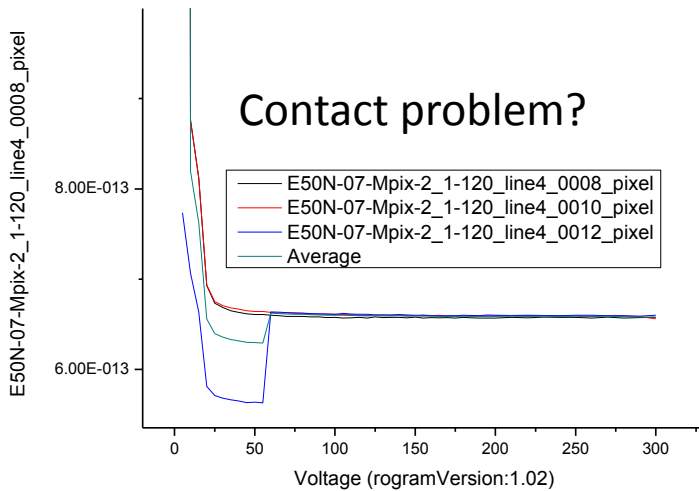


Results from Mpix- Measurements

Epitaxial silicon
(done by Sandro in the last weeks)

What I did



- Plot all single measurements for all sensors and all region (lot to do) and check if the measurements are ok
- Re-analyzed all (good) measurements with the tools I present in the last meeting and write them into the DB

Overview of measurements

	CVbias	IVBias	Cint	Rint	Rbias	Itotal	Ctotal
FZ120N-05-Mpix-1	x	x	x		for Rpoly	x	x
FZ120N-03-Mpix-2	x	x	x	x	for Rpoly	x	x
FZ120N-06-Mpix-1	x	x	x	x	for Rpoly	x	x
FZ120P-08-Mpix-2	x	x	x	x	for Rpoly	x	x
FZ120Y-10-Mpix-2		x	x	x	for Rpoly	x	
FZ200N-07-Mpix-2	x	x	x	x	for Rpoly	x	x
FZ200N-06-Mpix-2	x	x	x		for Rpoly	x	x
FZ200P-10-Mpix-1	x	x	x	x	for Rpoly	x	x
FZ200P-03-Mpix-1	x	x	x		for Rpoly		
FZ200Y-08-Mpix-1	x	x	x	x	for Rpoly	x	x
FZ200Y-03-Mpix-1	x	x	x		for Rpoly		
FZ200Y-03-Mpix-2	x	x	x		for Rpoly	x	x
FZ320N-04-Mpix-2	x	x	x	x	for Rpoly	x	x
FZ320N-03-Mpix-2	x	x	x		for Rpoly	x	x
FZ320Y-04-Mpix-2	x	x	x	x	for Rpoly	x	x
FZ320Y-06-Mpix-1	x	x	x		for Rpoly	x	x
FZ320P-07-Mpix-1	x	x	x	x	for Rpoly	x	x
FZ320P-02-Mpix-2	x	x	x		for Rpoly		

18 FZ with all thicknesses and substrates
(have to re-analyzed)

-> *not discussed here*

In DB and re-analyzed

all sensors are framed!	CVbias	IVBias	Cint	Rint	Rbias	Itotal	Ctotal
M200N-05-Mpix-2	x	x	x	x	for Rpoly	x	x
M200N-09-Mpix-1	x	x	x	x	for Rpoly	x	x
M200N-10-Mpix-1	x	x	x	x	for Rpoly	x	x
M200N-11-Mpix-2	x	x	x	x	for Rpoly	x	x
M200P-03-Mpix-1	x	x	x	x	for Rpoly	x	x
M200P-04-Mpix-2	x	x	x	x	for Rpoly	x	x
M200P-07-Mpix-2	x	x	x	x	for Rpoly	x	x
M200Y-02-Mpix-2	x	x	x	x	for Rpoly	x	x
M200Y-05-Mpix-1	x	x	x	x	for Rpoly	x	x

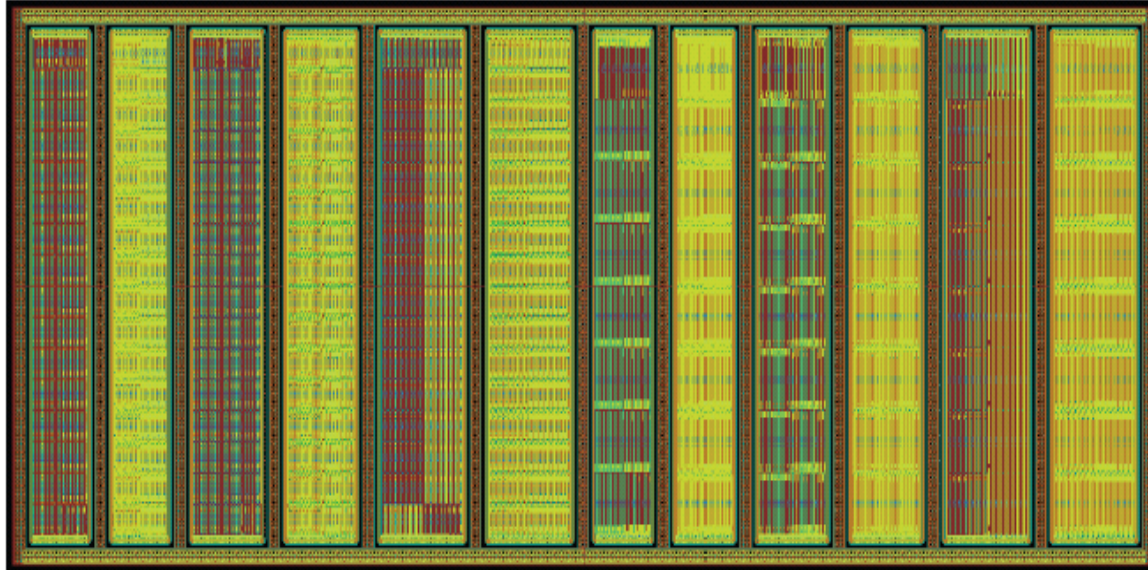
9 MCz; In DB and plotted, [Next Week](#)

all sensors are framed!	CVbias	IVBias	Cint	Rint	Rbias	Itotal	Ctotal
E50N-07-Mpix-2	x	x	x	x	for Rpoly	x	x
E50P-03-Mpix-1	x	x	x	x	for Rpoly	x	x
E50Y-01-Mpix-1	x	x	x	x	for Rpoly	x	x
E100N-03-MPix-2	x	x	x	x	for Rpoly	x	x
E100P-03-MPix-1	x	x	x	x	for Rpoly	x	x
E100Y-03-MPix-1	x	x	x	x	for Rpoly	x	x

6 Epi sensor measured by Sandro

Now: present first observation with discussion of unexpected...

