Report: CS02 electrical validation

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1 Electrical tests

1.1 Auxiliary board

Here, some parameters of the auxiliary board are measured.

- Consumption: 378 mA
- $V_{clp} = 2.1\ V$
- $V_{dd_D} = 3.357\ V$
- $V_{dd_A} = 3.301\ V$

1.2 CS02 smoke test

First smoke test done without changing the value of V_{clp}, V_{dd_D} of V_{dd_A}:

- POWER ON: 33 mA
- RESET: 33 mA
- ALL: 750 mA
- READ: 750 mA and no error sent by the JTAG software

- START: 1128 mA

Measurement of voltages at the capacitors close to the connector:

- V_{clp} = 2.072 V adjusted to 2.108 V
- V_{dd_D} = 2.923 V adjusted to 3.337 V
- V_{dd_A} = 2.746 V adjusted to 3.345 V

Second smoke test done after recalibrating V_{clp}, V_{dd_D} of V_{dd_A}:

- POWER ON: 1461 mA
- RESET: 40 mA
- ALL: 829 mA
- READ: 829 mA and no error sent by the JTAG software
- START: 1402 mA

2 Calibration

2.1 Sensors output checked on the oscilloscope

Chip 1:
- RESET/JTAG: OK
- Control Header/Trailer: OK
- No dead pixel

Chip 2:
- RESET/JTAG: OK
- Control Header/Trailer: OK
- No dead pixel

Chip 3:
- RESET/JTAG: OK
- Control Header/Trailer: OK
- Dead pixels

Chip 4:
- RESET/JTAG: OK
- Control Header/Trailer: OK
- No dead pixel

Chip 5:
- RESET/JTAG: OK
- Control Header/Trailer: OK
- No dead pixel

Chip 6:
- RESET/JTAG: OK
- Control Header/Trailer: OK
- No dead pixel

2.2 DAQ calibration

2.2.1 Chip 1

Few pixels are stuck to 1 on the sub-matrix C.

- Estimation of the "middle points":

V_{ref_2}	$V_{ref_{1A}}$	$V_{ref_{1B}}$	$V_{ref_{1C}}$	$V_{ref_{1D}}$
100	112	115	179	155

- Discriminators calibration:

V_{ref1_A} START	V_{ref1_B} START	V_{ref1_C} START	V_{ref1_D} START	V_{ref2}	V_{ref1_A} STOP	Step	Event nb / step	Number of Runs
84	87	151	127	100	140	2	500	29

- Temporal noise, fixed pattern noise and offset:

Matrix	TN	FPN	Offset
A	1.072	0.313	0.253
B	1,287	-0.611	0,968
C	0.948	0.388	0.911
D	0.936	0.362	0.644

- Fake Hit Rate estimation (DAQ values = middle point values + 20 and accumulation of 10^4 events): 2.9 hits/frame
- **Observations:** Few pixels are stuck to 0 on the sub-matrix C (col 731 line 48 to 64).

2.2.2 Chip 2

- Estimation of the "middle points":

V_{ref_2}	$V_{ref_{1A}}$	$V_{ref_{1B}}$	$V_{ref_{1C}}$	$V_{ref_{1D}}$
100	139	127	158	115

- Discriminators calibration:

V_{ref1_A} START	V_{ref1_B} START	V_{ref1_C} START	V_{ref1_D} START	V_{ref2}	V_{ref1_A} STOP	Step	Event nb / step	Number of Runs
111	99	130	87	100	167	2	500	29

- Temporal noise, fixed pattern noise and offset:

Matrix	TN	FPN	Offset
A	1.143	0.386	0.257
B	1.188	-0.175	0.955
C	1.104	-0.358	1.074
D	1.028	0.652	0.573

- Fake Hit Rate estimation (DAQ values = middle point values + 20 and accumulation of 10^4 events): 16.4 hits/frame

2.2.3 Chip 3

- Estimation of the "middle points":

V_{ref_2}	$V_{ref_{1A}}$	$V_{ref_{1B}}$	$V_{ref_{1C}}$	$V_{ref_{1D}}$
100	148	140	153	126

- Discriminators calibration:

