

20 Mpixel camera – overview

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UFO project group



Status of the camera

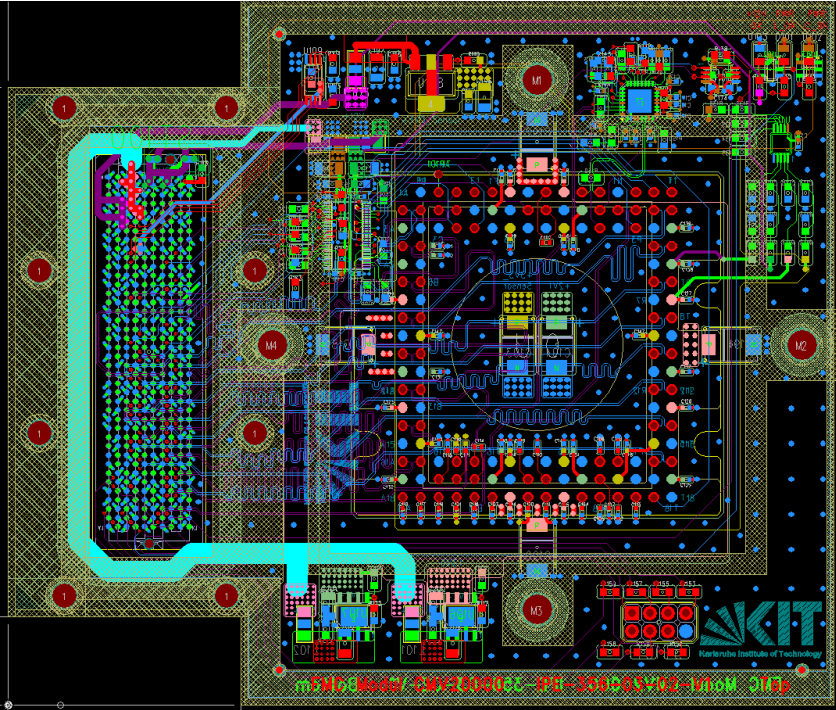
1. Camera HW status:
 1. PCB same size of previous FMC camera board
 2. PCB have been ordered → we expected to be IPE next week
 3. AVT → board assembly ASAP (next week)
 4. Nice solution to avoid to solder the sensor on the PCB → exchangeable 20 Mpixels sensors

2. Camera chamber → under construction (Moskow)
 1. Based on F-mount (instead of traditional C-mount)
 2. Vacuum pipe position → has been moved to accommodate the camera in the UFO transfromer

3. Firmware based on Virtex 6 (ML 605):
 1. first version → completed
 2. Camera handshaking → exactly the same of previous camera generation (same control_reg, command, status, streaming and etc.)
 3. Different readout sequence (different sensor) → mitigated inside the FPGA for a minimum work (software)
 4. Different internal register (mapping) → sensor side

20 Mpixels FMC camera board

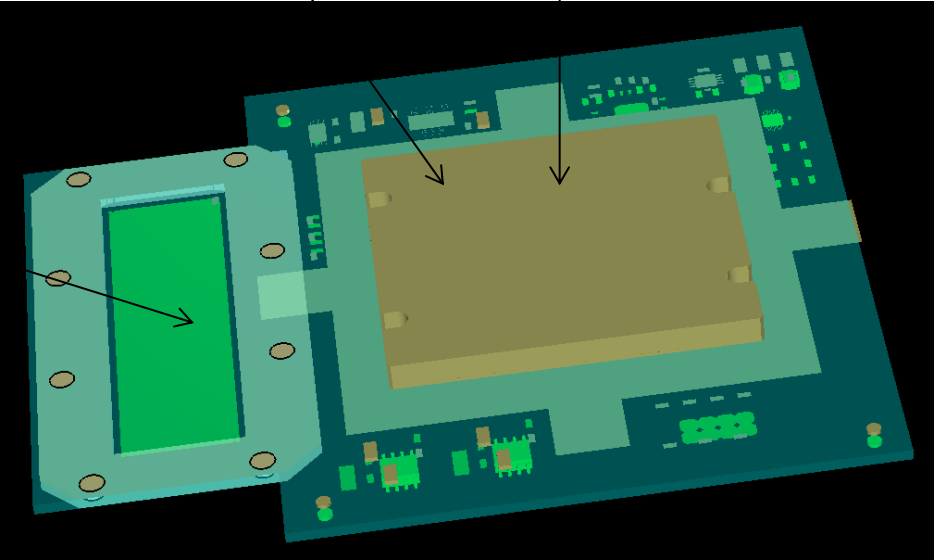
PCB ordered ...



