ON Semiconductor®

Energy Efficient Innovations

Medical Solutions

Specialized products, processes, and services from ON Semiconductor.

www.onsemi.com

Bringing Silicon to Life

An aging population and the pressure of rising healthcare costs are driving a shift towards home healthcare. This shift along with an increased interest in health and wellness and the adoption of intelligent and connected portable devices are driving medical device 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.

Products and Capabilities

- Precision mixed-signal microcontrollers
- Preconfigured and open-programmable DSP systems
- Mixed-signal ASIC development services with flexible engagement models
- CMOS image sensors for medical imaging
- Large portfolio of power management and discrete components
- FPGA and ASIC conversions
- Custom and semi-custom ultra-low-power SRAM and EEPROM
- Foundry and value-added front- and back-end services
- Advanced packaging and product miniaturization techniques
- Customization of many portfolio products

Expertise and Experience

- 30+ years of custom silicon experience, including high-reliability implantable applications
- Heritage of serving the 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

Quality, Reliability, and Committment

- 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
- Member of Continua Health Alliance
- Member of Hearing Industries Association

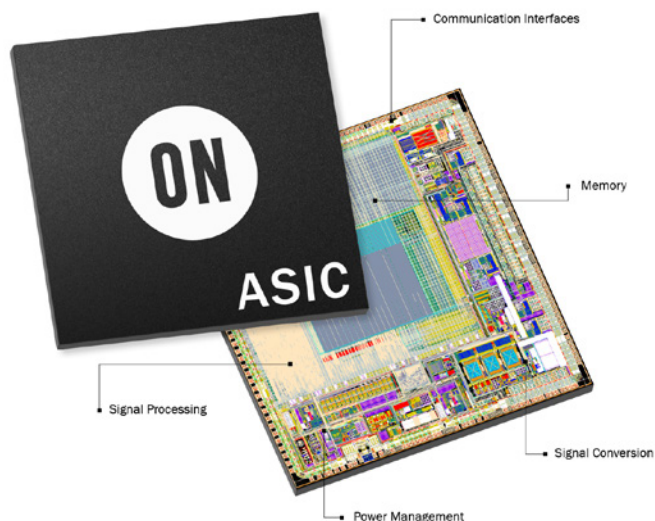# Medical ASIC Design and Manufacturing Services

ON Semiconductor has over three 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, memory, communication interfaces, and power management. 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:

- Sensor interface for blood gas monitoring
- Vital sign patch monitor
- Data acquisition system devices for CT scanners, X-Ray, Ultrasound, and PET machines
- Precision analog front-end for ECG

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.
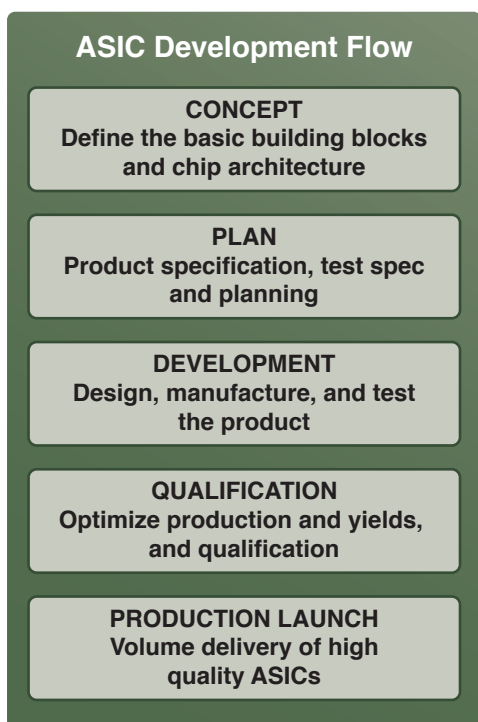
Miniature Medical Sensor Interface and Processing Solutions

ON Semiconductor supplies mixed-signal, 32-bit micro-controllers ideally suited for wearable, precision-sensing medical devices. Built around a programmable ARM® Cortex™-M3 processor, the power-optimized architecture is developed to pair with custom-designed, analog front-end ASICs in a single package, forming complete, miniature, energy-efficient processing systems.

Features

- Power Management
  - Off, Sleep, Standby and Run Modes
  - 150 µA/MHz in Run Mode @ 3 V supply voltage
  - <200 nA in sleep mode with real-time clock active
  - <500 nA in standby mode with RAM-retention
- Analog to Digital Conversion
  - 3-input, mixed, 12-bit A/D converter (<10 kilo-samples/second)
- Interfaces and Peripherals
  - Supports all standard interfaces such as UART, SPI (Master/Slave), I2C, PCM, 2-wire JTAG for debugging
- Memory
  - 512 kB FLASH
  - 24 kB RAM

Benefits

- Seamless integration with custom ASICs from ON Semiconductor
  - Pair a proprietary sensor interface ASIC with a standard microcontroller in one single package to reduce board space
  - Glueless connection from the ASIC to microcontroller
  - Connectivity via standard interfaces such as SPI, I2C, UART, JTAG
- Power management
  - Flexible power management to accommodate a variety of battery types (sizes and voltages)
  - Brown-out protection to handle sudden changes in battery voltage

Applications

- Blood glucose meters
- Wireless electrocardiographs
- Pulse oximeters
- Telehealth/remote patient monitors
- Personal emergency response systems
- Fitness and wellness monitoring devices (e.g., activity, calorie, and sleep monitors)

