Soitec’s engineered substrates for automotive megatrends

May 2020

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Outline

Automotive megatrends in numbers

C

Connected

16M

Sales of 5G enabled vehicles in 2030

Source: PwC, 2019

A

Autonomous

7M

Sales of L3 and above vehicles in 2030

Source: IHS Markit, 2020

S

Shared

1M

Global shared fleet in 2028

Source: Strategic Analytic, 2019

E

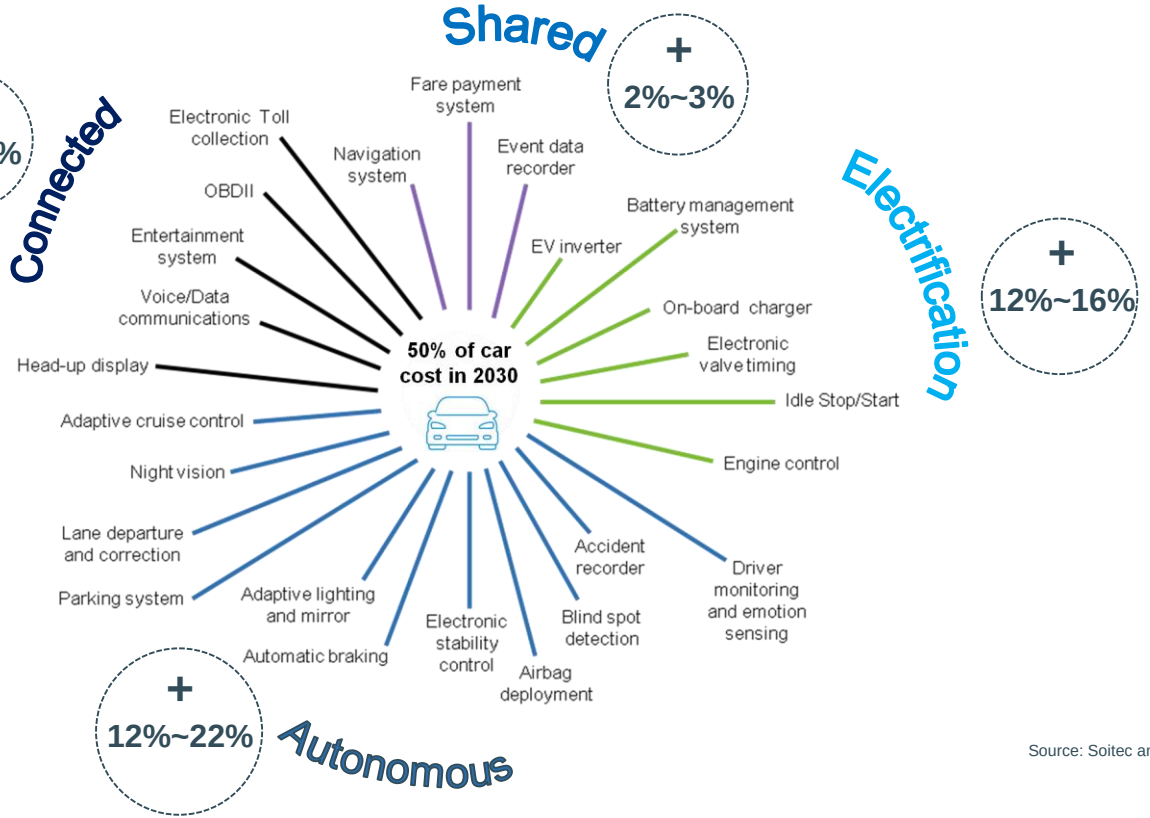
Electrification

23M

Global EV sales in 2030

Source: IEA, 2019

Electronic systems grow their part in car's BOM
Driven by automotive megatrends

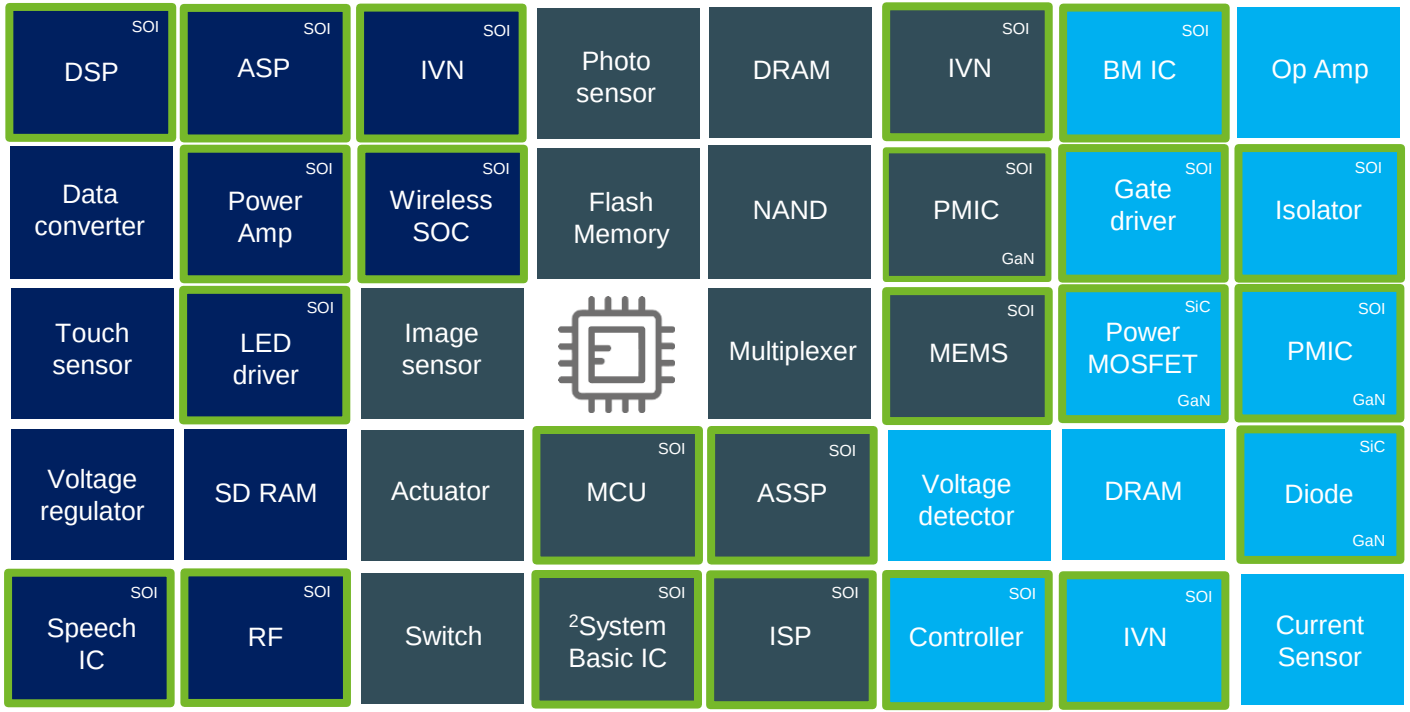


***Electronic system increase in car's BOM cost**

*Source: PwC 2019, Strategy& 2019 – compare to today's base vehicle

Source: Soitec analysis, CVEL 2020, Deloitte 2019

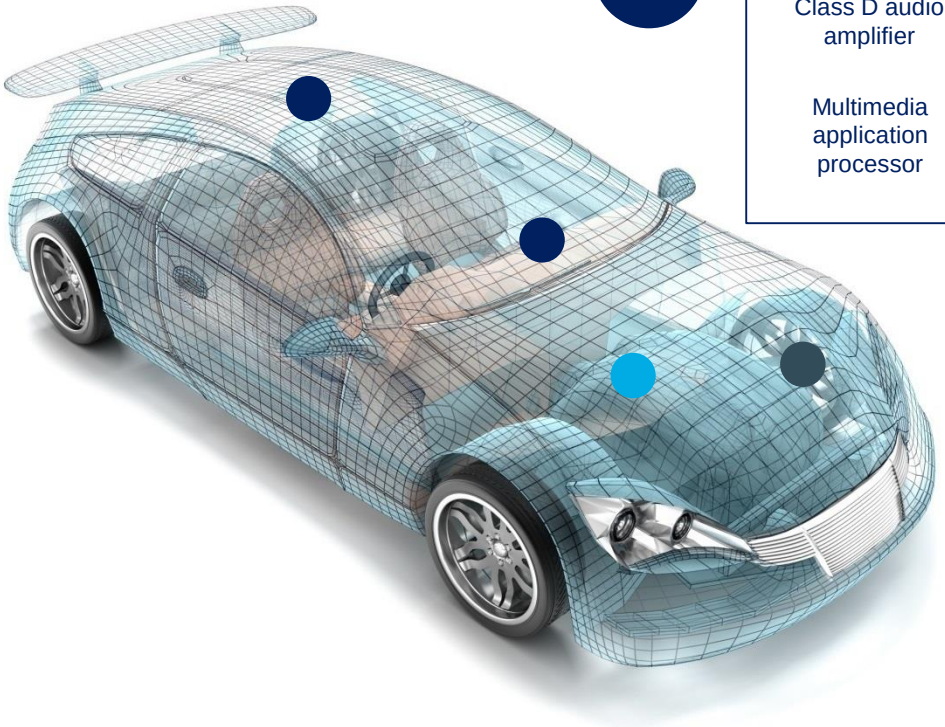
Automotive semiconductor devices heat map
Soitec's engineered substrates application opportunities



Source: Soitec analysis, 2020

Note:
[1]Shared is not reflected as it is highly correlated with Connected.
[2]System basic IC features have cross-functional support.

