Status attivita' Roma1 2010/2011

INDICE:

- **Attivita' per la "Camera Pulita":**

  a) Movimentazione micrometrica per
  - incollaggio
  - saldatura a ultrasuoni

  b) Microscopio e sua movimentazione fine

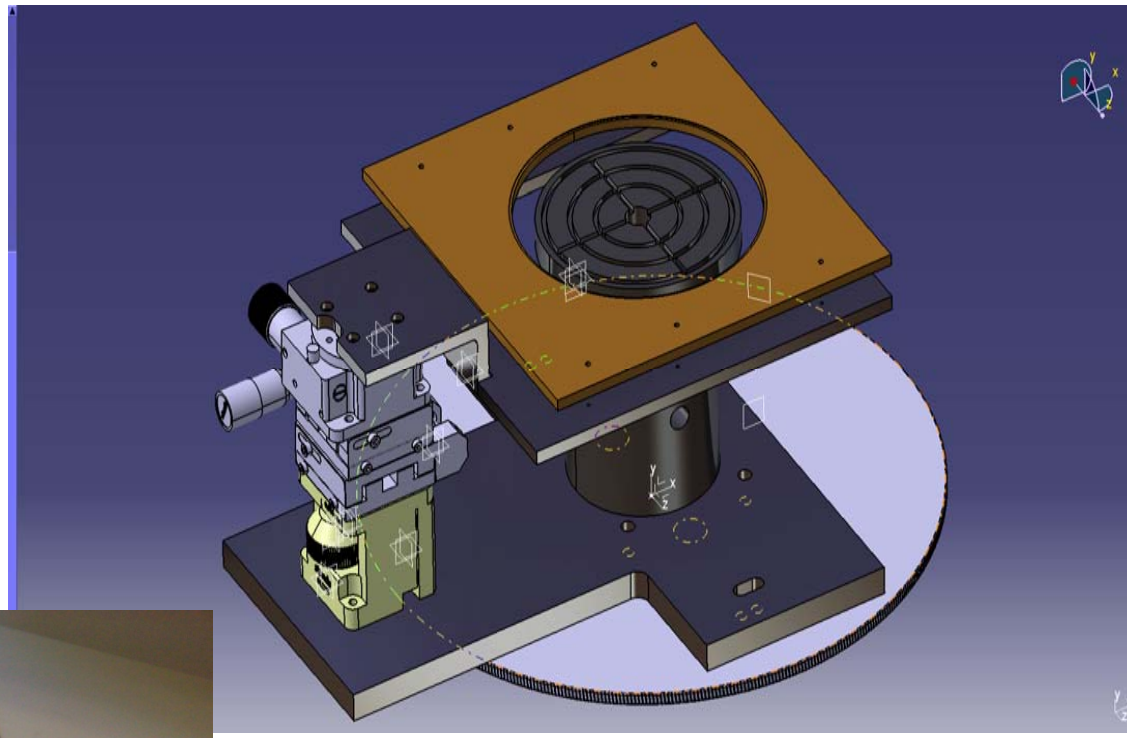
- **PCB rigido (FR4) Multilayer per SiD**

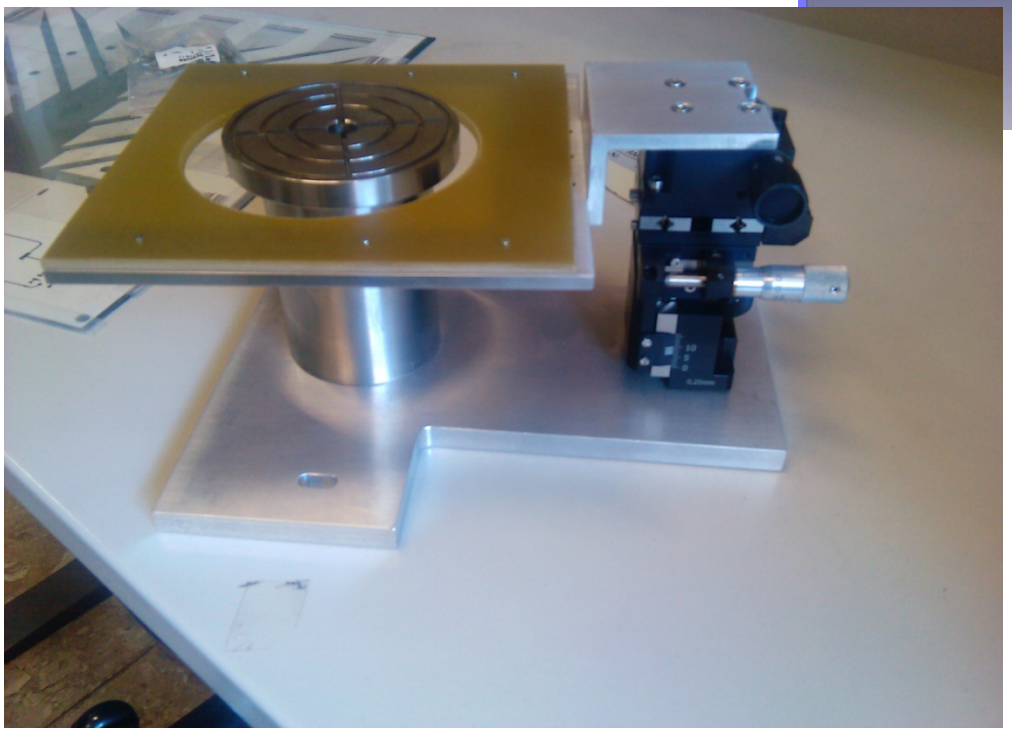
  - Piano X
  - Piano Y
  - Simulazioni con scelta della geometria per massimizzare SNR

- **Elettronica di Front-End**

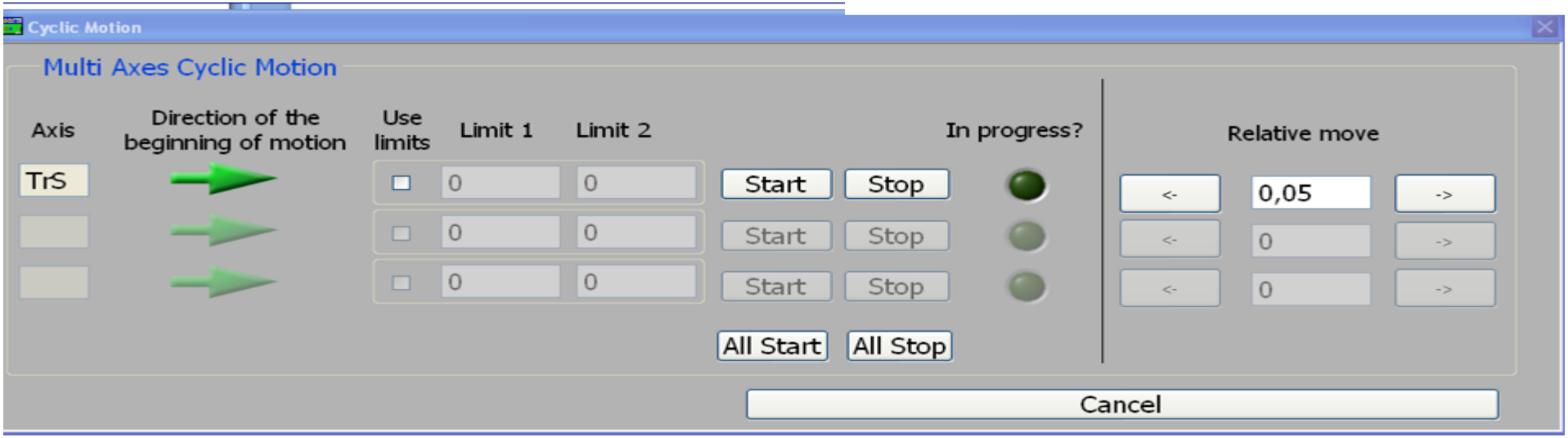
  Test APV25

Movimentazione fine per prove di incollaggio



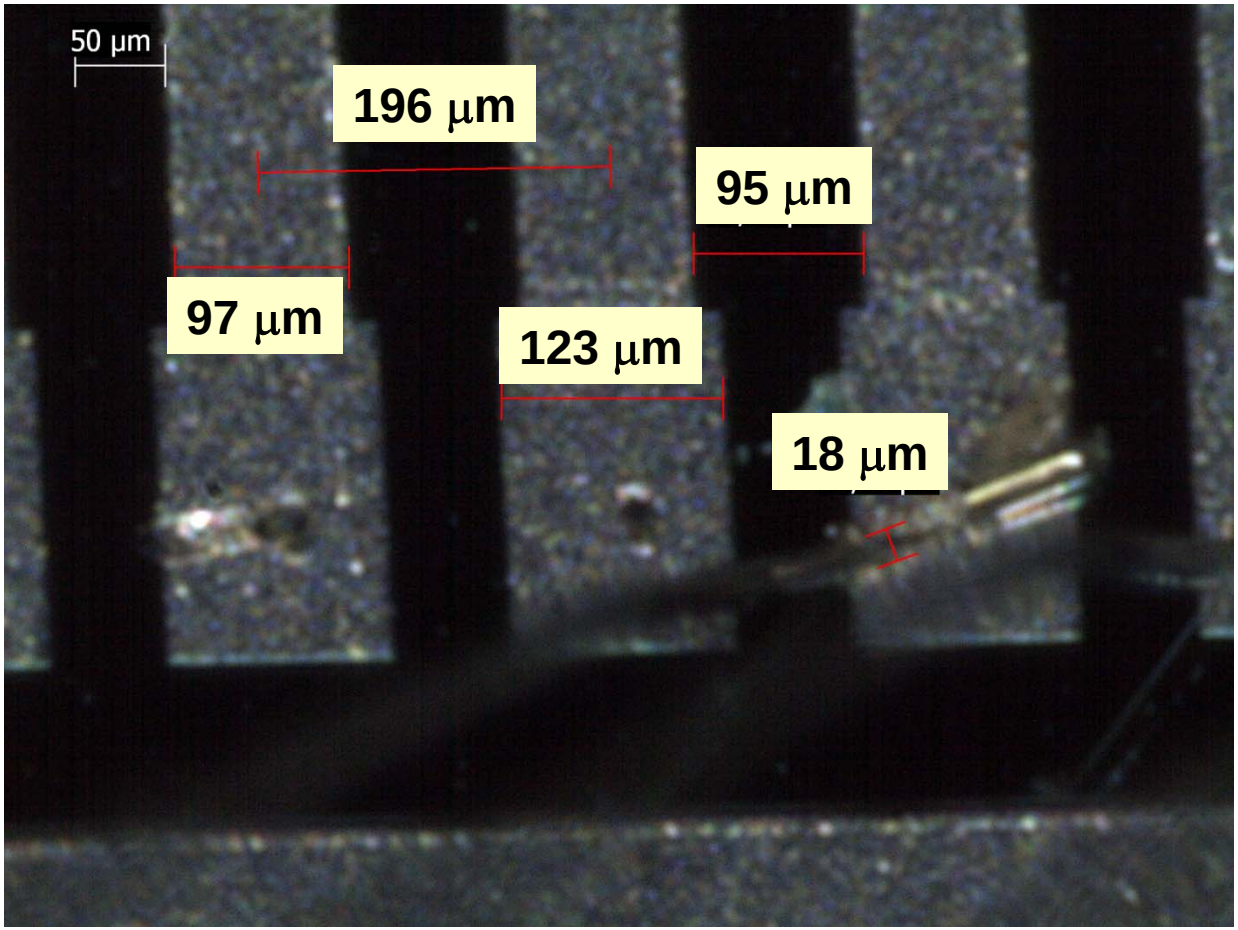


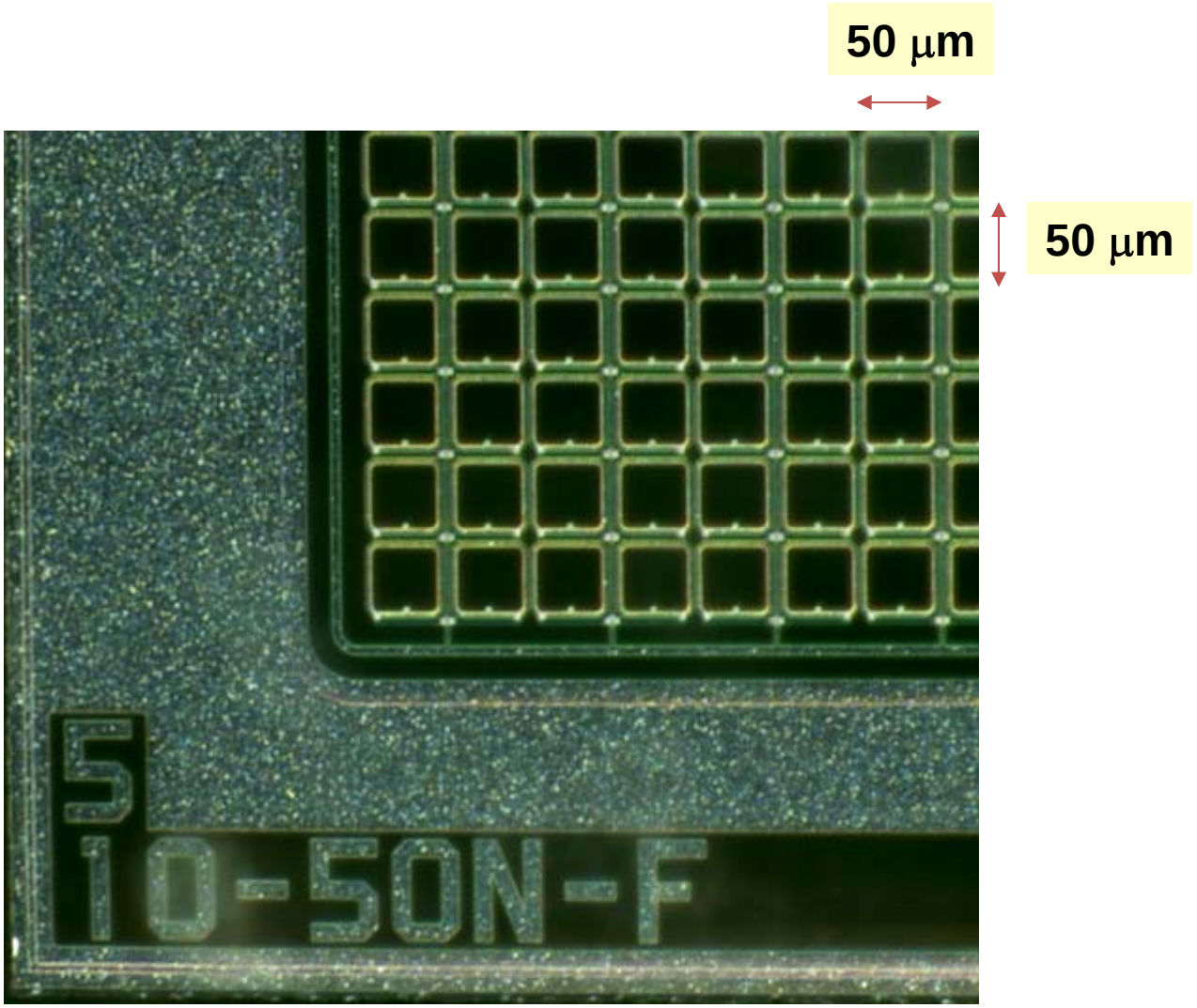
Movimentazione motorizzata per il wire-bonding