Block Diagram
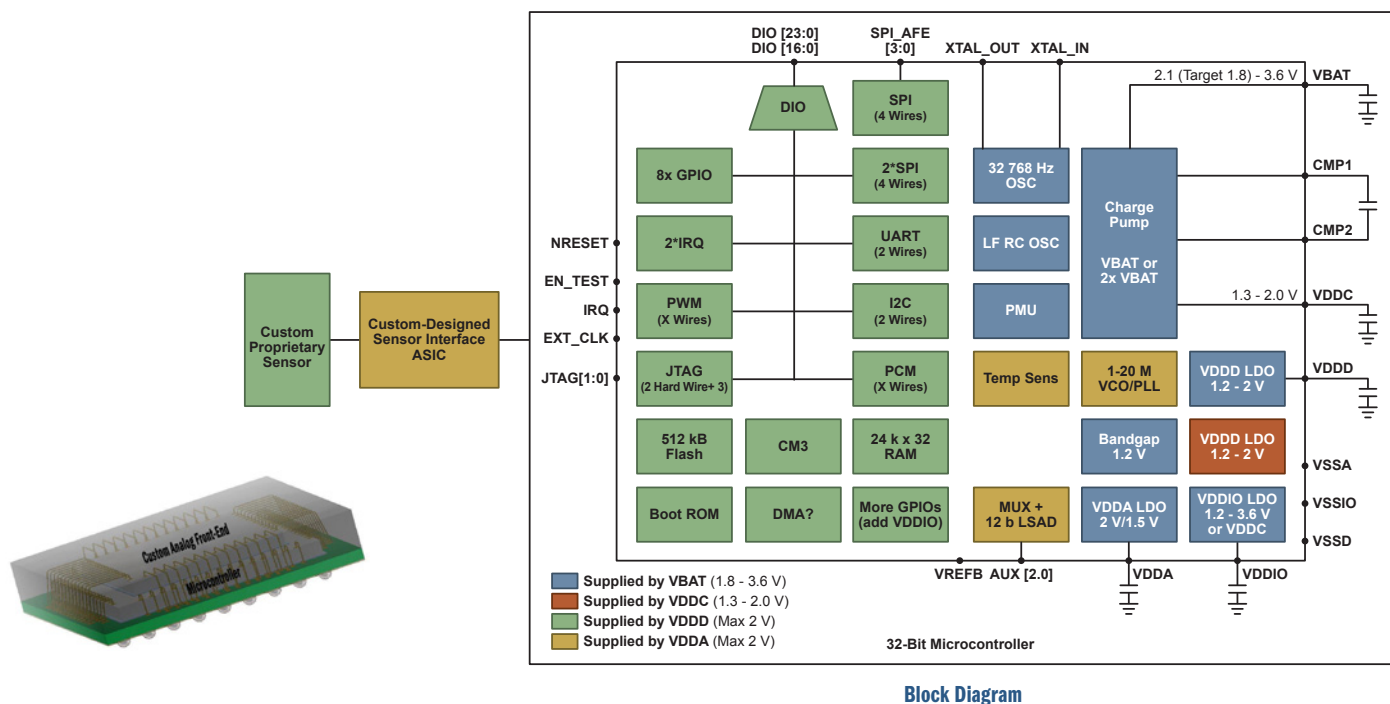
Ultra-Low-Power DSP Systems for Portable Medical Devices

BelaSigna® digital signal processors are complete, fully-programmable signal processing systems ideal for use in portable medical applications. Optimized for size, power consumption, signal integrity and computational power, BelaSigna processors deliver the flexibility of a generic DSP with the power consumption and size of a fixed-function ASIC.
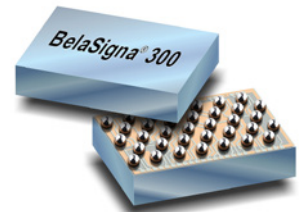
Features and Benefits

- Flexible to meet specialized requirements
- High precision analog input stage
  - 4 independent input channels
  - 88 dB dynamic range
  - A/D sampling rates from 1.27 – 60 kHz
- Ultra-low power consumption
  - Supply voltage down to 1.2 V
  - 511 µA @ 1.8 V current consumption in a 5-lead wireless ECG
- Miniature package size

- Dual-core computing
  - Open-programmable DSP core with a highly configurable coprocessor balances processing power and optimizes power consumption and design flexibility
- Comprehensive suite of development tools

Applications

- Wireless electrocardiographs
- Pulse oximeters
- Electronic stethoscopes
- Medical devices requiring audio processing
- See AND9035/D, BelaSigna 250 and 300 for Low-Bandwidth Applications
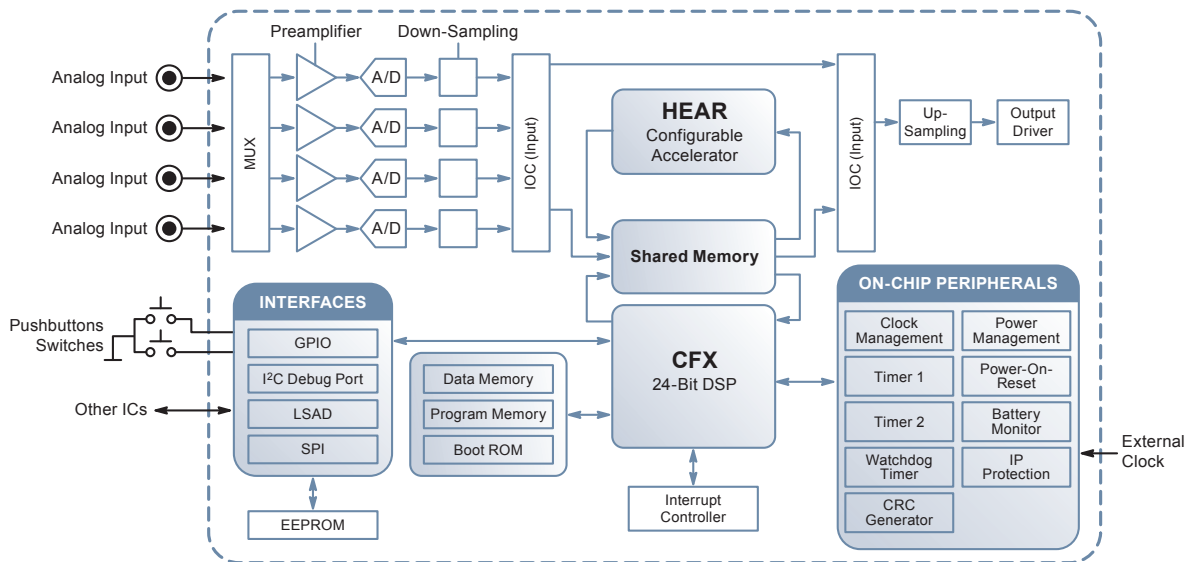
Device	Description	MIPS Max	Dynamic Range (dB)	RAM	Interfaces	Power Consumption	Standby Current (µA)	Analog Audio I/O	Packages
BelaSigna 300	24-Bit Audio Processor for Portable Communication Devices	240	110/88	110 kB	I2S, PCM, GPIO, I2C, SPI	1-5 mA Typical	40	4/1	WLCSP-35, DFN-44
BelaSigna 250	16-Bit Audio Processor, Full Stereo 2-In 2-Out	60	88	42 kB	I2S, PCM, GPIO, I2C, SPI, UART	5 mA @ 20 MHz	50	2/2	LFBGA-57, LFBGA-64

Open-Programmable DSP Systems for Hearing Aids

The highly customizable Ezairo® series of open-programmable DSP systems enables manufacturers to build hearing aids with high precision sound. With processing power to run several advanced software algorithms simultaneously, Ezairo DSP systems' unique and patented architecture optimally balances processing power, power consumption, and design flexibility. Ezairo systems are available in several hybrid package configurations, including the wireless-ready Ezairo 7100 series, and are ideally suited for hearing aid manufacturers wishing to develop or source their own innovative algorithms.