Soitec footprint and new opportunities in automotive



C

Infotainment

Class D audio amplifier

Multimedia application processor

Connectivity

Transceiver for ECU

Front-end module

SOC

A

ADAS

Vision processor

Radar

Domain Controller

E

Powertrain

Gate drivers

SiC MOSFET

BMS

Note:
Bold and underline reflect new opportunities

Today and tomorrow in automotive - Soitec technology content

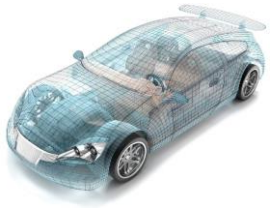
2019

- 100 mm² — Power-SOI
- 40mm² — FD-SOI
- 10mm² — RF-SOI

RF-SOI
Connectivity

FD-SOI
AP for ADAS and multi-media, MCU

Power-SOI
Gate driver, Class D Amplifier, Transreceiver



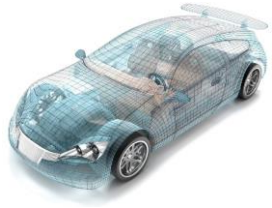
2020-2022

- 130 mm² — Power-SOI
- 130 mm² — FD-SOI
- 16mm² — RF-SOI POI

RF-SOI, POI
Connectivity

FD-SOI
AP for ADAS and multi-media, MCU , radar sensor FEM

Power-SOI
Gate driver, Class D Amplifier, Transreceiver, BMS



2022 and beyond

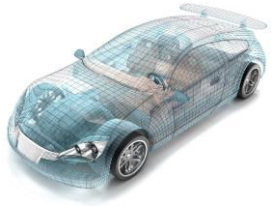
- 280 mm² — Power-SOI
- 300 mm² — FD-SOI
- 31mm² — RF-SOI POI
- 1400 mm² — SiC / GaN Power

RF-SOI , POI
Connectivity

FD-SOI
AP for ADAS and multi-media, MCU , radar sensor FEM

Power-SOI
Gate driver, Class D Amplifier, Transreceiver, BMS

SiC, GaN
EV Powertrain



Note: Soitec estimation - based on premium EV and fully autonomous vehicle

Outline

1 Automotive megatrend

2 **Electrification**

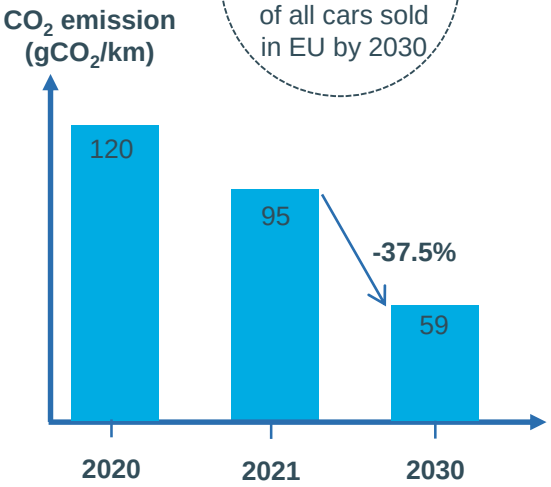
3 Autonomous

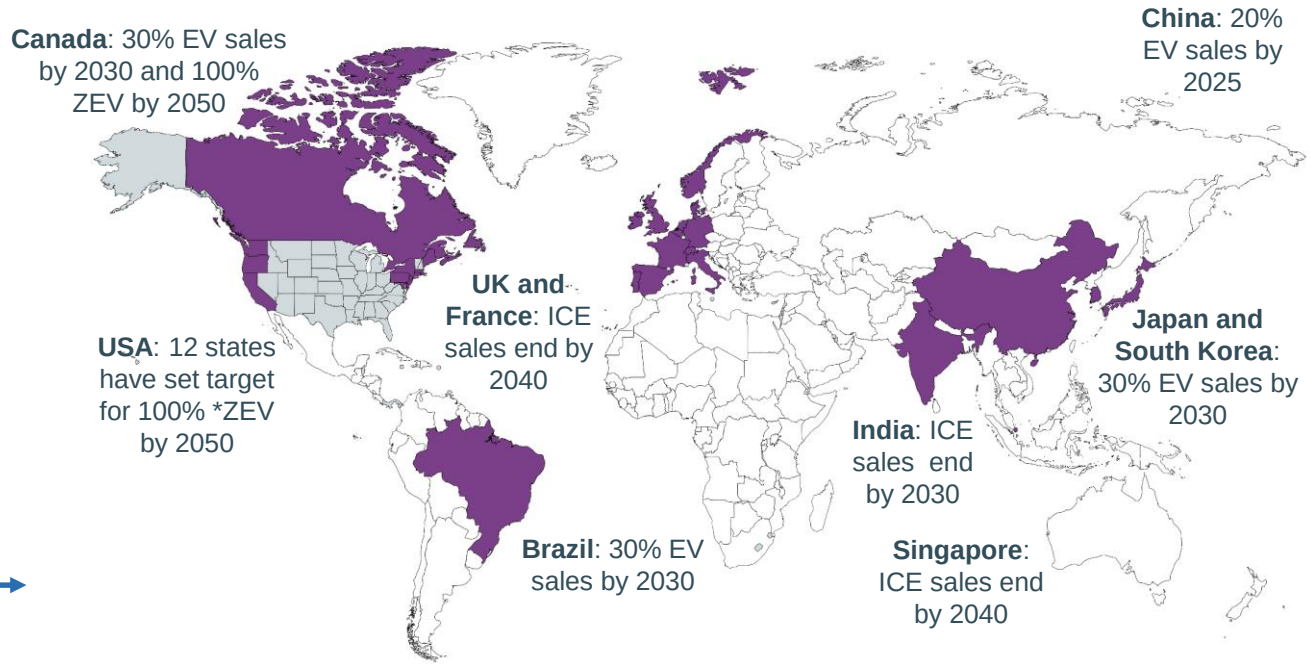
4 Connected

5 Soitec’s engineered substrates for automotive megatrends

Global emission policy and regulation drive electrification growth

EU CO_2 target will drive PHEV/BEV share to 40% of all cars sold in EU by 2030





› **Failure to meet the target will result in penalty of €95 for each gCO_2/km of target exceed.**

Source: https://ec.europa.eu/clima/policies/transport/vehicles/cars_en

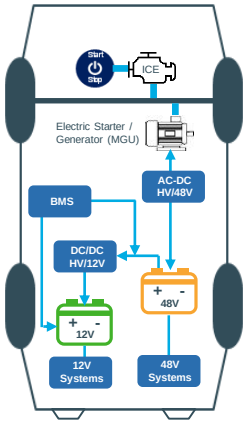
Source: Evercore ISI Research, 2019

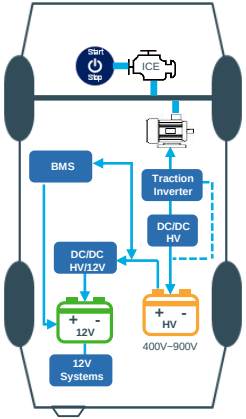
xEV powertrain type with different automotive electronics requirements

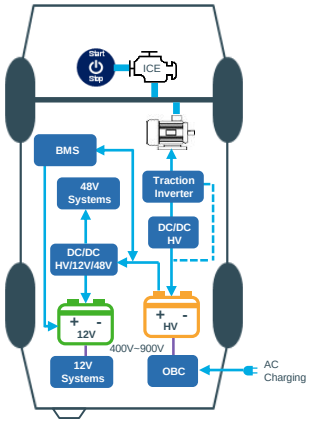
~80%

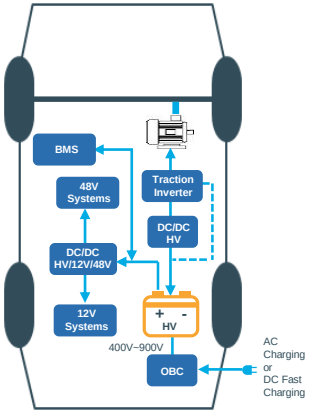
power semiconductor added content value is for Power MOSFET (e.g. SiC) in BEV

Source: UBS







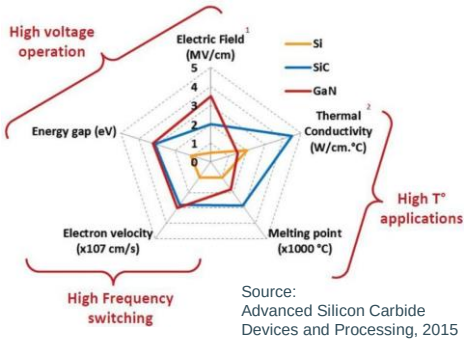


Powertrain	48V – Mild Hybrid (MHEV)	Full Hybrid (FHEV)	Plug-in Hybrid (PHEV)	Battery (BEV)
*CO2 reduction (vs. ICE)	~22%	~30%	~75%	100%
Battery type	48V Lithium + 12V Lead	HV Lithium + 12V Lead	HV Lithium + 12V Lead	HV Lithium
On-board charger	–	–	3.3kW~6.6kW	6.6kW~50kW
Electric traction	–	15kW~60kW	40kW~80kW	>80kW
**Added power semiconductor value	+$200	+$300	+$400	+$450

*Source: Continental, 2019 **Source: NXP 2019, UBS 2020 – compare to internal combustion engine

Silicon Carbide advantages drive electrification innovation

SiC has superior intrinsic characteristics



Source:
Advanced Silicon Carbide Devices and Processing, 2015

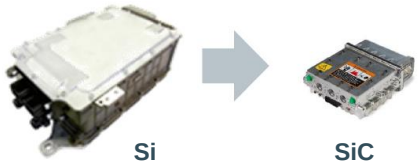
› Higher efficiency:
➔ **reduce power loss**

