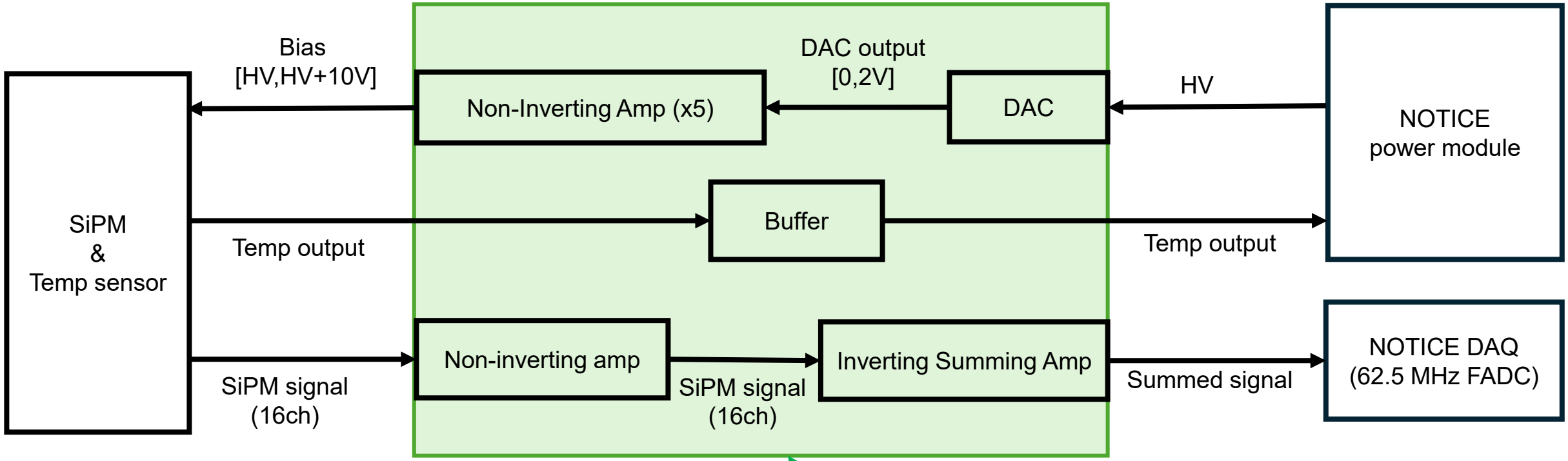
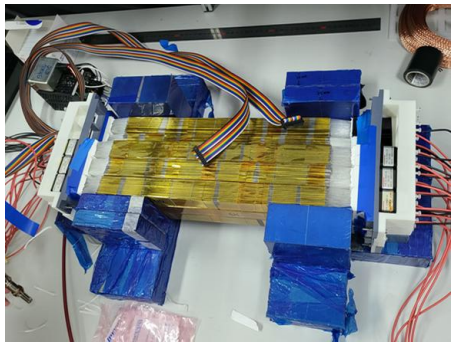
Trapezoidal SiPM Board Design

Jun Hyung Park, Shin Hyung Kim

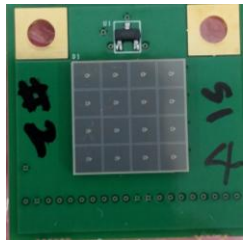
Department of Physics, Kyungpook National University

