ON

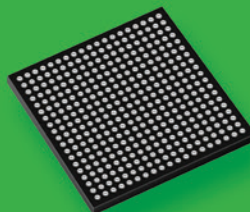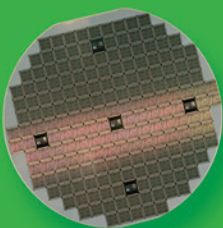**Energy Efficient Innovations**

Medical Imaging Solutions

Improving lives through innovative solutions from ON Semiconductor.

Bringing Silicon to Life

An aging population and the rising incidence of chronic diseases including cancer and cardiovascular disorders, emphasis on early diagnosis to improve health and to reduce healthcare costs has led to an increased need for diagnostic imaging. Diagnostic imaging includes the use of different imaging modalities to capture images of the body for diagnosis and treatment. These factors are playing a part in presenting a large global patient pool undergoing diagnostic imaging procedures. This is driving the demand for technologically advanced medical imaging equipment, adoption of intelligent and connected portable devices and innovation.

Semiconductor technology plays a significant role in that innovation. With a diverse portfolio of products and services, talented engineering staff with system expertise, a deep understanding of the quality, reliability and longevity requirements of the medical market, and global manufacturing and logistics capability, ON Semiconductor enables developers of medical technology to solve their unique design challenges with high performance silicon solutions.

Expertise and Experience
- 50+ years of custom silicon experience, including high-reliability life-critical and implantable applications
- Heritage of serving the medical imaging, neurostimulation, implantables, remote patient and blood glucose monitoring and hearing aid industry since early 1970s
- Extensive system knowledge in focus applications
- Fully certified and robust custom development process
- Rich portfolio of ultra-low-power analog, digital, and memory IP
- System architects for product concept and architecture review
- Highly skilled and experienced silicon, packaging, and test engineers
- Dedicated program managers for development tracking and reporting
- Volume Production Delivery

Quality, Reliability, and Commitment
- Process and product longevity to support extended product life-cycles
- Traceability and data retention processes that meet the special needs of medical applications
- Lot Acceptance Testing (LAT) performed on each individual lot
- World-class owned and operated fabs
- Reliability and failure analysis lab
- Quality certifications including ISO/TS 16949, ISO 9001, AS 9100, ISO 14001, MIL-PRF-38535, QML, C-TPAT and STACK
- ISO 13485 for advanced packaging facility
- FDA compliance
- REACH compliance
- IEC 62304 compliance

Products and Capabilities
- High voltage, low noise and low power processes
- System-in-Package (SiP) that include passive devices
- Precision mixed-signal microcontrollers
- Mixed-signal ASIC development services with flexible engagement models (Turnkey, Shared, Foundry)
- Complete supply chain and lifecycle management
- CMOS image sensors and SiPM for medical imaging
- Large portfolio of power management and discrete components
- FPGA and ASIC conversions
- Embedded Non-Volatile Memory (EEPROM, OTP) RAM & ROM, high speed interfaces and ARM cores
- Robust ESD protection
- Foundry and value-added front- and back-end services
- Advanced packaging and product miniaturization techniques
- Customization of many portfolio products

