

SPAD Detector Package for Space Born Applications

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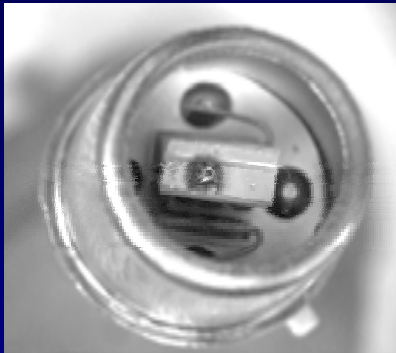
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Goals:

- To develop the photon counting detector package tailored for space applications
- requirements
 - ◆ solid state
 - ◆ low mass and low power
 - ◆ picosecond resolution & stability
 - ◆ CW operation (not gated)

Philosophy

- use the SPAD chips available operated in active quenching mode
- reduce the after-pulsing effects by shortening the circuit loop delay
- => develop a new quenching circuit with the loop delay $\ll 20$ nsec



100um K14 SPAD TE1 cooling

CW SPAD circuit

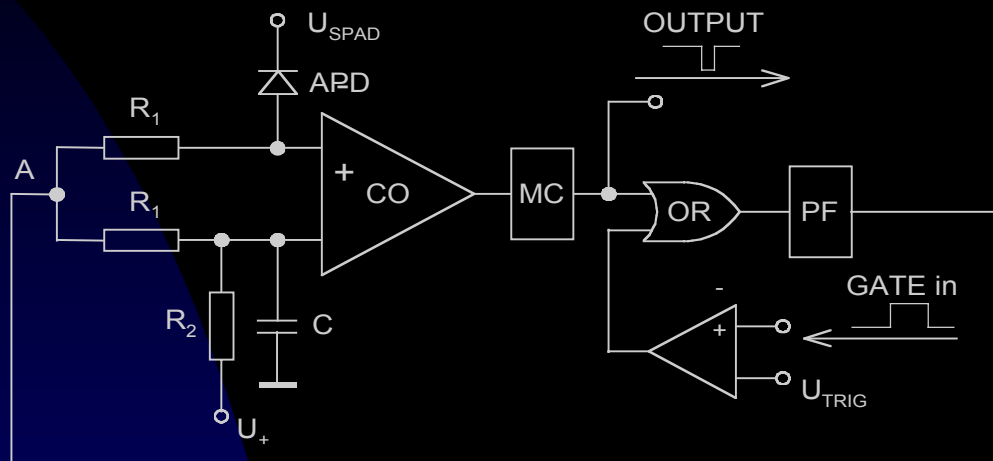
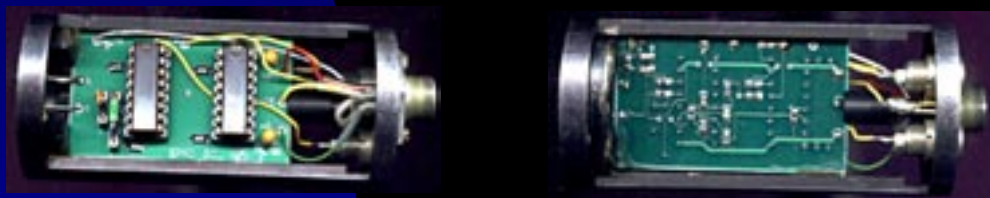


