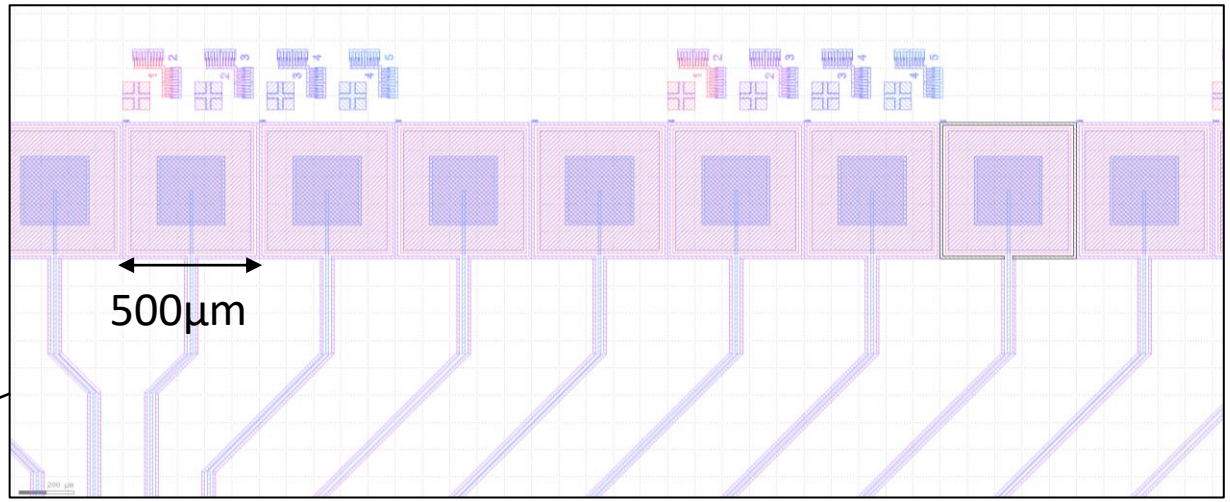
# LATEST FABRICATED SAMPLES

MATILDE SIVIERO

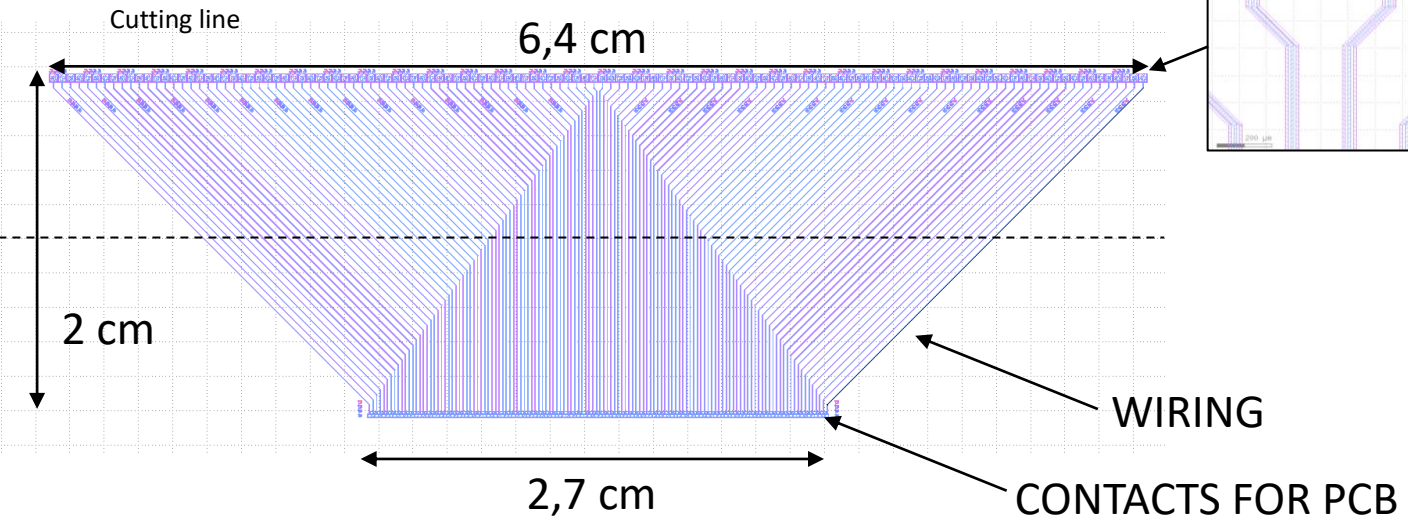
CRHEA

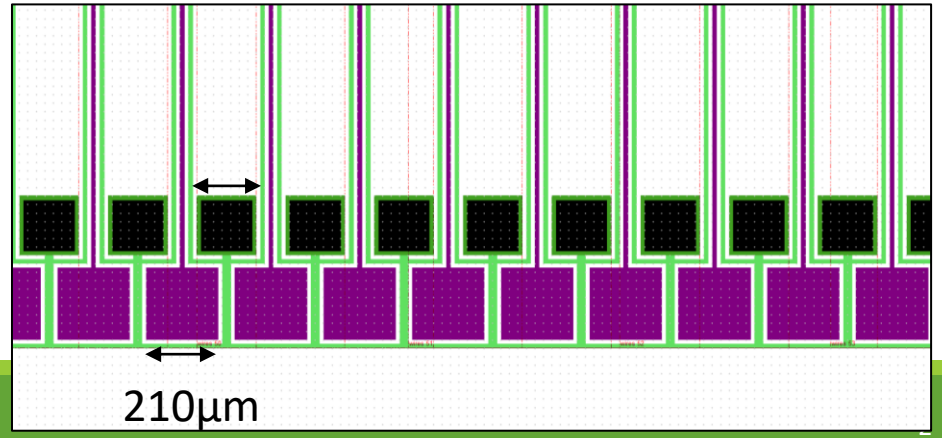
# FIRST 128 LINEAR ARRAY

DIODES LINE

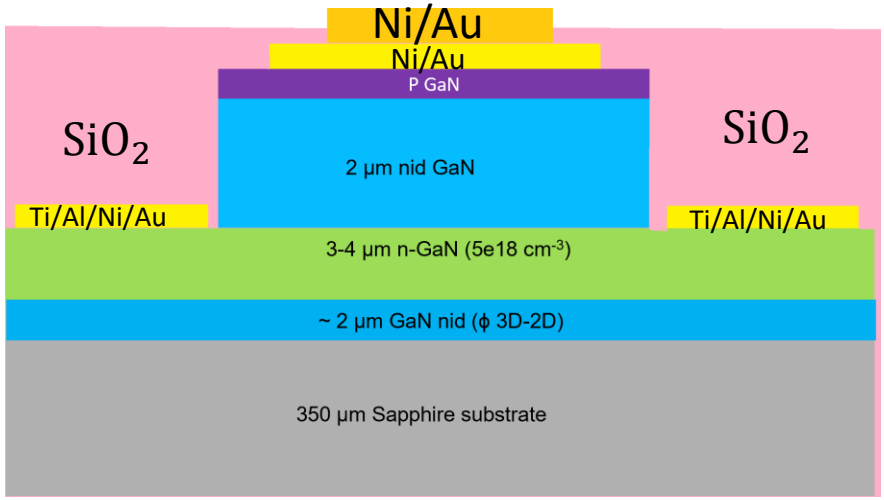



DIODES PITCH 500x500µm



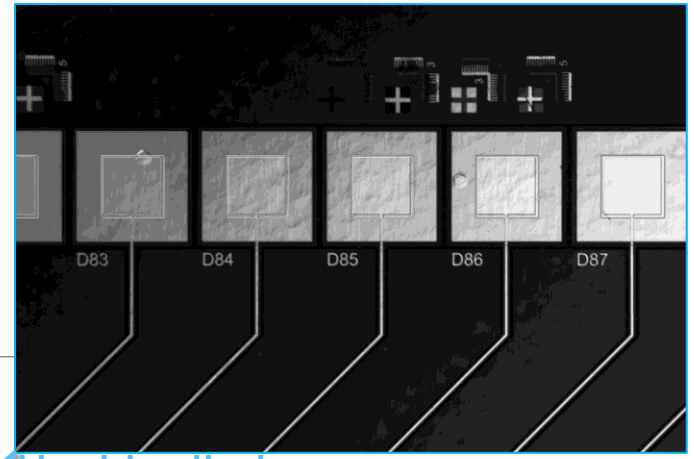
# FIRST 128 LINEAR ARRAY



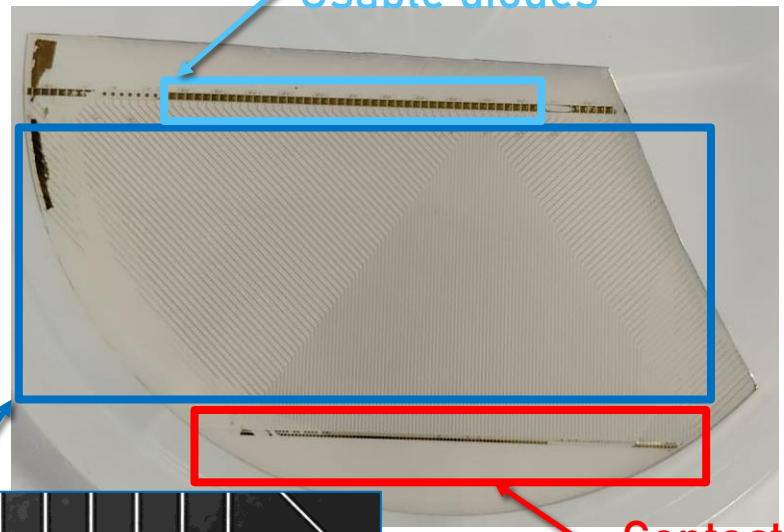

(Pin diode)

5 photolithography steps:

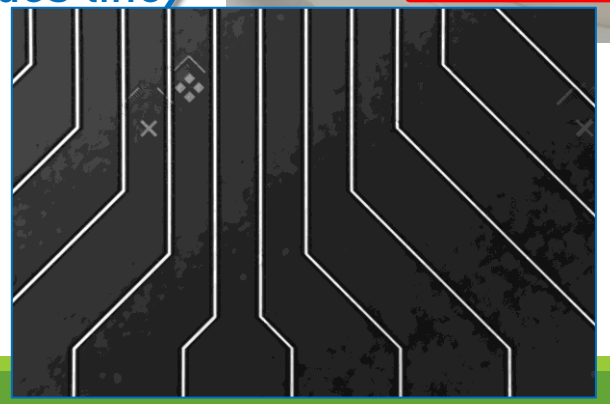
1. Mesa (litho+ plasma etch)
2. N contact(litho+metal dep)
3. P contact(litho+metal dep)
4. SiO2 (deposition+opening)
5. Gold deposition