Previous Setup

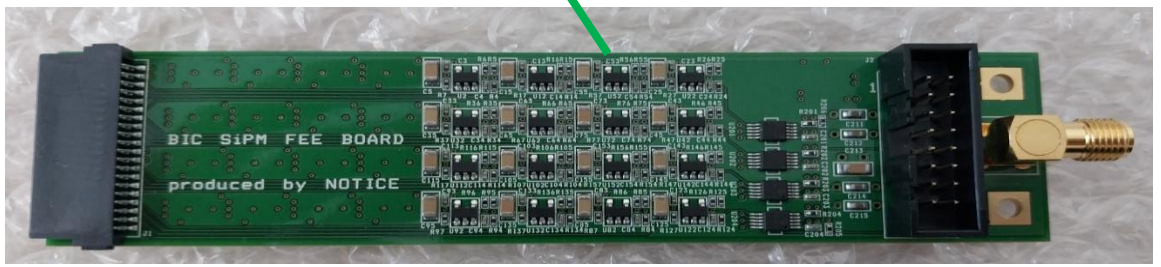




3 cm x 3 cm x 32 cm
prototype module



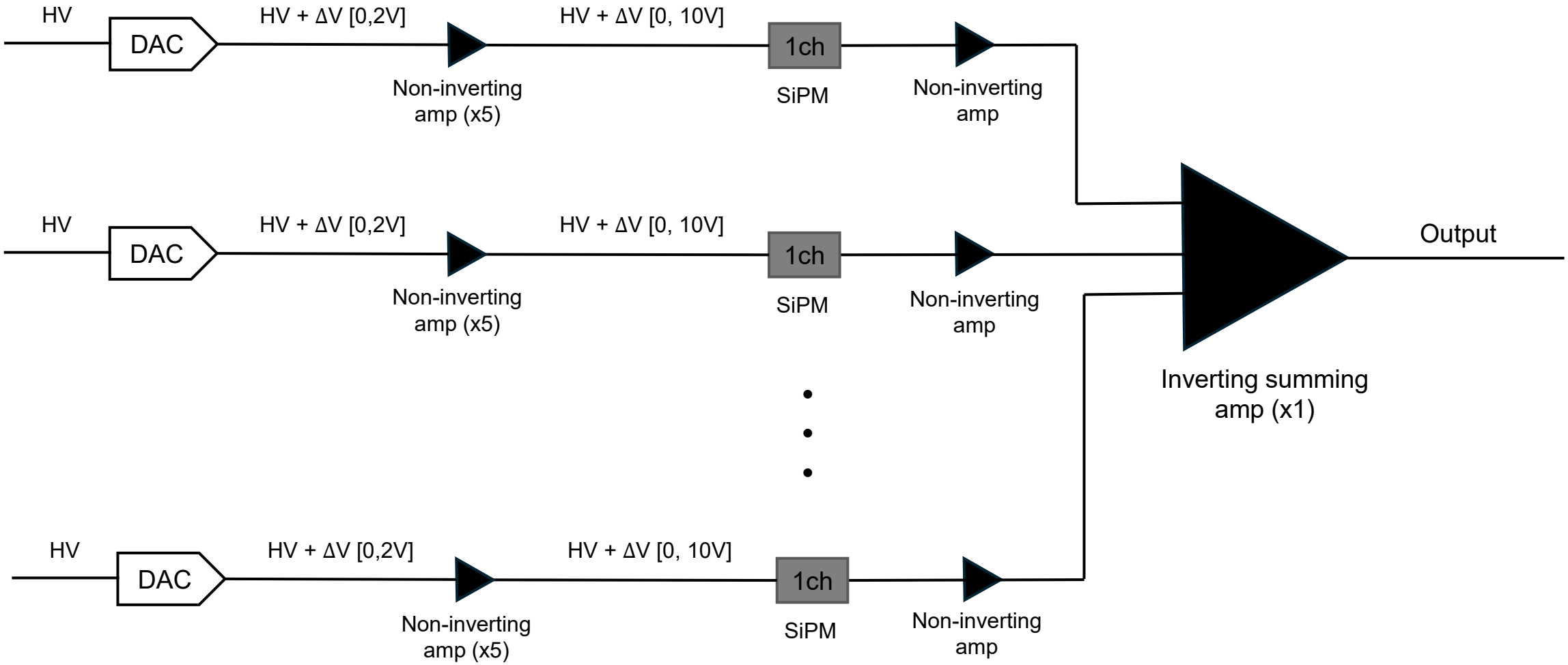
SiPM



FEE board

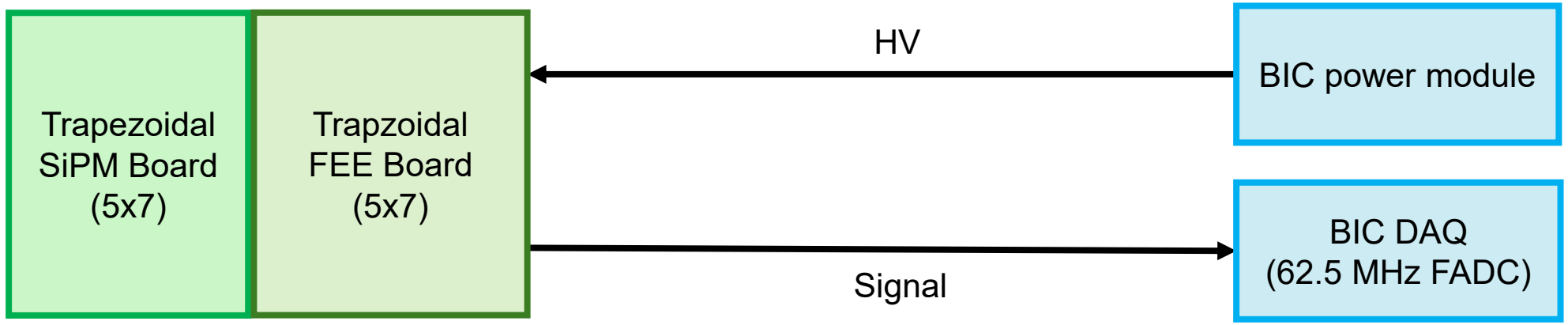
NOTICE DAQ & power module

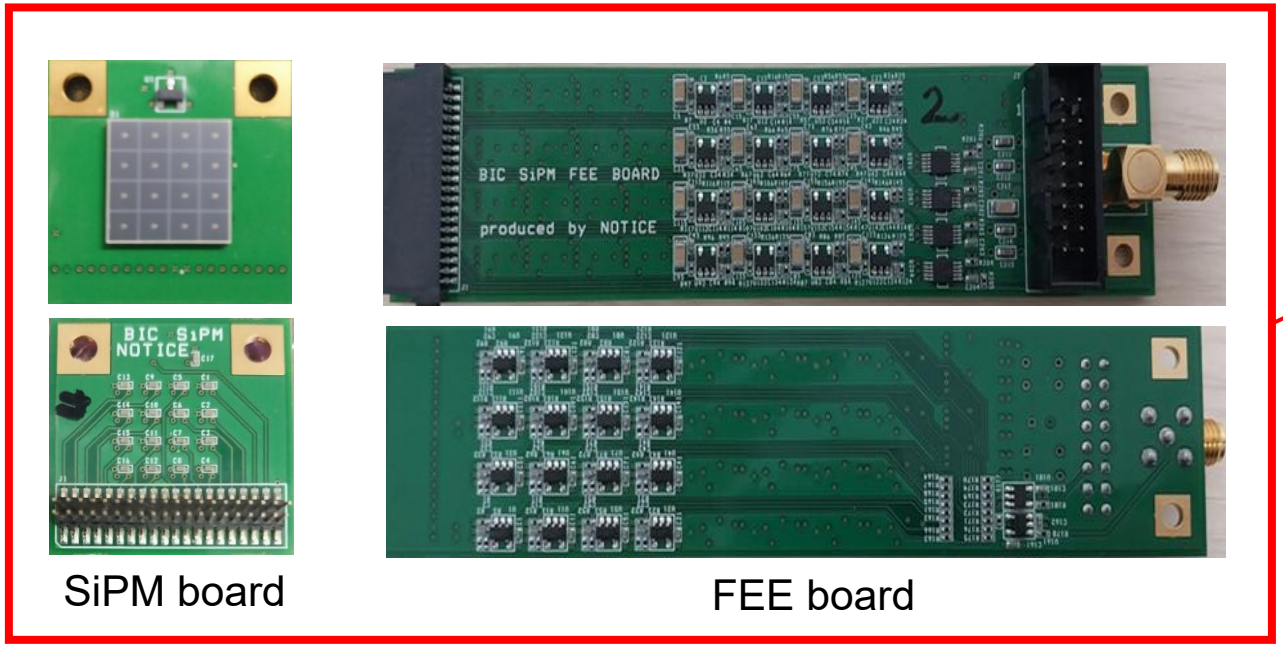
FEE board circuit

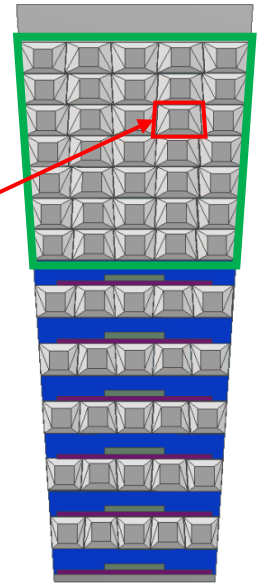


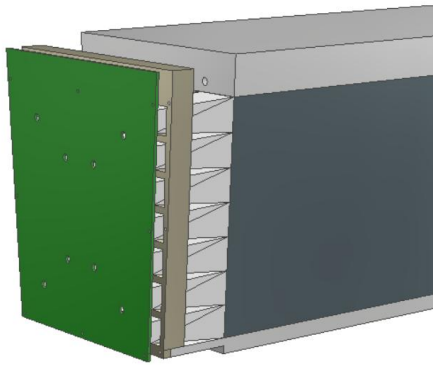
Unlike the H2GCROC circuit, each SiPM channel includes a preamplifier

