

SOI for HV and Power Management Applications

PIET WESSELS

Fellow

Technology Innovation

NXP Semiconductors

0.

COMPANY CONFIDENTIAL

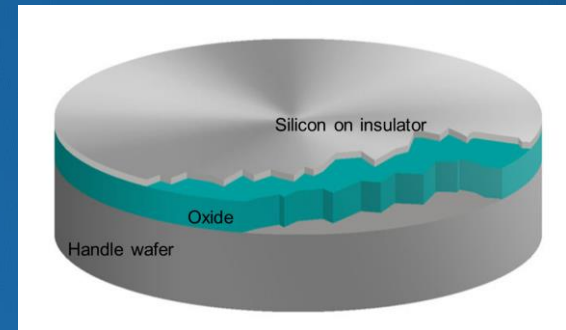


SECURE CONNECTIONS
FOR A SMARTER WORLD

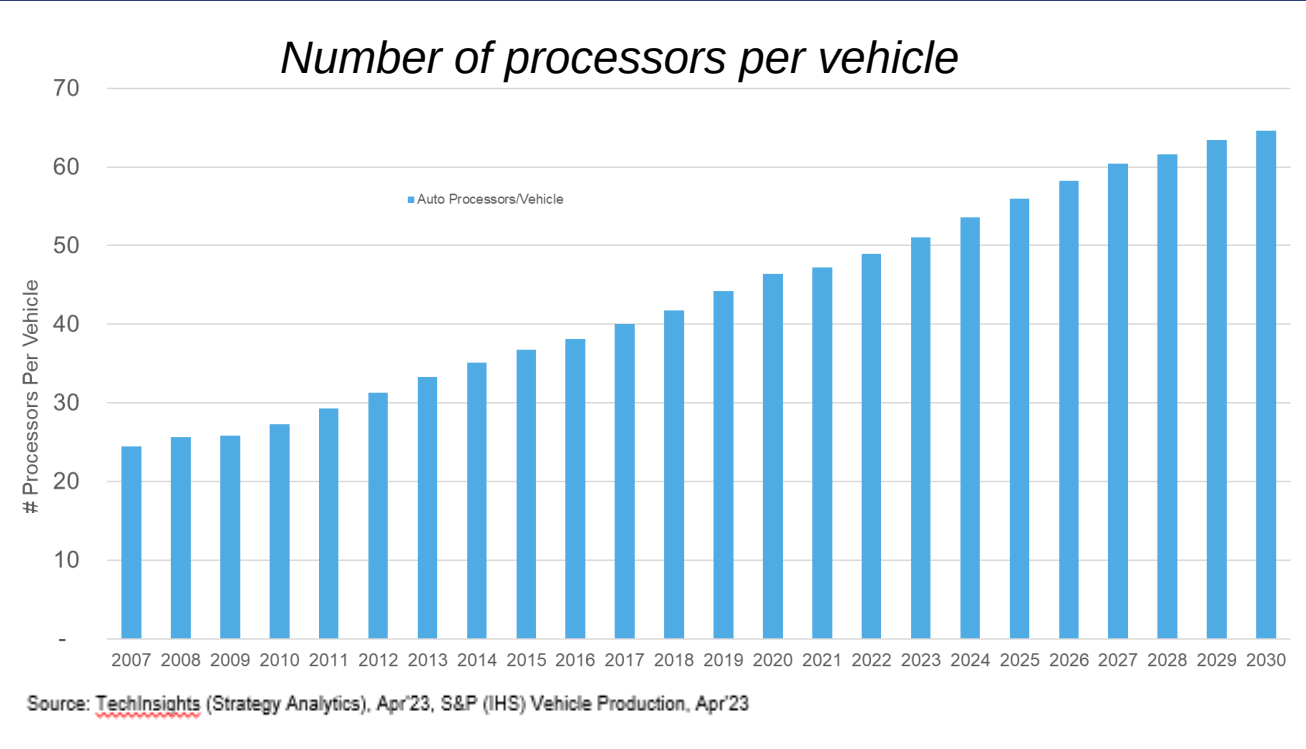
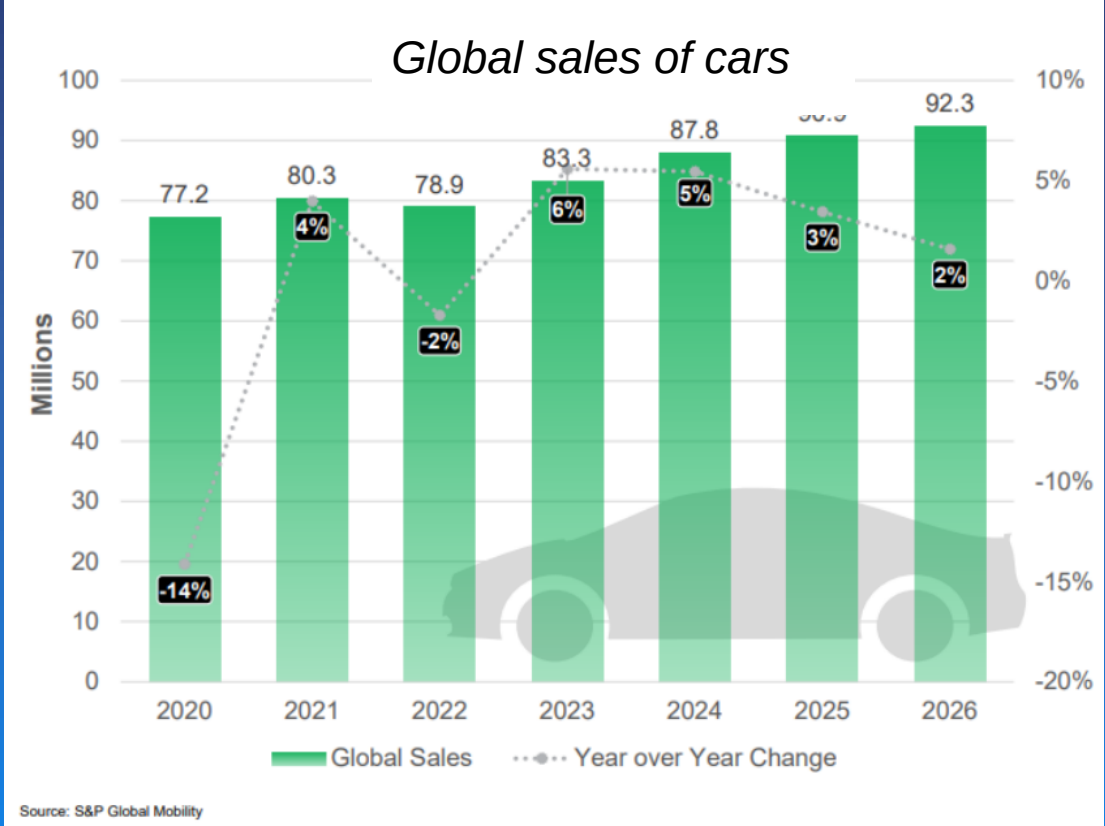