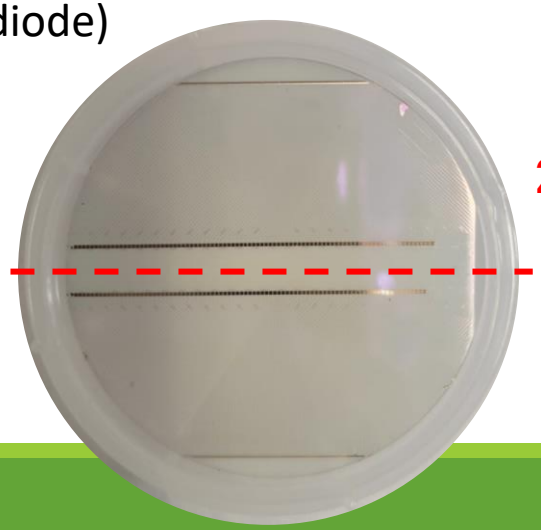

Usable diodes



Diodes line



Contacts for wiring

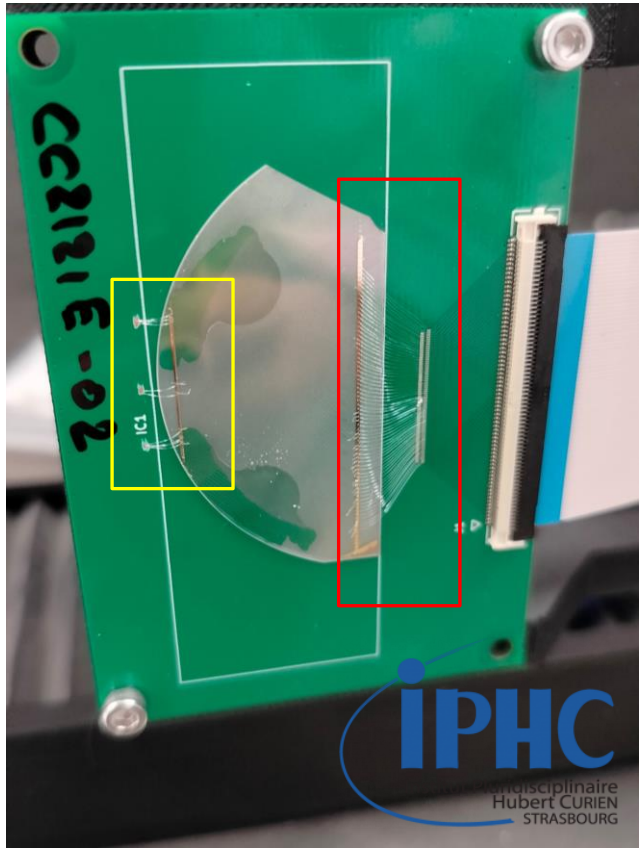


2 arrays on 1 wafer of 2”

YIELD: about 70 working diodes over 90

# Not only the gold lines were useless…

Only the ground was bonded using the contact pads

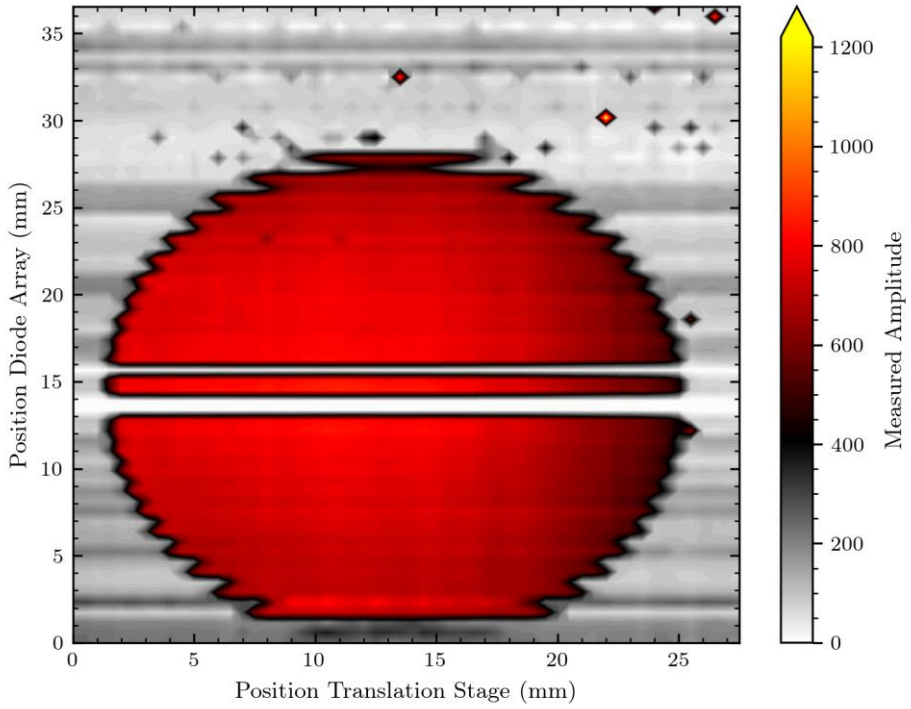


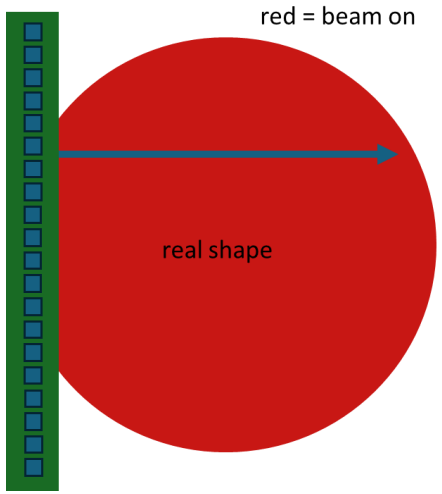

The diodes bonding to the PCB was done directly on top of the diodes

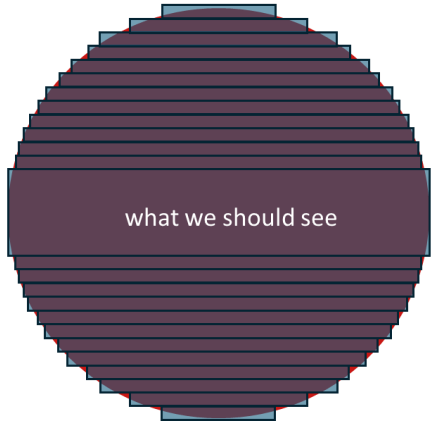
So the diodes pitch of 500µm was not a problem at all!
The bonding worked great

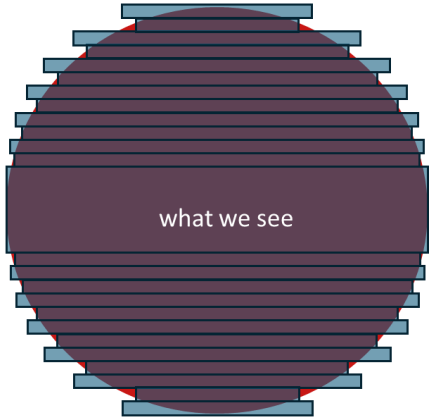
# …the gold lines only created issues

Gold wires generate a parasitic signal once irradiated leading to periodic line artifacts



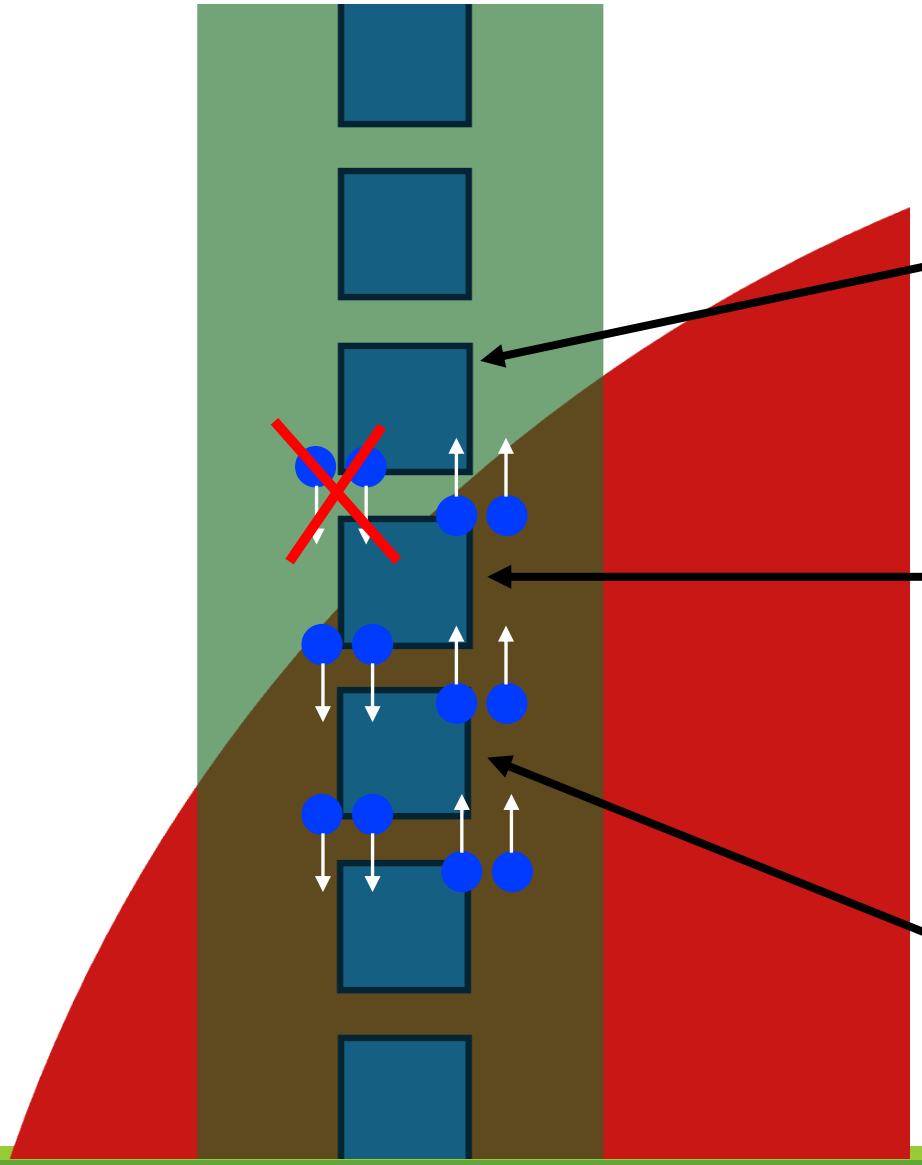




Images from Nico Brosda

Red = proton beam exposure



Diode n+1:

Electrons from diode n arrive = + $N_e$

No electrons are lost

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+ $N_e$ signal gained

Diode n:

Electrons from diode n-1 arrive = + $N_e$

Electrons are lost to diode n-1 and diode n+1 = - 2 x $N_e$

No electrons from diode n+1 arrive

---

- $N_e$ Signal lost

Diode n-1:

