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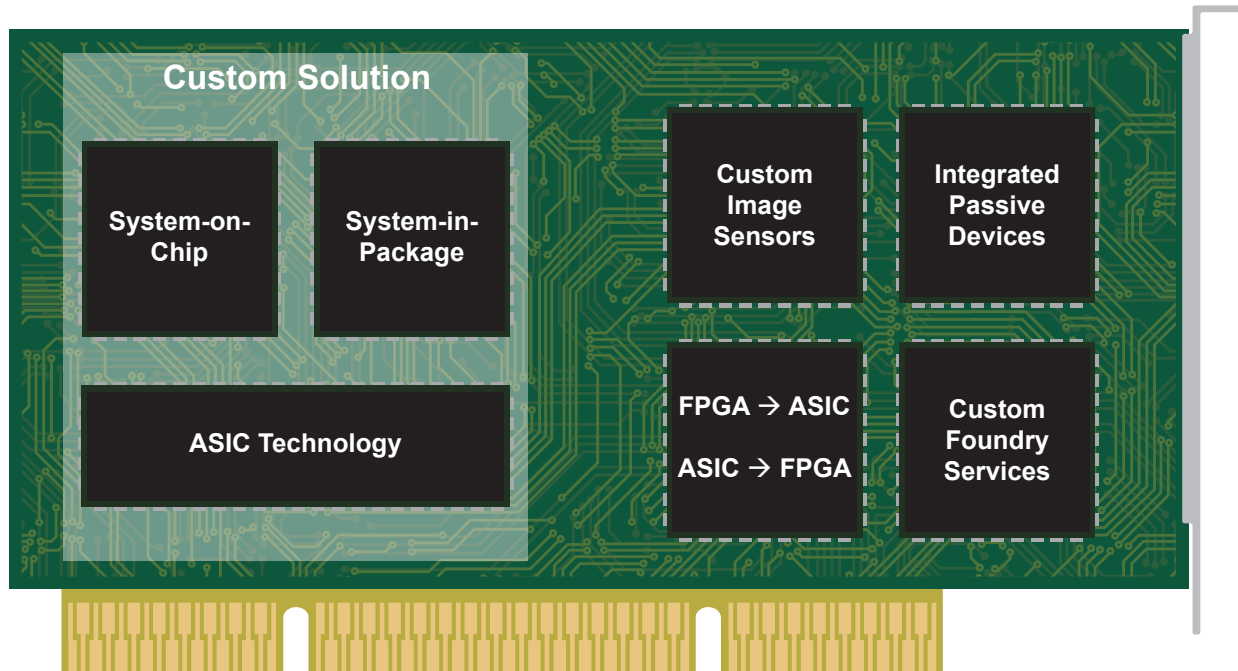
Energy Efficient Innovations

Custom Design & Manufacturing Services

A detailed photograph of a microchip manufacturing process. A large, circular, silver-colored wafer is mounted on a rotating stage. Two yellow, diamond-tipped cutting tools are positioned to cut a small, rectangular piece from the wafer. A bright light source illuminates the cutting area, creating a strong glare. The background is blurred, showing other industrial equipment.

*An extensive offering of custom products, processes,
and services from ON Semiconductor.*

SoC, SiP, and Custom Products



ON Semiconductor is a leading supplier of System-on-Chip (SoC), Application Specific Integrated Circuit (ASIC), and other custom solutions, supporting a wide range of applications in the automotive, industrial, medical, and aerospace & defense markets. ON Semiconductor has designed and manufactured more than 5,000 custom integrated circuits over the last 50 years.

ON Semiconductor SoC, ASIC, and Custom Product Benefits

Advanced, integrated SoC and ASIC devices enable optimized performance and power efficiency, through integration. Security of intellectual property may be enhanced through hardware embedding. The elimination of inter-package connections may reduce noise.

In addition, the reduction in the number of components may:

- Reduce required board space
- Simplify board routing
- Simplify board testing
- Improve reliability
- Lower BOM cost

Design and Manufacturing Expertise

System Architects at ON Semiconductor have detailed knowledge of fabrication process technologies and packaging capabilities, and are able to advise on system architecture, refine design specifications, identify IP, and align to most appropriate technology.

ON Semiconductor has been granted Category 1A Trusted Design, Trusted Test, Trusted Foundry, and Trusted Broker accreditation by the Defense Microelectronics Activity (DMEA).

ON Semiconductor owns and operates wafer fabs, assembly and test facilities. In-house capabilities include CMOS and BCDMOS process technologies, with line widths of 110 nm to 0.5 μm , on wafer diameters of 150 mm to 200 mm. Third-party relationships augment the company's internal manufacturing capability as required.

Responsive, Reliable World-Class Supply Chain and Quality Program

ON Semiconductor operates a flexible, reliable, responsive supply chain that supports complex manufacturing networks and dynamic global market conditions. This includes multiple manufacturing and logistics sites located near our customers to ensure supply continuity. The company shipped over 62 billion units through its global logistics network during 2016, representing ~8 units per person on earth. ON Semiconductor sustains world-class quality performance, and is certified to multiple international quality standards and programs.

