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Monolithic Driver in Smart Power Technology

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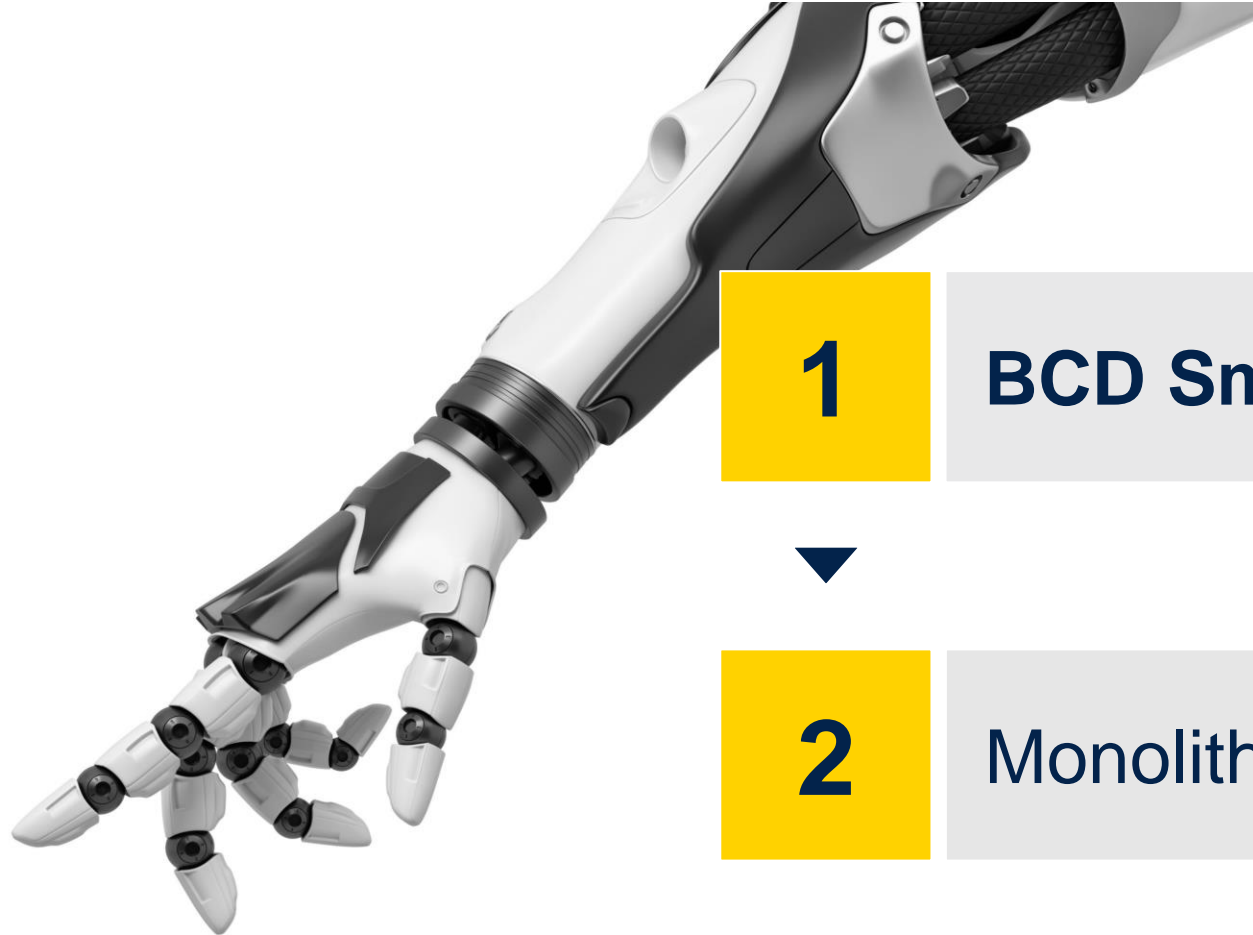
Technology R&D – Smart Power Technology