Electrons from diode n-2 and n arrive = + 2 x $N_e$

Electrons are lost to diode n-2 and diode n = - 2 x $N_e$

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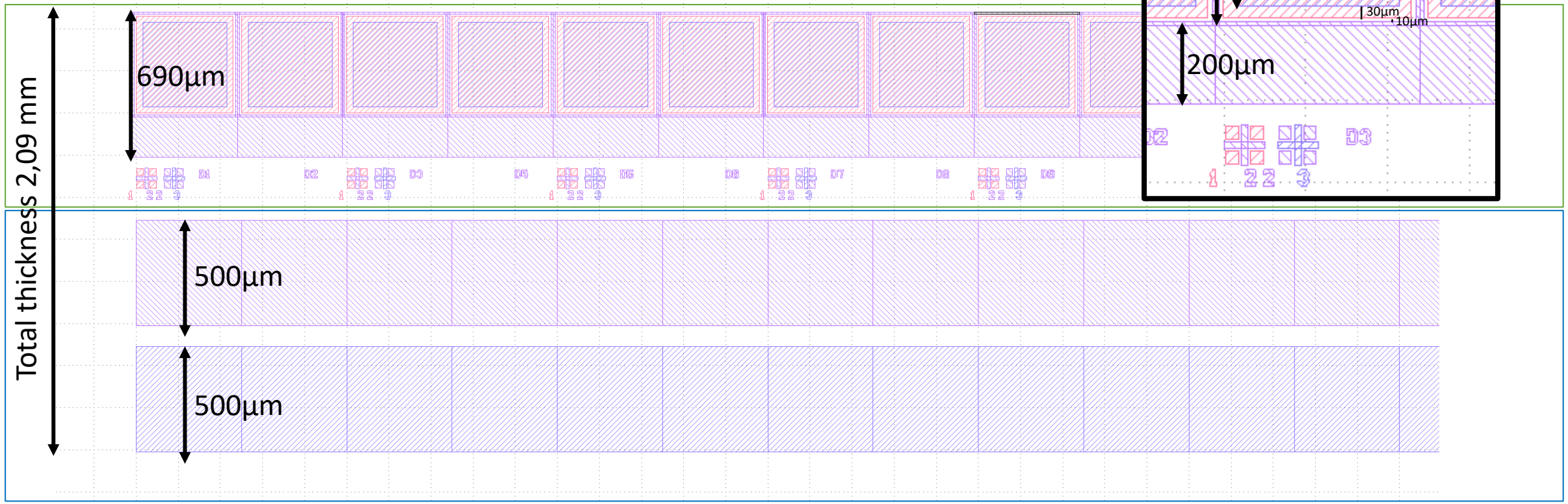
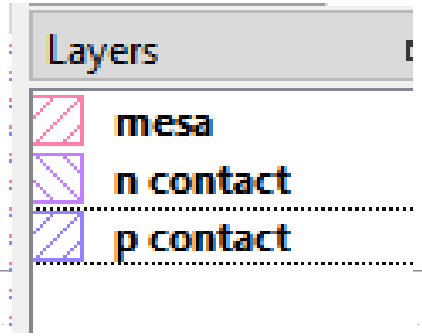
# NEW LINEAR ARRAY MASK

