CHIP CHARACTERISTICS
FOR
Loral/Lesser JG2605ST W_15-C CCD # 43

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1 General Description

Chip type	: Loral/Lesser JG2605ST Grade medium, thinned, AR coated, MPP
Chip characteristics:	AR coating: orange/red optimized, 850 Å HfO_2,
	: UV flooding required
Chip format	: 2688x511, 16 pre-scan pixels in horizontal direction
Pixel size	: 15 x 15μm^2
Serial No.	: W_15-C

This CCD is forseen as spare CCD for the CAT telescope at La Silla as # 43.

The cryostat electronic board has special clock shaping capacitors for this CCD (C65-67: 180nF).

2 UV – flooding and Continuous flow cryostat

see the same section in the report of CCD # 38

3 Flatness of the chip

The measured flatness of the CCD surface has a peak to peak deviation from the ideal plane of only **18 micron**. The **RMS** value is **5 micron**.

The detector assembly is adjusted and should not be opened, because the CCD plane is adjusted parallel to the CCD-flange plane.

4 System Setup

This chip has been tested with the ESO-VME CCD camera system.

The clock-pattern jg2605abmpp with MPP–mode have been used for the tests. At the telescope we recommend the clockpatter jg2605ab without MPP to have higher resolution and the amplifier D or 2, which has lower noise.

Parameters are set to SUBPATT 3 and GAIN 2, if not otherwise mentioned.

All tests were performed between 160 K and 180 K, if not otherwise mentioned.

5 Voltage Setup

See table 1 on page 2 for all voltage values.

```
VLO1 :  -8.00 VHI1 :  +2.00 VLO2 :  -3.00 VHI2 :  +4.00
HLO1 :  -2.00 HHI1 :  +12.00 HLO2 :  0.00 HHI2 :  +9.00
RLO1 :  -6.00 RHI1 :  0.00 RLO2 :  -3.00 RHI2 :  +9.00
VDD1 :  +21.80 VDR1 :  +20.00 VDD2 :  +21.80 VDR2 :  +20.00
VGS1 :  +10.00 VSS1 :  0.00 VGS2 :  +10.00 VSS2 :  0.00
```

Table 1: Telemetry values

6 Noise and Gain

Amplifier 1 or A:

The conversion factor is (at GAIN = 2)

1.586$\pm$0.059 **e$^-$/ADU.** at subpatt 3

The readout-noise is (at GAIN = 2)

18.8$\pm$0.9 **e$^-$ RMS** at subpatt 3

Amplifier 2 or D:

The conversion factor is (at GAIN = 2)

9.158±0.407 **e$^-$/ADU.** at subpatt 1

4.554±0.103 **e$^-$/ADU.** at subpatt 2

2.298±0.06 **e$^-$/ADU.** at subpatt 3

2.321±0.134 **e$^-$/ADU.** at subpatt 3 and 2x2 binning

The readout-noise is (at GAIN = 2)

9.8±0.6 **e$^-$ RMS** at subpatt 1

7.8±0.3 **e$^-$ RMS** at subpatt 2

6.8±0.2 **e$^-$ RMS** at subpatt 3

7.5±0.5 **e$^-$ RMS** at subpatt 3 and 2x2 binning

The noise and gain was measured using the HP-desktop procedure "MEASURE CONFACT" at different illumination levels. This procedure takes two equal dark– and two equal flat-field exposures calculating noise and gain independent from the light level with the variance of the difference of the two flat-fields.

7 Pick-up Noise

At slow-mode pick-up noise could not be seen at short dark exposures.