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- History of Automotive BCD at NXP
- SOI based BCD
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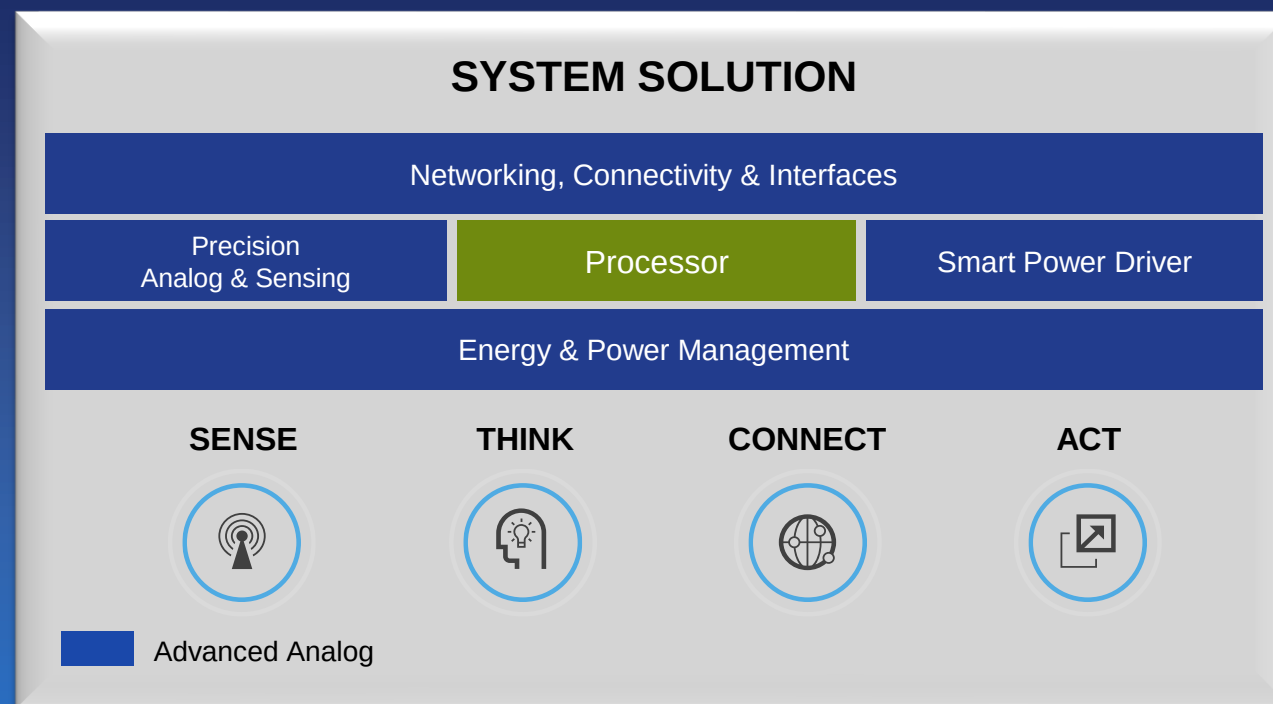
Automotive Market



Analog is bringing digital to life

SYSTEM SOLUTION REQUIREMENTS

Optimized Performance
Efficient BOM
Inherent Functional Safety
Scalable HW & SW
Optimized Footprint



ADVANCED ANALOG PORTFOLIO

Precision Analog & Sensing
System Power Management
Networking & Interfaces
Functional Safety & Security
System Design Approach



NXP IVN Transceivers | A History based on SOI

DISCOVER NXP's IVN
SOLUTIONS FOR E/E &
SDV ARCHITECTURES



CAN

**Strong Player and Innovators in CAN, since the beginning.
A benchmark in quality, expertise and portfolio**



Mantis and TJA144x CAN FD Transceivers



TJA1145A Partial Networking



TJA146x CAN Signal Improvement Transceivers



TJA115x Secure CAN Transceivers



TJA1052i Isolated CAN transceiver

LIN

Single and Multi-channel LIN transceivers and mini SBCs



TJA102x and TJA1124 series of LIN transceivers



TJA1028 and TJA1128 LIN Mini-SBCs



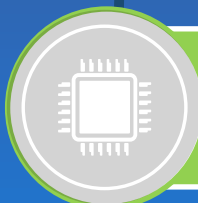
SJA1124 SPI to QuadLIN controller



Co-created IVN in 1992, key player since then



Drove and driving innovation and standards



5 Generations CAN, 3 in LIN, 3 in FlexRay



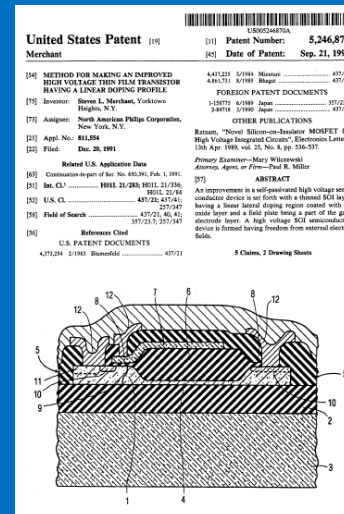
Multi-source, sub-ppm world-wide production