Certifications

- IATF 16949
- AS 9100 Rev. D
- MIL-PRF-38535
- Trusted Foundry, Design, Test, and Broker Accreditation
- ISO 9001
- ISO 14001
- QML, CTPAT, STACK
- ISO 26262

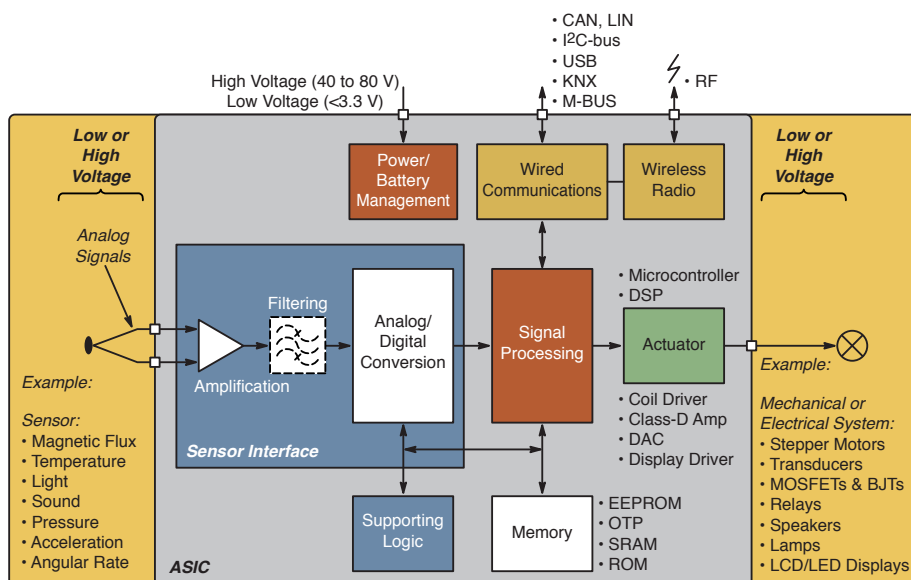
Mixed-Signal Custom Solutions

Value Proposition

- Experienced resources and assets to bring customers' design objectives successfully to market
- Ability to integrate customers' IP into single-chip solution, thereby protecting the IP
- Flexible cost models to reduce customers' total cost

Design Engineering

- Approximately 200 expert mixed-signal designers with extensive SoC and SiP experience
- Robust custom development process
- Dedicated project managers track & report development progress
- Flexible customer development engagement – from full turnkey to subcontractor production services
- Design expertise in:
 - » Sensor interface
 - » Wireless systems
 - » Medical imaging
 - » Energy management
 - » Building & home control



IP & Fab Processes

- ≥ 45 nm, analog-focused CMOS/BCDMOS and SOI technologies utilizing internal fabs and external foundry partners
- Low, medium, high voltages – ≤ 1 V to 90 V
- Low current optimization – active & standby
- Low noise design – “count the electrons”
- High temperature – $\leq 200^\circ\text{C}$ (profile, for selected technologies)
- Integrated low power wireless
- Non-Volatile Memory (EEPROM, OTP), RAM & ROM
- Embedded digital IP
- Robust ESD protection
- Extensive building block ‘starting points’ consisting of amplifiers, references, DACs, ADCs, linear & switching regulators, power management, etc.

Category	Mixed Signal Intellectual Property (IP)
Serial Interfaces	USB 3.0/2.0/1.1, HDMI, MIPI, I2C, SPI, CAN, UART
Microprocessors	ARM, RCore DSP, R8051, AMBA/AHB/APB Peripherals
Memory	SRAM, DPRAM, ROM, EEPROM, OTP, FLASH
Clocking	Oscillators, PLLs, DLLs
Communication	Wireless (Proprietary & Standards), Wired (KNX, PLC and others)
Encryption	ECC, AES, 3-DES, DES, RSA
Data Converters	DAC, ADC (8 - 20 bits, 1 KSPS - 120 MSPS)
Wireless IP	PGA, LNA, PLLs, Correlators, DSP
Power Management	Efficient Switching Regulators, LDOs, Charge Pumps, Thermal Protection
References	Precision Bandgaps, Current References, Temperature Sensors
Analog and High Voltage Interfaces	High-Voltage Drivers, Display and LCD Drivers, Class D Amplifiers
Signal Conditioning	PGA, Instrumentation Amps, Digital and Analog Filters