STMicroelectronics – Cornaredo – ITALY



External Paper Validation N. ID 1934

Agenda



1

BCD Smart Power Technology

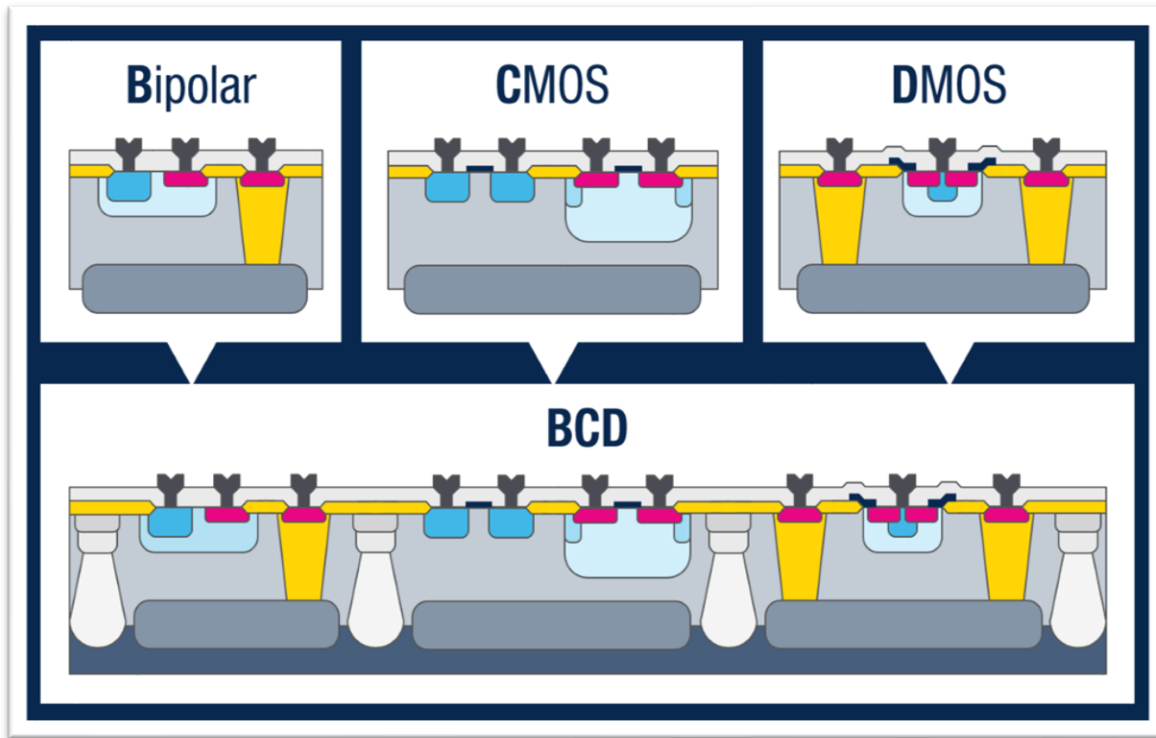


2

Monolithic Motor Driver

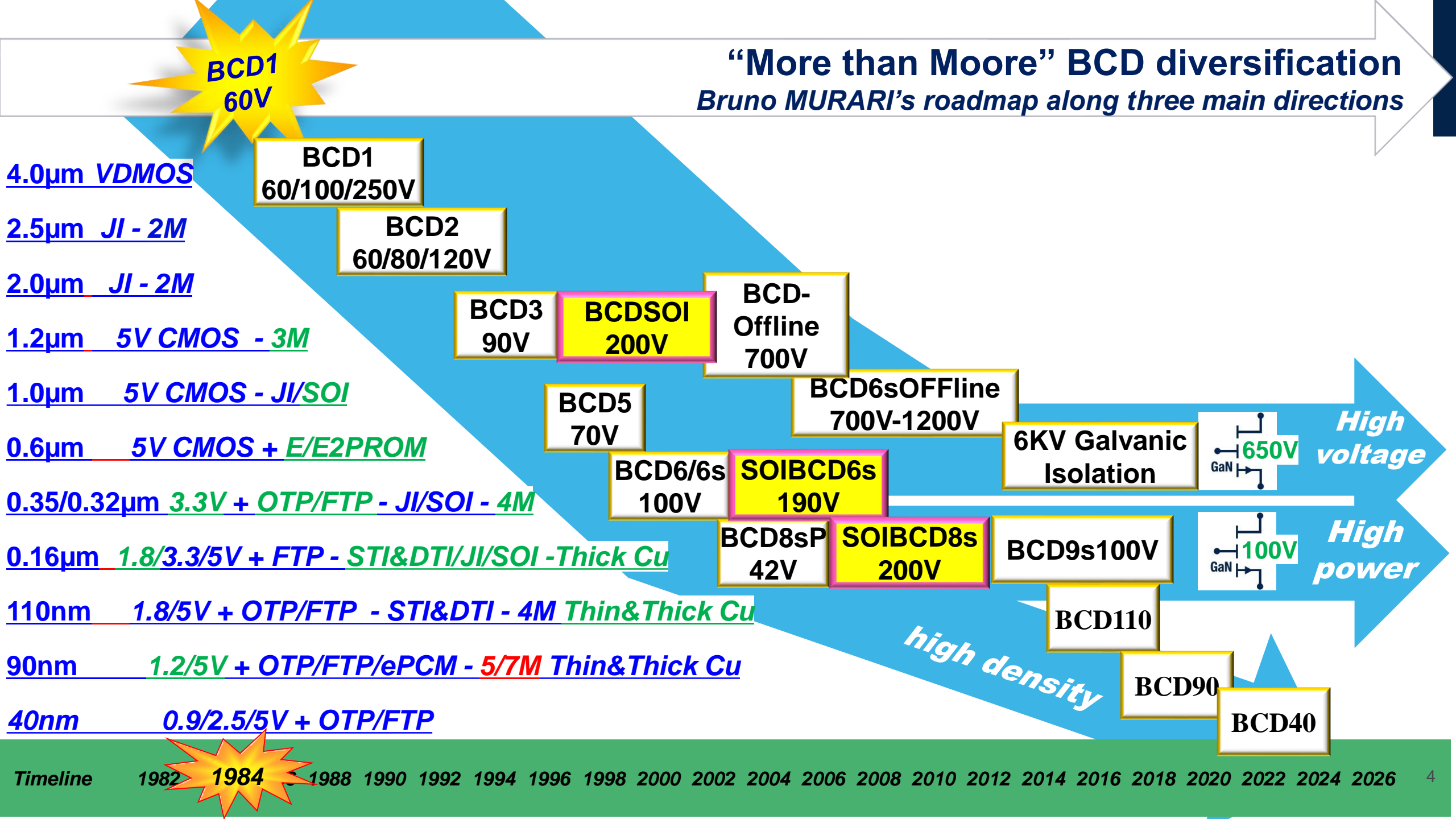
BCD Technology and IEEE Milestone recognition in May 2021

A concept invented by ST in the mid-80s,
widely used today in the industry



"More than Moore" BCD diversification

Bruno MURARI's roadmap along three main directions



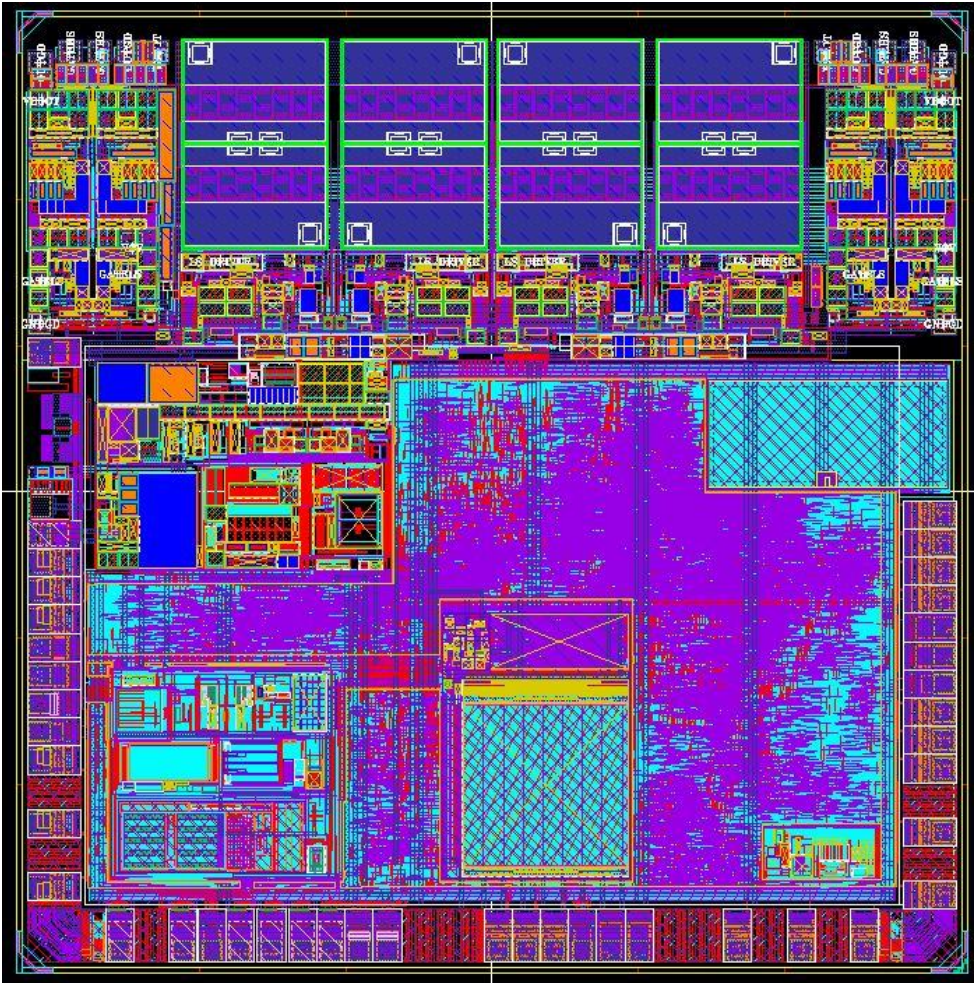
Example of a BCD product

High voltage & power section (DMOS) to drive external loads

Memory: RAM
NVM: ePCM (embedded Phase Change Memory)

Analog blocks to sense the external world

Digital core (CMOS) for signal processing



Why power density matters?

