ALCOR and the Hamamatsu UVE SiPM sensors

Fabio Cossio

ALCOR day - 25.02.2025

ALCOR with HPK UVE SiPMs

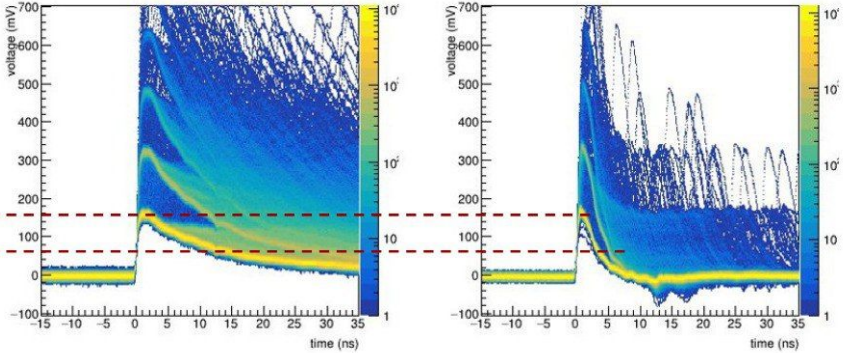
S13360-3050UVE - S14160-3075UVE

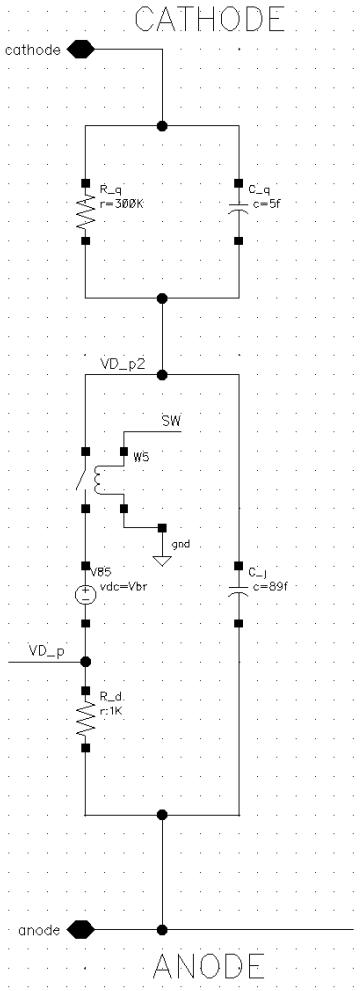
- improved NUV sensitivity, improved signal shape and recharge time

	Symbol	S13360-3050UVE	S14160-3075UVE	Unit	**S13360-3050VS**
Number of pixels / channel	*N*	3584	1600	-	3584
Junction capacitance	*Cd*	85	215	fF	89
Quenching capacitance	*Cq*	17	25	fF	5
Parasitic capacitance	*Cg*	19	19	pF	49
Quenching resistance	*Rq*	300	270	kΩ	300
Diode resistance	*Rd*	1000	1000	Ω	1000
Breakdown voltage	*Vbd*	53	53	V	53

same amplitude

> 5x faster recharge





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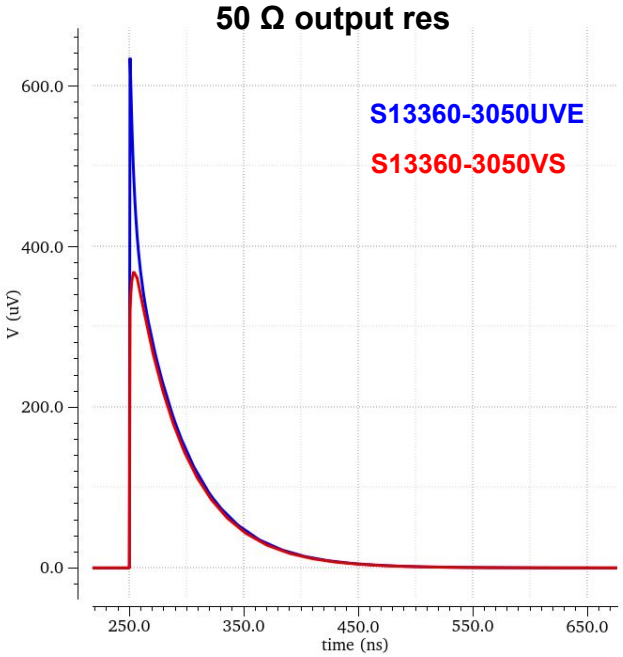

- $Q = (C_d + C_q) \cdot OV = 306\ fC \rightarrow G = 1.9 \cdot 10^6$
- $C_{tot} = N \cdot (C_d + C_q) + C_g = 385\ pF$
- Same R_q, R_d