V_{ref1_A} START	V_{ref1_B} START	V_{ref1_C} START	V_{ref1_D} START	V_{ref2}	V_{ref1_A} STOP	Step	Event nb / step	Number of Runs
120	112	130	98	100	176	2	500	29

- Temporal noise, fixed pattern noise and offset:

Matrix	TN	FPN	Offset
A	1.087	0.445	0.240
B	1.094	0.129	0.832
C	1.013	-0.377	0.962
D	0.947	1.022	0.356

- Fake Hit Rate estimation (DAQ values = middle point values + 20 and accumulation of 10^4 events): 367 hits/frame
- **Observations:** One column on sub-matrix D stuck to 0 (col: 1145). Strange pattern seen on the test monitoring to estimate the fake hit rate (see picture).

2.2.4 Chip 4

- Estimation of the "middle points":

V_{ref_2}	$V_{ref_{1A}}$	$V_{ref_{1B}}$	$V_{ref_{1C}}$	$V_{ref_{1D}}$
100	95	146	161	169

- Discriminators calibration:

V_{ref1_A} START	V_{ref1_B} START	V_{ref1_C} START	V_{ref1_D} START	V_{ref2}	V_{ref1_A} STOP	Step	Event nb / step	Number of Runs
67	118	133	141	100	176	2	500	29

- Temporal noise, fixed pattern noise and offset:

Matrix	TN	FPN	Offset
A	1.081	0.340	0.321
B	1.228	-0.244	0.880
C	0.956	-0.089	1.003
D	0.929	0.702	0.387

- Fake Hit Rate estimation (DAQ values = middle point values + 20 and accumulation of 10^4 events): 14.7 hits/frame

2.2.5 Chip 5

- Estimation of the "middle points":

V_{ref_2}	$V_{ref_{1A}}$	$V_{ref_{1B}}$	$V_{ref_{1C}}$	$V_{ref_{1D}}$
100	86	125	173	185

- Discriminators calibration:

V_{ref1_A} START	V_{ref1_B} START	V_{ref1_C} START	V_{ref1_D} START	V_{ref2}	V_{ref1_A} STOP	Step	Event nb / step	Number of Runs
58	97	145	157	100	114	2	500	29

- Temporal noise, fixed pattern noise and offset:

Matrix	TN	FPN	Offset
A	1.031	0.254	0.323
B	0.993	0.134	0.715
C	0.864	0.450	0.874
D	0.903	0.284	0.461

- Fake Hit Rate estimation (DAQ values = middle point values + 20 and accumulation of 10^4 events): 3.3 hits/frame (sub-matrix C Vref value a bit too low)

2.2.6 Chip 6

- Estimation of the "middle points":

V_{ref_2}	$V_{ref_{1A}}$	$V_{ref_{1B}}$	$V_{ref_{1C}}$	$V_{ref_{1D}}$
100	171	162	189	151

- Discriminators calibration:

V_{ref1_A} START	V_{ref1_B} START	V_{ref1_C} START	V_{ref1_D} START	V_{ref2}	V_{ref1_A} STOP	Step	Event nb / step	Number of Runs
143	134	161	123	100	199	2	500	29

- Temporal noise, fixed pattern noise and offset:

Matrix	TN	FPN	Offset
A	0.985	0.447	0.297
B	1.076	-0.032	0.768
C	1.019	-0.613	0.977
D	0.846	0.838	0.389

- Fake Hit Rate estimation (DAQ values = middle point values + 20 and accumulation of 10^4 events): 0.6 hits/frame (sub-matrix C Vref value a bit too low)

The fake hit rate measurements was done in the test beam acquisition mode. The acquisition was done in the dark, for different thresholds and 5.10^6 events were recorded per run.

