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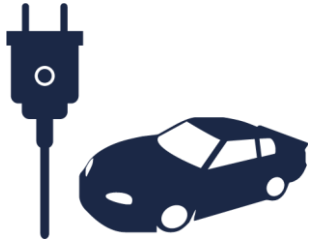
ST traction inverter system solution

June 2020

Traction inverter system

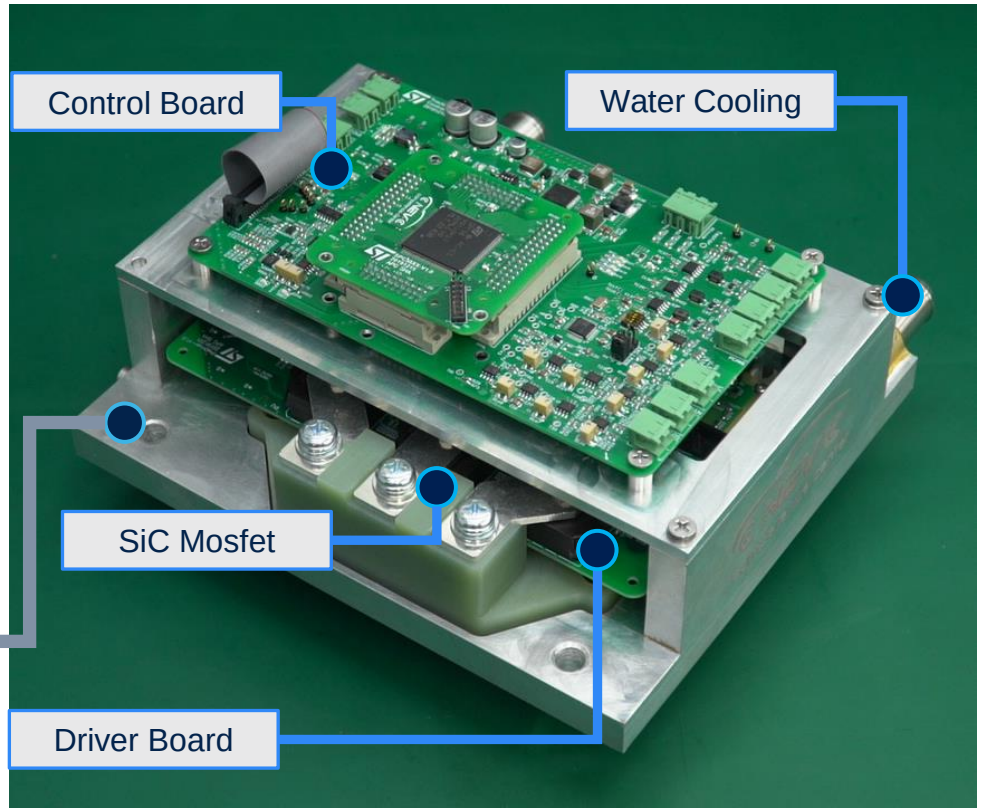
The traction inverter converts energy from the vehicle's battery in order to drive the motors in the drivetrain.



