Motor Control

EXPERTS FOR AUTOMOTIVE ICs

We have a broad expertise in analog mixed-signal integrated circuit design.

We deeply understand our customers application needs to create real system innovation.

We are a global player for automotive ASSPs and ASICs. We offer worldwide sales and application support.

elmos

CORPORATE KEY FACTS

~7 Elmos ICs

on average in every new car

6 product segments

Motor Control, Lighting, Safety/Power/Custom ICs,
Ranging, Optical, Sensor ICs

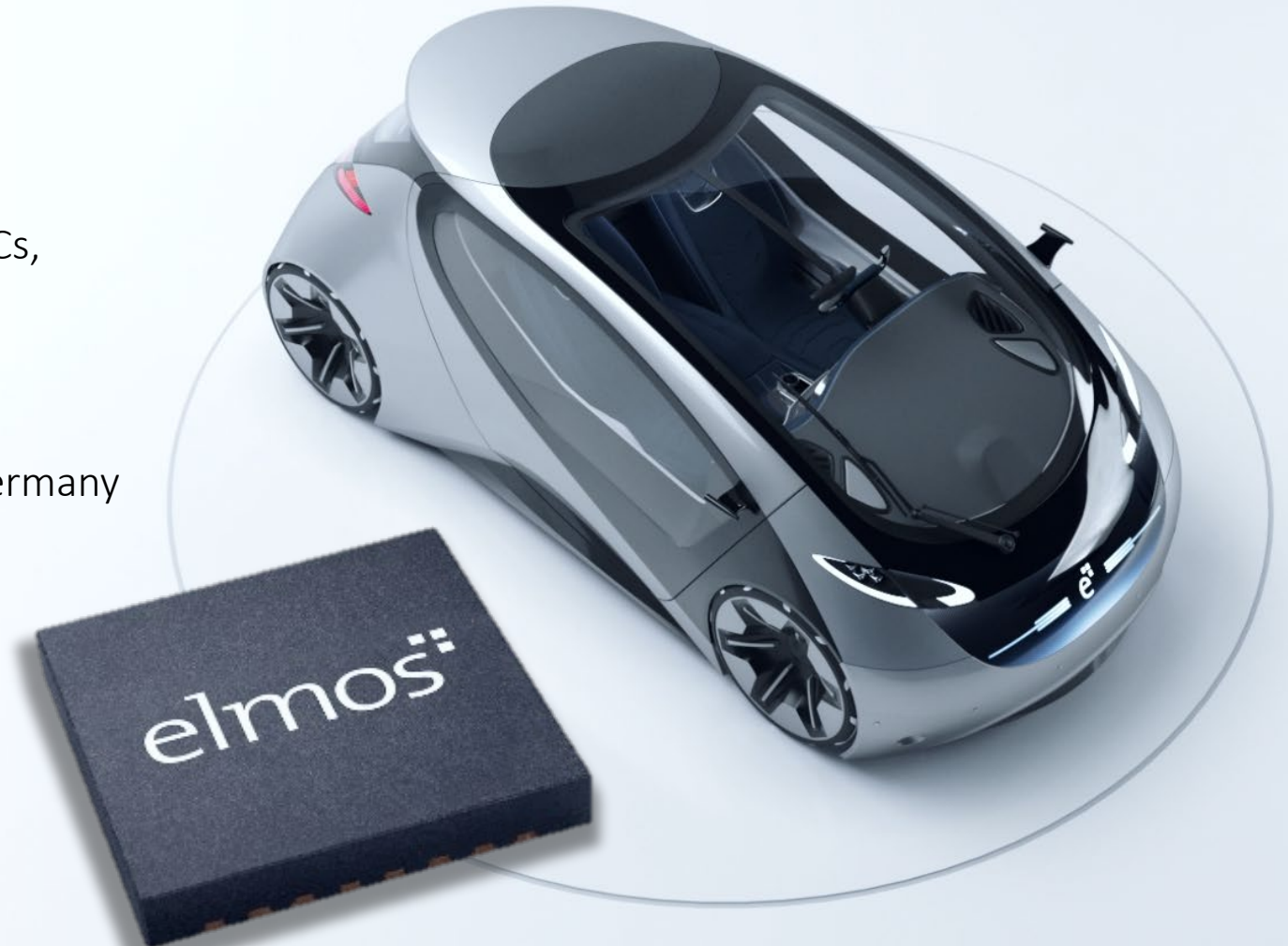**15** locations worldwide

incl. 6 R&D centers, HQ located in Dortmund, Germany

~40 years of experience

in analog mixed signal IC solutions

1,200 employees

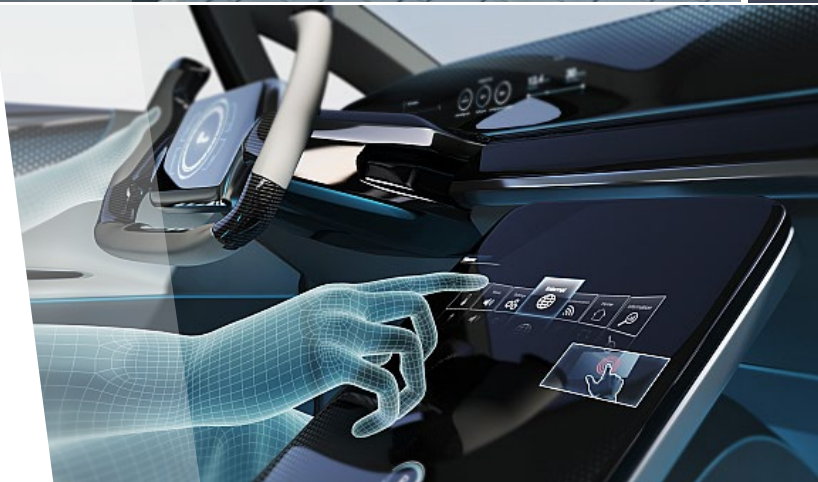thereof 350+ product developers & engineers
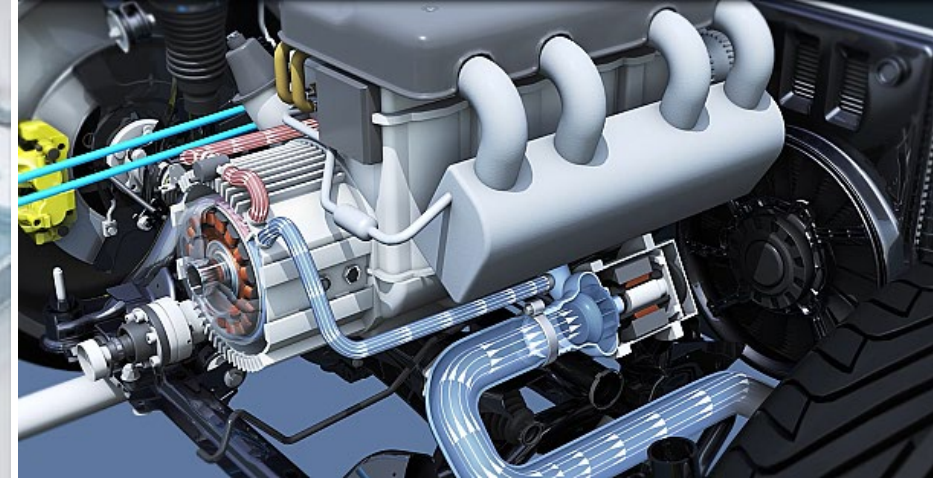
WE ARE LOCATED ALL OVER THE WORLD

World map with locations: Detroit (US), Dortmund (DE), Düsseldorf (DE), Bruchsal (DE), Berlin (DE), Frankfurt/Oder (DE), Dresden (DE), Seoul (KR), Tokyo (JP), Shanghai (CN), Singapore (SG)