## 128 DIODES ON 3 INCHES WAFERS

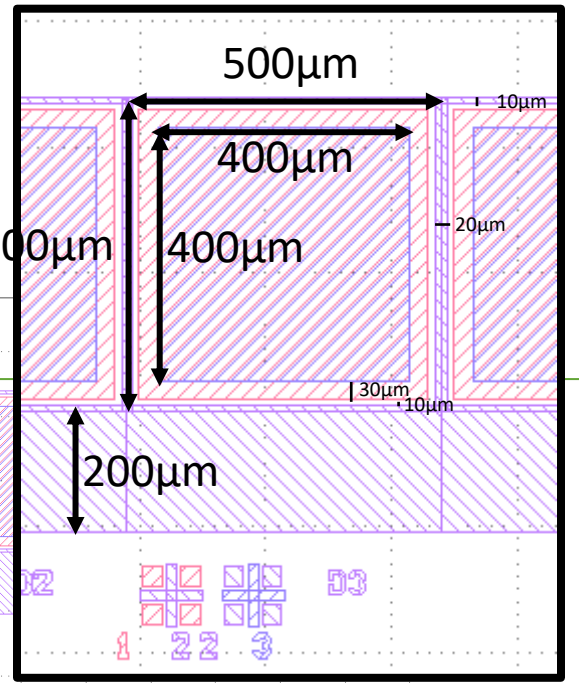
# 500x500µm

DIODES LINE (x140) Maximum total length 500µmx140=7cm



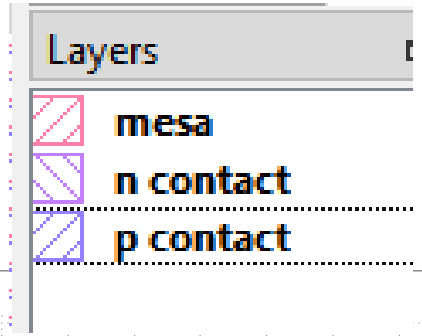

SINGLE DIODE



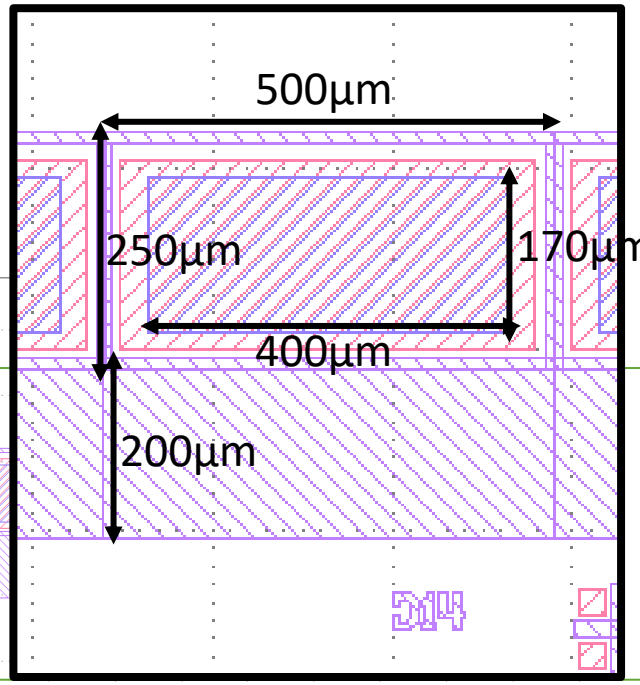

TESTING LINES FOR WIRE BONDING

# 500x250 µm

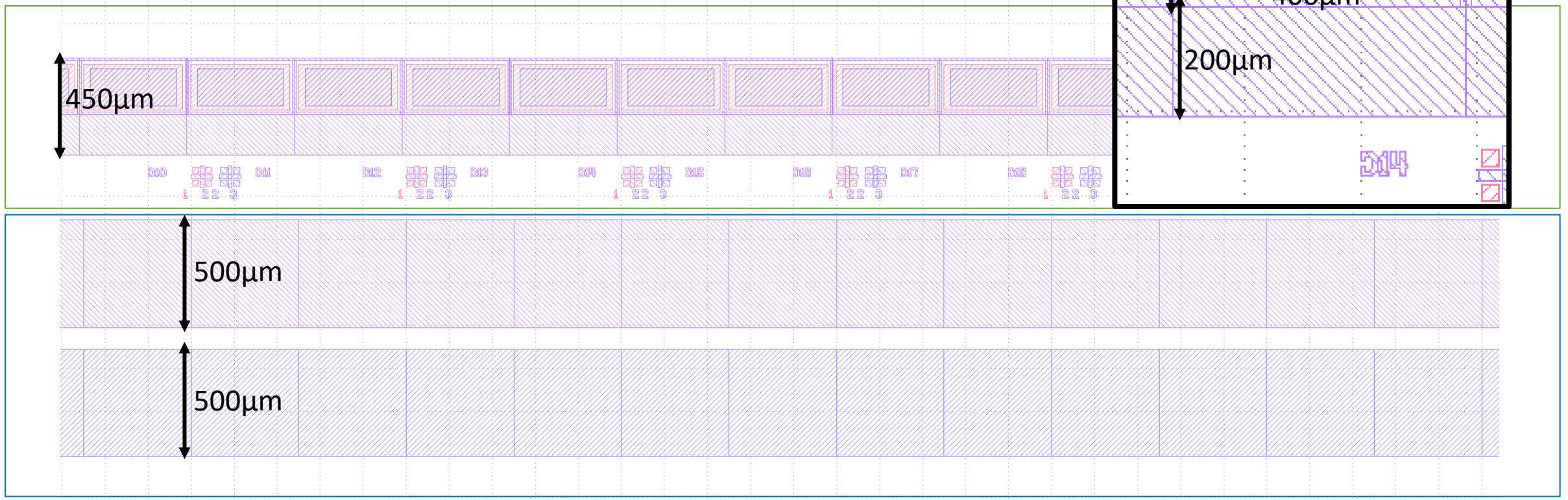
*n CONTACT = GROUND*




SINGLE DIODE



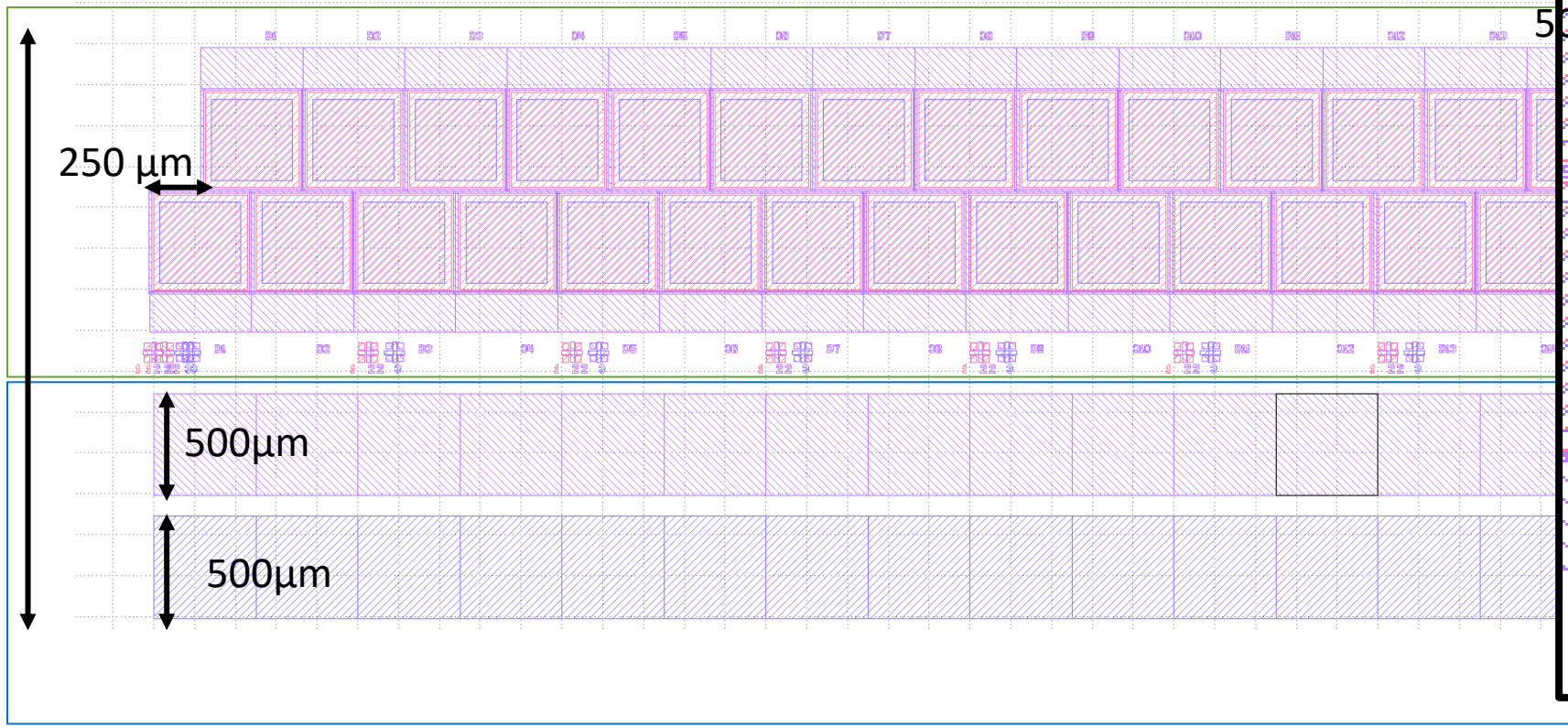

DIODES LINE (x140) Maximum total length 500µmx140=7cm

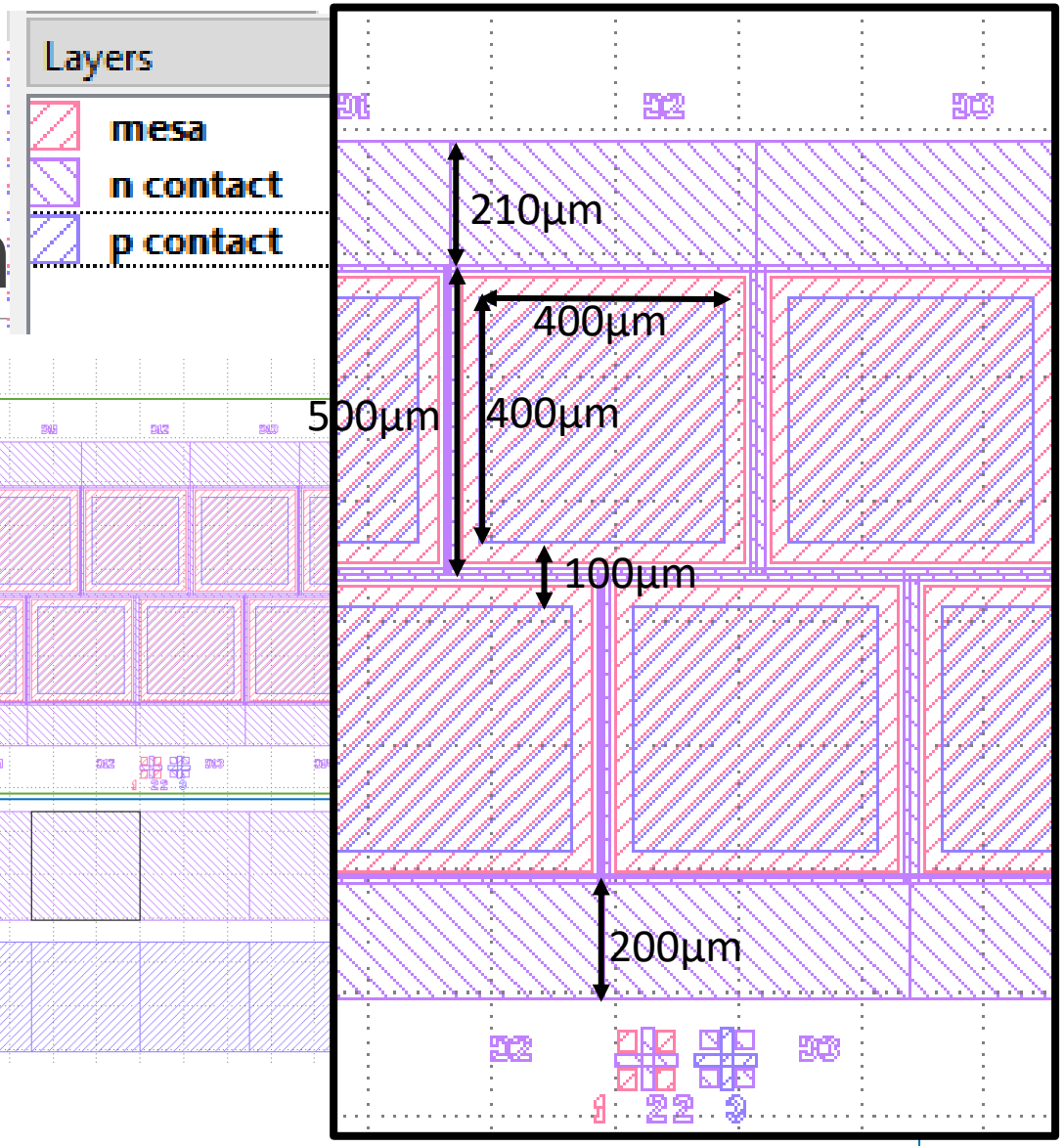



TESTING LINES FOR WIRE BONDING
(one continuous line for p contact and one of ground contact bonding test)

# DOUBLE LINE 500x500µm

DIODES LINE (x140) Maximum total length 500µmx70=3,5cm

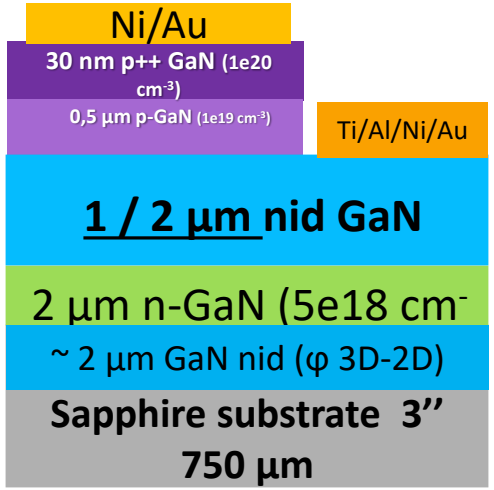



TESTING LINES FOR WIRE BONDING

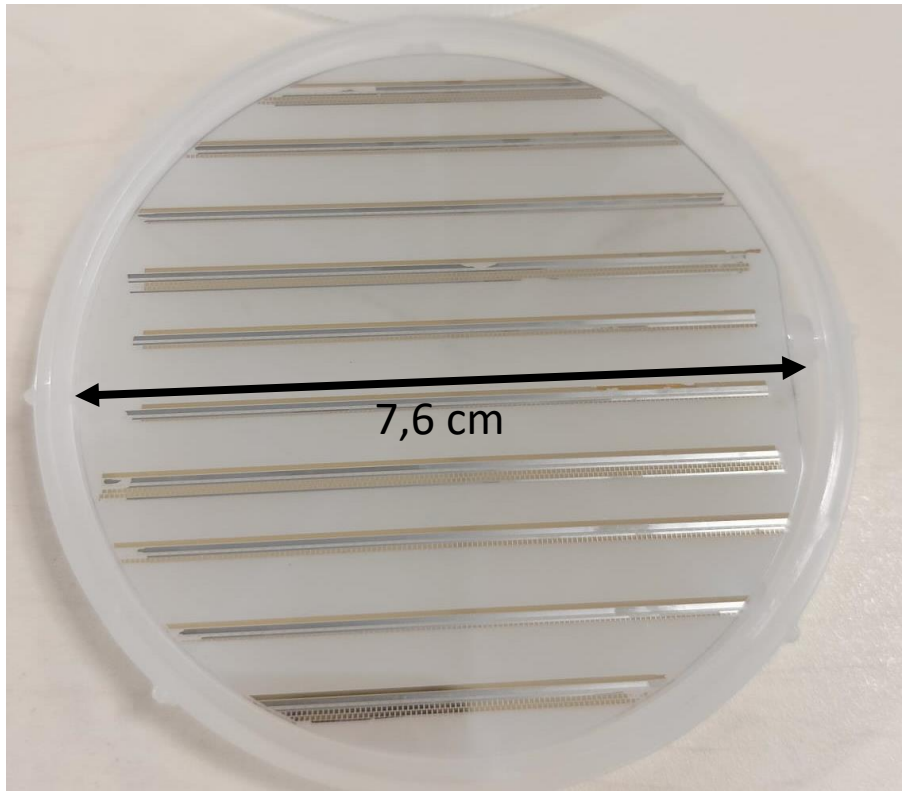
# FABRICATION ON 3”

PIN diode




Only 3 fabrication steps:

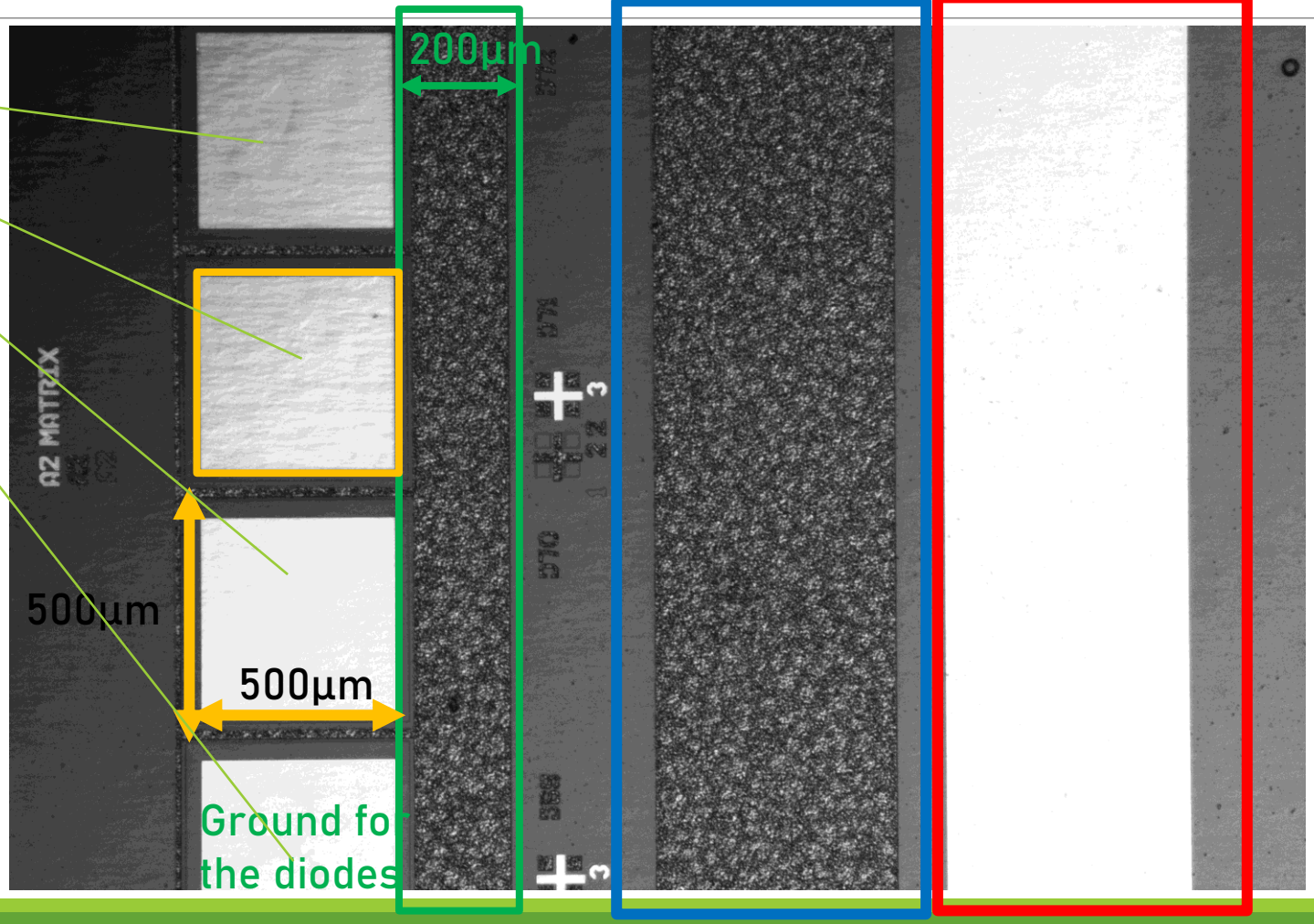
1. Mesa (litho+plasma etch)
2. N contact (litho+metal dep)
3. P contact (litho + metal dep)




