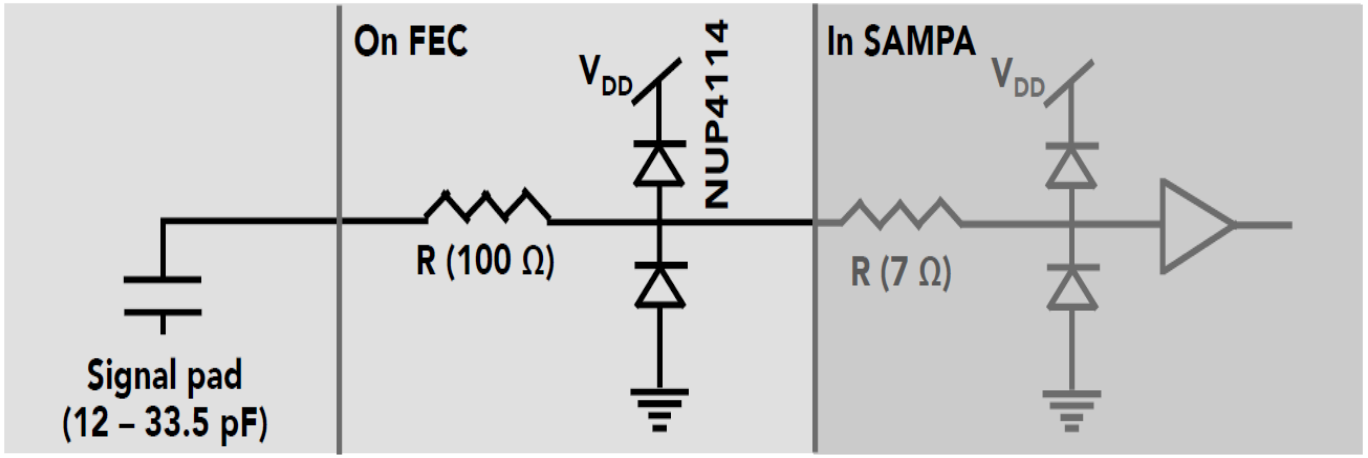
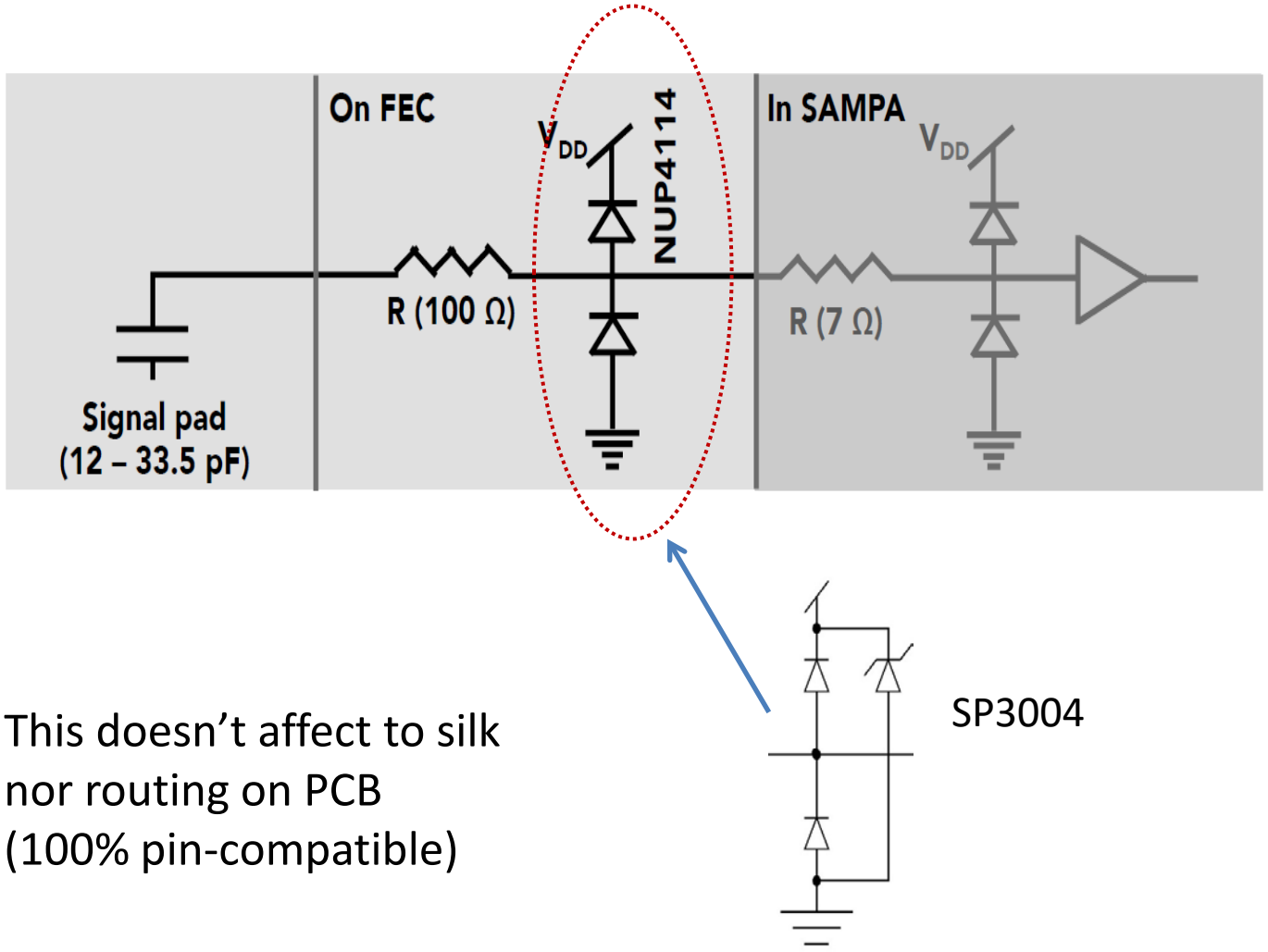
Input protection circuit catalogue