Features and Benefits

- High-precision sound with 24-bit precision computing
  - Allows development of more complex and efficient hearing aid algorithms
- Dual-core or quad-core computing
  - Balances processing power and optimizes power consumption and design flexibility
- Ultra-high audio fidelity
  - Enables substantially enhanced performance, especially for mild to moderate hearing loss profiles that demand more natural sound
- Ultra-low-power consumption
  - Extends life of small batteries
- Wireless capability
  - Seamless control of low-power radios for wireless-enabled hearing aids

	Ezairo 5920	Ezairo 7110
DSP	24 bits	24 bits
Accelerator	HEAR	HEAR
Wireless Control System	–	ARM Cortex-M3 Processor plus Hardwired Support
Clock Speed	Max 5.12 MHz	Max 10.24 MHz
Typical Power Consumption	~850 µA @ 5.12 MHz	~700 µA @ 10.24 MHz
Max MIPS	45	250
Total Program Memory	14 kwords	40 kwords
Total Data Memory	20 kwords	44 kwords
Battery Voltage	Typ 1.25 V, Max 1.5 V	Typ 1.25 V, Max 2.0 V
EEPROM	512 kbit	2048 kbit

e-LEGACY awards 2007

Development Tools

The Ezairo series is fully supported by an extensive suite of development tools to help manufacturers quickly and easily develop, debug and test software for hearing aid DSP systems. The development tools available include:

- Integrated Development Environment (IDE): A fully integrated software development environment that enables developers to code, compile, debug and validate hearing aid algorithms
- Communication Tool Kit (CTK): An easy-to-use universal software component library that facilitates communication with the DSP system for development, fitting system, manufacturing, and testing environments
- Evaluation and Development Board (EDB): Hardware for the development, demonstration, testing and debugging of hearing aid algorithms
- Hybrid Demo Board (HDB): Hardware for assessing and testing the audio performance and power consumption of hybrid modules
- Communication Accelerator Adapter (CAA): Facilitates high-speed communication between host PCs and the EDB and HDB

**Ezairo Development Tool Kit**

Preconfigured DSP Systems for Hearing Aids

ON Semiconductor preconfigured DSP systems are available in multiple hybrid options and feature bundles, supporting all hearing aid product portfolio needs. This series is ideally suited for hearing aid manufacturers who want implementation-ready solutions that require minimal programming or configuration.

A complete software development suite is available to help select speech processing options, hardware options, and interface to fitting software.

Advanced Algorithms

- Binaural synchronization
- Binaural telecoil
- Stereo audio streaming
- Environmental classification
- Automatic adaptive directionality
- FrontWave® directional sound processing
- Adaptive noise reduction
- Adaptive feedback cancellation
- Static feedback management
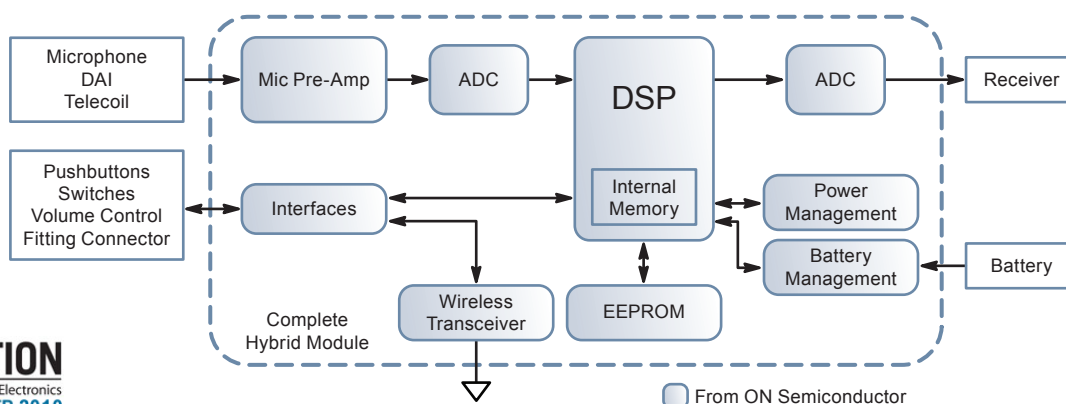
Generic Hearing Aid Application Diagram

Device	WDRC Channels	Wireless Transceiver	Advanced Algorithms	Graphic EQ Bands	Acoustic Indicators	Other Features	Program Modes
AYRE™ SA3291	up to 8	NFMI	Adaptive Feedback Cancellation; Adaptive Noise Reduction; Automatic Adaptive Directionality; Binaural Synchronization; Binaural Telecoil; Environmental Classification; FrontWave Directional Microphone; Static Feedback Management; Stereo Audio Streaming	16	EVOKE	Datalogging; Digital Volume Control	6
RHYTHM™ R3910	up to 8	–	Adaptive Feedback Cancellation; Adaptive Noise Reduction; Automatic Adaptive Directionality; Environmental Classification; FrontWave Directional Microphone; Static Feedback Management	16	EVOKE	Datalogging; Digital Volume Control	6
RHYTHM R3710	up to 8	–	Adaptive Feedback Cancellation; Adaptive Noise Reduction; Environmental Classification; FrontWave Directional Microphone; Static Feedback Management	16	EVOKE	Datalogging; Digital Volume Control	6
RHYTHM SB3231	up to 4	–	Adaptive Feedback Cancellation; Adaptive Noise Reduction; FrontWave Directional Microphone	8	EVOKE	Trimmer Support	4
RHYTHM SB3229	up to 4	–	Adaptive Feedback Cancellation	8	EVOKE	Digital Volume Control; Trimmer Support	4
FOUNDATION® GA3216	up to 2	–	Static Feedback Management	–	–	Trimmer Support	4
CONSOLIDATOR™ GA3227	up to 2	–	Static Feedback Management	–	–	Trimmer Support	3