Trapezoidal SiPM Board





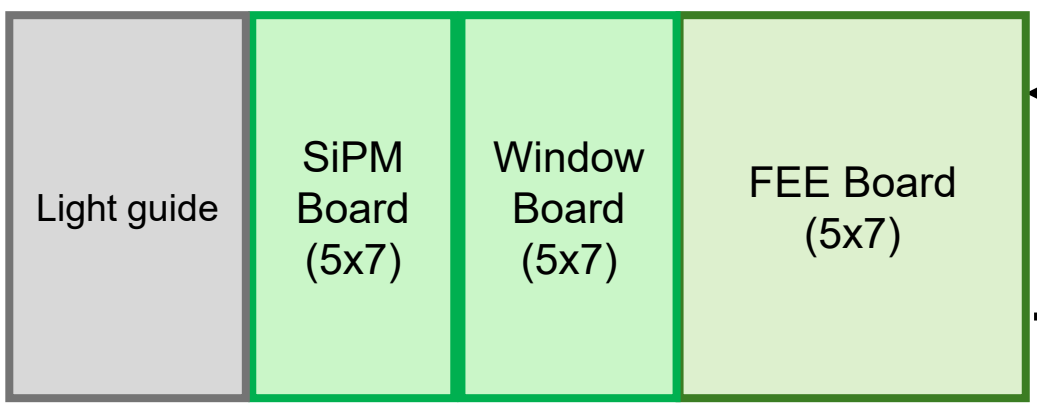


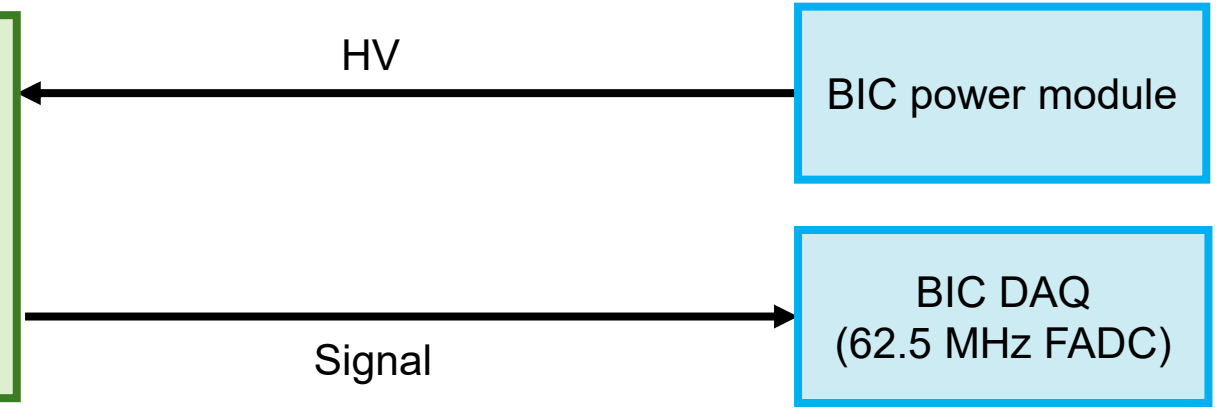


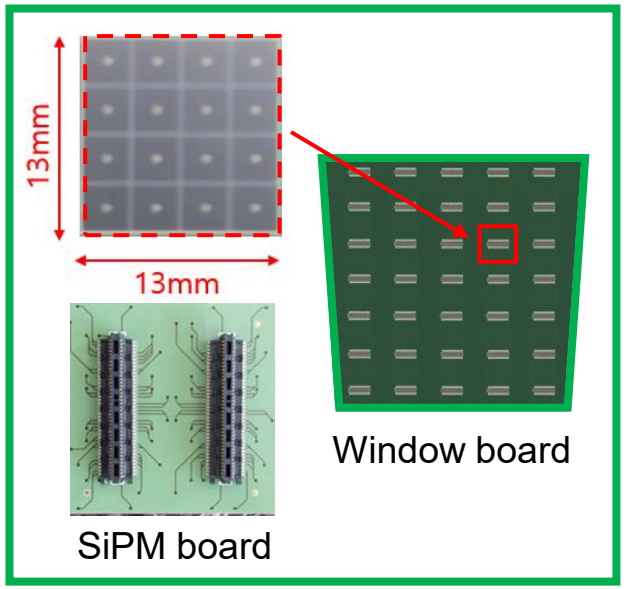
Placement example

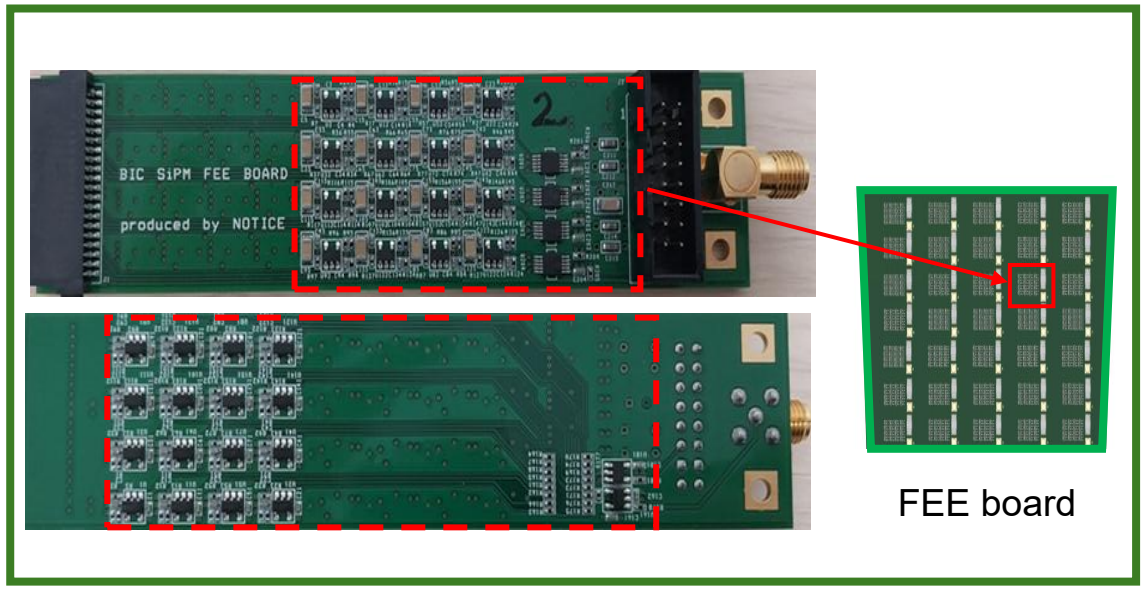
Design of a 5×7 SiPM board for bulk with NOTICE DAQ & power module

