

Summary of System Test Data

Camera Overview

Readout Noise $\times 1$ and Dark Mean Level

Description	Model						Serial Number
Head <input checked="" type="checkbox"/>	DV8	87	C	CS	-	BV-963	X-1089
Controller Card	CCI-202 ^{ausg}						C-2283
Other:							
Other:							

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

Special Feature	(<input checked="" type="checkbox"/>)
AR coated Window 200-340 nm	
AR coated Window 430-700 nm	
MgF ₂ Input	<input checked="" type="checkbox"/>
Other (specify)	

A/D Feature	
A/D resolution	14-bit & 16 bit
Readout Speed	200 nS, 333nS and 1uS per pixel
Other (specify)	

CCD Details

Manufacturer / Model No.	Pixels	Serial Number
E2V TECH CCD65	576x288, 20x30 μ m ²	
E2V TECH CCD87	512x512, 16 μ m ²	01471-15-12
E2V TECH CCD60	128x128, 24 μ m ²	

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

Sensor Options			
FI	Front illuminated (FI)	UV	FI+UV coating
BV	Back illuminated (BI with 550nm AR coating)		

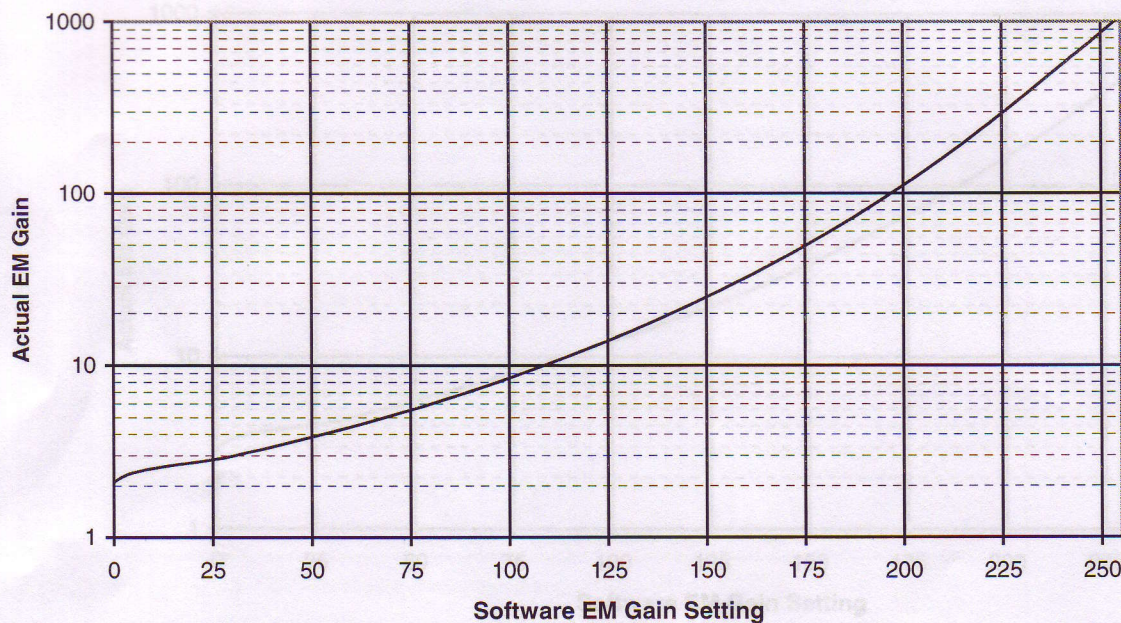
Summary of System Test Data

Readout Noise ♦1 and Base Mean Level

A/D Rate	Digitization Time (ns)	CCD Sensitivity ♦3 eles per A/D count	Single Pixel electrons	Base Level ♦2 (Counts)
5 MHz 14 bit EMCCD	200 nS	19.7	52.5	774
3 MHz 14 bit EMCCD	333nS	18.6	39.5	1404
1 MHz 16 bit EMCCD	1uS	9	23.0	863
3 MHz 14 bit CCD	333nS	3.4	9.0	1702
1 MHz 16 bit CCD	1uS	1.6	6.8	1421
Saturation Signal per pixel (5MHz 14 bit EMCCD)		275800	Electrons/pixel	

EMCCD Gain Characteristics

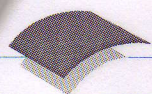
Electron Multiplication Gain Curve 5MHz 14 bit@-50°C