More power in less space thanks to BCD



Imagine to save just 1 W*h
per each phone recharge cycle.
Multiply it for 1 Billion units every day



Since beginning of electronics era, users' needs have dictated a clear trend toward **size and weight reduction** of electronic equipment

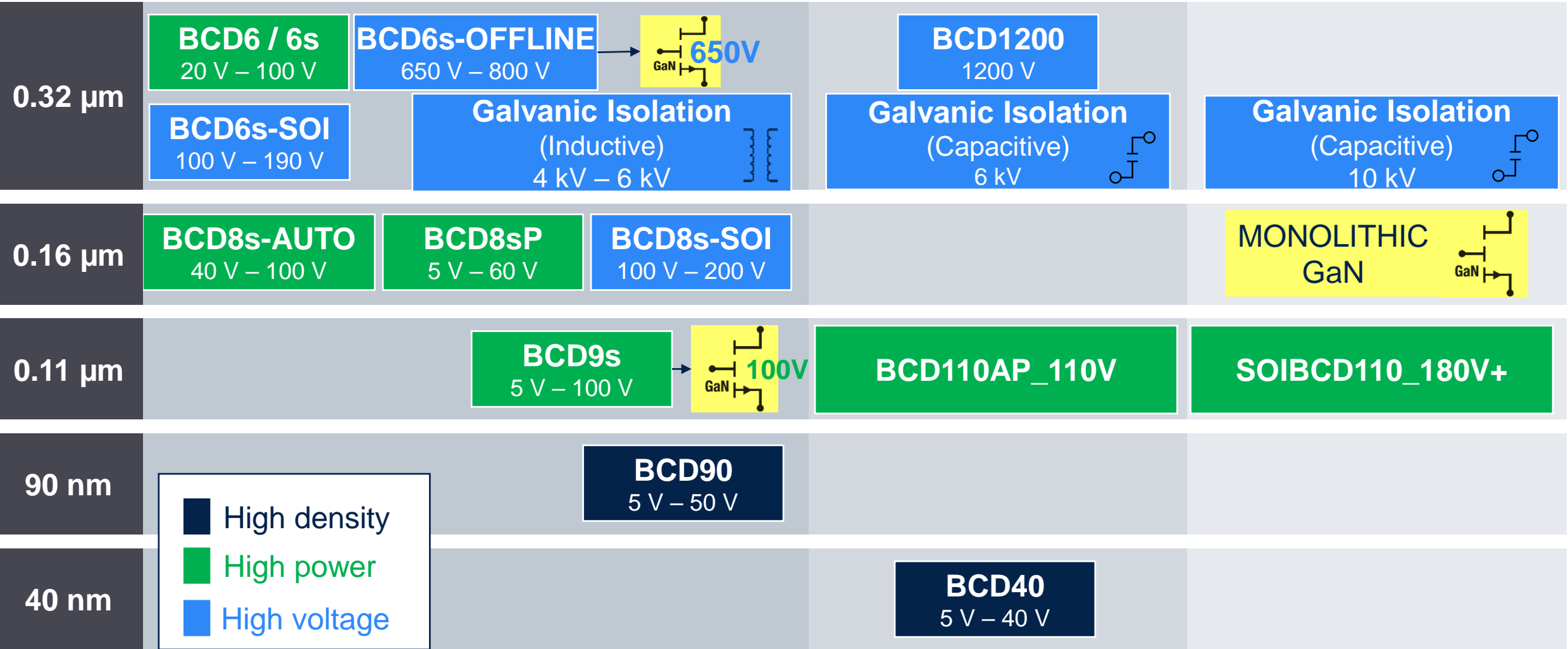


Reducing size and weight can **cut total cost of ownership** by making installation and maintenance both easier and quicker



Portability needs high power density. Smaller, lighter, yet more powerful (shorter recharge time): this is perceived by users as added value

BCD technology portfolio



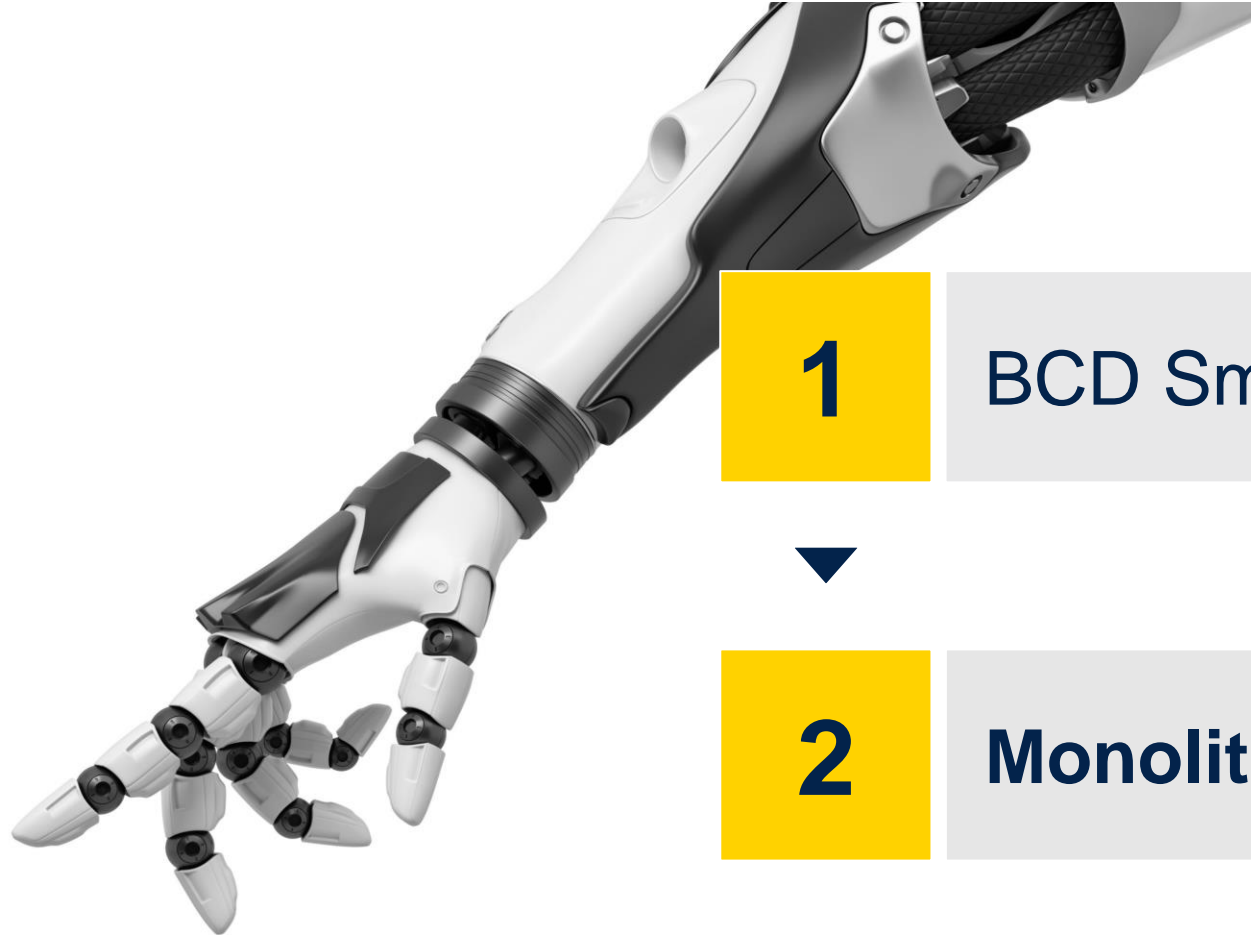
- High density
- High power
- High voltage