Reminder Multi-Pixel

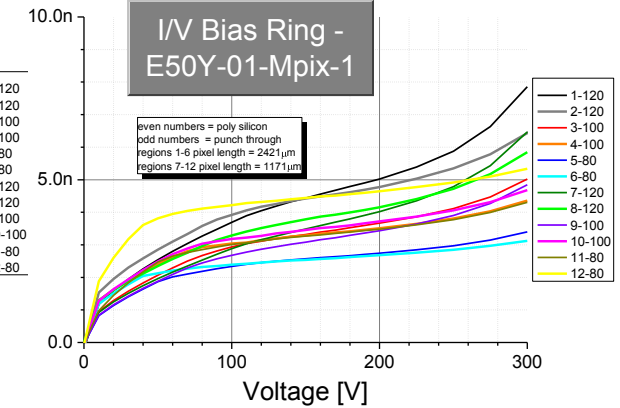
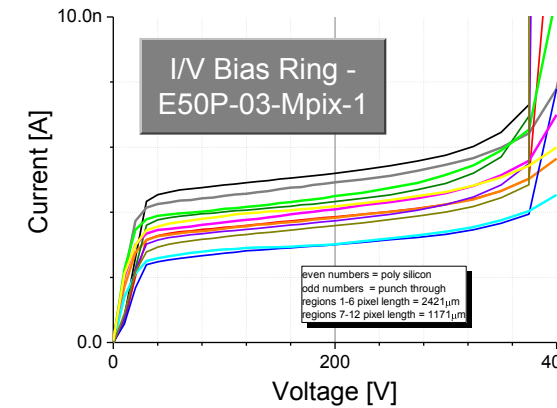
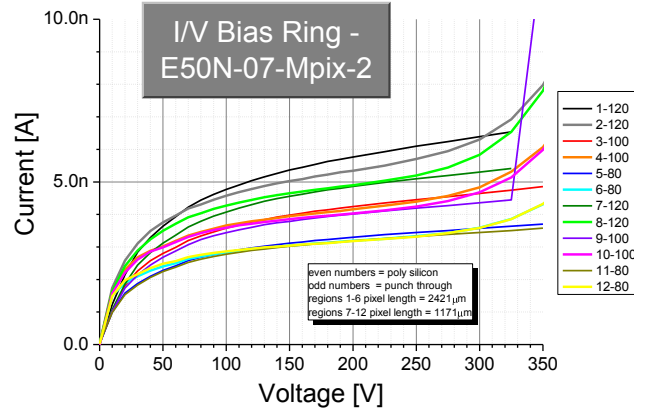
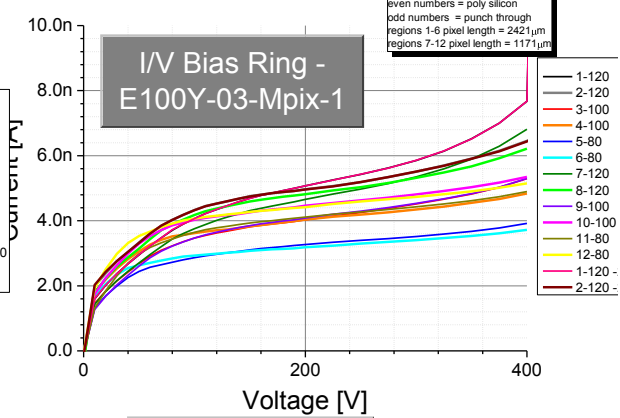
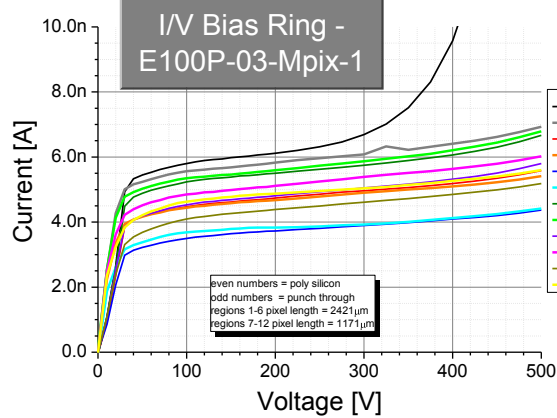
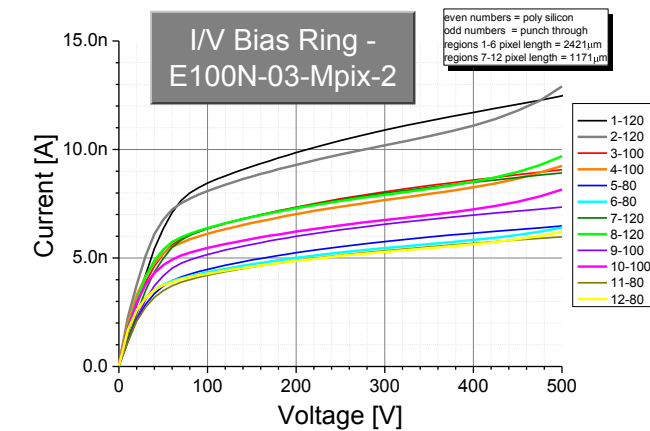


- 12 regions (3 ratios w/p, 2 diff. pixel lengths, 2 diff. Bias)

region	1	2	3	4	5	6	7	8	9	10	11	12
p+/n+	18	18	23	23	28	28	18	18	23	23	28	28
alu	31	31	36	36	41	41	31	31	36	36	41	41
length alu	1171	1171	1171	1171	1171	1171	2421	2421	2421	2421	2421	2421
pitch	80	80	100	100	120	120	80	80	100	100	120	120