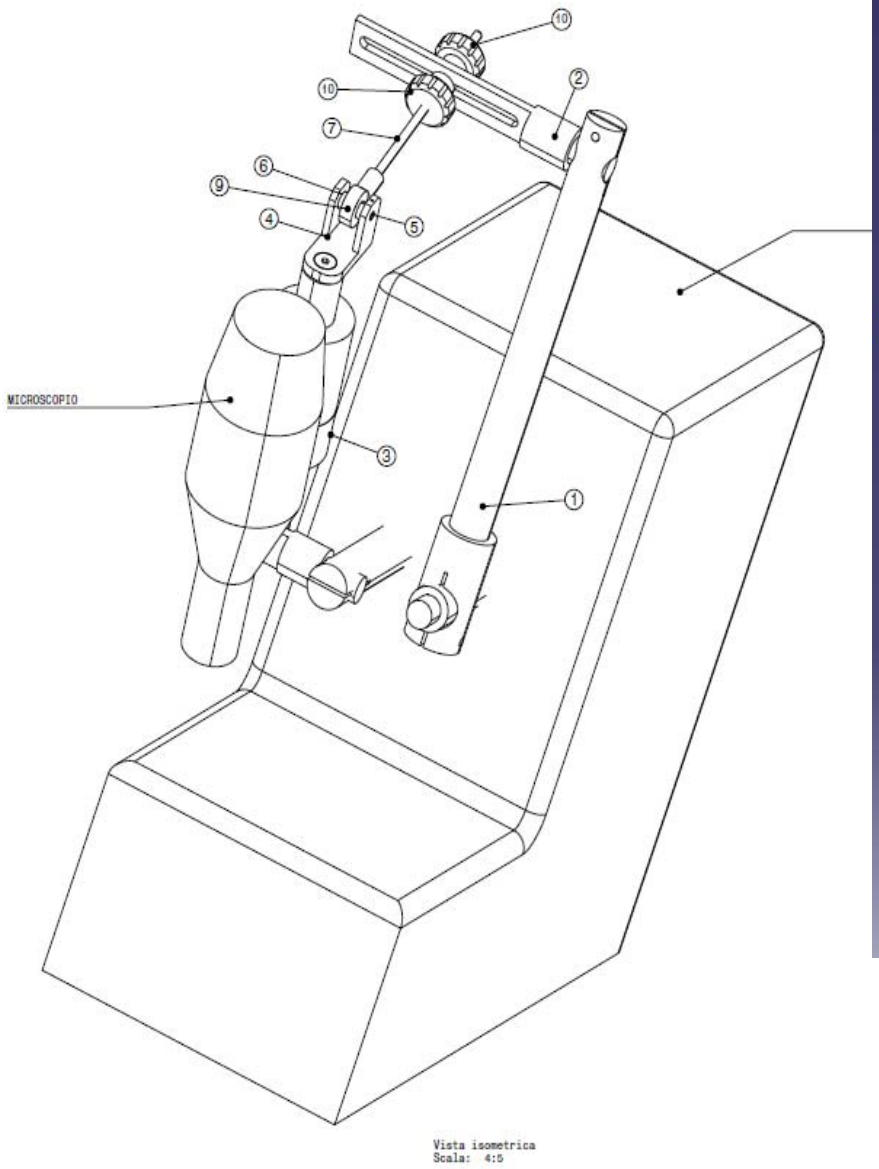
Microscopio Leica APO Z 16

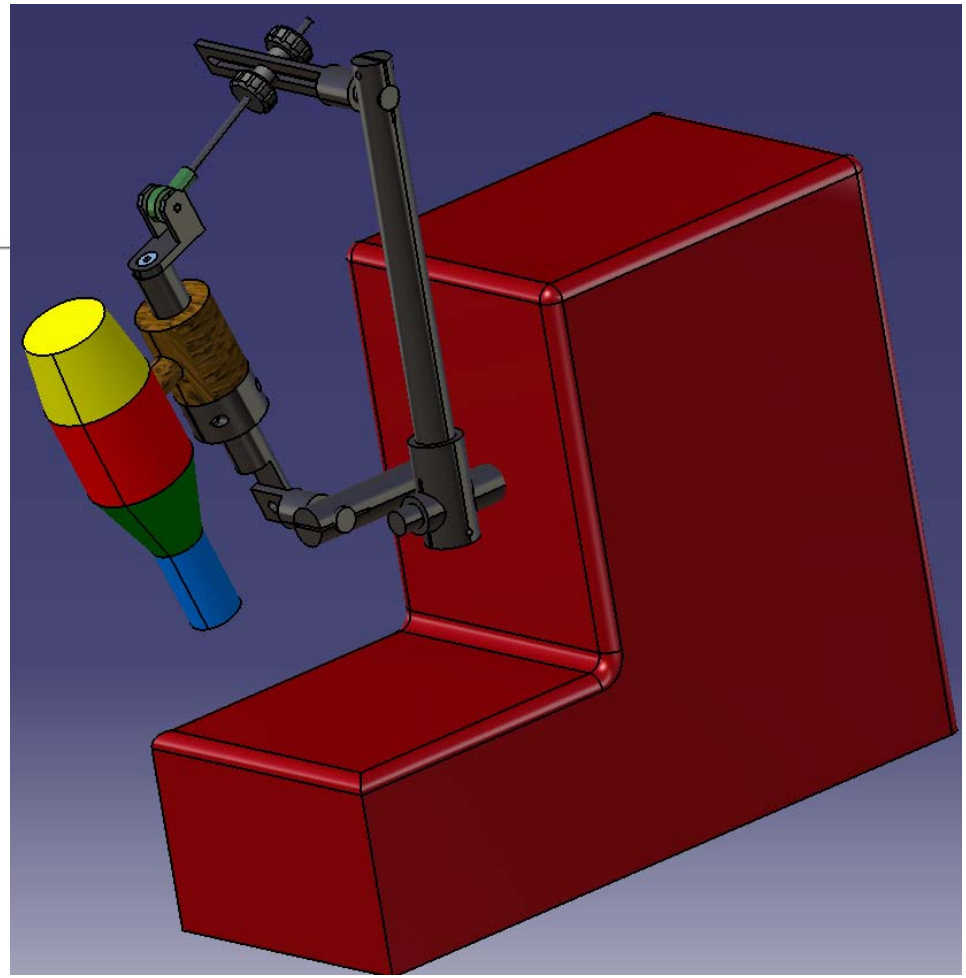
Ingrandimento Massimo :**154X**

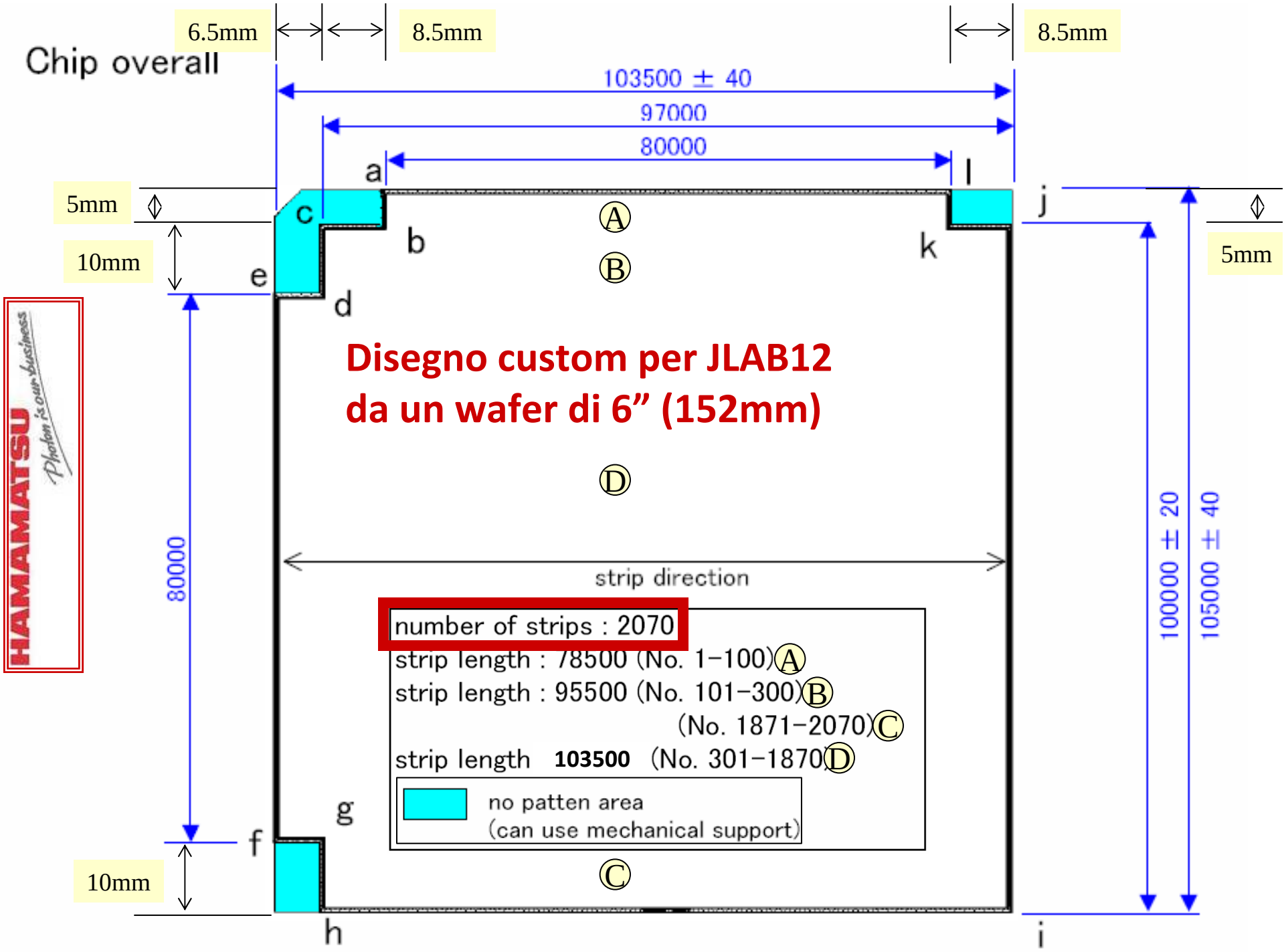


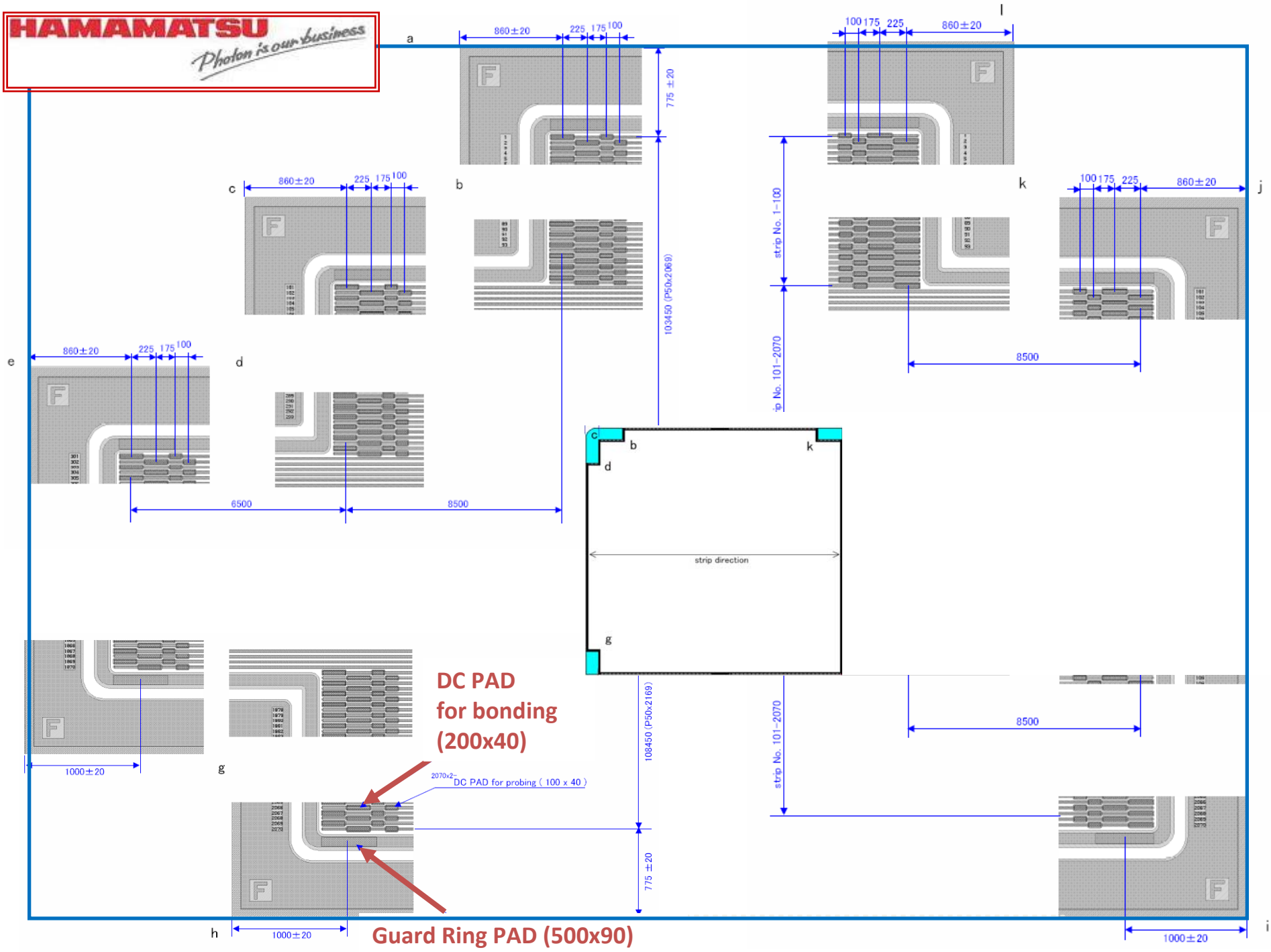

50 μm
50 μm
10-50N-F

Supporto e Movimentazione fine per il Microscopio Leica sulla saldatrice

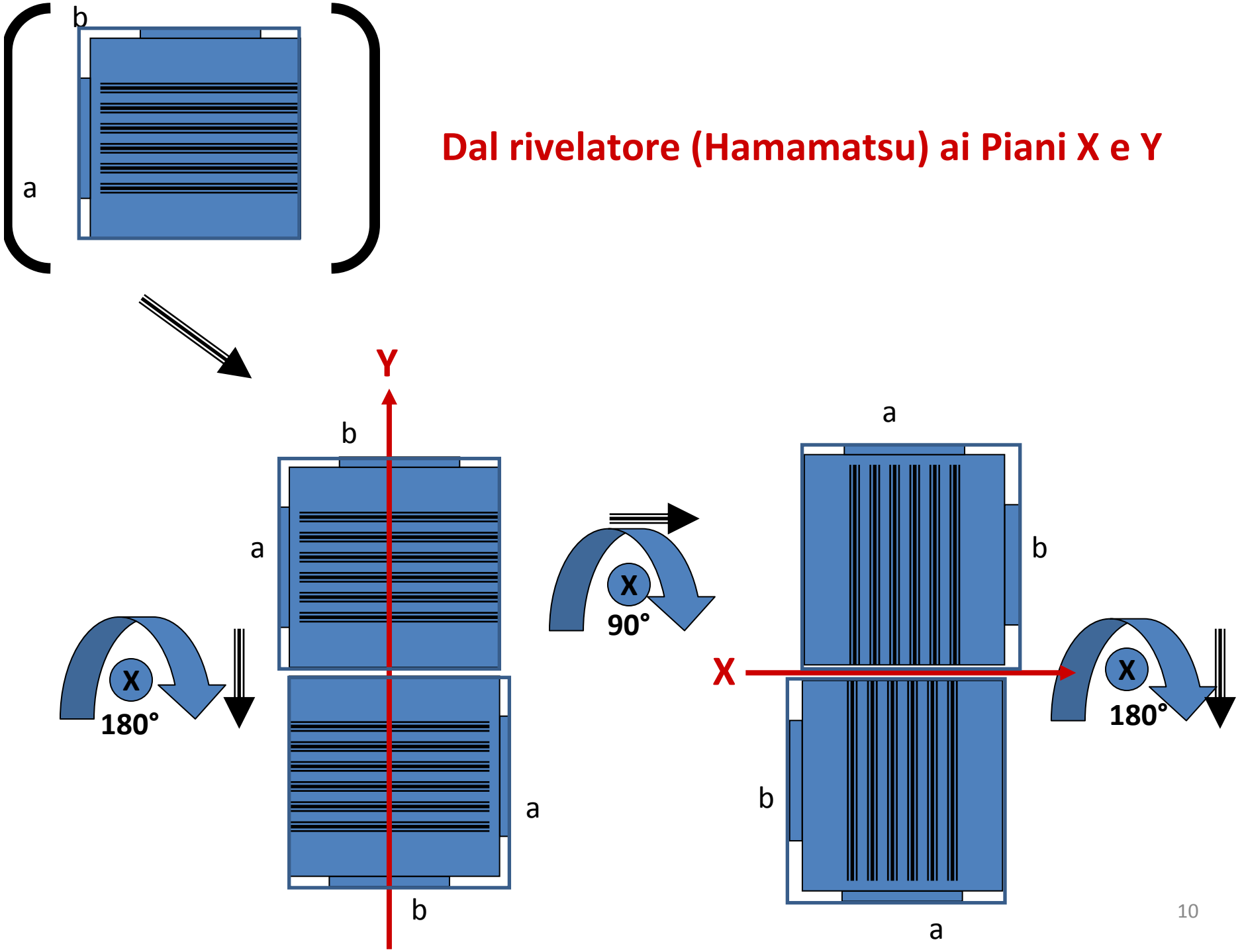





Chip overall
6.5mm
8.5mm
8.5mm
103500 ± 40
97000
80000
a
l
5mm
c
A
j
5mm
10mm
b
k
B
e
d
Disegno custom per JLAB12
da un wafer di 6” (152mm)
D
80000
strip direction
number of strips : 2070
strip length : 78500 (No. 1-100)A
strip length : 95500 (No. 101-300)B
(No. 1871-2070)C
strip length 103500 (No. 301-1870)D
no patten area
(can use mechanical support)
g
f
C
10mm
h
i
100000 ± 20
105000 ± 40
HAMAMATSU
Photon is our business


HAMAMATSU
Photon is our business
a
b
c
d
e
g
h
i
j
k
l
860±20
225
175
100
775 ±20
103450 (P50x2069)
strip No. 1–100
strip No. 101–2070
8500
6500
1000±20
strip direction
108450 (P50x2169)
2070x2
DC PAD for probing (100 x 40)
DC PAD
for bonding
(200x40)
Guard Ring PAD (500x90)

Dal rivelatore (Hamamatsu) ai Piani X e Y



PCB Rigido per SiD:

- **Necessità di ottimizzare gli ingombri, e la lunghezza delle piste.**

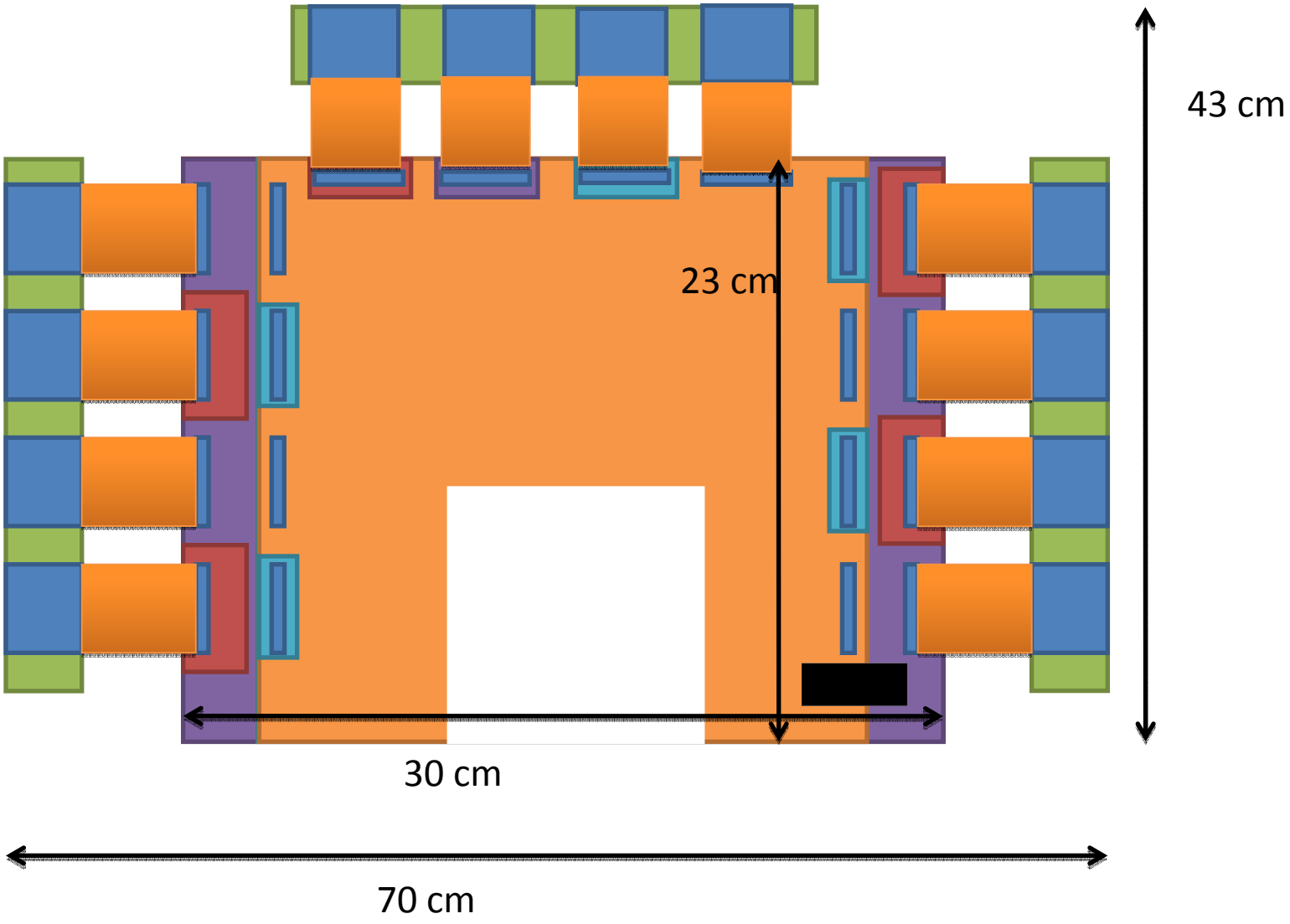
- **Necessità di ottimizzare il piano di massa.**

- **Necessità di progettare due PCB rigidi distinti, di uguali dimensioni, per i piani X e Y.**

- **Necessità di prevedere una culla di alloggiamento del rivelatore al silicio (SiD) nel PCB rigido stesso.**

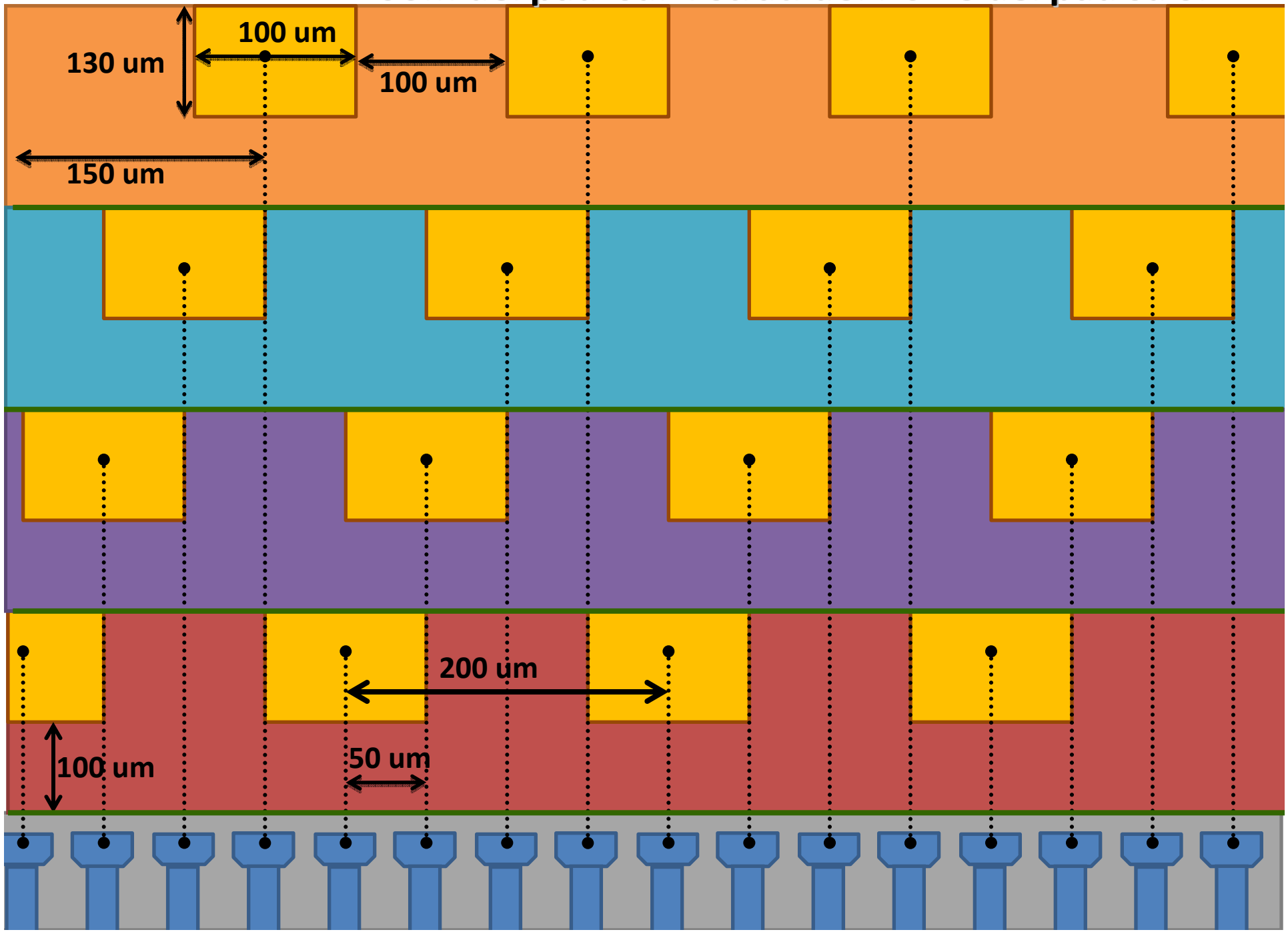
- **Necessità di poter essere realizzato con le attuali capacità tecnologiche ad un costo contenuto.**

Vista Frontale del semi piano X



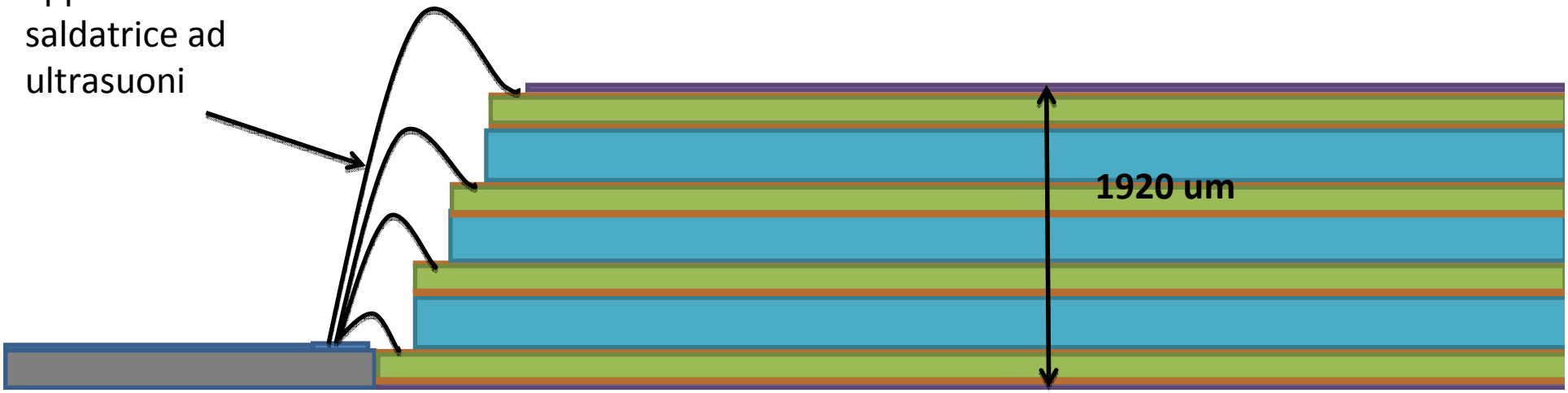
Divisione del PCB nei 4 Layer costituenti, 518 x 4 linee di segnale in totale

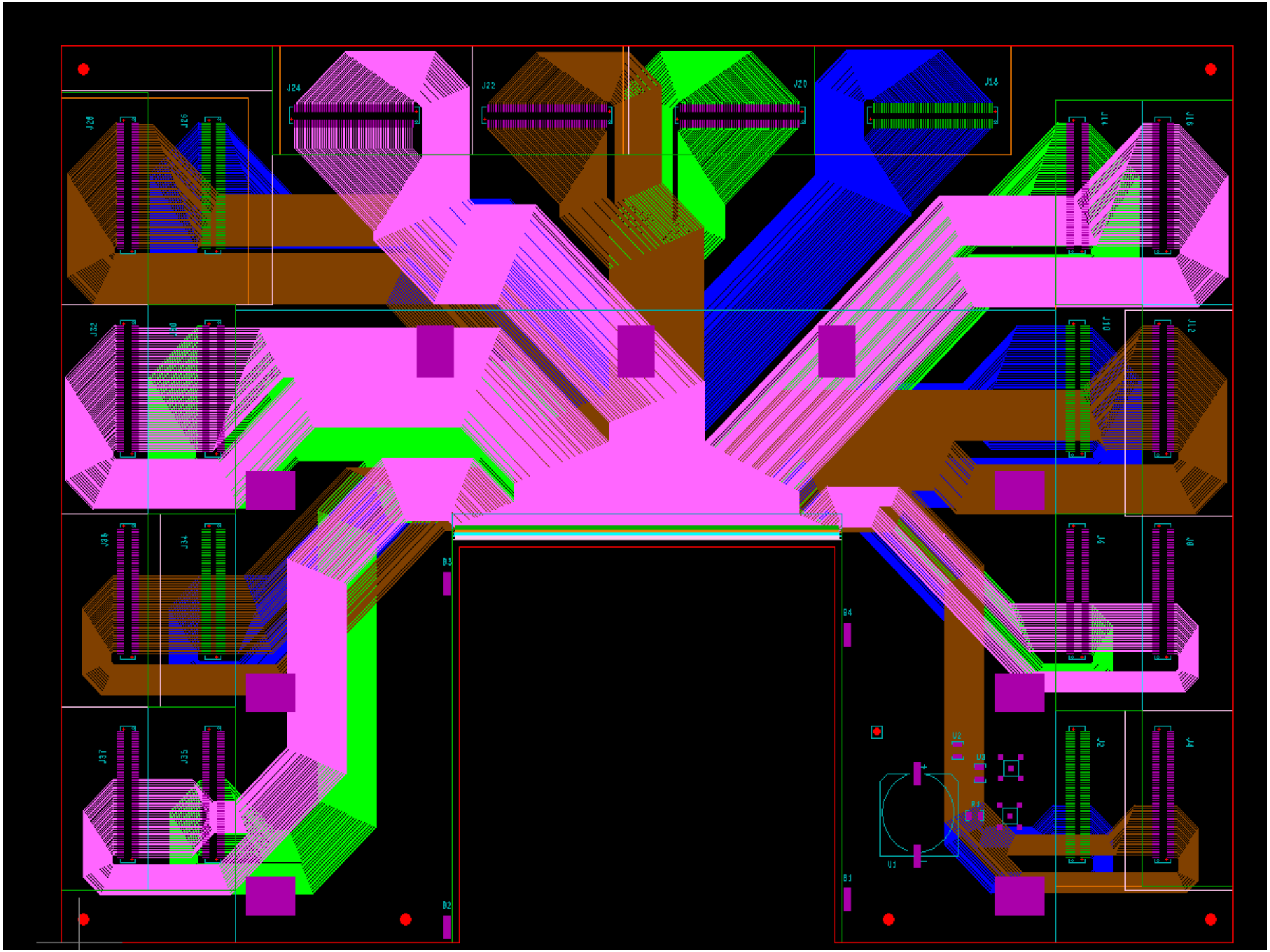
Zoom dei pad sui 4 strati del PCB e dei pad su SiD



Visione in sezione verticale dell'intero sistema SiD + PCB

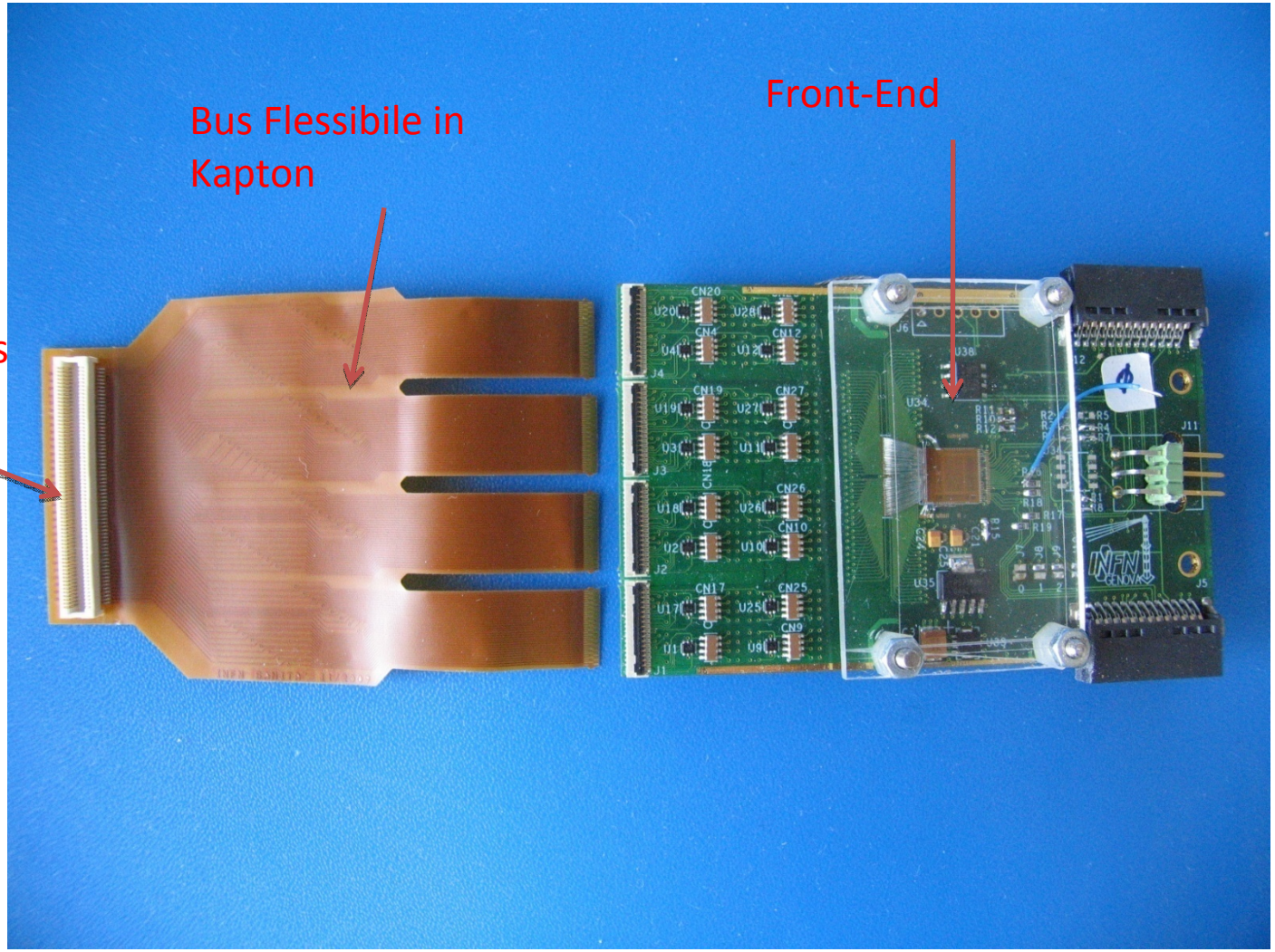
Filo in alluminio applicato con saldatrice ad ultrasuoni