110 kW motor control test bench

Traction motor

Traction inverter demo



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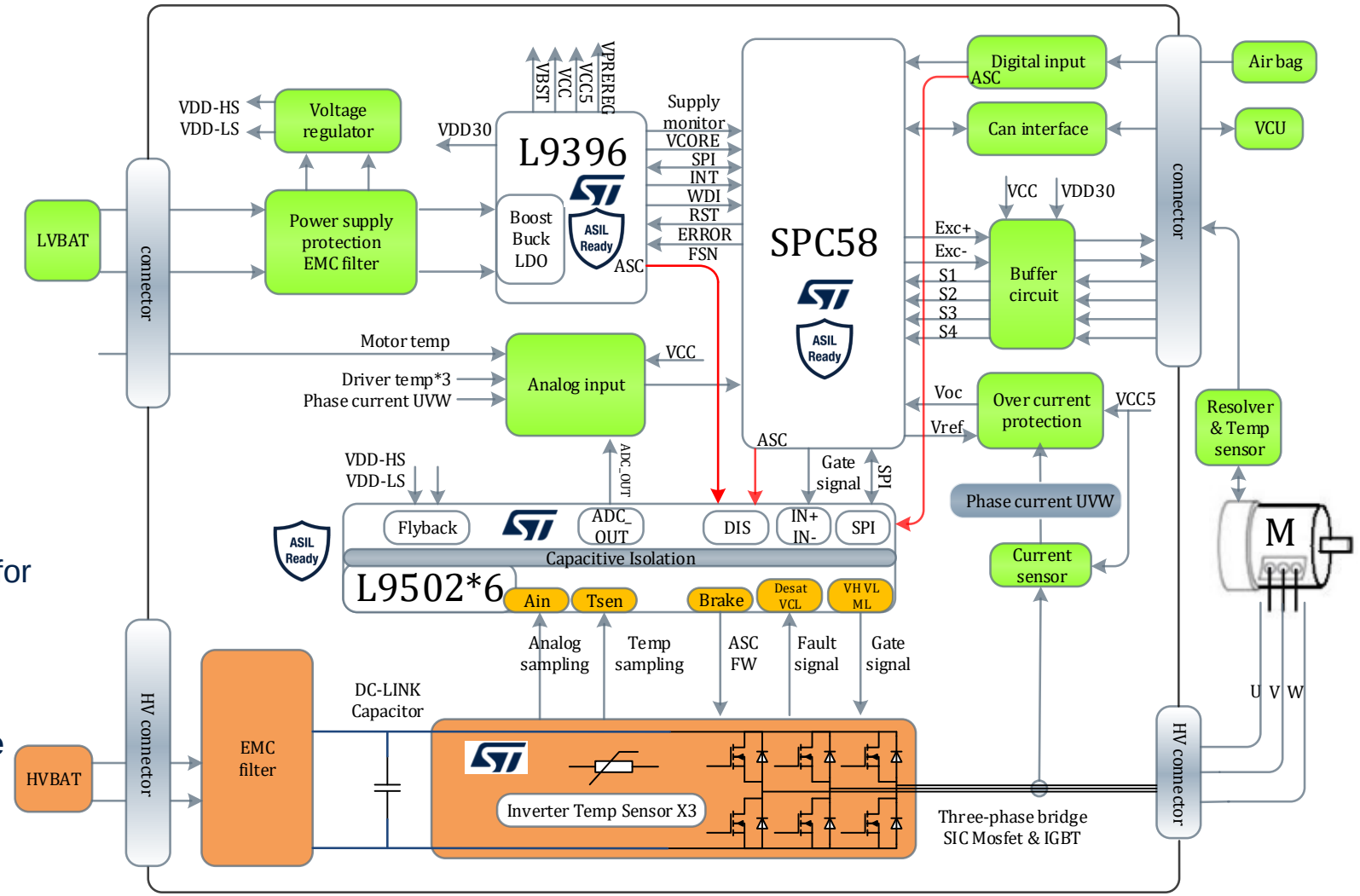
System architecture