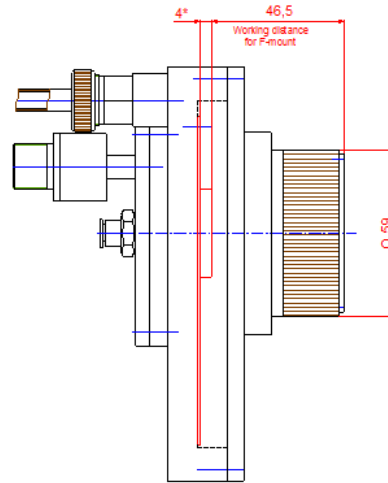
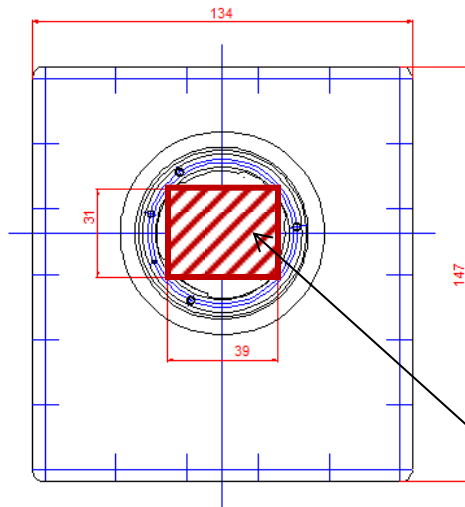
Sensor

Pix 0,0

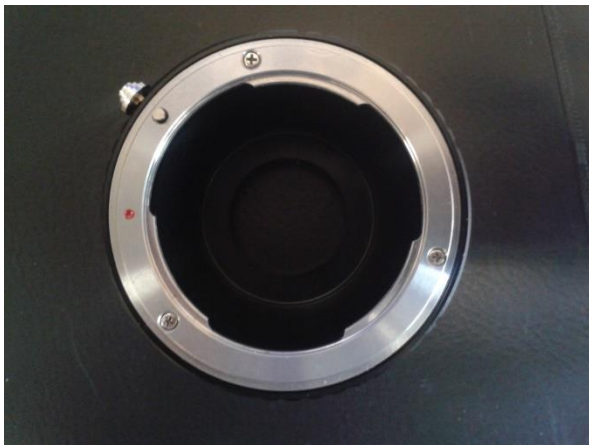
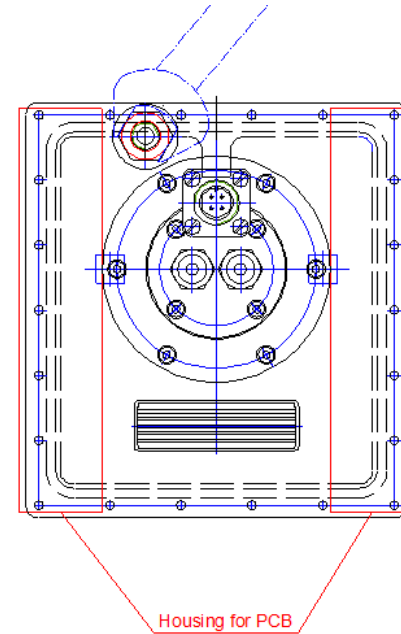
samtec



20 Mpixels chamber with F-mount (Nikon) adapter



New sensor



F-mount

| Firmware ver. | Sensor | DMA/driver | experiment |
|------------------|------------------|------------|------------------------------|
| 7 | Polaris / Awaiba | KIT | UFO and futures.. |
| 6 (<i>new</i>) | CMV 20000 | KIT | Phase contrast and futures.. |
| 5 | CMV 2000/4000 | KIT | UFO and Phase contrast |
| 4 | CMV 2000/4000 | NW | NOT USED |