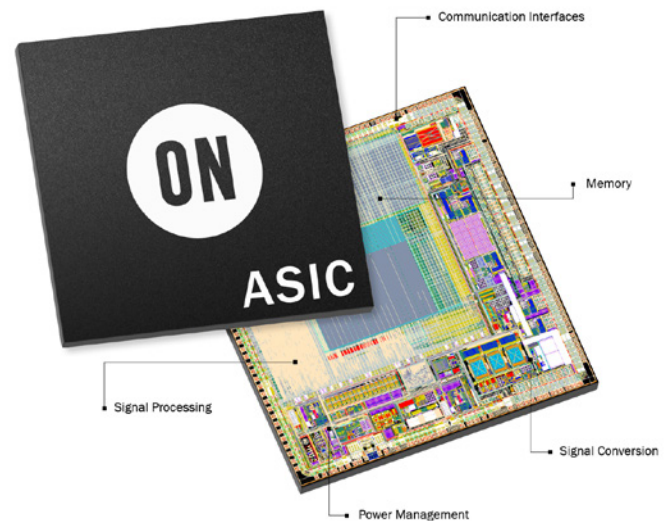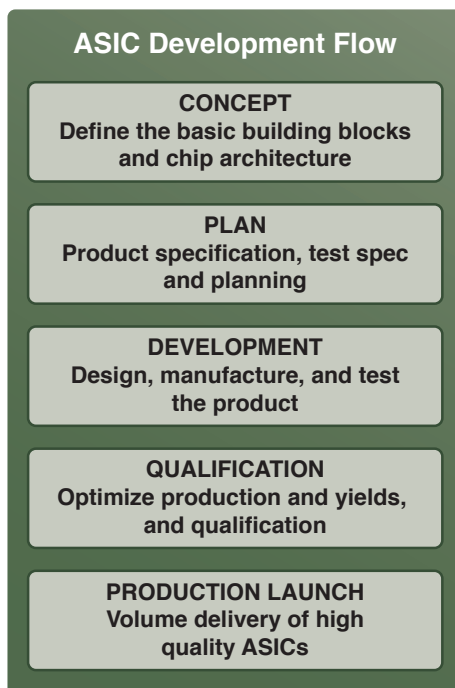# Medical ASIC Design and Manufacturing Services

ON Semiconductor has over five decades of experience designing and manufacturing complex ASICs for medical applications, offering both mixed-signal and digital solutions.

With an increasing number of medical devices becoming portable, more intelligent, and connected, medical device manufacturers are looking for highly integrated semiconductor solutions that enable higher performance, smaller size, lower power consumption, and higher reliability.

With proven design methodologies, dedicated system architects, an extensive IP portfolio, wide selection of fab process technologies, and advanced packaging solutions, ON Semiconductor helps customers transform their concept and initial specifications into volume production of a finished device.

Intellectual Property

ON Semiconductor offers an extensive library of IP blocks for use in ASIC designs, including signal conversion, signal processing, ADCs, memory, communication interfaces, power management, and low-noise circuits. System architects work with customers to identify the most appropriate technology and IP selection.

ASIC Development Flow

CONCEPT
Define the basic building blocks and chip architecture

PLAN
Product specification, test spec and planning

DEVELOPMENT
Design, manufacture, and test the product

QUALIFICATION
Optimize production and yields, and qualification

PRODUCTION LAUNCH
Volume delivery of high quality ASICs

System Architects

System architects help to refine design specifications to ensure feasibility and maximize functionality, while optimizing performance, power consumption, and size.
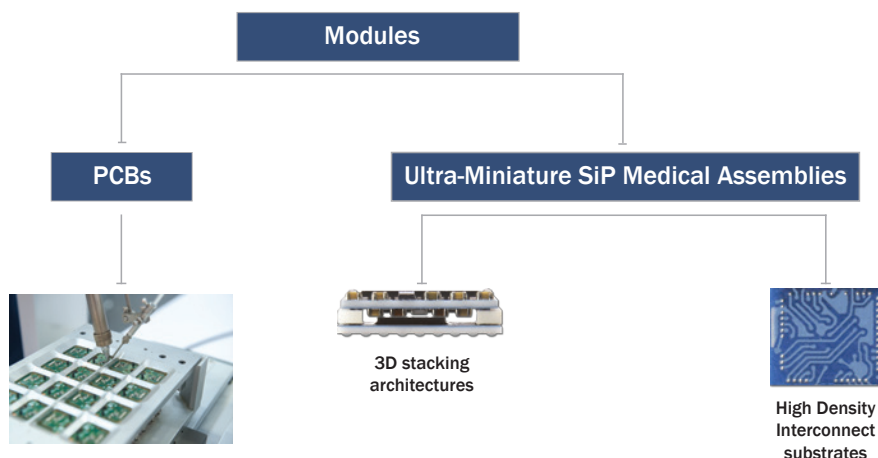
Some of the ASIC devices that ON Semiconductor system architects and engineering staff have recently developed include:

- Data acquisition system devices
- Sensor interface circuits

Flexible Engagement

Whether the requirement is full or partial definition and design, design services after an RTL or netlist handoff, foundry services, custom advanced packaging of existing designs, or full turnkey service, ON Semiconductor tailors services to the unique requirements of medical customers. FPGA to ASIC conversions are also available.

