# SiPM-2000

**BRIDGEPORT** INSTRUMENTS, LLC    **Versatile MCA for SiPM**



SiPM-2000 Assembly
with 50mm scintillator

This is the Swiss Army Knife equivalent of an MCA. With many built-in functions it assists the user in their varied measurement tasks.

It measures the radioactivity of samples, automatically subtracts the background and reports the accuracy of the measurement. It can raise an alarm if a sample truly is more radioactive than expected.

It can act as a portal monitor, where it records passing vehicles or persons and raises an alarm if something unusual is found. It tracks slowly changing radiation backgrounds to avoid false alarms.

Up to 4000 spectra can be stored on board without a computer attached to it.

It implements two-bank listmode acquisition with programmable time stamp reolution and lossless data acquistion.

Neural-network powered pulse shape discrimination supports phoswiches and neutron detectors.
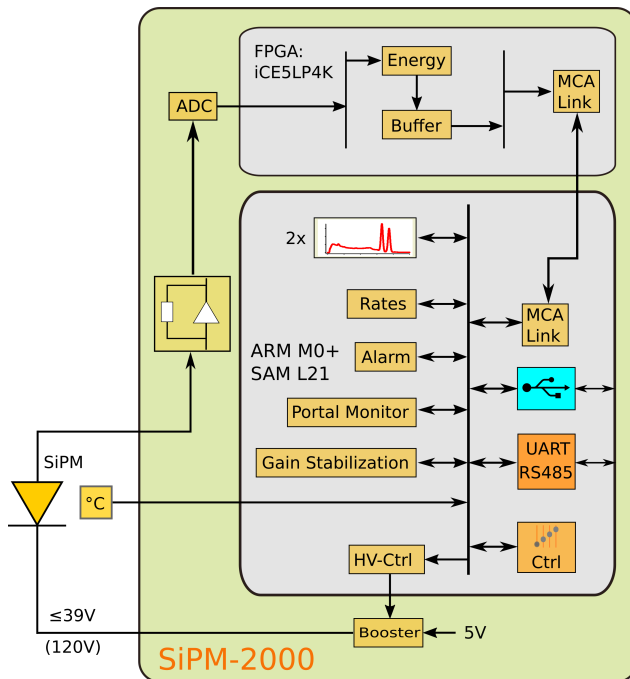


### ● MCA
- Two-bank MCA; sample vs background
- Two 2K×32 or one 4K×32 MCA
- Digital gain stabilization, including LED
- Digital alarm pulse out with adjustable threshold

### ● Sample counting
Measure:
- Sample and background count rate, with statistical errors
- Difference count rate
- Probability that sample rate is more than background
- Restricted to an MCA region of interest.

### ● Dynamic alarms
- Alarm on a passing source
- Compute alarm 10×/s
- Programmable false alarm rate
- Automatic background tracking

The MCA, the high voltage generator and the high voltage divider are all combined into a single unit with a JEDEC B14A socket. There are model variants for 8 and 10 dynode SiPM. The unit is environmentally sealed and users only need to protect the pins of the SiPM against moisture.

## The SiPM-2000 is ideal for

- NaI and plastic scintillators
- Contamination probes for food, soil, pipes, lumber, etc.
- Portable and stationary portal monitors, backpacks etc.
- Autonomous environmental monitors storing thousands of spectra.
- Industrial applications such as density gauges, fill-level meters, activation analysis in mining

### ● Ideal for embedded systems:
- Very low power consumption 5V@30mA=150mW
- Data logging without computer
- USB or UART serial interface
- Open-source software
- Including for Raspberry Pi

The MCA ships with a number of useful built-in functions that go beyond the acquisition of histograms, listmode and trace capture:

- 2K×32 or 4K×32 histogram with count rates and error analysis
- Measuring the radioactivity of samples while subtracting backgrounds and computing alarms.
- Computing alarms 10 times per second for a wearable backpack or a portal monitor
- Maintain a stable MCA gain and trigger threshold as the temperature changes.

This MCA realizes its standard and custom capabilities using 32-bit software implemented on a modern ARM M0+ processor. Real time processing of events, listmode, trace capture and pulse shape discrimination is performed in the onboard FPGA.

BPI provides software to communicate with the MCA via USB or serial port. All software and data formats are completely open-source.

BPI provides client software examples for Linux/Windows, x86, x64 or ARM.

The built-in capabilities are powerful. For example the MCA can autonomously operate a portal monitor or backpack detector. It will track changes of the background radioactivity, and raise an alarm on the fact that the last 4 seconds of measured counts were too much to be caused by background. This can be used to create an incredibly low-cost core component for a sweeper, a backpack or a portal monitor.

## Principle of operation
- Embedded ARM 32-bit SoC controls all aspects.
- Low power high voltage generator and divider: internal 3.3V@14mA for HV=1000V
- Fully transistorized high-voltage divider reacts quickly to count rate changes.
- All computations are implemented in C-Code.
- Event processing and listmode in FPGA
- Developers may request custom software and functions.

## ARM M0+ Functions
- Control the 1400V booster to power the SiPM
- Software-controlled gain stabilization via lookup tables of operating voltage vs temperature.
- Selectable gain stabilization on energy deposited within an MCA region of interest.
- Measure count rates and statistical errors
- Compute alarm probabilities
- Compute portal monitor alarming

## Histogramming rate
- 560kcps for periodic pulses.
- Programmable integration time per event

## Security
- Embedded software can not be read back.
- Default gain stabilization tables cannot be read back.
- Developer and user can program gain stabilization tables that cannot be read back.

## SiPM operating voltage
- Positive or negative polarity; up to 1400V

- 8 and 10-dynode pinouts

## Server-side software
- Device communicates via USB on Windows and Linux; x86/x64 & ARM processors, using libusb0.1 or libusb1.0
- MCA Data Server encapsulates device operation
- JSON command interface
- TCP/IP communication via robust transport layer using ZeroMQ (zeromq.org).

## Client software
- wxWidgets and Matplotlib GUI (wxMCA)
- Example clients in Python communicate with MCA Data Server via ZMQ
- Client can be written in any programming language.
- API in Python
- Hardware simulator for "Try before you buy".

## Power supply
- Supply: 3.3V to 5.5V; 5V@30mA for HV=1000V

## Environmental
- Operational from -40°C to +60°C

## Select part numbers
- For R6231/3: SiPM1K-P81T
- For 10-stage: SiPM1K-P10T
- For CR105: SiPM1K-P105T
- For CR119: SiPM2K-NaI-P80T
- For negative HV: -N80T, -N81T, -N10T, -N105T