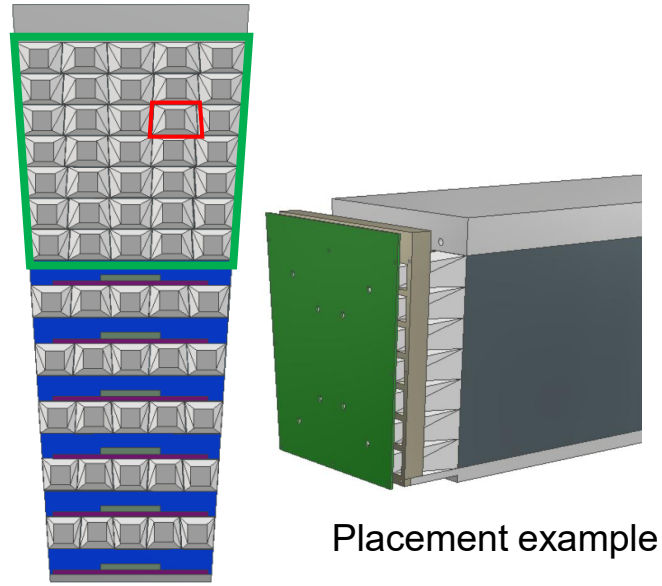
Trapezoidal SiPM Board





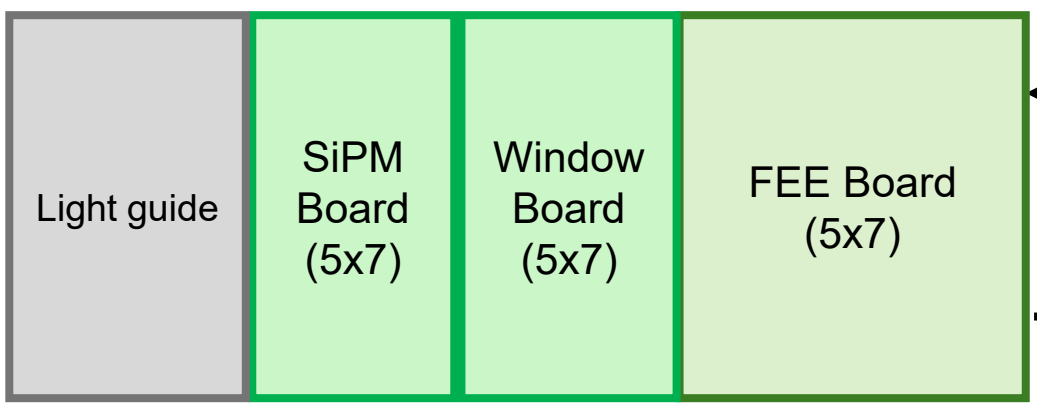


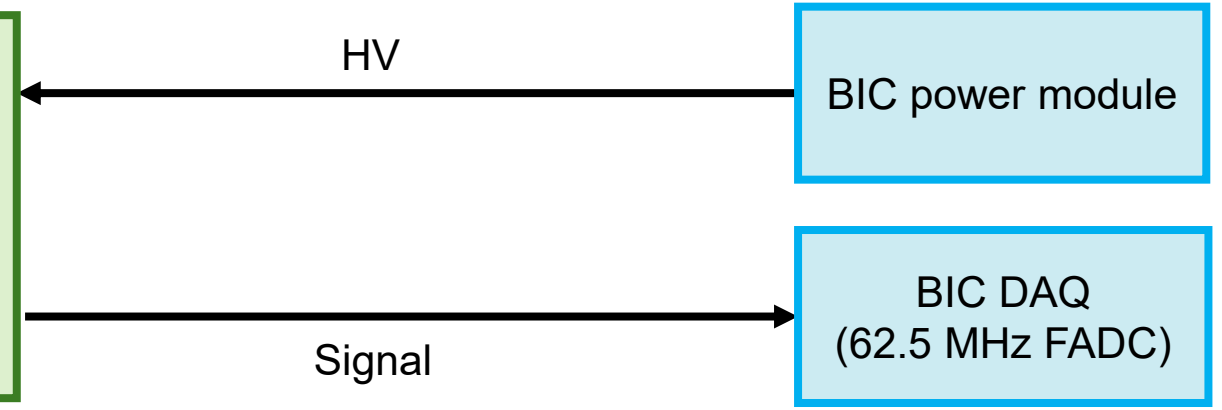


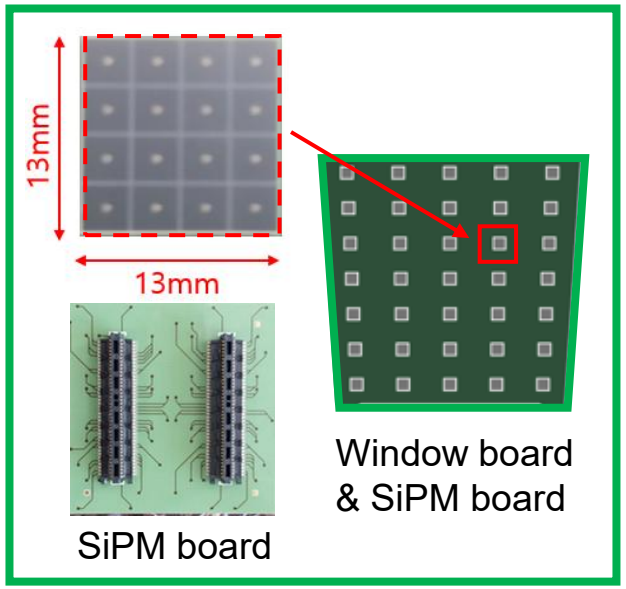


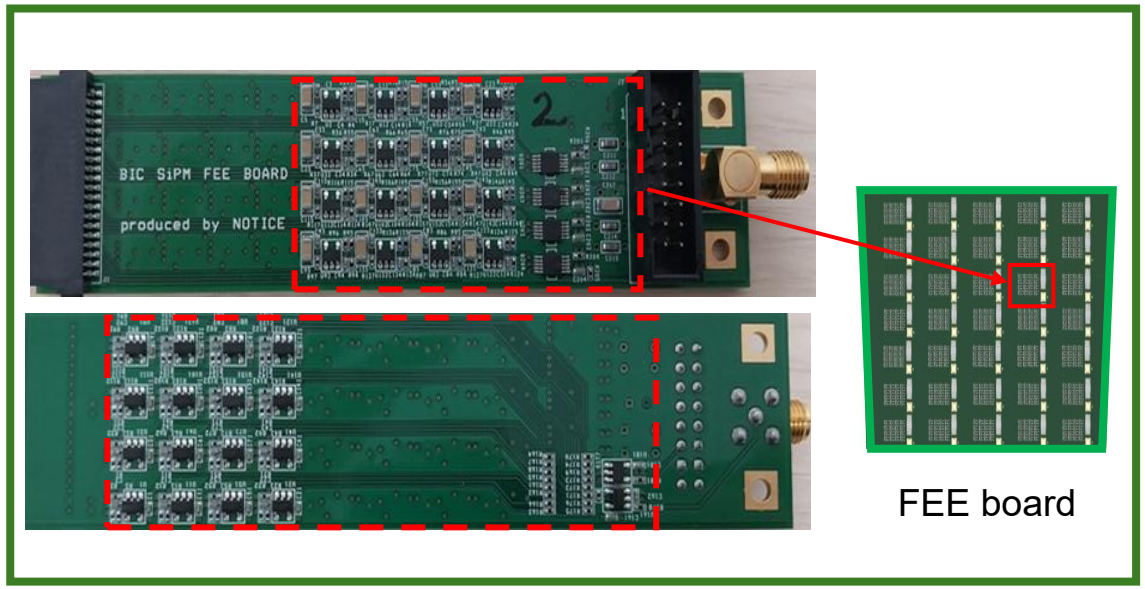
Trapezoidal board design for SiPM & FEE placement on 5×7 light guide at sector end