Sensors	Run number	Thresholds (σ)
1-2	7078	3
1-2	7079	5
1-2	7080	7

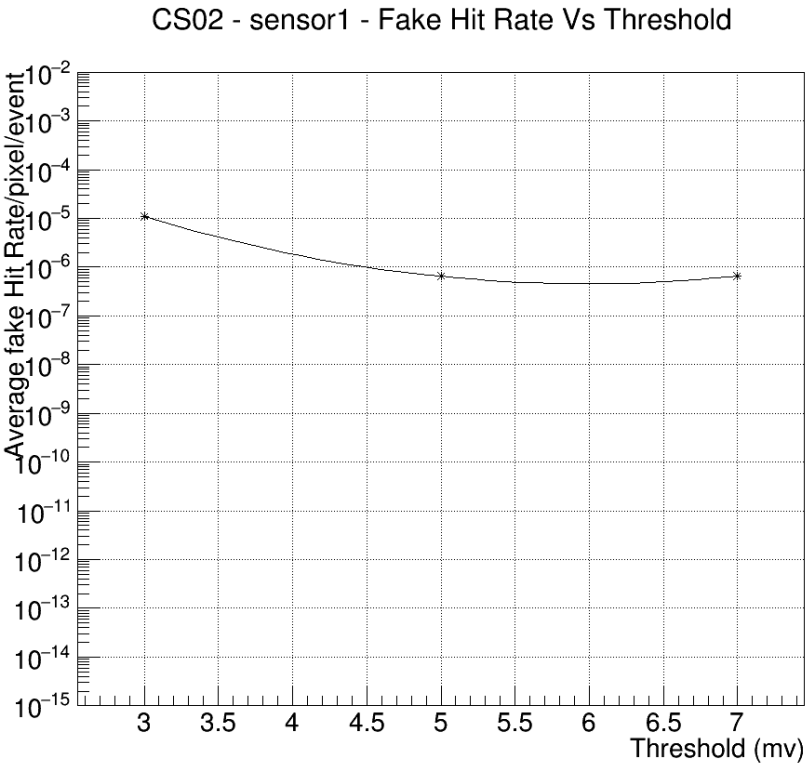

Figure 1: Average Fake Hit Rate per pixel per event as a function of the Threshold.

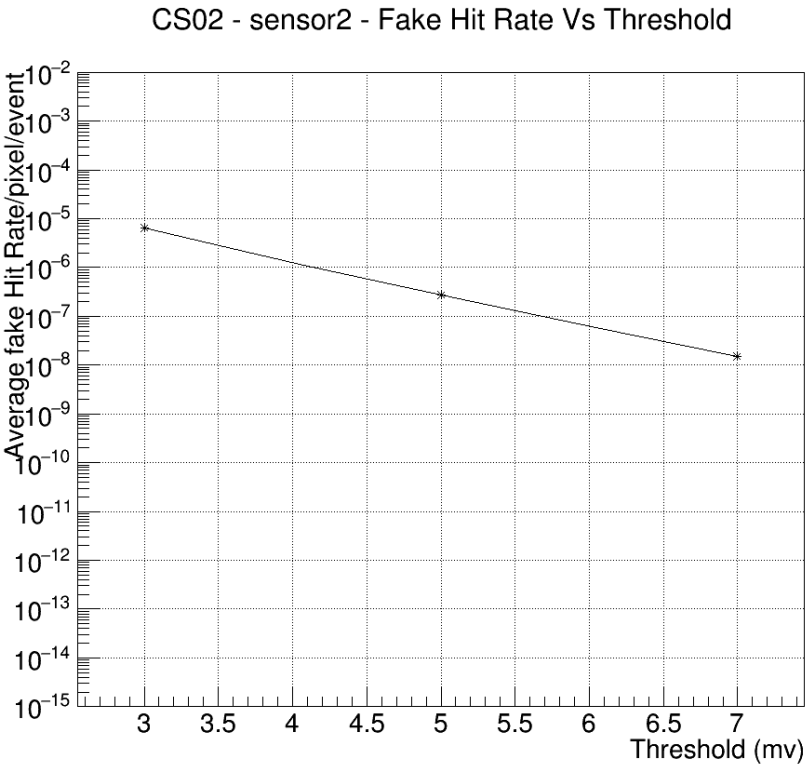

Figure 2: Average Fake Hit Rate per pixel per event as a function of the Threshold.