Available

Prototyping

Development

Agenda



1

BCD Smart Power Technology

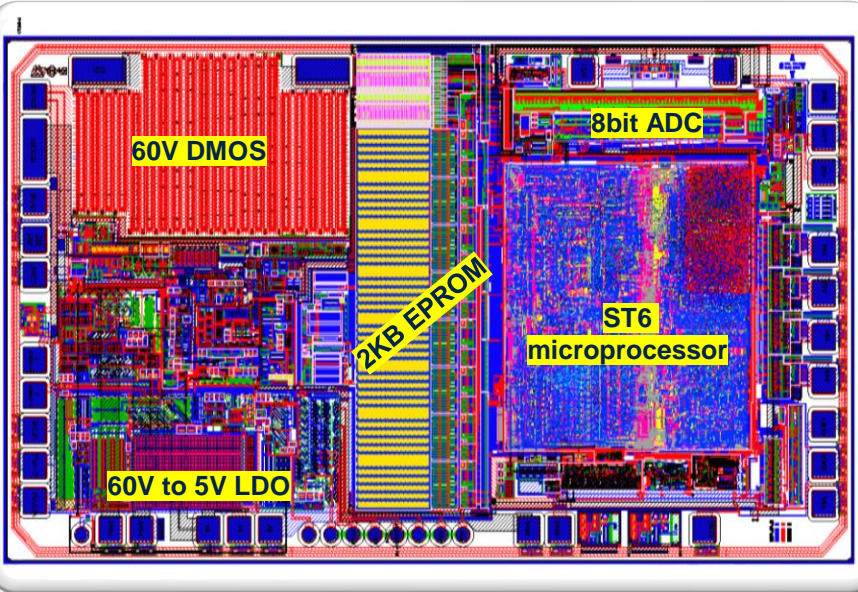


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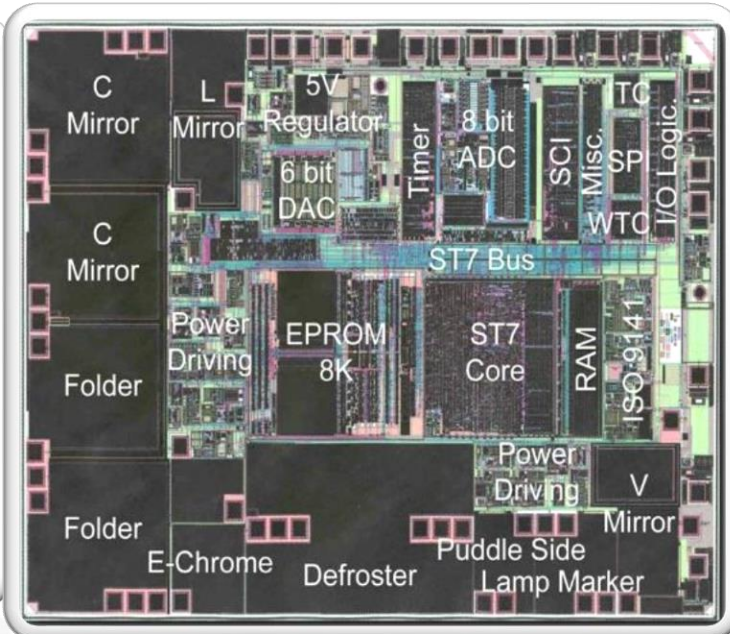
Monolithic Motor Driver

History of microprocessor and POWER in BCD technology

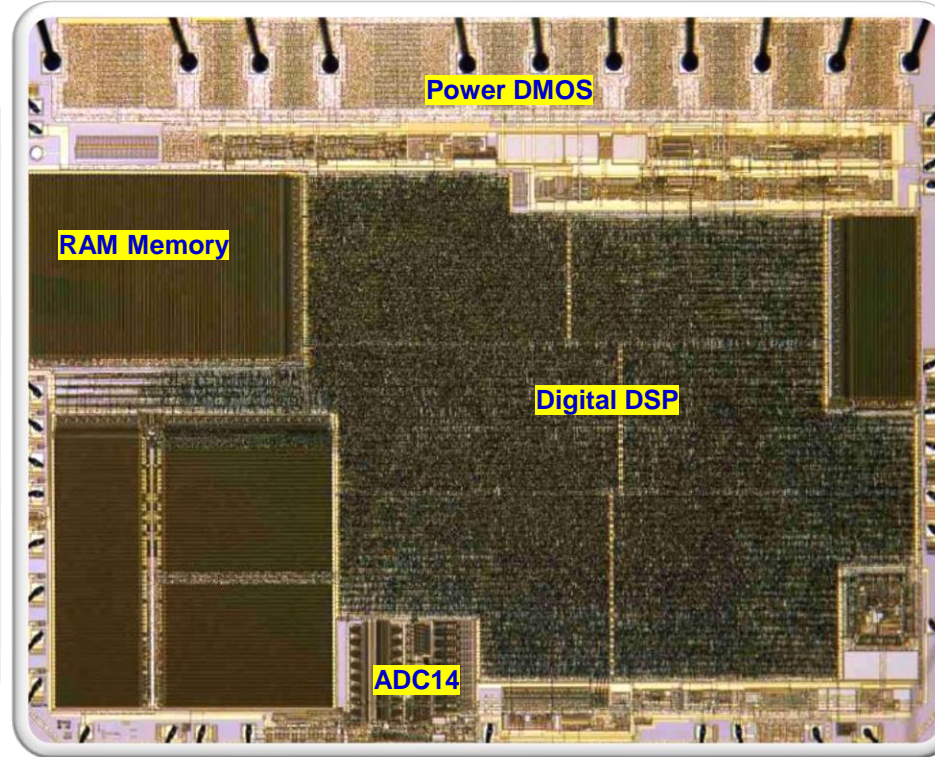
1995 – BCD3 L6901
Smart Battery Charger
ST6+EPROM+POWER_60V-3A