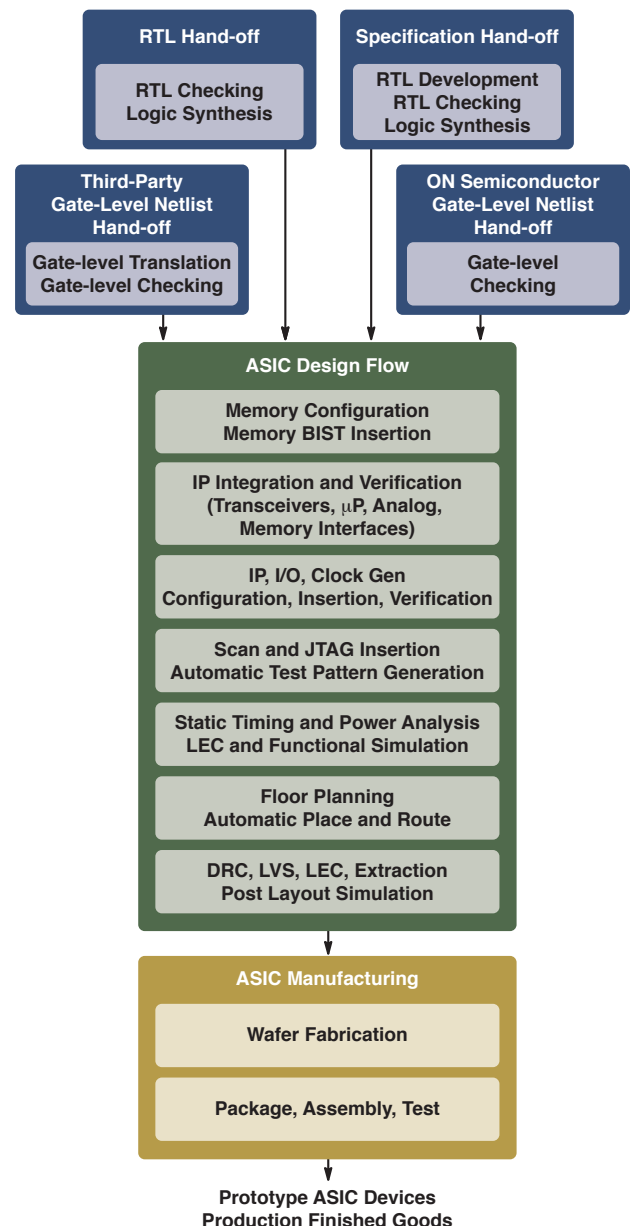
Digital ASIC Solutions

Proven Expertise

The comprehensive digital ASIC offering from ON Semiconductor includes multiple manufacturing locations with state-of-the-art to legacy technologies to support your design requirements. We provide complete solutions from product development, manufacturing, test, and packaging, to quality engineering support and supply. We offer early engagement with our System Architects to assess the best overall technical solution enabling a strong partnership throughout each step of the project lifecycle, from concept to production. ON Semiconductor supports reliable long-term manufacturing to meet the requirements of aerospace/defense, automotive, industrial, communication and other markets. With more than 40 years of IC experience, we guide our customers to the best technical and most economical ASIC solution.

Solutions for Your Requirements

- Complete value stream offering including product development, test, package engineering, quality engineering, and failure analysis
- Proven state-of-the-art and legacy technologies
- System architects consultation for best overall solution
- Extensive IP offering
- Secure, long term, continuous supply
- Support of small volume applications
- Multiple design interface support (RTL, Netlist, GDS, etc.)
- FPGA-to-ASIC, ASIC-to-ASIC, and multi-chip-to-ASIC conversions
- Big D (Digital) / Small A (Analog) ASIC capability to increase integration and simplify board design
- High reliability, high temperature, special packaging and handling
- Full ITAR handling available
- DO/254-ED80 compliance solutions
- QML Flow, Trusted Supplier
- Radiation hardened by design
- Libraries characterized for neutron soft error rates



Digital Standard Cell Product Families

Standard Cell Product Families					
Family	Core Voltage (V)	I/O Voltage (V)	I/O Types	System Performance	Special Features
SC5 0.5 μm	5.0	5.0, 3.3	PCI, TTL, LVTTTL, LVCMOS	75 MHz	Long-Term 5 V Support, High Temp
SC3 0.35 μm	3.3, 2.5	5.0, 3.3	PCI, GTL, HSTL, SSTL, LVTTTL, LVCMOS, LVPECL	100 MHz	EEPROM, High Temp
ONC18 180 nm	3.3, 1.8, 1.5, 5.0	3.3, 2.5, 1.8, 5.0	PCI33/66, DCI, HSTL, SSTL, LVTTTL, LVCMOS, LVPECL, LVDS	266 MHz	NVM, OTP, High Vt, High Temp
SP110 110 nm	1.2	3.3, 2.5, 1.8, 1.5, 1.2	PCI33/66, DCI, HSTL, SSTL, LVTTTL, LVCMOS, LVPECL, LVDS, CML, PCIX	450 MHz	OTP, Dual Source Capability, Mil Temp
SP65/55 65 nm, 55 nm	1.2, 1.0	3.3, 2.5, 1.8, 1.5, 1.2	PCI33/66, DCI, HSTL, SSTL, LVTTTL, LVCMOS, LVPECL, LVDS, CML, PCIX	600 MHz	Extensive IP Portfolio
SP45/40 45 nm, 40 nm	1.1, 0.9	3.3, 2.5, 1.8, 1.5, 1.2	PCI33/66, DCI, HSTL, SSTL, LVTTTL, LVCMOS, LVPECL, LVDS, CML, PCIX	850 MHz	Extensive IP Portfolio
SP32/28 32 nm, 28 nm	0.85 ~ 1.05	3.3, 2.5, 1.8	PCI, DCI, HSTL, SSTL, LVCMOS, LVPECL, LVDS, CML	1000 MHz	Extensive IP Portfolio
GF22 FDX/FDSOI	0.88, 0.72, 0.40	3.3, 1.8, 1.5, 1.2	PCI, DCI, HSTL, SSTL, LVCMOS, LVPECL, LVDS, CML	1.8 GHz, 2.1 GHz w/BB	Body Bias, Ultra Low Power, Extensive IP Portfolio



Digital Standard Cell Product Families

Comprehensive Intellectual Property Offering

ON Semiconductor offers a suite of system IP suitable for a variety of applications, including those requiring high-speed serial I/O (SerDes), external high performance memory interfaces, processors and a variety of other hard and soft IP. Combined with support for a rich family of I/O standards, our digital ASIC technologies and IP provide optimal solutions for aerospace/defense, automotive, communications, industrial, consumer, computing, and medical applications. ON Semiconductor is an Arm® microprocessor licensee, and has access to multiple Arm cores for integration into silicon products.