Sensors	Run number	Thresholds (σ)
3-4	7081	3
3-4	7082	5
3-4	7083	7

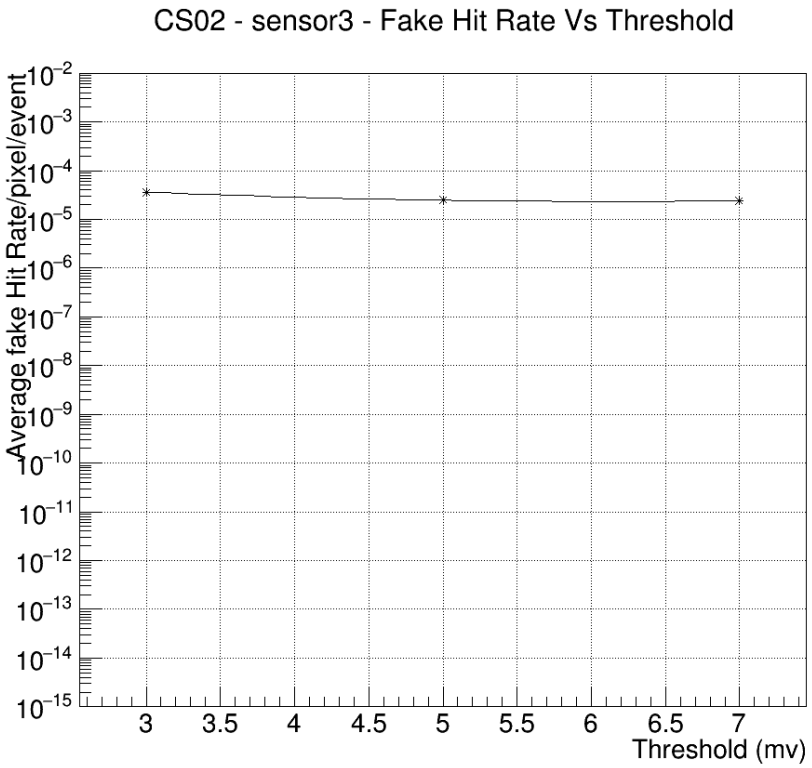

Figure 3: Average Fake Hit Rate per pixel per event as a function of the Threshold.

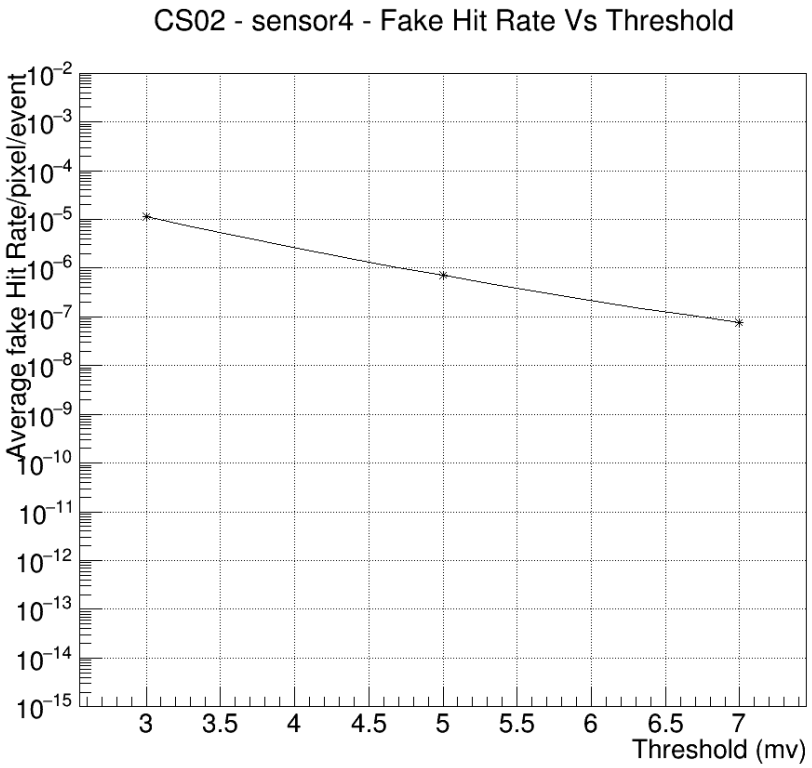

Figure 4: Average Fake Hit Rate per pixel per event as a function of the Threshold.