Advanced Packaging and Assembly Capability

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            │    PCBs      │      │ Ultra-Miniature SiP Medical Assemblies│
            └──────────────┘      └────────────────────────────────────┘
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3D stacking
architectures

High Density
Interconnect
substrates

ON Semiconductor is a pioneer in the development of miniaturized, 3D and custom packaging solutions for the medical microelectronics industry.

The company offers turnkey solutions for medical applications where size, performance, and system integration are critical. ON Semiconductor has proven leadership in 3D System-in-Package (SiP), and unique module solutions.

Whether the need is for a custom component such as a complete tested printed circuit board, fully integrated SiP, ceramic, laminate or silicon Interposer with surface mount discretes, ON Semiconductor offers custom package development and manufacturing services, from design and test through volume manufacturing.

The ON Semiconductor facility located in Burlington, Canada, offers manufacturing compliance with US Food & Drug Administration (FDA) regulations.

Printed Circuit Board Modules

ON Semiconductor offers printed circuit board module design, manufacturing, assembly, and test services to standards of quality and traceability demanded by medical device manufacturers. Features like 2D barcodes screened onto every board for individual tracing is just one example of how our standard process is tailored to medical needs.

Advanced 3D Packaging

Custom 3D packaging connects different silicon die and discrete components together in the same package to dramatically save space and improve electrical performance by decreasing signal distances.

- Stacking with wirebonds or flipchip
- Au and Cu bumping
- 3D Packaging with TSV
- Modular, scalable architectures with high degree of manufacturing testability
- Mature, robust technologies and structures
- RoHS-compliant and ISO-certified
- For applications with high reliability requirements

Detector

Circuitry   Circuitry

Unique Module Solution

Side by Side

Stacked

ON

System in Package

Multi-Chip Module Solutions
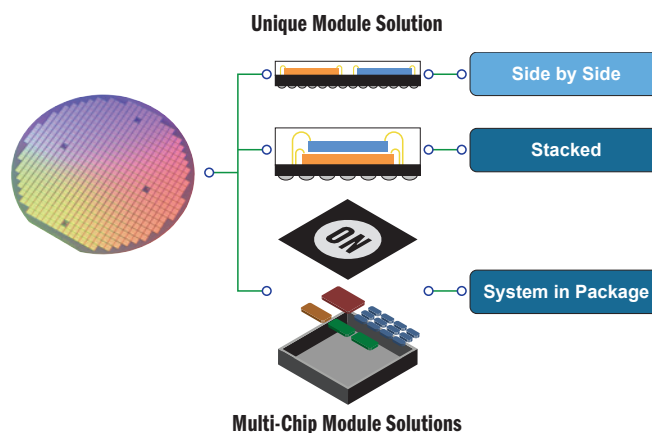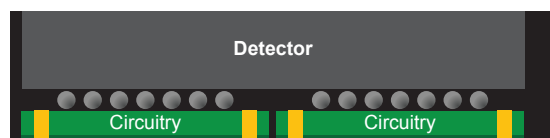
Foundry Services

ON Semiconductor offers foundry services specifically tailored to the medical market. With analog, high voltage, and low power options, these world-class processes are ideally suited for applications such as Ultrasound, Computed Tomography (Traditional and Photon Counting), X-Ray, Positron Emission Tomography, Magnetic Resonance Imaging and Nuclear Imaging among others.

The company provides process design kits (PDKs) and design guides for our technology. Customers are ensured direct technical communication with the foundry through a development customer service representative (DCSR). The DCSR coordinates the project through the engineering and prototype stages and responds to customer inquiries.

