Design of H2GCROC–SiPM PCB

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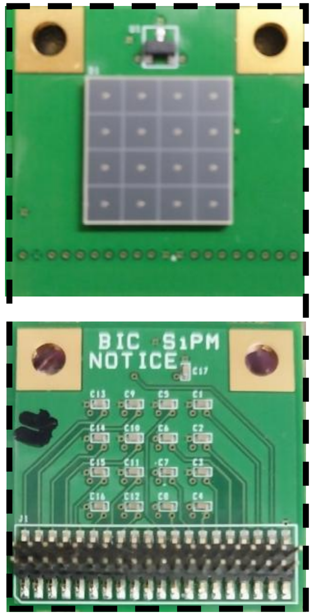
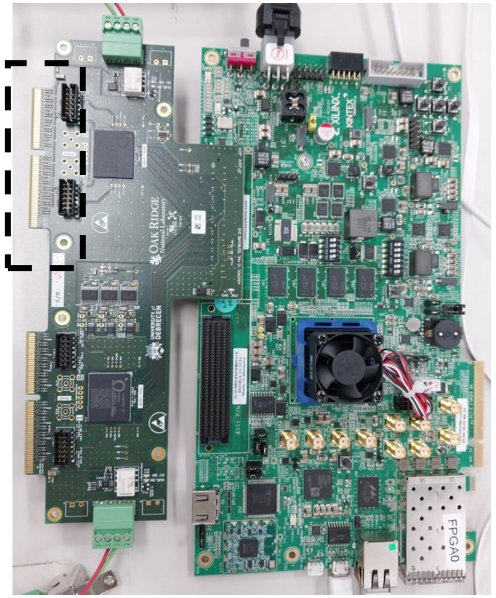
Department of Physics, Kyungpook National University

H2GCROC–SiPM PCB

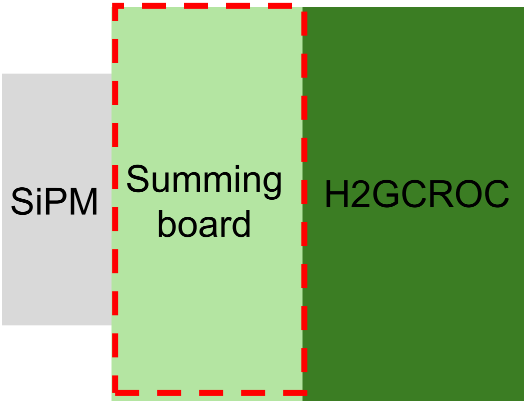


S14161-3050HS-04

SiPM Signal Summing board for H2GCROC



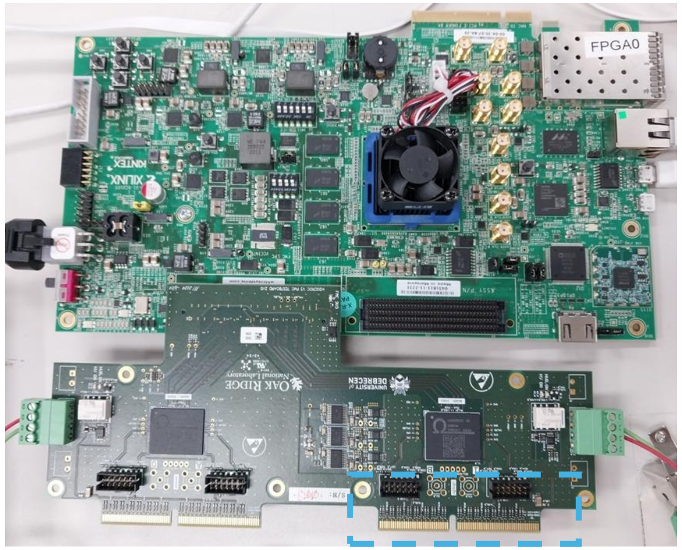
H2GCROC and KCU105



SiPM signal summing methods

- 16ch individual readout (Board 1)
- Parallel: broader pulse due to summed SiPM capacitance (Board 2, Based on Dr. Norbert Novitzky's circuit)
- Series: bias voltage increases with SiPM count
- Hybrid: combines parallel and series (Board 3)

H2GCROC–SiPM PCB



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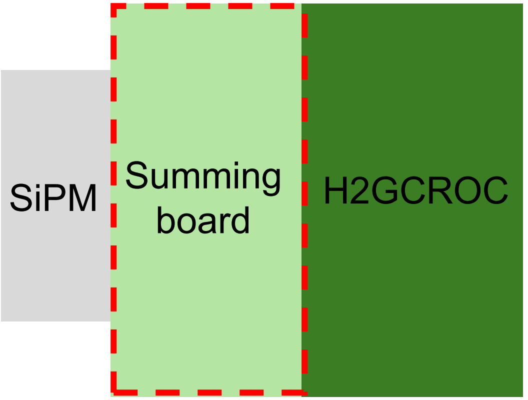
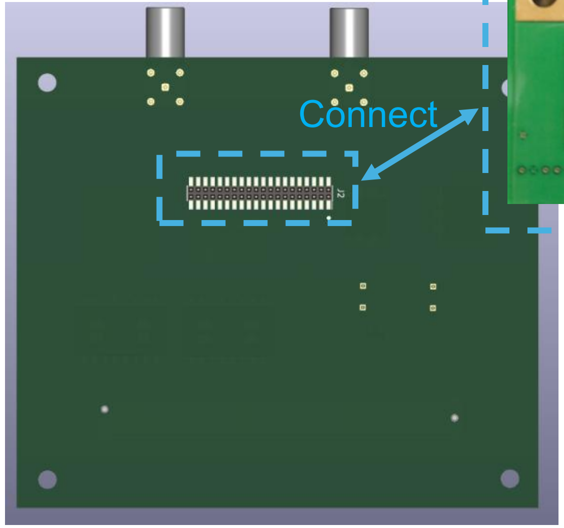
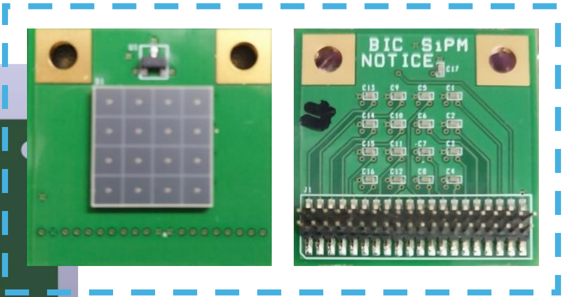