Measurements:
3 slides as information for you

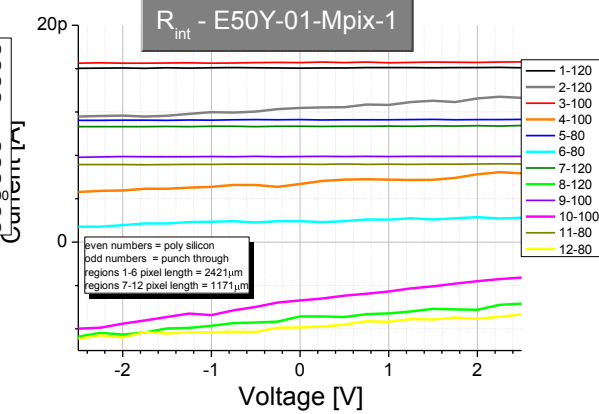
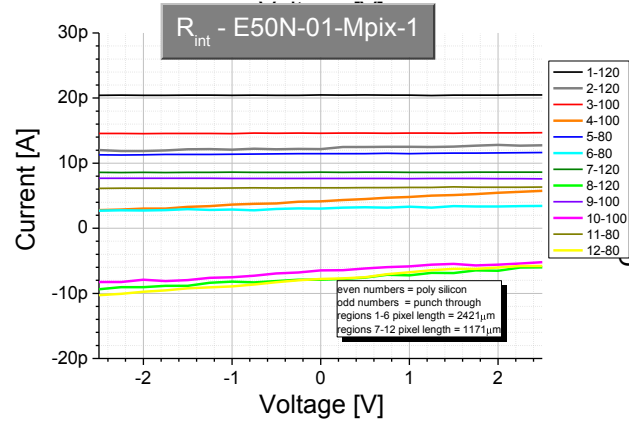
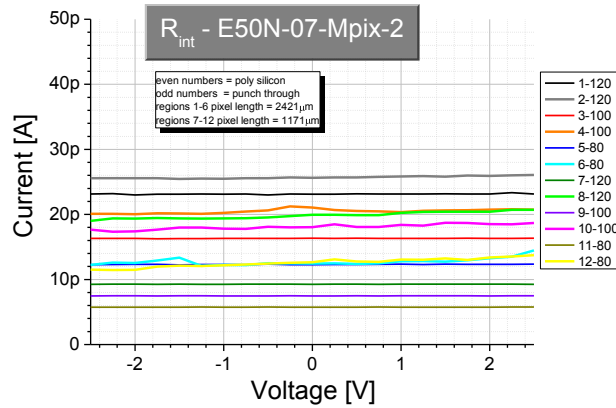
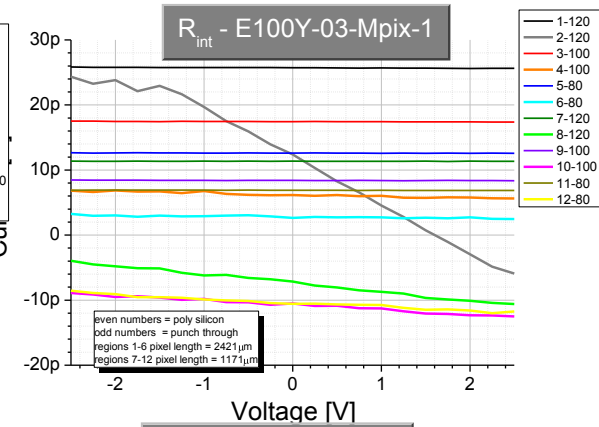
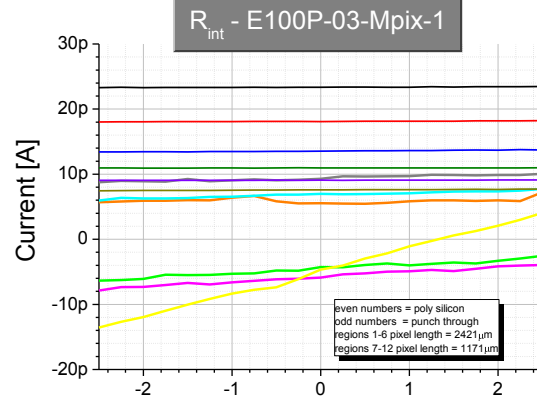
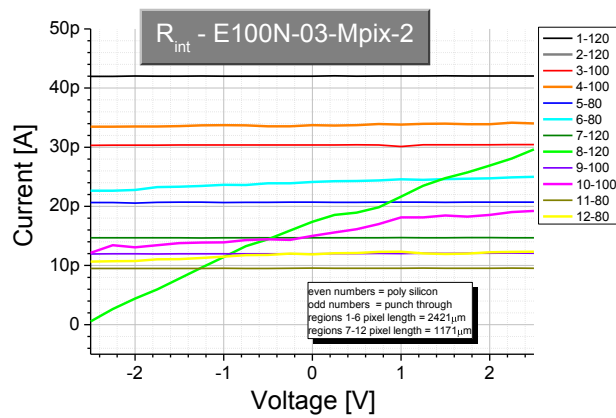
Life is simple 😞