larger Gain

smaller C_g, larger C_q and C_d

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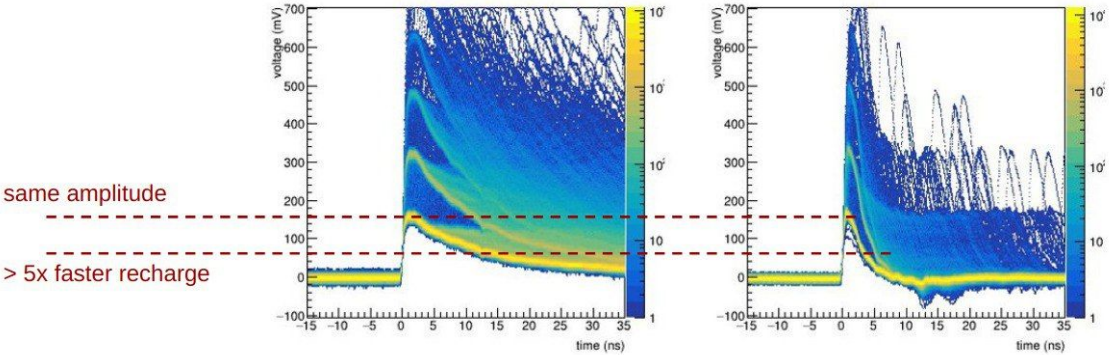
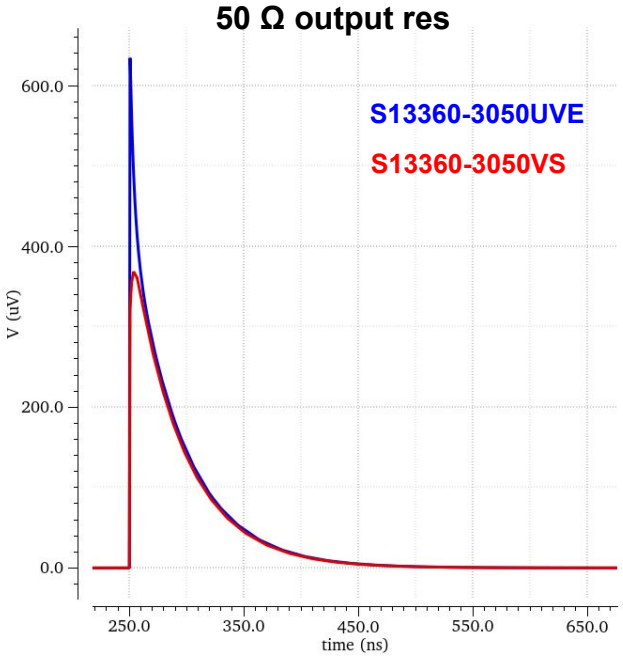




ALCOR with HPK UVE SiPMs

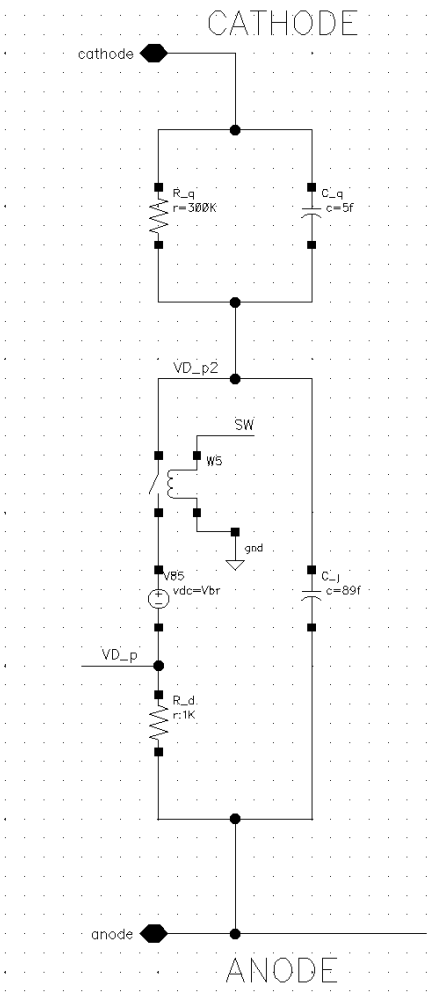
Avalanche begins → switch is closed, C_d discharges through R_d with time constant

- $\tau_{rise} = R_d \cdot (C_d + C_q)$

Avalanche quenched → switch is opened, V_{bias} recharges C_d with an exponential process with two time constants

1. Fast supply path across C_d and the capacitive coupling through Cq, fast time constant
   - $\tau_{fast} = R_L \cdot C_{tot} = 20\ \Omega \cdot 385\ pF = 7.7\ ns$
   - $C_{tot} = C_g + N \cdot (C_d + C_q)$
   - R_L = input impedance of the FE electronics
2. Slow component due to the exponentially decreasing recharge current flowing through R_q (SiPM recovery time constant), dominates the tail of the response
   - $\tau_{slow} = R_q \cdot (C_d + C_q) = 300\ k\Omega \cdot 102\ fF = 30.6\ ns$

How is the faster recharge done? Something wrong in SiPMs models?



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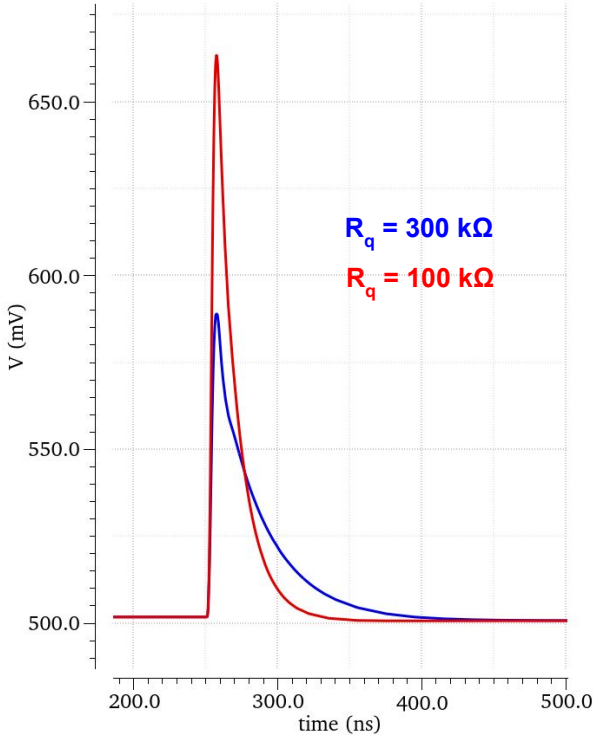

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