PRODUCT SEGMENTS

- **RANGING**

- **OPTICAL**

- **SENSOR ICs**

- **MOTOR CONTROL**

- **LIGHTING**

- **SAFETY, POWER & CUSTOM ICs**

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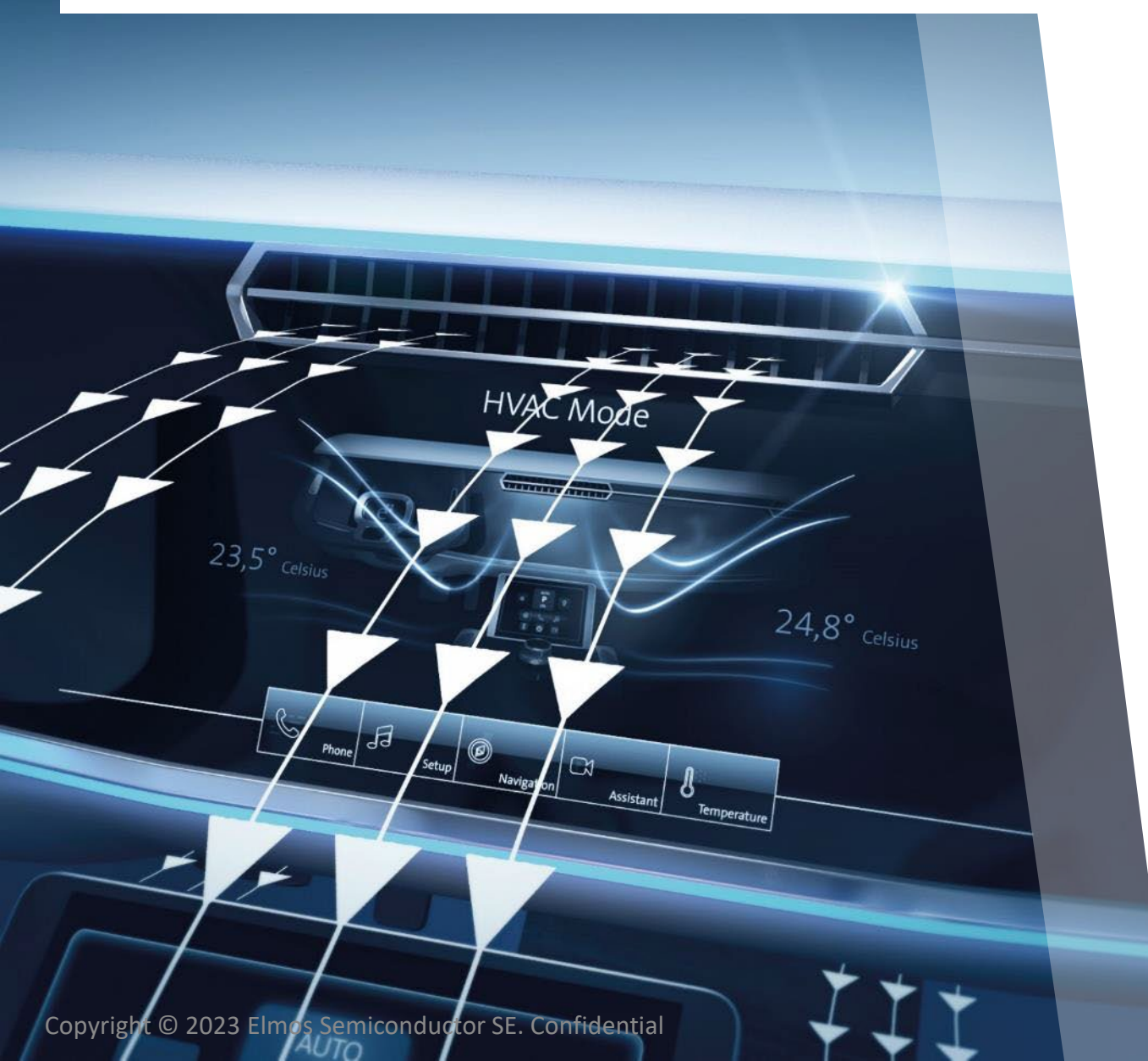
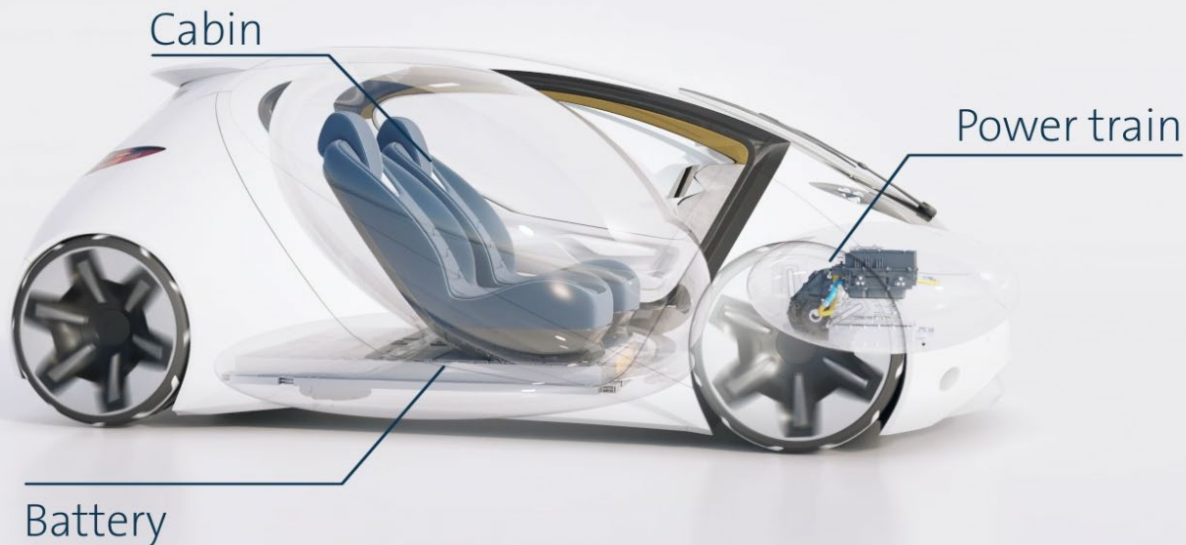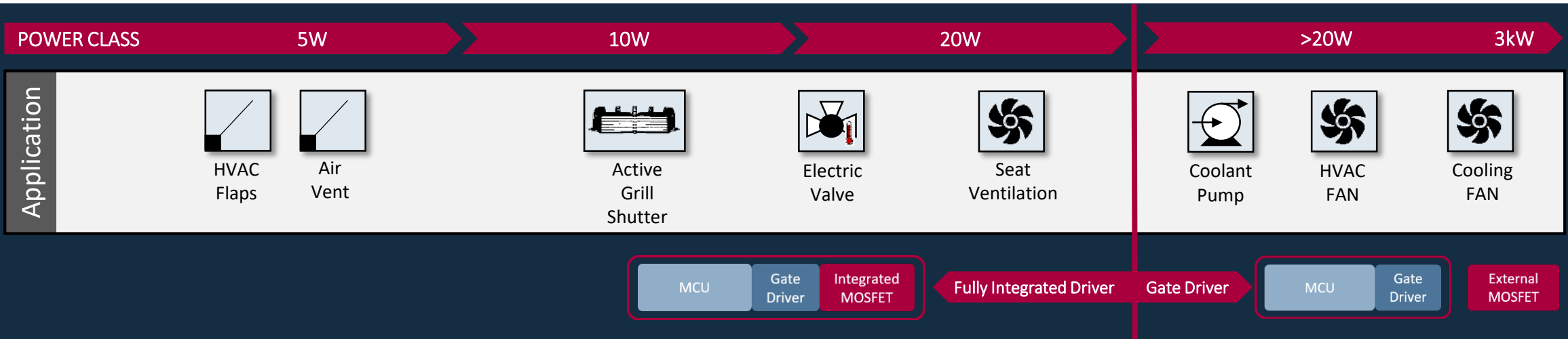## HIGHLY INTEGRATED MOTOR CONTROL ICs: BEST PERFORMANCE AND LOW SYSTEM COST