› Higher switching frequency:
➔ **increase power density**

› Higher temperature operation:
➔ **improve long term reliability**

Excellent system improvement

SiC brings performance improvement and miniaturization for traction inverter system



Si SiC

From Si-IGBT based module to SiC MOSFET based module:

› Size reduction: **50%**

› Efficiency improvement: **2%**

› Reliability: **extended life in use**

Source: STMicroelectronics, APEC 2019

Enhance user experience

SiC conveys better total cost of ownership for electric vehicle

› **Mileage extension**
(using same 100kW battery pack)

Source:
Tesla Blog, Apr 2019

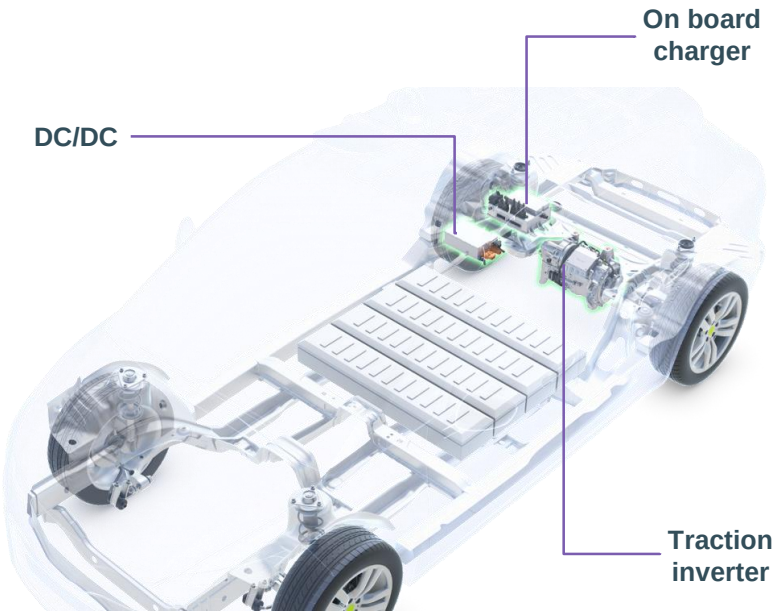
› **Fast charging**

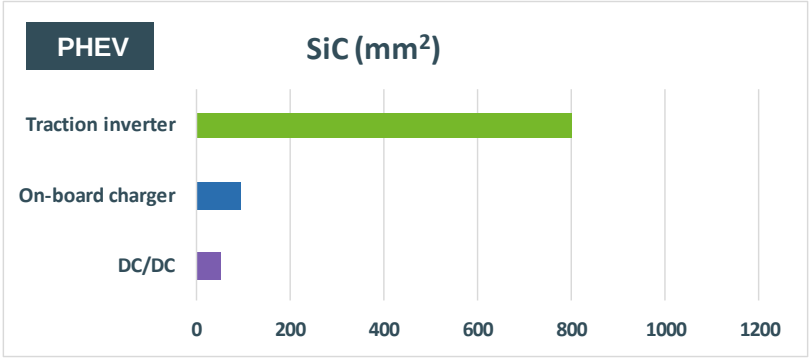
DC fast charge (Level 3 or 4)

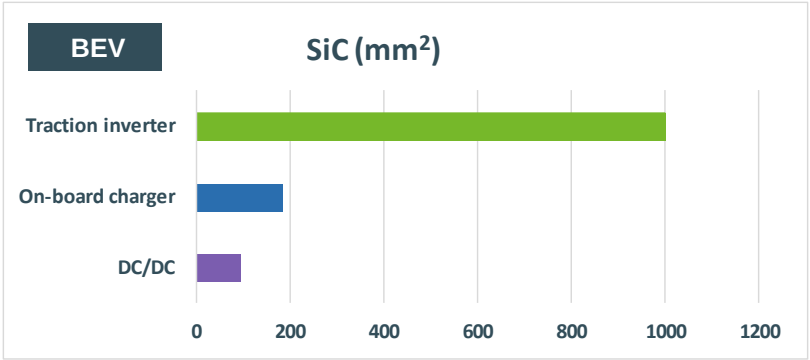
AC charge (Level 1 or 2)

Source: Wolfspeed 2020, On Semi 2020

EV powertrain revolution
Significant content growth for SiC

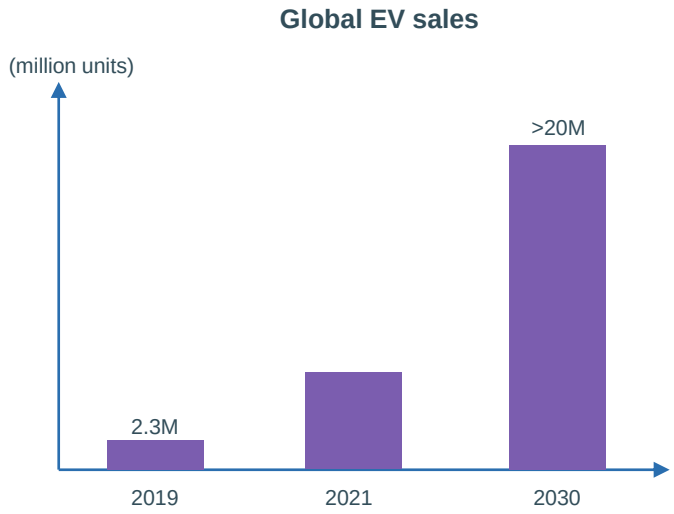




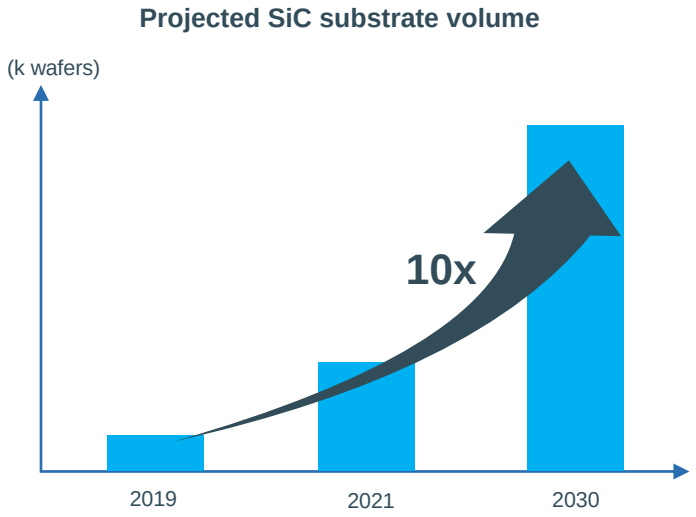


Source:
Soitec estimates, 2020 – based on premium BEV/PHEV
Note: mm² are serviceable accessible market

EV growth drives demand for SiC substrates



Source:
IEA - Global EV Outlook 2019, CleanTechnica, IHS Markit 2019 - the data exclude mild hybrid and full hybrid vehicles,



Source:
Yole 2020, IHS Markit 2019, Soitec estimates, 2020 – including other industrial applications

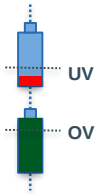
BMS opportunity for Power-SOI with increasing level of electrification

Battery management system (BMS) for automotive electrification

Key concerns when using lithium ion battery packs that are usually constructed with hundreds of individual cells:

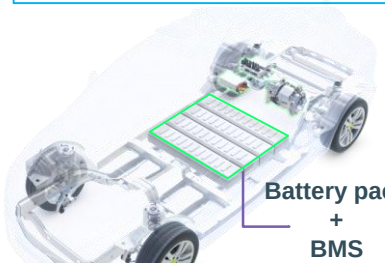
Safety

- over voltage (OV)
- under voltage (UV)
- thermal runaway



Performance

- safe and fast charging
- lifetime degradation
- cell mismatch
- state of charge / health

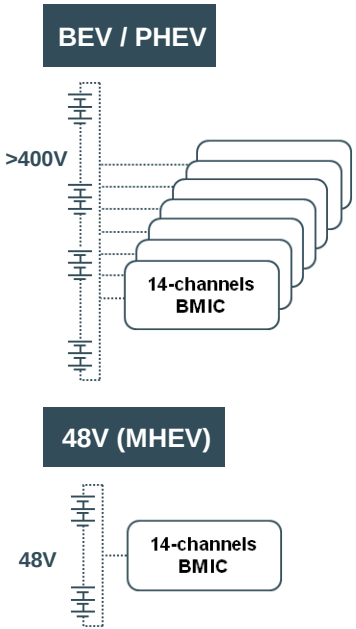


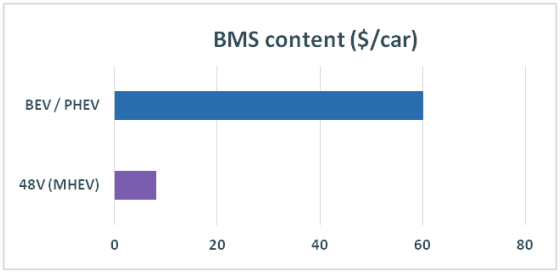
BMS is necessary in EV for long term use of battery packs and prevent deterioration through key functions:

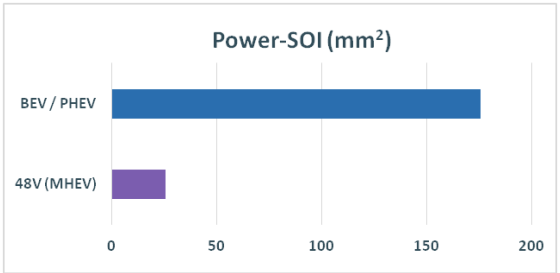
- accurate cell voltage(V), current(I), temperature(T) and charge (Q) measurement
- cell balancing