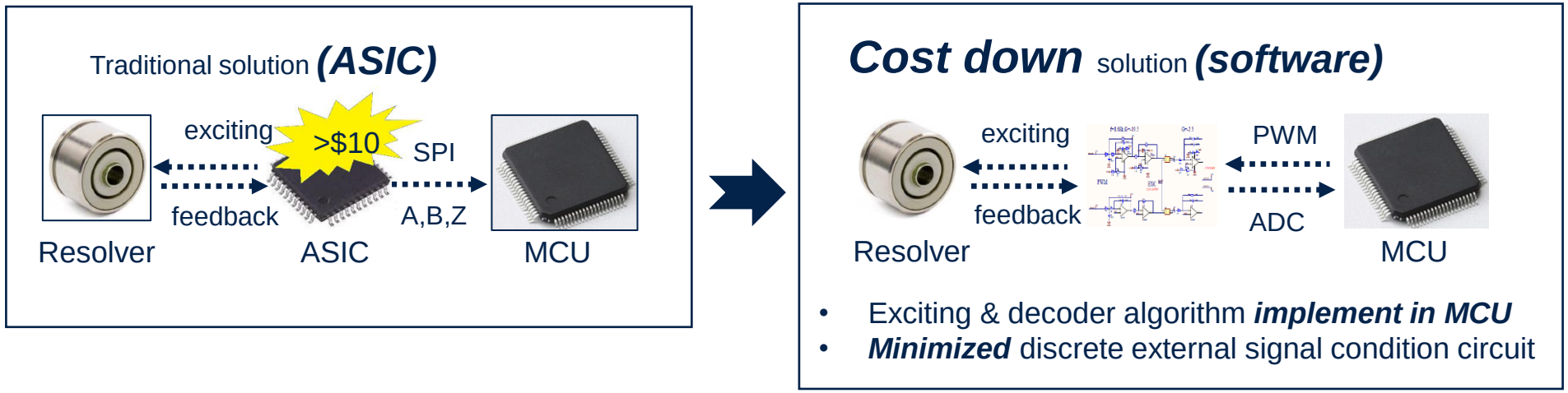
- **MCU SPC58NN**
  - 3 core 200Mhz, 2core lockstep
  - ISO26262 – ASILD
- **SBC L9396**
  - Multiple Power Supply IC
  - ASILD
- **SiC MOSFET**
  - 750V 500A SiC MOSFETs Gen 2
- **L9502 / STGAP**
  - Single isolated Gate Driver (6kv) for Traction inverter with protection , diagnostics and communication
- **Designed for ISO26262 compliance**