Note: Electron Multiplication Gain will reduce by approximately a factor of two for every 10°C rise in temperature

CCD Dark Current

Minimum Dark Current Achievable ♦5	0.015	electrons/pixel/sec
♦6 Sensor Temperature of ♦4	-60 ±3	°C
	15.0	°C water cooling
	With P&U	



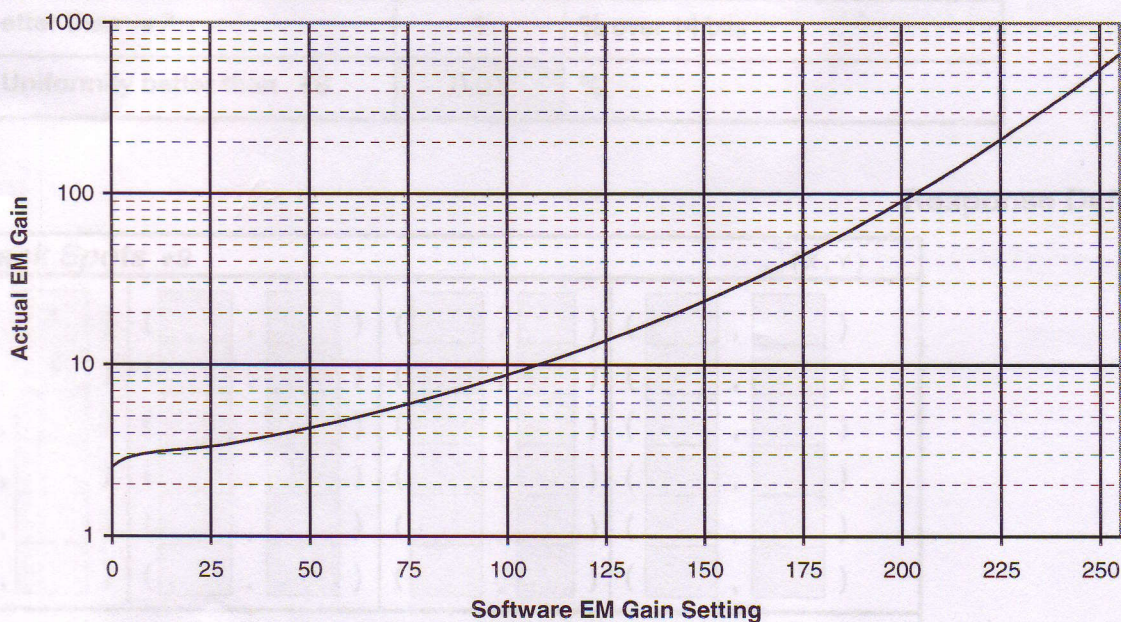
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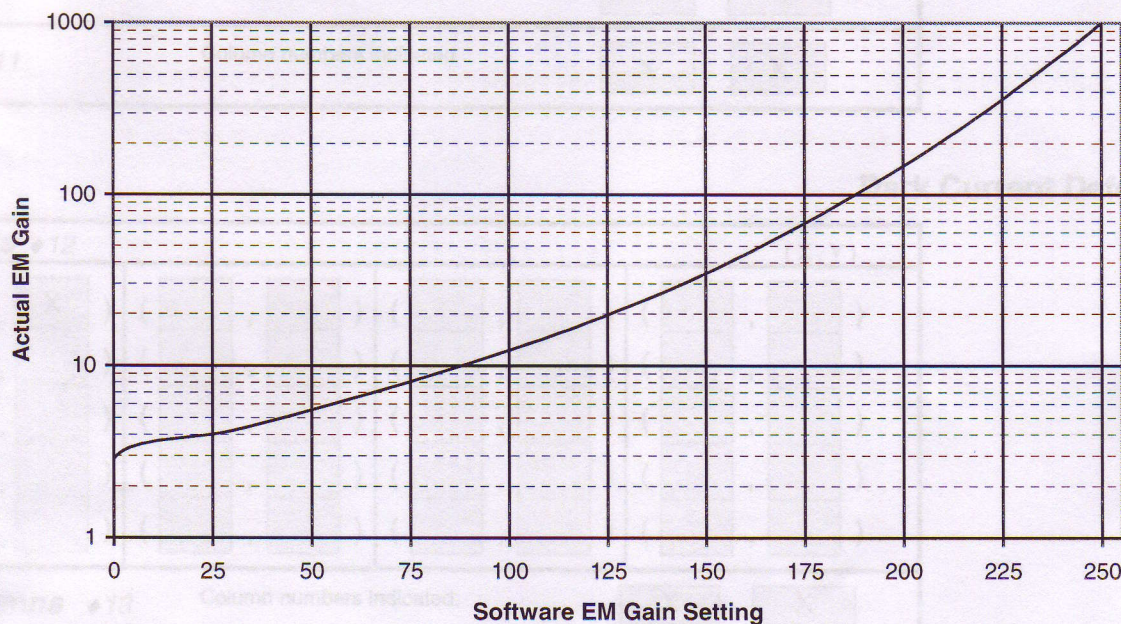