Category	IP Cores
Hi-Speed SerDes	PCI Express Gen 1/2/3, XAUI, SATA I/II/III, EPON, Serial Rapid I/O (SRIO), 1G Ethernet, 10G Ethernet
Serial Interfaces	USB 3.0/2.0/1.1, HDMI, I2C, CAN, UART
Application Layer Support	10/100 Ethernet, 1G Ethernet, 10G Ethernet, PCI Express Gen 1/2/3, SATA I/II/III, SRIO, USB 3.0/2.0/1.1, DDRX Controllers, EMAC4, MII, RMII, SMII, XFI, HDMI
Bus Interfaces	PCI, AMBA/AHB, ARM7, PLB, PCMCIA
Microprocessors	Arm, ARC, PowerPC, R-Core, M8051, AMBA/AHB Peripherals
Memory Interfaces	DDR, DDR2, DDR3, DDR4, QDR-II
Data Converters	ADC, DAC
Memory	SRAM, DPRAM, Register File, ROM, OTP
Clocking	PLLs, DLLs, MSDLL
Error Correction, Encryption & Anti-Tamper	ECC, DES, 3DES, Reed-Solomon, RNG, PK Processor, Secure SRAM
DSP Functions	FFT, Mult, Divide, Accumulate, Up/Down Converter, FIR
FPGA Conversion IP	Memory Wrappers, LUT RAM, I/O Standards, Hardware DSP Functions, FIFOs, Clocking Emulation

ON Semiconductor is adding 300 mm production capability, through the recently announced acquisition of a 300 mm fab located in East Fishkill, New York. The agreement includes a technology transfer and development agreement, and a technology license agreement. ON Semiconductor has immediate access to advanced CMOS capability, including 45 nm and 65 nm technology nodes. ON Semiconductor is expected to assume full operational control of the fab at the end of 2022. ON Semiconductor also plans to include the East Fishkill fab and technologies within the portfolio of Trusted, ITAR, and QML capable manufacturing technologies.

ASIC Conversions FPGA-to-ASIC, ASIC-to-ASIC

ASIC Conversions and EOL Solutions

ON Semiconductor provides long-term solutions to customers facing device or process obsolescence with their current ASIC or FPGA vendor. We provide reliable second sourcing options as well as cost reduction solutions to help you maintain your competitive edge. Conversion of an older technology to an optimized ASIC solution can provide a mid-life enhancement and extended life cycle.

FPGA Conversions

ON Semiconductor is the industry leader specializing in converting FPGAs to ASICs. We provide significant cost savings, performance enhancement, and product assurance. Our customers have been able to reduce system costs considerably by successfully substituting their high cost FPGAs with drop-in ASIC replacements in over 4,000 applications. In most cases, higher performance, lower power and better thermal performance can be achieved in the ASIC. ON Semiconductor offers a parallel development path for FPGA development. This leverages the FPGA development benefits while accelerating the path to production with an ASIC.



**FPGA
Conversion
Flow**



FPGA to ASIC Conversion The Best of Both Worlds

METRIC	FPGA	ASIC
Development Cost	①	
HW/SW Co-Design	①	
ECO Turn-Around	①	
Time to Market	①	
System Performance		①
Power Consumption		①
Unit Cost		①
Security		①
Non-volatility (LAPU)		①
Life Cycle Support		①
Harsh Environments		①

Single-chip solution
3-4x typical power reduction with ASIC solution
ASIC price 25 to 75% of the FPGA piece price
No configuration boot-up vulnerabilities
Cold-start, Hot-swap enabling
ASIC production stability
Radiation effects, flight-criticality, on-shore

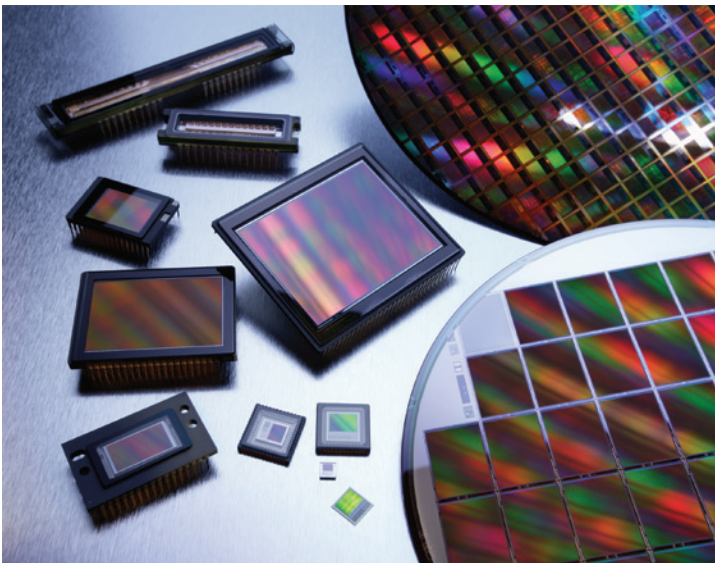
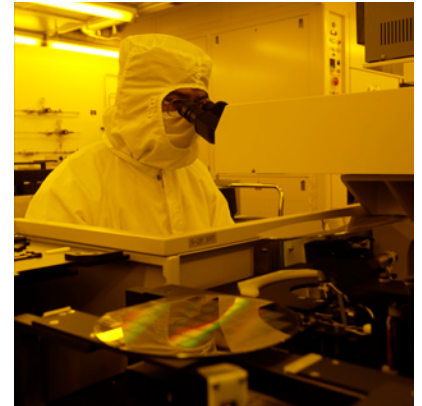
Conversion Features and Benefits