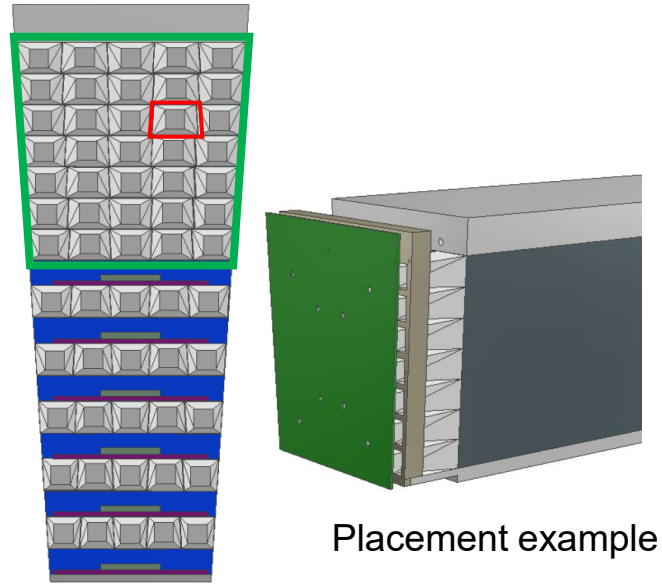
Trapezoidal SiPM Board





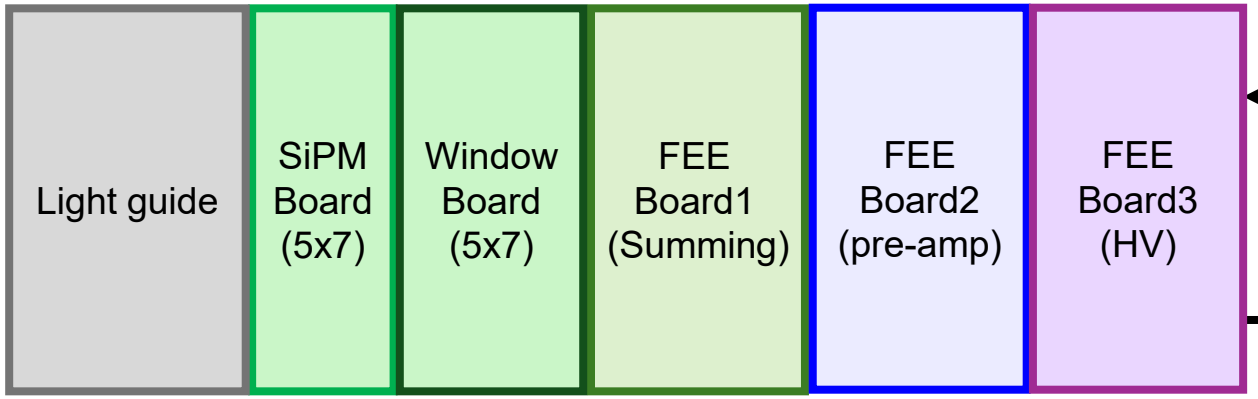


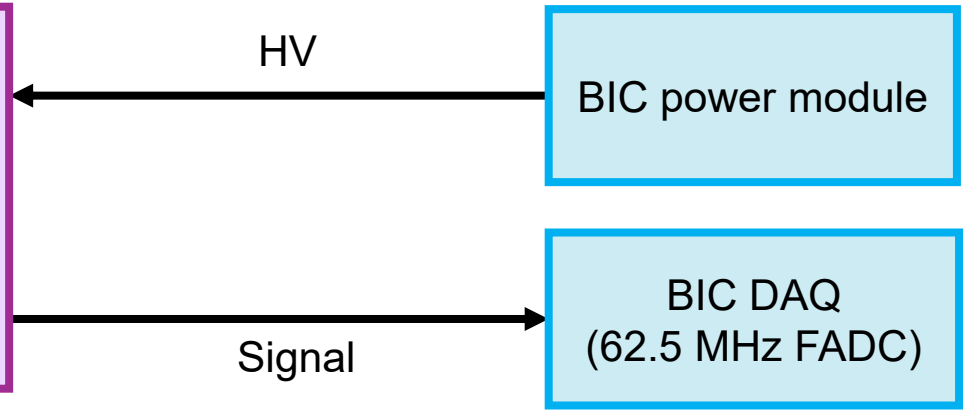


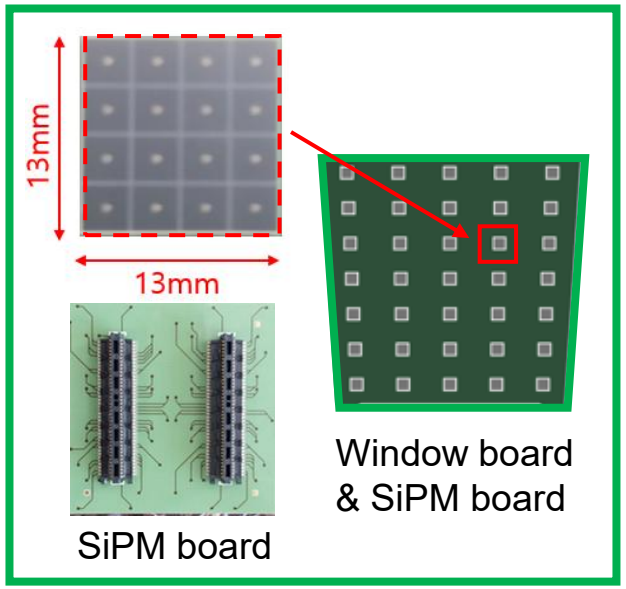


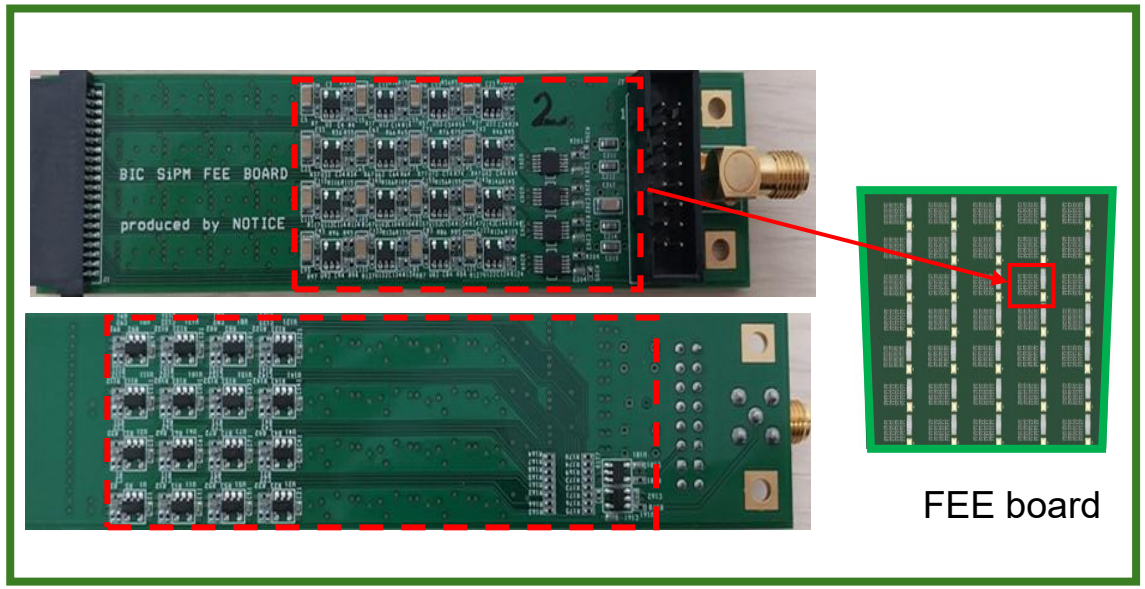
Trapezoidal board design for SiPM & FEE placement on 5×7 light guide at sector end

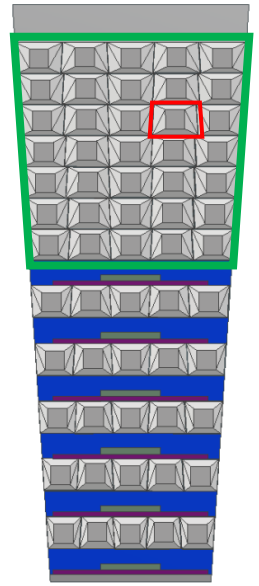
Full Trapezoidal SiPM Board Assembly (Preliminary)