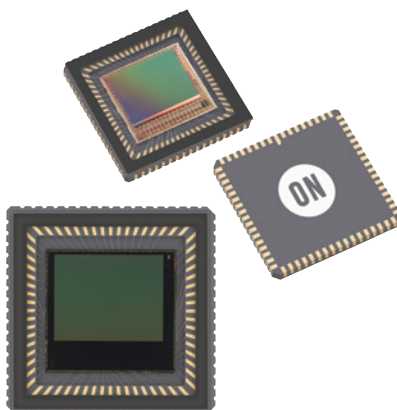| Features	CONSOLIDATOR™	FOUNDATION®	RHYTHM™	
Root Part Number	GA3227	GA3216	SB3229	SB3231
Advanced Algorithm Features				
Binaural Synchronization				
Binaural Telecoil				
Stereo Audio Streaming				
iSceneDetect™ Environmental Classification				
Automatic Adaptive Directionality				
FrontWave® Directional Microphone				•
Adaptive Noise Reduction				•
Advanced Adaptive Feedback Cancellation			•	•
Static Feedback Management	•	•		
Performance				
Adaptive AGC-O				
Input Dynamic Range	95 dB	95 dB	96 dB	96 dB
Bandwidth	12 kHz or 16 kHz	12 kHz or 16 kHz	8 kHz or 16 kHz	8 kHz or 16 kHz
High Power Compatibility	•	•	•	•
Audio Path Word Length	20-bit	20-bit	20-bit	20-bit
WDRC Amplification				
Number of WDRC Channels	1 or 2	1 or 2	1, 2 or 4	1, 2 or 4
Adjustable Thresholds and Time Constants	•	•	•	•
Adjustable Expansion Ratio			•	•
In-channel Expansion	•	•	•	•
Twin Average Detection	•	•	•	•
Frequency Response Shaping				
Graphic Equalization			8 band	8 band
Additional Parametric Filters	•	•	•	•
Preconfigured Filters	•	•	•	•
Generic Biquad Filters	•	•	•	•
Acoustic Indicators				
EVOKE™ Advanced Acoustic Indicators			•	•
Configurable Low Battery Indicator	•	•	•	•
Click-free Memory Switching with Cross Faders			•	•
Programmable Memory Change Indicator	•	•	•	•
Trimmer Functionality				
Trimmer Support	•	•	•	•
Number of Trimmers	4 + VC	4 + VC	4 + VC	4 + VC
Other Features				
Datalogging				
Internal Noise Generation for Tinnitus Treatment			•	•
Real Ear Feedback Measurement				•
In-Ear Stimulation with Narrow Band Noise			•	•
Rocker Switch			•	•
Digital Volume Control			•	•
Programmable VC Range			•	•
VC/MS Software Lock			•	•
Programmable Power-on Delay			•	•
Programmable Interface	SDA	SDA	SDA/I2C	SDA/I2C
Program Modes	3	4	4	4
Number of Inputs	2 (1 MIC, 1 TCOIL)	2 (1 MIC, 1 TCOIL)	4 (2MIC, 1 DAI, 1 TCOIL)	4 (2MIC, 1 DAI, 1 TCOIL)
Advanced Power Management			•	•
Software Support				
ARK Support	•		•	•
Feedback Path Modelling Tool				•
SOUNDFIT® Fitting Software	•	•	•	•
Software Security	•	•	•	•
Packaging				
Hybrid Size	6.35 x 3.80 x 1.17 mm 0.250 x 0.150 x 0.046 in	4.82 x 3.12 x 1.52 mm 0.190 x 0.123 x 0.060 in	5.59 x 3.18 x 1.52 mm 0.220 x 0.125 x 0.060 in	5.59 x 3.18 x 1.52 mm 0.220 x 0.125 x 0.060 in
Suitable for Invisible-in-Canal (IIC)				
Reflowable	•	•	•	•
RoHS	•	•	•	•
Hybrid Package – Actual Size				

	RHYTHM™		AYRE™
	R3710	R3910	SA3291
			•
			•
	•	•	•
		•	•
	•	•	•
	•	•	•
	•	•	•
	•	•	•
	96 dB	96 dB	96 dB
	8 kHz or 16 kHz	8 kHz or 16 kHz	8 kHz or 16 kHz
			•
	20-bit	20-bit	20-bit
	1, 2, 4, 6 or 8	1, 2, 4, 6 or 8	1, 2, 4, 6 or 8
	•	•	•
	•	•	•
	•	•	•
	•	•	•
	16 band	16 band	16 band
	•	•	•
	•	•	•
	•	•	•
	•	•	•
	•	•	•
	•	•	•
	•	•	•
		•	•
		•	•
		•	•
		•	•
	Software Adjustable	•	•
	•	•	•
	•	•	•
	•	•	•
	SDA/I2C	SDA/I2C	SDA/I2C
	4	6	6
	2 (1 MIC, 1 MIC or 1 TCOIL)	4 (2 MIC, 1 DAI, 1 TCOIL)	4 (2 MIC, 1 DAI, 1 TCOIL)
	•	•	•
	•	•	•
	•	•	•
	•	•	•
	4.57 x 3.12 x 1.39 mm	5.59 x 3.18 x 1.52 mm	6.35 x 3.68 x 1.65 mm
	0.180 x 0.123 x 0.055 in	0.220 x 0.125 x 0.060 in	0.250 x 0.145 x 0.065 in
	•	•	•
	•	•	•
	•		

VITA

FEATURES

- 1.3 to 25 megapixel resolution
- Pipelined and triggered global shutter with dual slope readout
- Rolling shutter with CDS
- Up to 150 fps full frame readout
- Configurable operation modes
- Ease of operation
- LVDS or CMOS outputs
- 10-bit or 8-bit accuracy
- Multiple parallel window readout
- Mono and color variants

VITA Standard Image Sensors

The growing demand for new applications is opening up exciting opportunities for high-performance CMOS image sensors. Besides high-end machine vision, there is a rapidly expanding market for 2D barcode readers, high-end security solutions, and a new breed of intelligent traffic management systems. The needs of these new markets can be addressed by the VITA family from ON Semiconductor. VITA offers configurability, flexibility and ease of operation.