History of automotive BCD at NXP

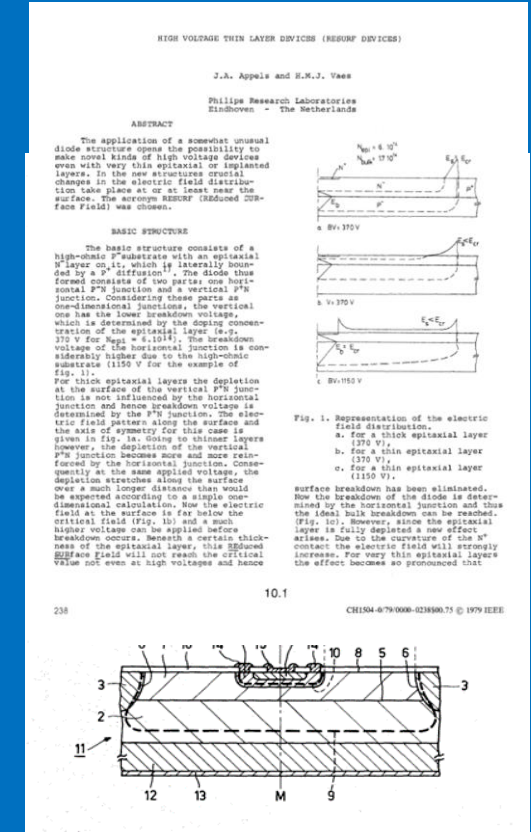
- Freescale in BCD since 1983
- NXP in BCD since 1985
- NXP started with SOI in BCD in 2000
- NXP and Freescale merge in 2015