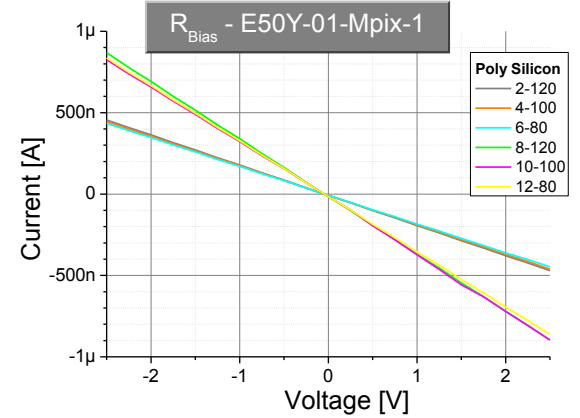
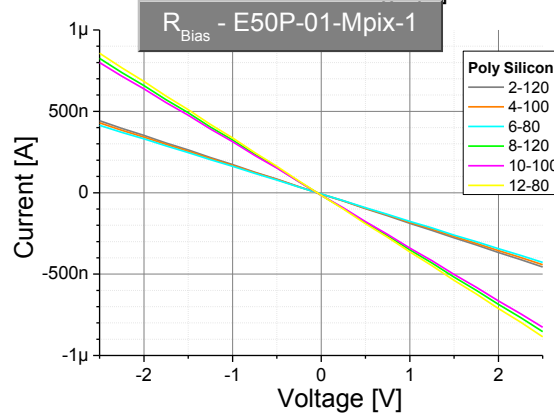
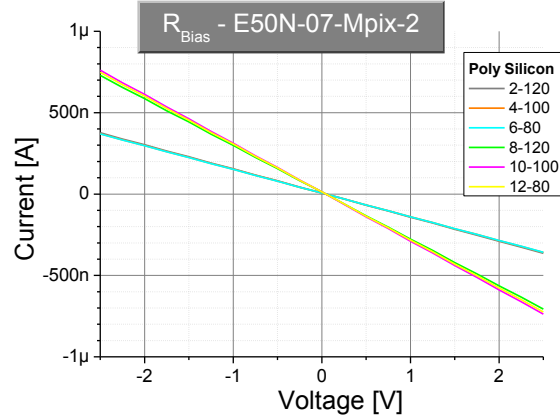
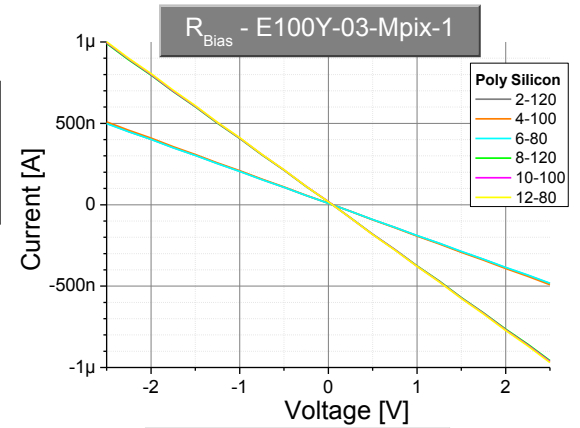
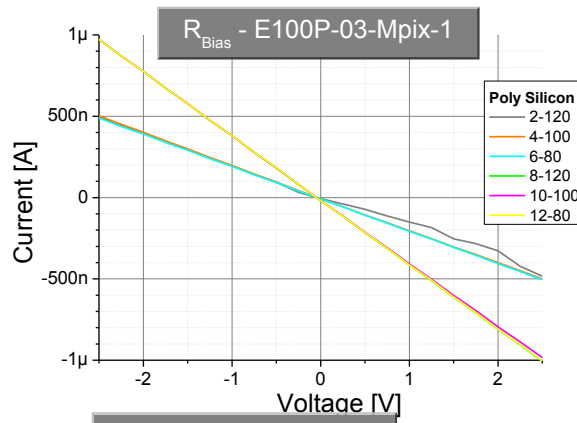
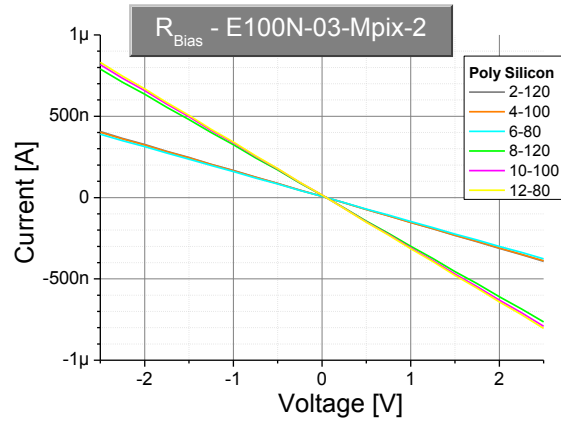
Nothing to discuss here...

1.) 120 > 100 > 80

2.) (PT > PS)?