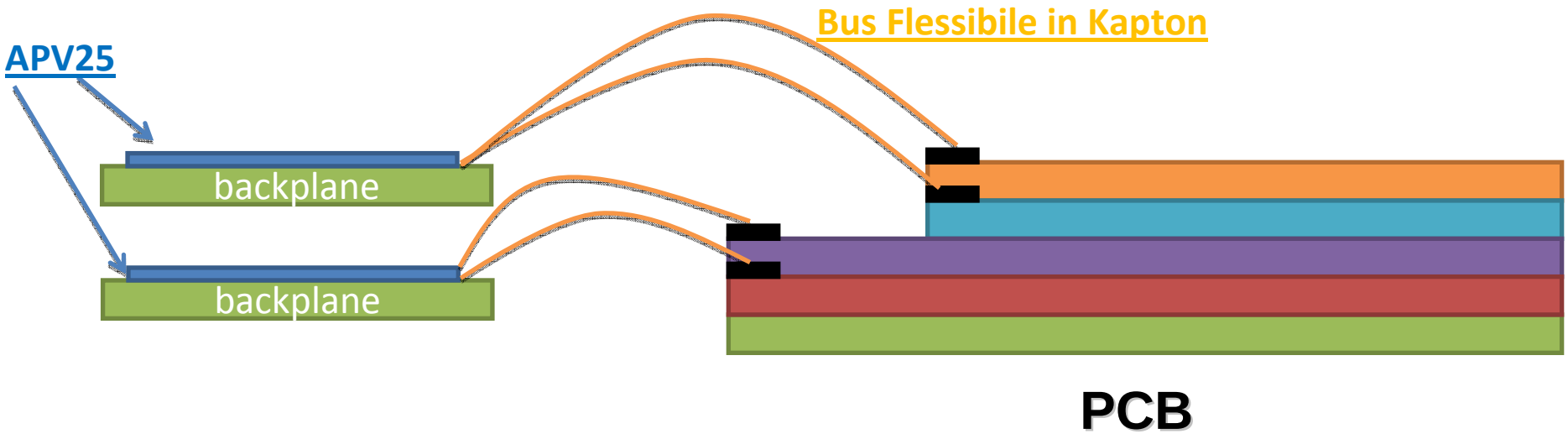

J24
J22
J20
J16
J28
J26
J32
J30
J34
J36
J37
J35
J14
J12
J10
J8
J6
J4
J2
B3
B4
B1
B2
U1
U2
U3
R1

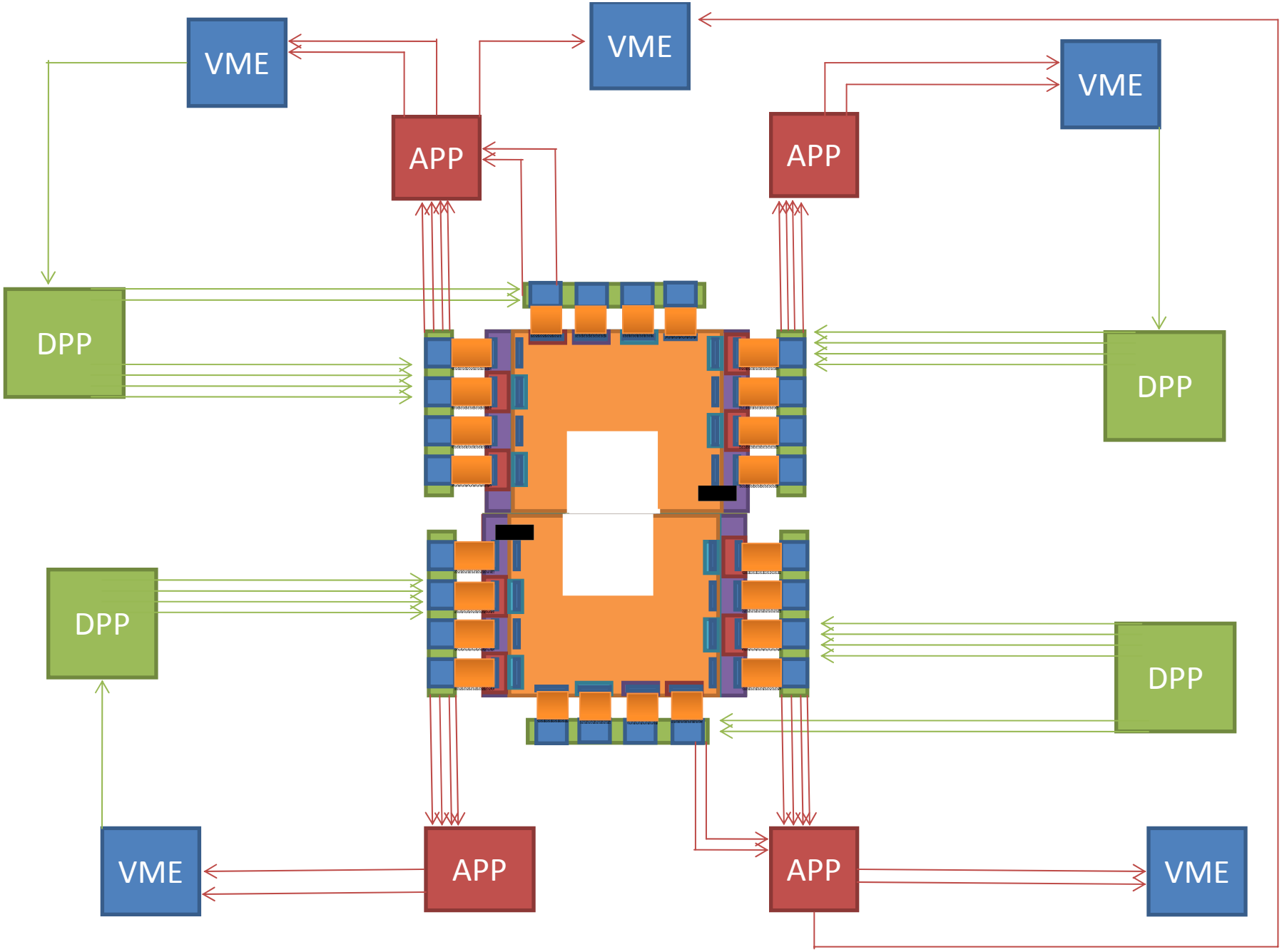
PCB + KAPTON + APV25

Connettore Femmina bus flessibile – bus rigido

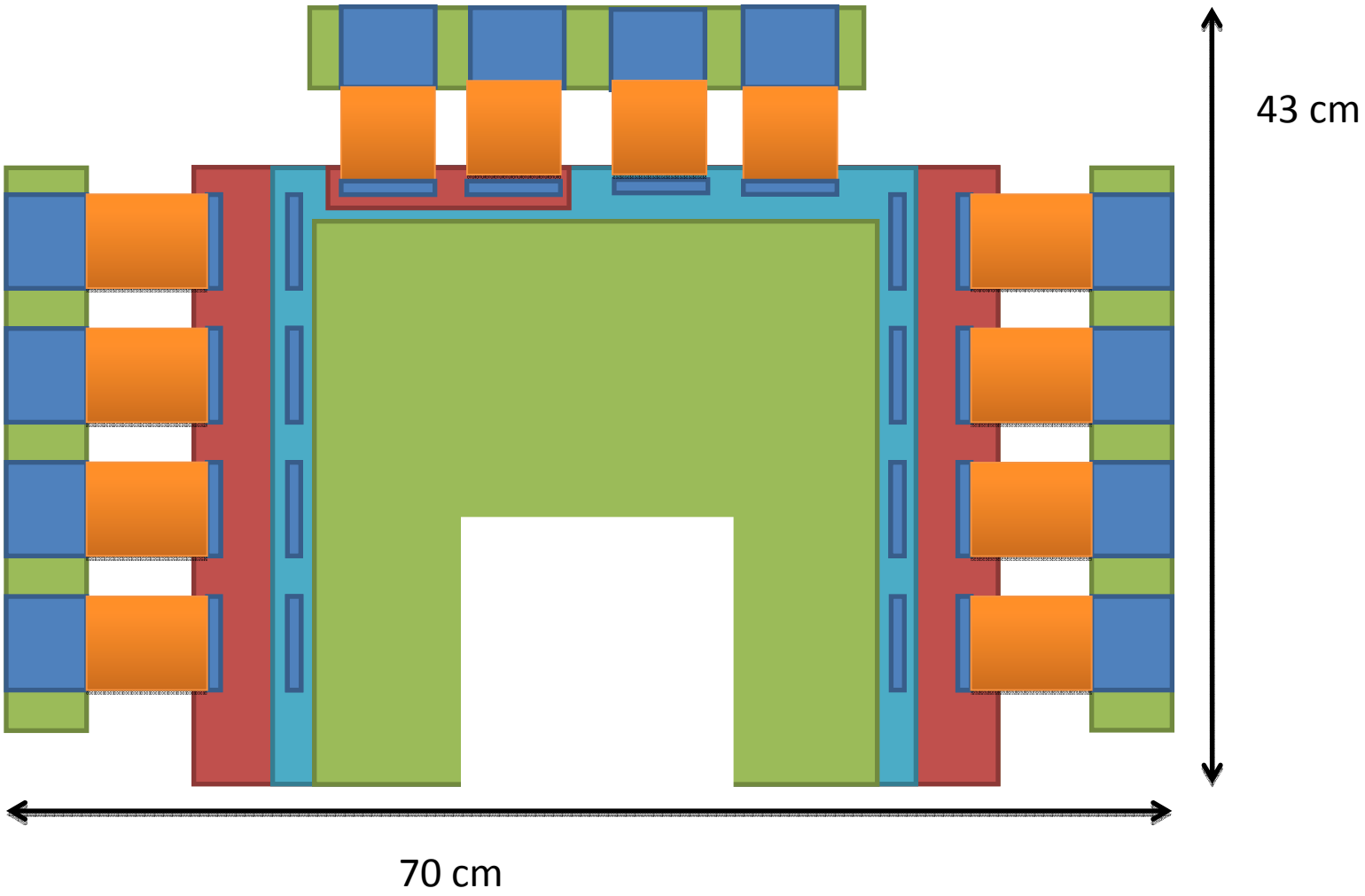


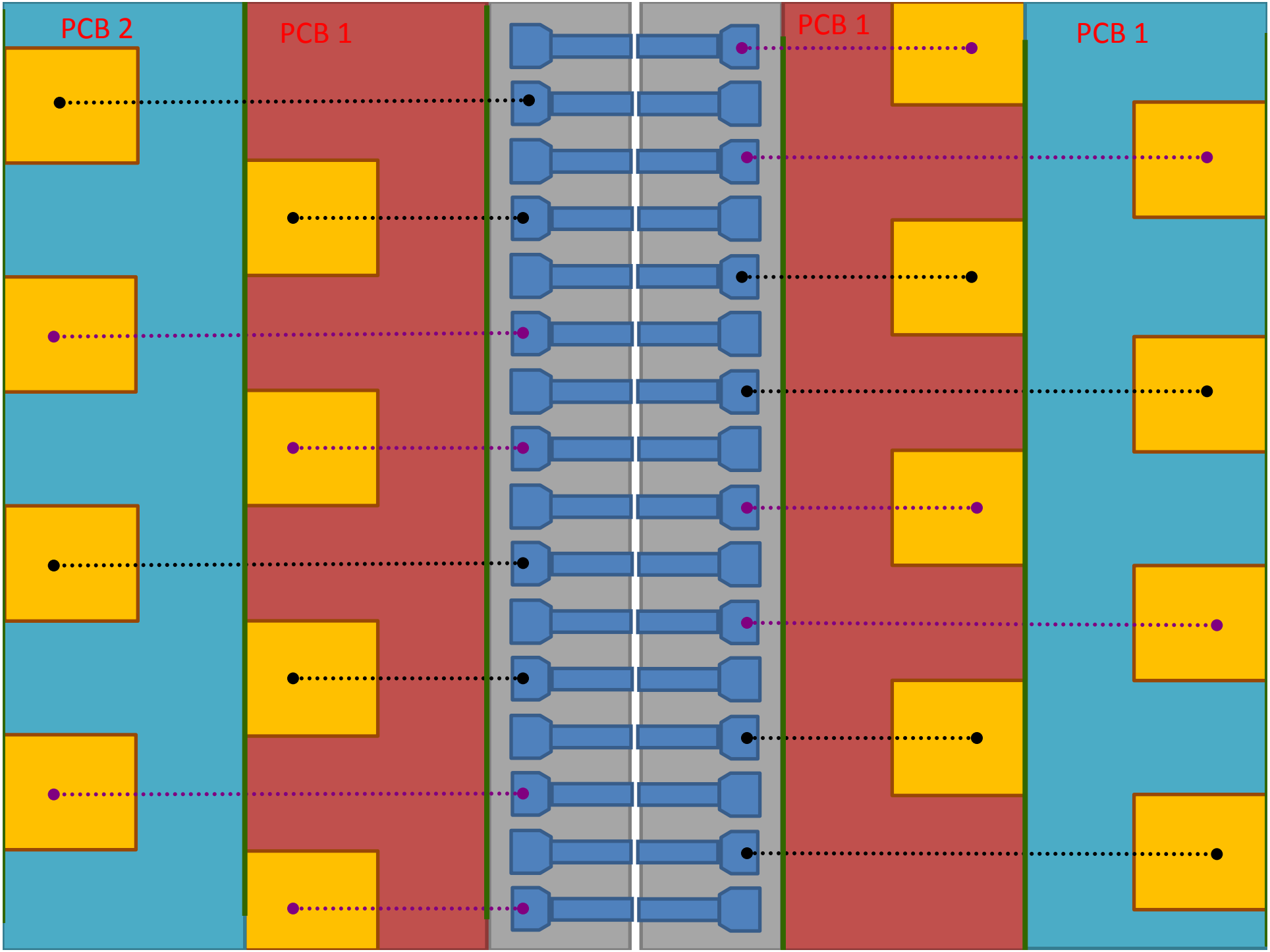
PCB + KAPTON + APV25 (terrazzati su Backplane a 2 livelli)