PERFORMANCE

Electron Multiplication Gain Curve 3MHz 14 bit@-50°C



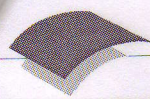
Electron Multiplication Gain Curve 1MHz 16 bit@-50°C



Note: Electron Multiplication Gain will reduce by approximately a factor of two for every 10°C rise in temperature

CCD Dark Current

Minimum Dark Current Achievable ♦5	0.019	electrons/pixel/sec		
@ Sensor Temperature of ♦6	-90.93	°C	15.0	°C water cooling
		With PSU		

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Linearity better than ♦7	1	% over 14 bits
Response Uniformity better than ♦8	0.01	%

Response Defects

White/Black Spots ♦9		(X, Y)	
(X , X)	(,)	(,)	(,)
(X , X)	(,)	(,)	(,)
(,)	(,)	(,)	(,)
(,)	(,)	(,)	(,)
(,)	(,)	(,)	(,)
(,)	(,)	(,)	(,)
White/Black Columns ♦10		Column numbers indicated.	X X
			X X
Traps ♦11		Column numbers indicated.	X 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	-50	°C with	15.0	°C water cooling
Base Mean Level measured at	-50	°C with	15.0	°C water cooling
Blemishes tested at	-50	°C with	15.0	°C water cooling

System Passed for Shipping

Signed
Date
BARRY ORCHIN
04-09-2003

Version control information

Hardware	POLO BOARD	CONNECTOR	DIGITAL	ANALOGUE	POWER BOARD	EEPROM
Version #	B	C	C	A	E	5.12
Shipping	MCD	COF	RBF	Pattern #1	Pattern #2	
Software	1.1.27	146	36	P02B872C	P02B873A	
Version #						
Testing	MCD	COF	RBF			
Software	1.1.26	146	36			
Version #						

Notes

All tests are carried out with standard test card

Actual performance may differ slightly with supplied card, but will remain within specification

- ◆1 Readout Noise is measured for single pixel readout with the CCD in darkness at temperature indicated and minimum exposure time.
- ◆2 Average electronic DC offset for CCD in darkness at temperature indicated and minimum exposure time under dark conditions and single pixel readout.
- ◆3 Sensitivity 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 The Electron multiplication gain characteristics on the sensor. Note that the gain achieved varies with operating temperature and may reduce slowly over time.
- ◆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 Linearity is measured from a plot of Counts vs. Signal over the 14 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 operation illuminated with uniform white light (defects not included).
- ◆9 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.
- ◆10 Columns which have ≥ 10 blackspots with uniform illumination across the sensor.



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- ◆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.

Camera Overview

Model	
Serial Number	

Model and Serial Number are printed at 1.5mm x 1.5mm for each two digits in the Model Number.

Supporting optics	(*)
AR coating (nm)	400-550 nm
AR coating (nm)	400-550 nm
MgF ₂ input	
Other (specify)	

AD Features	
AD resolution	14-bit & 16-bit
Readout speed	200 nS, 333 nS and 1nS per pixel
Other (specify)	

CCD Details

Model/Technology/Device etc.	Pixels	Serial Number
EMV TECH CCD/BS	576x288, 20x30µm ²	
EMV TECH CCD/BS	512x512, 16µm ²	01471-15-12
EMV TECH CCD/BS	128x128, 24µm ²	

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

Sensor Options			
FI	Front Pumped (FI)	UV	FI+UV coating
BS	Back Illuminated (BI) with 550nm AR coating		