SOI provides 'intrinsically safe' process to achieve high functional safety requirement in BMS

BMS content for different level of electrification







Source: Soitec estimates, 2020 – case study based on 400V system for BEV/PHEV

Note: mm² are serviceable accessible market

Outline

1 Automotive megatrend

2 Electrification

3 **Autonomous**

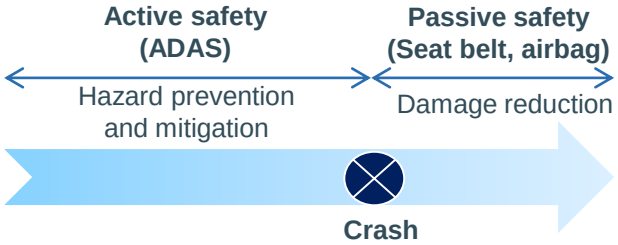
4 Connected

5 Soitec’s engineered substrates for automotive megatrends

Global safety mandates drive growth of advanced driver assistance systems

› ***Global road fatalities annually is about 1.35M with 94% due to human error**

› **Incorporating active safety systems to existing passive solution**



› **Car manufacturers are required to achieve the highest safety rating in EU and USA with increase safety standards**

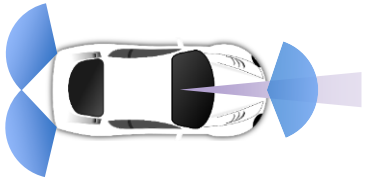
EU: NCAP roadmap requiring the need for driver monitoring, autonomous emergency steering, autonomous emergency braking, child presence detection and V2X between 2022 ~ 2024

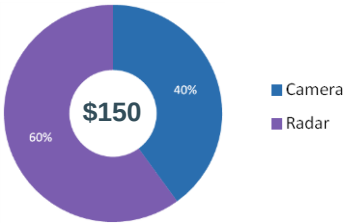
USA: to incorporate active safety in all passenger vehicles by September 2022

*Source: WHO 2020, NHTSA 2019

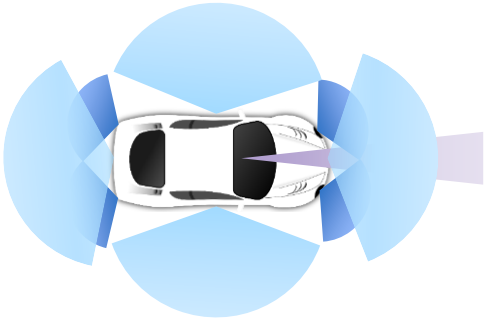
Incremental semiconductor content with increasing automation

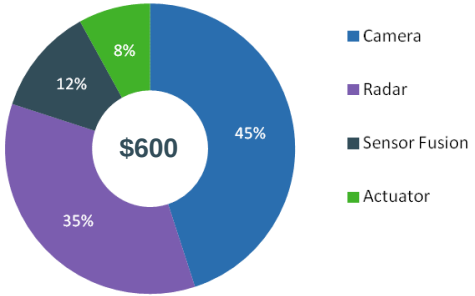
Level 1 & 2



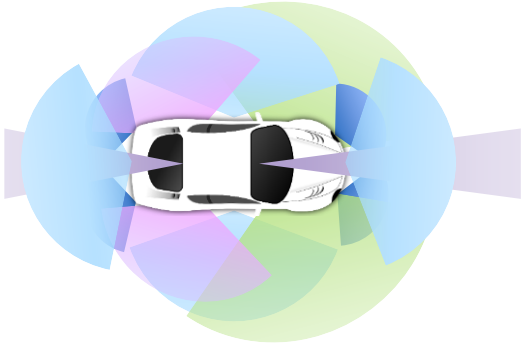


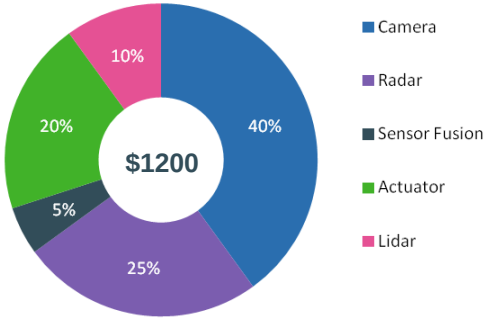
Level 3





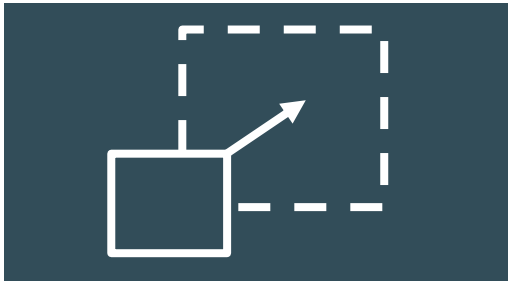
Level 4 & 5





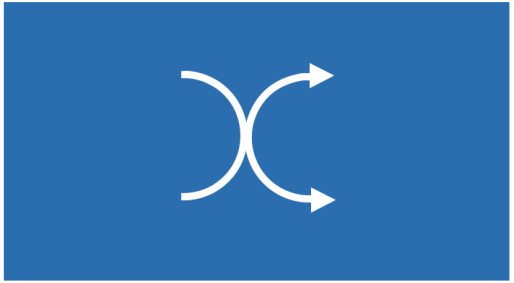
Source: NXP 2019, Infineon 2019

FD-SOI capabilities pave the way for ADAS evolution from L1 to L5



Scalable systems

- Automated range
- High resolution
- 3D positioning



Flexible architectures

- Efficient RF / mmW
- High speed mixed-signal
- Low power digital

Reliable technology

- Ageing compensation
- CMOS integration
- Improve soft error rate (SER)
- AEC-Q100 readiness

FD-SOI benefits for autonomous innovations

40% more speed at same node for TOPS, lower power
Vison processor, Edge AI Control

Fewer CMOS design masks, simpler TTM
Cost competitive

Microwave and mmW system on chip
Connectivity solution and Long and Short-Range Radar

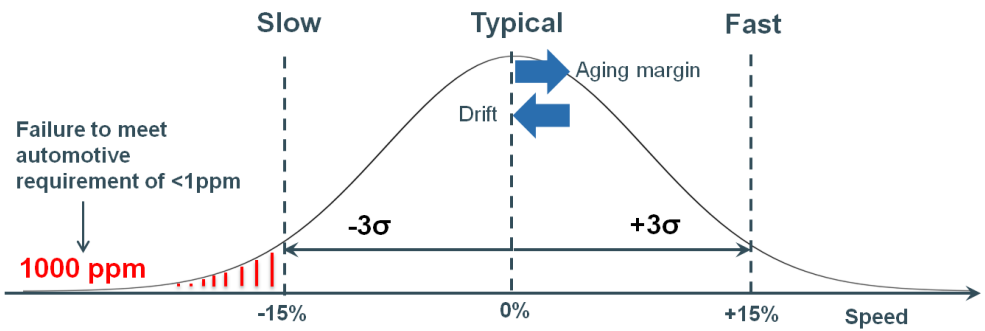
5x power efficiency on low power MCU
Always On and low power sensors

Immunity to electromagnetic, low SER
Automotive AEC compliant - robustness

Stable performance in operations with Adaptive Body-Biasing
Automotive AEC compliant – reliability

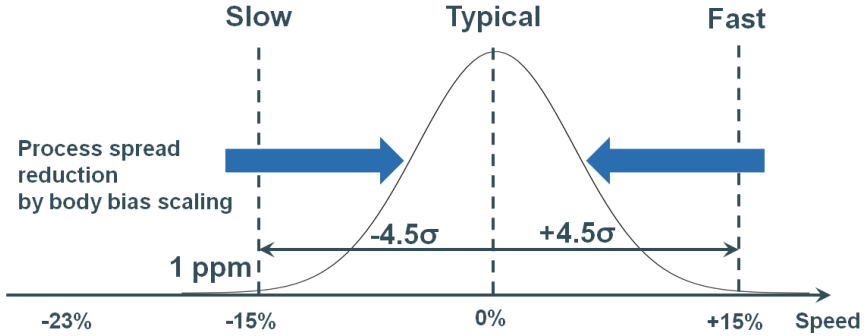
FD-SOI introduces unique method of compensating ageing Enhancing safety and reliability for automotive requirement

Without any process compensation



Ageing compensation with adaptive body-biasing (ABB)

DOLPHIN DESIGN



Source: Soitec analysis, 2020

- ADAS digital performance dominated by meeting **±4.5σ** boundary conditions
- Traditional (VDD) scaling improves process control but degrades power and ageing control
- **FD-SOI specific (ADAPTIVE BODY-BIASING) scaling improves both power and ageing control over ±4.5σ**
  ➔ easily meeting automotive requirement of <1ppm for enhanced reliability and safety

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Dolphin - IP and ASIC enabler for Automotive applications

