Radiation detection solutions for miniaturized pager and handheld markets
Mission

Working with our customers we identify, design and deliver low light detection solutions which solve customer problems and add value. We aim to be the partner of choice because of our flexibility, capabilities and the desire to meet our customer needs.
Motivation

...is to provide a lower cost and technology enabling solid-state alternative to the vacuum tube based photomultiplier tube (PMT)...
Introduction

• Silicon PhotoMultiplier (SPM) detectors are the next generation detector choice for handheld radiation detection
  – For radiation detection, protection and identification

• sensL offer a fully developed prototype system for radiation detection

• sensL seek partners to take this technology to the marketplace
SPM concept

Geiger mode Detector
A photon counting diode detector fabricated in silicon forms the basis for all sensL products

Silicon Photomultiplier (SPM)
By fabricating large arrays of photon counting detectors, sensL create a high gain detector to replace the PMT
Where does an SPM come from?

- sensL SPM detectors are bulk manufactured in a ISO9000 controlled semiconductor foundry
- sensL test and package to produce the best SPM products on the market
Why use SPM detectors?

- Compared to PMT detectors
  - Very small form factor
  - Rugged and immune to magnetic fields and vibrations
  - User safe voltages
  - Similar high gain

- Compared to PIN and APD detectors
  - Much higher gain – simpler system design
  - Much lower system cost and power
  - Less sensitive to bias and temperature change
  - Can operate at higher temperatures
SPM for radiation detection

SPM detectors detect light from scintillating crystals

Combining a SPM detector with CsI(Tl) crystals for example, allows radiation to be detected

Plastic scintillators can be added for body dose response

SPM detector in robust ceramic package

Combination of crystal with a sensL SPM
Radiation Detection Prototype

- Portable gamma radiation detector has been built to demonstrate SPM properties and capabilities
  - Ch1: CsI (Tl) scintillator used with the sensL SPM detector
  - Ch2: Plastic scintillator for body equivalent dose response possible
  - Pulse shaping, amplification along with the multi-channel analyzer has been integrated on a demonstration board
  - Temperature compensation has been implemented through detector bias control and an on-board temperature monitor
  - Spectra data are stored in on board memory
  - USB connection allows data to be uploaded to the PC for analysis
  - Alarms, LCD display, casing or interface buttons are not included at prototype stage and are added as per customer requirements
System Architecture

- ~30V
- HV Supply
- Temp Monitor
- CsI (Ti)
- SPM
- Detector
- Integrating Amplifier
- Pulse Shaper
- Variable Gain Amplifier
- MCA
- Multi-Channel Analyzer

Additional channels as required
Simple compact board design. Additional features possible depending on customer sensitivity and power requirements.
# Performance Comparison

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<th>Isotope Identifier</th>
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<td>PIN Diode with scintillators</td>
<td>PMT with scintillators</td>
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<td><strong>Description</strong></td>
<td>These pager sized electronic devices track the total radiation dose received by the wearer.</td>
<td>These pager sized electronic devices are used to find low levels of radiation using sensitive crystal scintillators.</td>
<td>These devices are typically larger than PRD’s and measure the gamma ray spectra to identify the originating isotope. This information is important in determining the appropriate response actions.</td>
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<td><strong>Users</strong></td>
<td>Suitable for emergency responders who need to be notified if dangerous levels of radiation are present.</td>
<td>Suitable for law enforcement or inspectors who need to be notified of any unusual radiation in their proximity.</td>
<td>Suitable for HAZMAT teams, inspectors or specialised emergency response teams.</td>
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# The sensL advantage

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Energy resolution

sensL SPM are ideal for detection of common high energy sources and particles.
Energy resolution
Cs-137

Cs-137 662 keV Peak
(Energy Resolution is 9% at 662keV)
Isotope identification

Low Energy Gamma Spectra

![Graph showing Am-241 and Co-57 peaks]

High Energy Gamma Spectra

![Graph showing Cs-137 and Mn-54 peaks]

Measurements for a variety of radiation sources
Temperature stability

Cs-137 Spectra Taken With Temperature Compensated Bias

Operation is stable over a wide temperature range
Linearity

Detection Linearity

Good linearity up to 3MeV
Conclusions

• sensL have developed the technology required for a compact, portable, pager style radiation detection and identification system

• sensL seeks partners to take this technology to the market

• Benefits to our customers: low system cost, high performance, robustness, reliability, user safe operating voltages, high volume and scalable technology with a rapid time to market