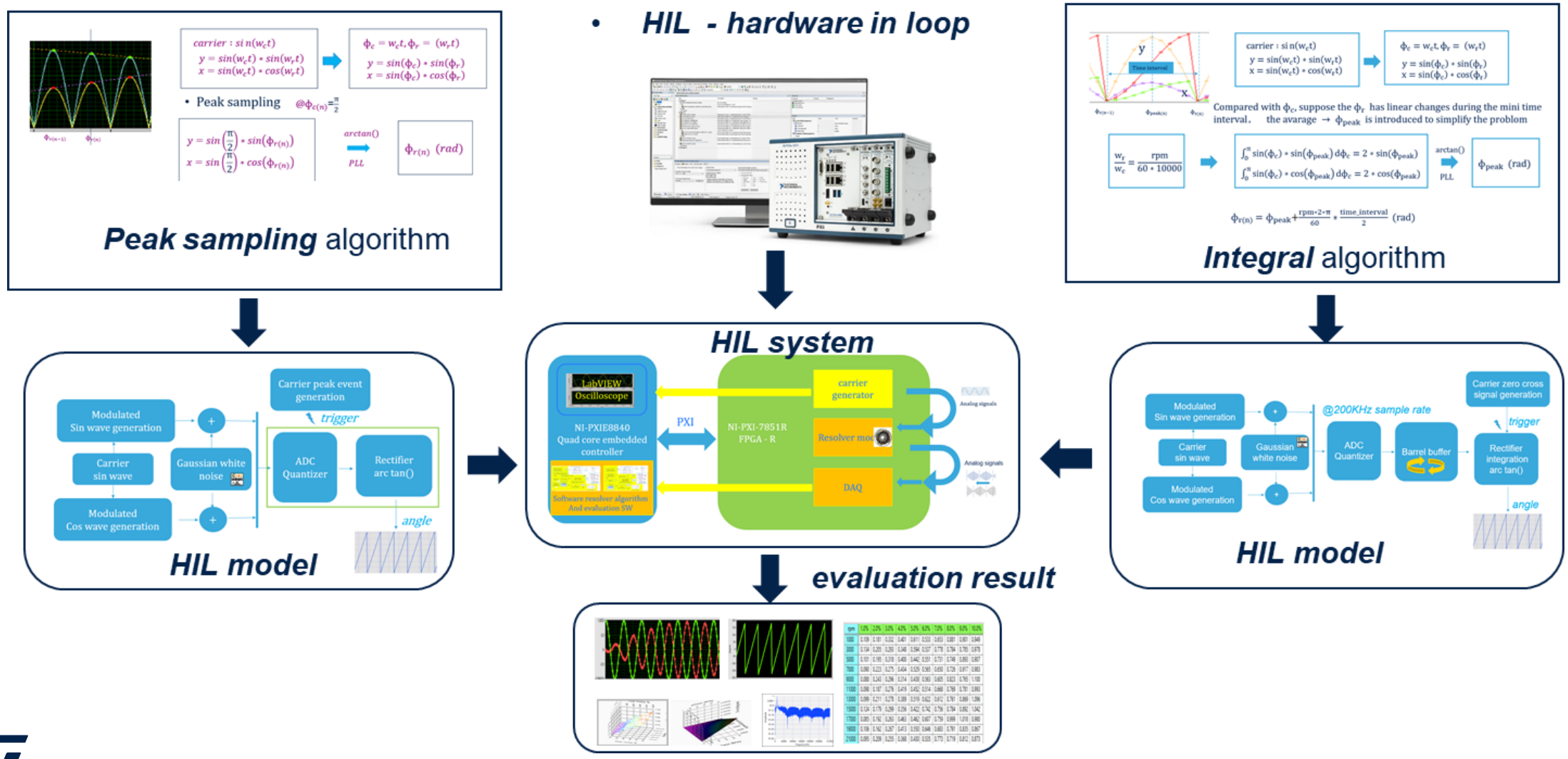
Traction inverter system highlights

System highlight software resolver

- ***Motor Axis Angle*** measurement is very important for ***motor efficiency*** and ***torque stability***
- ***Resolver* sensor** of Motor Axis Angle measurement for ***higher accuracy*** and ***reliability***



System highlight performance evaluate with hardware in loop



System highlight performance evaluation on SPC58NN

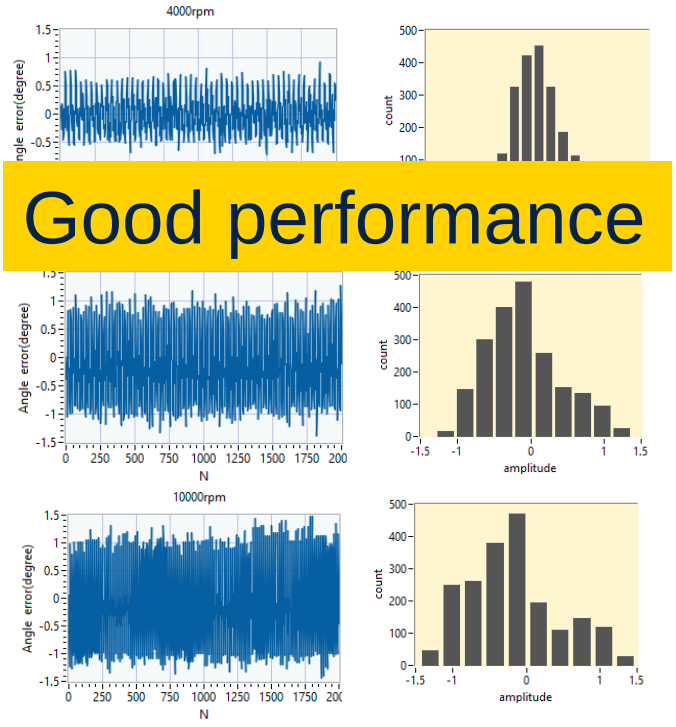
- Bench evaluation:
  - traction motor: 50KW, <12000 rpm
  - **4 pole pair resolver**, 10KHz Frequency.
  - ***10 points*** digital sampling rate @integral algorithm
  - ***Real - Time < 2usec***