Takao

Protection circuit as of now



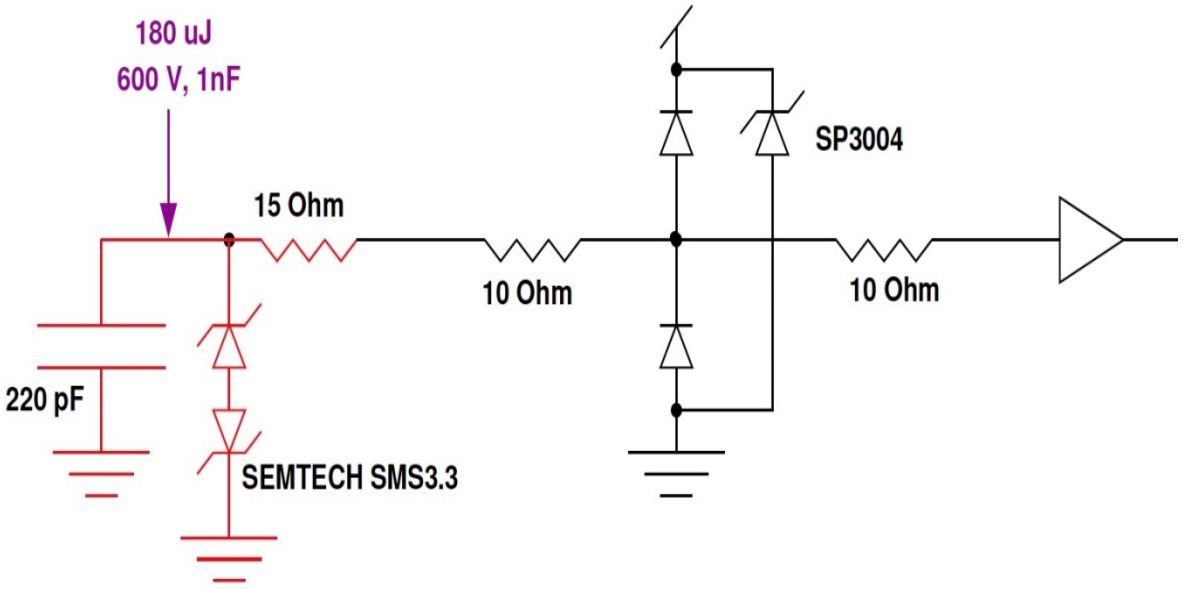
(1) Minimally this is necessary



This doesn't affect to silk nor routing on PCB (100% pin-compatible)