8 Quantum Efficiency

```
CCD SENSITIVITY CALIBRATION:                        19 May 1995   00:29:02
============================

Detector ID         : JG2W15C      Detector            : Loral
Calibrated against  : _SDC1_NP_1   Type                : JG2605S
Detector area (cm2) : 2.25E-06     ESO CCD No.         :    2123
e-/[ADU]            :  2.30        Used Output(s)      :     1
System gain         :     2        Subpattern          :     3
Misc.Comments       : jg2605abW15-_C

CCD System values   :          Scanned CCD area
-----------------   :          ----------------
Hor. act. Pixels    :  2720        First pixel         :    21
Tot. vert. Lines    :   560        Last pixel          :  2701
Hor.  Binning       :     1        First line          :     5
Vert. Binning       :     1        Last line           :   509

Lambda Time  Dens  Temp Counts  RQE  +/-    Sensitivity Photon flux  Irradiance
  [nm] [sec] [log]  [K]  [ADU]  [%]   [%]   [A/(W/cm2)]  [Phot/cm2]   [W/cm2]
*******************************************************************************
   320   300  0.0  165.2   443 42.47  2.82   +2.481E-07  +3.558E+06  +2.194E-12
   340   300  0.0  165.2  1535 39.53  2.13   +2.445E-07  +1.324E+07  +7.710E-12
   360   300  8.6  165.2  1376 35.88  1.98   +2.346E-07  +1.308E+07  +7.205E-12
   380    60  8.6  165.2  1284 43.73  2.14   +3.022E-07  +5.005E+07  +2.609E-11
   400    40  0.0  165.2  1994 55.21  2.42   +3.997E-07  +9.238E+07  +4.596E-11
   450    10  0.0  165.2  2264 65.03  2.68   +5.300E-07  +3.562E+08  +1.574E-10
   500    10   .3  165.2  2556 77.11  3.15   +6.993E-07  +3.391E+08  +1.347E-10
   550    10   .3  165.2  6790 84.86  3.27   +8.473E-07  +8.185E+08  +2.953E-10
   600    10   .9  165.2  2469 90.18  3.67   +9.800E-07  +2.801E+08  +9.284E-11
   650    10   .9  165.2  2752 90.84  3.60   +1.060E-06  +3.099E+08  +9.565E-11
   700    10   .9  165.2  3605 90.79  3.48   +1.152E-06  +4.062E+08  +1.153E-10
   750    10   .9  165.2  2278 82.22  3.25   +1.117E-06  +2.834E+08  +7.515E-11
   800    10   .6  165.2  4426 73.21  2.76   +1.061E-06  +6.184E+08  +1.537E-10
   850    10   .3  165.1  8679 56.81  2.03   +8.769E-07  +1.563E+09  +3.647E-10
   900    10  0.0  165.2  7841 39.17  1.46   +6.391E-07  +2.047E+09  +4.521E-10
   950    10  0.0  165.2  4603 23.66   .91   +4.071E-07  +1.990E+09  +4.166E-10
  1000    20  0.0  165.2  5407 10.22   .41   +1.850E-07  +2.705E+09  +5.384E-10
Calibration_error=    1.50%  Conversion_factor_error=   2.10%
_JG2W15C_22 stored on /users/ms/cali:HFS at 19 May 1995 02:59:51
```