DOLPHIN DESIGN

IP Portfolio

Energy efficiency IP
ABB IP

Power management
Speed platform

High temperature
Up to 150ºC

Ageing & safety monitors
Slack guards

High reliability
Rad hard FF

FD-SOI Expertise

ASIC Design Services

Auto Grade 1

ISO26262 ISO9001 EN9100

Partners & Customers

NXP
KALRAY
BOSCH
arbe ROBOTICS
AutoChips
ANALOG DEVICES

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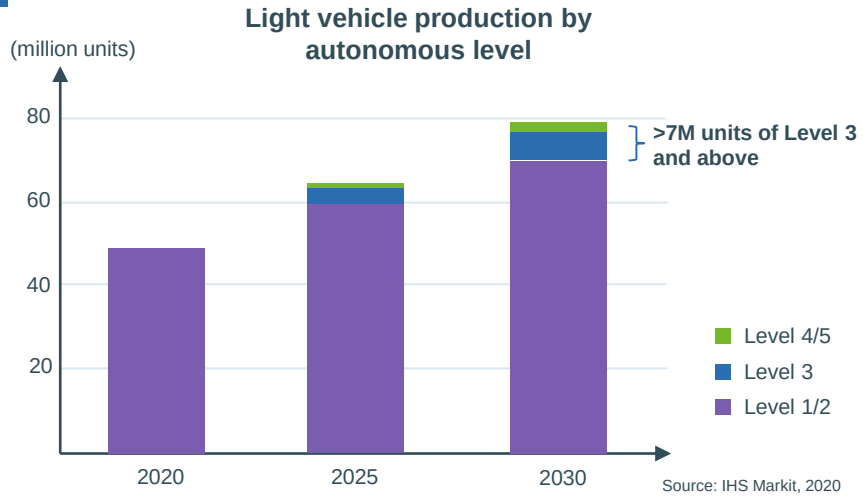
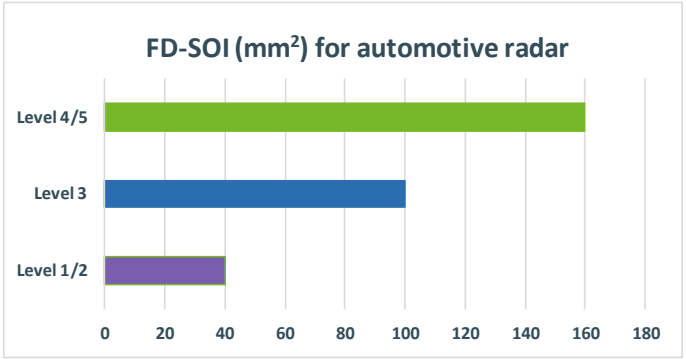
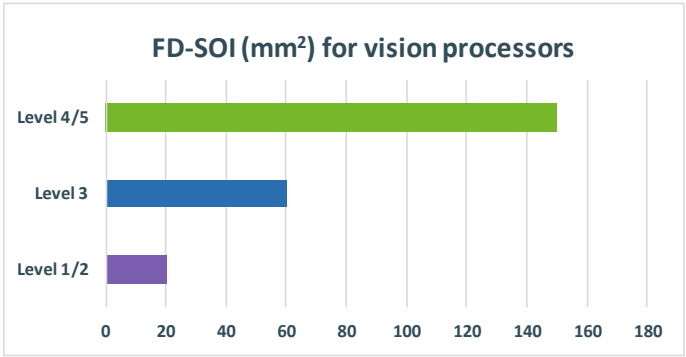
FD-SOI content growth with increasing level of autonomous



Source: IHS Markit, 2020



Note: Automotive radar includes radar transceiver and radar MCU, 28nm node



Source: Soitec estimate, 2020 – 28nm for Level 1/2/3 and 12nm for Level 4/5
Note: mm² are serviceable accessible market

- Growth in Level 4/5 requires a platform technology that is ***scalable***, ***flexible, robust*** and ***reliable***
- FD-SOI (an insulator technology) ***isolates*** and ***enables*** advance RF, mixed-signal and digital benchmarks
- FD-SOI is the ***unique solution*** to meet Level 4/5 object detection, positioning and compute efficiencies.

Outline

1 Automotive megatrend

2 Electrification

3 Autonomous

4 **Connected**

5 Soitec’s engineered substrates for automotive megatrends

Connectivity is a key enabler for all vehicle services

Connectivity to driver/ passenger

INFOTAINMENT

in-vehicle

Wi Fi · Bluetooth

Internet services
Navigation system
Screen mirroring

Hands free voice
Multimedia streaming

Connectivity to cloud

TELEMATICS

cloud ↔ vehicle
satellite ↔ vehicle

Wi Fi · 5G

OTA Update
Vehicle maintenance
Vehicle location
Optimum routing

Internet access
Remote access
Fleet utilization
Media services

Connectivity to environment

ENVIRONMENT

V2V, V2I, V2P,
V2N, V2D, V2H

5G · Bluetooth · Wi Fi

Dynamic traffic signaling
Connection to home
Pedestrian warning

Driver assistance
Remote control

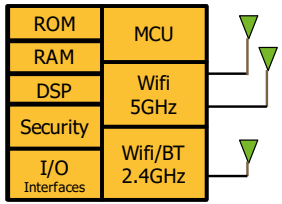
Soitec technologies are indispensable for 4G and 5G
Now also in connected vehicle

Fully adopted with: RF-SOI

Partially and to be adopted with: POI, RF-SOI, FD-SOI

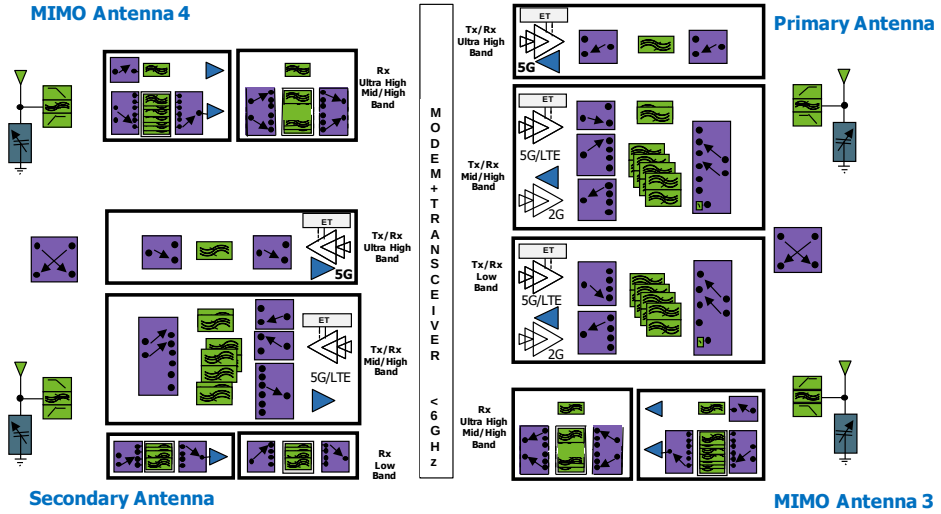
INFOTAINMENT in-vehicle

Wifi / BT / FM SoC hotspot



TELEMATICS
cloud ↔ vehicle
satellite ↔ vehicle

Cellular / WiFi / GNSS Front-End Module

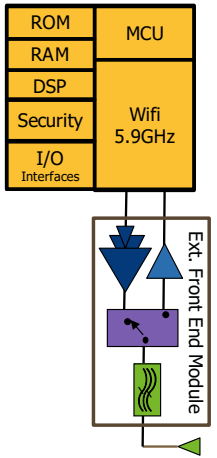


4G/5G Front-End Module

Note: Wifi and 5G mmW not shown

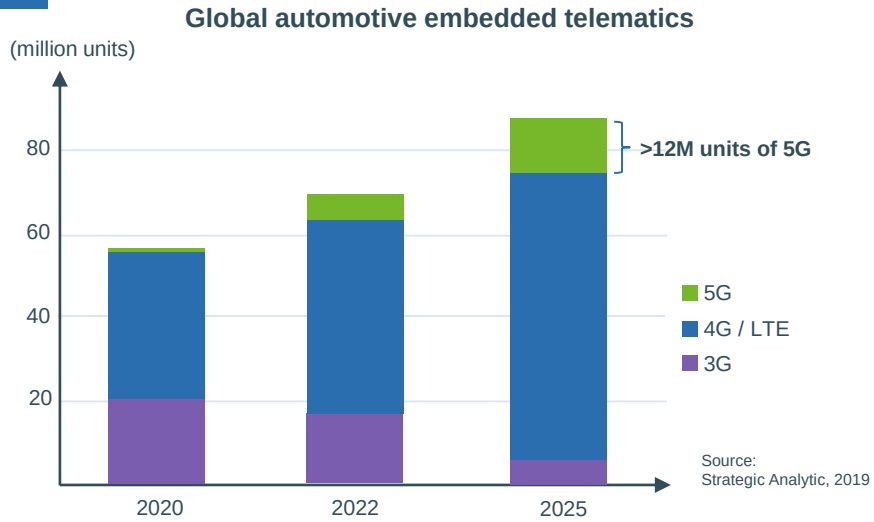
ENVIRONMENT
V2V, V2I, V2P, V2N, V2D, V2H

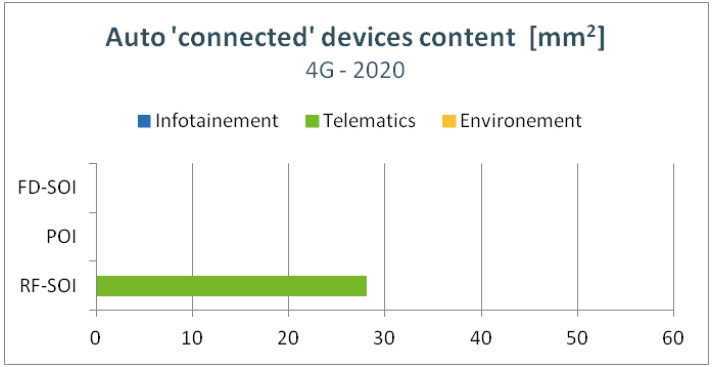
Cellular-V2X and/or WiFi 5.9Ghz SoC 'V2X'