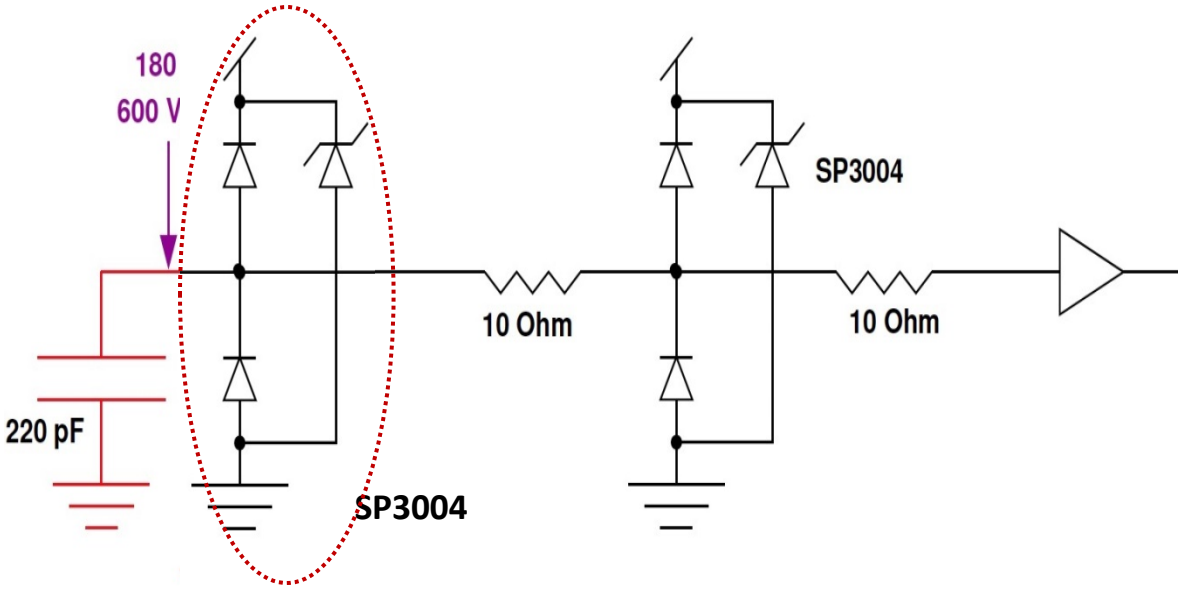
(2) Follow ATLAS as it is

- The first resistor will take most energy of the spark and likely to break, but if a Zener is placed, significant energy will be drained by Zener, and the probability of breakage is much reduced
- 15 ohm in front of 10 ohm doesn't change situation much
- Line capacitance increases by 5pF