Table: RQE measurement protocols for the CCD chip

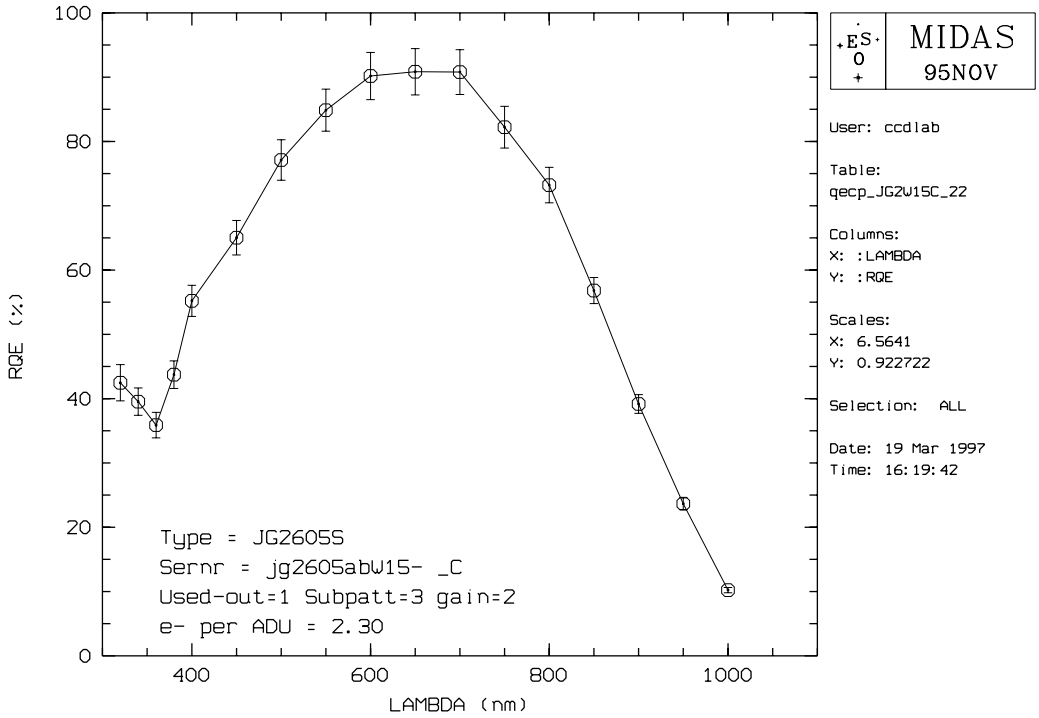


Figure 1: Plot of RQE values of the CCD (complete surface) at 168 K

The RQE was measured in an automatic mode using the test-bench computer. The quantum-efficiency values and their errors are listed below. The given error is the geometrical sum of the error of test-bench calibration (approximate 1.5 %), the error of the CCD conversion factor measurement (approximate 2.1 %) and of the variation of the quantum-efficiency over the whole chip surface (dependent from the light wavelength). The variation of quantum efficiency over the chip can be seen in detail in the homogeneity measurement in section 14 on page 9. To achieve the stated Quantum efficiency, the CCD was 25 minutes UV flooded.
The peak value for RQE of CCD was approx. 91 % at 650 nm.

Figure 1 on page 5 shows the plot of QE for the CCD.

9 Charge Transfer Efficiency

The CTE was measured using Flat Field exposures and its over-scan regions and gives:

Amplifier 2:

Serial CTE = 0.9999879 and Parallel CTE = 0.9979843

10 Dark Current

The dark current was measured with a 20 minutes dark exposures wit MPP–mode after more than 5 hours in the dark wiping the CCD every minute.

The mean dark current rate is approx. 9.4 ± 0.75 $e^-/pixel/hour$ at 168 K.

11 Linearity

Linearity was measured taking exposures of the same exposure-time at different light levels and at a wavelength of 700 nm.

Amplifier 2:

There is a maximum deviation of less than $\pm 0.73\%$ from the average value within 3.05 decades from 107 to 120000 e^- per pixel.

See figure 2 on page 6 for details.