10 ARRAYS ON A SINGLE 3 INCHES WAFER
3 GEOMETRIES

# Single line 500x500 µm

P contact line for bonding tests

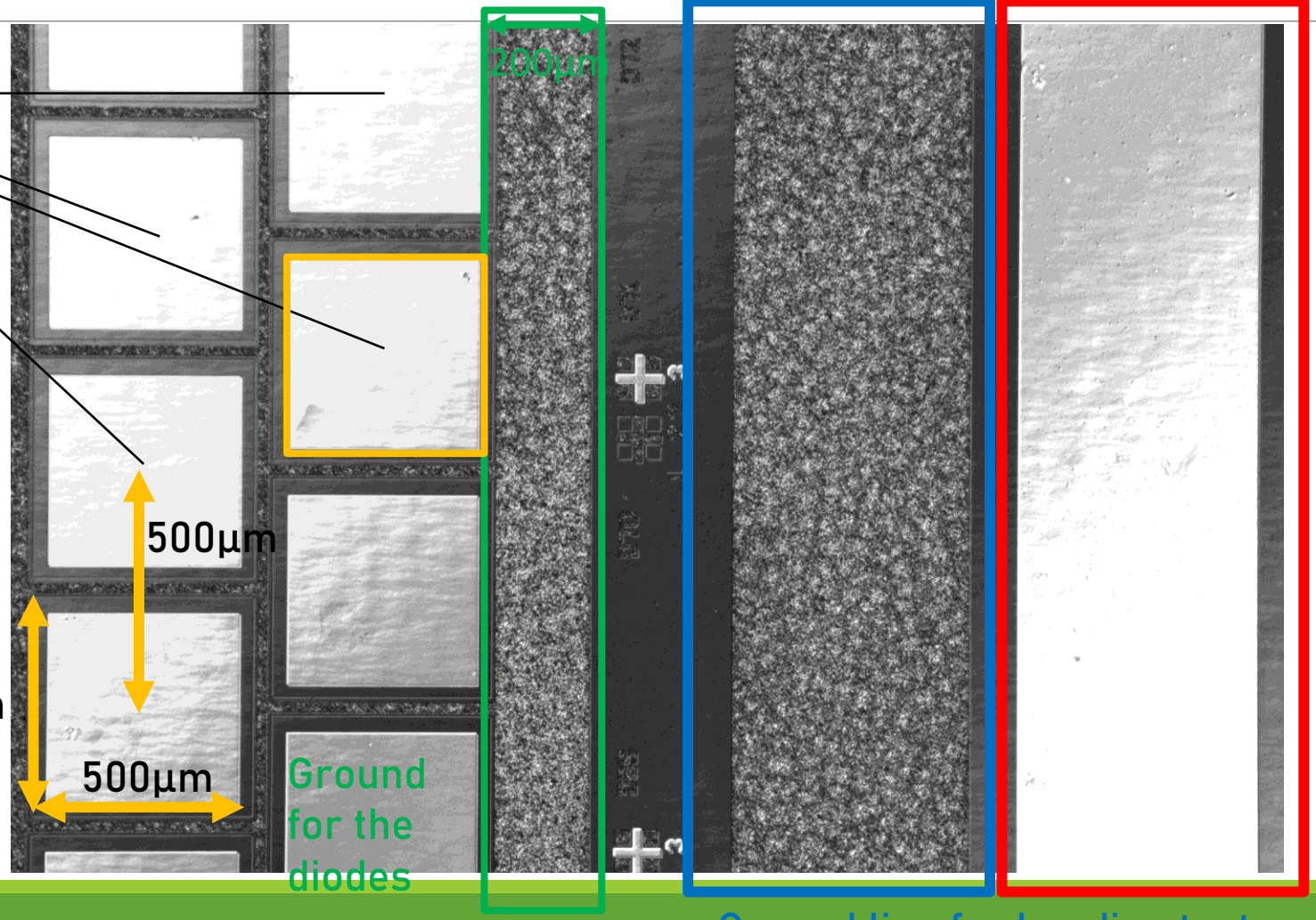



P contact of diodes

Period between diodes : 500 µm

Ideal: to bond 128 consecutive diodes

# Double line 500x500µm

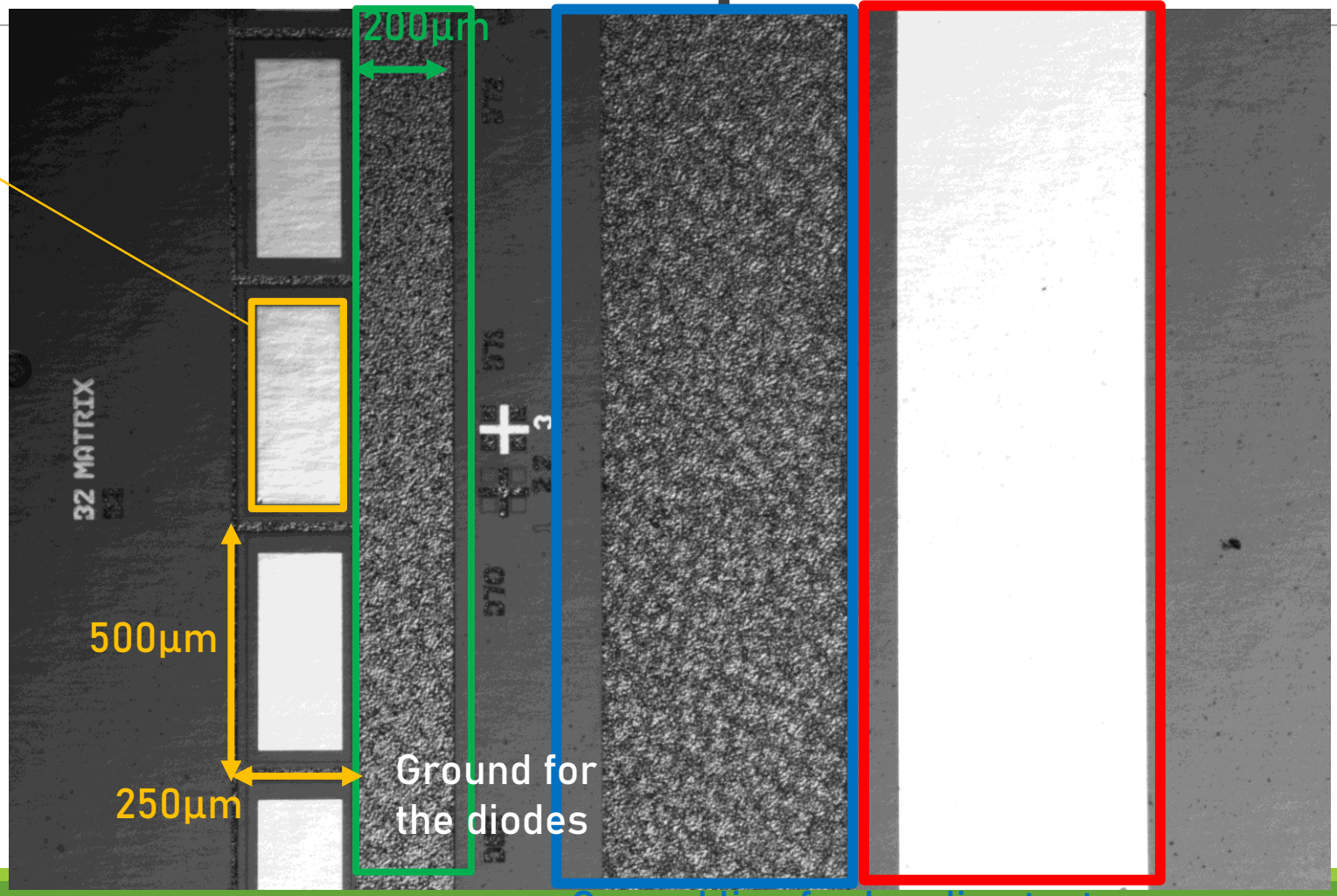



Ideal: to bond 64 diodes on the first line and 64 on the second

# Single line 250x500µm

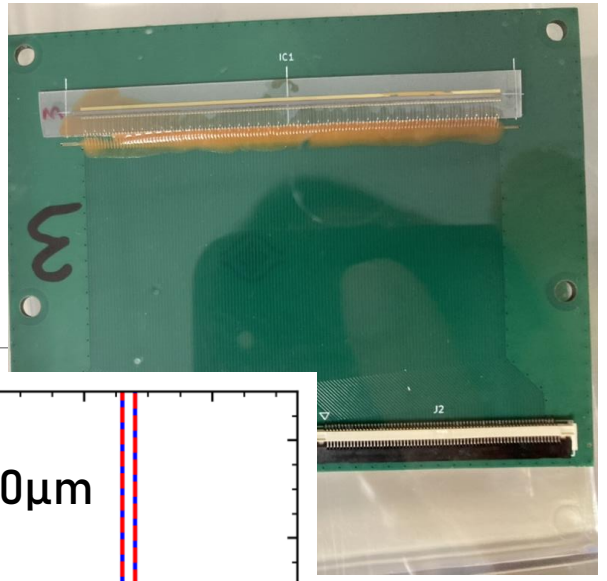
P contact of diodes