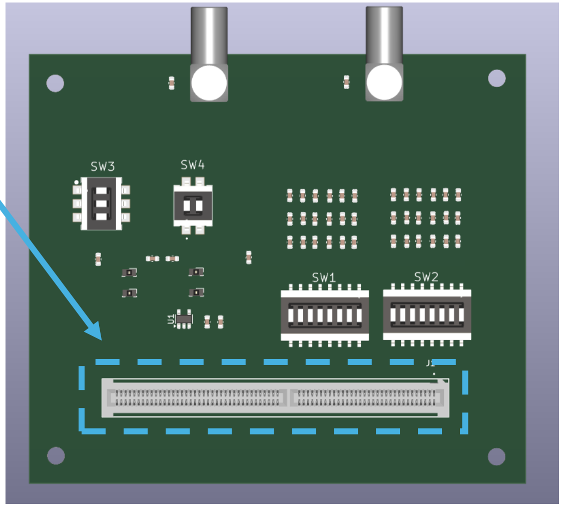
Connect



Connect

Summing board top





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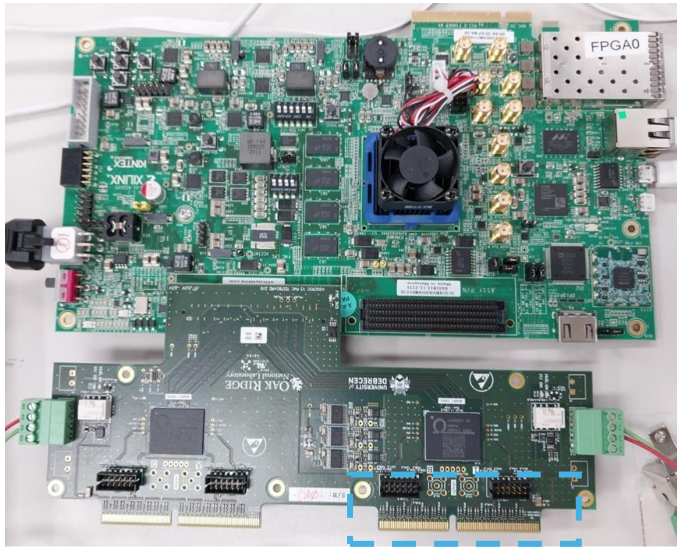
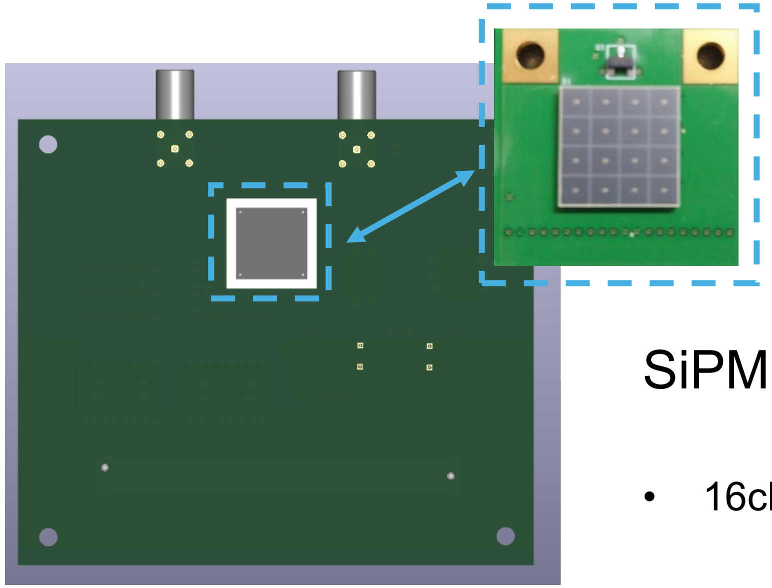


H2GCROC and KCU105



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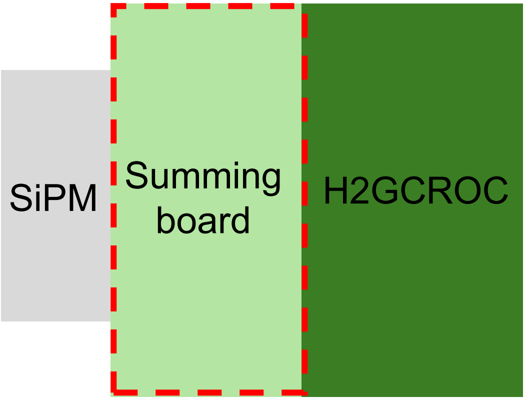

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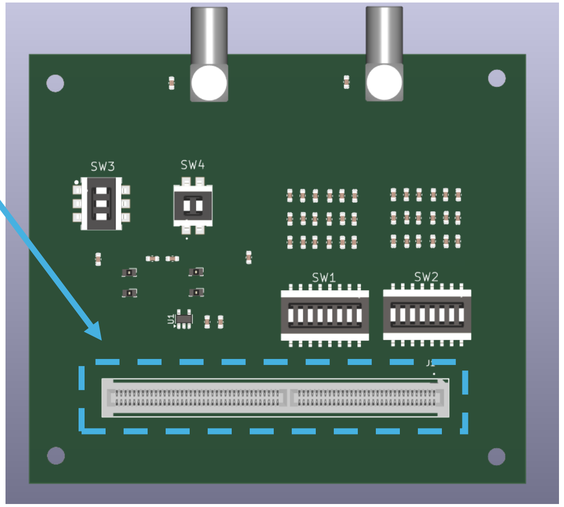