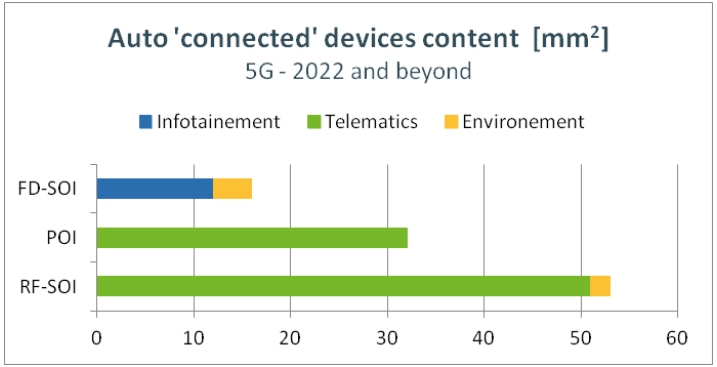


Note: Cellular -V2X modem is shared with cellular pipe

Soitec content in connected car is driven by telematics







- Telematics is moving to 100% adoption in cars
- Major Soitec total addressable content growth per connected vehicle
  - up to 2mm² on 3G
  - up to 28mm² on 4G in 2020
  - up to 100mm² on 5G beyond 2022 (without mmW)
- RF-SOI is in 100% of Smartphone and will be in automotive

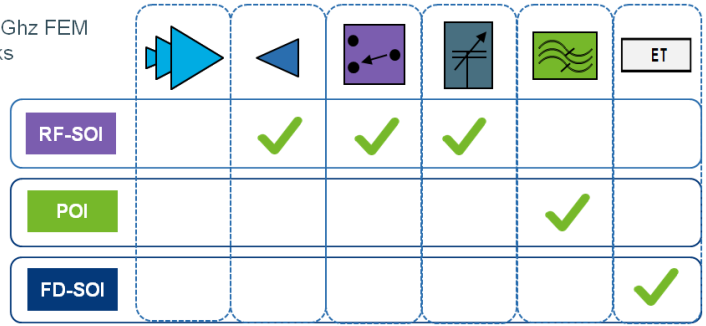
Note: mm² are serviceable accessible market
2mm² on 3G, 5G mmW not taking into account – opportunity is 60mm2 FD or RF-SOI
Source: Soitec estimates, 2020

Soitec portfolio is ready to address long term connected car vision
Ready for combination of 5G networks evolution

5G sub-6GHz

- RF-SOI mainstream technology for switch, LNA, tuner
- POI target to become mainstream technology for filters

5G sub-6Ghz FEM key blocks

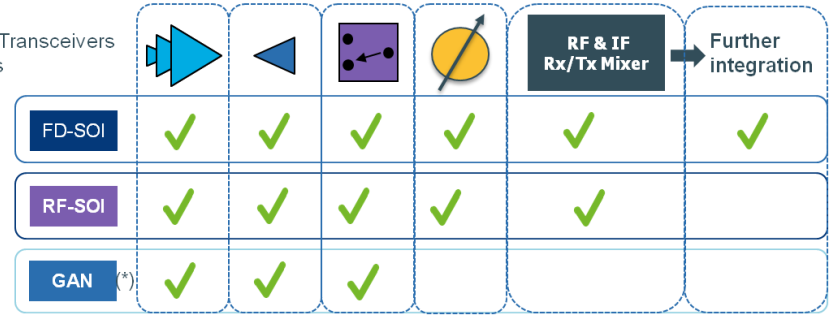


✓ suitable solution

5G mmW – potential adoption in automotive

- Addressing different integration options
- FD-SOI and RF-SOI (<65nm node) are both ideal technologies for mmW FEM
  - Enable full FEM integration on single die critical for mmW to avoid interconnect losses
  - Chipset leaders favor FD-SOI while FEM leaders favor RF-SOI
- GaN delivers high performance for PA

5G mmW Transceivers key blocks



(*) : No public data available for GaN

Outline

1 Automotive megatrend

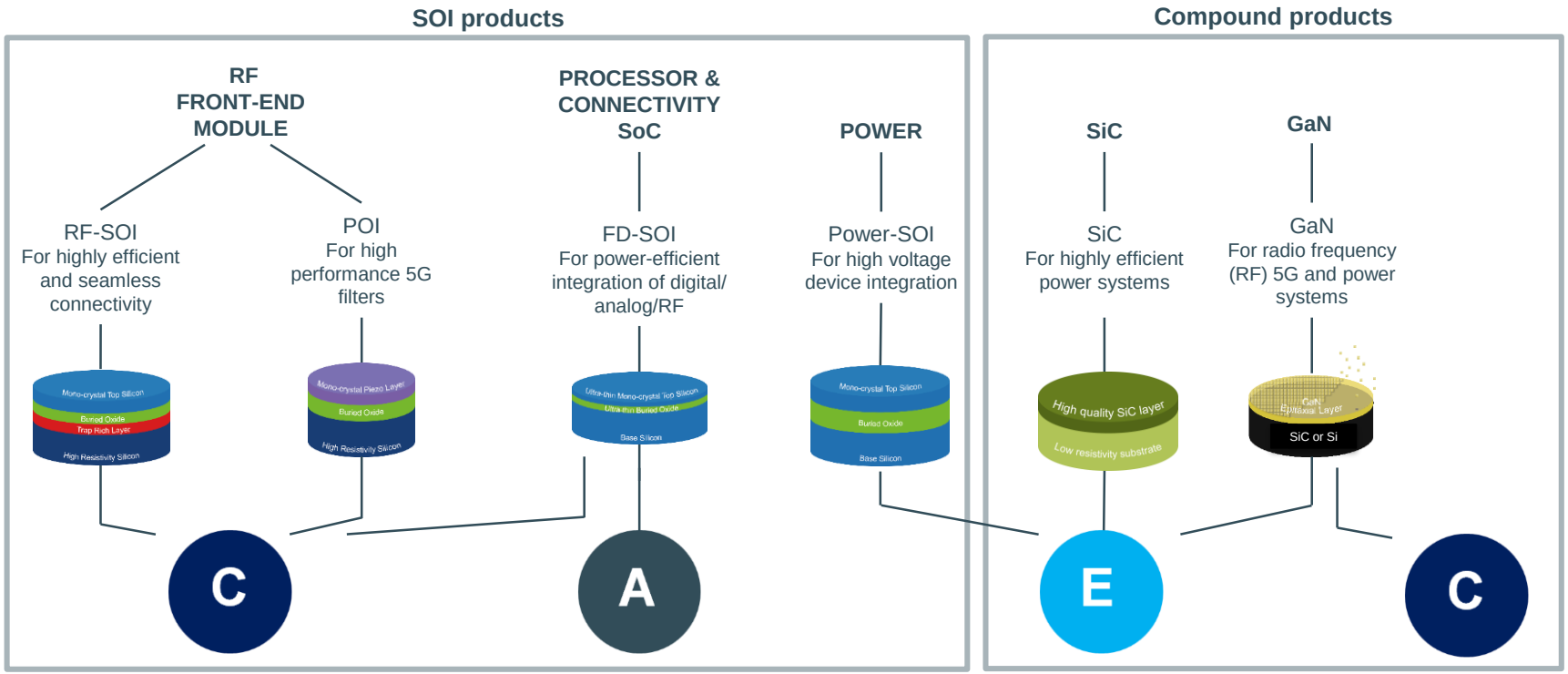
2 Electrification

3 Autonomous

4 Connected

5 **Soitec's engineered substrates for automotive megatrends**

A broad product portfolio of engineered substrates for automotive megatrends

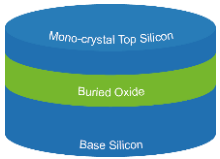


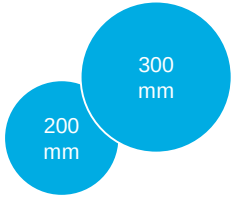
Note: Other engineered substrates for automotive applications include InGaNOS and Imager-SOI – not shown above

Power-SOI for automotive electrification

Power-SOI

Product description





› SOI and SOI + epi application specifics with best in class uniformity and thickness control

Power-SOI offering

Parameters		200-mm*	300-mm*
Top	Thickness	0.14µm to 20µm	0.14 µm to 10µm
	Uniformity	+/-50Å up to +/-300Å	+/-50Å up to +/-100Å
	Resistivity	8-100 ohm.cm, P or N type	
Box	Thickness	0.3µm to 4µm	0.1µm to 2µm
	Breakdown Voltage	VBD>5MV/cm Thermal oxide quality	
Base	Resistivity	0.3-100 ohm.cm, P or N type	

*Note: capability shown - some features are under development

Value proposition vs. alternative technologies

	Power-SOI	Bulk
Electrical isolation, low and high voltage integration	+	=
Area density	+	=
Electromagnetic compatibility	+	=
High temperature operation	+	=
Total cost of ownership (TCO)	+	=
High volume manufacturing	+	+

