

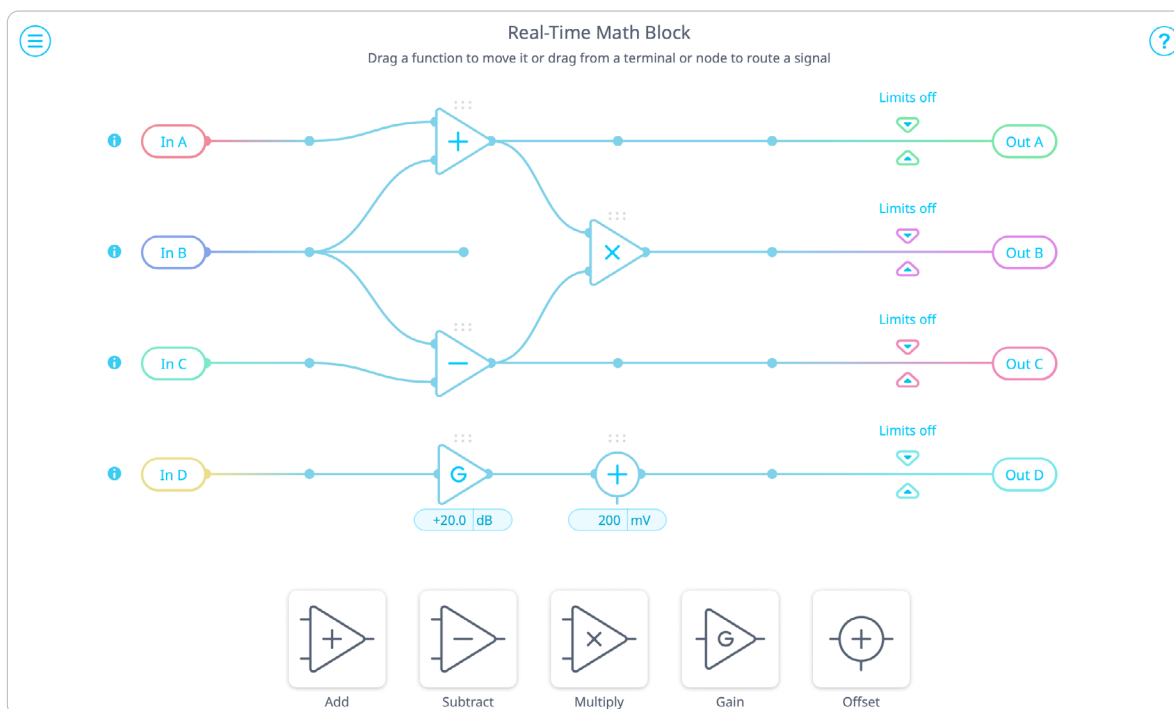


Real-Time Math

Configurable, real-time mathematical processing for Moku



The Real-Time Math block enables real-time mathematical processing of signals within Multi-Instrument Mode. Combine signals across channels and chain arithmetic operations through configurable processing stages, without writing FPGA code. Its architecture supports a range of mathematical functions, including addition, subtraction, multiplication, gain, and offset, allowing complex signal transformations to be constructed with ease. Integrated alongside other Moku instruments, Real-Time Math adds flexible signal processing directly into measurement and control workflows.



Features

- Six node functions: Add, Subtract, Multiply, Gain, Offset, and Passthrough
- Use any input channel at any node and cascade results through successive stages
- Independent upper and lower output limits on each channel
- Configure graphically, or with Python, MATLAB, or the REST API
- Run alongside other instruments in Multi-Instrument Mode

Specifications

- Up to 16 processing nodes
- Gain: -20 to +20 dB
- Offset and output limits: up to ± 5 V, depending on platform
- Latency:
 - Moku:Go: < 440 ns
 - Moku:Lab: < 120 ns
 - Moku:Pro: < 60 ns
 - Moku:Delta: < 70 ns
- Numerical precision: 16-bit
- Overflow handling: clipping

Applications

- Signal scaling and offset
- Differential measurements
- Cross-channel arithmetic
- Multi-stage signal processing
- Feedback signal conditioning



Platform specifications

	Moku:Delta	Moku:Pro	Moku:Lab	Moku:Go
Multi-Instrument Mode configuration	3, 5, or 8 slots	4 slots	2 or 3 slots	2 or 3 slots
Processing channels	4 (5-slot) 2 (3- and 8-slot)	4	2	2
Processing stages per channel	4	4	3	3
Latency*	< 70 ns	< 60 ns	< 120 ns	< 440 ns
Offset range	-0.5 to +0.5 V	-1 to +1 V	-1 to +1 V	-5 to +5 V
Output limit range	-0.5 to +0.5 V	-1 to +1 V	-1 to +1 V	-5 to +5 V

*Latency does not depend on the function, the number of stages in use, or the slot configuration.

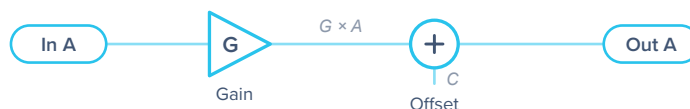
Available signal bandwidth depends on the hardware platform and Multi-Instrument Mode configuration.

Example configurations

Signal scaling and offset

$$Y = G \times A + C$$

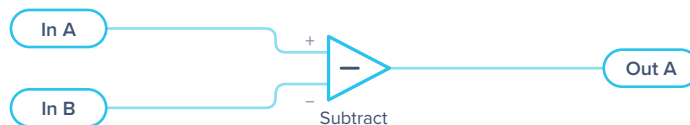
Apply gain to an input signal, then add a DC offset. Use this to rescale a signal and shift its operating range before routing it to another instrument or output. G is the linear equivalent of the gain set in dB.



Differential processing

$$Y = A - B$$

Subtract one input from another to extract their difference, for example to remove a reference signal. Later stages can scale or offset the result.



Multi-stage, cross-channel processing

$$Y = (A + B)(B - C)$$

Combine intermediate results from different channels. In the first stage, one node computes $A + B$ while another computes $B - C$. A second-stage Multiply node then combines the two results.