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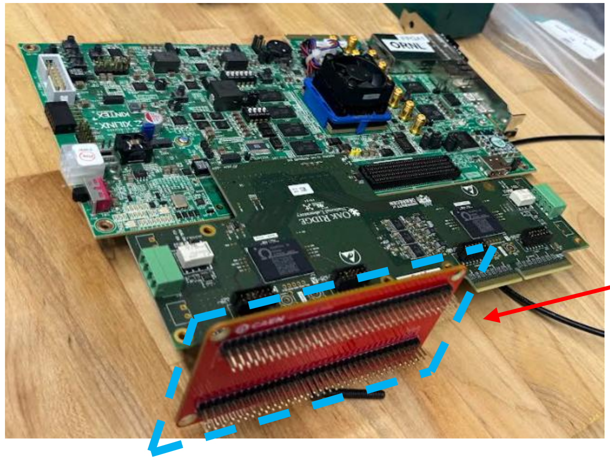
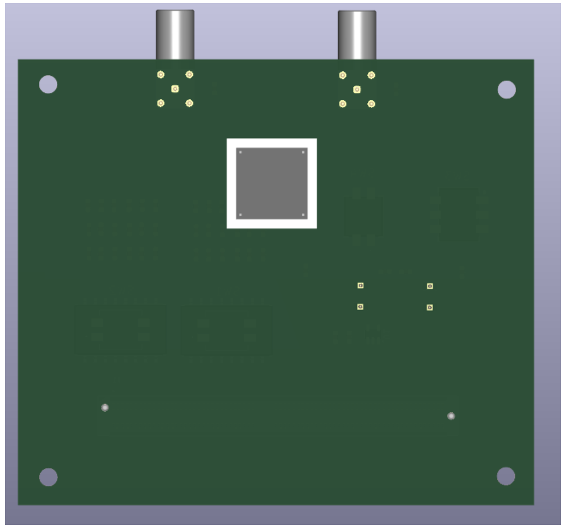
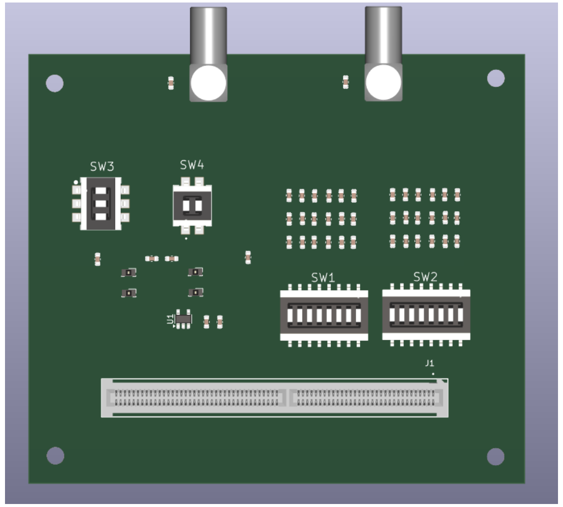


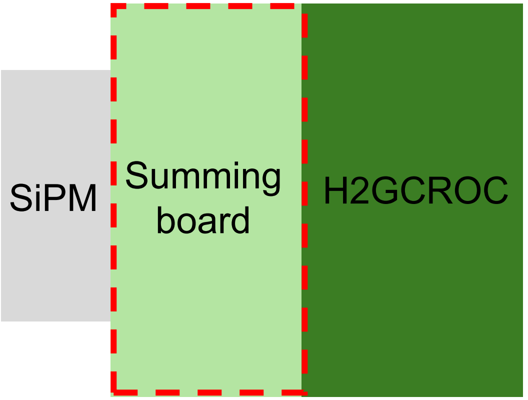
H2GCROC–board connection example



Summing board top



Summing board bottom



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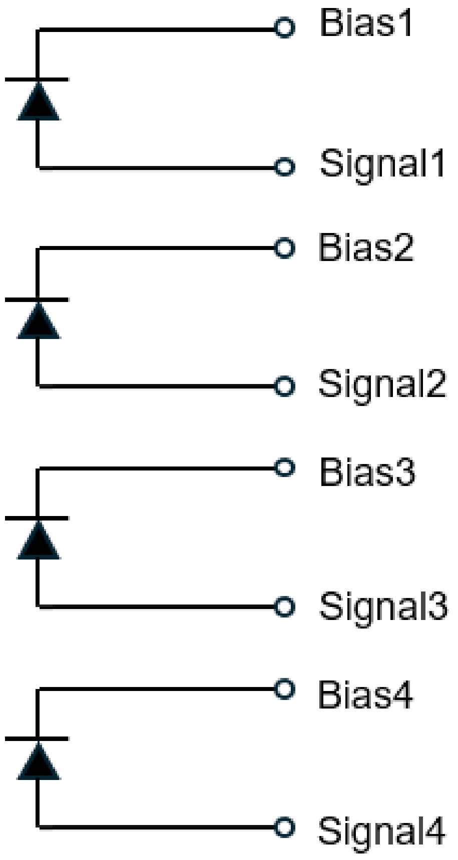
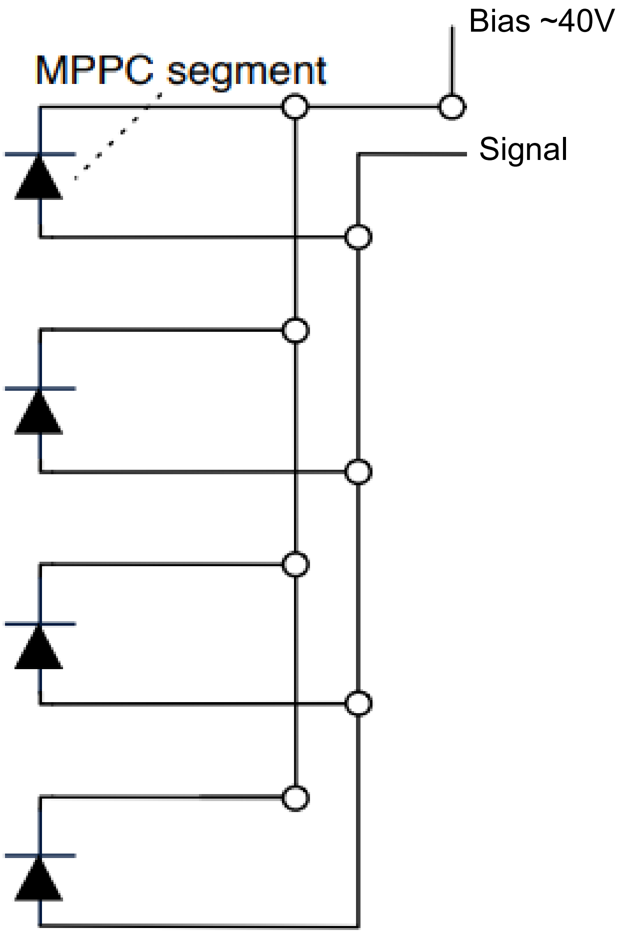
Designed board