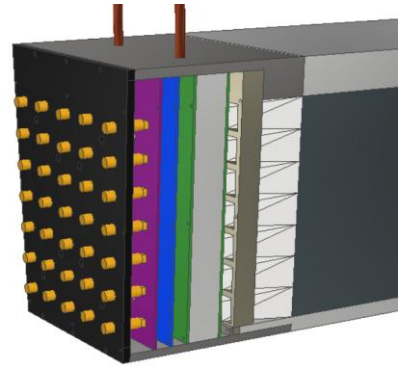








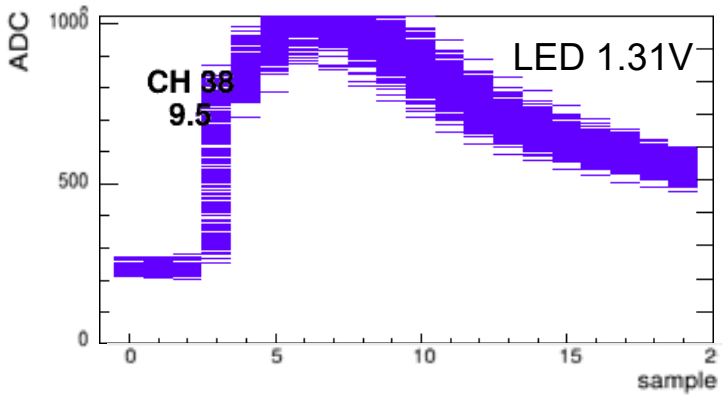




- FEE board segmentation is required due to area limits
- Test SiPM summing board for H2GCROC, select final circuit, then design a trapezoidal board for H2GCROC

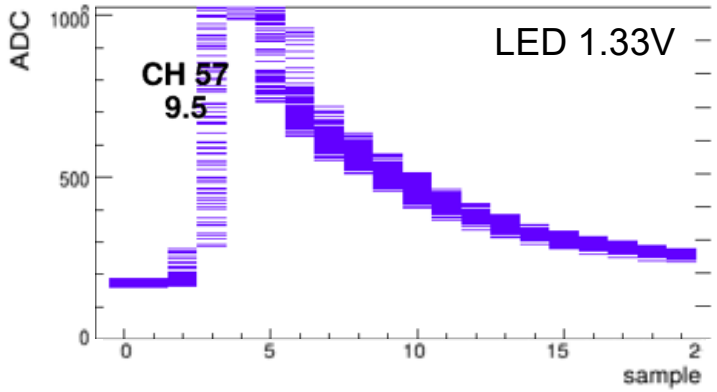
H2GCROC SiPM summing board test

Parallel 16ch sum



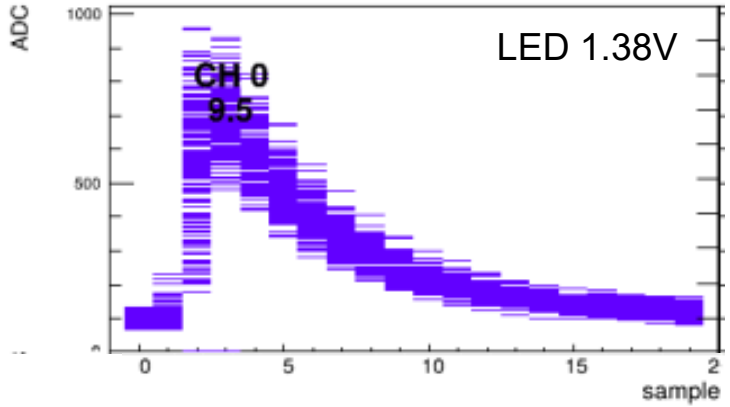
- rising time: 75 ns
- falling time: ~1 μs