Value-Added Services

Other front-end and back-end services are available, such as wafer probe, custom short flow wafer processing, backgrind, backmetal, custom packaging, test, logistics, and supply chain management.

Features

- Optimized in-house process technologies tailored to medical applications
- Process longevity to support long product life cycle requirements
- World-class, high-reliability manufacturing sites certified to multiple international standards
- Access to extensive IP including configurable SRAM and EEPROM
- Multi-project wafer (MPW) and multi-layer reticle (MLR) prototyping support
- Extensive failure analysis capability
- Low cost shuttle service for development
- Flexible manufacturing: process modifications and lot splits

Mixed-Signal Process Technologies

ON Semiconductor offers ultra-low-power and low-leakage CMOS processes, as well as high voltage CMOS and BCD, tailor-made for the stringent demands of medical applications.

0.5 to 55 nm

Node (μm)	Process Name	No. Metal Layers	Wafer Size (mm)	Operating Voltage (V_{gs})	HV Devices (V_{ds})	N-Ch DMOS	P-Ch DMOS	Bi-Polars	Linear Cap	RAM	ROM	OTP	EEPROM
0.055	GF55	5–8	300	1.2, 1.8, 2.5, 3.3	3.3	Yes	Yes	Yes	MOM	Y	Y	Y	N
0.055	ONK65BCD	5–8	300	1.2, 1.8, 2.5, 3.3	24, 45	Yes	Yes	Yes	MIM	Y	Y	Y	Y
0.065	ONK65	5–8	300	1.2, 1.8, 2.5, 3.3	3.3	No	No	Yes	MIM	Y	Y	Y	N
0.18	I4Te SOI *	4–6	200	1.3, 3.3	160	Yes	Yes	TBD	MIM	Y	Y	TBD	TBD
0.18	I4T + I4Te	4–6	200	1.8, 3.3	45, 60, 70	Yes	Yes	No	MIM	Y	Y	Y	Y
0.18	ONC18 18v18v	4–6	200	5, 18	18	Yes	Yes	No	MIM	Y	Y	Y	Y
0.18	ONC18 5v30v	4–6	200	1.8, 5	30	Yes	Yes	No	MIM	Y	Y	Y	Y
0.18	ONC18 G/MS	4–6	200	1.8, 3.3	15	Yes	Yes	No	MIM	Y	Y	Y	Y
0.25	ONBCD25	2–5	200	1.8, 3.3	40	Yes	Yes	No	MIM	N	N	Y	N
0.25	ONC25	2–5	200	2.5, 3.3, 5	5	No	No	Yes	MIM	N	N	Y	N
0.35	C3	3–5	200	3.3, 5	5	No	No	No	PIP	Y	Y	N	Y
0.35	I3T80	3–5	200	3.3	70	Yes	Yes	Yes	MIM	Y	Y	Y	Y
0.35	I3T50	3–5	200	3.3	40	Yes	Yes	Yes	MIM	Y	Y	Y	Y
0.35	I3T25	3–5	200	3.3, 12	18	Yes	Yes	Yes	MIM	Y	Y	Y	N
0.5	C5	2–3	200	5, 12	20	Yes	Yes	No	PIP	Y	Y	N	Y

* Process on roadmap.

Silicon Photomultipliers (SiPM)
for high performance, time-of-flight positron emission tomography

Time-of-Flight Positron Emission Tomography (ToF-PET) systems seek to optimize the coincidence resolving time (CRT) between a pair of radiation detection elements in order to provide the best image quality. ON Semiconductor has a range of high performance Silicon Photomultipliers (SiPM) that can be used as the photosensor element in PET detectors to provide excellent CRT performance.
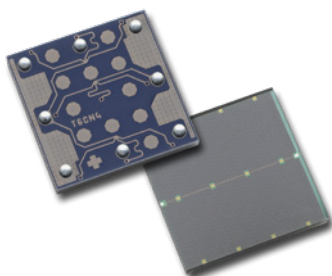
J-Series SiPM Features