Board 1: Individual readout



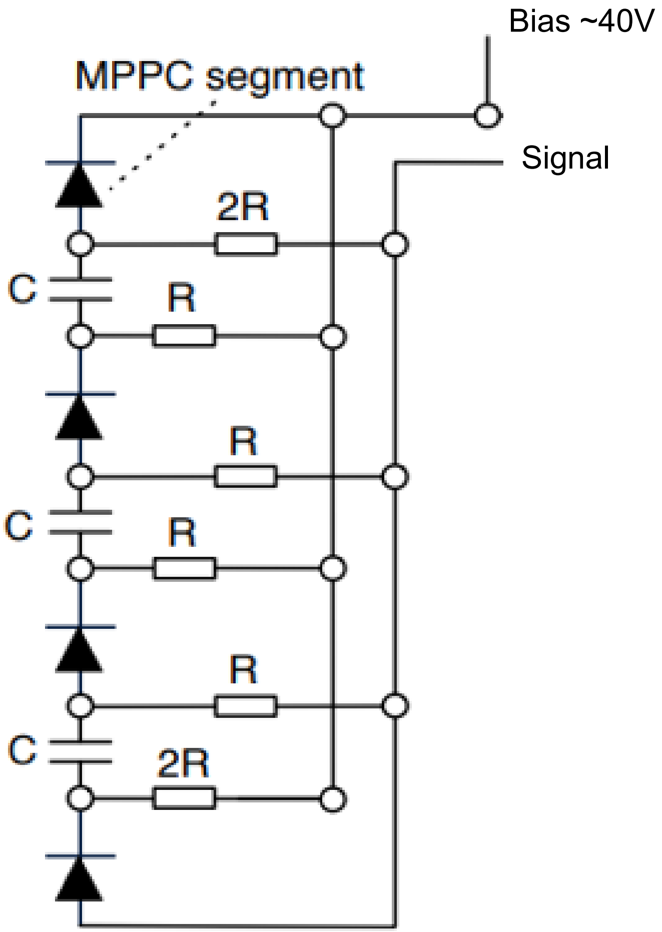
16 channel individual readout

Board 2: Parallel



Broader pulse due to added SiPM capacitance

Board 3: Hybrid



Parallel power, series signal

Designed board

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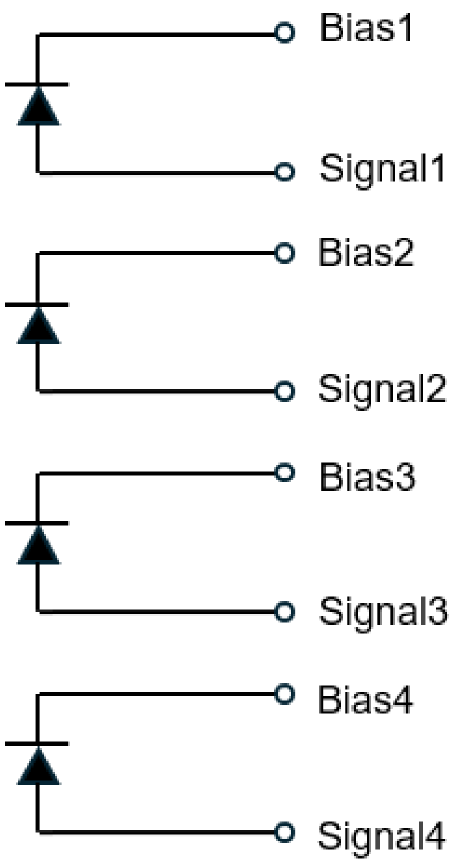
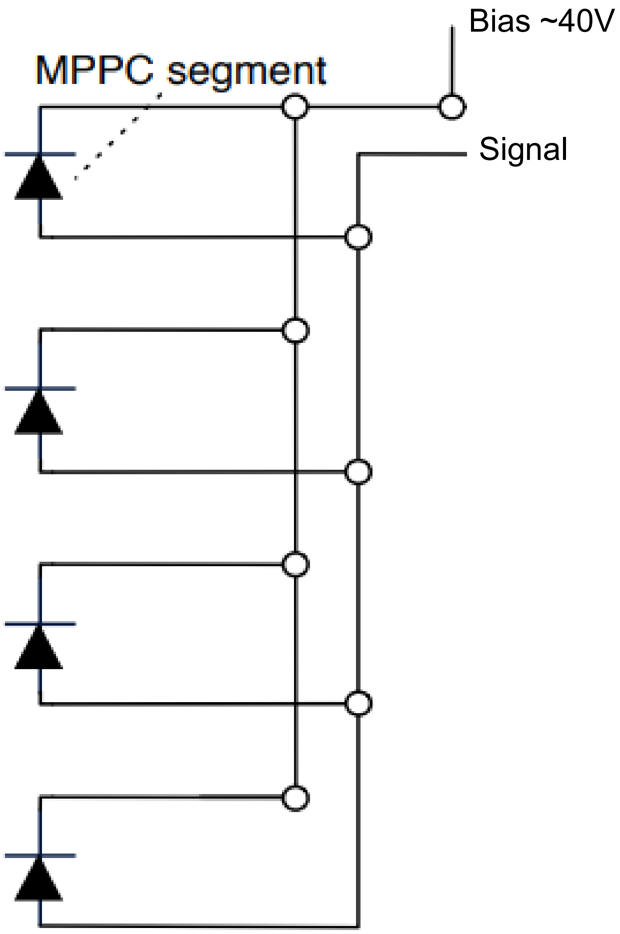