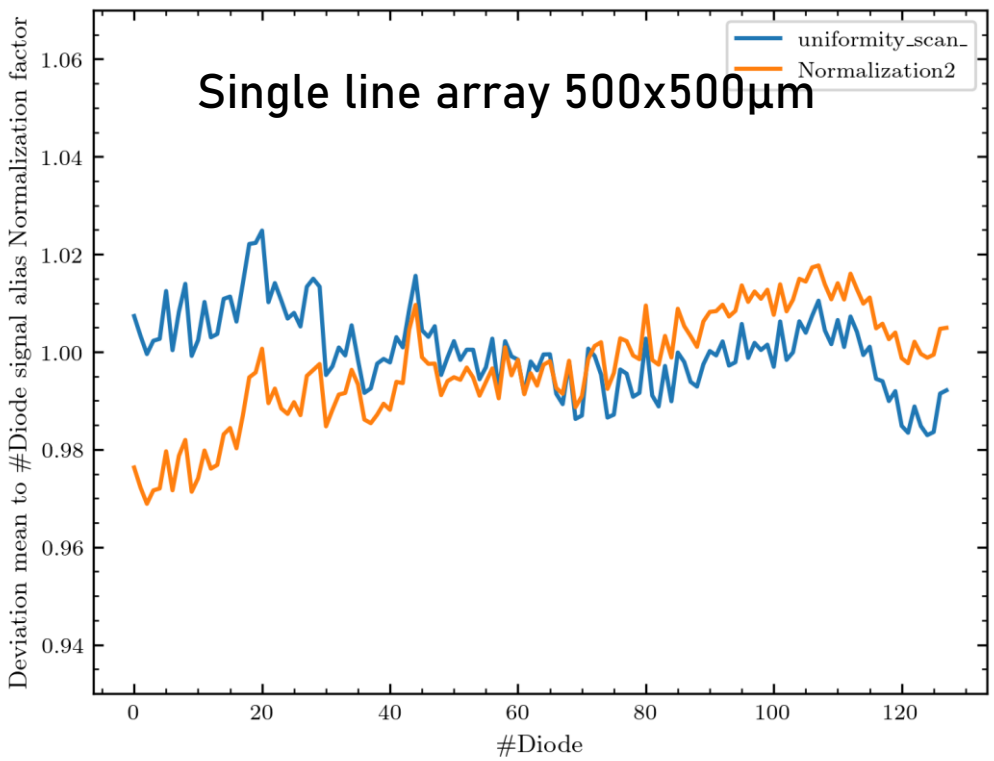
Period between diodes : 500 µm

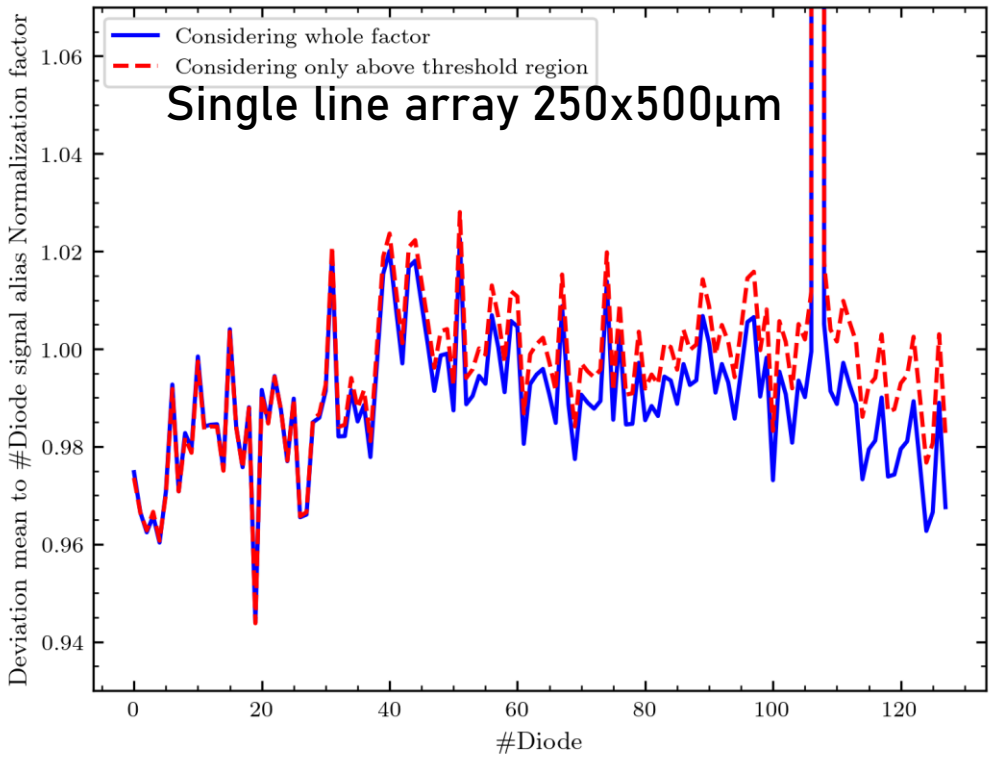



Ideal: to bond 128 consecutive diodes

# Homogeneity of the response





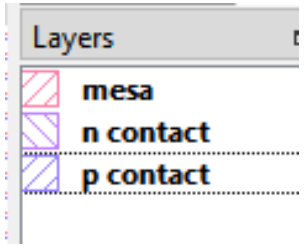




Homogeneity <2 % before normalization ☺

# First 2D array mask

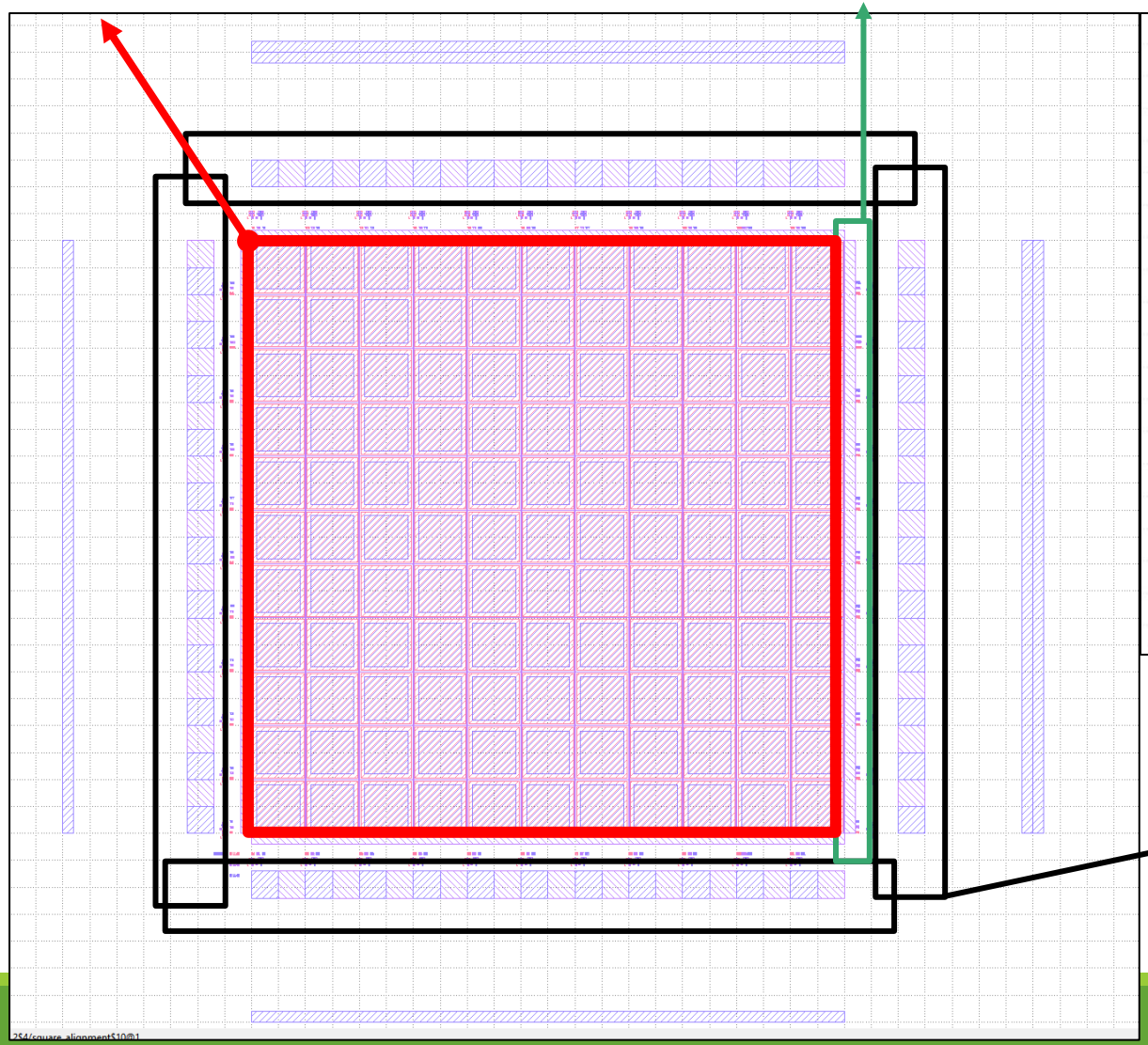
11X11 MATRIX

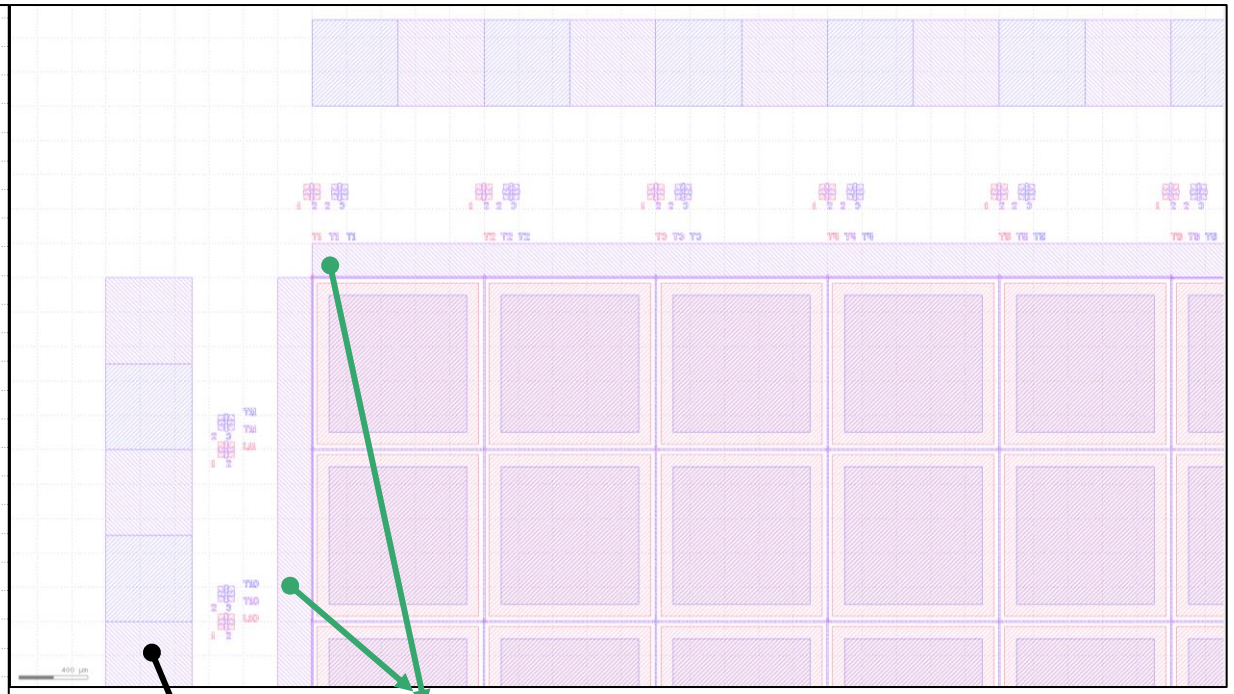
BECAUSE WE ONLY HAVE 128 CONTACTS ON THE OSRAM CIRCUIT