- Automatic design migration to a Standard Cell ASIC
- Low NRE, low cost drop-in replacements
- Multiple-to-one conversions for higher level of integration
- Original circuit functionality and performance maintained
- Optional performance enhancements for a competitive edge
- ASIC IP optimized for FPGA migrations
- Single-chip, non-volatile solution results in Live-at-Power-Up (LAPU); enhanced security; immunity to configuration logic errors resulting from SEE
- Significant reduction in power usage
- Improved cost through die size reduction
- Directly owned and operated fabs, plus access to industry standard third-party foundries
- Long fabrication process life
- On-shore production paths for most technologies

Custom Image Sensor Solutions

ON Semiconductor develops custom and application-specific CMOS image sensors that help customers create unique products with state-of-the-art performance. Designs can leverage existing technology blocks or include the development of new technologies to provide new levels of performance and functionality.

Custom image sensor designs provide great flexibility in product specifications, providing opportunities for key end-product differentiation in the target application. Devices can be developed with commercial, industrial, or military grade qualification, and an advanced supply chain supports long-term supply.



Custom Image Sensor Capabilities

- Frame rates up to 18 K frames per second at megapixel resolution
- Windowing to 1 M frames per second
- Die sizes from less than 1 mm by 1 mm up to wafer scale
- Radiation tolerant designs
- 8, 10, 12, 14 and 16-bit ADC options
- High speed parallel and serial digital outputs
- Optimized pixel architectures
- In-pixel noise reduction

Integrated Passive Devices (IPD) An Efficient RF System-in-Package Solution

Integrating passive devices into our HighQ™ copper platform gives a cost-effective, smaller footprint solution for all RF needs.

IPD Technology Characteristics

- Target frequency: 500 MHz to 40 GHz
- Low profile, minimal footprint
- Tight tolerance
- High reliability

Typical RF Applications

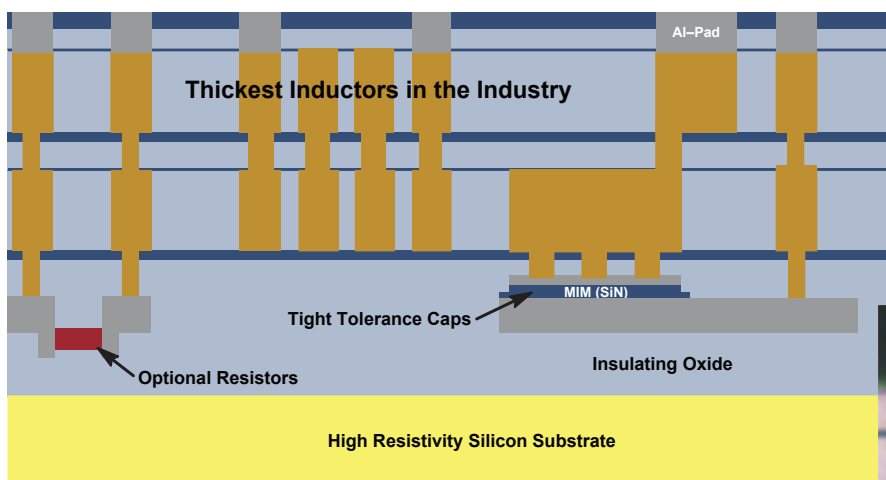
- Cellular – front end and base stations
- 5G solutions for handheld and infrastructure
- IoT solutions
- Data centers
- WiFi™/Bluetooth®/Zigbee® solutions
- Aerospace and defense

Typical IPD Designs

- Baluns
- Couplers
- Diplexers
- Low pass and band pass filters
- Splitters
- Matching networks
- Interposers



IPD Technology (R, L, C)



Performance

- Guaranteed $\pm 5.0\%$ capacitor tolerance
- Typical $< 1\%$ variance between capacitors on common IPD
- Dual Cu stack up of 12 μm for high Q inductors

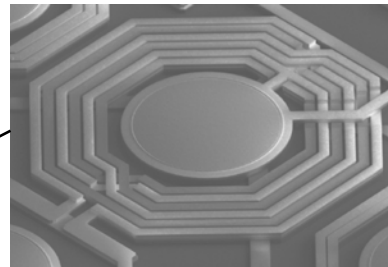
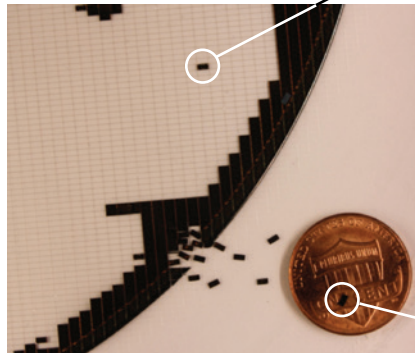