Hybrid 16ch sum



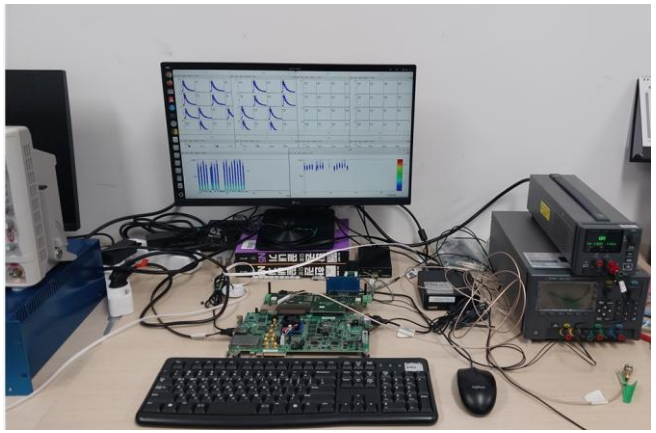
- rising time: 25 ns
- falling time: ~300 ns

Individual 1ch



- rising time: 25 ns
- falling time: ~250 ns

- x-axis: 25 ns/div
- LED intensity was adjusted to match the signal amplitudes
- Hybrid has a narrower signal width
- Hybrid has a smaller signal amplitude

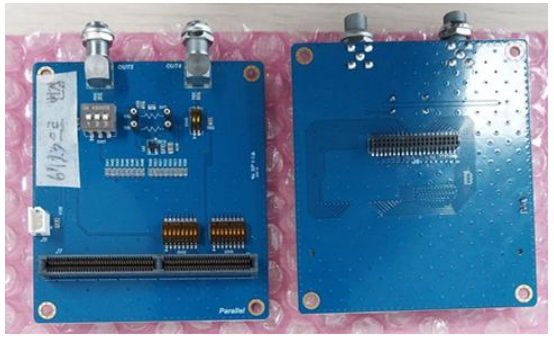


Backup

Board type (power supplied by H2GCROC)

- Hybrid summing
  - w/o op amp, w/ op amp (Board #1, LMH6629)
  - w/o op amp, w/ op amp (Board #2, LMH6723)
- Parallel summing
  - w/o op amp, w/ op amp (Board #3, LMH6629)
  - w/o op amp, w/ op amp (Board #4, LMH6723)
- Individual
  - SiPM 16ch individual readout (Board #5, #6)

Hybrid summing



Parallel summing

Individual

Board type (power supplied by Notice power module)

- Hybrid summing

  - w/o op amp, w/ op amp (Board #7, #8)

- Parallel summing

  - w/o op amp, w/ op amp, 4ch summing (Board #9, #10)

- SMA to H2GCROC (Board #11, #12)

- Samtec cable adapter board (Board #13, #14)