Nothing here to discuss
1.) Offset 0V ~ I @ Bias Voltage

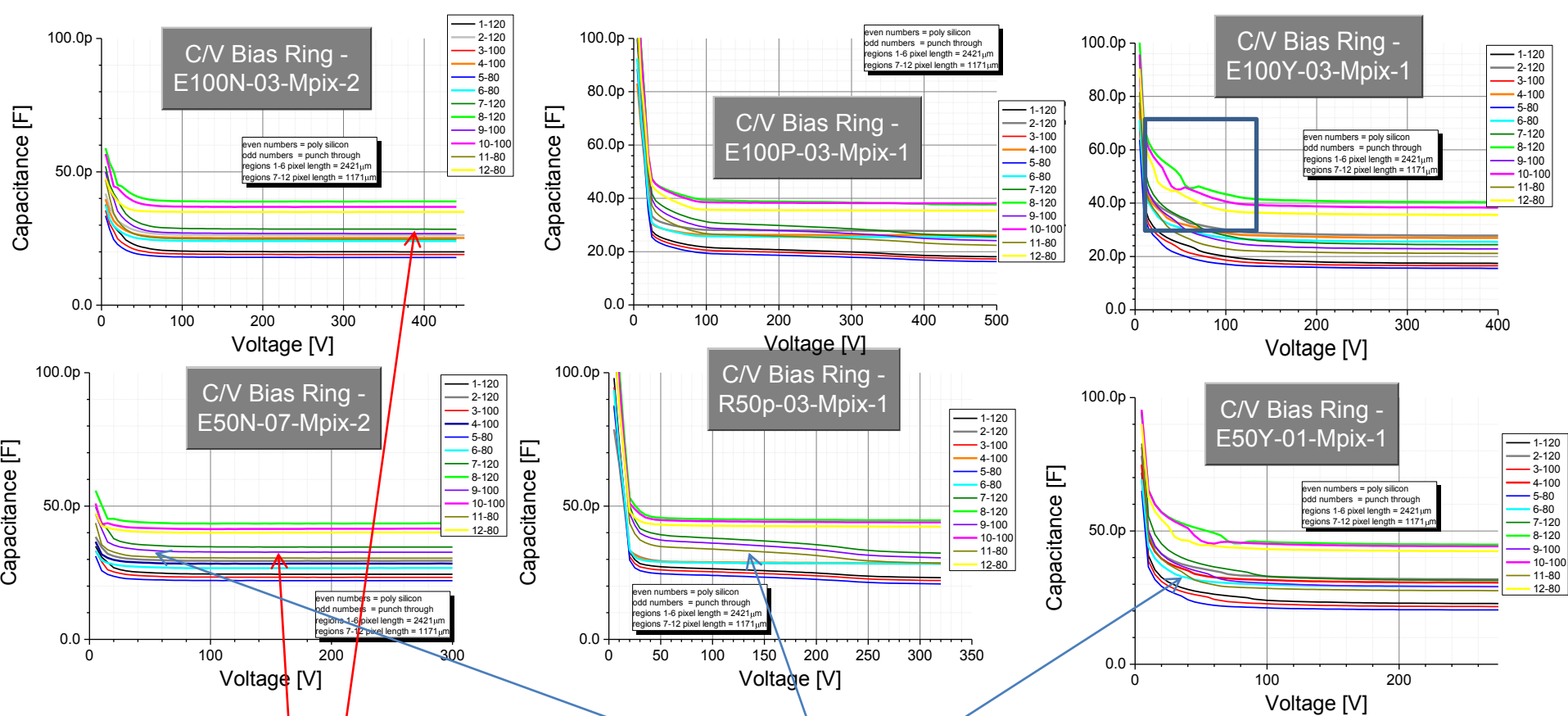


Nothing here to discuss
-> best and uncomplicated measurement

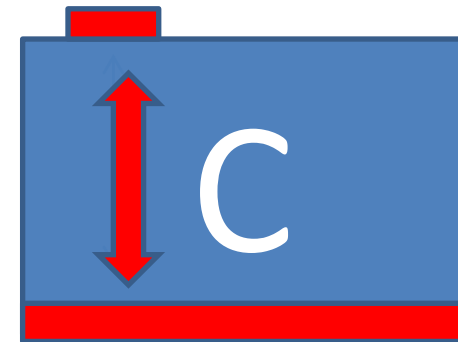
Measurements 2

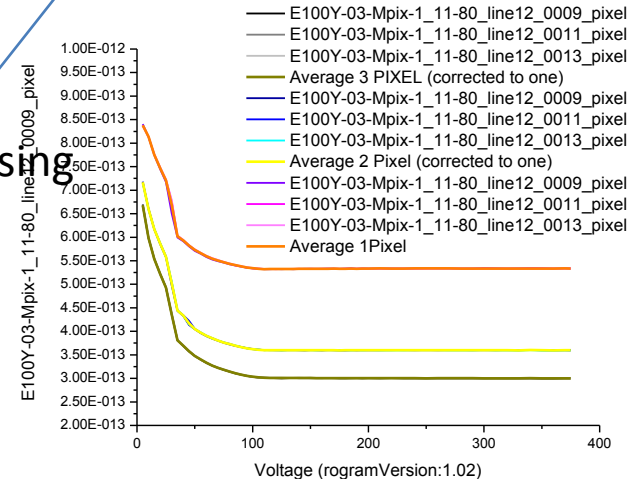
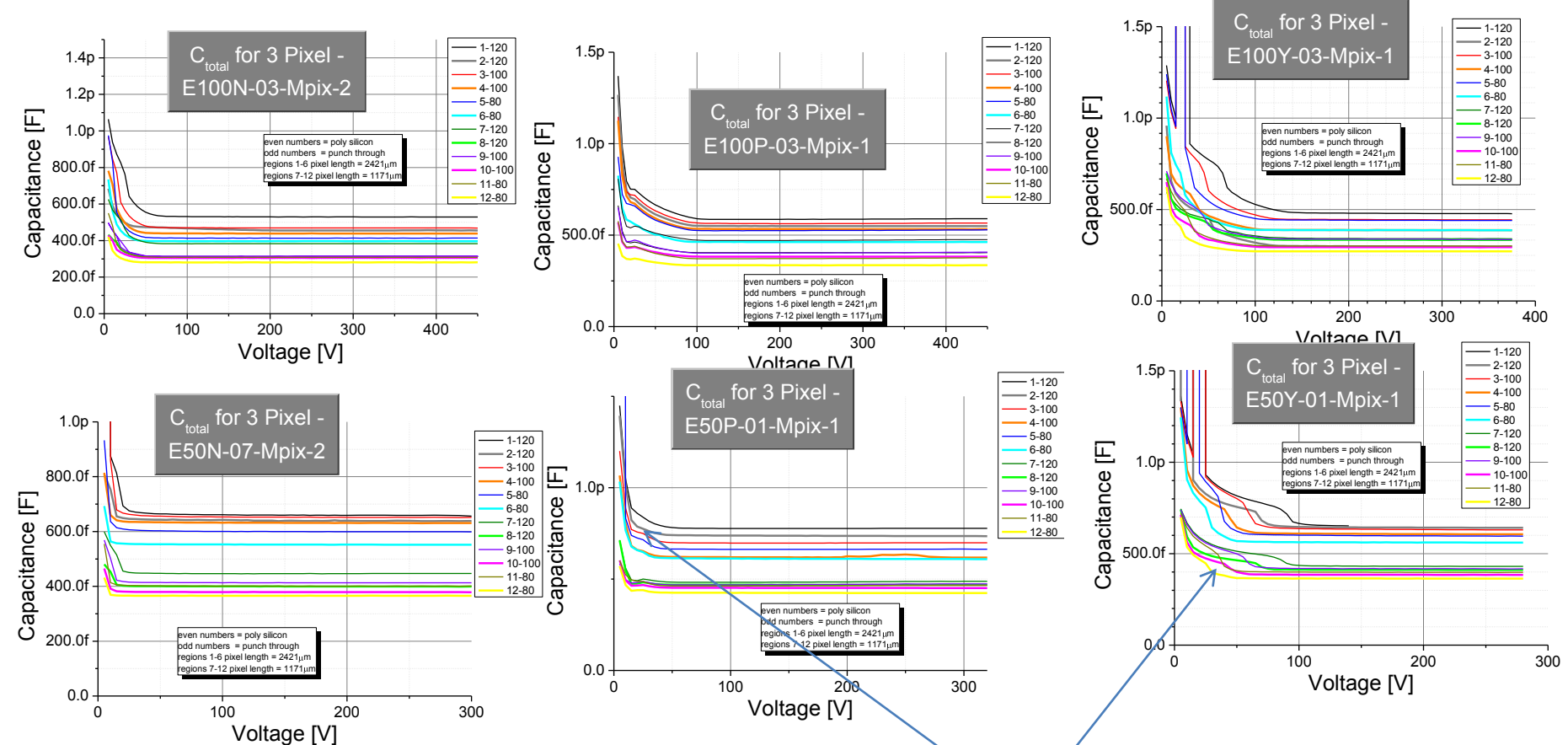
More problematic results