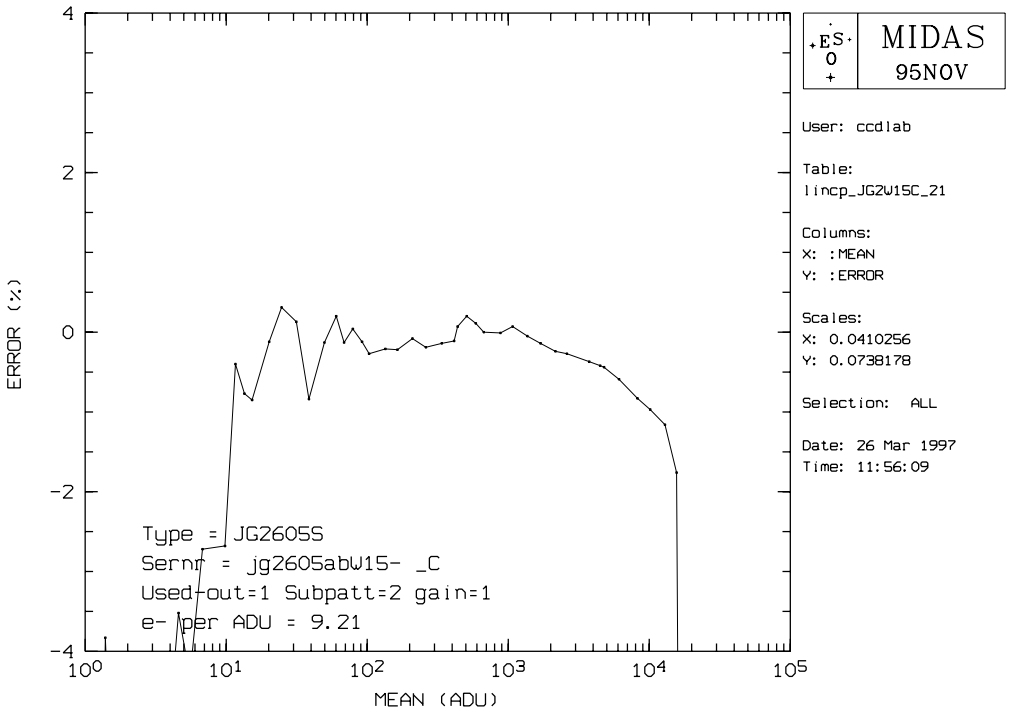


Figure 2: Linearity Measurement with amplifier 2

In view of the other problems with this CCD, the linearity was not optimized with the voltage setup.

12 Full well capacity

The full well capacity was measured with flat-field exposures of high intensities in MPP–mode. The limit of linearity is reached, if at higher intensities the deviation from linearity starts to get larger than the given maximum deviation in the section 10 on page 6.

Amplifier 2:

Upper limit of linearity: 95 000 e^-/pixel
Saturation-value: 117 000 e^-/pixel

Horizontal voltage has to be adjusted to prevent charge smearing at high illumination values.

13 Cosmic Ray Events

The Cosmic Ray Event rate was measured using our standard method (MIDAS Batch: COSMIC) to count *events* independently of their actual size.

The cosmic ray event rate is $1.93 + 0.2 - 0.2$ $events/min/cm^2$**.**

14 Blemishes

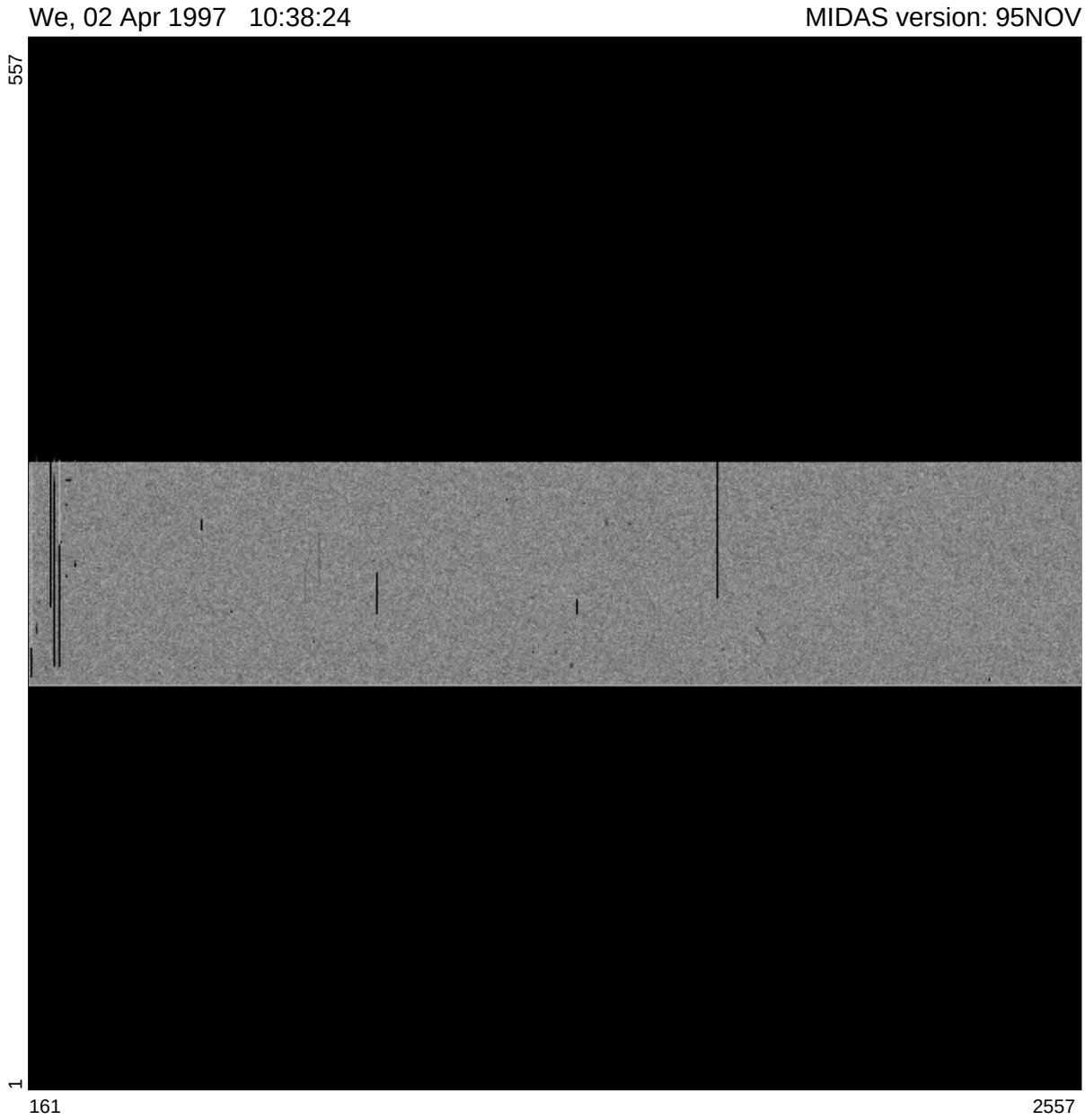
With the Amplifier 2 we found 4816 defective pixels. This was measured using three weak light images with a level of approximate 150 e^- per pixel (see page 8) and an automatic MIDAS-procedure to identify and catalogue the defects.