Matrix of diodes

Ground bar

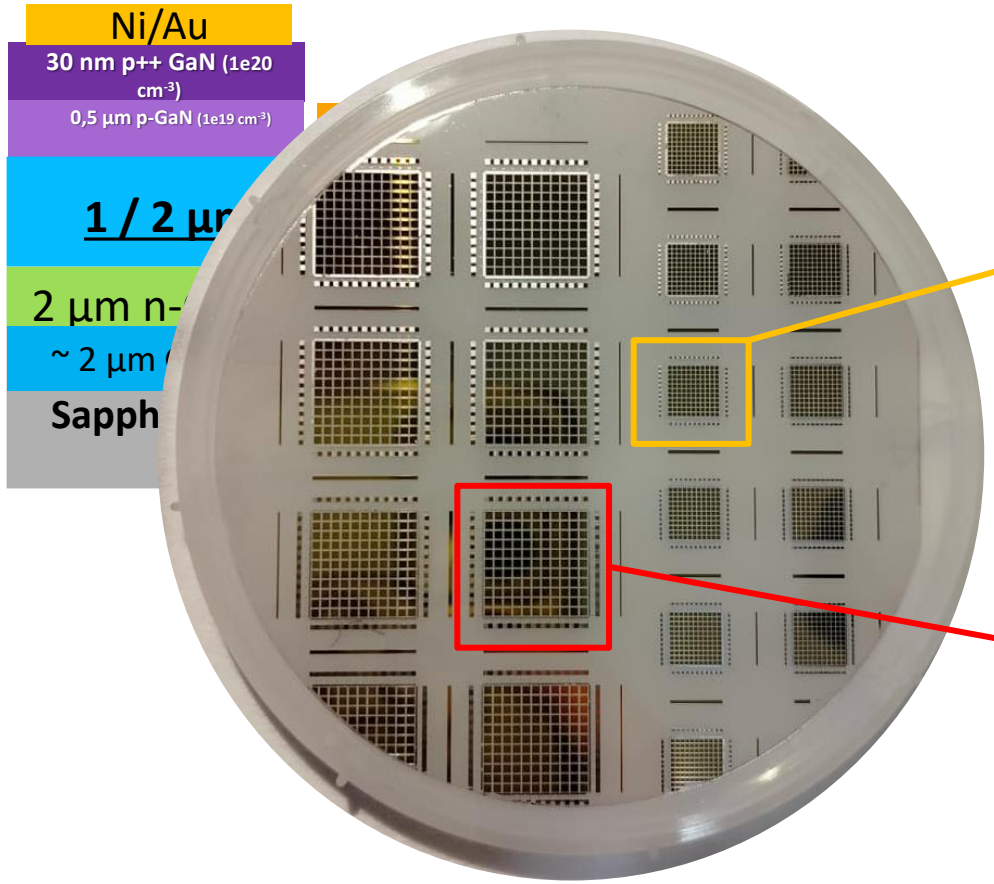


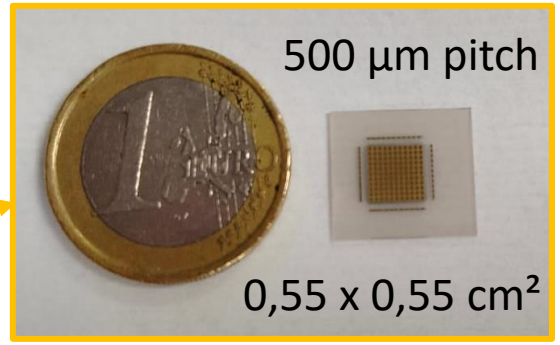


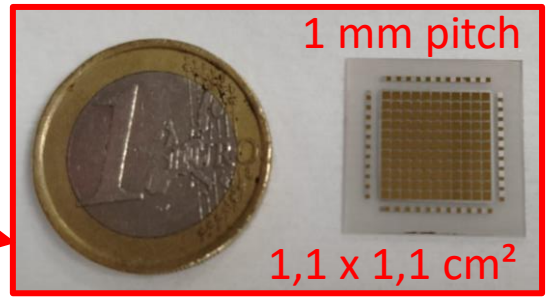
Ground bar (one on each side)
Thickness = 200 µm

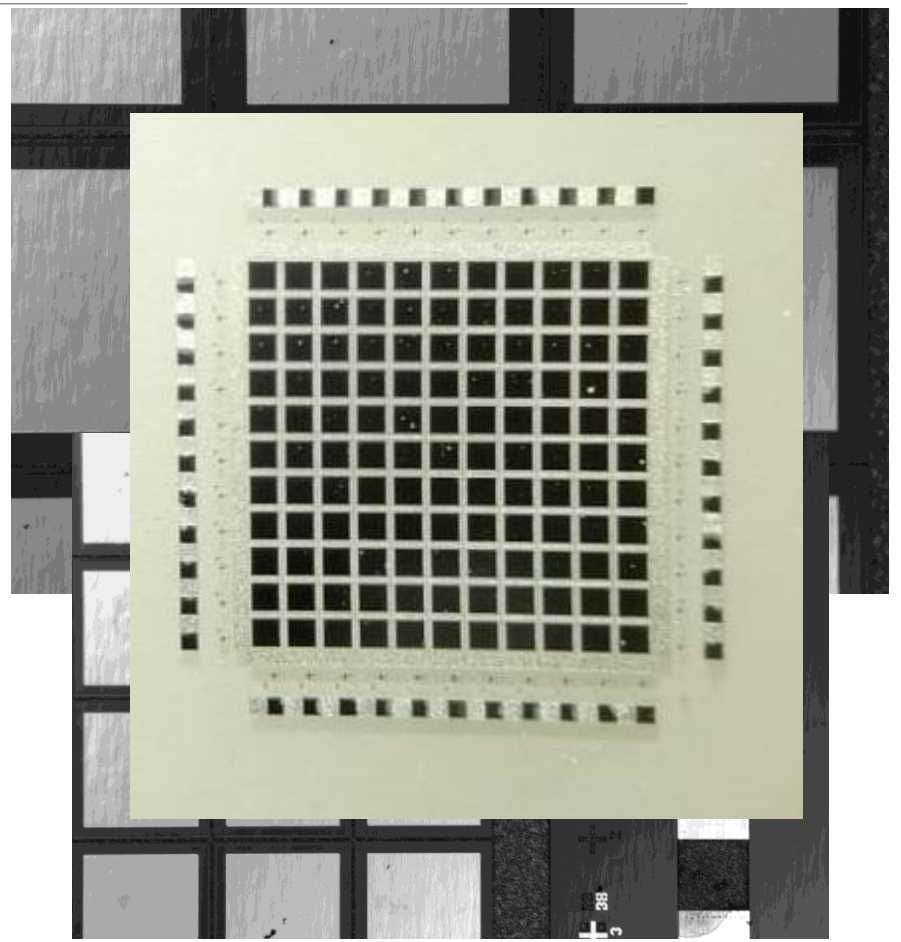
Contact testing pads (one on each side)
500x500µm
(p contact and ground are alternated, period 500µm)

# Fabrication on 3 inches

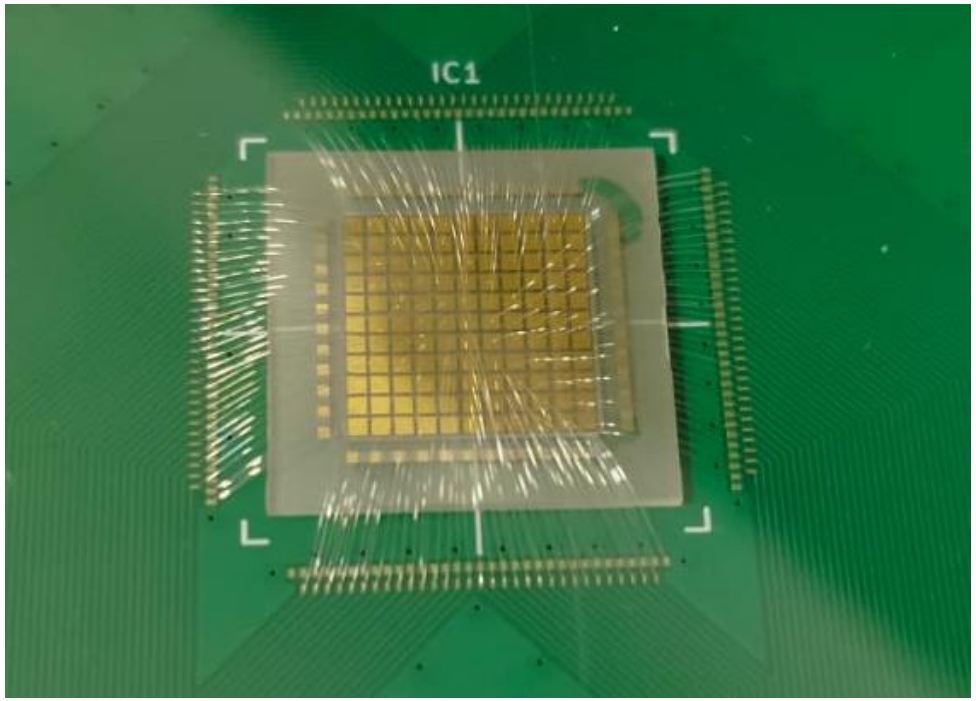


# Bonding of 121 diodes

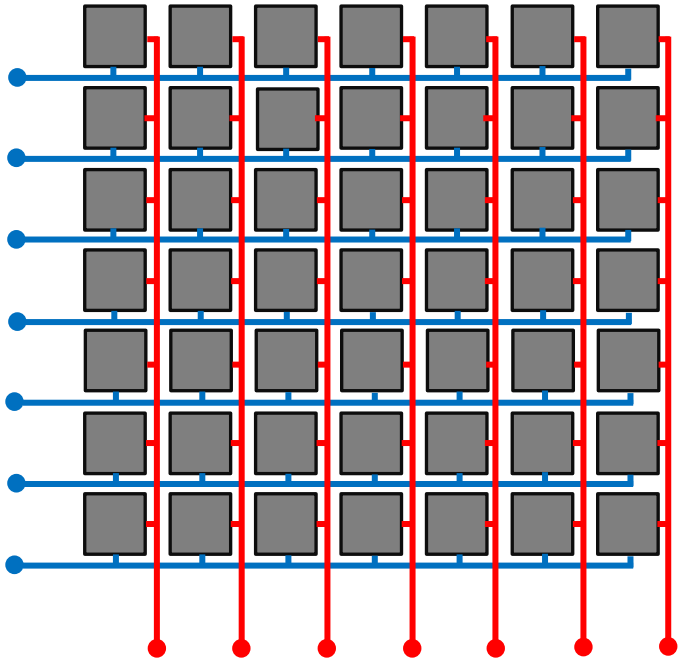


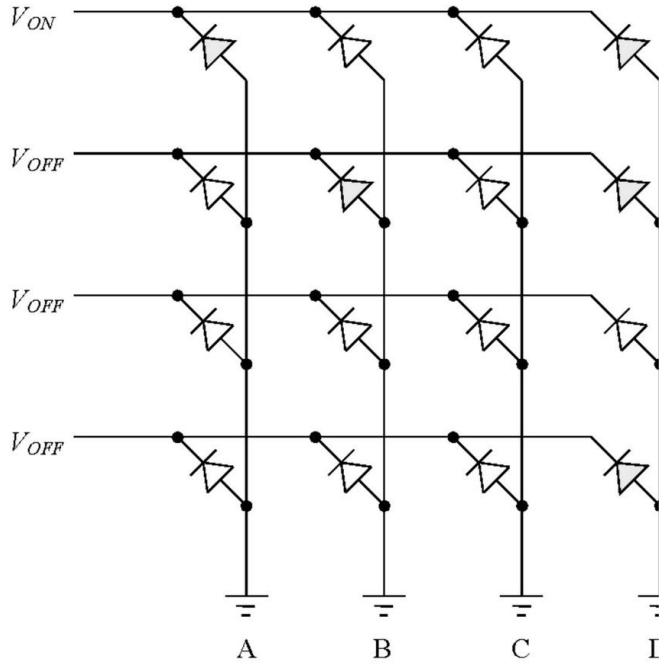

Yield: 1-2 broken diodes or contacts over 121

# Next: 128xN diodes matrix

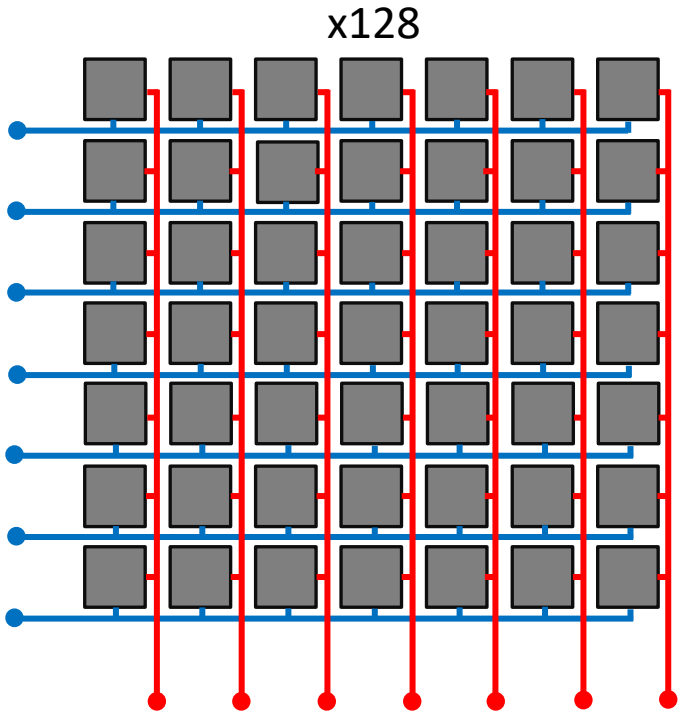
x128

x16?