- Broad product portfolio for DC, Stepper and BLDC motors
  - Unique BLDC motor control family supporting 5W up to 3000W motors
  - Advanced motor control algorithms for sensor-less drives
- Innovative ICs for motor driven HVAC systems
  - #1 for smart HVAC actuators
  - 500+ million ICs delivered
  - Benchmark for low noise and high efficiency

MOTOR CONTROL FOR THERMAL MANAGEMENT

POWER CLASS	5W	10W	20W	>20W	3kW

Application

| HVAC Flaps | Air Vent | Active Grill Shutter | Electric Valve | Seat Ventilation | Coolant Pump | HVAC FAN | Cooling FAN |

MCU | Gate Driver | Integrated MOSFET

Fully Integrated Driver | Gate Driver
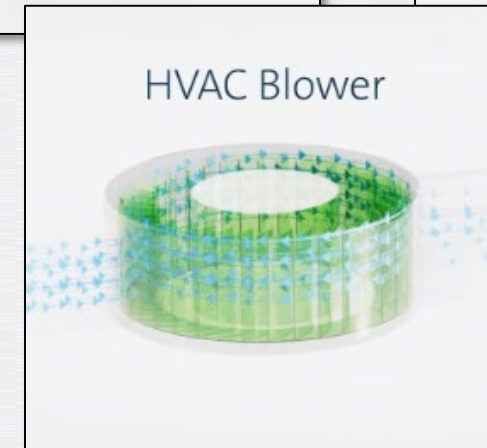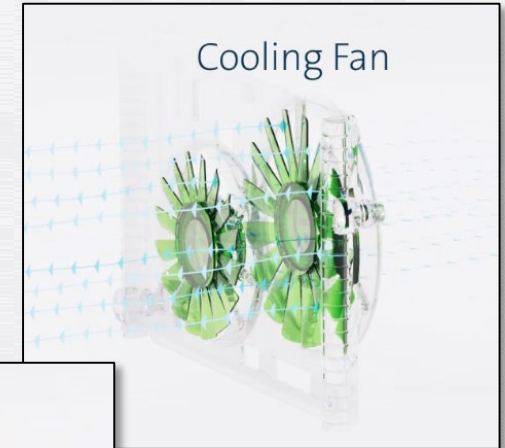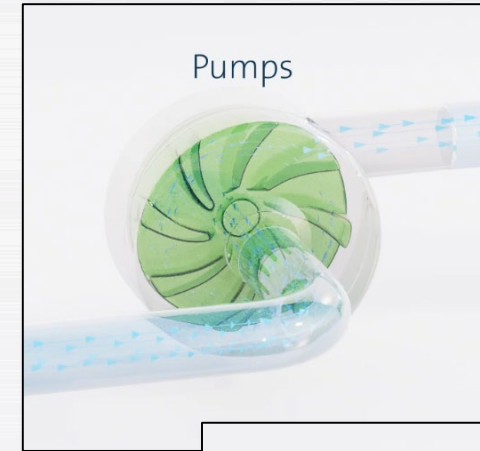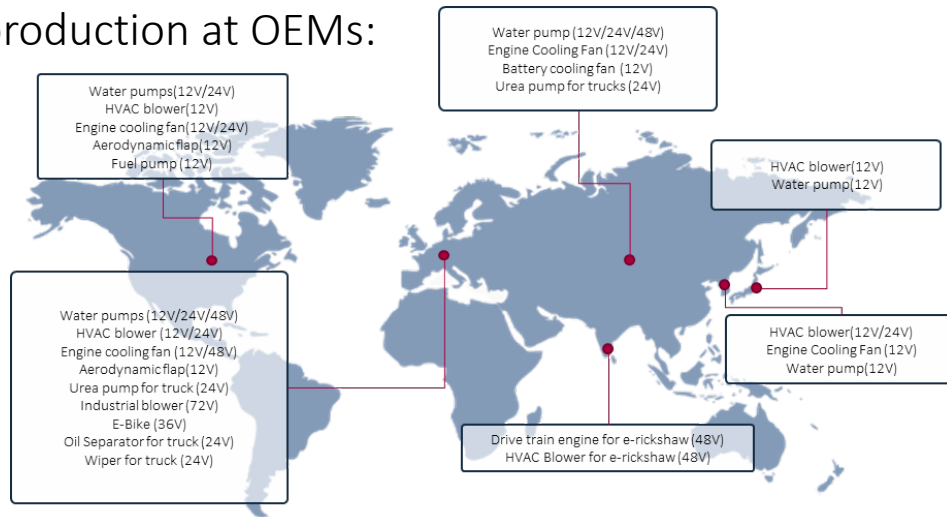
MCU | Gate Driver