HEADER UFO 6

DHEADER_1 = {4'h5, 24'h111111, header_vers[2:0], ext_header[0]};

if (1) => “no ext” then “ext” -- 001 → This version

51111113

DHEADER_2 = {4'h5, 28'h22222222};

DHEADER_3 = {4'h5, 28'h33333333};

DHEADER_4 = {4'h5, **INT_TIME** [27:0] }; → integration time = INT_TIME* 20 nsec

DHEADER_5 = {4'h5, **Output_mode** [3:0], **ADC_Resolution**[3:0], 4'd0, start_line[15:0]};

DHEADER_6 = {4'h5, skip_lines[11:0], number_of_lines[15:0]};

DHEADER_7 = {4'h5, 4'h6, frame_number[23:0]};

DHEADER_8 = {4'h5, 4'h0, **FR_timestap**[23:0]};

| ADC Resolution | ADC_Resolution (code) |
|----------------------|-----------------------|
| 10 –bit | 0 |
| 11 –bit | 1 |
| 12 –bit | 2 (DEFAULT) |
| Output_mode | Code |
| 16 outputs (used) | 0 (DEFAULT) |
| 8 outputs (not used) | 1 |
| 4 outputs (used) | 2 |
| 2 outputs (not used) | 3 |

Black: same field of previous version

Red: new field

| Data format version | definition |
|---------------------|----------------|
| 5 | UFO 5 |
| 6 | 20 MPixel |
| 7 | Polaris/Awaiba |

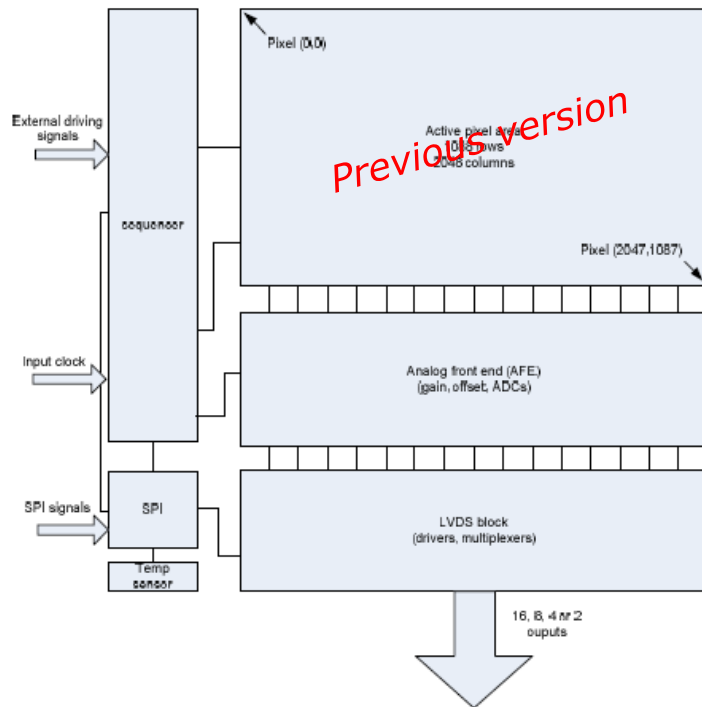
New data Format

The data format → with same philosophy than previous versions:

→ Data consistency bits → to check the data format

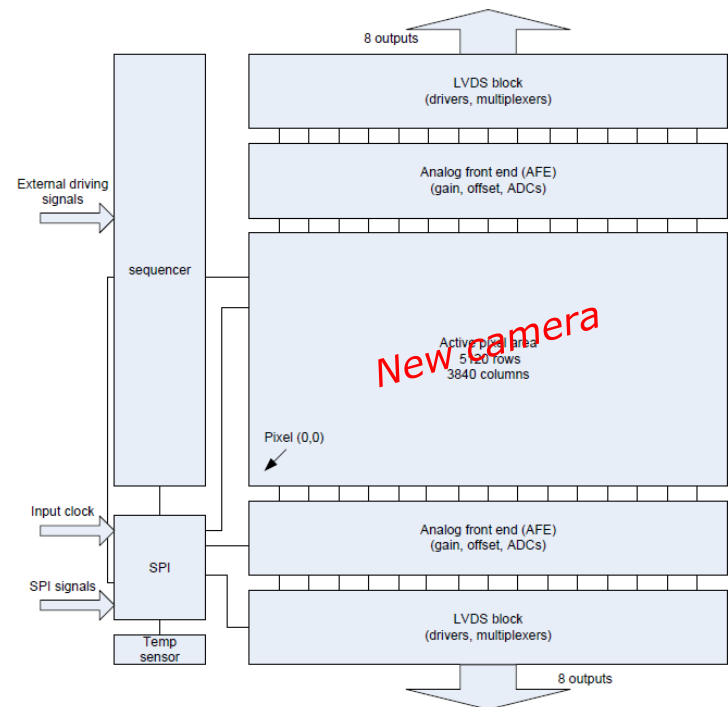
→ capable to recover and decode pixels in case of transmission errors (SEU)