Dual Copper Stackup with Full Length Stitched Via

IPD Technology

Advantages

- Smaller than discrete solutions
- Thinner & higher precision than LTCC
- Lower cost than GaAs
- Best performance among silicon-based IPDs



Inductor Coil

Dual Low Pass Filter

State of the Art Fab

- Standard Mechanical InterFace system (SMIF) results in high and consistent yields
- Located in Gresham, Oregon
- Fab Certifications:
 - » ISO 14001
 - » QML (DoD)
 - » IATF 16949
 - » ITAR (DoD)
 - » AS 9100 Rev. D
 - » Trusted Foundry Status
 - » OHSAS-18001



Design and Foundry Services

- Complimentary feasibility study
- Design services available
- Self-service design with full featured PDK for Cadence and Agilent
- 8-inch high resistivity silicon wafers
- Shuttles with multiple designs/variants

Custom Foundry Services Overview

ON Semiconductor has a broad portfolio of custom and standard foundry offerings, including mixed-signal processes.

Our mixed-signal processes with high voltage and low power options are ideally suited for products in sensor applications and in the communication, mil/aero, automotive, medical and industrial markets.

Other offerings include custom process installation & modification, custom short-loop wafer processing, and back-end services, such as backside metallization, wafer thinning, probe, packaging, test, and logistics.

Service Oriented

ON Semiconductor understands customer needs and is dedicated to meeting them, from unsorted wafers to tested and packaged units. Customers are paired with a single contact for all business and technical issues for consistent support from initial engagement to production.

With high quality manufacturing facilities in the U.S., Europe and Asia, ON Semiconductor delivers prompt, cost-effective solutions to electronic manufacturers worldwide.

Our technology is design ready with excellent, easy to download design kits through MyON link on the www.onsemi.com Web site.

Trusted Source

ON Semiconductor is a registered ITAR supplier and has also been granted Category 1A Trusted Design, Trusted Test, and Trusted Foundry accreditation for its on-shore fabrication facilities in Idaho and Oregon.

Company Certifications

IATF 16949, ISO 9001, AS 9100, ISO 14001, MIL-PRF-38535, OHSAS-18000, CTPAT, STACK, and QML.

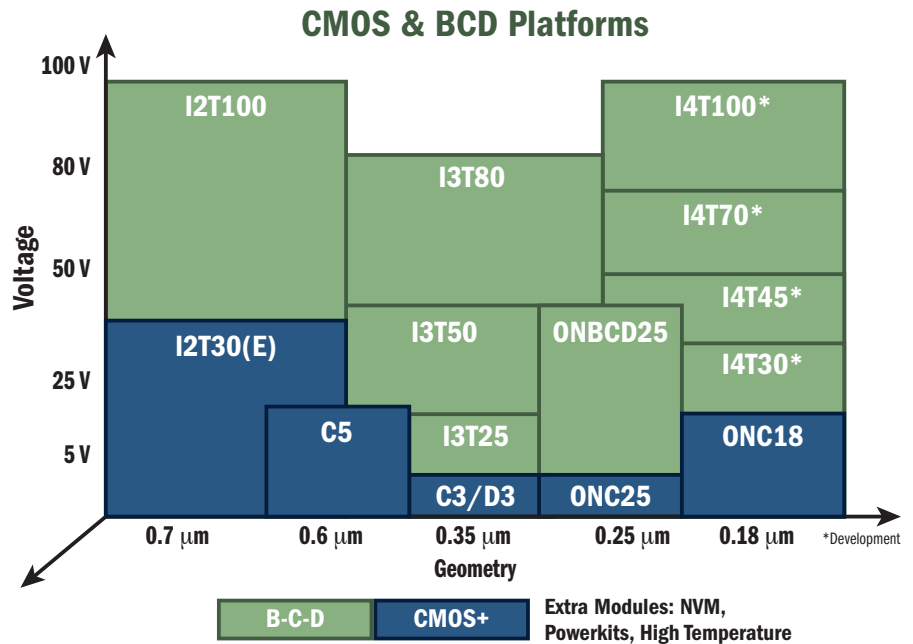
Process Longevity

ON Semiconductor's philosophy for process longevity means we keep needed processes around to accommodate your long-term needs. We are committed to supporting long-life products and are dedicated to building long-term relationships. Supporting this is the company's financial strength and commitment to effective use of resources. As a result, our customers have the confidence to make long-term product decisions without the concern of process obsolescence.