VITA 5000
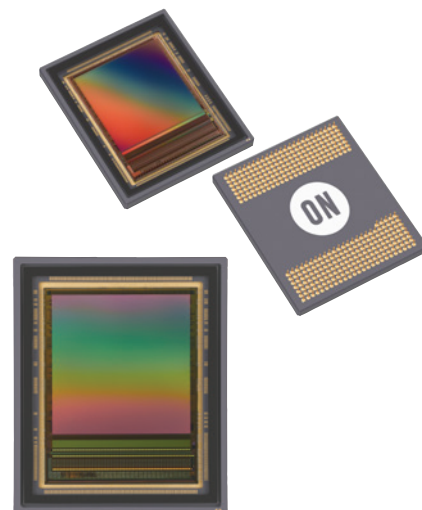
VITA 25K

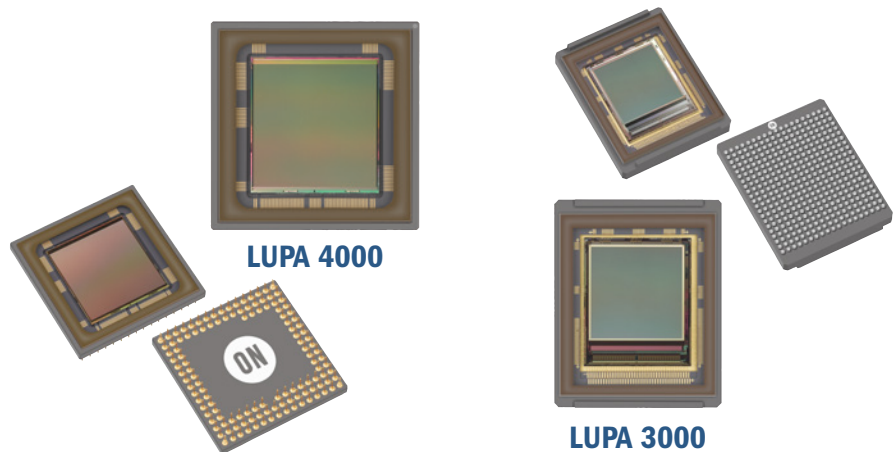| Parameter	VITA 1300	VITA 2000	VITA 5000	VITA 25K
Active Pixels	1280 (H) x 1024 (V)	1920 (H) x 1200 (V)	2592 (H) x 2048 (V)	5120 x 5120
Pixel Size	4.8 μm x 4.8 μm	4.8 μm x 4.8 μm	4.8 μm x 4.8 μm	4.5 μm x 4.5 μm
Shutter Type	Global and Rolling shutter	Global and Rolling shutter	Global and Rolling shutter	Global and Rolling shutter
Master Clock	62 MHz (PLL)	62 MHz (PLL)	62 MHz (PLL)	310 MHz (10-bit output)
Windowing	8 randomly programmable ROI. Normal, sub-sampled and binned readout modes.	8 randomly programmable ROI. Normal, sub-sampled and binned readout modes.	8 randomly programmable ROI. Normal, sub-sampled and binned readout modes.	32 randomly programmable ROI. Normal, sub-sampled and binned readout modes.
ADC Resolution	10-bit, 8-bit	10-bit, 8-bit	10-bit, 8-bit	10-bit, 8-bit
LVDS Output	4 data + sync + clock	4 data + sync + clock	8 data + sync + clock	32 data + sync + clock
CMOS Outputs	10-bit parallel output, frame valid, line valid, clock	10-bit parallel output, frame valid, line valid, clock	NA	NA
Power Dissipation	475 mW in 10-bit mode	510 mW in 10-bit mode	1000 mW in 10-bit mode	3.5 W in 10-bit mode
Package	LCC-48	LCC-52	LCC-68	μPGA-355
Optical Format	1/2 inch	2/3 inch	1 inch	35 mm
Frame Rate	150 fps (LVDS) 37 fps (CMOS)	90 fps (LVDS) 22 fps (CMOS)	75 fps	53 fps
Responsivity @ 550 nm	4.58 V/lux.s, 23.82 LSB10/nJ/cm^2	4.58 V/lux.s, 23.82 LSB10/nJ/cm^2	4.58 V/lux.s, 23.82 LSB10/nJ/cm^2	3.3 V/lux.s, 18.16 LSB10/nJ/cm^2
FPN	0.5% RMS	0.5% RMS	0.5% RMS	0.5% RMS

LUPA

FEATURES

- Frame rates up to 500 fps at several megapixel resolutions
- Unprecedented sensitivity
- Pipelined global shutter
- Low power dissipation
- High resolution
- No blooming or image lag
- Mono and color variants

LUPA Standard Image Sensors

The LUPA family is a result of in-depth research and extensive experience developing high speed CMOS image sensors.

LUPA devices offer resolution as high as 2048 x 2048 and frame rates up to 500 fps. These features, combined with power consumption as low as 150 mW with absolutely no blooming or lag, create a perfect foundation for highly reliable, high sensitivity image sensors.

LUPA 4000

LUPA 3000

Parameter	LUPA 300	LUPA 1300-2	LUPA 3000	LUPA 4000
Active Pixels	640 (H) x 480 (V)	1280 (H) x 1024 (V)	1696 (H) x 1710 (V)	2048 x 2048
Pixel Size	9.9 μm x 9.9 μm	14 μm x 14 μm	8 μm x 8 μm	12 μm x 12 μm
Shutter Type	Pipelined and Triggered Global shutter	Pipelined and Triggered Global shutter	Pipelined and Triggered Global shutter	Pipelined and Triggered Global shutter
Master Clock	80 MHz	315 MHz	206 MHz	33 MHz
Windowing	1 randomly programmable ROI. Windowed, mirrored and sub-sampled readout possible.	4 randomly programmable ROI. Windowed, mirrored and sub-sampled readout possible.	1 randomly programmable ROI. Windowed, mirrored and sub-sampled readout possible.	1 randomly programmable ROI. Windowed, mirrored and sub-sampled readout possible; voltage averaging in the x-direction.
ADC Resolution	10-bit	10-bit	8-bit	NA
Power Dissipation	190 mW	1350 mW	1100 mW	150 mW
Package	LCC-48	μPGA-168	μPGA-369	PGA-127
Data Rate	80 Mbps	12 x 630 Mbps	32 x 412 Mbps	1 x 66 MSps (analog) or 2 x 33 MSps (analog)
Optical Format	1/2 inch	1 inch	1 inch	35 mm
Frame Rate	250 fps	500 fps	485 fps	15 fps
Responsivity @ 550 nm	3.2 V/lux.s	10.2 V/lux.s	3.8 V/lux.s	2.8 V/lux.s
FPN	2.5% RMS	2% RMS	2% RMS	1.25% RMS

Ultra-Low-Power SRAM Memory

ON Semiconductor offers ultra-low-power embedded and discrete custom SRAM memory in a variety of densities designed for the low power, high reliability, and long-term support requirements of medical manufacturers.