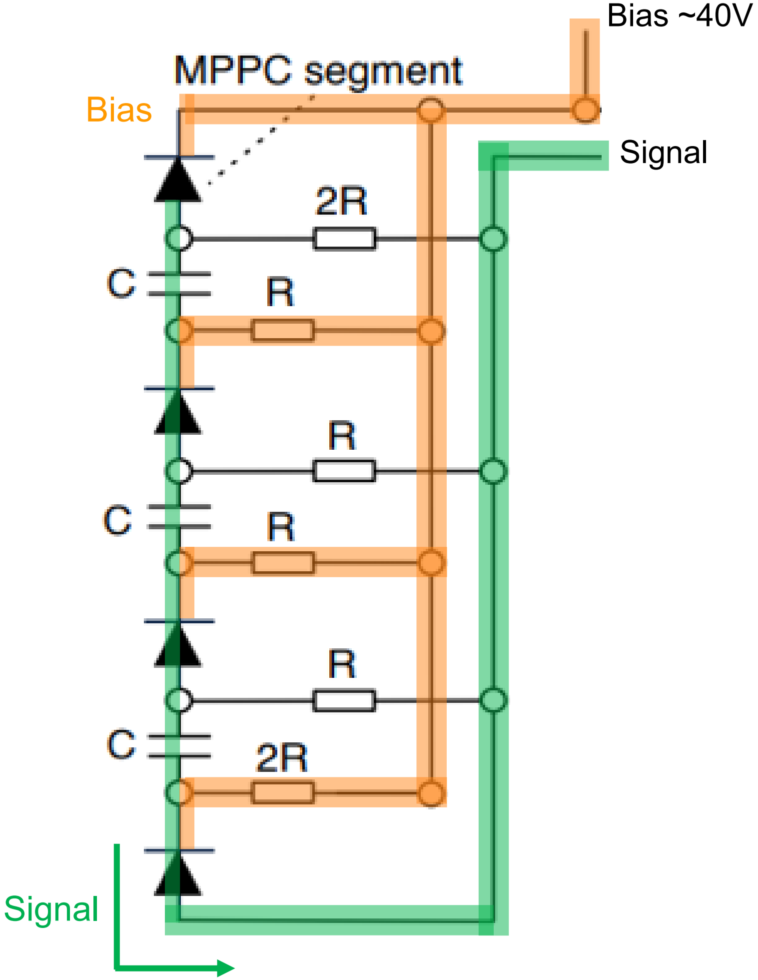
16 channel individual readout

Board 2: Parallel



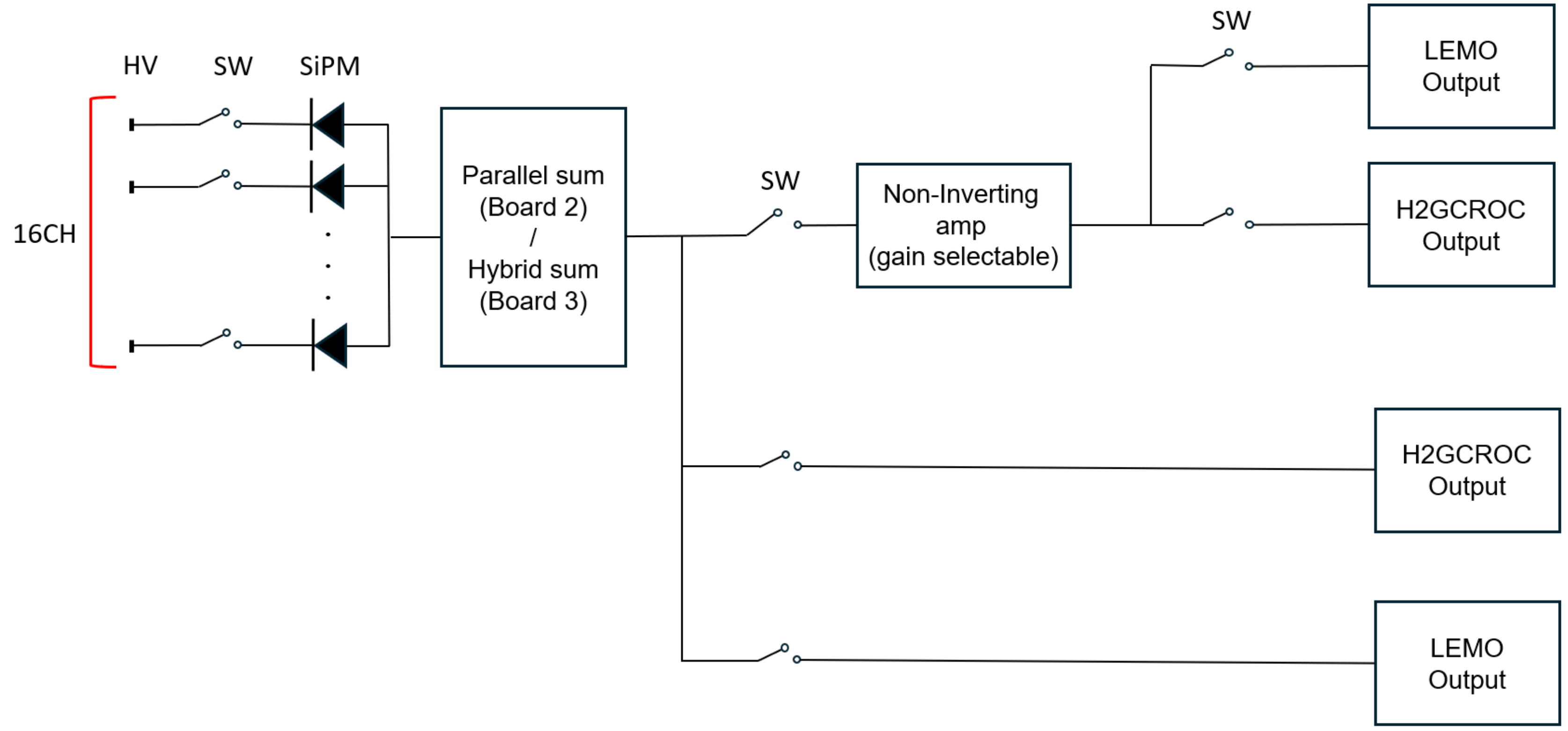
Broader pulse due to added SiPM capacitance