Node (μm)	Process Name	Number of Metal layers	Wafer Size (mm)	Operating Voltage (V _{gs})	HV Devices (V _{ds})	N-Ch DMOS	P-Ch DMOS	Bi-Polars	Linear Cap	Memories			
										RAM	ROM	OTP	EEPROM
0.11	ONC110AL	5-7 + 1 RDL	200	1.2	3.3	No	No	No	MIM	Y	Y	N	N
0.18	I4T	4-6	200	1.8, 3.3	45, 70	Yes	Yes	No	MIM	Y	Y	Y	Y
	ONC18 18v18v	4-6	200	5, 18	18	Yes	Yes	No	MIM	Y	Y	Y	Y
	ONC18 5v30v	4-6	200	1.8, 5	30	Yes	Yes	No	MIM	Y	Y	Y	Y
	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
	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
	I3T80	3-5	150, 200	3.3	70	Yes	Yes	Yes	MIM	Y	Y	Y	Y
	I3T50	3-5	150, 200	3.3	40	Yes	Yes	Yes	MIM	Y	Y	Y	Y
	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
1.6	ON50	2	150	50	50	No	No	Yes	MIP	N	N	N	N

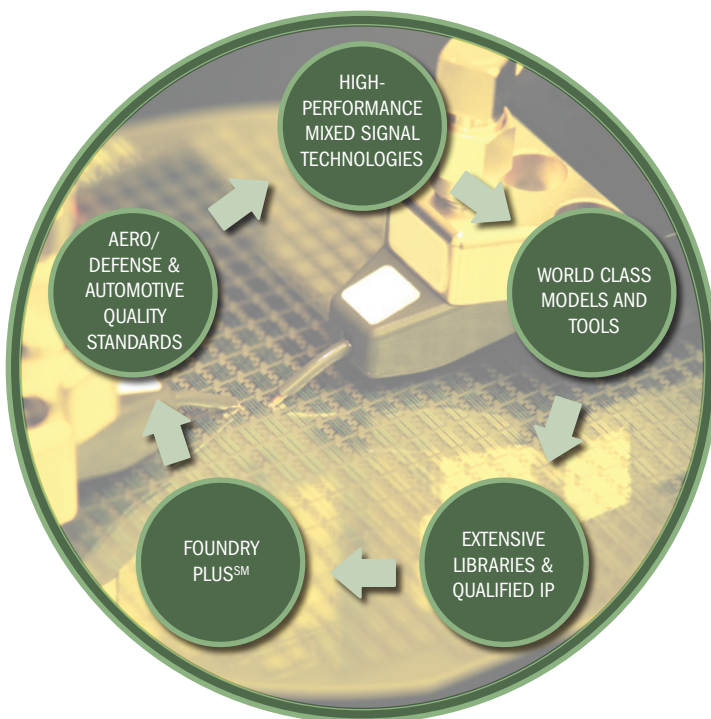
Flexible Manufacturing

- Wide variety of standard CMOS, BCD and high voltage process offerings
- Flexible manufacturing available (process modifications, lot splits, etc.)
- Multiple fab strategy to enable dual sourcing
- Specialty services such as advanced die stitching
- Shuttle services for prototyping
- DMEA Accredited Trusted Foundry and Broker
- Low volume strategic engagements
- Partial fab processing, assembly & test services



Our commitment to long-term technology support and a wide range of process offerings enable our customers to provide the highest quality end products at the most cost effective rate.

Full Service Custom Foundry



Capability

- Design Kits for 0.8 μm to 110 nm CMOS, BCD & High-Voltage Technologies
- Internal & external IP offerings
- FoundryPlusSM Added-Value Services – wafer sort, thinning, backside metalization, packaging, testing
- Custom Process Expertise – development, transfers, & modifications

Experience

- Servicing Foundry customers in aerospace, defense, industrial, automotive, & consumer markets for over 45 years
- Long-term strategic relationships
- Flexible manufacturing options
- Process longevity
- Full service optimized supply chain

Quality

- Quality culture – Road To Zero Defects
- QML (DoD) Certifications
- ISO-9001, AS9100
- TS-16949, ISO-26262, AEC-Q100
- Trusted Supplier, ITAR Certification
- OHSAS 18001

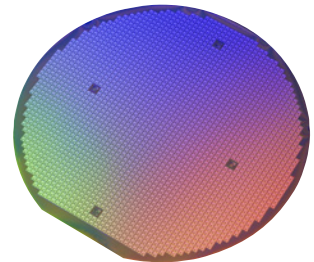
Automotive Die/Wafer Sales

The automotive die sales program from ON Semiconductor is designed to meet the requirements of today's automotive market. The increasing complexity of electronic systems is accompanied by demands for increased component density, improved subsystem reliability, and reduced functional costs. ON Semiconductor offers thousands of discrete and integrated circuit devices in chip form to address today's market needs. Built around our manufacturing Center of Excellence, we offer thorough electrical testing and visual inspection of every die we produce under our bare die program.