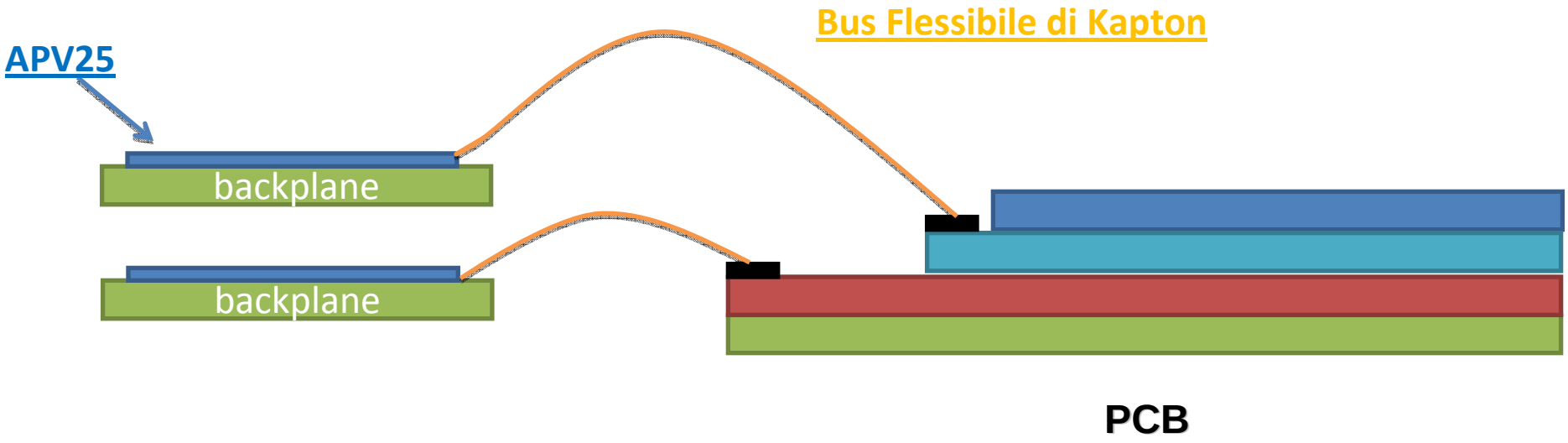

VME
VME
VME
APP
APP
DPP
DPP
DPP
DPP
VME
APP
APP
VME

Vista Frontale del semi piano Y



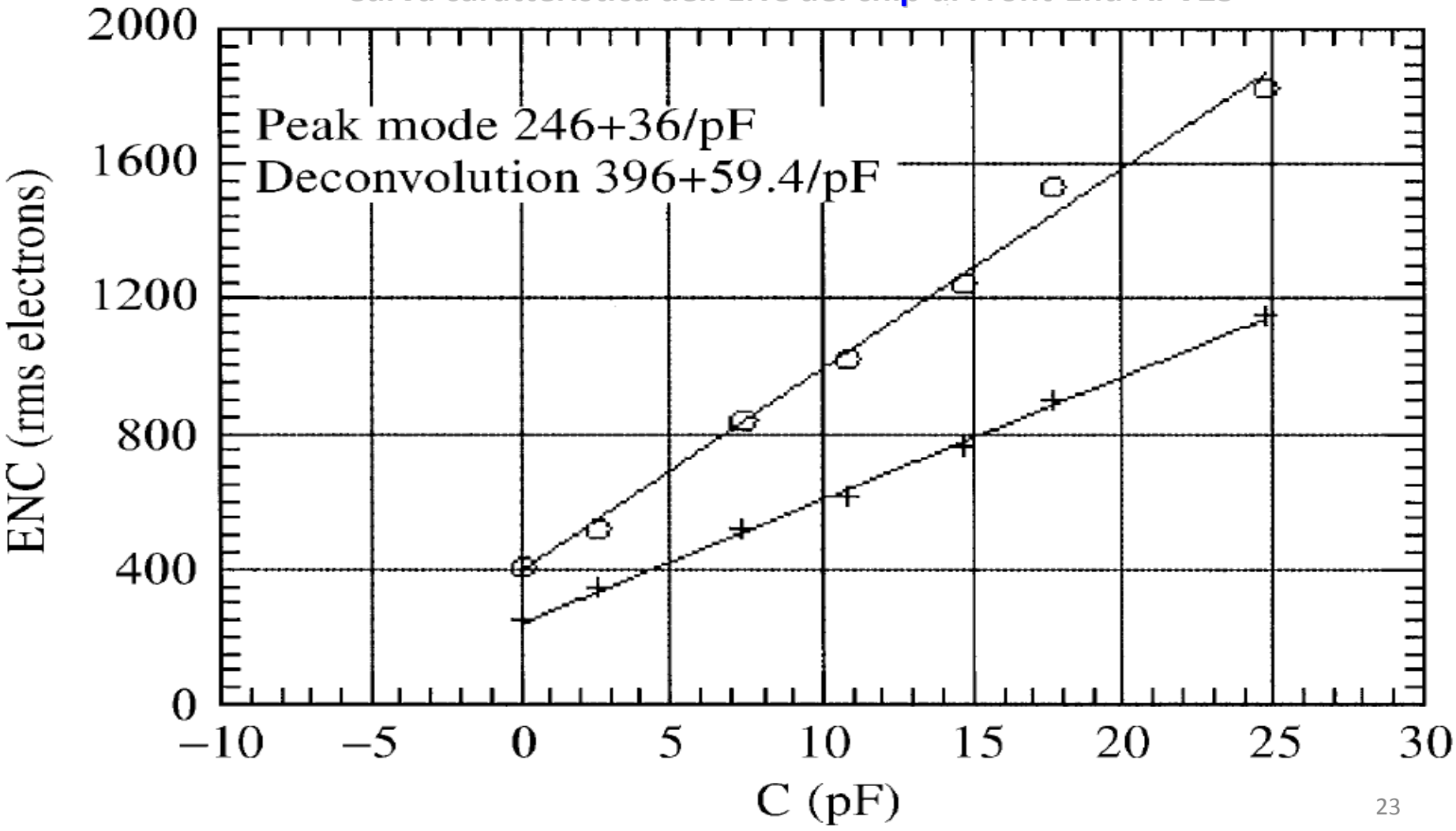

PCB 2
PCB 1
PCB 1
PCB 1

PCB + KAPTON + APV25 (terrazzati su Backplane a 2 livelli)



Studio del Piano di Massa: Importante per ottimizzare SNR

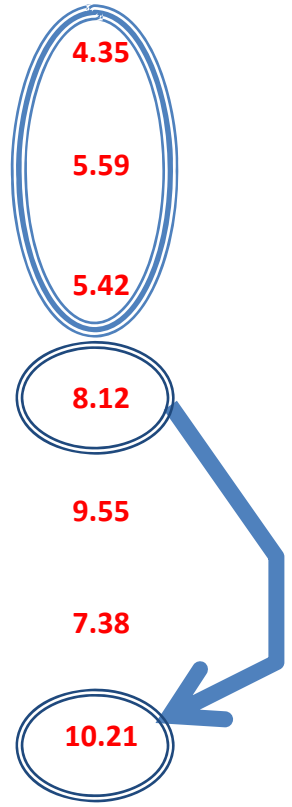
Curva caratteristica dell'ENC del chip di Front-End APV25



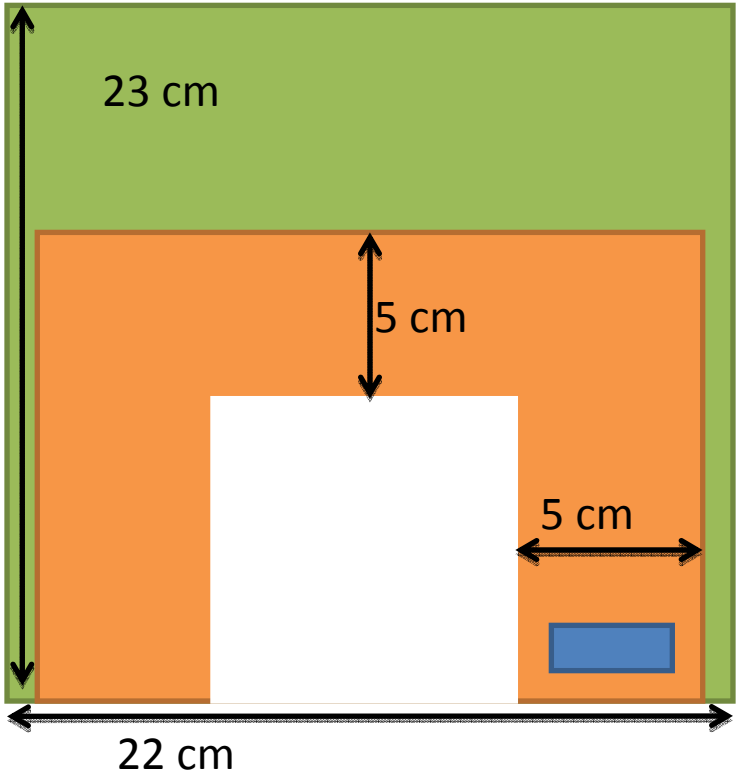
SNR al variare del numero dei piani di massa e della distanza dalle piste

N piani di Massa	SNR L = 10 cm	SNR L = 30 cm
nessun piano di Massa	21.78	15.65
5 piani di Massa	11.31	4.35
2 piani di Massa Layer 0 et Layer 3	13.33	5.59
1 piano di Massa BOTTOM 200 um Layer 0	13.13	5.42
1 piano di Massa BOTTOM 700 um Layer 0	16.19	8.12
1 piano di Massa BOTTOM 1200 um Layer 0	17.43	9.55
1 piano di Massa BOTTOM 200 um Layer 0, piano di massa sagomato a 20 cm	14.87	7.38
1 piano di Massa BOTTOM 700 um Layer 0, piano di massa sagomato a 20 cm	16.19	10.21
1 piano di Massa BOTTOM 1200 um Layer 0, piano di massa sagomato a 20 cm	17.43	11.24

Non e' realistico!

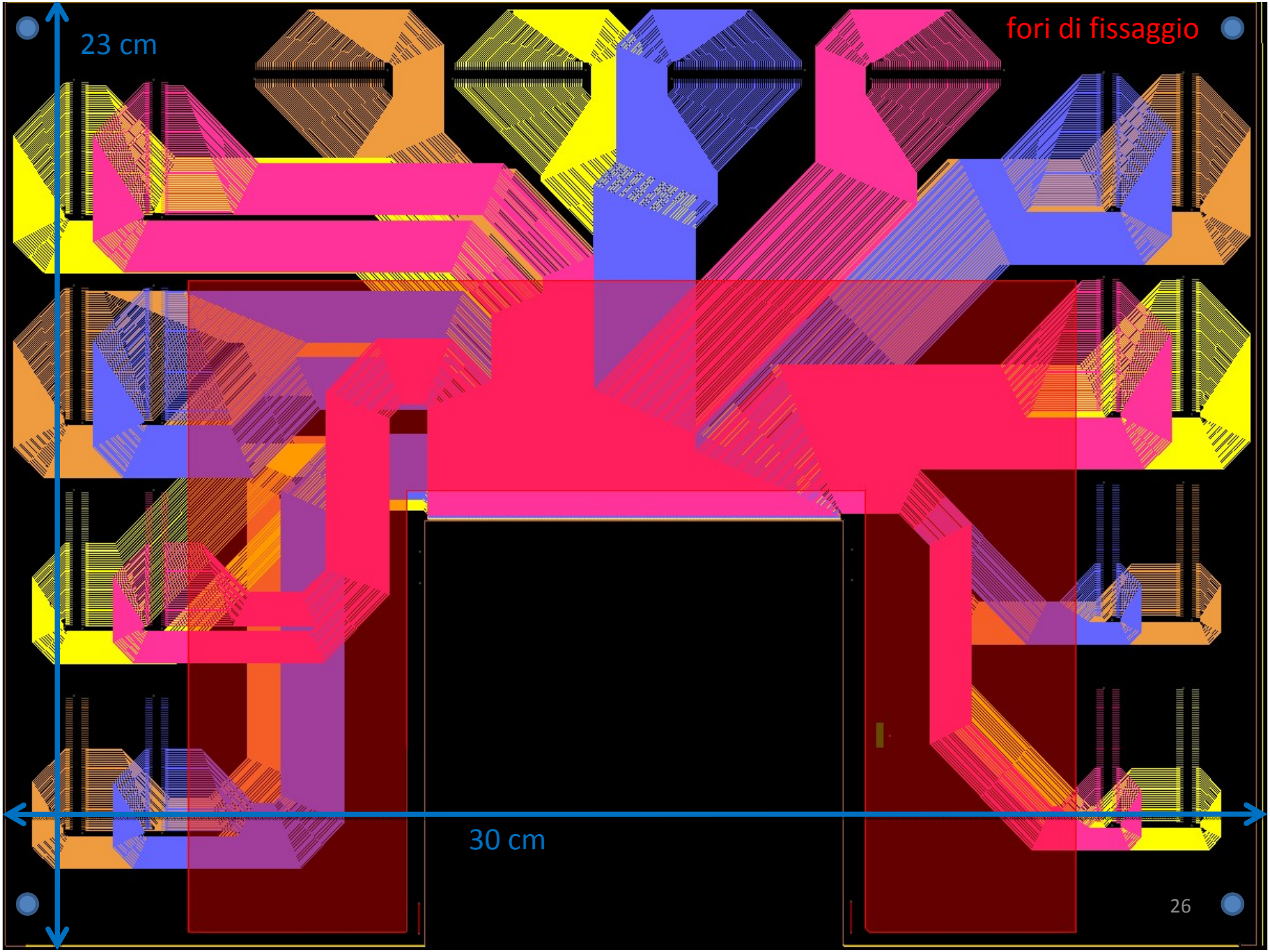


Soluzione Adottata :



PCB 5 (Top) : con piano di massa ridotto e circuito di Pulsing

➔ SNR = 16 ~ 20


23 cm
fori di fissaggio
30 cm

Simulazione Strip di maggiore lunghezza in PCB4 : L = 20.1 cm.
Distanza minore dal piano di massa (PCB 4) 630 um.
5.6 cm di percorrenza sotto il piano di massa.

Embedded Microstrip Impedance Calculator:

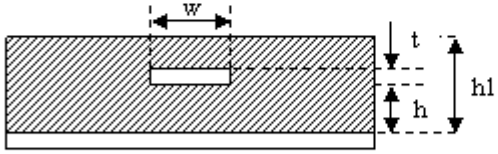
$$Z_0 = \frac{60}{\sqrt{\varepsilon_{re}}} \ln\left(\frac{5.98h}{(0.8w+t)}\right) \qquad T_{pd} = 0.278\sqrt{\varepsilon_{re}}$$

$$\varepsilon_{re} = \varepsilon_r\left(1-\exp\left(-1.55\frac{h_1}{h}\right)\right)$$

Valori per tratto sotto il piano di massa

Note: valid for (h1/h) greater than 1.2

Dimensional units: (•) mm ( ) mils

w (trace width) =	0.1
t (trace thickness) =	0.02
h (trace dielectric thickness) =	0.63
h1 (overall dielectric thickness) =	3.78
er (relative dielectric constant) =	4.5
	Calculate
Zo (Impedance, Ohms) =	102.647
Propagation Dealy, Tpd (ps/cm) =	58.970
Inductance, L (nH/cm) =	6.053
Capacitance, C (pF/cm) =	0.57449

Note: 1oz = 1.4mils = 0.03556mm

Embedded Microstrip Impedance Calculator:

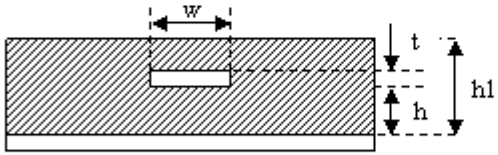
$$Z_0 = \frac{60}{\sqrt{\varepsilon_{re}}} \ln\left(\frac{5.98h}{(0.8w+t)}\right) \qquad T_{pd} = 0.278\sqrt{\varepsilon_{re}}$$

$$\varepsilon_{re} = \varepsilon_r\left(1-\exp\left(-1.55\frac{h_1}{h}\right)\right)$$

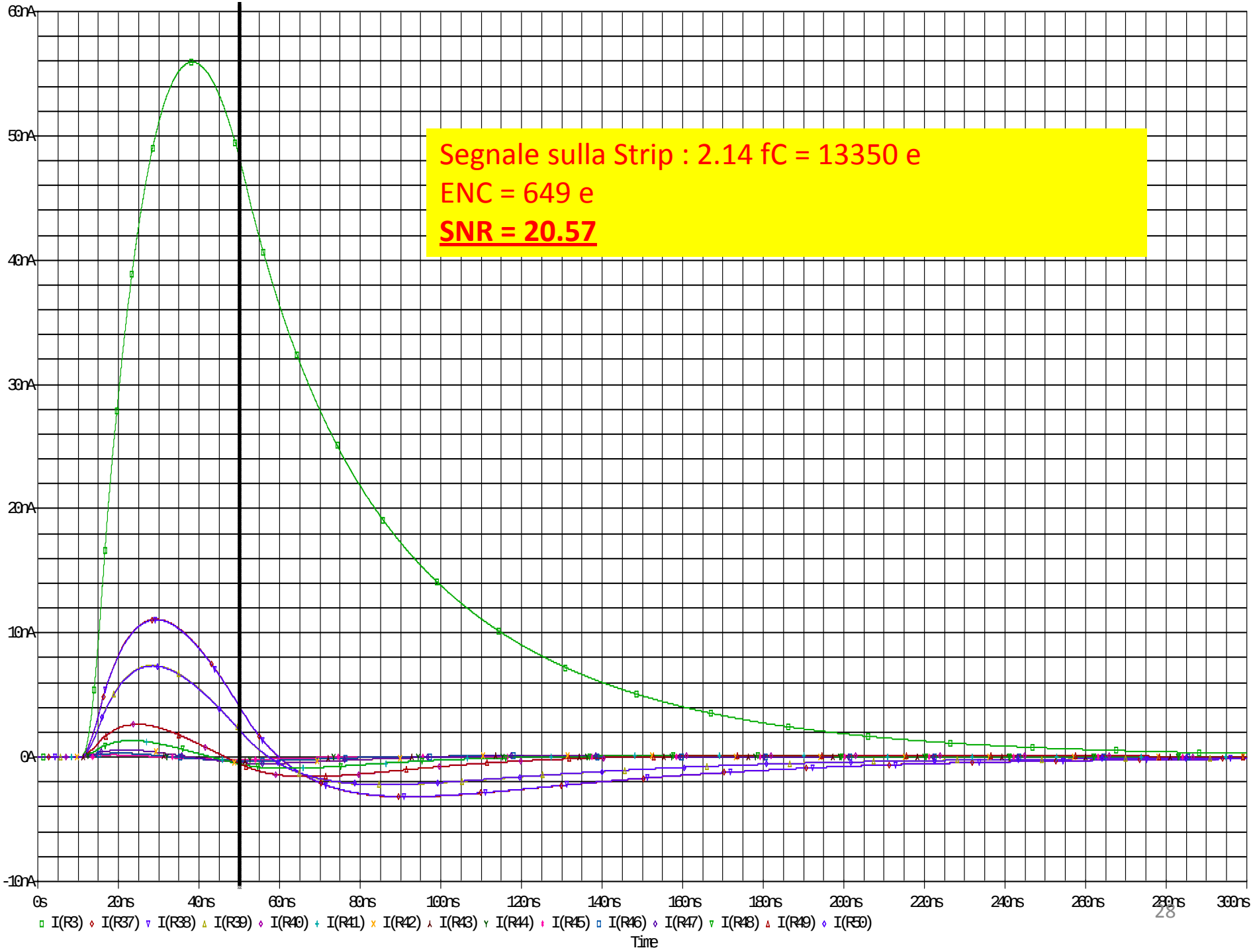
Valori per tratto senza il piano di massa