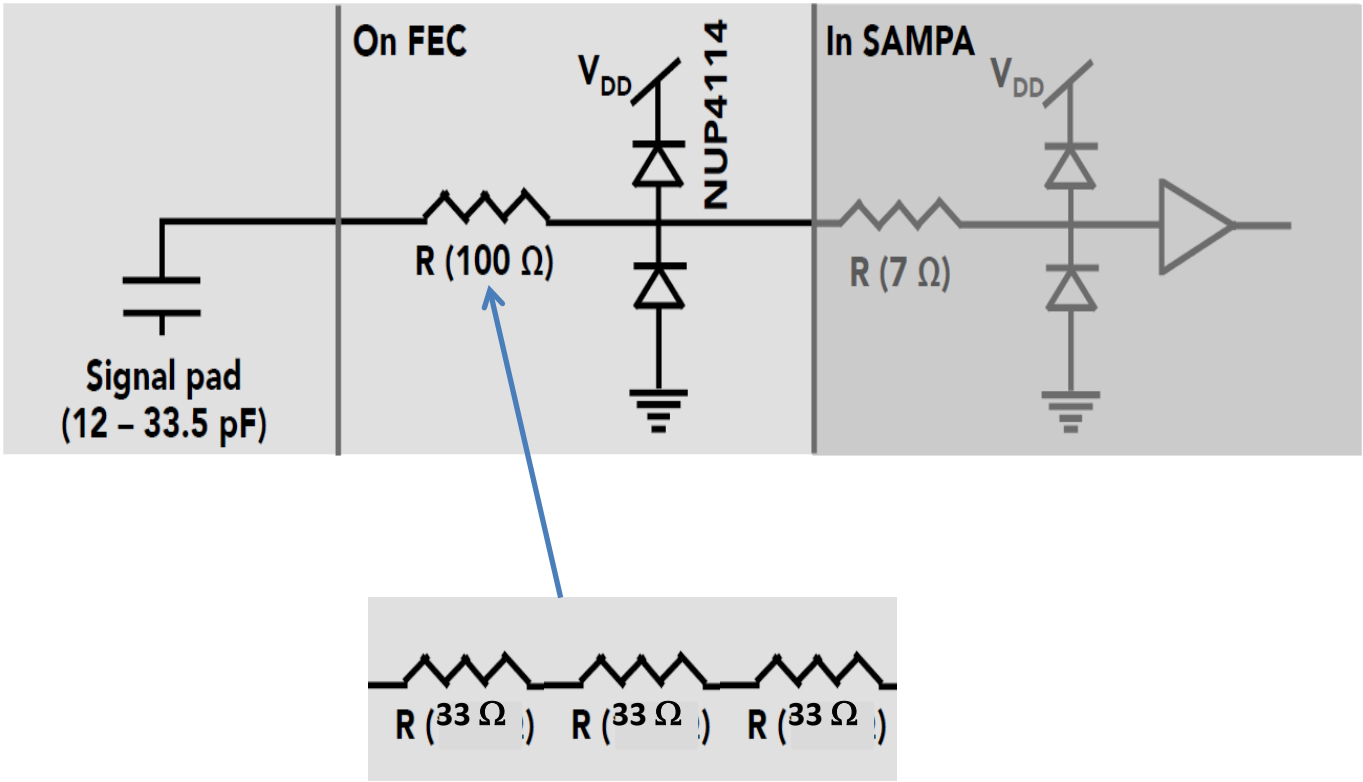
(3) Modified ATLAS scheme

- Vinnie and TS discussed about a modified version of ATLAS scheme.
- Placing additional SP3004 may help. Not as persistent as Zener, though. Assembly cost will be cheaper even compared to Zener option. (one SP3004 has 4 diode pairs)
- Line capacitance increases only by 0.5pF!



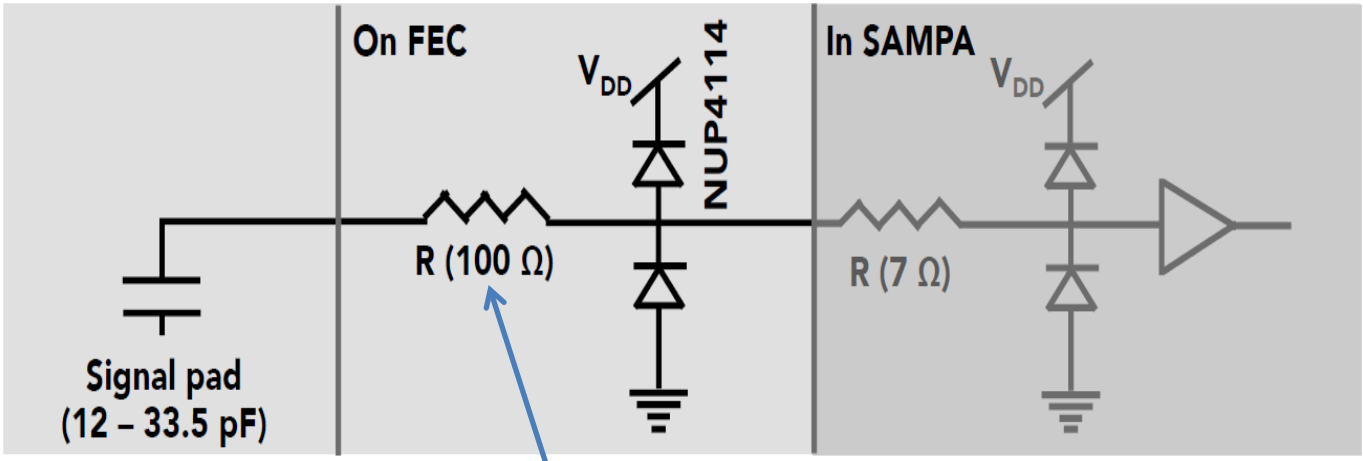
(4) Tom's idea

- Endurance to HV should depend on the distance between pads of a resistor. Therefore, instead of using single 100 Ω, three 33 Ω should gain more distance and thus be stronger
- No Zener → No additional line capacitance.
- Assembly cost is very high