+ optimum = suitable - not suitable

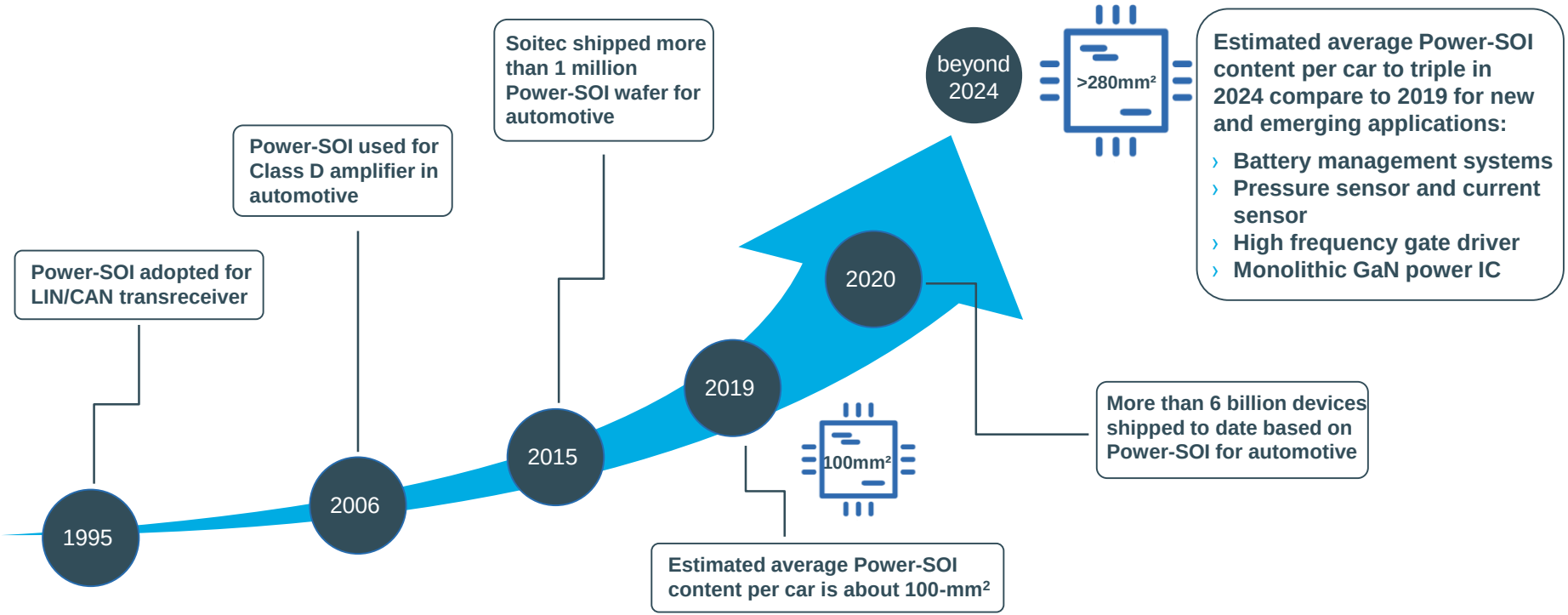
Source: Soitec analysis

Soitec manufacturing

Bernin 1 200-mm	Bernin 2 300-mm	Simgui 200-mm

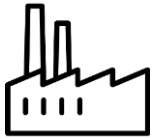
Customers shipped >6 billion Power-SOI based chip Illustrating industry-leading reliability for automotive applications

Power-SOI



Soitec solutions address key challenges for SiC market adoption

SiC



Supply Chain

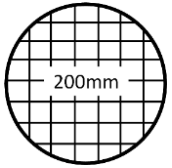
Limited availability of high quality substrates vs. demand

Quality

Quality and reliability issues are caused by defects coming from wafer and/or epitaxy

Cost

SiC substrate with Epi represents >50% of power device cost



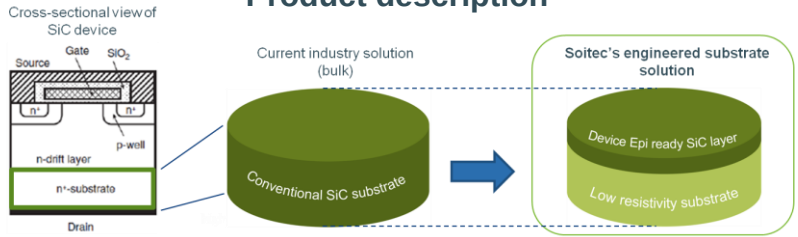
Scalability

200mm time to market for SiC device roadmap acceleration

SiC for automotive electrifications
Industry standard for best-in-class quality and electrical performances

SiC

Product description



SiC roadmap

Timeline	150-mm	200-mm
2020	Development	R&D
2023	Production	Ramp up

Value proposition vs alternative technologies

Access to substrate

Quality of substrate

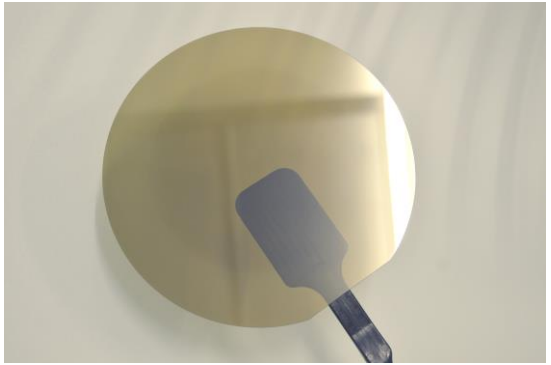
Cost of ownership

- **Use and recycle ~10x** of best in class high quality SiC layer
  - ➔ supply chain stability
- **Significant reduction of defect density**
  - ➔ increase of number of good dies
- **Lower substrate vertical specific on-resistance** improves overall device RDSon
  - ➔ RDSon lowering* (performance improvement)
  - ➔ die size reduction* (more dies per wafer)
- **Simplification of device manufacturing process**

Strategic partnership with Applied Materials Accelerate Smart Cut™ SiC time to market

SiC

- Joint technology development program on next-generation SiC substrates.
- The program aims to provide technology and products to improve the performance and availability of SiC to address surging demand for electric vehicles, telecommunication and industrial applications.
- Installation of a SiC engineered substrate pilot line.
- The line is expected to be operational by the first half of 2020, with the goal of producing SiC wafer samples using Soitec's Smart Cut™ technology in the second half of 2020.



Soitec engaging across full automotive ecosystem

SiC

PowerAmerica

OEM

Tier1

Tier2

Tier3

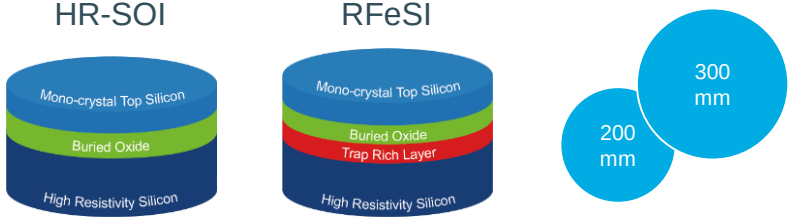
Source: Soitec, 2019

soitec

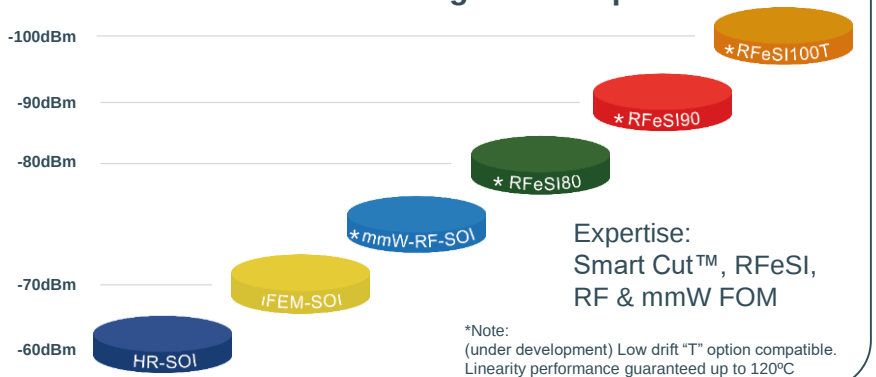
RF-SOI for automotive RF and mmWave front ends

RF-SOI

Product description



Product offering / roadmap



Expertise:
Smart Cut™, RFeSI,
RF & mmW FOM

*Note:
(under development) Low drift "T" option compatible.
Linearity performance guaranteed up to 120ºC

Global platform for AEC-Q100 automotive RF and mmWave FEM

	SOITEC RF-SOI	HR Silicon Bulk	Silicon Germanium	MEMS	GaAs
Switch	+	=	-	+	+
Tuner	+	-	-	+	+
Power Amplifier	=	-	=	n.a	+
Cost	+	+	=	-	=
Integration / Area	+	+	+	-	-
Volume manufacturing 200/300mm	+	=	=	-	-

+ optimum = suitable - not suitable

Source: Soitec analysis

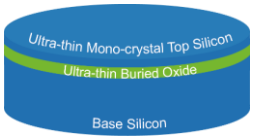
Soitec manufacturing

Bernin 1 200-mm	Bernin 2 300-mm	Pasir Ris 300-mm	Simgui 200-mm

FD-SOI for automotive radar and processors

FD-SOI

Product description



FD-SOI offering

node	55nm	28nm	22nm	18nm	12nm	≤10nm
Status	Prod	Prod	Prod	Pilot	Dev	R&D
eMemory	No	Yes	Yes	Yes	Dev	R&D
RF perf.	Yes	Yes	Yes	Yes	Dev	R&D

Unique value propositions:

- Robust operation against ageing, PVT variations with body-biasing control
- Highly-linear switches for wide-band object detection at greater ranges
- High resistive substrate (optional) for state-of-the-art Sub-THz operation

Value proposition vs alternative technologies

	SOITEC FD-SOI	Bulk Planar sub-40nm	Bulk FinFET sub-16nm	Silicon Germanium
Best in class RF/mmW technology	+	=	=	+
System energy efficiency	+	=	+	=
Robustness (safety mission)	+	=	=	=
Cost	=	+	=	-
Integration SoC plateform	+	+	=	-

\+ optimum = suitable - not suitable

Source: Soitec analysis

Soitec manufacturing

Bernin 2
300-mm

Pasir Ris
300-mm

FD-SOI for automotive

Automotive radar

- FD-SOI yields state-of-the-art radar (RF) performance
- Embedded radar (DSP) at lower-power footprint
- Enhances detection via highly-linear data conversion

Arbe Robotics
4D imaging radar
22nm FD-SOI

Source: Arbe Robotics, 2020

Autonomous driving vision processor

- Most advanced vision computing ASIC on the market
- Multi-camera (up to 8) sensor processing plus radar and LiDAR
- Intel EyeQ®4 shipping in automobiles since late 2017