- 50% PDE @ 420 nm
- High fill factor package, giving a packing fraction of >90%
- Optimized for fast timing applications and featuring unique fast output
- Low dark count rate of <100 kHz/mm^2
- Available as single sensors (3 mm, 4 mm, or 6 mm) or as pre-fabricated arrays
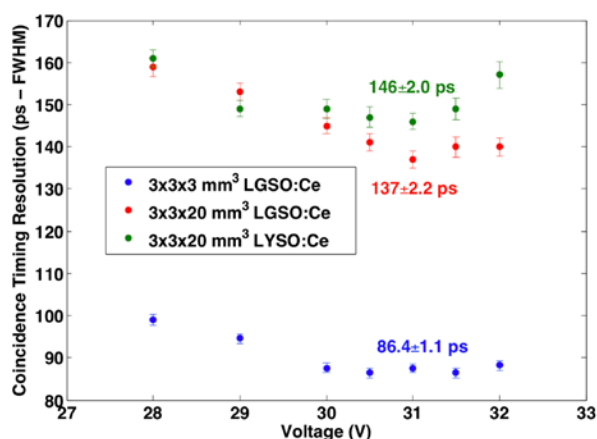
CRT values as a function of bias voltage for different crystals, obtained with the fast outputs from two MicroFJ-30035-TSV sensors in coincidence, results courtesy of J. Cates and C. Levin of Stanford University.
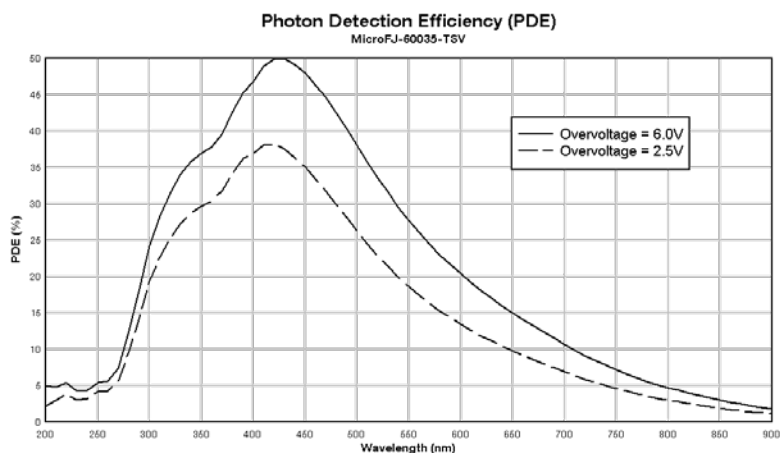
PDE (photon detection efficiency) of J-Series SiPM sensors, showing 50% at 420 nm, which is the peak emission of the commonly used LYSO scintillator.

Device	Sensor Size (mm)	Cell Size (μm)	Package
MicroFJ-30035-TSV	3	35	TSV Chip Scale
MicroFJ-40035-TSV	4	35	TSV Chip Scale
MicroFJ-60035-TSV	6	35	TSV Chip Scale

These sensors are also available in a selection of arrays.
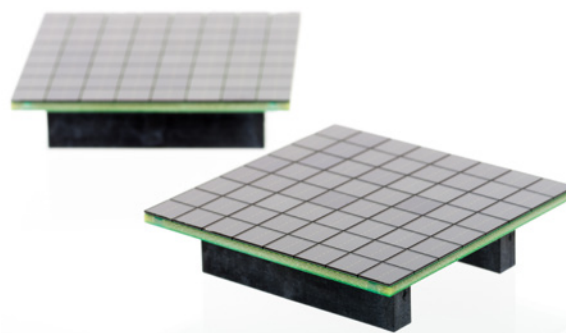
ArrayJ-60035-64P-PCB array of SiPM

For additional information, please visit our website at:

www.onsemi.com/solution/medical/medical-imaging-devices

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