Traction invertor

SPC58NN + L9396+L9502+Sic MOS

Traction motor

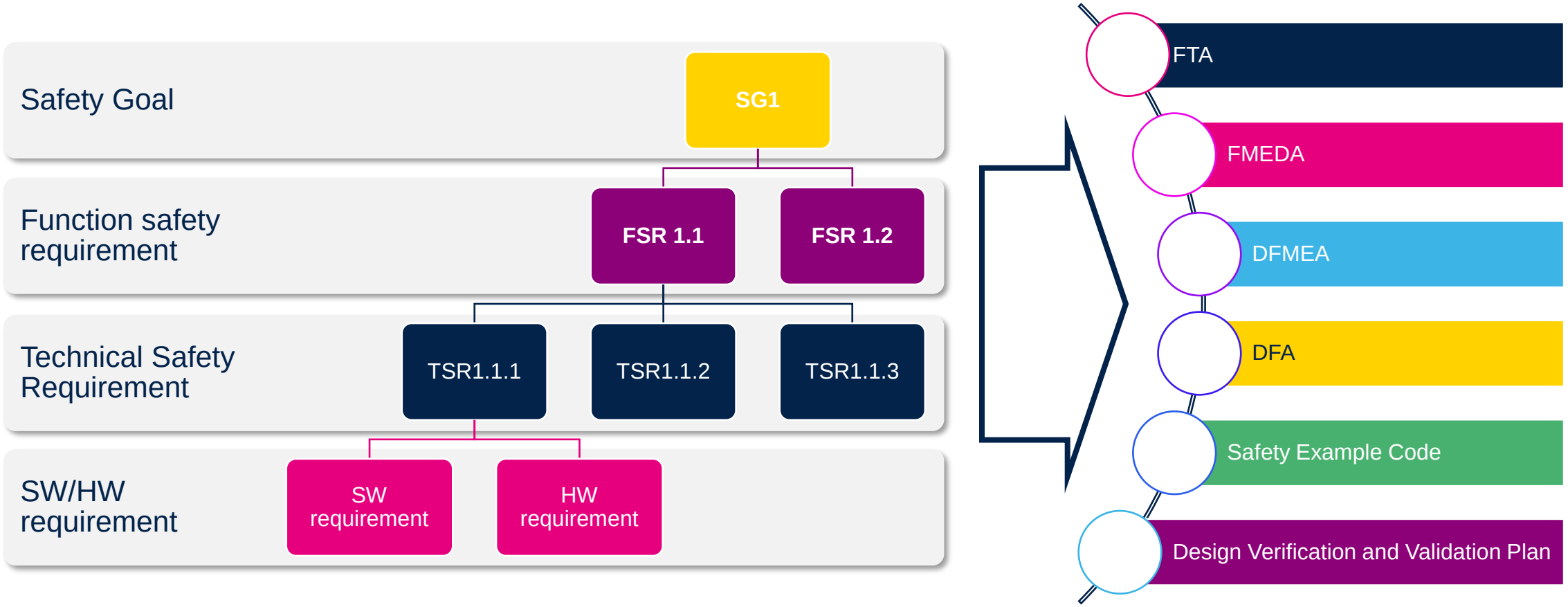
Motor Test Bench



Good performance

Electronic angle error

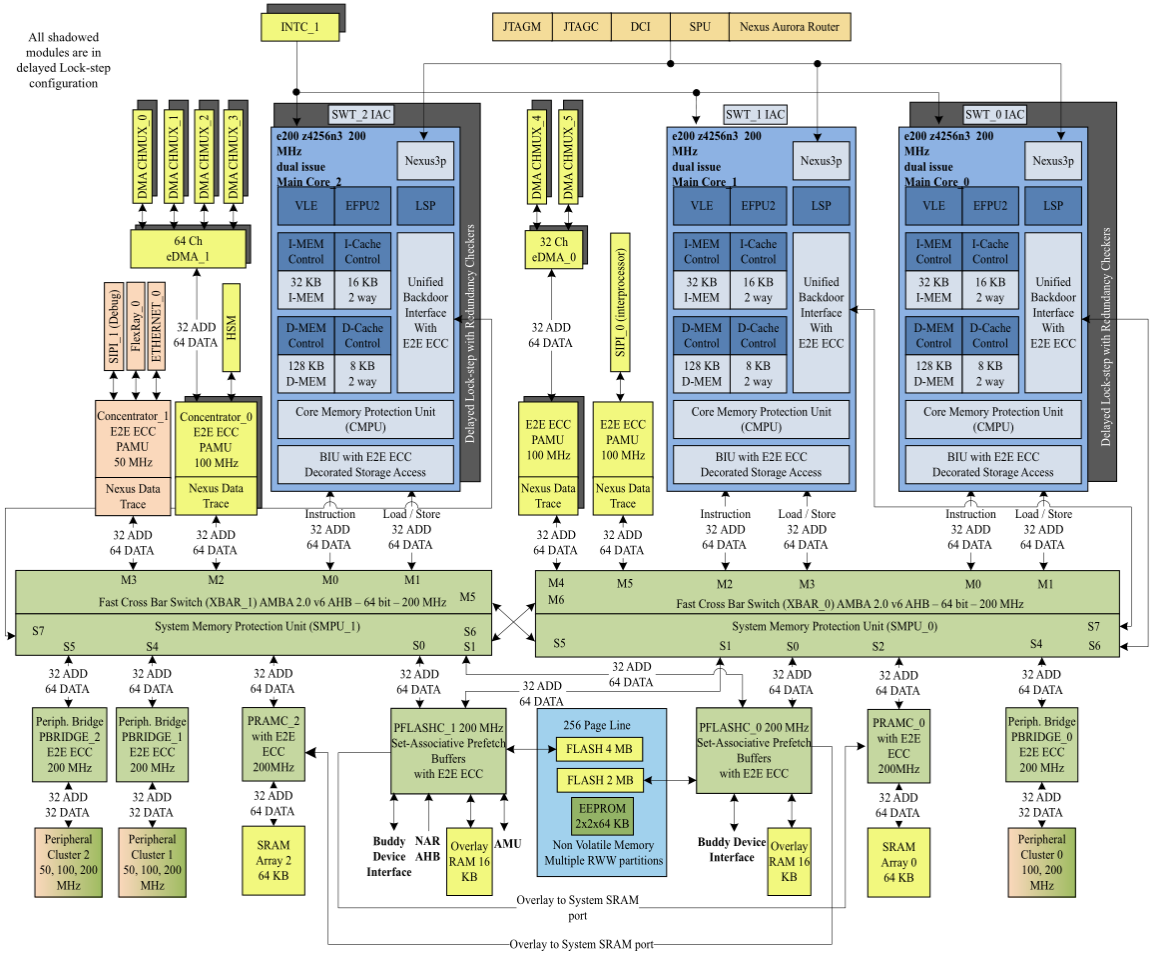
System highlight functional safety



Functional safety reference documents available

Traction inverter system key components

MCU SPC58NN



SPC58NN	Traction inverter
Automotive ASIL-D applications	ISO26262
GTM344	SVPWM
SDADC	Resolver software decoding
SARADC	High accuracy current sampling , temperature sampling and high voltage sampling
Flash : 6576KB	OTA
8X SPI 8X CANFD	Communication between micro and SBC, micro and Pre Driver , micro and CAN transceiver ,etc. Support calibration , CAN Bus Communication