Parallel SRAM for Implantable Medical Devices

Features and Benefits

- Optimized for ultra-low-power operation
  - Low voltage operation down to 1 V
  - Typical leakage of ~100 nA for 8 Mb SRAM
- 1 Mb through 8 Mb densities
- Mature technology; in production for over 10 years
- Quality driven design and manufacturing
  - RIGID ID Traceability requirements are in place for all medical products
  - Design For Test/Quality (DFQ) incorporated into products
  - Soft Error protection expertise

Applications

- Pacemakers
- Implantable cardioverter defibrillators (ICDs)
- Neurostimulators
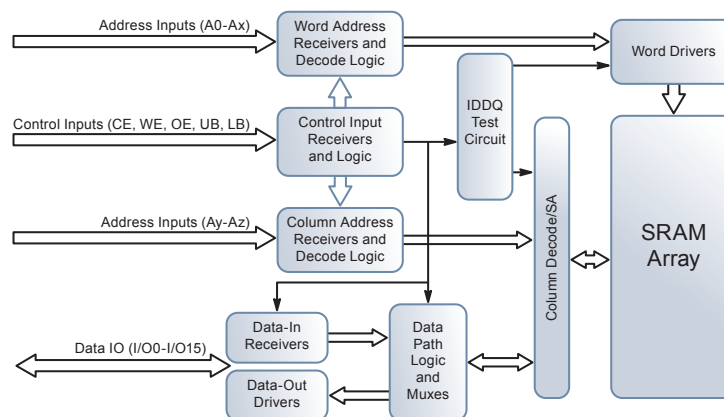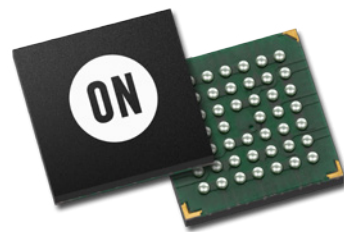
Typical Parallel Medical Memory Implementation

Serial SRAM for Medical Applications

Features and Benefits

- Easy-to-use 4-pin SPI interface
  - Programmable DUAL and QUAD I/O functionality
- High voltage operation
  - 5 V added capability (in addition to existing 1.8 V and 3 V power supplies)
- 20 MHz serial operation, fast write cycles (no wear-out)
- Ultra-low-power (1 µA typical standby current)

Applications

- Patient monitors
- Pulse oximeters
- Electrocardiographs
- Cardiac monitoring devices
- Blood glucose meters

Low-Power Serial EEPROMs

ON Semiconductor offers a range of low-power serial EEPROM products ideally suited for storing system configuration and user data in medical devices.

Features and Benefits

- Full range of densities from 1 kb to 2 Mb*
- Flexible interface protocols including SPI and I2C
- Supply voltage range from 1.7 V to 5.5 V
- Optimized versions available for hearing aids where low absolute power consumption and low write current operation is essential
- Available in industry-standard and space-optimized packages (also available in die form)

Applications

- Hearing aids
- Blood glucose meters
- Patient monitors
- Test strips
- Medical patches
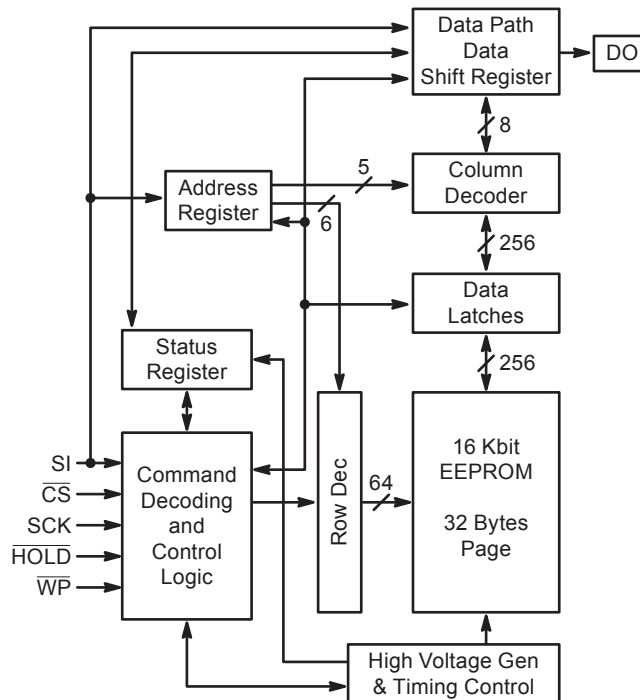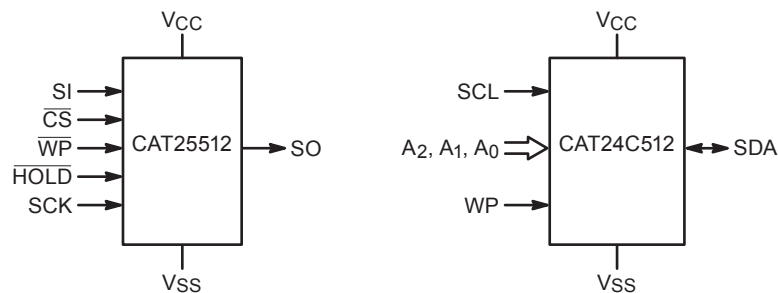
Medical Discretes

ON Semiconductor offers a broad catalogue of standard discrete components for use in medical applications, including diodes, MOSFETs, IGBTs, and power regulators.

For medical applications, customized support for value-added services is available to address the specific needs of medical customers:

- Lot Acceptance Testing (LAT)
- Visual inspection
- Bare die flows
- Custom multi-chip packaging
- Labeling and Certificate of Compliance
- Record retention
- Lot traceability
- Process longevity to support extended product life cycles
- Security/continuity of supply commitments

Medical-grade versions of standard components suitable for use in implanted or life-critical applications (FDA Class III or equivalent) can also be supported on a custom engagement model. High reliability process flows patterned on MIL-Standard protocols are available:

- MIL-PRF-19500
- MIL-STD-750 Test Method Certified
- JAN/JANHC quality levels supported
- Manufacturing done in DLA-approved line (where required)

Transient Surge Suppressors (TSS)

ON Semiconductor offers a family of multi-channel TSS devices for implanted lead protection.