1999 – BCD5
Mirror Drivers in Automotive
ST7+EEPROM+POWER_40V

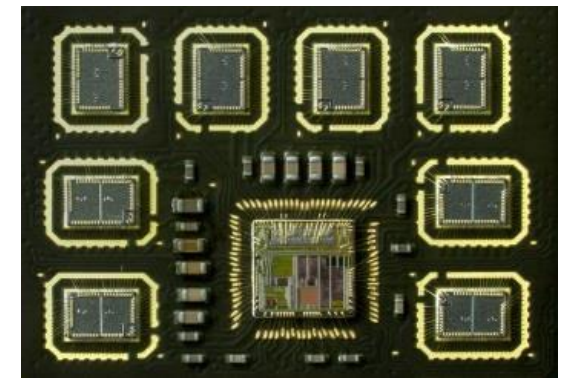
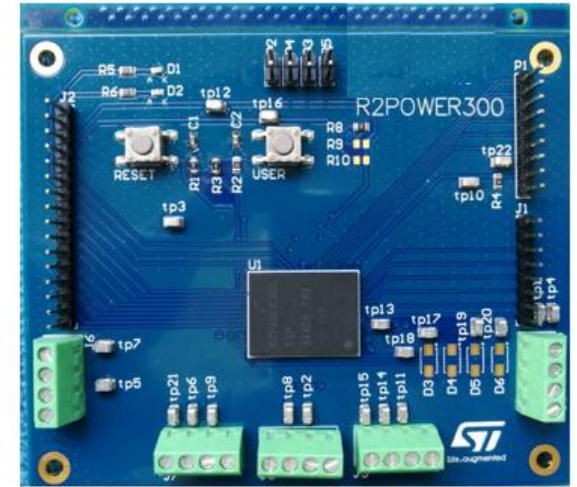
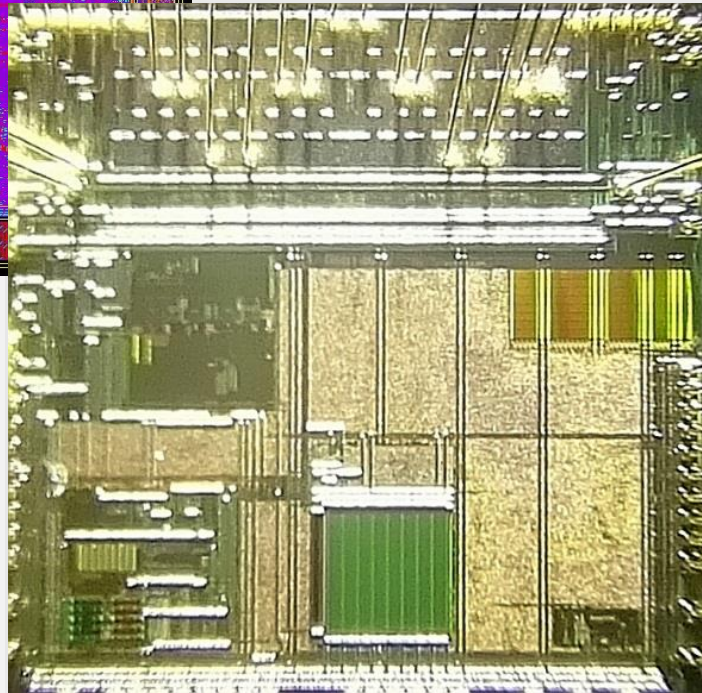
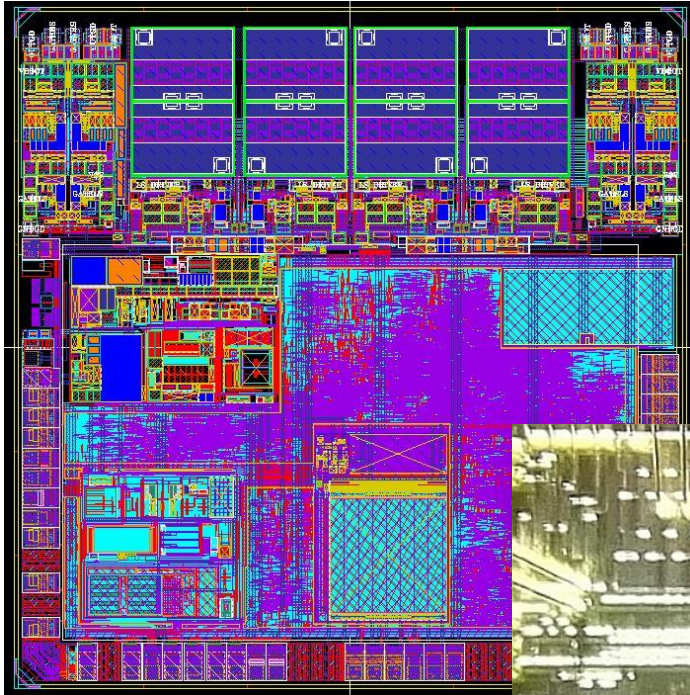