Mobileye Eye®Q4
Vision processor
28nm FD-SOI

Source: Mobile Eye, 2020

Advanced MCU for domain controller

- High density technology
- High speed access non-volatile memory
- Low power consumption

STMicrolectronics
Stellar
28nm FD-SOI

Source: STM, MWC 2019

Application processor for infotainment

- Feature and performance scalable multi-core platform
- FD-SOI improves system reliability and robustness

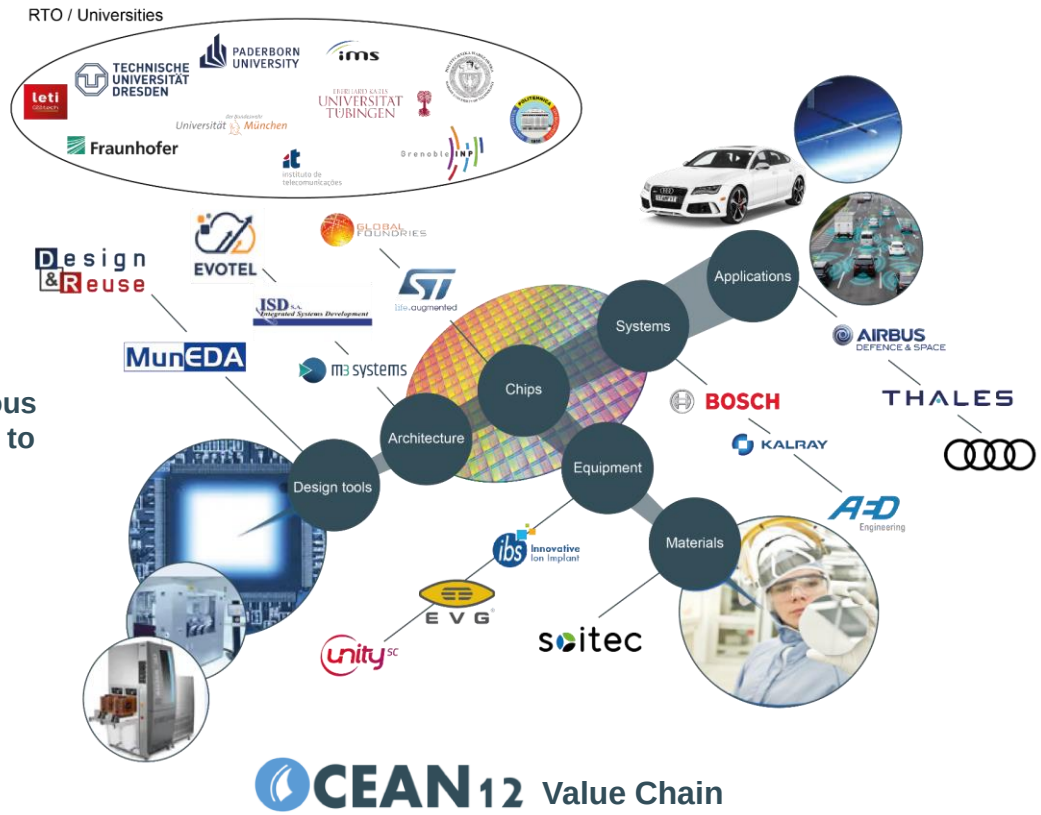
NXP
i.MX8
28nm FD-SOI

Source: NXP, June 2019

European innovation partnership to accelerate autonomous driving adoption

FD-SOI

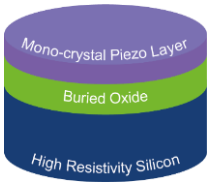
OCEAN12
Opportunity to Carry European Autonomous driving further with FD-SOI technology up to 12nm node



POI for Automotive

POI

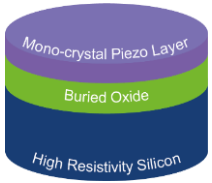
Product description

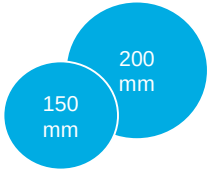


150 mm

Versatile product roadmap

● Device layer : Lithium Tantalite or Lithium Niobate

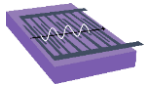
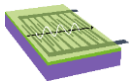
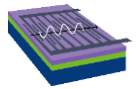




Expertise :
Smart Cut™, materials, Acoustics FOM

200-mm to support filter pricing roadmap

Best value proposition for 5G filters

	SAW	TC-SAW	BAW	SAW on POI
				
Energy efficient	=	=	+	+
New 5G band (wide >200Mhz)	-	-	+	=
Temperature stabilty	-	+	=	+
Cost	+	=	-	=
Area	=	=	=	+
Volume manufacturing	+	+	=	+

\+ optimum = suitable - not suitable

Source: Soitec analysis

Soitec manufacturing

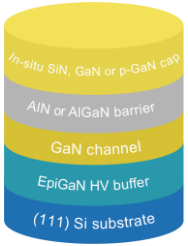
Bernin 3
150-mm

Soitec GaN products for Automotive

Epigan

Product description

› AlGaN epilayer stack deposited on silicon for normally-on or normally-off operation in power switching applications



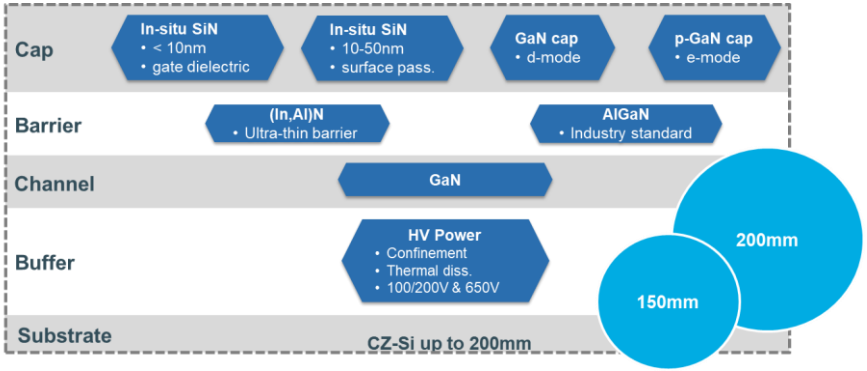
Value proposition vs. alternative technologies

› EpiGaN products are used for numerous high-power switching applications for industrial, consumer and automotive.

› This technology enables:
- › Very low conduction loss (low Ron)
- › Low switching loss
- › High frequency switching
- › High temperature operation

Product offering / roadmap

› Toolbox for 100V/200V and 650V product differentiation



Soitec manufacturing

Hasselt (Belgium) - GaN/Si up to 200-mm

Take Aways

- Automotive megatrends require lot of innovation in automotive electronic systems and Soitec has ready products to meet this evolution: Power-SOI, FD-SOI, RF-SOI and upcoming new generation of SiC substrates

- Soitec's engineered substrates bring strong value propositions across connectivity, autonomous and electrification megatrends.

- Soitec has been successfully serving Automotive markets for two decades and will largely expand its position in coming years with opportunity to establish new standards with engineered substrates

Thank you

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www.soitec.com

Glossary

AC	Alternating Current
ADAS	Advanced Driving Assistance Systems
AEC	Automotive Electronics Council
Amp	Amplifier
ASIC	Application Specific Integrated Circuit
ASP	Audio Signal Processor
ASSP	Application Specific Standard Product
BAW	Bulk Acoustic Wave
BEV	Battery Electric Vehicle
BM IC	Battery Management Integrated Circuit
BMS	Battery Management System
BOM	Bill of Material
BT	Bluetooth
CMOS	Complementary Metal Oxide Semiconductor
CPU	Central Processing Unit
DC	Direct Current
DRAM	Dynamic Random Access Memory
DSP	Digital Signal Processor
ECU	Electronic Control Unit
EMC	Electromagnetic compatibility
Epi	Epitaxial
ESD	Electrostatic Discharge
EV	Electric Vehicle
FD	Fully Depleted
FE	Front End
FEM	Front End Module
FHEV	Full Hybrid Electric Vehicle
FOM	Figure of Merit
GaAs	Gallium Arsenide
GaN	Gallium Nitride
HR	High Resistivity
HV	High Voltage
HVM	High Volume Manufacturing
IC	Integrated Circuit
ICE	Internal Combustion Engine
IGBT	Insulated Gate Bipolar Transistor
IP	Intellectual Property
ISP	Image Signal Processor
IVN	In-Vehicle Network
LED	Light Emitting Diode
LNA	Low Noise Amplifier
MCU	Micro Controller Unit
MEMS	Micro Electro Mechanical Systems
MHEV	Mild Hybrid Electric Vehicle
mmW	millimeter Wave
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
PMIC	Power Management Integrated Circuit
POI	Piezoelectric on Insulator
ppm	parts per million
PVT	Process Voltage Temperature
RDSON	On Resistance
RF	Radio Frequency
ROM	Read Only Memory
Rx	Receiver
SAW	Surface Acoustic Wave
SER	Soft Error Rate
Si	Silicon
SiC	Silicon Carbide
SOC	System on Chip
SOI	Silicon on Insulator
TC-SAW	Temperature Compensated Surface Acoustic Wave
TOPS	Tera Operation Per Second
TTM	Time To Market
Tx	Transmitter
V2D	Vehicle to Device
V2H	Vehicle to Home
V2I	Vehicle to Infrasructure
V2N	Vehicle to Network
V2P	Vehicle to Pedestrian
V2V	Vehicle to Vehicle
V2X	Vehicle to Everything
VBD	Breakdown Voltage