CMV 2000



16 outputs (single row)

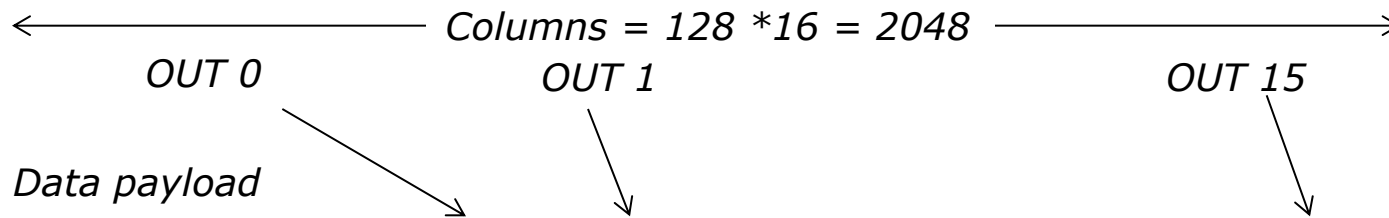
CMV 20000



8 outputs (for even row)
8 outputs (for even odd)

Data Format (UFO 5)

| | | | | | | | | | | | | | |
|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-----|-------|-------|
| 0,0 | 0,1 | ... | 0,127 | 0,0 | 0,1 | ... | 0,127 | ... | 0,0 | 0,1 | ... | 0,127 | Row 0 |
| 1,0 | 1,1 | ... | 1,127 | 1,0 | 1,1 | ... | 1,127 | ... | 1,0 | 1,1 | ... | 1,127 | Row 1 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| N,0 | N,1 | ... | N,127 | N,0 | N,1 | ... | N,127 | ... | N,0 | N,1 | ... | N,127 | Row N |