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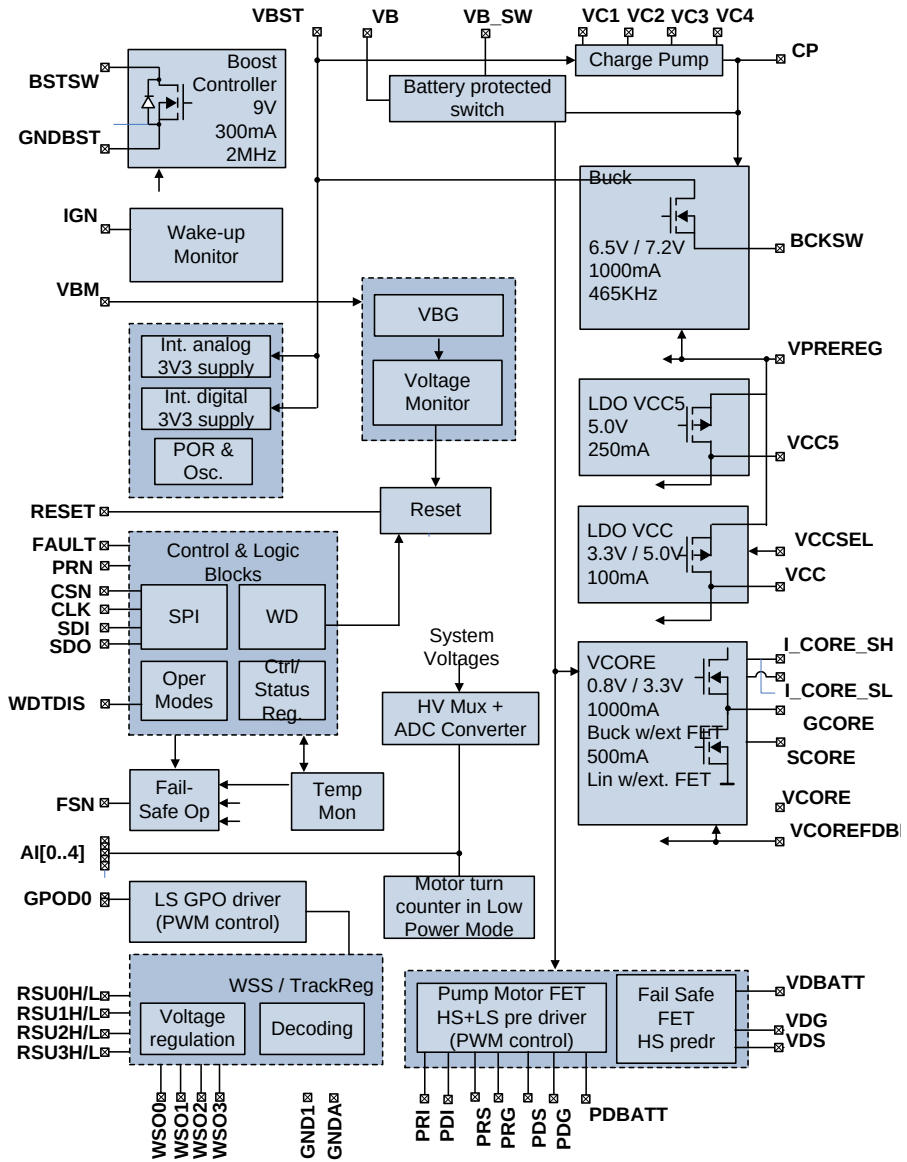
SBC L9396

L9396	Traction inverter
LDO (5V, 250mA), LDO (3.3V / 5V, 100mA), VCORE (0.8V / 5V +/-2% - µC core supply, max 1000mA in switching mode, max 750mA in linear mode)	Power supply : micro Analog chip Pre driver chip
Voltage monitor WD 2X	System safety
HS Pre driver	Cooling pump control
IGN input	Hardware wake-up
SPI	Communication (CRC)
Fault single output FSN	Fault diagnosis and fault protection

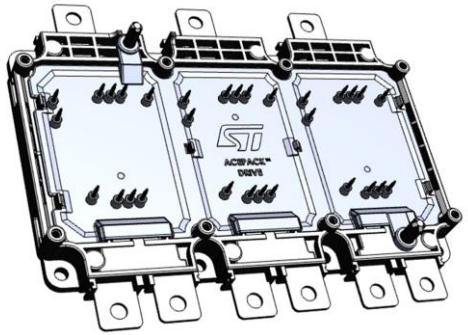


ACEPACK drive

Direct liquid cooled high performance power module

- Press FIT connections for high reliable and long-lasting connection
- SiC-MOSFET based, 750V and 1200V
- Pin-fin for direct cooling
- Dedicated NTC for each single substrate
- Unequalled $R_{DS(on)}$

ACEPACK™ DRIVE



- Internal layout optimized for minimized stray inductace
- High reliability and robustness: Dice sintered to substrate
- Different bus bar available to fit welding or screwing connection methods.
- AMB substrates for better thermal managment
- Incredibile high power density