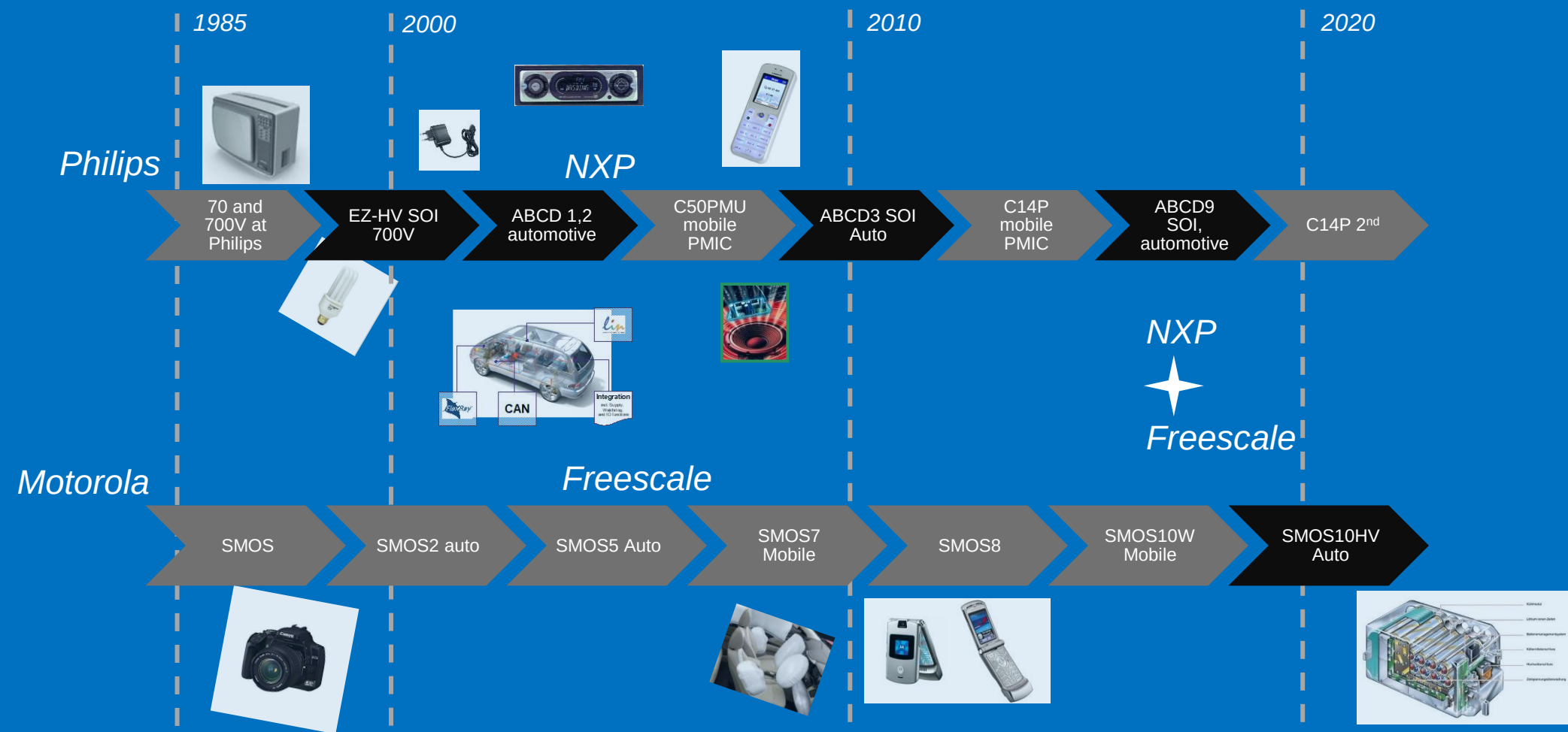
SOI for BCD 1993



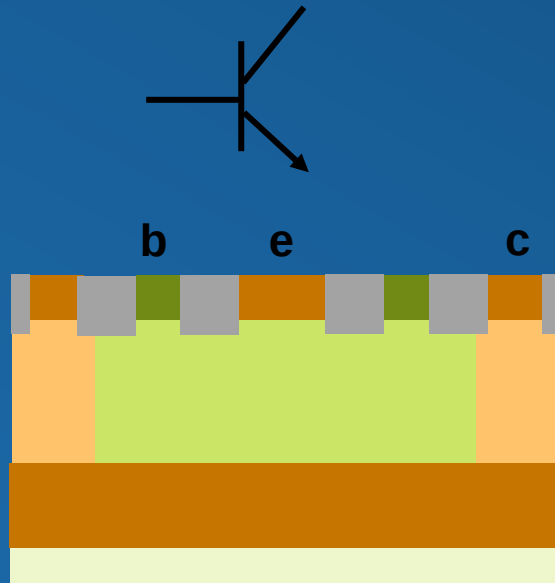
Resurf
"Philips invention", 1979



Journey of BCD - technologies at NXP

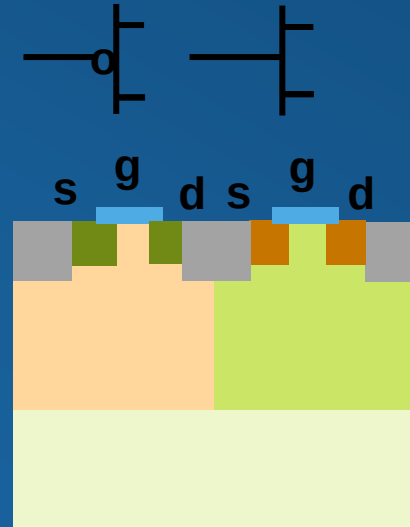


BCD technology: Bipolar – Cmos - Dmos



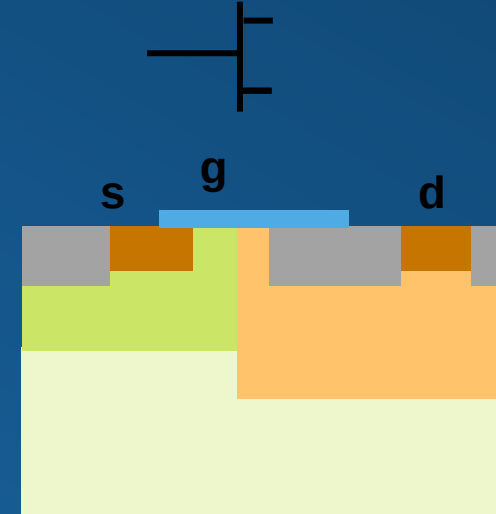
Bipolar

- Accurate voltage reference
- ESD protection



Cmos

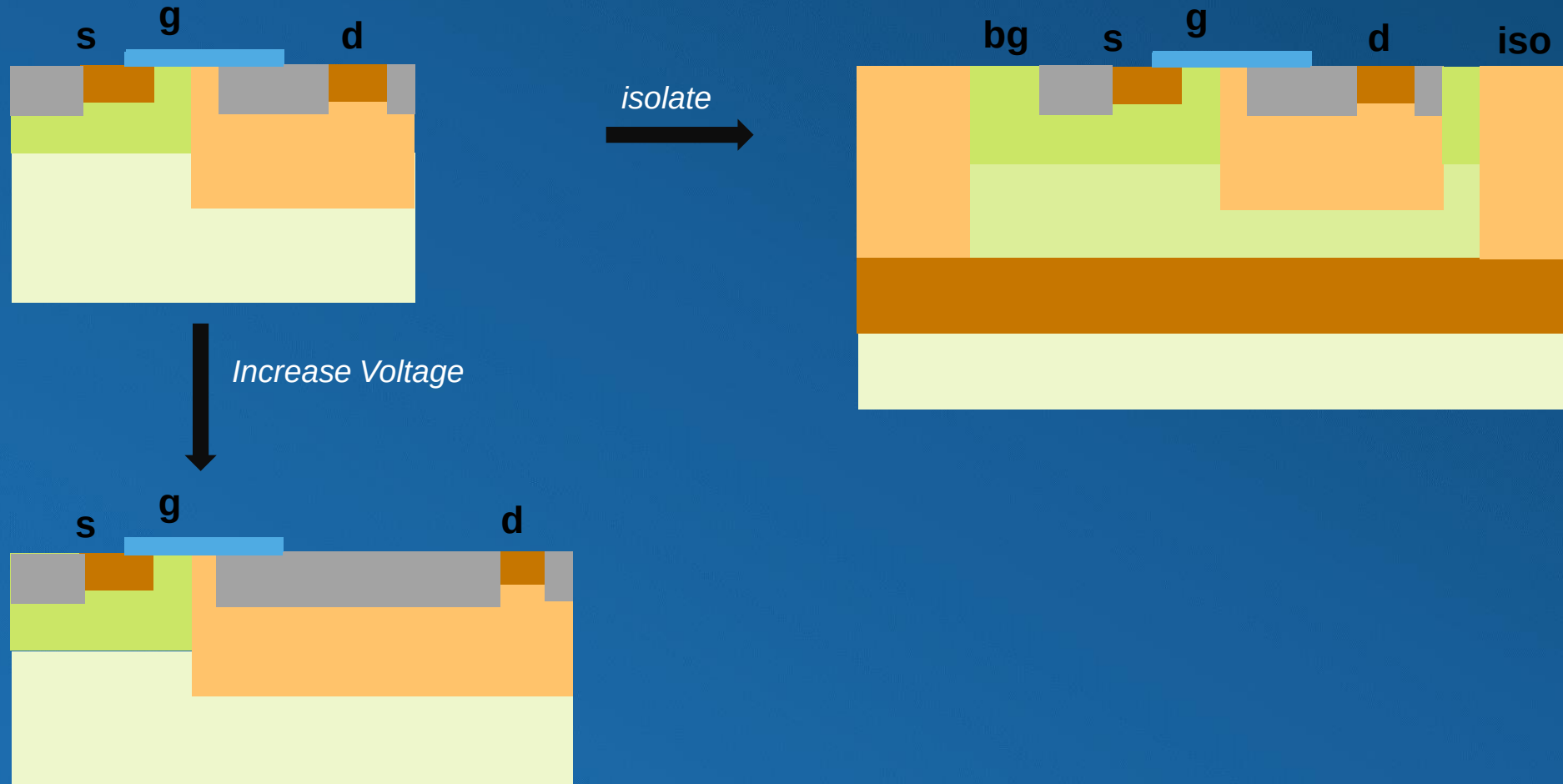
