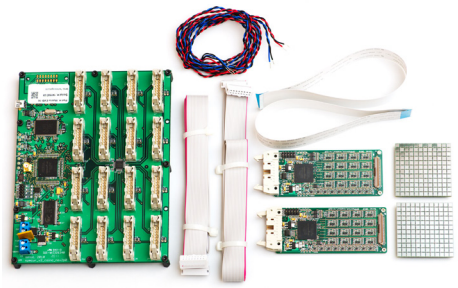
MatrixB System

PRODUCT BRIEF

Modular Scintillator Readout Solution for Nuclear Medicine



SensL's Matrix products provide a modular, turnkey readout system specifically designed for nuclear medicine applications. Building on SensL's silicon photomultiplier technology, the MatrixB provides a fully solid-state, four-side scalable sensor for the readout of L(Y)SO or BGO scintillator arrays. It integrates all of the electronics required to localize, time stamp and discriminate scintillation events. Digitized event data comprising time, location and energy are sent to the host system via a high speed USB interface. Integrating multiple sensor arrays, the system can perform temporal coincidence analysis thereby reducing data rates and the computational load on the host system.

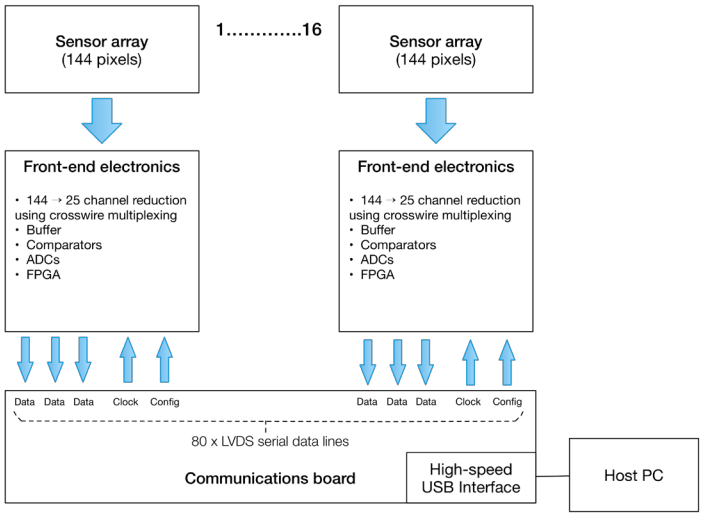
SYSTEM OVERVIEW

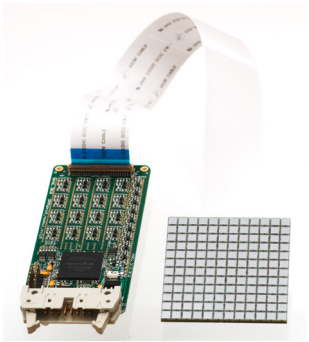
The Matrix system is specifically designed for the readout of scintillator matrices for Positron Emission Tomography (PET) applications. Employing SensL silicon photomultiplier (SiPM) technology, the MatrixB sensor array requires low power and operating voltage, is compact, robust and offers excellent spatial segmentation and optical response uniformity. Addressing the needs of high-resolution imagers such as small animal, pre-clinical and mammography PET, the MatrixB array is a compelling alternative to the multi-anode PMT. A high degree of modularity makes the Matrix system a cost effective substitute for the PMT in full-body PET systems. The Matrix system architecture is based on three principal sub-systems:

1. The **Sensor Array** is a 12 x 12 array of SMT-packaged SiPM sensors mounted on a four-side tileable PCB board. The PCB has integrated cross-wire readout for multiplexing. It is fitted with mechanical mounting points and connects via a 50-way flexible printed circuit cable to the front-end electronics board.

2. The **Front-end Electronics Board** serves to bias the 144 SiPM and amplify their signals. Candidate signals are flagged through a programmable threshold discriminator and are digitized, time stamped, buffered and subsequently read out to the Matrix Communications board through a high speed serial interface.

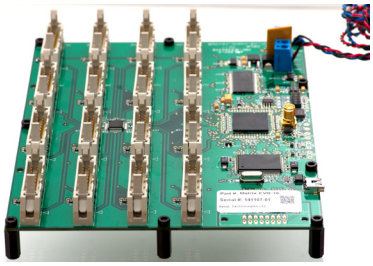
3. The Matrix **Communications Board** (Matrix-EVB-16 - ordered separately) supports up to 16 MatrixB modules. It provides a common clock, retrieves and buffers event data, performs temporal coincidence analysis for events from different sensor arrays and interfaces with the host computer through a high speed USB connection.





