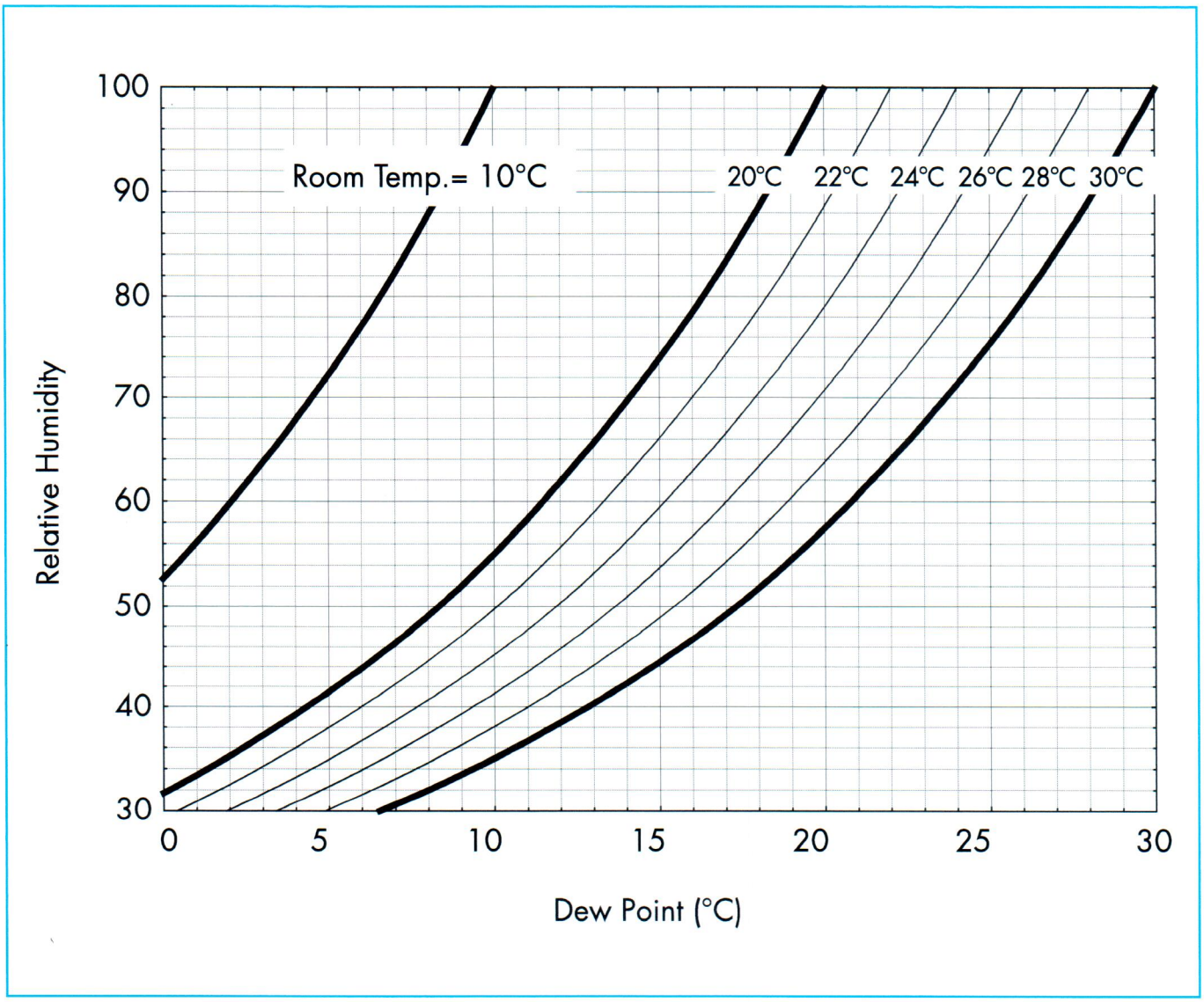
♦11 Pixels which absorb charge as it is clocked through the defective area. When the light source is switched off, the signal from the trap appears to drop off more slowly than the signal from the surrounding pixels.

♦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.

Dew Point

To achieve ultimate cooling performance you need 10°C water. In humid conditions this will cause condensation and hence damage to the CCD head. Unfortunately in such con-ditions you will have to use warmer water. The following graph gives you a guideline to determine the dew point and select water temperature in humid conditions. For example if the room temperature is 24°C and relative humidity is 50%, the dew point can be determined from the graph to be 12°C. Therefore water temperature must be higher than dew point (i.e. >12°C). Typical water temperature should be 2°C higher than dew point (in this example ~14°C). This will limit the minimum CCD temperature (refer to the table in the manual).



ANDOR™ TECHNOLOGY

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