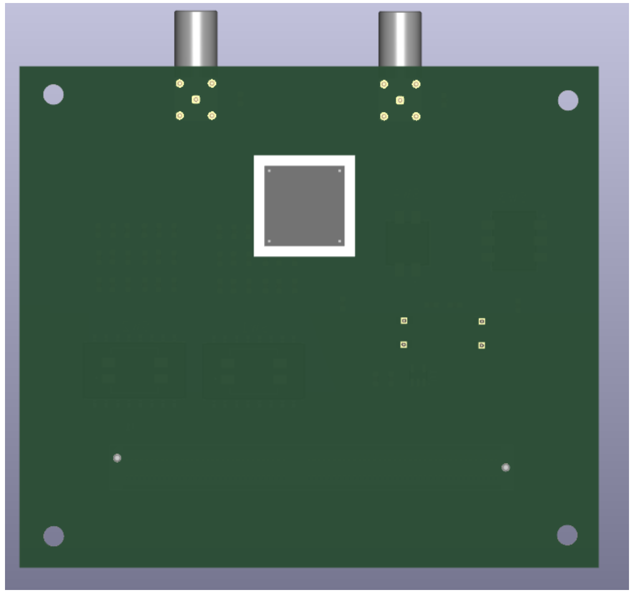
Board 3: Hybrid



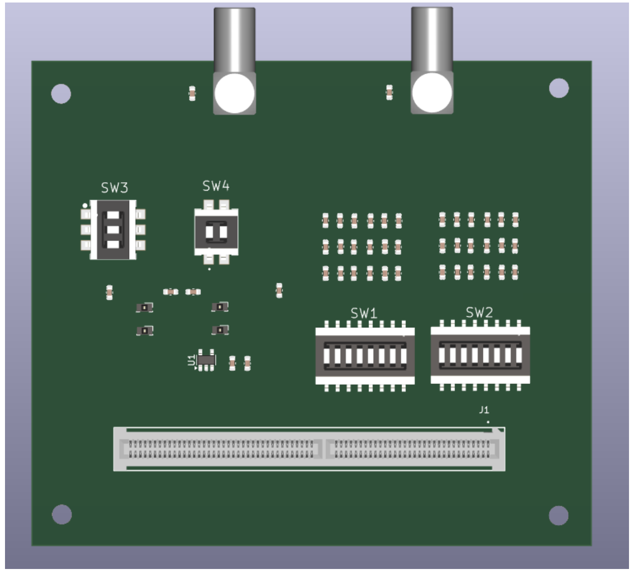
Parallel power, series signal

Circuit diagram





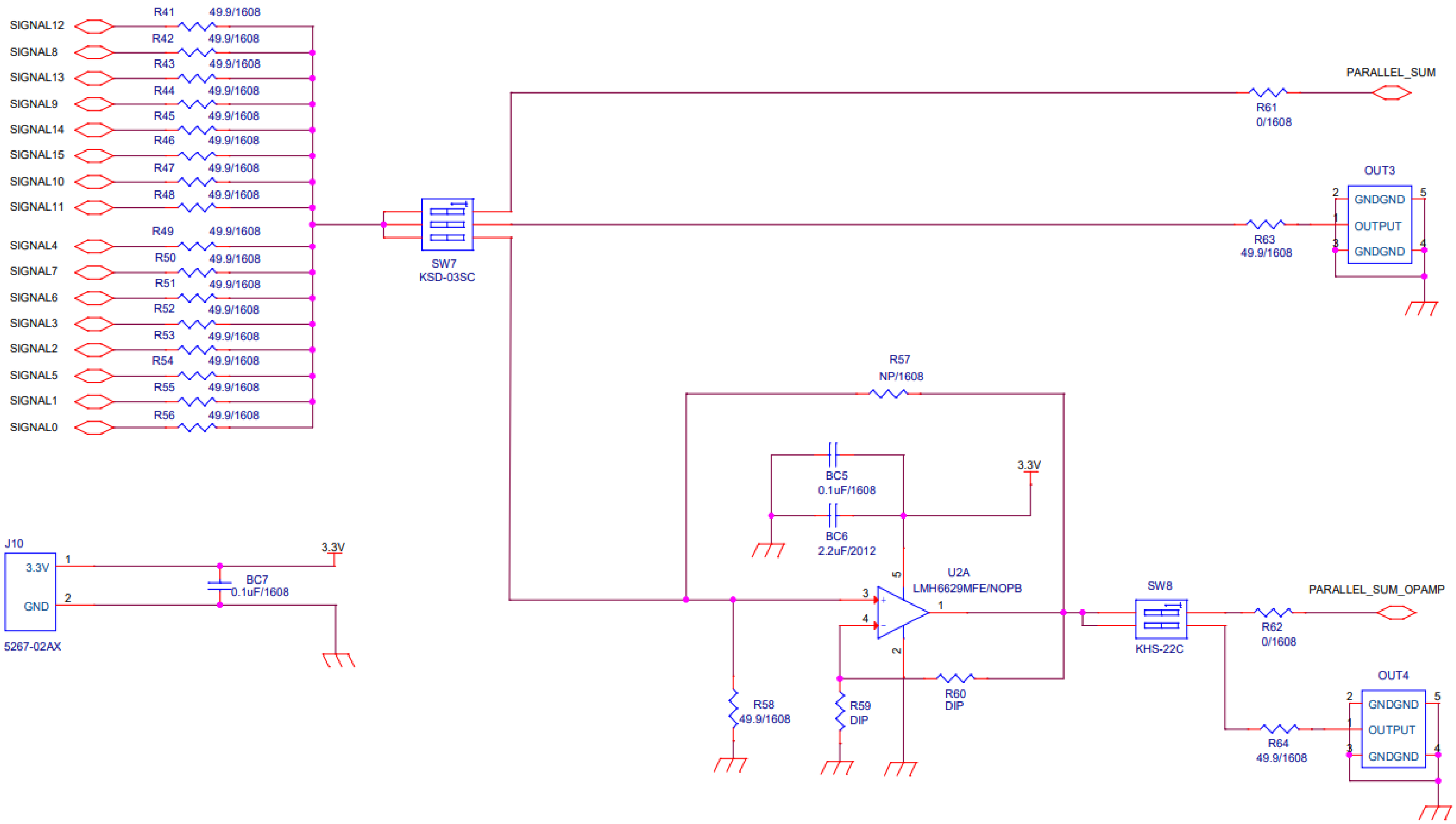
Summing board top



Summing board bottom

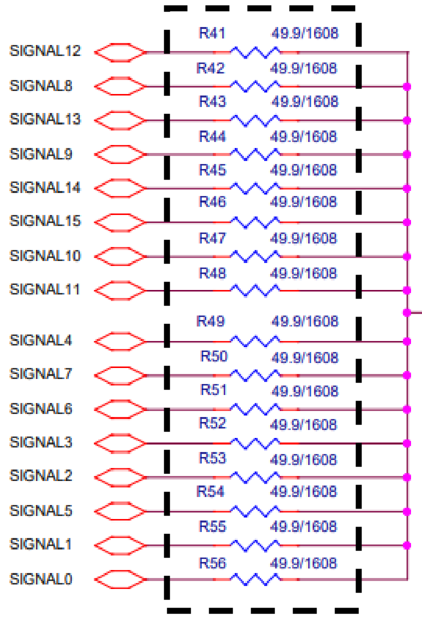
- Check whether amplification is needed using a non-inverting amplifier
- Check the signal on an oscilloscope via a LEMO connector