- Digital processing



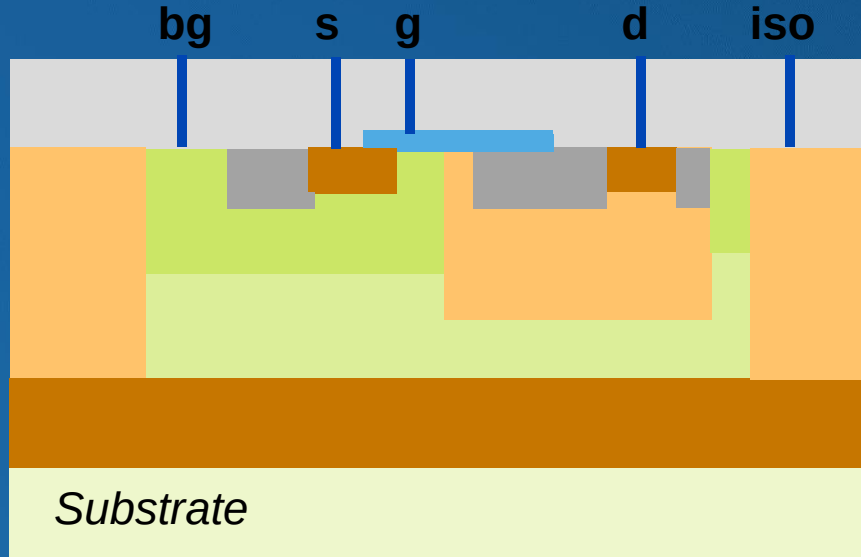
Dmos

- High voltage
- High current

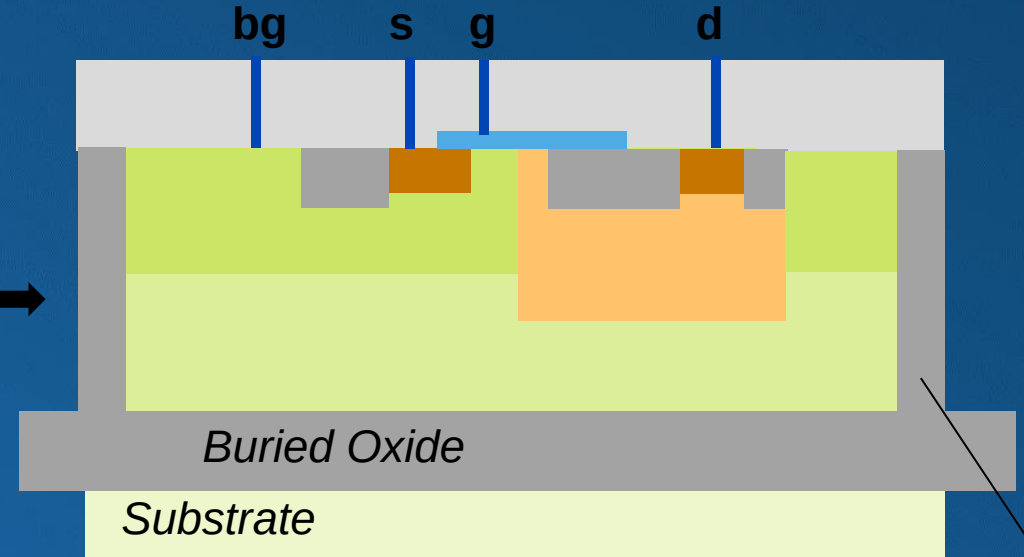
Dmos in bulk based process



Bulk based dmos

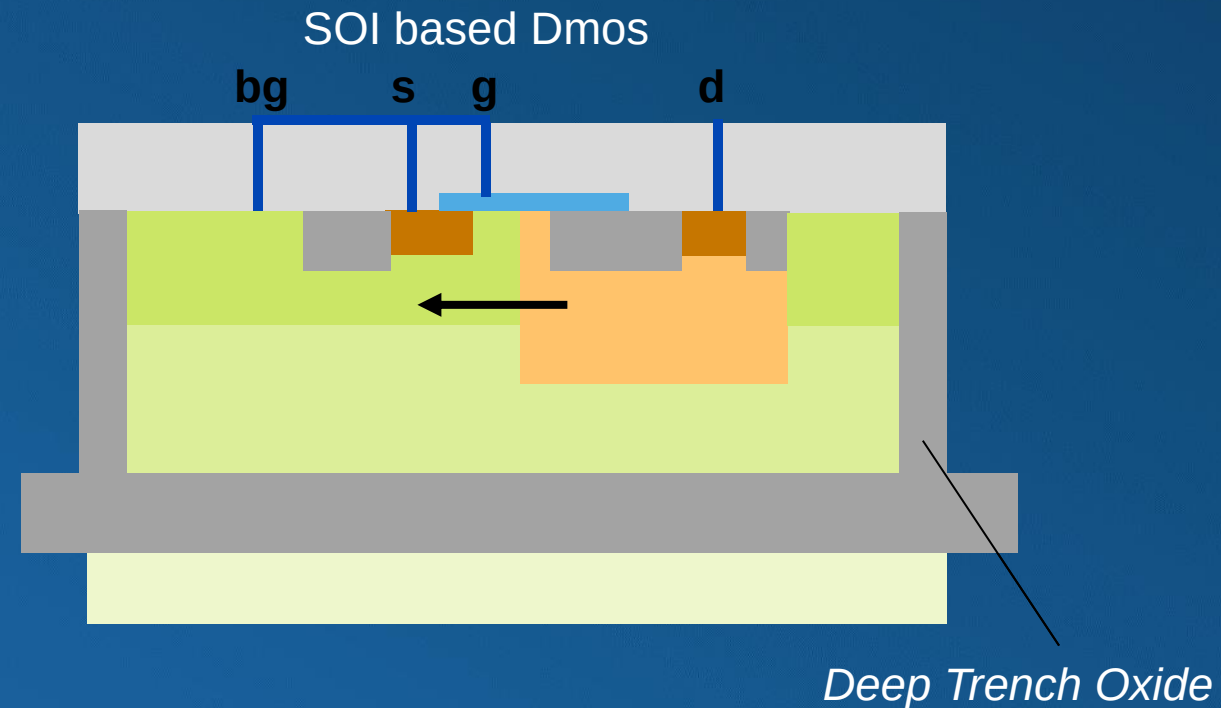
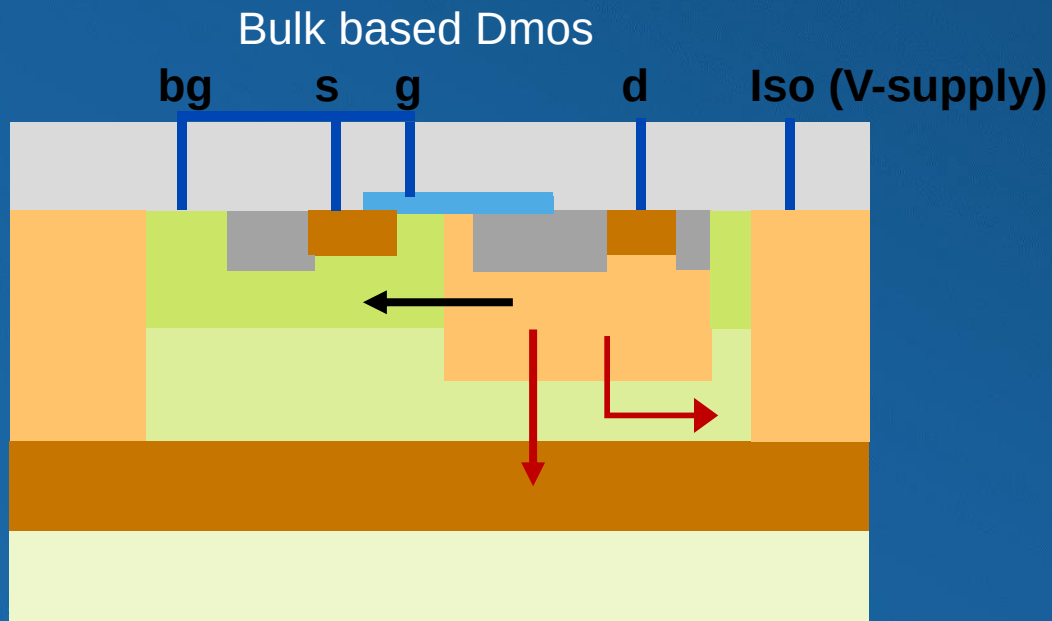


SOI based DMOS



Replace N-type isolation by oxide

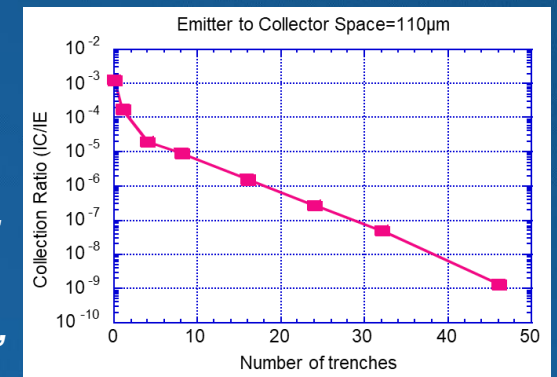