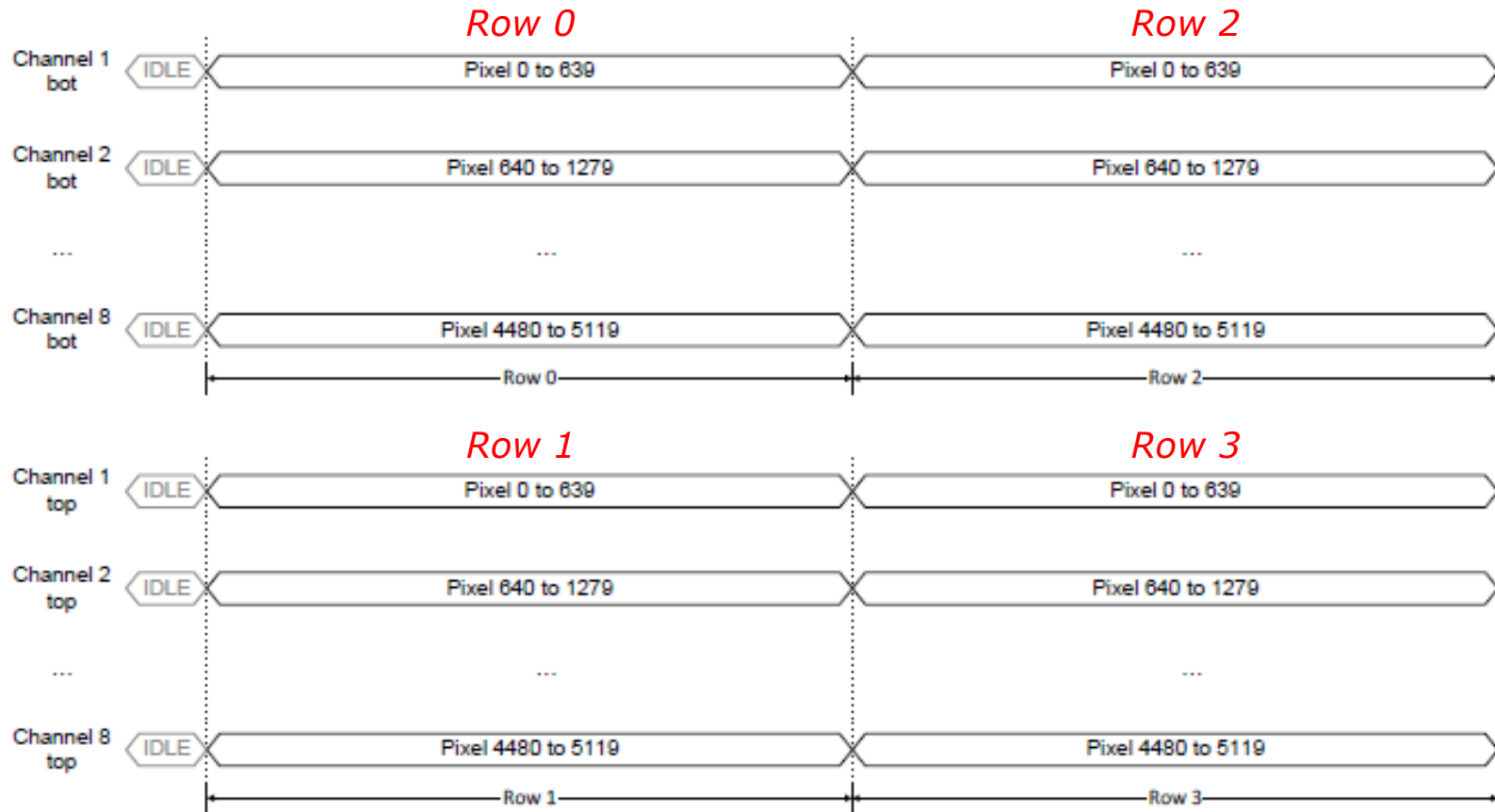


| | | | | | | | | |
|--------|----------|---------------|---------------|--|--|--|----------------|-------------|
| Header | 00000000 | Pix out 0,0 | Pix out 1,0 | | | | Pix out 15,0 | } 128 lines |
| Header | 00000000 | Pix out 0,1 | Pix out 1,1 | | | | Pix out 15,1 | |
| Header | 00000000 | Pix out 0,127 | Pix out 1,127 | | | | Pix out 15,127 | |
| | | | | | | | | |
| Header | 00000000 | Pix out 0,0 | Pix out 1,0 | | | | Pix out 15,0 | } 128 lines |
| Header | 00000000 | Pix out 0,1 | Pix out 1,1 | | | | Pix out 15,1 | |
| Header | 00000000 | Pix out 0,127 | Pix out 1,127 | | | | Pix out 15,127 | |

Header: 8'h80, pixel_size_reg, 1'b0,row_number_reg ,1'b0, pixel_number_reg, 32'd0

Robust data format → only 16 pixel lost in case of errors (transmissions)