MatrixB-30035-144C-**X**CB
Sensor array and front-end readout board. Together these are referred to as the sensor module. The 'X' in the part number above can either be 'S' for use with the slower BGO, or 'F' for use with the faster LYSO.

Matrix-EVB-16
Communications board that can interface with up to 16 of the above sensor array+readout modules (MatrixB-30035-144C-XCB), and sends the data to the host PC.



FRONT-END READOUT SYSTEM CHARACTERISTICS

Parameter	Unit	Value
Board size	mm^2	42.5 x 100.0
Max. cable length to sensor array	mm	70
Module power consumption	W	0.7
Signal threshold discriminator resolution	mV	1
Module interface signal architecture	serial	LVDS
System dead time (1)	µsec	2
Event loss rate @10kHz (100kHz) rates (2)	%	2 (20)
Saturated event rate (2)	kHz	500
Readout modes (3)		3
Firmware updates via host computer		YES

(1) Time required to process a scintillation event that exceeds signal threshold.
(2) Readout in Single Pixel mode.
(3) The module supports three software selectable readout modes:

- ***Single Pixel** - location, time and energy for a single pixel above signal threshold - event size: 8 bytes*
- ***Full** - location and time of single pixel above signal threshold. Readout of recorded energies for all 144 pixels - event size: 38 bytes*
- ***Region of Interest** - location, time and energy of single pixel above signal threshold. Energy for each of its 8 neighboring pixels - event size: 24 bytes.*

COMMUNICATIONS BOARD CHARACTERISTICS

Parameter	Unit	Min.	Max.
Board size	mm^2	141.0 x 183.0	
No. MatrixB arrays supported	mm^3	1	16
USB readout buffer	MB	2	
USB speed	Mbps	20	
Internal clock time resolution	ns	0.5	
Max. cable length to sensor array	cm	250	
Power consumption	W	1.0	
Sustainable event rate - single pixel mode	kHz	200	
Firmware upgrades via host computer		YES	

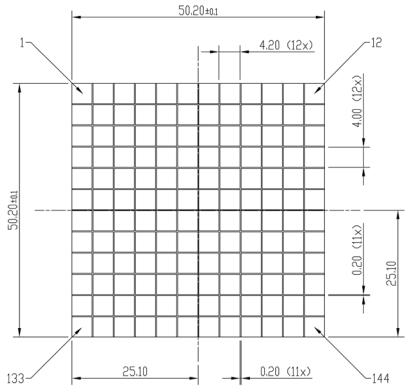
***Time coincidence analysis:** The communications board can match events from different MatrixB modules in terms of event timing. Dropping events that do not satisfy a software selectable time window constraint are dropped, thereby reducing data rates the host computer.*

MATRIXB SENSOR ARRAY CHARACTERISTICS

Parameter	Unit	MatrixB
Sensor array footprint	mm^2	50.2 x 50.2
Number of SiPM pixels		144
Pixel pitch	mm	4.2
Pixel sensitive area	mm^2	9
dE/E (FWHM) for LYSO at 511keV	%	< 14
Optical response uniformity over all pixels (5)	%	< +/-10

(5) Measured as $\frac{PixelResponse}{Median(PixelResponse)}$

Corresponding to a multi-anode PMT uniformity of 1:1.2.



MATRIX SOFTWARE

MatrixB is shipped with a suite of software tools for Windows XP and 7. These include:

- DLL drivers and C header files.
- Fully documented C-code examples.
- A GUI based application for visual display of MatrixB event data and analysis of timing and energy spectra.
- Firmware upload utility.

ORDERING INFORMATION

Product Code	Description
MatrixB-30035-144C-FCB	144-pixel, cross-wire multiplexed, B-Series SMT Array and front-end readout board. Optimized for LYSO ER and CRT.
MatrixB-30035-144C-SCB	144-pixel, cross-wire multiplexed, B-Series SMT Array and Front-end readout board. Optimized for slower crystals requiring only ER.
Matrix-EVB-16	Matrix communications board. [1]
Matrix-EVB-2500cm	2.5 meter ribbon cable for use with the Matrix-EVB-16

[1] *One Required for every 16 MatrixB sensor modules.*

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All specifications are subject to change without notice