Sensors	Run number	Thresholds (σ)
5-6	7084	3
5-6	7085	5
5-6	7086	7

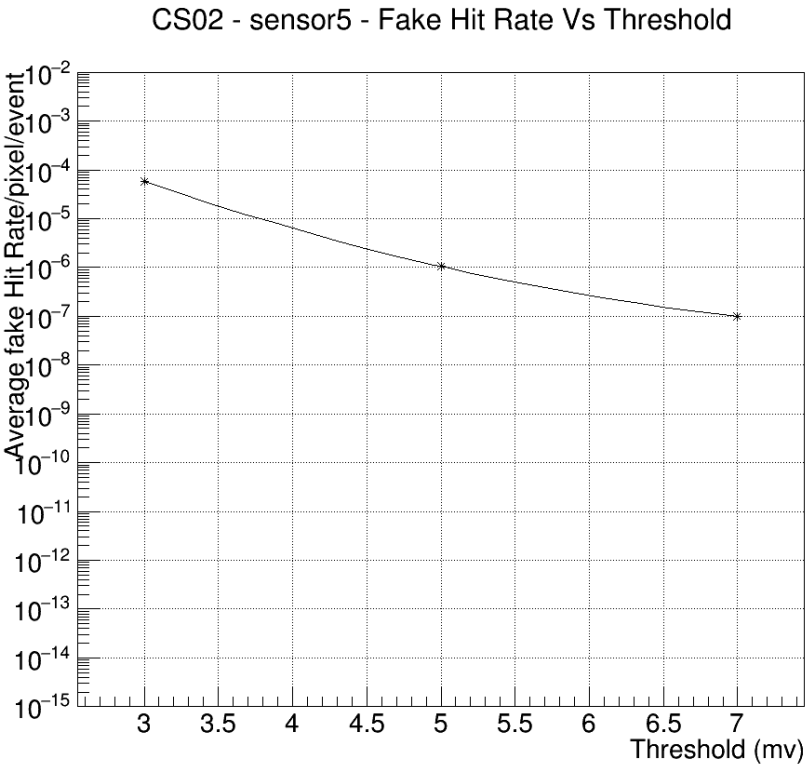

Figure 5: Average Fake Hit Rate per pixel per event as a function of the Threshold.

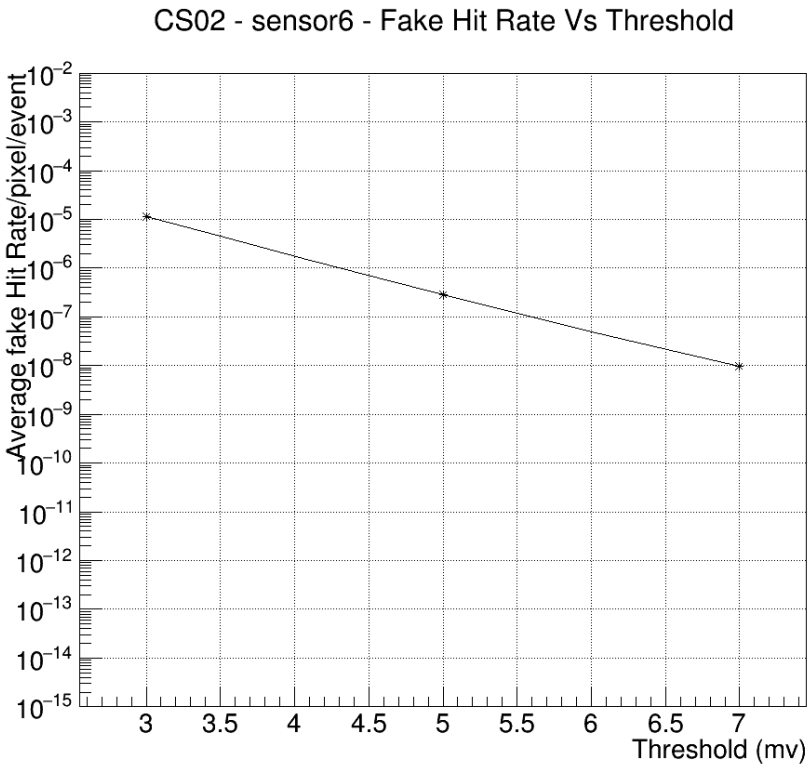

Figure 6: Average Fake Hit Rate per pixel per event as a function of the Threshold.