This test is very sensitive: A column defect is any defect which is longer than 10 pixels and a defect is any pixel which is lower than 50 % or higher than 200 % of the mean level of a weak light flat field exposure.

```
Number of hot defects:
Hot spots: 8; Hot cluster: 44; Hot columns: 17

Number of dark defects:
Dark pixel: 9; Dark cluster: 117; Dark columns: 20; Traps: 44

Number of all defects: 259
```



Frame : weakmean
Identifier : average frame
ITT-table : ramp.itt
Coordinates : 161, 1 : 2557, 557
Pixels : 1, 1 : 600, 600
Cut values : 191.52, 235.46
User : ccdlab

Figure 3: Weak Flat field (700nm,2.5): approx. 150 e^- per pixel with amplifier 2.

15 Uniformity

The homogeneity was measured using a standard method of sampling the whole sensitive area and using the RMS value of it. Values of deviations from homogeneity are given in table 2 on page 9.

Flat-field exposure at a wavelength in [nm]	Maximal RMS Deviation from mean value in [%]
320	6.11
340	4.72
360	4.88
380	4.17
400	3.53
450	3.21
500	3.16
550	2.86
600	3.14
650	3.01
700	2.83
750	2.99
800	2.74
850	2.47
900	2.70
950	2.87
1000	3.01

Table 2: Uniformity of the CCD

No fringing occures at a wavelength of 850 and 1000 nm.

16 Remanence

Exposure Type	Exposure Time in [sec]	Illumination in [photons/pixel]	CCD Saturation	Remanence in [e^- per pixel]
FF white	1(Dens=1)	218000	1.35	—–
DK	600	—	—	0
FF white	1	1924000	11.84	—–
DK	600	—	—	2
DK	600	—	—	0
DK	600	—	—	0
FF white	10	19240000	118.4	—–
DK	600	—	—	1
DK	600	—	—	0
DK	600	—	—	0

Table 3: Remanence of the CCD at 168 K

The Remanence test was made after 10 hours in the dark and periodical wiping at at temperature of 168 K. After a high level flat field with white light which give oversaturation on the CCD, several ten minutes dark exposures have been taken. The mean level in the centre of these dark exposures was compared with the mean level of a ten minute dark before these saturations and the remanence in e^- per pixel has been calculated. The results can be seen in table 3 on page 10.

References

[1] S. Deiries, M. Cullum: ESO Maintenance Manual No.5 July 89, CCD Cryostat for new VME-based Control Camera.

[2] J. Janesick, JPL: Private communication