Note: valid for (h1/h) greater than 1.2

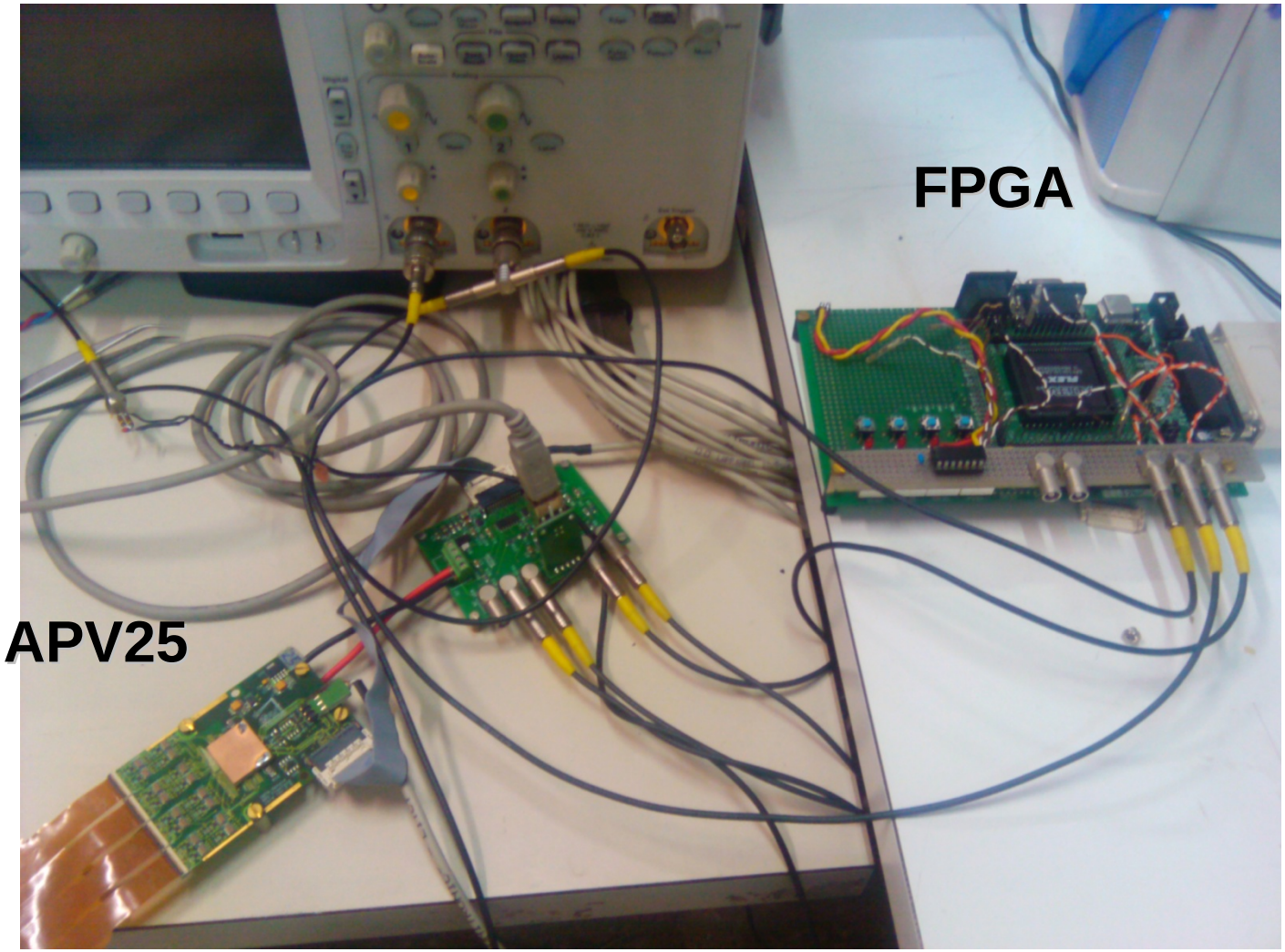
Dimensional units: (•) mm ( ) mils

w (trace width) =	0.1
t (trace thickness) =	0.02
h (trace dielectric thickness) =	1000000
h1 (overall dielectric thickness) =	1000030
er (relative dielectric constant) =	4.5
	Calculate
Zo (Impedance, Ohms) =	570.635
Propagation Dealy, Tpd (ps/cm) =	52.342
Inductance, L (nH/cm) =	29.868
Capacitance, C (pF/cm) =	0.09173

Note: 1oz = 1.4mils = 0.03556mm


Segnale sulla Strip : 2.14 fC = 13350 e
ENC = 649 e
SNR = 20.57
60nA
50nA
40nA
30nA
20nA
10nA
0A
-10nA
0s
20ns
40ns
60ns
80ns
100ns
120ns
140ns
160ns
180ns
200ns
220ns
240ns
260ns
280ns
300ns
I(R3) I(R37) I(R38) I(R39) I(R40) I(R41) I(R42) I(R43) I(R44) I(R45) I(R46) I(R47) I(R48) I(R49) I(R50)
Time

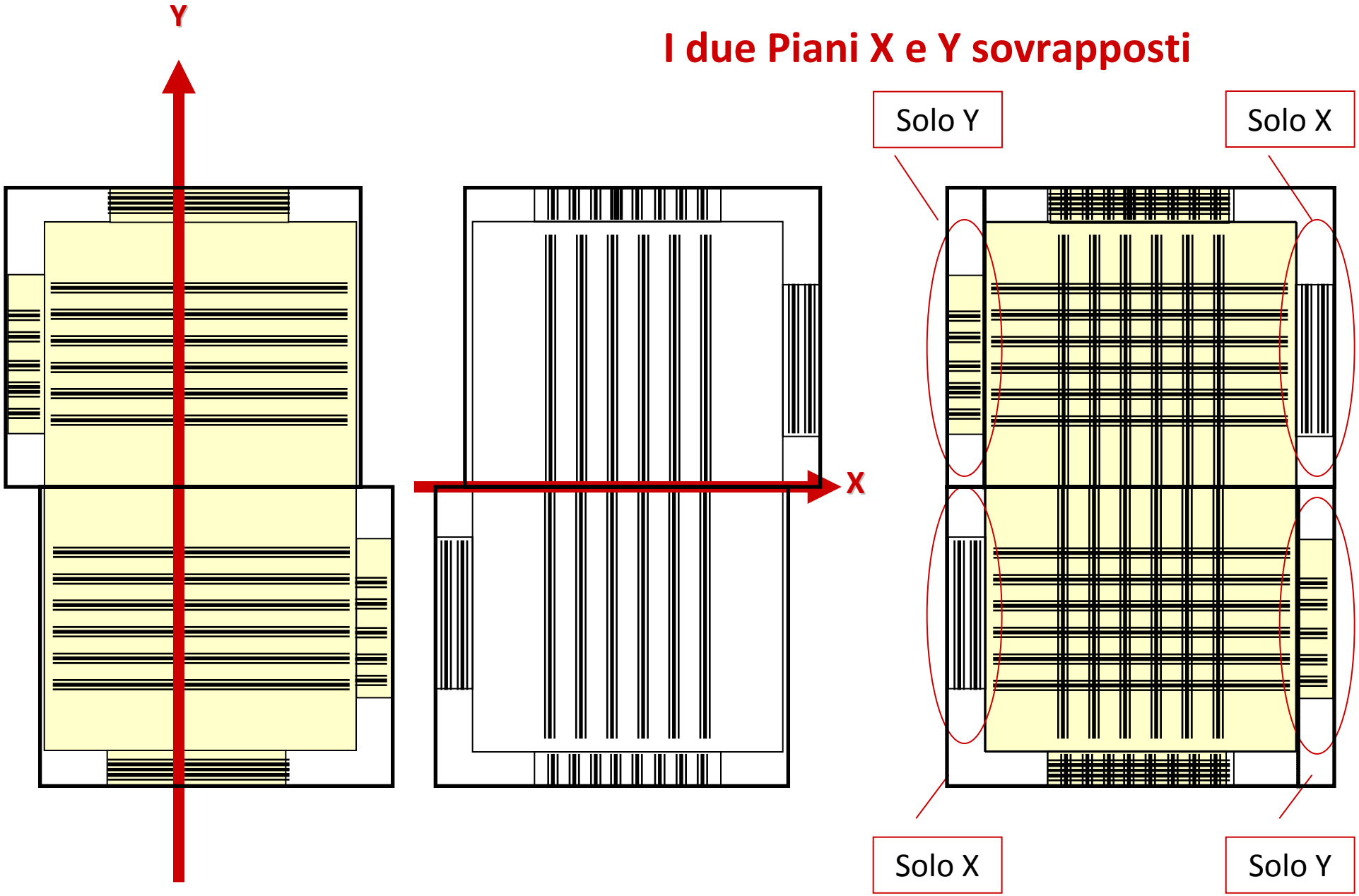
APV25 + FPGA



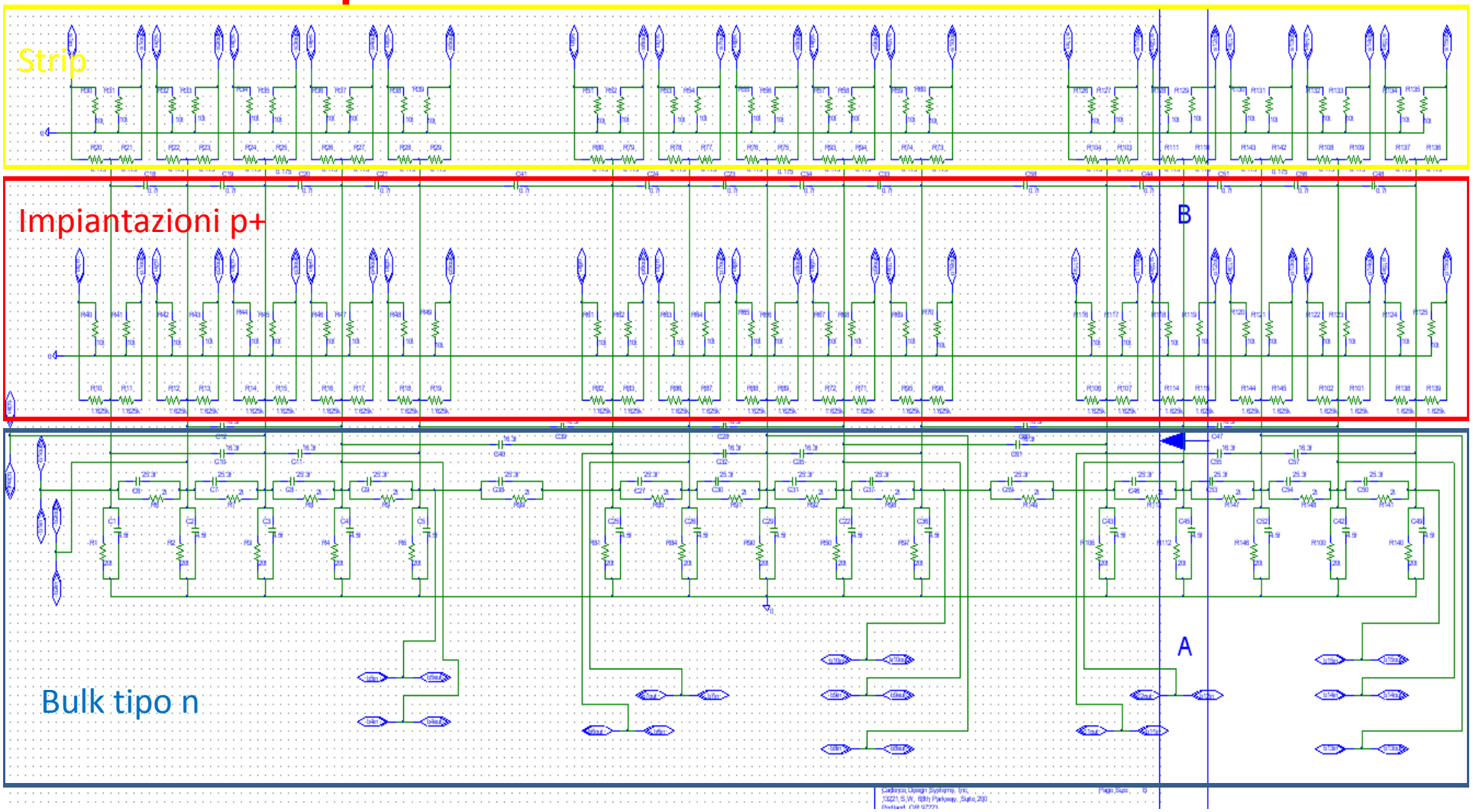
Test dei canali 0-31

RISERVA

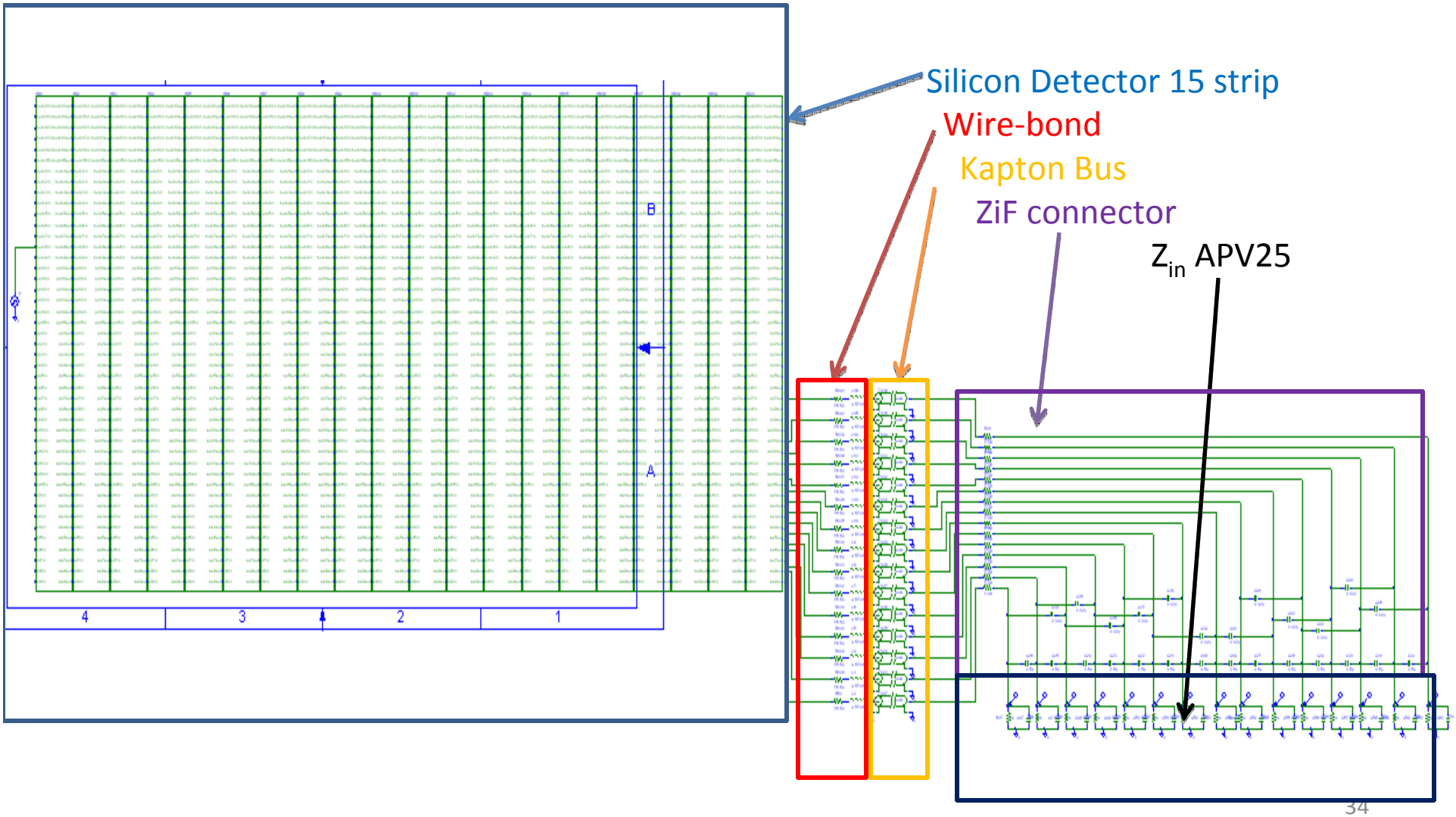
I due Piani X e Y sovrapposti



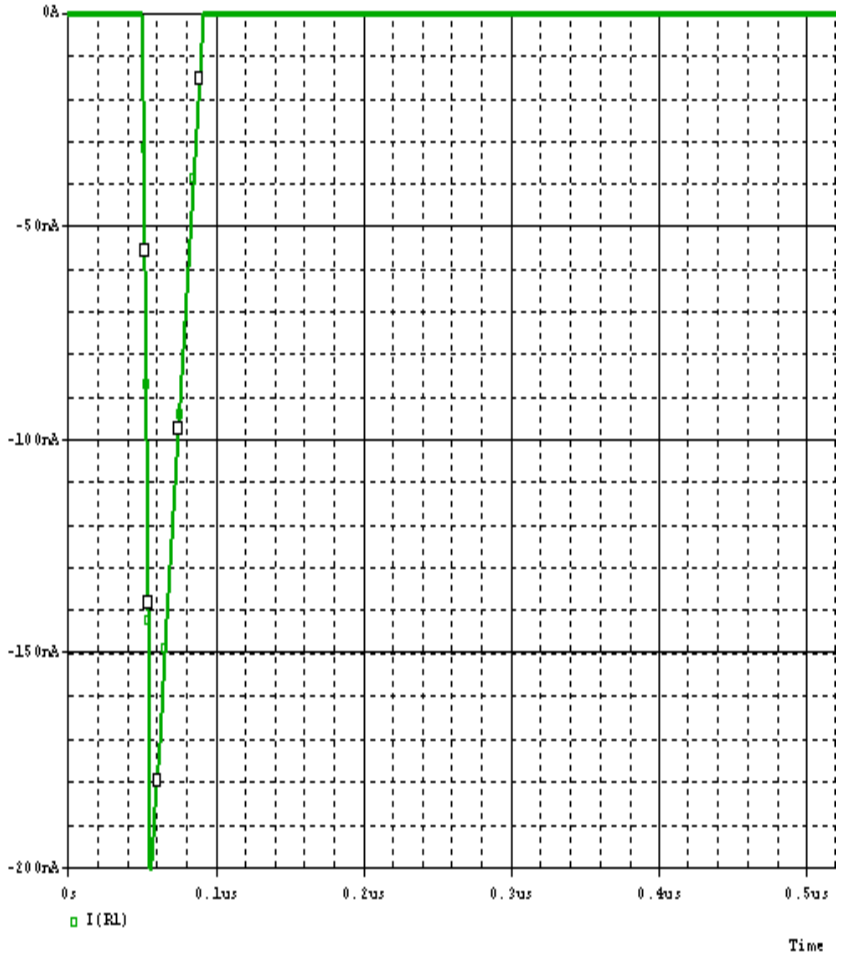
Microcella del Rivelatore con parametri HAMAMATSU