A forward biased diode - High side is easy to manage on SOI



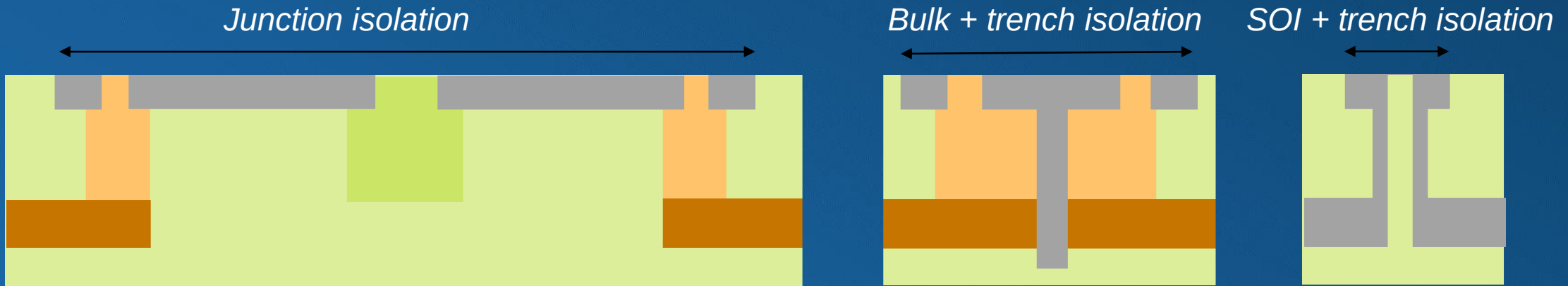
At Bulk

- Forward biased drain – bg diode act as emitter
- Iso (at V-supply) acts as collector, which creates unwanted currents

Example:
significant current collected at 110μm
for “Bulk + trench isolation”

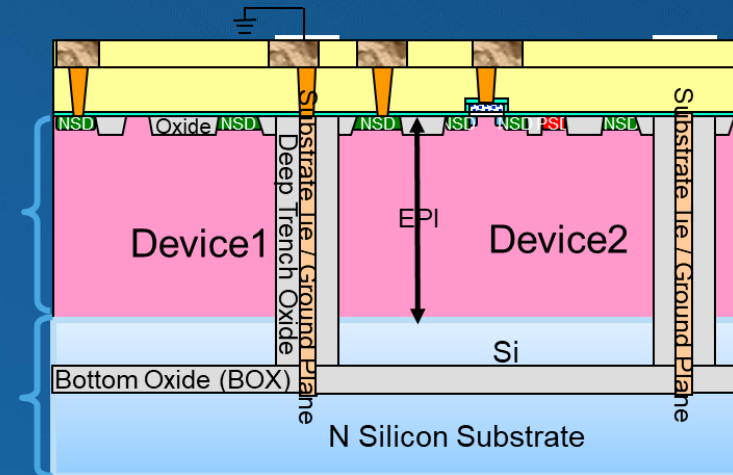


Extreme small isolation width with “SOI + Trench”