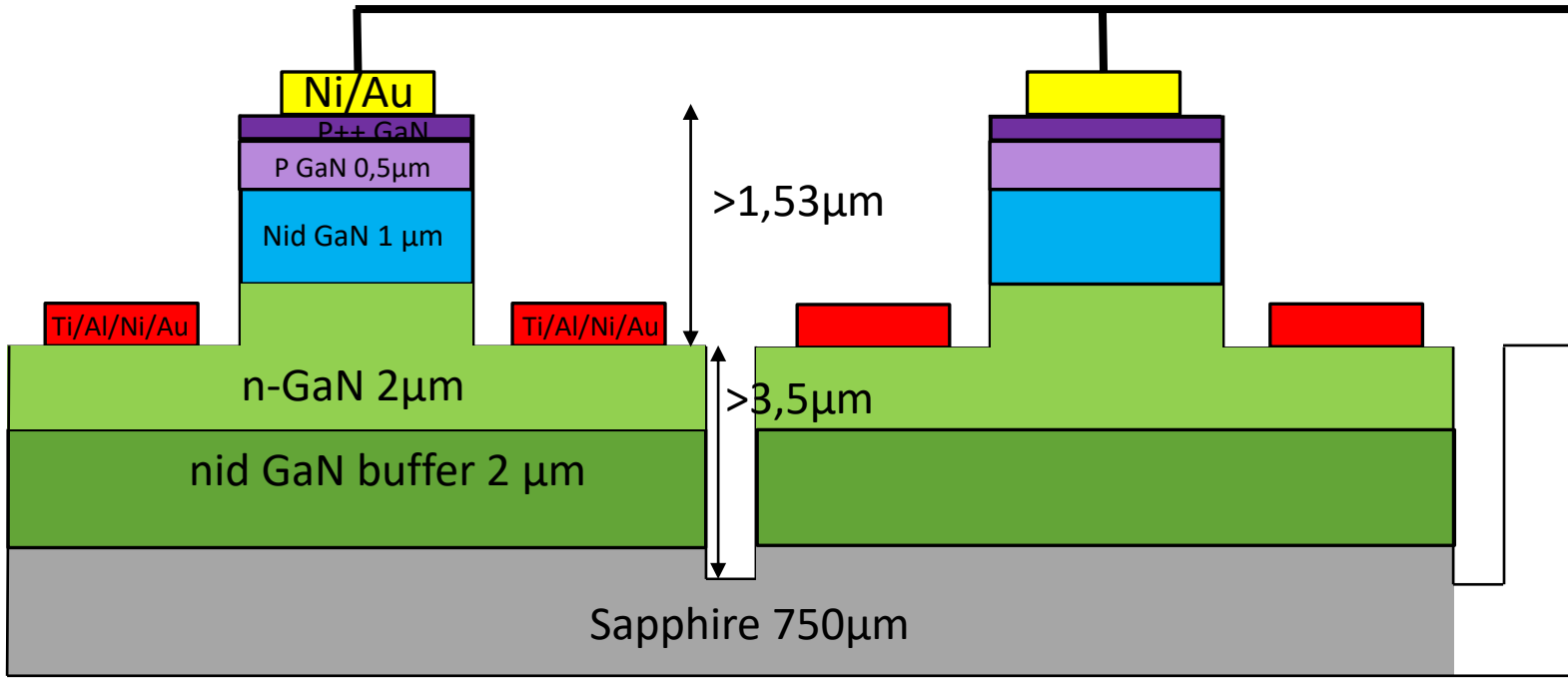




# Next: 128xN diodes matrix




Cross section view:



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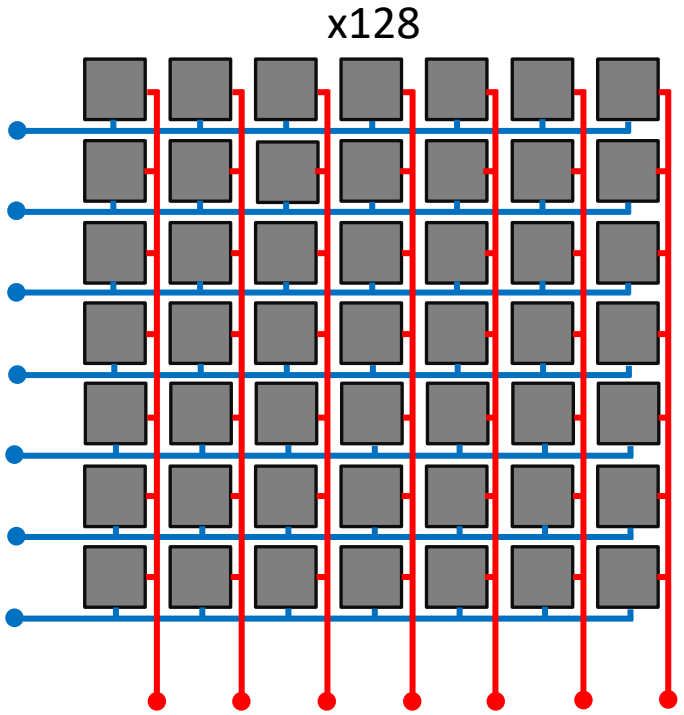
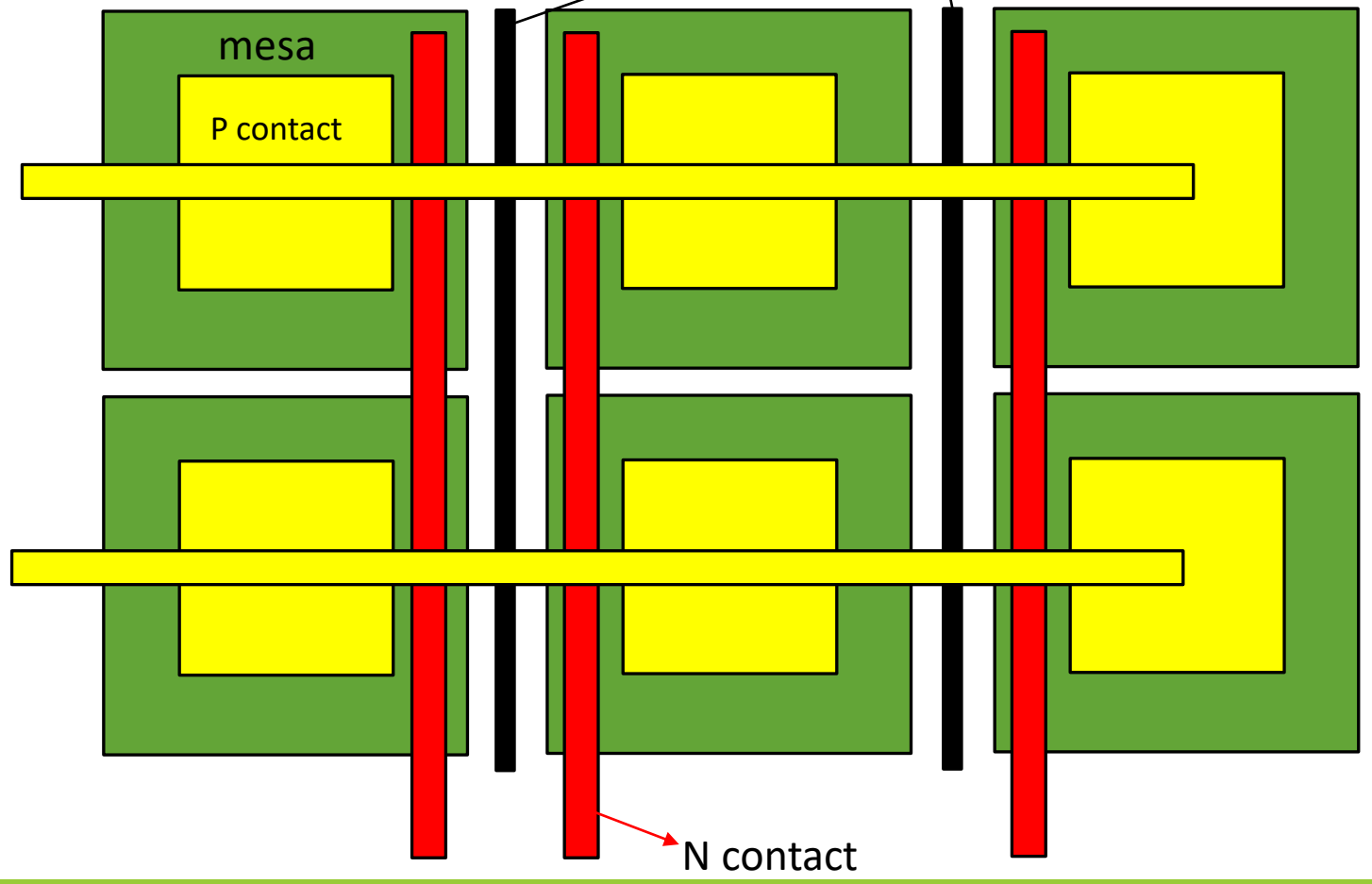
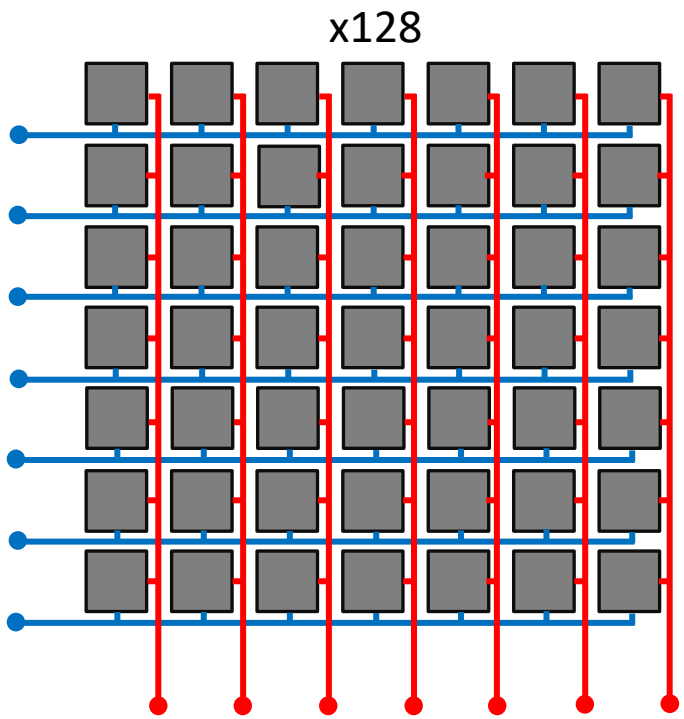


# Next: 128xN diodes matrix




For this kind of design we need more fabrication steps:

1. Mesa (litho + etch)
2. N contact (litho + metal deposition)
3. P contact (litho + metal deposition)
4. Deep etching between lines (?) (litho + etch)
5. Insulator coating (SiO2)
6. Insulator opening (plasma etch)
7. Ni/Au line deposition(red ones)
8. Insulator coating (SiO2)
9. Insulator opening (plasma etch)
10. Ni/Au line deposition (blue ones)

7-8 lithography masks

(for the last samples I had 3 masks)

Issues:

1. Higher number of photolithograhy masks (=more steps): lower yield
2. Periodic parasite signal due to gold lines