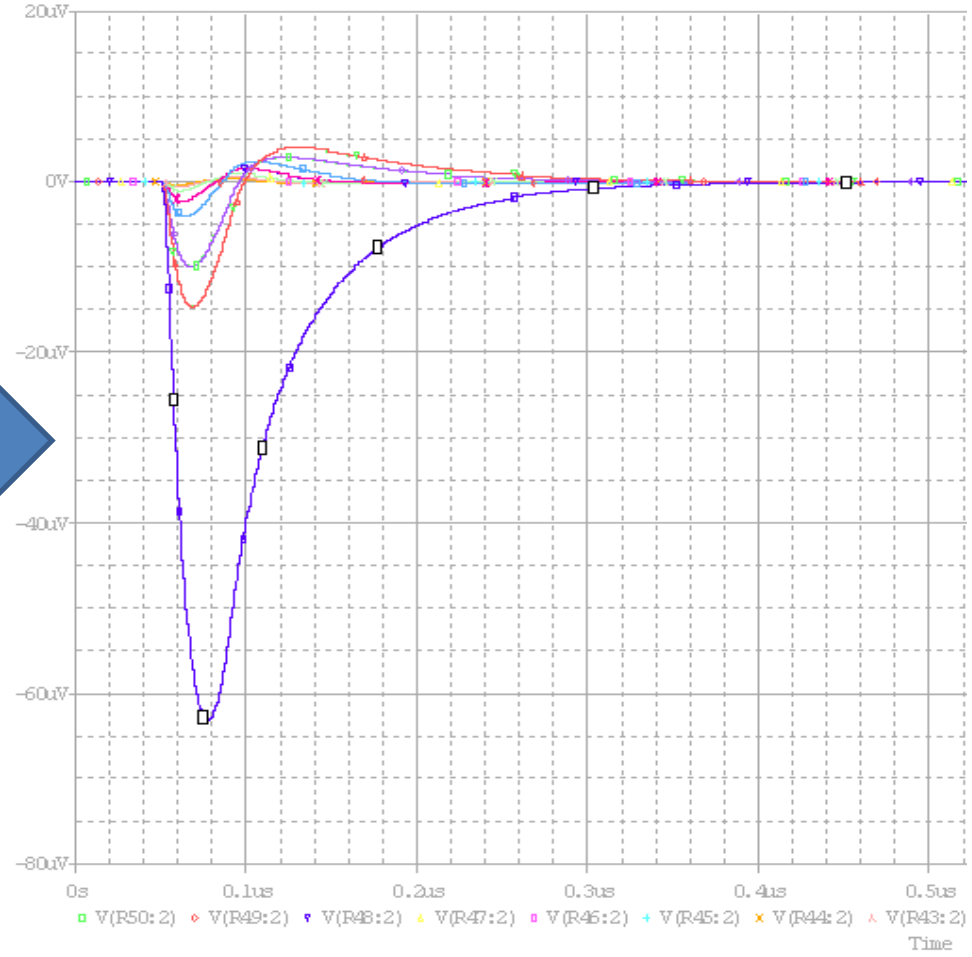


Schema Circuitale completo

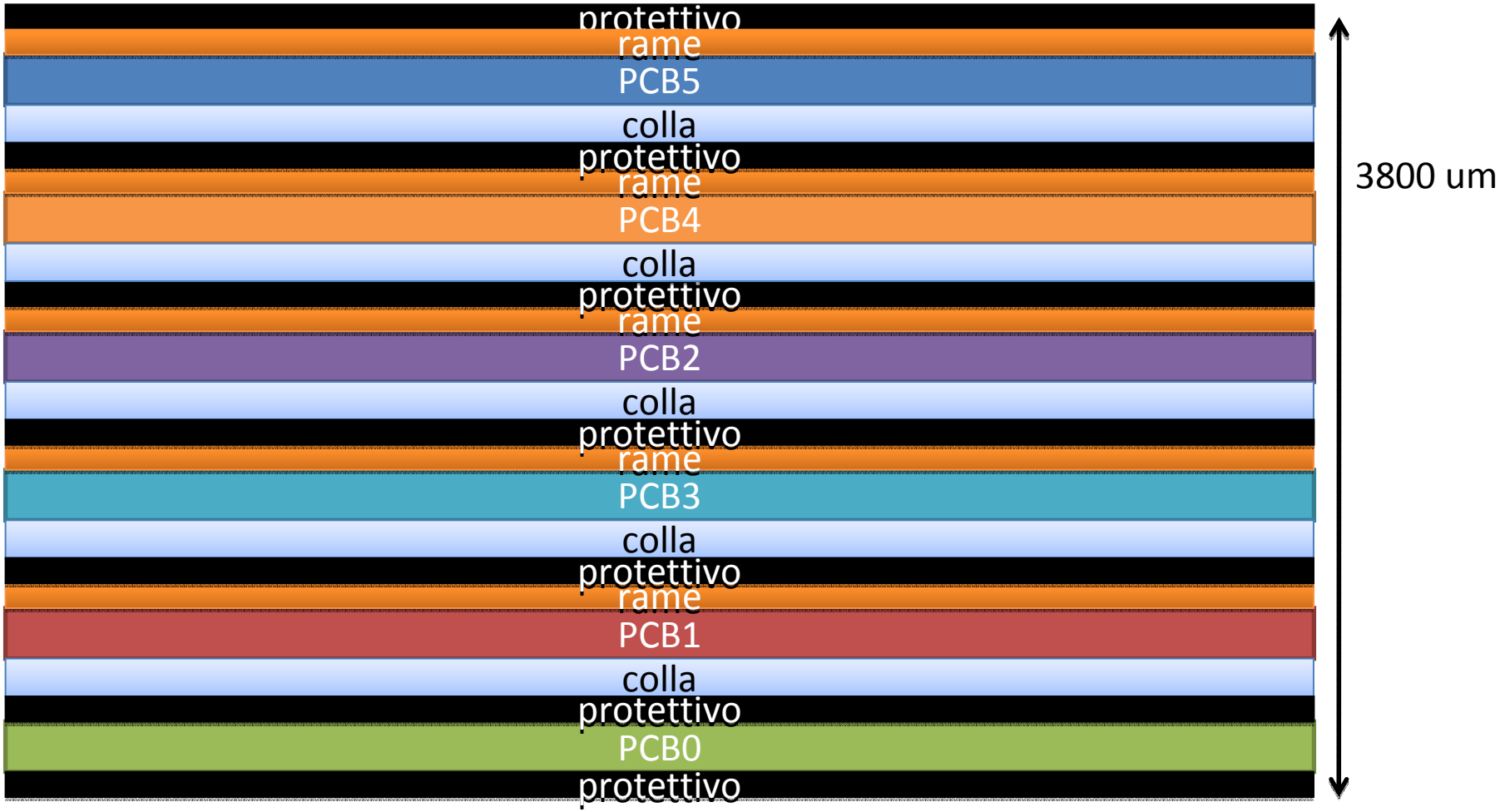


Risposta del rivelatore di 10 cm ad una MIP all'ingresso dell'APV25

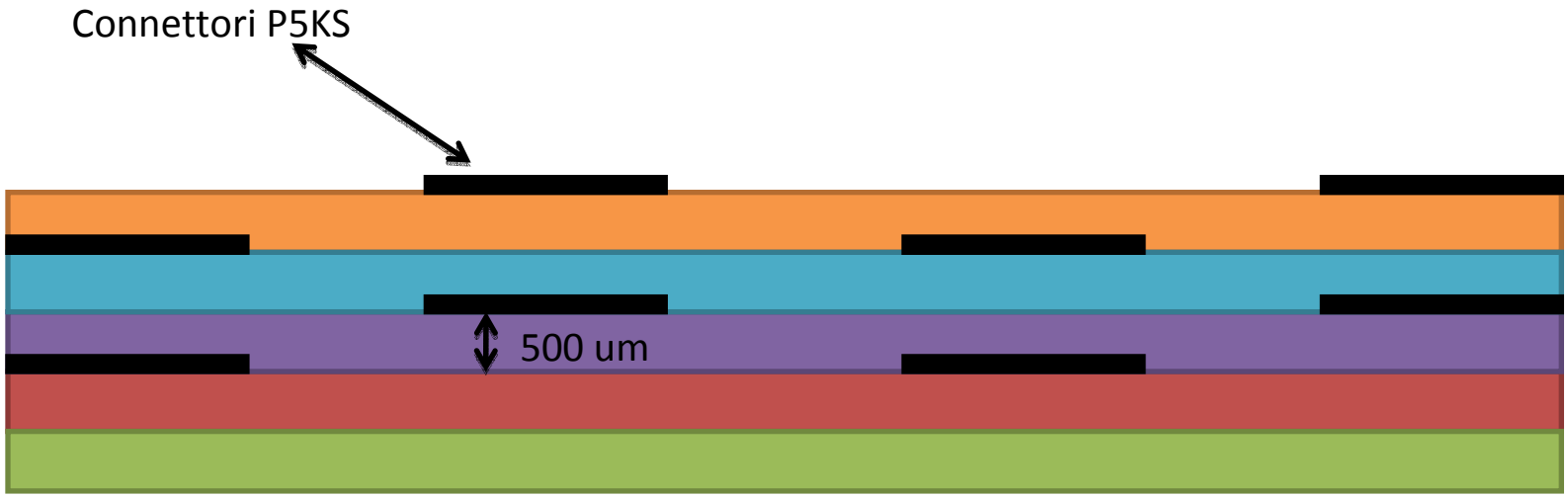




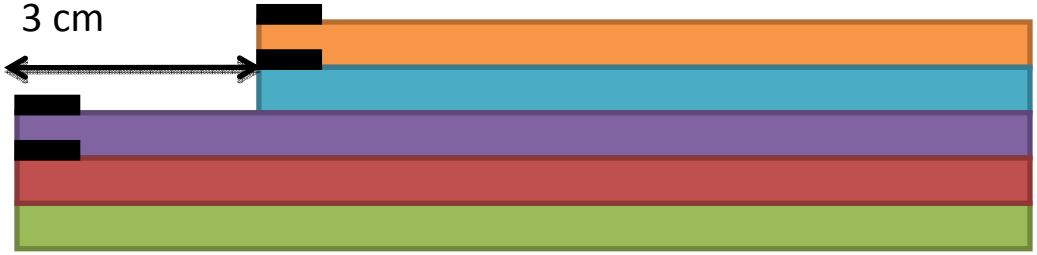
Stack-Up del PCB

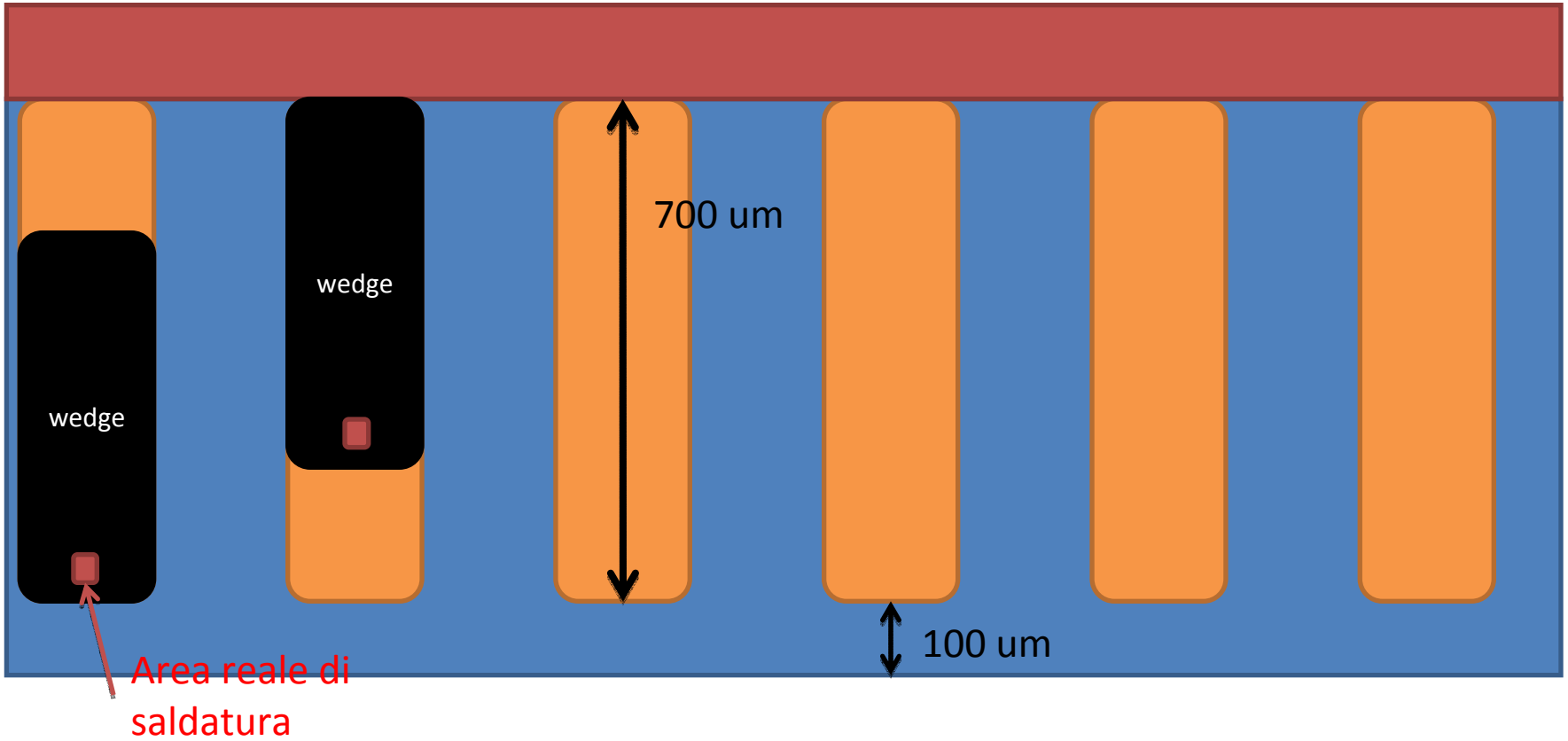


Vista frontale della zona con i connettori



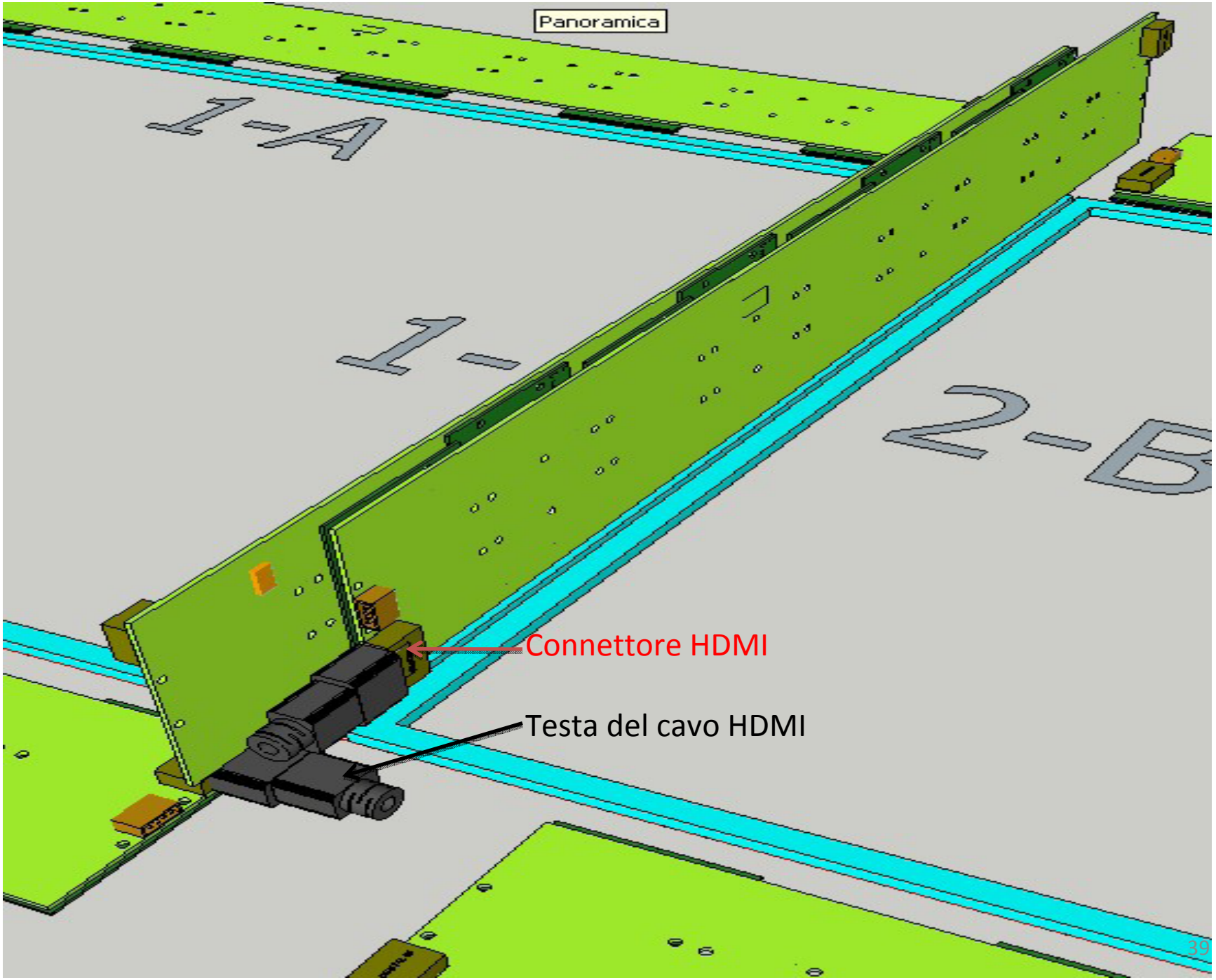
Vista in sezione della zona dei Connettori





(700+100)x4 + 800 = 4000 um = 4mm

Massimo disponibile dalla macchina con la Y motorizzata


Panoramica
1-A
1-1
2-B
Connettore HDMI
Testa del cavo HDMI

High-Definition Multimedia Interface HDMI

Nel progetto si utilizzerano cavi hdmi di due tipi:

Type A : trasporto segnali digitali dal VME al Front-End

5 segnali

Reset
Trigger
Clock
I2C (necessita di 2 linee)

Type B : trasporto segnali analogici dal Front-End al VME

8 segnali

Ogni canale trasporta il contenuto dei 128 canali serializzati di un APV25

Table 1: APV25 features and performance

FEATURE	VALUE/DESCRIPTION/COMMENT
front end	128 channels, low noise CR-RC amplifier, 50ns shaping time
analogue pipeline	40 MS/s, 192 cells deep. Allows up to 4 µs level 1 trigger latency, plus buffering for events awaiting readout
pipeline readout	*peak* or *deconvolution* operating modes *peak mode*: 1 sample/channel *deconvolution*: weighted sum of 3 samples gives single bunch crossing time resolution
output stage	128:1 analogue multiplexer, single differential current output
noise	peak mode: 270 + 38/pF deconvolution: 430 + 61/pF
I^2C slow control I/F	programmable bias registers, operating mode, trigger latency ….
LVDS fast control I/F	40 MHz clock and level 1 trigger
test pulse	on-chip test pulse generator with programmable amplitude and delay
rad-hard	> 100 kGray (10 Mrads)

Distanza dal piano di massa.
Dalla lunghezza delle piste.