(5) Try 0402 resistors if at all possible

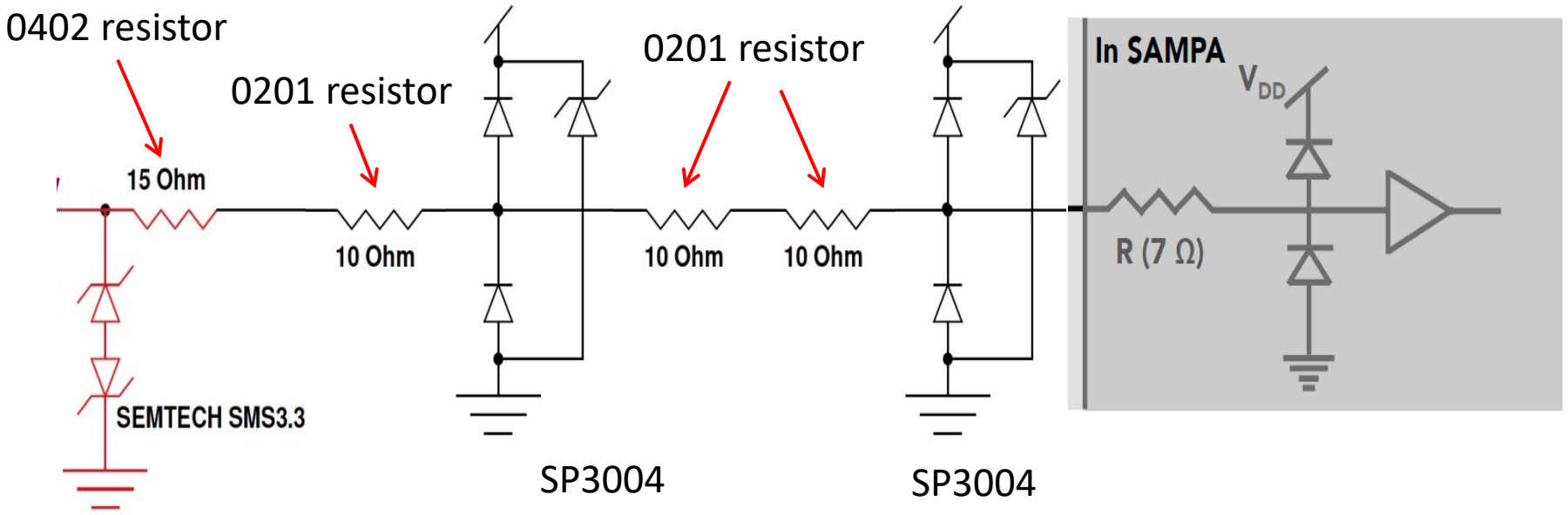
- We have never checked if 0402 resistor fits to the board
- Four candidates by now.
- 0603 size of three of them are found to pass ALICE's test.
- We should at least try some.



Name	Type	Power rating
MultiComp MCHVR02	Thick film	0.063 W
ROHM ESR01	Thick film	0.2 W
Vishay MCS0402AT	Thin film	0.1W
Vishay RCS0402 e3	Thick film	0.2W

Proposed PCB circuit for all

- Any other idea on option?
- If not, I propose to populate following circuit over channels, and mount differently channel-by-channel
- If 0402 turned out not working, it would be put off.



Backup

Resistor test summary

Name	Type	Size	Power rating	Resistance (Ω) after 1 spark	Resistance (Ω) after 11 sparks	Resistance (Ω) after 201 sparks
Default resistor (Yageo)	Thick film SMD	0603		100	102	✗
YAGEO RT0603FRE07100RL	Thin film SMD	0603	0.1 W	107	200	✗
Vishay MCT0603MD1000DP500 (automotive qualified)	Thin film SMD	0603	0.15 W	101	102	105
TE Connectivity RP73PF1J100RBTDF	Thin film SMD	0603	0.166 W	100	103	✗
Vishay PCAN0603E1000BST3	Thin film SMD	0603	0.5 W	✗		
ROHM ESR03EZPJ101 (anti-surge, discharge resistant)	Thick film SMD	0603	0.25W	100	100	102
ROHM KTR03EZPF1000 (high voltage, automotive)	Thick film SMD	0603	0.1 W	100	100	101
ROHM SFR03EZPF1000	Thick film SMD	0603	0.063 W	100	150	500
BOURNS CRS0603AFX-1000ELF (pulse withstanding)	Thick film SMD	0603	0.125 W	100	100	100
MULTICOMP MCHVR03JTEX1000 (high voltage rated)	Thick film SMD	0603	0.1 W	100	100	103
VISHAY MCT06030C1000FP500 (automotive)	Thick film SMD	0603	0.125 W	100	101	✗
VISHAY CMA02040X6809GB300 (automotive, high pulse load)	Carbon film MiniMELF	1.4 x 3.6 mm2	0.4 W	100	100	100