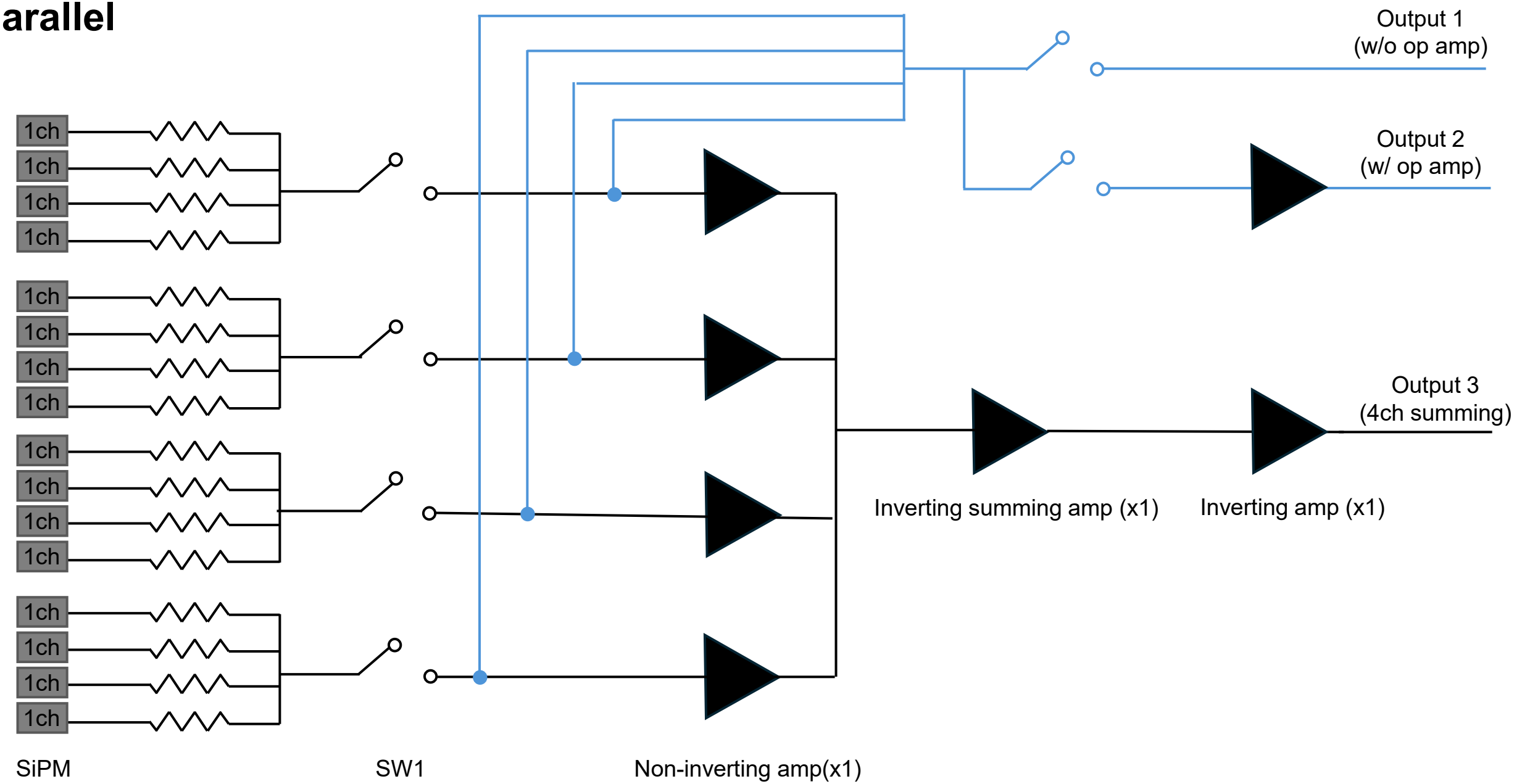
Parallel

Hybrid

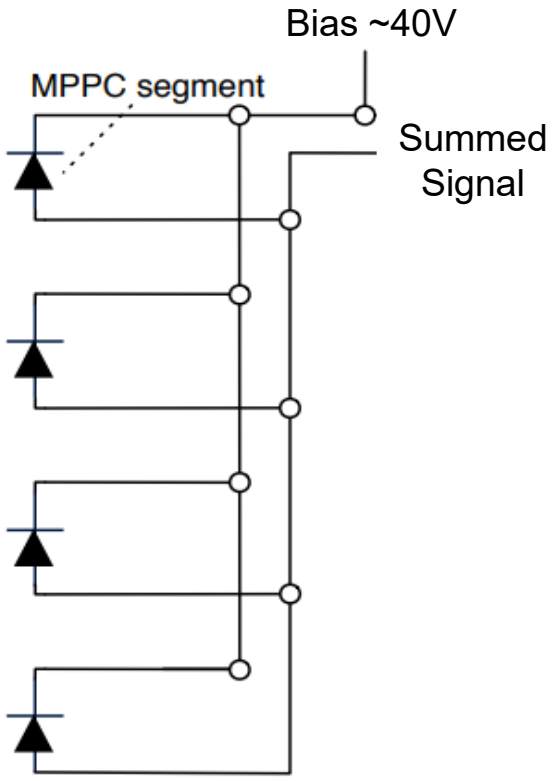
SMA to H2GCROC

Samtec cable adapter board

Parallel

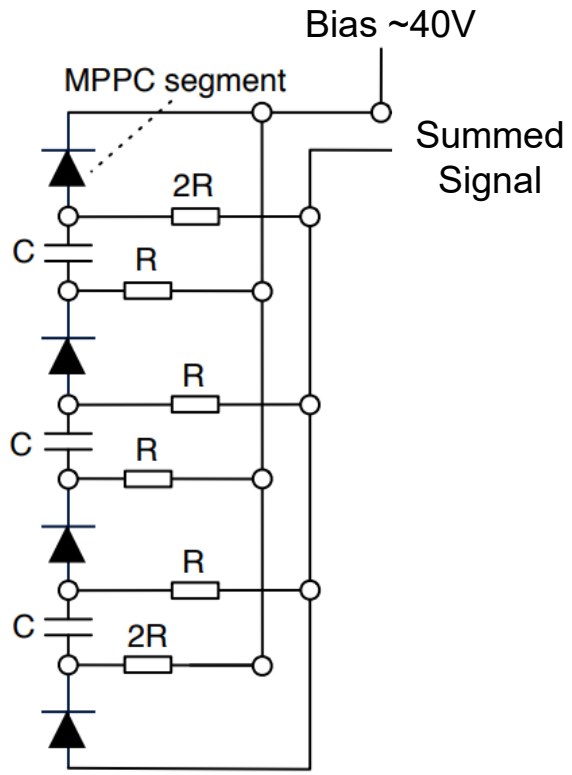

1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
1ch
Output 1
(w/o op amp)
Output 2
(w/ op amp)
Output 3
(4ch summing)
Inverting summing amp (x1)
Inverting amp (x1)
SiPM
SW1
Non-inverting amp(x1)

Signal summation: Parallel vs Hybrid



Parallel

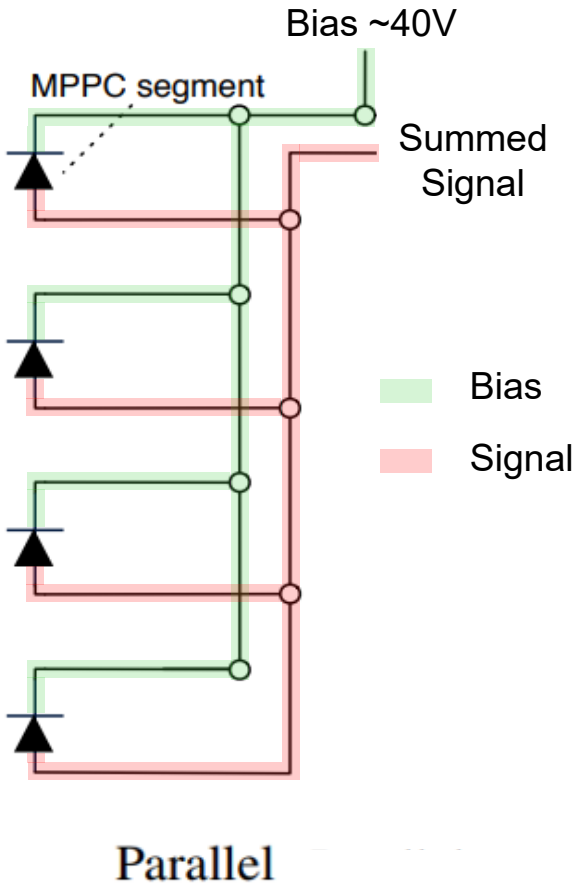
- **Broader pulse** due to added SiPM capacitance



Hybrid

- Bias is applied in parallel, while signals are summed in series
- Narrower than parallel, but **large channel-to-channel amplitude variation**

Signal summation: Parallel vs Hybrid



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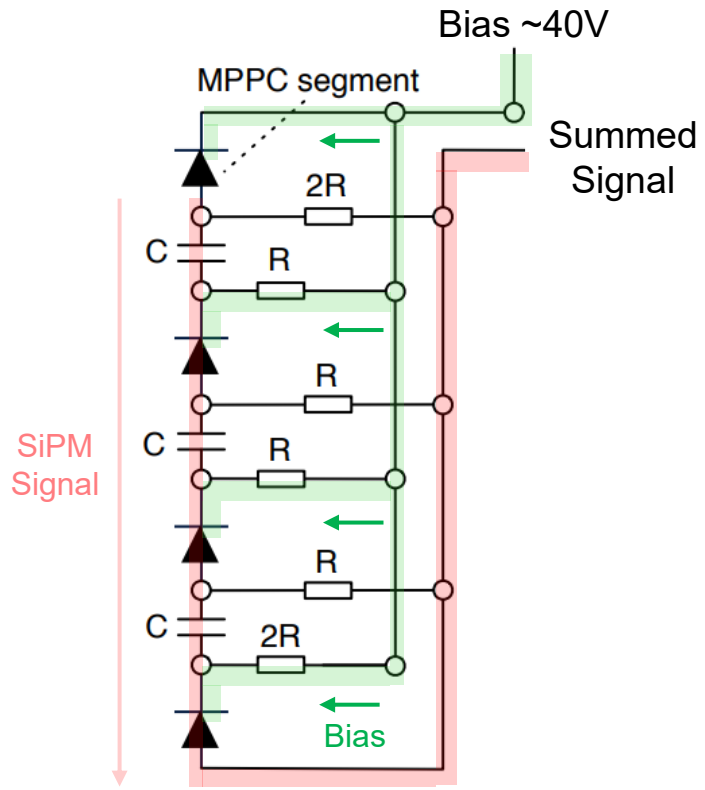

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