External MOSFET

- Elmos provides high integrated motor control solution for a wide range of applications:
  - ➢ High Power BLDC Drivers/Controllers for Pumps, Fans and HVAC Blowers
  - ➢ Small/Medium Power Integrated Drivers for HVAC Flaps, Grille Shutters, Valves, Seat Ventilation and Small Pumps
- Supporting power range from 1W to ~3kW

HIGH PERFORMANCE
GATE DRIVER TYPE DRIVERS

Where we are successful

- Applications:
  HVAC Fan, ECF, Water Pumps, High Power Actuators, others

- In production at OEMs:

Water pumps(12V/24V)
HVAC blower(12V)
Engine cooling fan(12V/24V)
Aerodynamic flap(12V)
Fuel pump(12V)

Water pump (12V/24V/48V)
Engine Cooling Fan (12V/24V)
Battery cooling fan (12V)
Urea pump for trucks (24V)

HVAC blower(12V)
Water pump(12V)

Water pumps(12V/24V/48V)
HVAC blower (12V/24V)
Engine cooling fan (12V/48V)
Aerodynamic flap(12V)
Urea pump for truck (24V)
Industrial blower (72V)
E-Bike (36V)
Oil Separator for truck (24V)
Wiper for truck (24V)

HVAC blower(12V/24V)
Engine Cooling Fan (12V)
Water pump(12V)

Drive train engine for e-rickshaw (48V)
HVAC Blower for e-rickshaw (48V)

Pumps

Cooling Fan

HVAC Blower

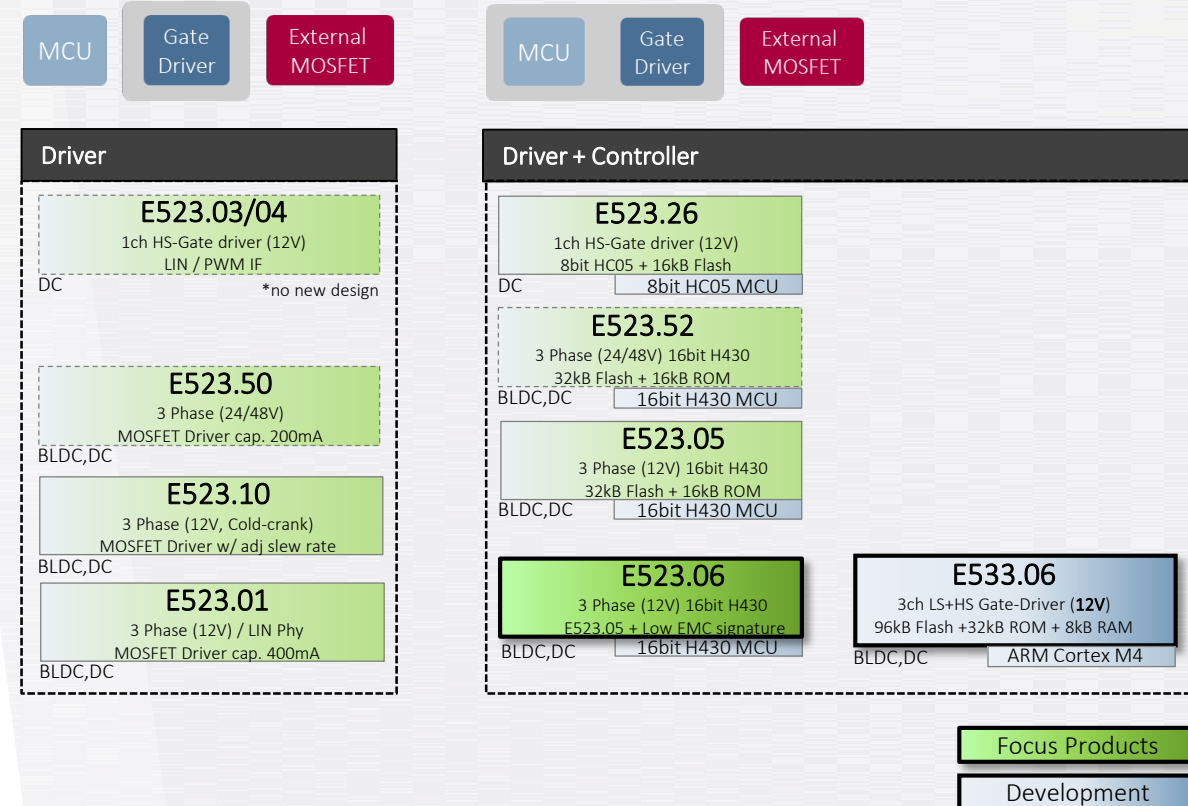# HIGH PERFORMANCE
GATE DRIVER TYPE DRIVERS

Key Differentiators

- Optimized Motor Control architecture for
  silent and efficient sensor-less motor algorithm

- Enabling ultra low noise motor drive,
  best in class efficiency and EMC performance
  due to embedded fast Op-Amp, ADC & PMW
  accelerators which allow fast
  FOC / Sine commutation

- Low total system cost of ownership
  for sensor-less single shunt solution

- Functional Safety Support for new products
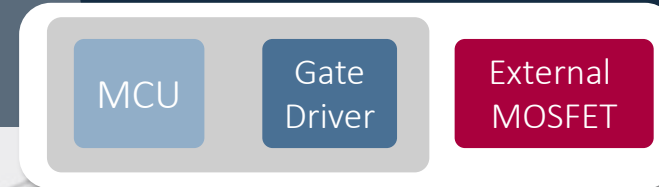
Performance →