2000 – BCD5
Fully Digital Hard Disk Driver
DSP+RAM+POWER_16V



BCD9s Demo Main features

30 Ampere version

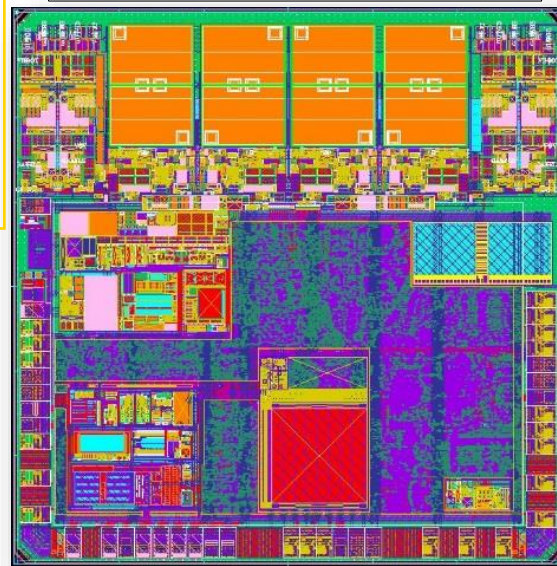
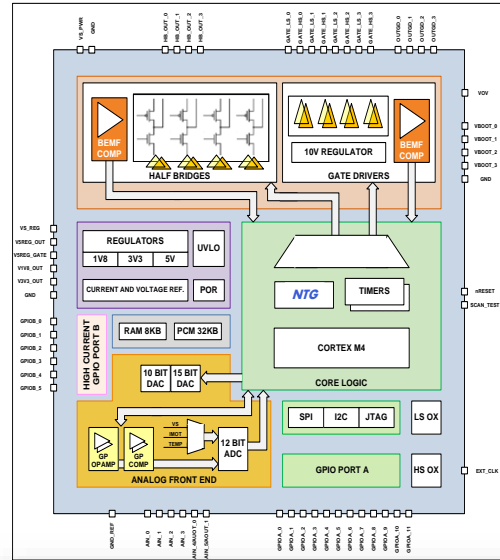
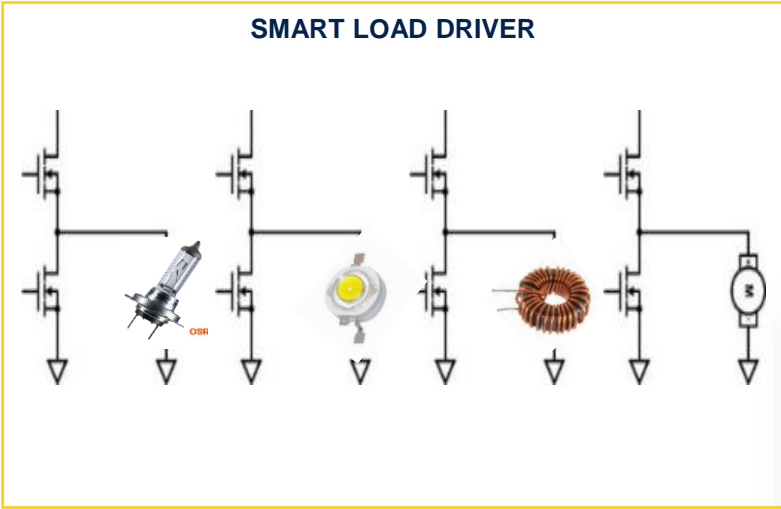
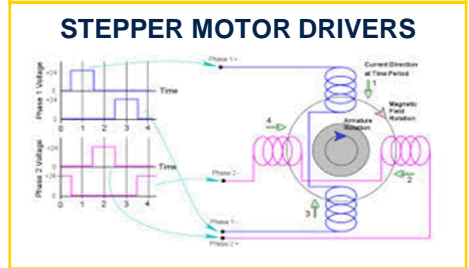
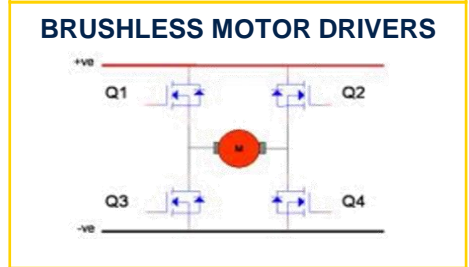
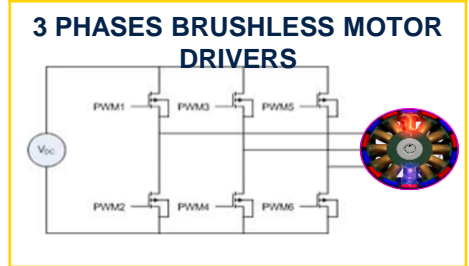
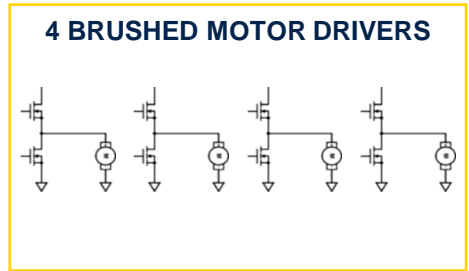


Monolithic Solution for motor control

2015 – BCD9s
 Smart Power Management
 CORTEX_M4+ePCM+POWER_40V

Different motors can be targeted

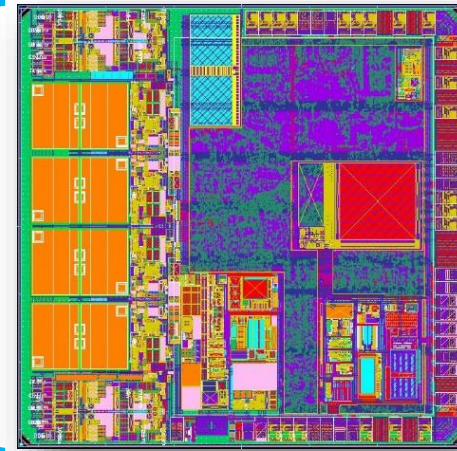
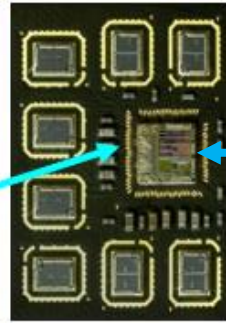
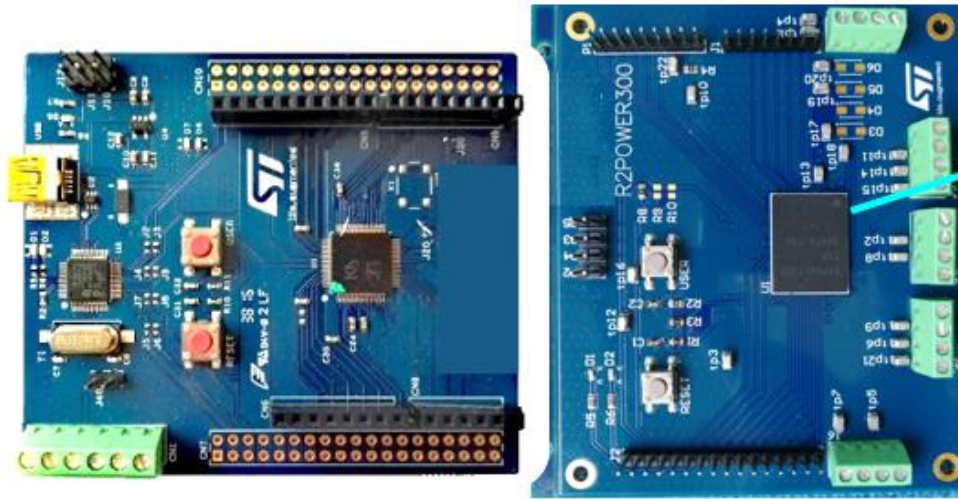
Single chip solution:
 Microcontroller, memories
 and 40V Power Stages