Board 2: Parallel circuit

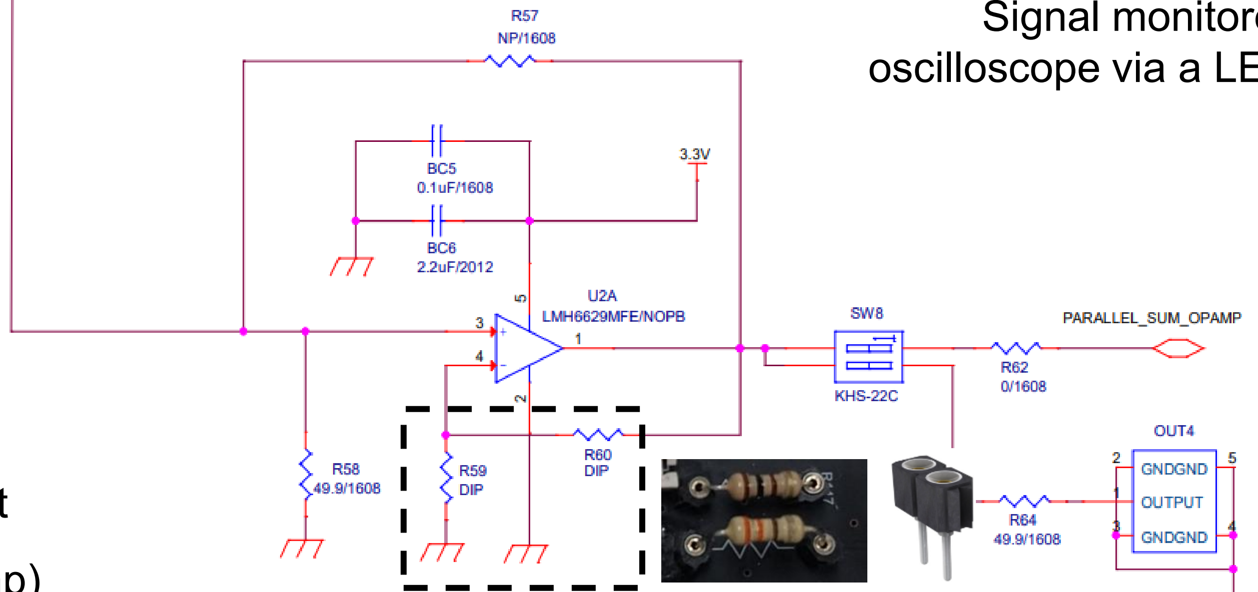


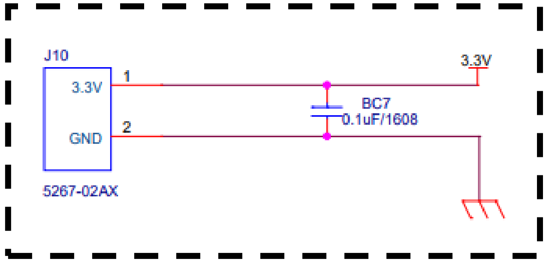
Board 2: Parallel circuit

Added a resistor to prevent reverse current
(0 Ω → 50 Ω)



Signal monitored on an oscilloscope via a LEMO connector





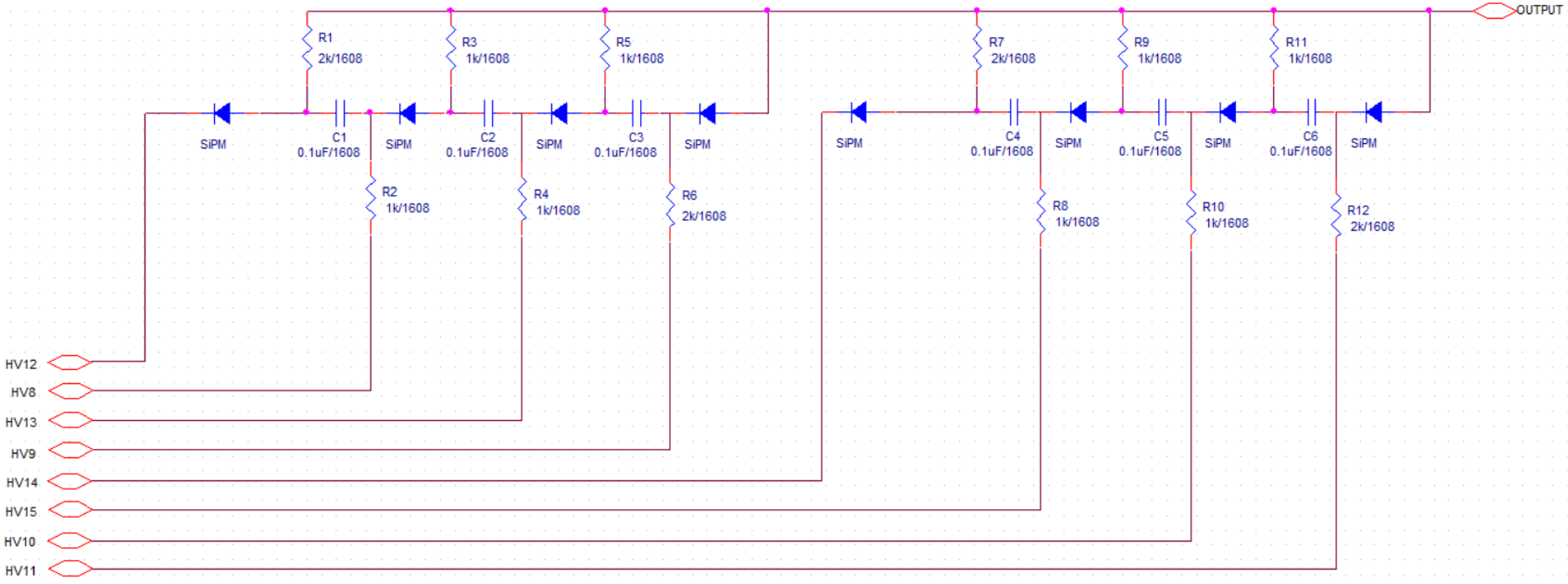
2 pin connector for op-amp power input

(for comparison with a low power op-amp)