New FMC camera Board

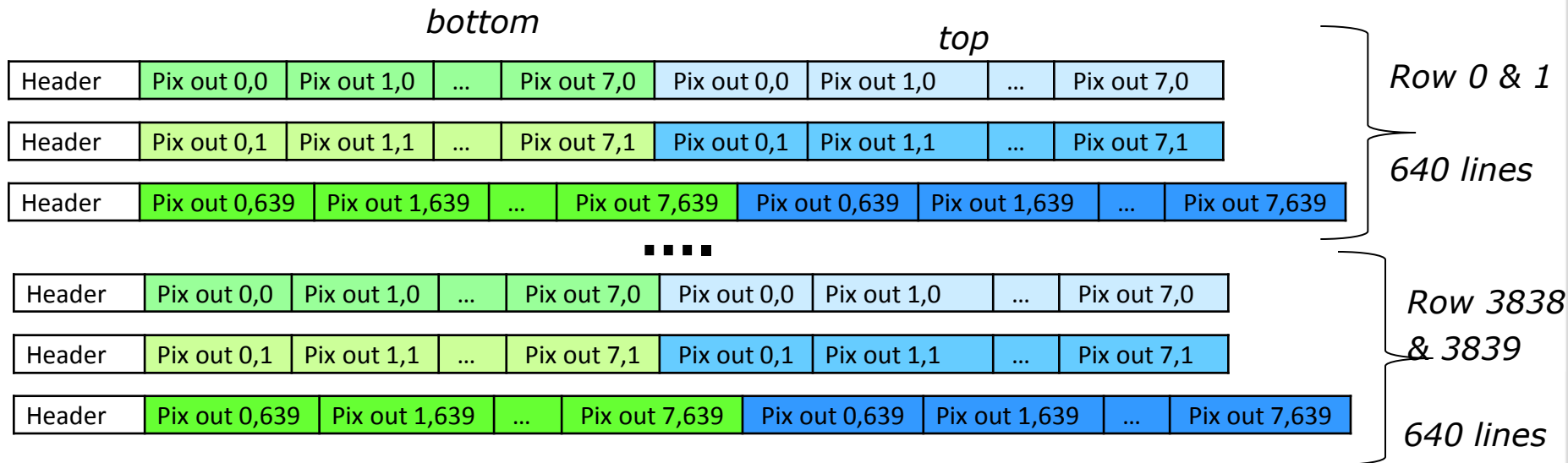
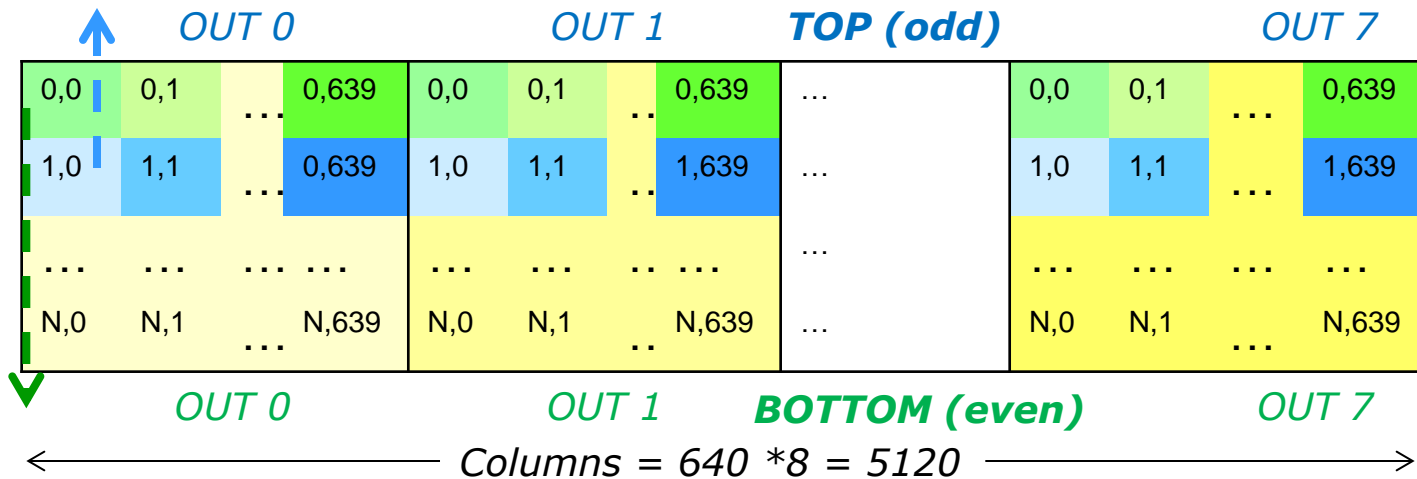


Channel N "bot" and "top" → at same time.

For each ROW → pixel from 0 to 639 (before was from 0 to 127)

Row number For each ROW → 3840 (before was 2047 for 2MPixel)

Data Format (UFO 6) - *New*



Header: 8'h80, pixel_size_reg, 8'd0,row_number_reg[11:0], 6'd0, pixel_number_reg[12:0], 16'd0

Sensor – internal register map

The internal register map → different than previous camera

Should be no issues for the latest XML driver

Consists of 127 integral register (like previous generation)

Each register 8 bit wide (like previous generation)

Reference to datasheet