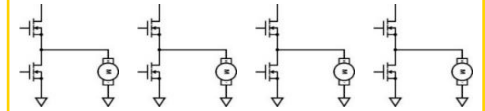
NUCLEO-STM32-like
 development board



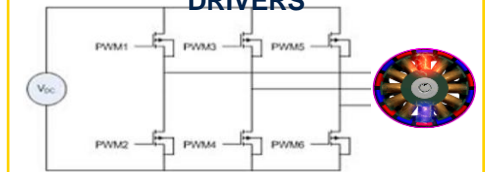
System in Package: Smart Motor Driver + 8 Power MOS for 30A current capability



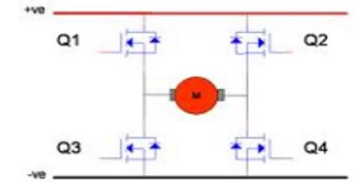
4 BRUSHED MOTOR DRIVERS



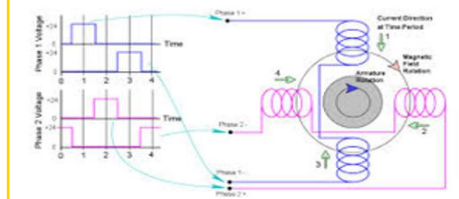
3 PHASES BRUSHLESS MOTOR DRIVERS



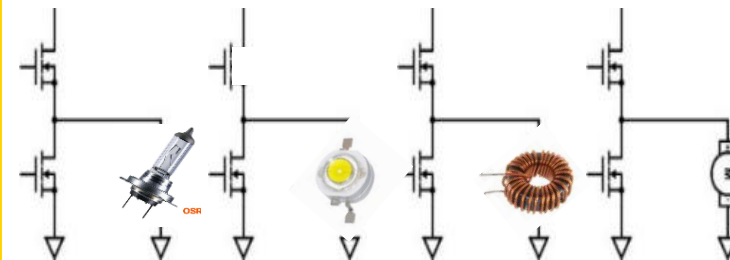
BRUSHLESS MOTOR DRIVERS



STEPPER MOTOR DRIVERS



SMART LOAD DRIVER

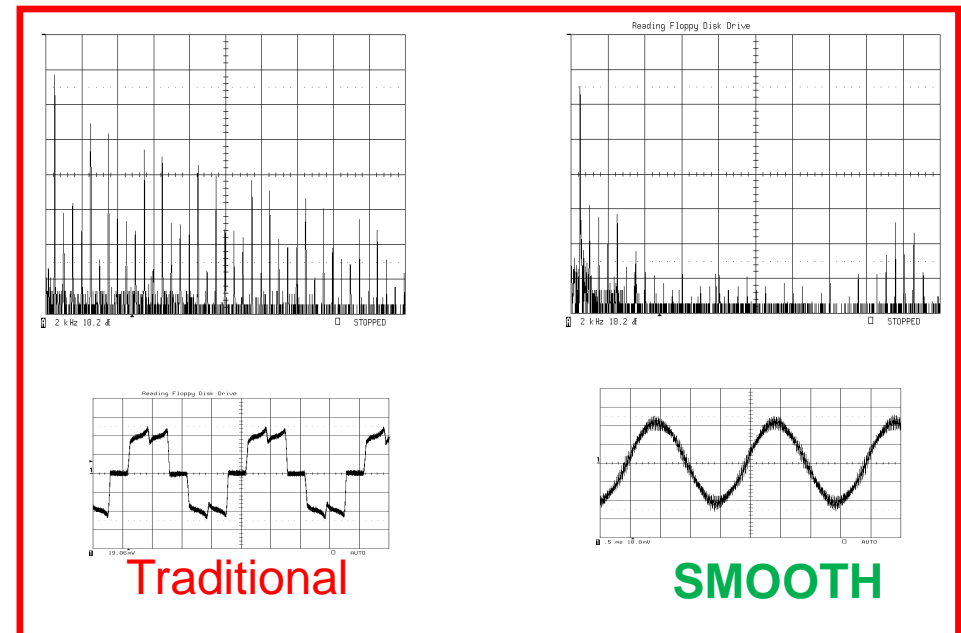
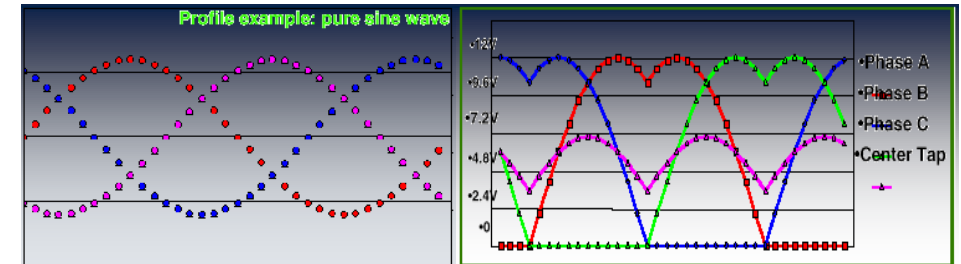