Valori del CrossTalk Massimi (L = 20.9 cm)

PCB 4 (630 um dal piano di massa)

Crosstalk interstrip : 0.12%
Crosstalk con PCB 3 : 0.09%
Crosstalk con PCB 2 : 0.06%
Crosstalk con PCB 1 : 0.04%

Crosstalk Totale 0.31%

PCB 1 (2520 um dal piano di massa)

Crosstalk interstrip : 0.13%
Crosstalk con PCB 2 : 0.12%
Crosstalk con PCB 3 : 0.09%
Crosstalk con PCB 4 : 0.04%

Crosstalk Totale 0.38%

Crosstalk per i tratti senza piano di massa : 4.5%

Simulazione Strip di maggiore lunghezza : L = 20.9 cm in PCB 2
In questo caso è anche la strip con maggiore percorrenza sotto al piano di massa
Distanza dal piano di massa 1890 um.
14.2 cm di percorrenza sotto il piano di massa.

Embedded Microstrip Impedance Calculator:

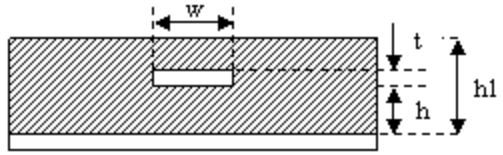
$$Z_0 = \frac{60}{\sqrt{\varepsilon_{rp}}} \ln\left(\frac{5.98h}{(0.8w+t)}\right) \qquad T_{pd} = 0.278\sqrt{\varepsilon_{rp}}$$

$$\varepsilon_{rp} = \varepsilon_r\left(1-\exp\left(-1.55\frac{h_1}{h}\right)\right)$$

Note: valid for (h1/h) greater than 1.2

Dimensional units: (•) mm ( ) mils

Valori per tratto sotto il piano di massa

w (trace width) =	0.1
t (trace thickness) =	0.02
h (trace dielectric thickness) =	1.89
h1 (overall dielectric thickness) =	3.78
er (relative dielectric constant) =	4.5
	Calculate
Zo (Impedance, Ohms) =	136.834
Propagation Dealy, Tpd (ps/cm) =	57.629
Inductance, L (nH/cm) =	7.886
Capacitance, C (pF/cm) =	0.42116

Note: 1oz = 1.4mils = 0.03556mm

Embedded Microstrip Impedance Calculator:

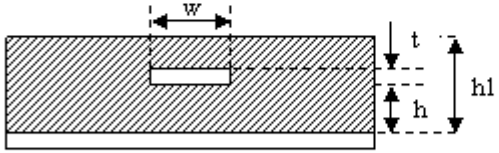
$$Z_0 = \frac{60}{\sqrt{\varepsilon_{rp}}} \ln\left(\frac{5.98h}{(0.8w+t)}\right) \qquad T_{pd} = 0.278\sqrt{\varepsilon_{rp}}$$

$$\varepsilon_{rp} = \varepsilon_r\left(1-\exp\left(-1.55\frac{h_1}{h}\right)\right)$$

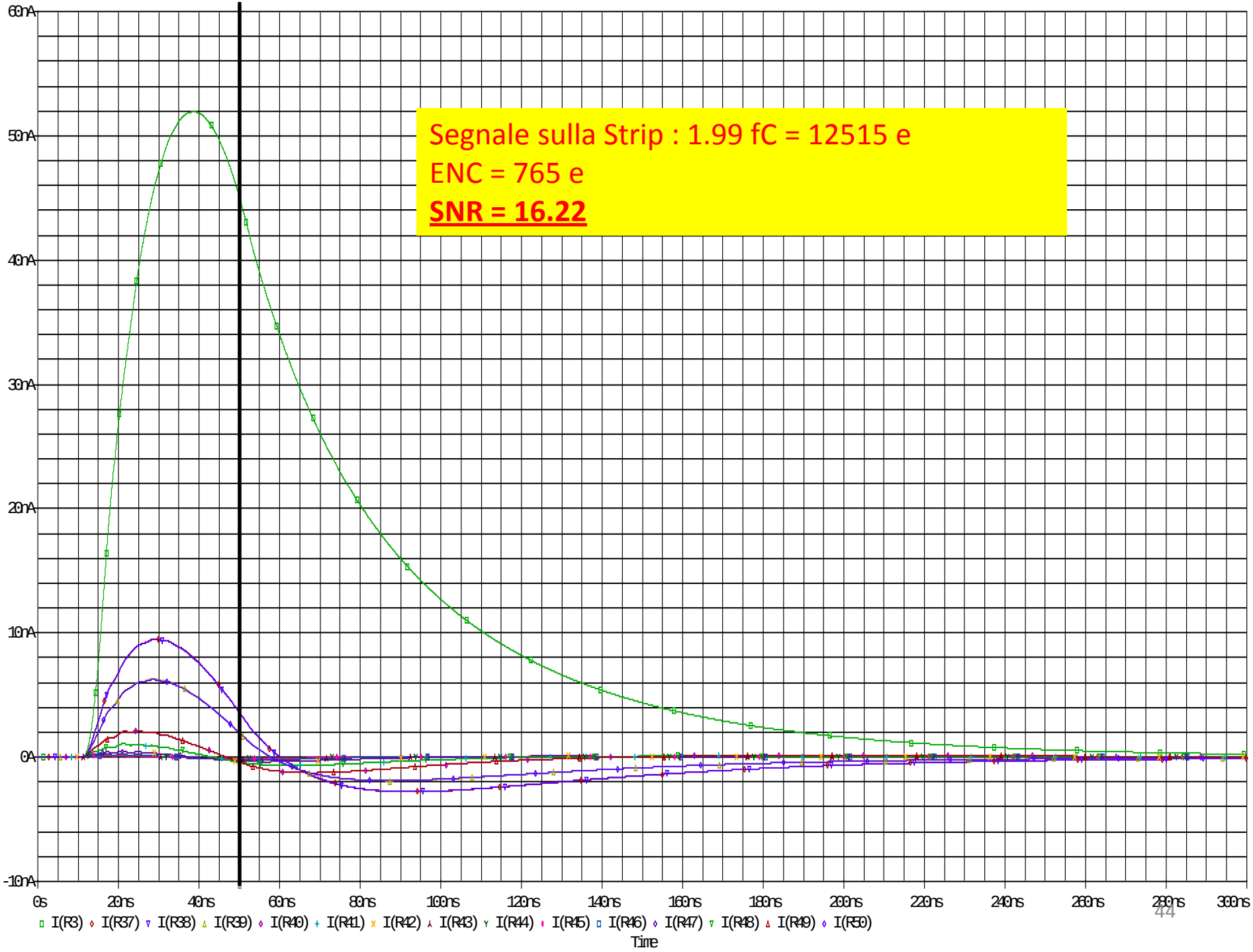
Note: valid for (h1/h) greater than 1.2

Dimensional units: (•) mm ( ) mils

Valori per tratto senza il piano di massa

w (trace width) =	0.1
t (trace thickness) =	0.02
h (trace dielectric thickness) =	1000000
h1 (overall dielectric thickness) =	1000030
er (relative dielectric constant) =	4.5
	Calculate
Zo (Impedance, Ohms) =	570.635
Propagation Dealy, Tpd (ps/cm) =	52.342
Inductance, L (nH/cm) =	29.868
Capacitance, C (pF/cm) =	0.09173

Note: 1oz = 1.4mils = 0.03556mm


Segnale sulla Strip : 1.99 fC = 12515 e
ENC = 765 e
SNR = 16.22
60nA
50nA
40nA
30nA
20nA
10nA
0A
-10nA
0s
20ns
40ns
60ns
80ns
100ns
120ns
140ns
160ns
180ns
200ns
220ns
240ns
260ns
280ns
300ns
I(R3) I(R37) I(R38) I(R39) I(R40) I(R41) I(R42) I(R43) I(R44) I(R45) I(R46) I(R47) I(R48) I(R49) I(R50)
Time

Simulazione Strip in PCB4 di lunghezza : L = 16 cm.
Distanza minore dal piano di massa (PCB 4) 630 um.
11.2 cm di percorrenza sotto il piano di massa.

Embedded Microstrip Impedance Calculator:

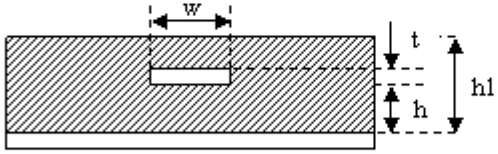
$$Z_0 = \frac{60}{\sqrt{\varepsilon_{re}}} \ln\left(\frac{5.98h}{(0.8w+t)}\right) \qquad T_{pd} = 0.278\sqrt{\varepsilon_{re}}$$

$$\varepsilon_{re} = \varepsilon_r\left(1-\exp\left(-1.55\frac{h_1}{h}\right)\right)$$

Valori per tratto sotto il piano di massa

Note: valid for (h1/h) greater than 1.2

Dimensional units: (•) mm ( ) mils

w (trace width) =	0.1
t (trace thickness) =	0.02
h (trace dielectric thickness) =	0.63
h1 (overall dielectric thickness) =	3.78
er (relative dielectric constant) =	4.5
	Calculate
Zo (Impedance, Ohms) =	102.647
Propagation Dealy, Tpd (ps/cm) =	58.970
Inductance, L (nH/cm) =	6.053
Capacitance, C (pF/cm) =	0.57449

Note: 1oz = 1.4mils = 0.03556mm

Embedded Microstrip Impedance Calculator:

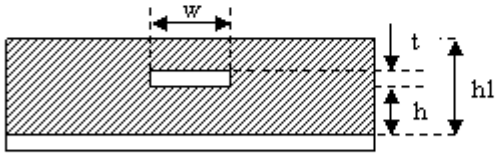
$$Z_0 = \frac{60}{\sqrt{\varepsilon_{re}}} \ln\left(\frac{5.98h}{(0.8w+t)}\right) \qquad T_{pd} = 0.278\sqrt{\varepsilon_{re}}$$

$$\varepsilon_{re} = \varepsilon_r\left(1-\exp\left(-1.55\frac{h_1}{h}\right)\right)$$

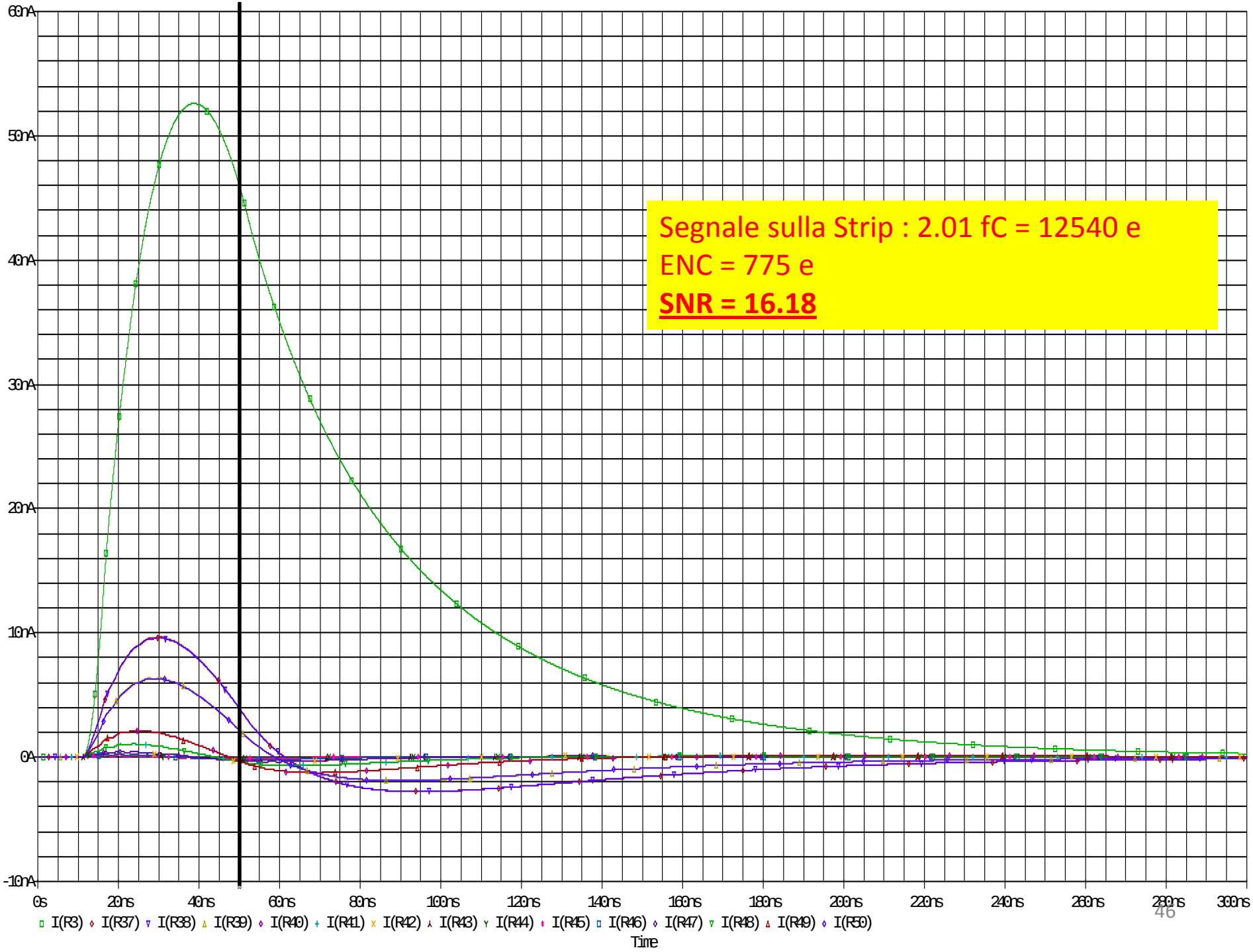
Valori per tratto senza il piano di massa

Note: valid for (h1/h) greater than 1.2

Dimensional units: (•) mm ( ) mils

w (trace width) =	0.1
t (trace thickness) =	0.02
h (trace dielectric thickness) =	1000000
h1 (overall dielectric thickness) =	1000030
er (relative dielectric constant) =	4.5
	Calculate
Zo (Impedance, Ohms) =	570.635
Propagation Dealy, Tpd (ps/cm) =	52.342
Inductance, L (nH/cm) =	29.868
Capacitance, C (pF/cm) =	0.09173

Note: 1oz = 1.4mils = 0.03556mm


60nA
50nA
40nA
30nA
20nA
10nA
0A
-10nA
0s
20ns
40ns
60ns
80ns
100ns
120ns
140ns
160ns
180ns
200ns
220ns
240ns
260ns
280ns
300ns
I(R3) I(R37) I(R38) I(R39) I(R40) I(R41) I(R42) I(R43) I(R44) I(R45) I(R46) I(R47) I(R48) I(R49) I(R50)
Time
Segnale sulla Strip : 2.01 fC = 12540 e
ENC = 775 e
SNR = 16.18