NXP's SOI BCD:

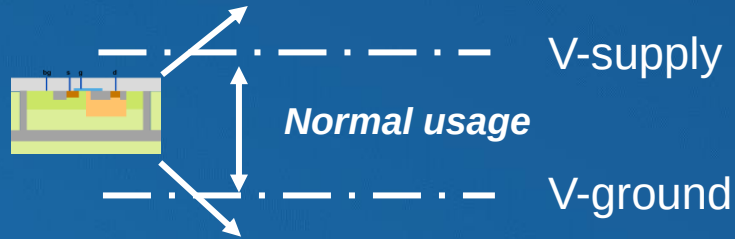
- Every device is fully isolated with oxide, and surrounded with ground plane.
- Trench lay out is flexible and very dense:



SOI versus bulk for BCD

SOI

- Allows IP to be biased above supply or below ground (+100V to -100V)



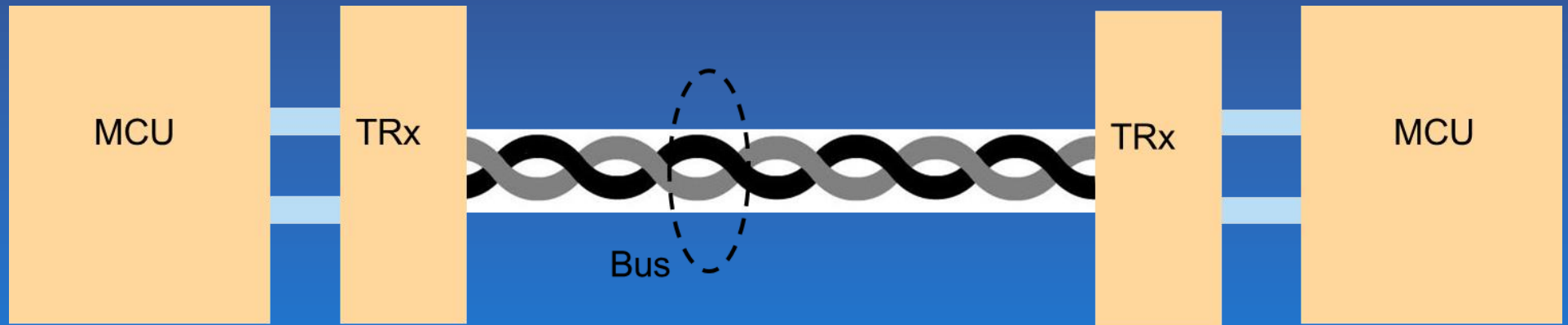
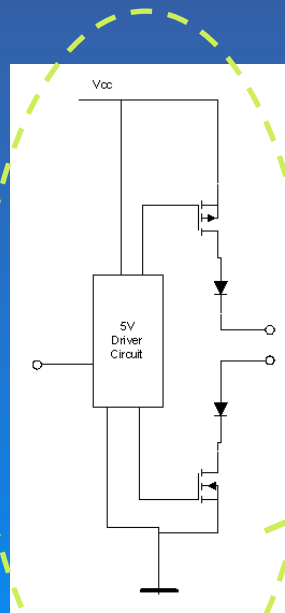
- No latch up.
- Low cross talk. Reduced noise propagation
 - Simpler design.
 - Easier Functional Safety.
- Small power device, and small isolation.
- Fast reverse recovery

Bulk

- Better thermal conductivity
- Lower substrate costs

CAN Transceivers

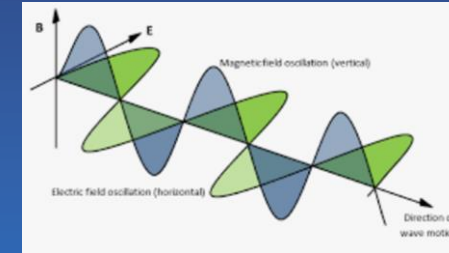
- Enable communication between nodes
- Apply CAN protocol
- 1.8V to uC and 5V to bus.



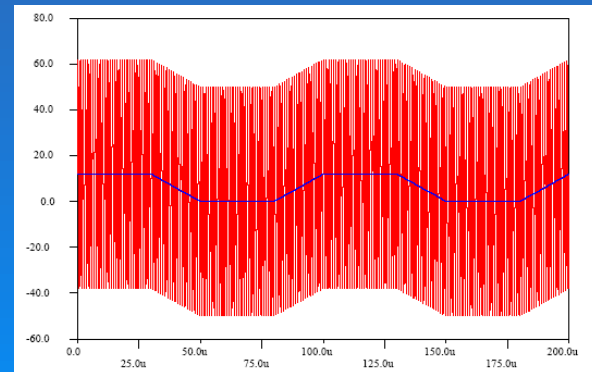
The bus acts as antenna



- Radiation of signals via the bus should be controlled
 - This requires symmetric signal on CAN-H and CAN-L