SMOOTHTM

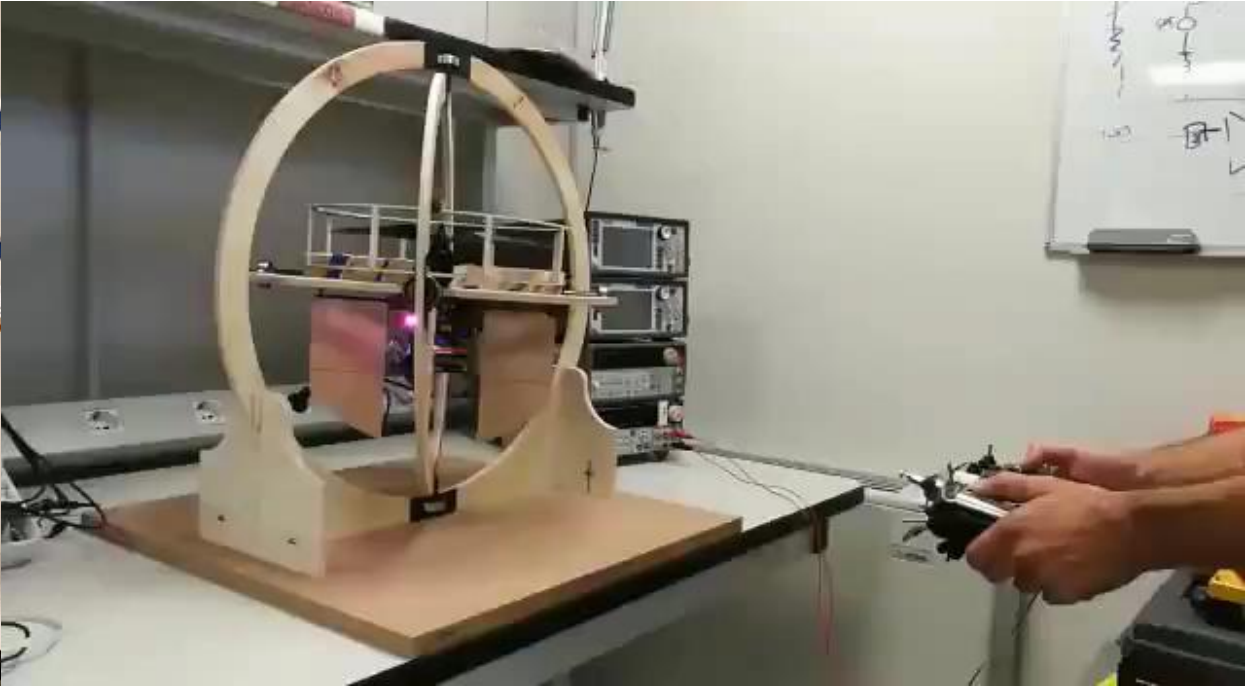
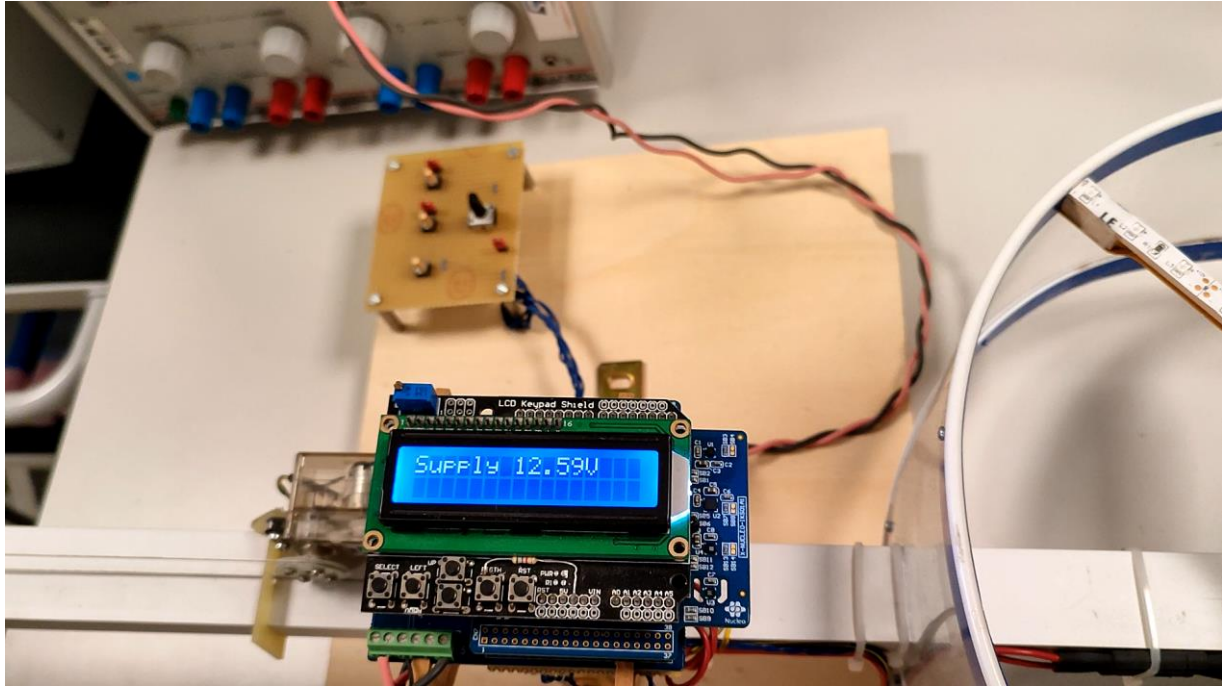
DRIVE

- Hardware accelerator and automatic closed control loop for synchronous motor driving
- Already proven the integration as STM32 plug & play peripheral
- The peripheral manages all the motor signals leaving to the uP only the high-level tasks
- High efficiency due to adaptive driving
- Very low speed rotation ripple
- More than 40dB attenuation in acoustic noise
- 25 patents on SMOOTH driving
- Motor life is increased by SMOOTH driver minimizing the mechanical vibration and solicitation on the bearing

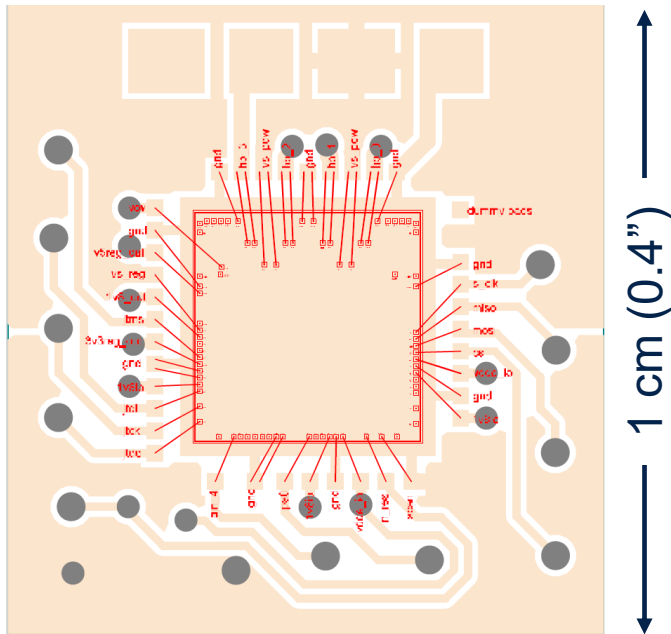
Smooth-drive is a digital system for the sinusoidal driving of the motor. The voltage profile is programmable according to the motor to match the Back Electro Magnetic Force profile.



CORTEX-M4+ePCM+PWR in BCD9s: DEMO Videos



Monolithic solution for smart motor-drive - Demo



Single microcontroller directly soldered on board and directly connected to the main battery (supports up to 35V)

All voltage supplies (1.8V, 3.3V, 5V) self generated and direct connection from the chip to the 3 BLDC phases

Automatic synchronous control of the rotor spinning thanks to motor control hardware accelerator

Cortex-M4 processor and PCM non-volatile memory to run custom firmwares for high-level task, e.g. stroboscopic LED driving, synchronous with rotor spinning (the white label on the motor seems to be frozen).

The SMART POWER DRIVING...



- ... simplifies the system hardware
- ... improve the control precision
- ... is feasible in monolithic solution
- ... improves the control loop bandwidth
- ... reduces drastically the dimensions especially for small motors or actuators
- ... optimizes the power consumption
- ... minimize the connection wires
- ...
- ... Any questions? ...

Our technology starts with You



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