- Customizable for unique electrical characteristics
- Extremely fast turn-on
- Maximum surge currents of greater than 12 A
- Forward breakdown voltage requirements can be tuned to application needs
- Off-state leakage currents of 100 nA
  - Customizable physical footprint and terminal connections

- Specific to the number of terminals/leads needed
- Physical layout can be linear terminals or matrix terminals
- Device can be wire bonded or bumped for reflow
  - Devices are tested, bumped (if needed) and shipped in wafer form
  - Lot Acceptance Testing (LAT) performed on wafer lots

8-Lead Bumped Device with a 2 by 4 Matrix Layout

5-Lead Bumped Device with a Linear Layout

5-Lead Wirebond Device with a Linear Layout and Substrate Connections

9-Lead Wirebond Device with a 3 by 3 Matrix Layout
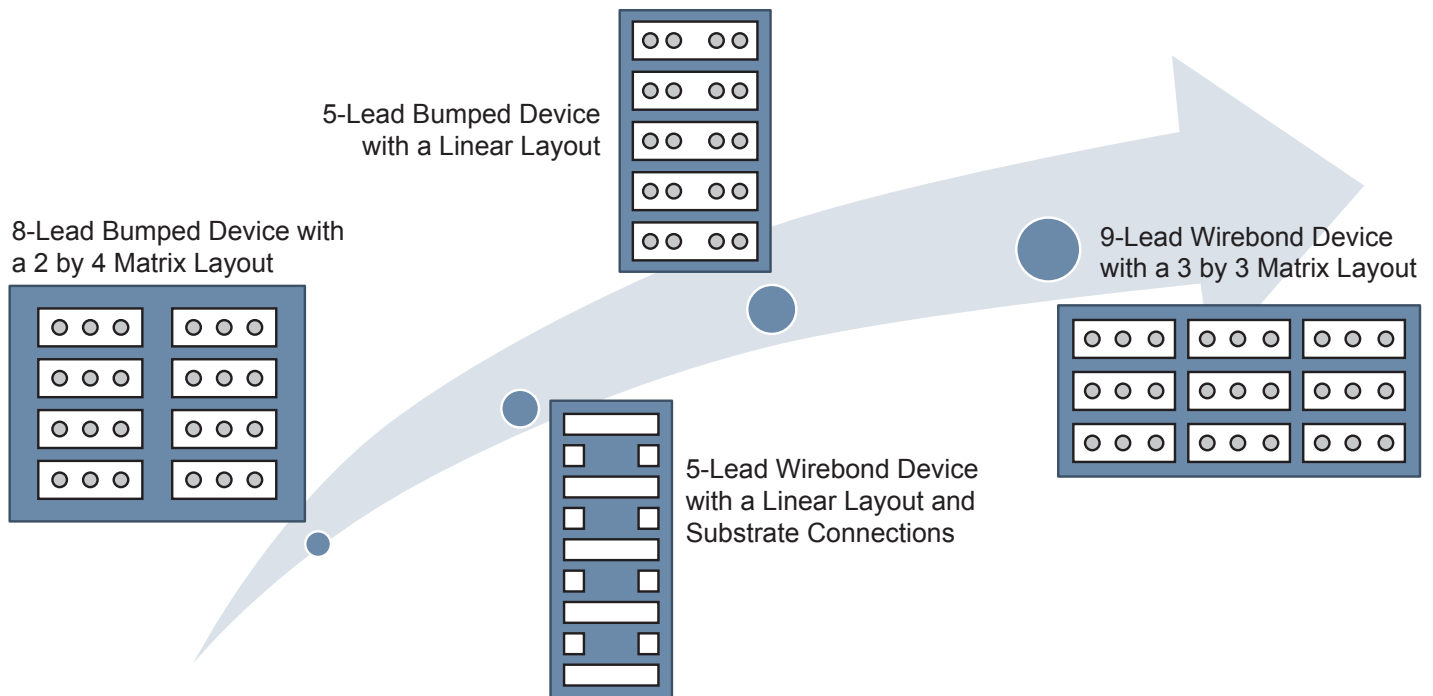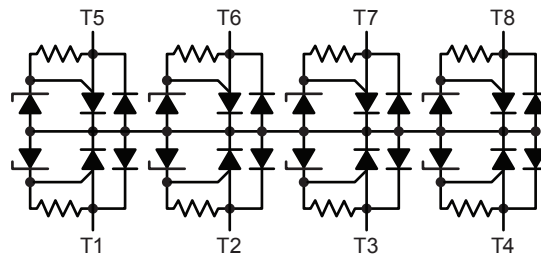
Examples of Customizable TSS Devices

ASIC Conversion

ON Semiconductor is the industry leader in converting FPGAs to ASICs. FPGA conversions provide significant cost savings with drop-in ASIC replacements; and in most cases achieve higher performance, lower power, and better thermal performance.

To support customers facing End-of-Life device or process obsolescence from current ASIC vendors, the company also provides ASIC-to-ASIC conversions. Advanced design processes match functionality and timing across the same operating conditions and voltages of the original device to produce an ASIC with the same form, fit, and function.

Features
- Successfully converted thousands of designs over three decades
- Significant cost savings and performance enhancement
- Process longevity to support long product life cycle requirements

FPGA Conversion Flow
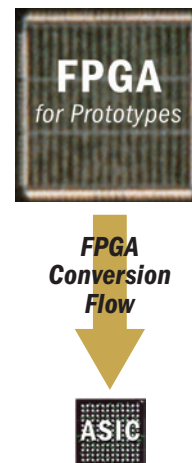
Foundry Services

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 cardiac rhythm management, neurostimulation, patient monitoring, and hearing aid devices.

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, silicon ingots, 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) prototyping support
- Extensive failure analysis capability
- 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.

Process Name	Min Drawn Poly (μm)	No. Metal Layers	Wafer Size (in)	Max Operating Voltage (Vgs)	NVM	Linear Cap	Trans Char	Other Devices
I4T 45V75V*	0.18	4-6	8	1.8/3.3	Y	MIM	Salicide	Resistors
ONC18 18V18V*	0.18	4-6	8	5/18	Y	MIM	Salicide	Resistors
ONC18 5V30V*	0.18	4-6	8	1.8/5	Y	MIM	Salicide	Resistors
ONC18G/MS	0.18	4-6	8	1.8/3.3	Y	MIM	Salicide	Resistors
ONC25	0.25	2-5	8	2.5/3.3/5	Y	MIM	Salicide	Misc
ONBCD25	0.25	2-5	8	5/12	Y	MIM	Salicide	Misc
C3/D3	0.35	3-5	8	3.3/5	Y	PIP	Salicide	Resistors
I3T25	0.35	3-5	8	3.3/12	Y	MIM	Salicide	Resistors
I3T50	0.35	3-5	6 & 8	3.3	Y	MIM	Salicide	Misc
I3T80	0.35	3-5	6 & 8	3.3	Y	MIM	Salicide	Misc
C5	0.6	2-3	8	5/12	Y	PIP	Poly	Misc
I2T30	0.7	2-3	6	5	N	PIP	Poly	Misc
I2T100	0.7	2-3	6	5	N	PIP	Poly	Misc

* Pending 1Q14

Advanced Packaging

ON Semiconductor is a pioneer in the development of miniaturized packaging solutions for the medical microelectronics industry.