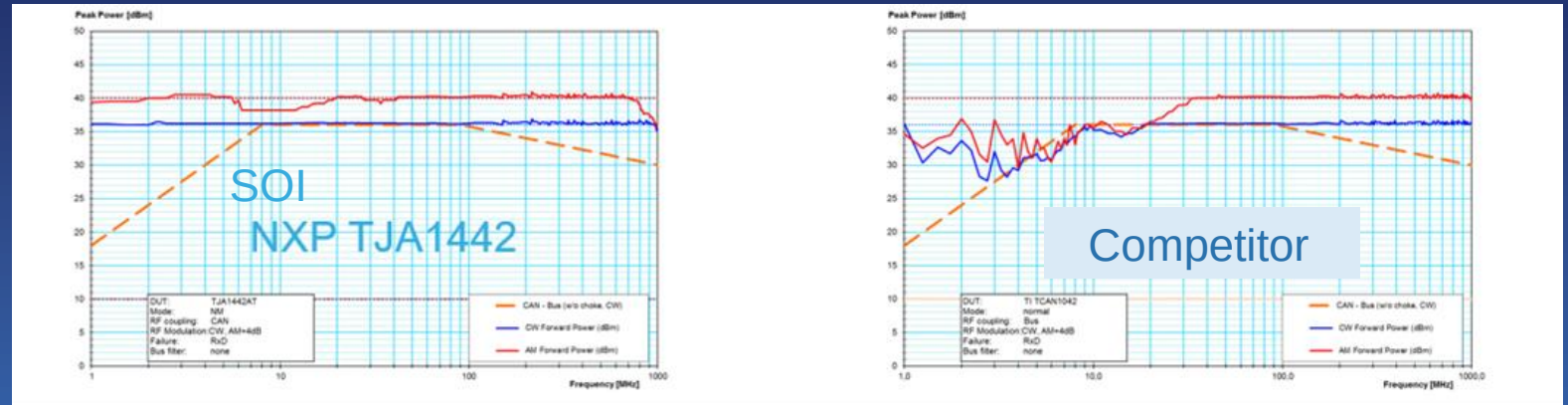


- The bus picks up noise which contaminates the 5V signal or can damage the Tx.



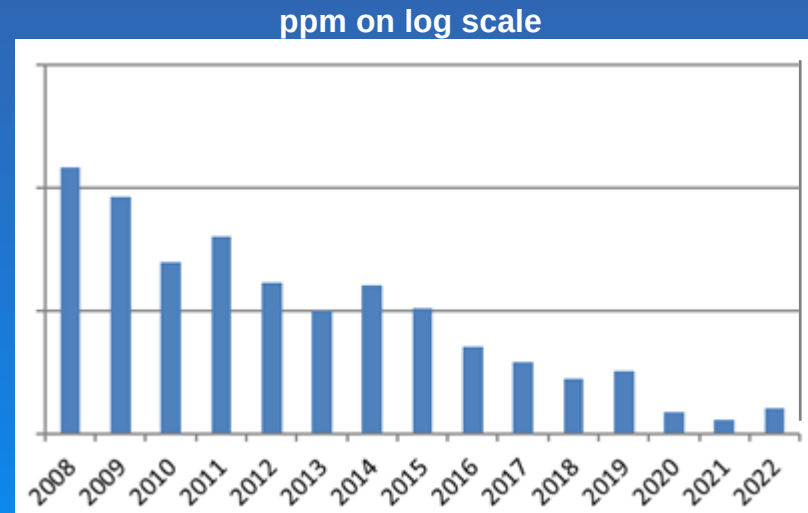
A SOI based CAN transceiver:

- EMI is superior on SOI

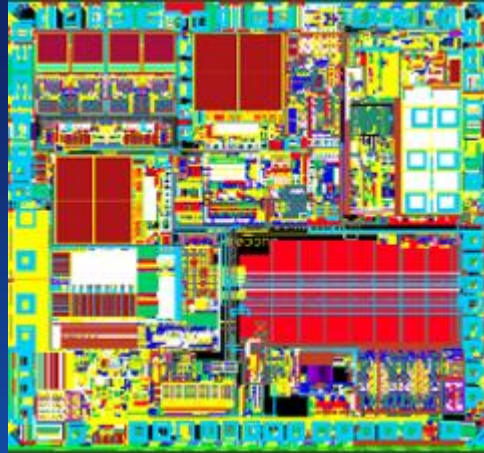


- NXP's CAN is robust up to -40V
 - No latch up

- Customer returns are $\ll 1$ ppm
 - On track for 1 ppb in 2030



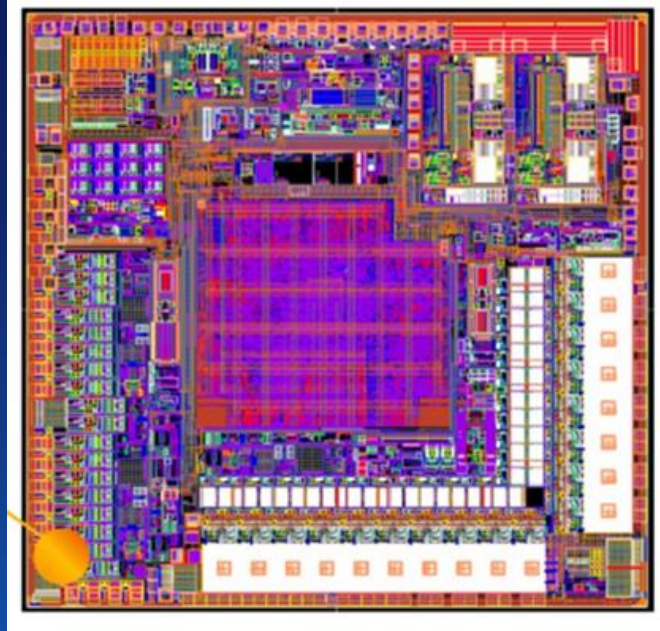
FS23: SBC



- Integrated: Buck, Boost convertors, LDO's + CANFD + LIN + FuSa
- FuSa ASIL D
- 40V input, up to 0.4A output
- Extreme robustness allows direct connection to car battery pin.
- Excellent EMI performance on CANFD with DC-DC running
- A0 silicon passing EMC DPI & CE



BCC18



- Battery Management Controller for 18 cells.
- Superior Hot plug performance (no parasitic diodes).
- Extreme robustness due to SOI. No parasitic bipolar in isolation construction.
- Excellent EMC performance (Voltage accuracy during DPI/BCI).
- Very high accuracy (0.8mV) over full lifetime.



Closing remarks

- NXP has a long and unique history in SOI based BCD technologies
- SOI BCD enables extreme robust solutions for the harsh automotive environment
- SOI BCD is one of the key aspects that allows NXP to deliver CAN products at very low ppm levels.

Acknowledgements

- Acknowledgements to all NXP colleagues, especially:

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