Life is hard 😊

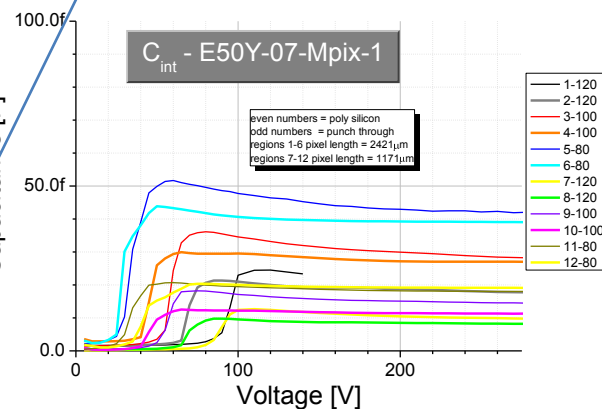
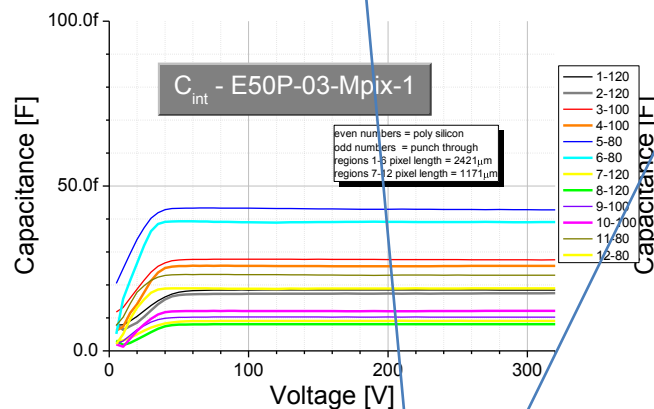
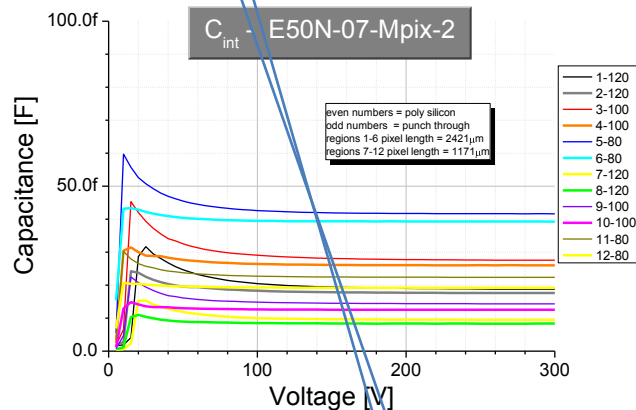
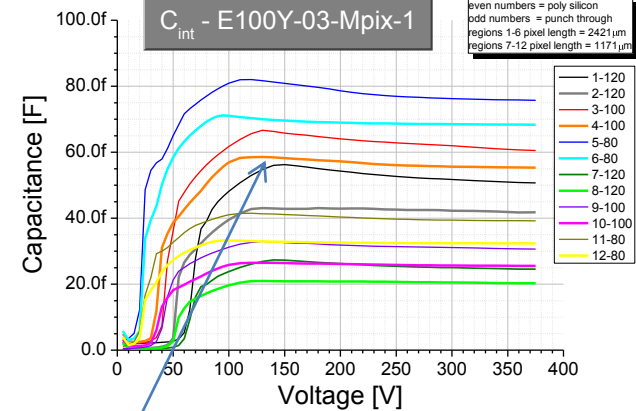
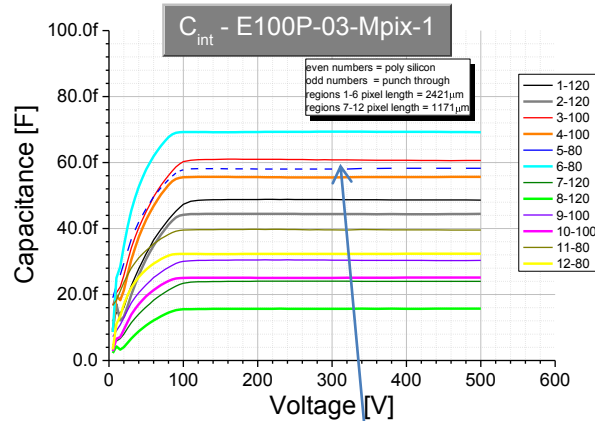
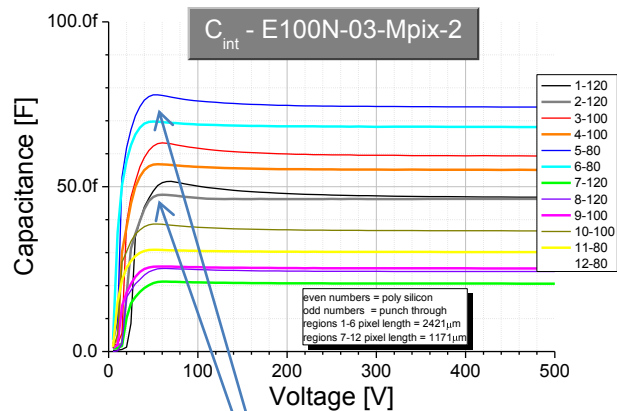


- 0.) *p* substrate has knee in curves
- 1.) Values are higher for poly silicon
- 2.) 120 > 100 > 80
- 3.) Short > long
- 4.) Not thickness dependend???





- 1.) Low voltage peaks for P and Y
- 2.) Value for poly silicon is smaller than for punch through biasing
- 3.) pitch: 120 > 100 > 80
- 4.) C total (50 μ m) > C total(100 μ m)
 - Why not in Bias Ring measurement?
 - Why not factor 2?
 - What influence we measure, too?