Modular

Memory

Cost $

| MCU | Gate Driver | External MOSFET |

Driver

E523.03/04
1ch HS-Gate driver (12V)
LIN / PWM IF
DC   *no new design

E523.50
3 Phase (24/48V)
MOSFET Driver cap. 200mA
BLDC,DC

E523.10
3 Phase (12V, Cold-crank)
MOSFET Driver w/ adj slew rate
BLDC,DC

E523.01
3 Phase (12V) / LIN Phy
MOSFET Driver cap. 400mA
BLDC,DC

| MCU | Gate Driver | External MOSFET |

Driver + Controller

E523.26
1ch HS-Gate driver (12V)
8bit HC05 + 16kB Flash
DC   8bit HC05 MCU

E523.52
3 Phase (24/48V) 16bit H430
32kB Flash + 16kB ROM
BLDC,DC   16bit H430 MCU

E523.05
3 Phase (12V) 16bit H430
32kB Flash + 16kB ROM
BLDC,DC   16bit H430 MCU

E523.06
3 Phase (12V) 16bit H430
E523.05 + Low EMC signature
BLDC,DC   16bit H430 MCU

E533.06
3ch LS+HS Gate-Driver (12V)
96kB Flash +32kB ROM + 8kB RAM
BLDC,DC   ARM Cortex M4

Focus Products

Development

E523.06

High Performance BLDC Controller

Key features

- Fully integrated and optimized peripherals for sensor less FOC operation
  (fast Op-Amp; PWM/ADC accelerators)

- Embedded 16bit MCU with Hybrid Memory Concept:
  32kB Flash + 24/16kB ROM (including LIN stack)

- Dedicated SW knowhow and support from Elmos and proven partners

Gate Drivers + MCU

| MCU | Gate Driver | External MOSFET |

AVAILABLE!

E533.06
Next Generation BLDC Controller

Gate Drivers + MCU

| MCU | Gate Driver | External MOSFET |

Key features

- High performance ARM Cortex M4 @40MHz with 96kB Flash and no memory wait states

- Optimized measurement unit with fast Op-Amp, and ADC & PMW HW accelerators

- Developed according FUSA: ISO 26262 compliance

- Optional software frame work MotCoS including a high efficient motor control algorithm and a standardized application interface

- E533.06 enables best in class system efficiency, acoustic performance and cost of ownership for embedded sensor-less single shunt solution
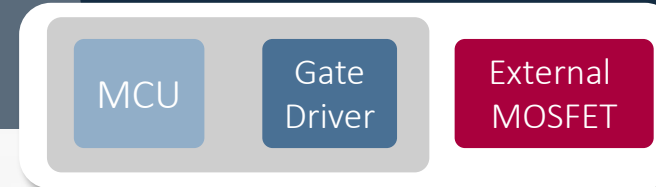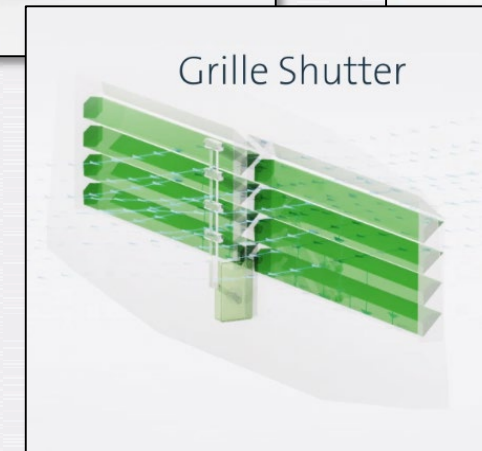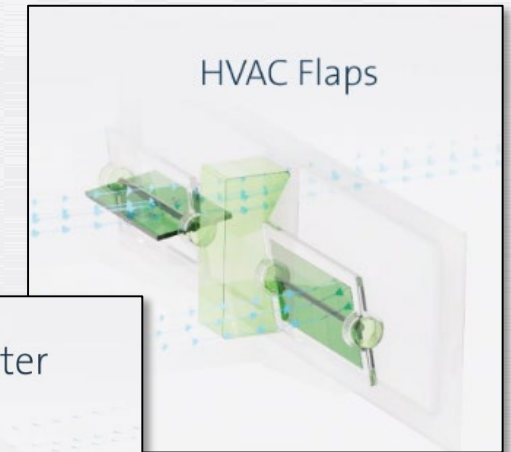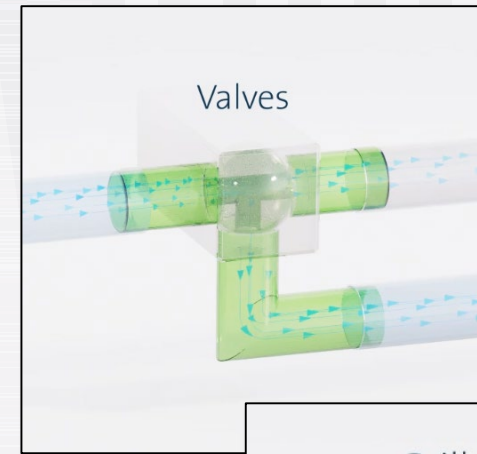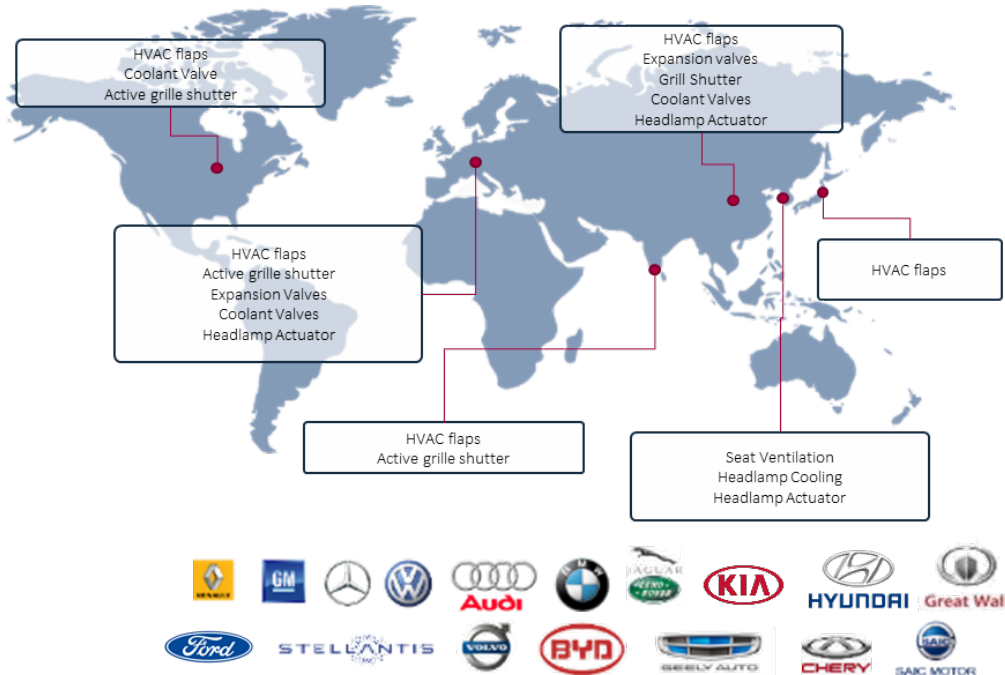
IN DEVELOPMENT