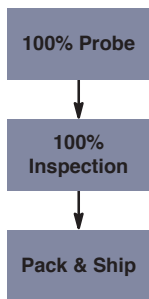


The ON Semiconductor Advantage

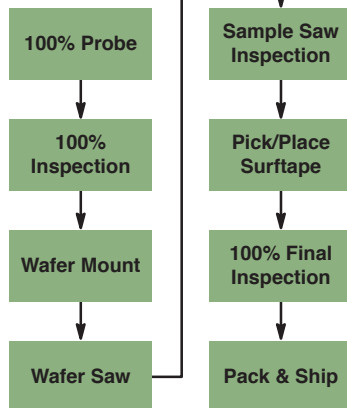
- Dedicated die center of excellence
- 100% electrical testing per device specification
- 100% visual inspection
- Whole wafers or Surftape®
- Certified to ISO/TS-16949
- Certified to ISO 9001
- AEC qualified die/wafers available



Wafer Sales

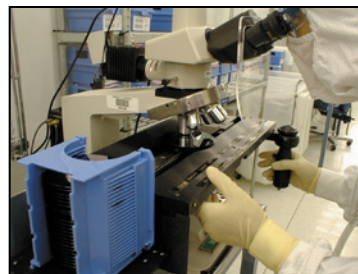
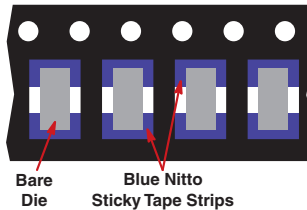


Surftape

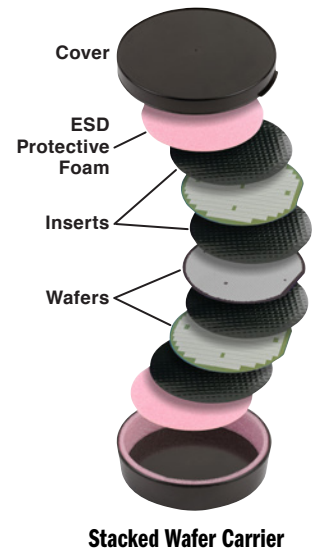


Surftape Detail

Punched Plastic Carrier



100% Probe and Inspection

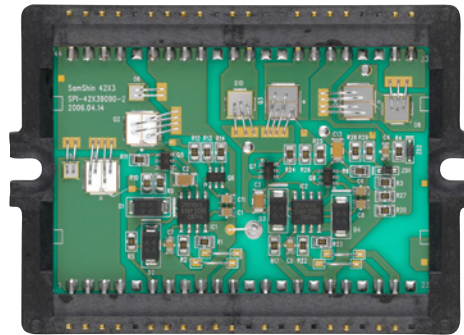


Commercial Die/Wafer Sales

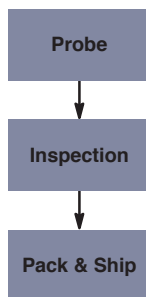
The commercial die sales program from ON Semiconductor is designed to meet the challenges of today's consumer market. Rapid device miniaturization, increased thermal and electrical performance and improved reliability requires module designs utilizing bare die. ON Semiconductor offers thousands of products in various packaging options to meet these evolving market requirements. Our manufacturing Center of Excellence performs the electrical and visual inspection testing to ensure our bare die exceed customer requirements.

The ON Semiconductor Advantage

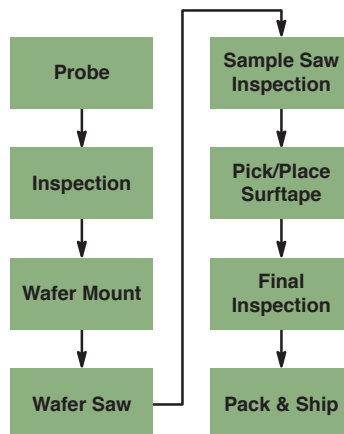
- Dedicated die center of excellence
- Sample electrical testing per device specification
- Whole wafers or Surftape
- Certified to ISO 9001



Wafer Sales

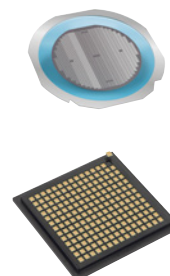


Surftape



Third-Party Partners

- Micross
- Semi Dice



Sales and Design Assistance from ON Semiconductor

ON Semiconductor Technical Support
www.onsemi.com/support

ON SEMICONDUCTOR INTERNATIONAL SALES OFFICES		
GREATER CHINA	Beijing	86-10-8577-8200
	Hong Kong	852-2689-0088
	Shenzhen	86-755-8209-1128
	Shanghai	86-21-5131-7168
	Taipei, Taiwan	886-2-2377-9911
FRANCE	Paris	33 (0)1 39-26-41-00
GERMANY	Munich	49 (0) 89-93-0808-0
INDIA	Bangalore	91-80-427-74100
ISRAEL	Raanana	972 (0) 9-9609-111
ITALY	Milan	39 02 9239311
JAPAN	Tokyo	81-3-6880-1777
KOREA	Seoul	82-31-786-3700
MALAYSIA	Penang	60-4-6463877
SINGAPORE	Singapore	65-6496-8888
SLOVAKIA	Piestany	421 33 790 2450
THAILAND	Bangkok	66-2-115-0542
UNITED KINGDOM	Maidenhead	44 (0) 1628 244326

**For a comprehensive listing of
ON Semiconductor Sales Offices, Distributors,
and Rep Firms, please visit:**

Americas & EMEA: www.onsemi.com/sales
China: www.onsemi.cn/sales
Japan: www.onsemi.jp/sales



AMERICAS REP FIRMS

Alabama	Huntsville	e-Components	(256) 533-2444
Brazil	Countrywide	Ammon & Rizos	(+55)224688-1960
California	Bay Area	Electec	(408) 496-0706
Canada	Eastern Canada	Astec	(905) 607-1444
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