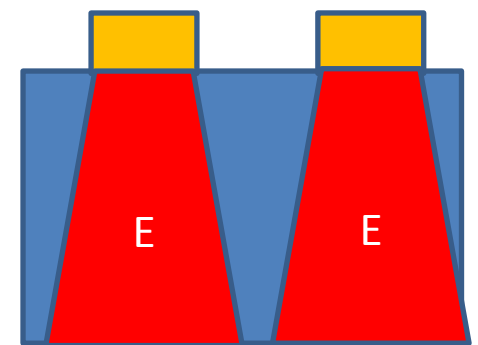
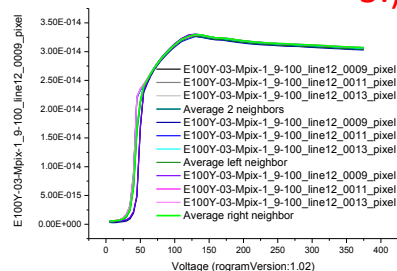
- 1.) Maximum is at lower voltages for smaller pitches
- 2.) value for poly silicon is less than for punch through
- 3.) 120 < 100 < 80
- 4.) N: small Peak; P: flat; Y: large peak(s)?
- 5.) Thinner sensor => smaller (around factor 2)

-> Measure bulk effects and not only surface?

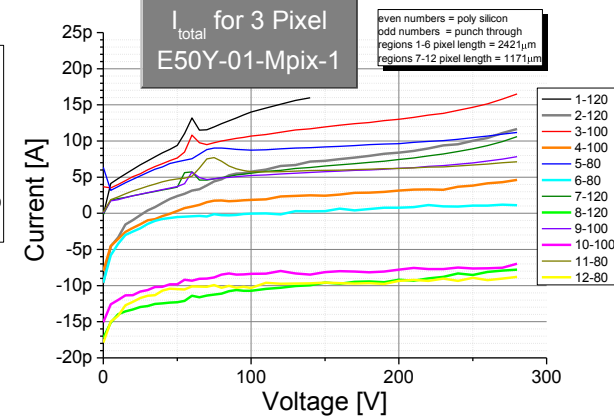
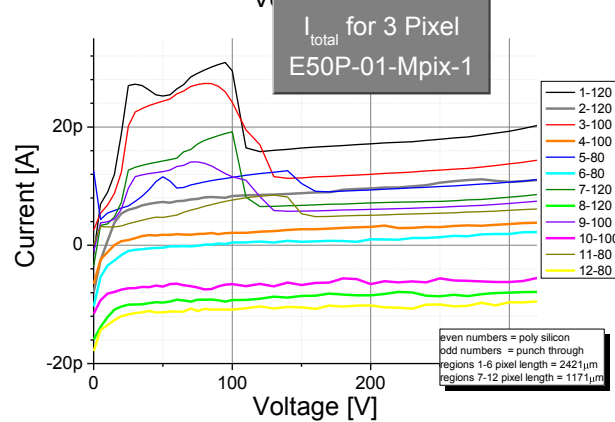
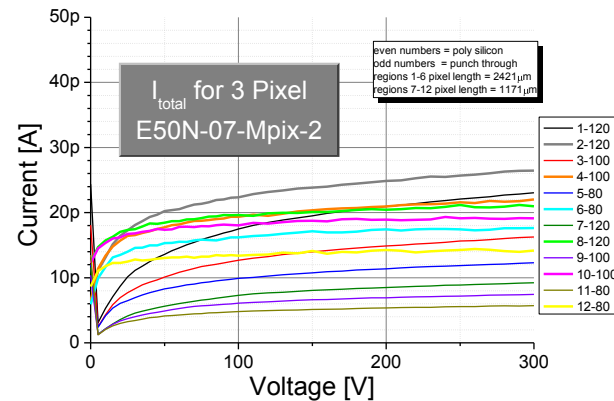
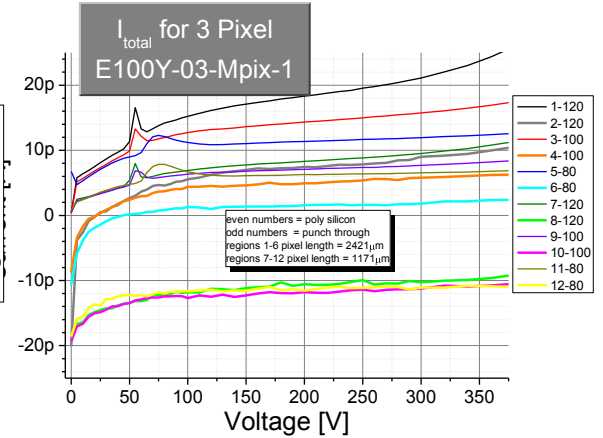
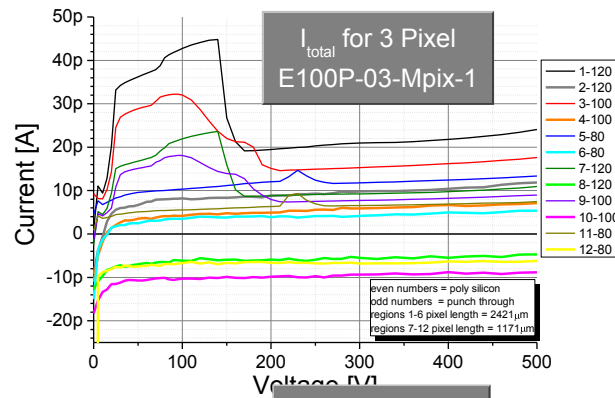
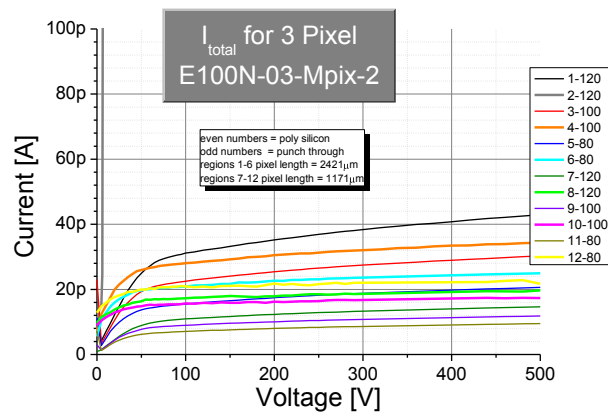
-> Explains increase for lower voltages?