FULLY INTEGRATED DRIVERS (MCU + POWER STAGE)

Where we are successful

- High market share for Smart LIN actuator control
- #1 for smart LIN HAVC flaps actuator control
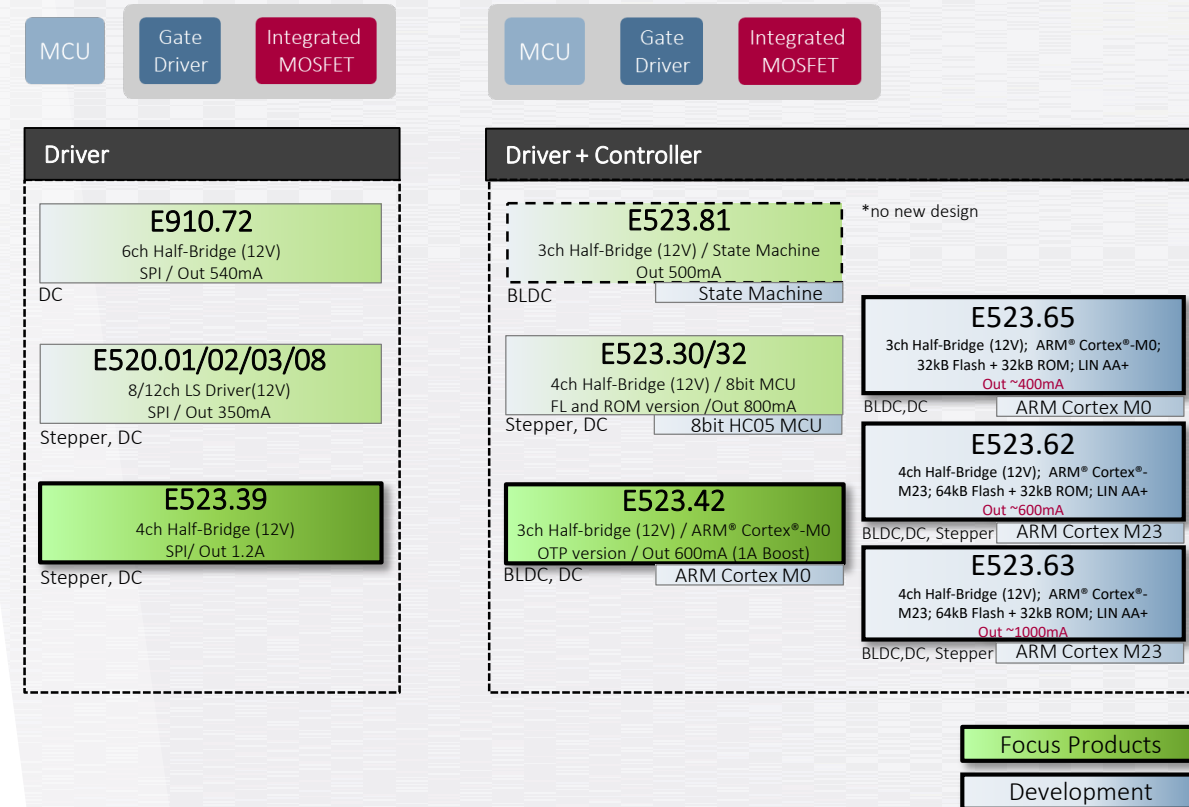- In production at OEMs:

FULLY INTEGRATED DRIVERS (MCU + POWER STAGE)

Key Differentiators

- Deep understanding of architecture and system requirements for smart actuator
- Highest integration level for optimized system cost
- LIN auto-addressing
- High performance & silent motor control

Where we are successful

- High market share for Smart LIN actuator control
- #1 for smart LIN HAVC flaps actuator control
- In production with Active Grill shutter and Electrical Water Valves at major OEMs

| MCU | Gate Driver | Integrated MOSFET |
| MCU | Gate Driver | Integrated MOSFET |

Driver

E910.72
6ch Half-Bridge (12V)
SPI / Out 540mA
DC

E520.01/02/03/08
8/12ch LS Driver(12V)
SPI / Out 350mA
Stepper, DC

E523.39
4ch Half-Bridge (12V)
SPI/ Out 1.2A
Stepper, DC

Driver + Controller

E523.81
3ch Half-Bridge (12V) / State Machine
Out 500mA
BLDC   State Machine
*no new design

E523.30/32
4ch Half-Bridge (12V) / 8bit MCU
FL and ROM version /Out 800mA
Stepper, DC   8bit HC05 MCU

E523.42
3ch Half-bridge (12V) / ARM® Cortex®-M0
OTP version / Out 600mA (1A Boost)
BLDC, DC   ARM Cortex M0

E523.65
3ch Half-Bridge (12V); ARM® Cortex®-M0;
32kB Flash + 32kB ROM; LIN AA+
Out ~400mA
BLDC,DC   ARM Cortex M0

E523.62
4ch Half-Bridge (12V); ARM® Cortex®-M23; 64kB Flash + 32kB ROM; LIN AA+
Out ~600mA
BLDC,DC, Stepper   ARM Cortex M23

E523.63
4ch Half-Bridge (12V); ARM® Cortex®-M23; 64kB Flash + 32kB ROM; LIN AA+
Out ~1000mA
BLDC,DC, Stepper   ARM Cortex M23

Focus Products

Development

E523.39

Smart SPI Stepper Driver

Key features

- Optimized for:
  - very silent motor run
  - low number of external components

- Fully integrated Stall Detection function with complete post processing

- Unique Fail Current Detection which detects changing motor parameters before the motor stops working.

- E523.39 enables the implementation of innovating feature such as adaptive holding torque with programmable brake force or adaptive run currents.

SPI Drivers

| MCU | Gate Driver | External MOSFET |

AVAILABLE!

E523.62/63

Next Generation Universal Smart LIN Motor Controller

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Key features

- Family concept to support large power range (400mA, 1000mA)

- Continuous sensing by integrated current mirrors

- LIN 2.x compliant to SAE J 2602, ISO17987 incl. LIN AA+

- Optional software frame work MotCoS including a high efficient motor control algorithm and a standardized application interface

- E523.62/63 enables lowest total system cost of ownership for Smart actuators driven by Brushed DC, Bipolar Stepper Motors or BLDC motors.

Integrated Drivers

| MCU | Gate Driver | External MOSFET |

IN DEVELOPMENT

A complete set of tools for state of the art application development

Simulation
MotCoS SimLab

Hardware
MotCoS Reference Boards

Software
MotCoS OS and GUI

Fully integrated motor control algorithm (FOC, …)
Speed up design-in time at customers
Model based design flow, ASPICE compliant

Saving up to **80%** of development time

SMART MOTOR CONTROL
VALUE PROPOSITION

- **Broad application know-how**
  - More than 20 years experience in embedded motor controllers and drivers
  - Benchmark for low noise and high efficiency for single shunt, sensor-less BLDC FOC operation

- **Product development according FUSA: ISO 26262 compliance with safety target ASIL B**

- **Implementing ARM Cortex MCUs for all new controller products**

- **Preparing production ready software frame work**

  SOFTWARE + REVERENCE BOARDS + SYSTEM LEVEL SIMULATION
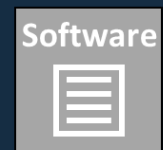 A complete set of tools for state of the art application development

  - integrated motor control algorithm (FOC, ..)
  - speed up design-in time at customers
  - model based design flow; ASPICE compliant

Performance

Motor Control

Safety !

Software

MotCoS
Motor Control System
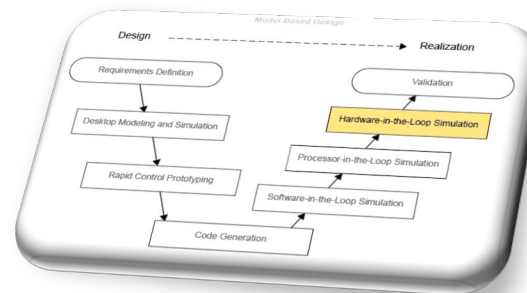
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Innovation Matters

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