Pin socket for gain adjustment

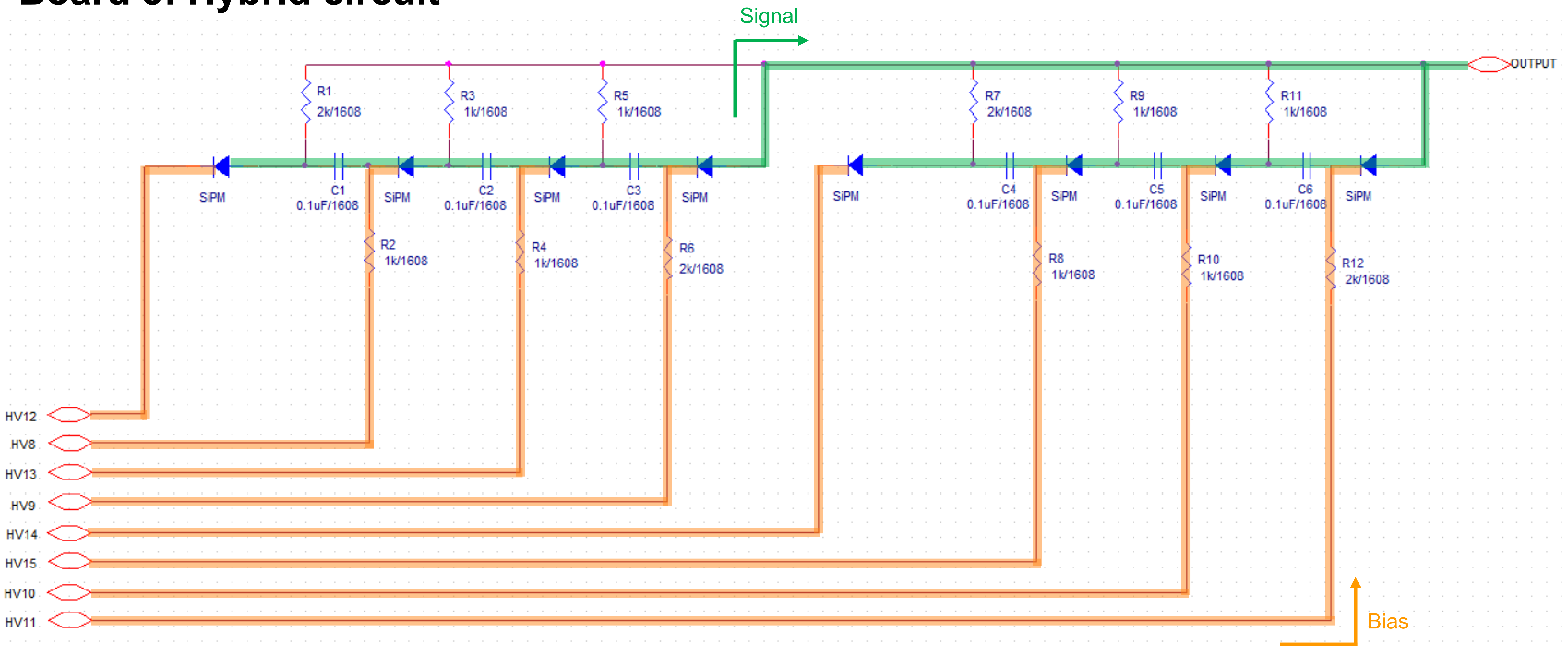
(gain = 2 → gain selectable)

Board 3: Hybrid circuit



- Split into two outputs in parallel: one through the op-amp, one bypassing it
- Only 8 of 16 channels shown

Board 3: Hybrid circuit



- Split into two outputs in parallel: one through the op-amp, one bypassing it
- Only 8 of 16 channels shown

Future plan

- The board is currently under fabrication and is expected to arrive this week
- Upon arrival, an LED test will be performed, and the output will be monitored via the LEMO connector
- For H2GCROC testing, a Thunderbolt-to-SFP+ adapter will be purchased and used for testing

Backup

op-amp comparison

LMH6723/LMH6724 Single/ Current Feedback O

1 Features

- Large Signal Bandwidth and Slew Rate 100% Tested
- 370 MHz Bandwidth (A_V = 1, V_{OUT} = 0.5 V_{PP}) −3 dB BW
- 260 MHz (A_V = +2 V/V, V_{OUT} = 0.5 V_{PP}) −3 dB BW
- 1 mA Supply Current
- 110 mA Linear Output Current
- 0.03%, 0.11° Differential Gain, Phase
- 0.1 dB Gain Flatness to 100 MHz
- Fast Slew Rate: 600 V/μs
- Unity Gain Stable
- Single Supply Range of 4.5 to 12V
- Improved Replacement for CLC450, CLC452, (LMH6723)

LMH6629 Ultra-Low Noise, High-Speed

1 Features

- Specified for V_S = 5 V, R_L = 100 Ω, A_V = 10V/V WSON-8 Package, unless Specified. –3dB Bandwidth 900 MHz
- Input Voltage Noise 0.69 nV/√Hz
- Input Offset Voltage Max. Over Temperature ±0.8 mV
- Slew Rate 1600 V/ μs
- HD2 @ f = 1 MHz, 2V_{PP} −90 dBc
- HD3 @ f = 1 MHz, 2V_{PP} −94 dBc
- Supply Voltage Range 2.7 V to 5.5 V
- Typical Supply Current 15.5 mA
- Selectable Min. Gain ≥4 or ≥10 V/V
- Enable Time: 75 ns
- Output Current ±250 mA
- WSON-8 and SOT-23-5 Packages

Product	Small signal Bandwidth (MHz)	Noise level (nV/√Hz)	Slew rate (V/μs)	Power (W/cm²)	Price (USD)	Remark
LMH6723MF	290 @ gain = 1	4.3	400	0.124	3.47	Low power, V_{op} = 5V
LMH6629MFE	950 @ gain = 10	0.69	1100	1.005	6.49	Dr. Norbert Novitzky's circuit, V_{op} = 3.3V
SiPM				0.046		
CALOROC				0.045 @ 5W		