-> overlap of depleted areas explain decreasing f for higher voltages???

-> Why different for types???

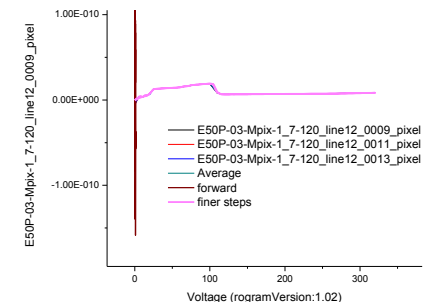
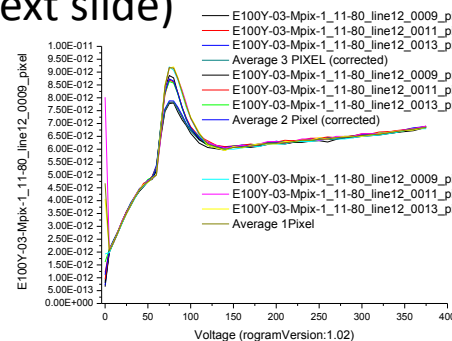


Simulation???

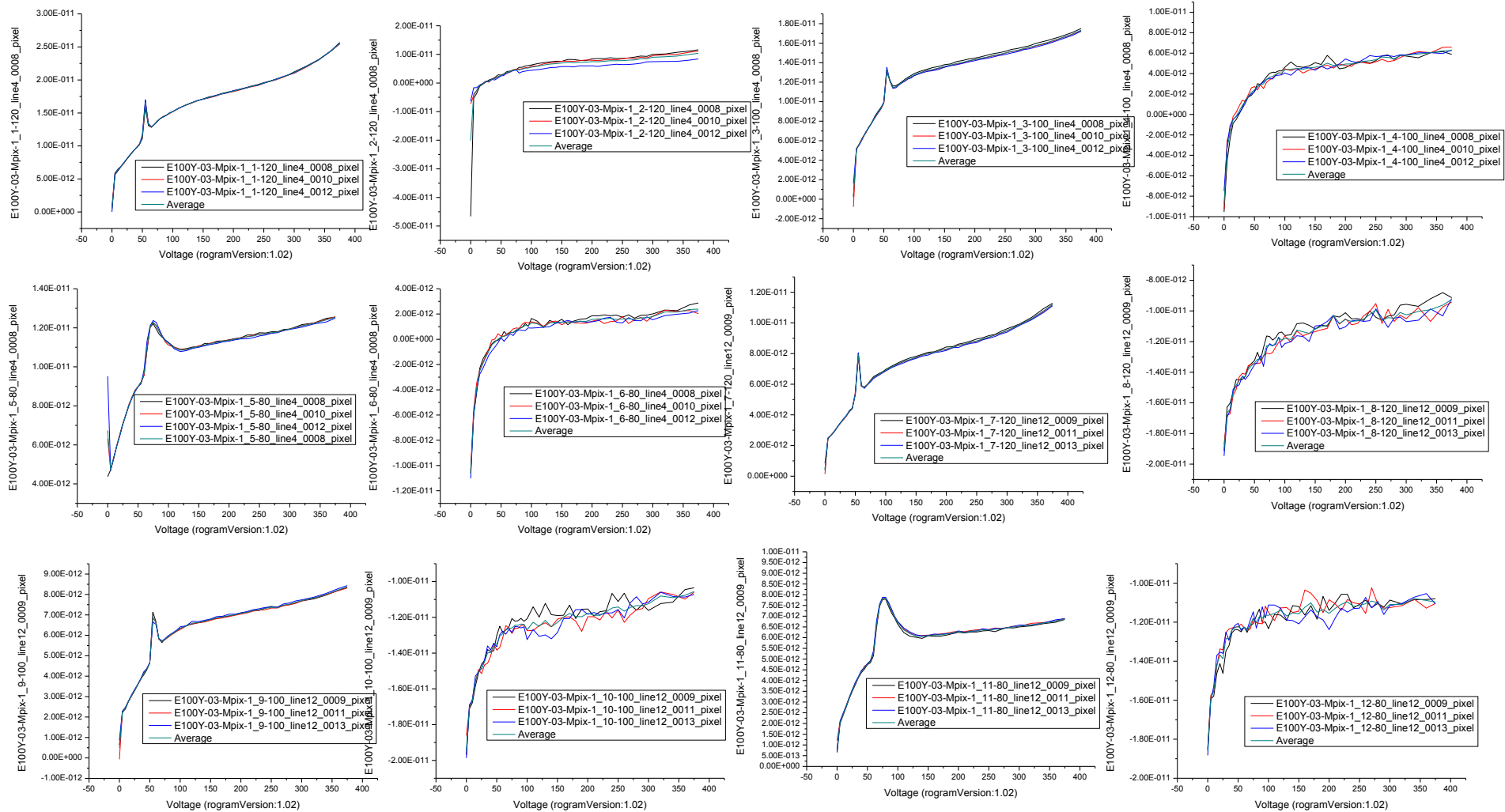


- 1.) No low voltage peak for N, small for Y, large for P; peak is pitch dependend (next slide)
- 2.) Poly silicon measurements are noisy (next slide)
- 3.) OFFSET for PS for P and N !!! Why???

Open: Measure one pixel;
with and without neighbors to ground
-> See if peak is edge effect



E100Y-03-Mpix1



Conclusions and Outlook

- Sandro makes good work 😊
- Some results have to be better understood
 - Ideas what could be done/ what could be tested???
 - Want send IV-Pixel results to people from CEC and ask if they have one idea
- Task list:
 - Request for irradiated sensors
 - Compare results with Mcz Silicon and see if same effects are there (e.g. IV offset is not there for Mcz-p-type...)
 - Debug read out tool and look more into details:
 - Values@Voltage, Vdp, Rbias&Rint; Ratios PS and PT, ...