CCD PERFORMANCE

System Overview

Description	Model						Serial Number
CCD Head ∇	D	V	4	01	-	BV-350	CCD-4100
TE Cooler performance (✔)	Moderate		High	✔	Ultra-high		
Controller Card	CC	I-001					CCD-4100
Accessories	Power Supply Unit (PS150)						Multi I/O Box (IO160)
Serial Number							
	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
MARCONI CCD30-11	1024x256, 26μm^2	
MARCONI CCD40-11	1024x128, 26μm^2	00013-01-11
MARCONI CCD42-10	2048x512, 13.5μm^2	
MARCONI CCD47-10	1024x1024, 13μm^2	
MARCONI CCD47-20	1024x1024 (FT), 13μm^2	
MARCONI CCD55-20	770x1152, 22.5μm^2	
MARCONI CCD57-10	512x512, (FT), 13μm^2	
MARCONI CCD77-00	512x512, 24μm^2	

Special Feature	(✔)		(✔)
NIMO		AR coated Window	
Fringe Suppression		SMB Backplate	✔
Shielded Anti-Blooming		Custom Cables	
MgF_2 Input		Other (specify)	

Card Details

Model		A/D Resolution	Readout Speed
CCI-010/CC-010/CC100	(1 MHz)	16-bit	1, 2, 16, 32 μs per pixel
CCI-001/CC-101/CC101	(62 kHz)	16-bit	16, 32 μs per pixel

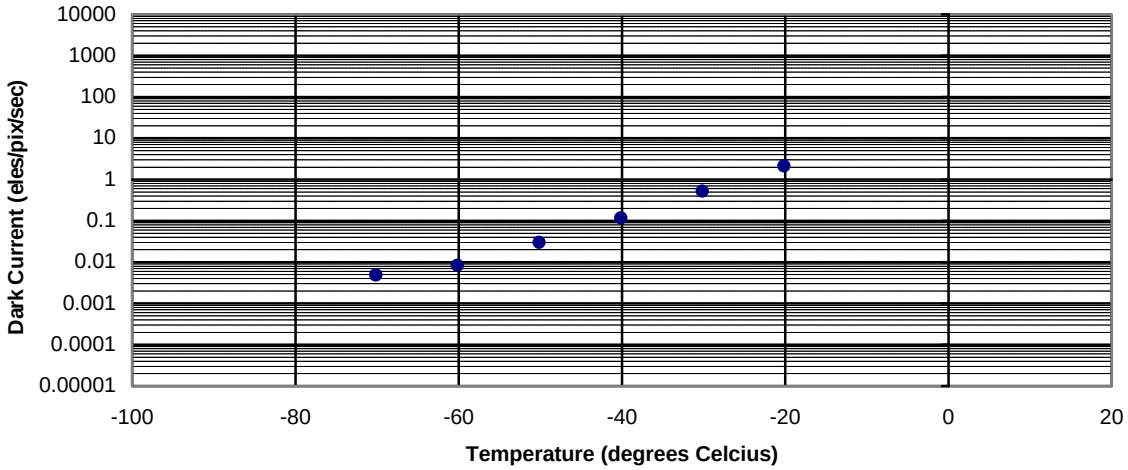
Summary of System Test Data

Readout Noise ♦*1 and* Base Mean Level

A/D Rate	Digitization Time (µs)	CCD Gain ♦*3* eles per A/D	Single Pixel electrons	Full Vert Bin electrons	Base Level ♦*2* (Counts)
1 MHz (where applic.)	1				
500 kHz (where applic.)	2				
62 kHz	16	7	5.8	6.0	280
31 kHz	32	3.5	4.7	5.2	500

CCD Readout Noise ♦*4*		6.4	electrons
Controller Noise	@ 62 kHz	0.7	A/D counts
Saturation Signal per pixel		458745	Electrons/pixel

CCD Dark Current



Minimum Dark Current Achievable ♦*5*	0.0046	electrons/pixel/sec		
@ Sensor Temperature of ♦*6*	-69.9	°C with	11	°C cooling water
		without PSU		
CCD Dark Current Uniformity better than ♦*7*	0.18	electrons/pixel/sec		

Linearity and Uniformity

Linearity better than ♦*8*	1	% over 16 bits
Response Uniformity better than ♦*9*	1.19	%

Response Defects

White/Black Spots ♦10				(X , Y)
(173 , 33)	(,)	(,)	(,)	
(\ , \ )	(,)	(,)	(,)	
(\ , \ )	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	

White/Black Columns ♦11 Column numbers indicated.		\	\
		\	\
Traps ♦12	Column numbers indicated.	\	\

Dark Current Defects

Hot Spots ♦13				(X , Y)
(\ , \ )	(,)	(,)	(,)	
(\ , \ )	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	
(,)	(,)	(,)	(,)	

Hot Columns ♦14	Column numbers indicated.	\	\

Test Conditions

Readout Noise tested at	-50	°C with	11	°C cooling water
Base Mean Level measured at	-20	°C with	11	°C cooling water
Dark Current Uniformity tested at	-20	°C with	11	°C cooling water
Blemishes tested at	-20	°C with	11	°C cooling water

Additional Comments

System Passed for Shipping

Signed	**Date**
MICHAEL J.F. MCELLIGOTT	**07\10\03**

Hardware Version #	HEADBOARD	CC	CABLE	PSU	PLD	
	J	J2	TPO4	\	\	
Shipping Software Version #	MCD	SDK	COF	RBF		
	\	2.7	67	35		
Testing Software Version #	MCD	SDK	COF	RBF		
	2.62 i2c	\	67	35		

∇ 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 using 1,2,16 & 32μs per pixel readout. Note that the nominal gain changes for readout at 32μs per pixel.

♦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 Gain is measured in photoelectrons per A/D count from a plot of Total Noise against Signal. This quantity is not measured on individual systems.

♦4 CCD readout noise is for the sensor alone as measured by the CCD manufacturer. Measurement is for single pixel readout.

♦5 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.

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

♦7 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.

♦8 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.

♦9 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).

♦10 A spot can be up to 3 pixels in size. White/black spots have signals >25% above/below the average (25% contrast) with uniform illumination across the sensor.

♦11 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.

♦12 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.

♦13 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.

♦14 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.