Traction inverter for (H)EV, Trucks, Bus

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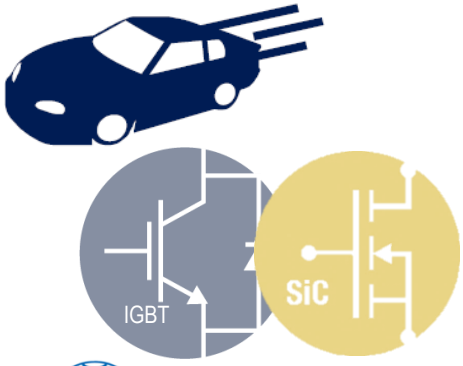
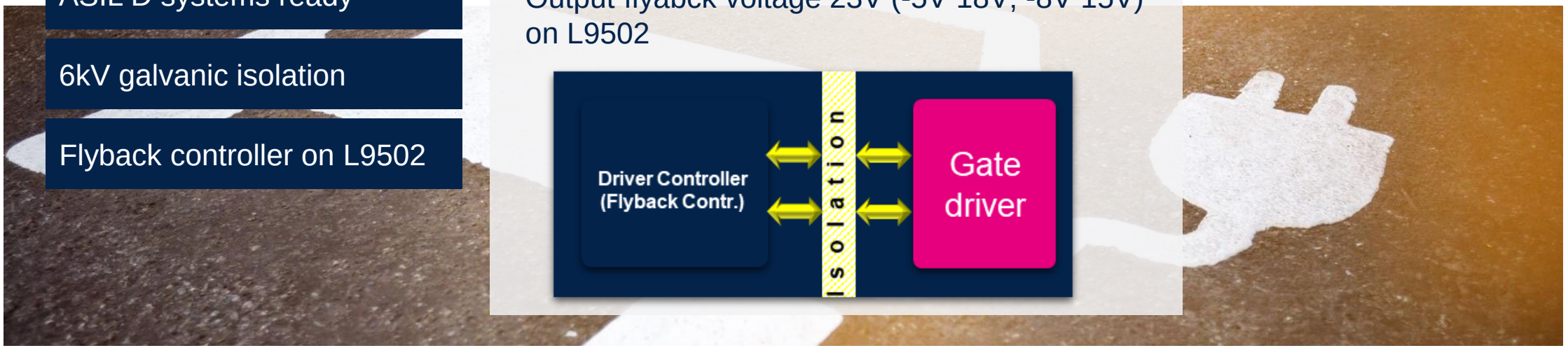
Isolated gate driver L9502

- Single channel isolated gate driver
- AEC-Q100 Grade 1
- ASIL D systems ready
- 6kV galvanic isolation
- Flyback controller on L9502

- 15A driver sink/source current capability
- Miller clamp
- Advanced Diagnostic and Protection
- 10-bit A/D Converter with 2 exteranl inputs
- BRAKE pin with programmable safe state
- 5MHz SPI interface with enhanced safety
- Output flyabck voltage 23V (-5V 18V; -8V 15V) on L9502



ISO 26262



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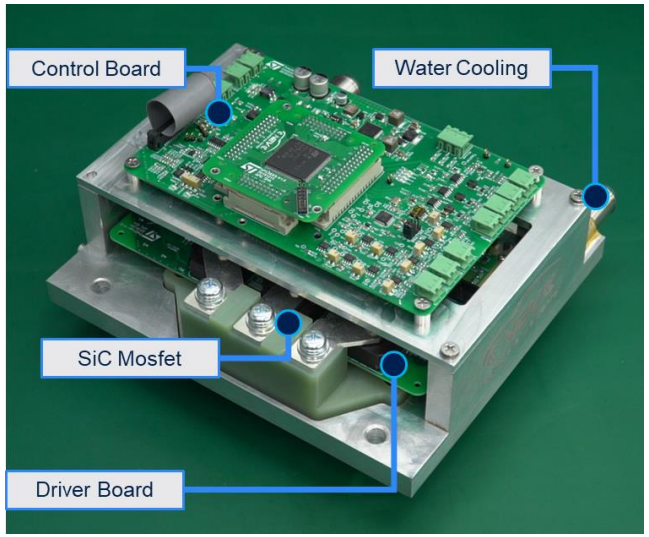
Traction inverter system support package

Support package

- ST can provide a set of product application solutions
  - MCU SPC58NN
  - SBC L9396
  - Pre driver L9502
  - Pre driver STGAP
  - Power module SiC MOSFET
- ST provides valuable application materials for customers



Design kit	Validation report	Functional safety	3rd party partners

• System architecture
• Requirements analysis
• Hardware schematic
• PCB,BOM
• Software
  • low level driver
  • AUTOSAR complex driver
  • AUTOSAR MCAL
	• Double pulse test data
	• Bench test data
		• FTA
		• FMEDA
		• DFMEA
		• DFA
		• Safety example code
		• Design verification and validation Plan
			• Vector
			• ETAS
			• EB
			• Greenhills
			• Hightec
			• GIICS

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Thank you

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