Figure 1: Active quenching circuit for the laser transponder

CO comparator
PF pulse forming
MC monostable
OR gate

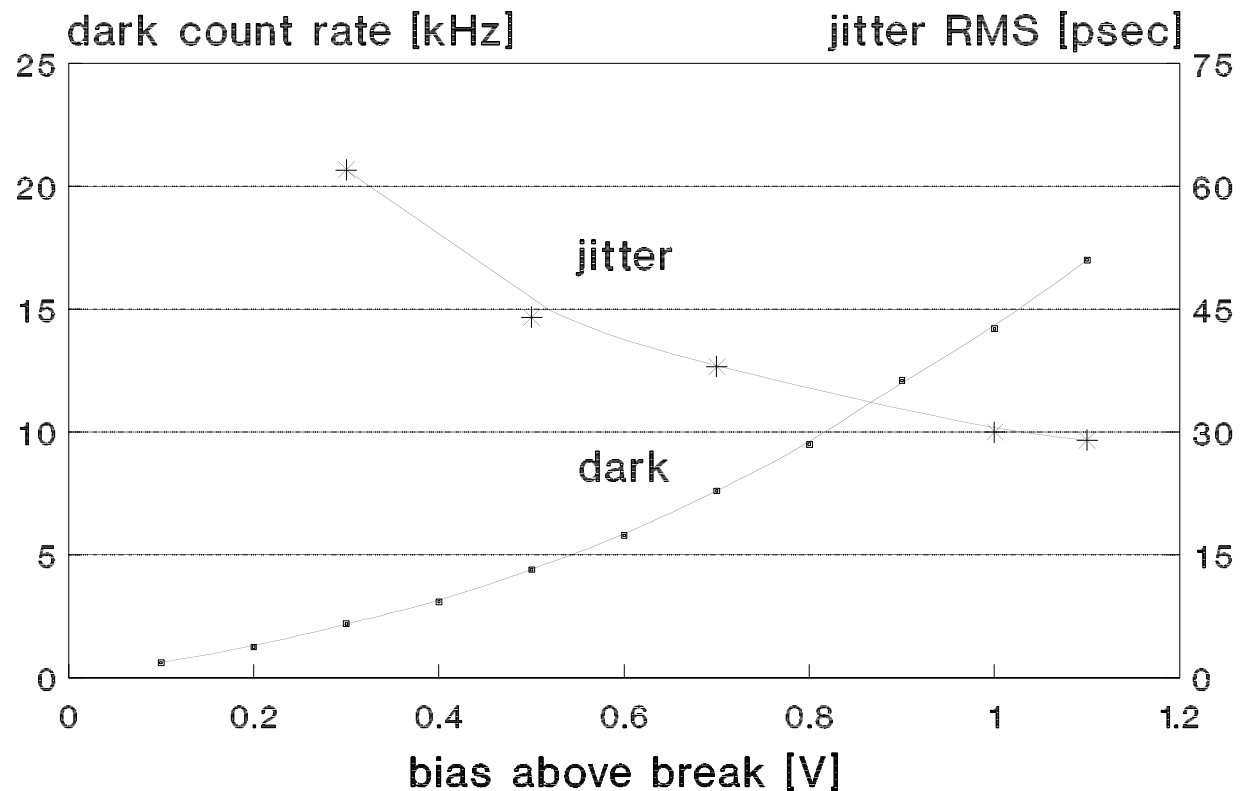
PROTOTYPE BOARD



ECL 100 k logic
32x40 mm, SMD
loop delay 2.6ns
 $V_{ab} < 1.2$ Volt

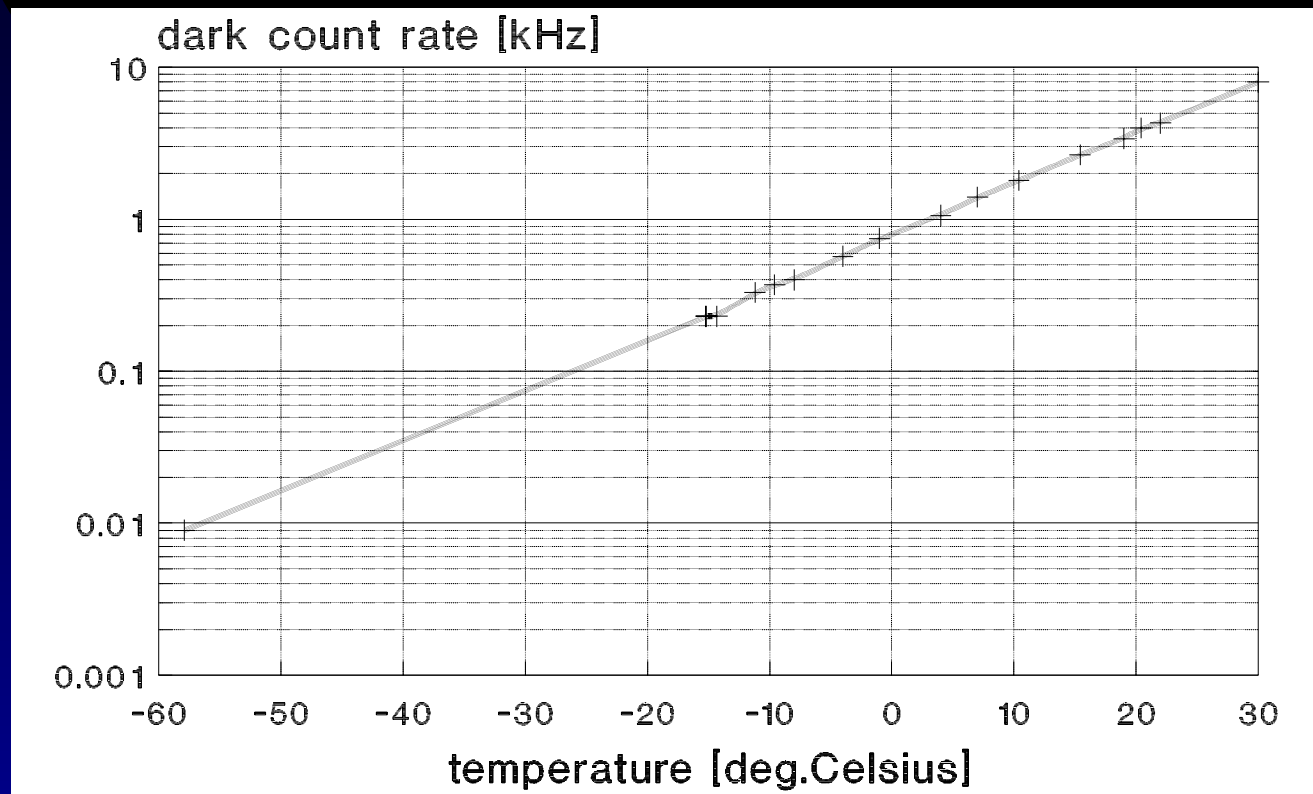
CW SPAD operation

Dark count and timing resolution versus bias
Active area diameter 40 μm , +25 C



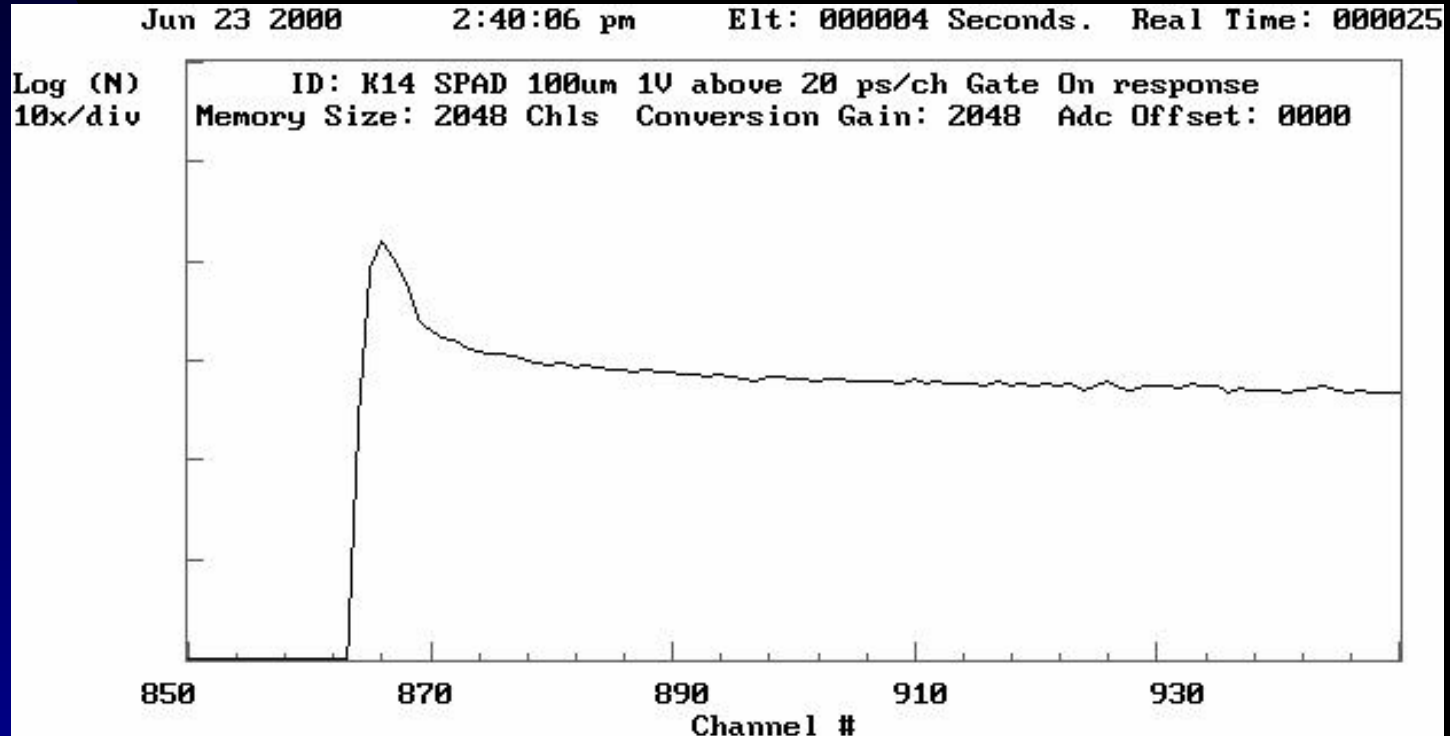
CW SPAD operation

Dark count rate versus temperature
Active area diameter 40 μm



CW SPAD optional gating

Gate ON time response, 100 um chip, 1 V above
risetime < 80 psec, risetime+overshoot < 140 psec



20 psec/channel, 2 nsec / screen

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Conclusion

- The active quenching and gating circuit for the CW operation of Si SPAD 40 μm has been designed and tested
- the SPAD dark count rate is 10 Hz to 10kHz within the temperature range -60 to +25 C
- the timing resolution is 30 psec RMS
- suitable for space : radiation resistant
Mass < 30 grams, Power < 400 mW