The company offers an array of technologies for medical applications where size, performance, and system integration are critical. ON Semiconductor has proven leadership in this field, addressing the highly space-constrained requirements of hearing aid manufacturers for over four decades. As other medical devices shrink in size, they too can benefit from miniaturization techniques.

Whether the need is for a custom component such as a high-density thin film capacitor array or a fully integrated 3D System-in-Package (SiP) solution, ON Semiconductor offers custom package development and manufacturing services, from design and test through volume manufacturing.

High-Density Ceramic Substrates

By utilizing a combination of thick and thin film processing techniques coupled with specialized thick film materials, ON Semiconductor fabricates high density, high performance ceramic-based substrate circuits to achieve further miniaturization in advanced packages.

- Proprietary multi-layer double-sided thick film ceramic substrates
- High density interconnect (1 mil line/space geometries)
- Fine-pitch through-ceramic vias for 3D interconnection
- Excellent high frequency and thermal properties
- Low $/wiring density ratio provides excellent value proposition

High-Density Integrated Capacitor Arrays

Utilizing a proprietary multi-layer production process, a single chip can be designed to include multiple high-density capacitors with integrated routing and fine-pitch I/O pads, saving board space and eliminating the need for surface-mount capacitor placements.

- High-frequency (characterized to 20 GHz)
- High capacitance density (100 nf/mm2)
- Tight tolerance (<10%) and matching (<1%)
- Low leakage
- Stable over temperature, AC voltage, and time (no aging effect)
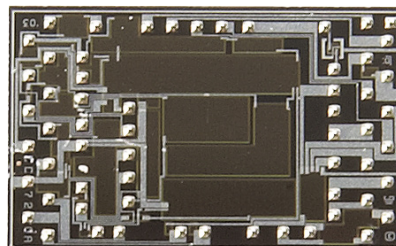
Sample Array
Chip Size: 4.6 mm x 2.9 mm
Total Number of Capacitors: 21
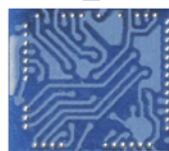**Capacitor Value Range: 0.6 nF – 132 nF**

Ultra-Miniature SiP Medical Assemblies
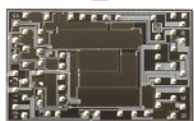
High-Density Capacitor Arrays

3D Stacking Architectures

HDI Substrates

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 or without wirebonds
- Modular, scalable architectures with high degree of manufacturing testability
- Mature, robust technologies and structures
- RoHS-compliant and ISO-certified
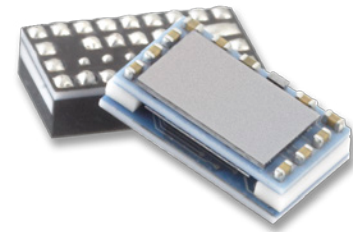
AYRE SA3291 - Wireless DSP SiP for Hearing Aids
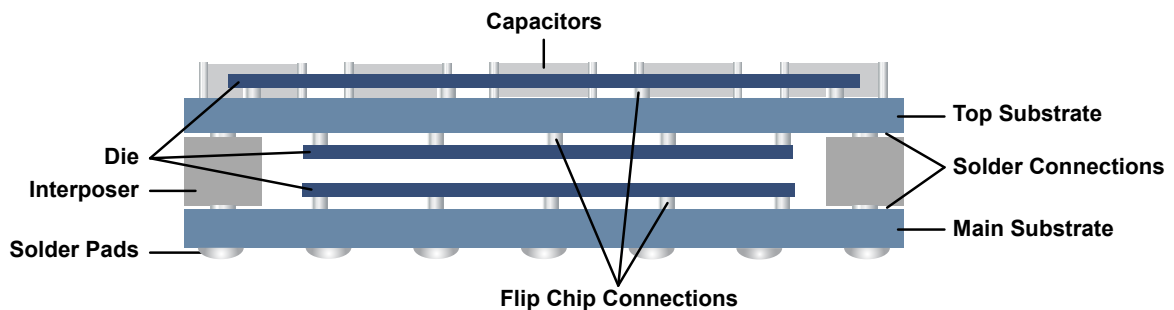
High-Performance Integrated Passive Devices

Integrating passive components (resistors, capacitors, and inductors) in HighQ Copper-on-Silicon Integrated Passive Device (IPD) platform give customers a high-performance and cost-effective solution for wireless RF system-in-package applications. Key features include:

- Excellent electrical performance via high-quality integrated components (resistors, MIM capacitors, high-Q inductors)
- Reduced package size via elimination of discrete passives
- Potential for reduced total cost of ownership
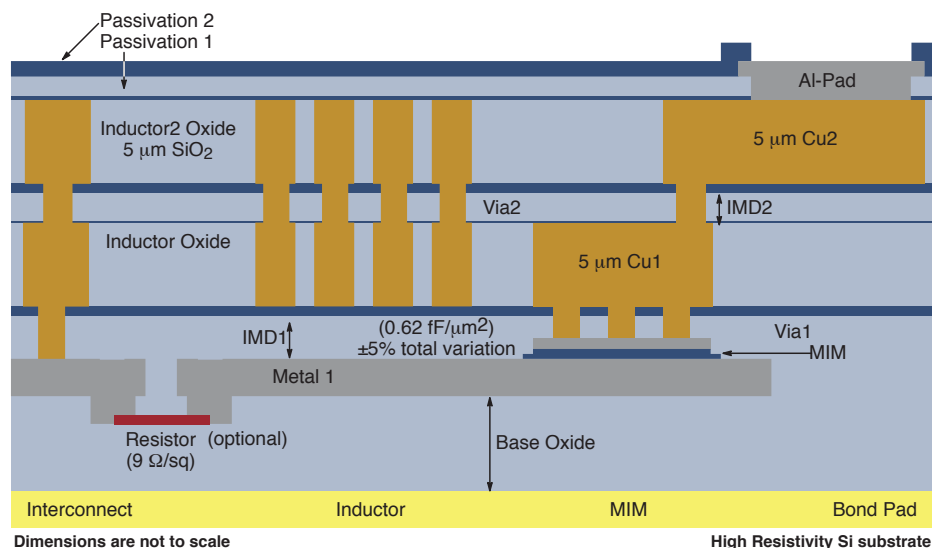
Cross-section view of HighQ Copper-on-Silicon IPD Process

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