

MAGNIV微控制器在车身电子中的应用

RAYMOND TANG

JUNE 2020



PUBLIC



SECURE CONNECTIONS
FOR A SMARTER WORLD



Agenda

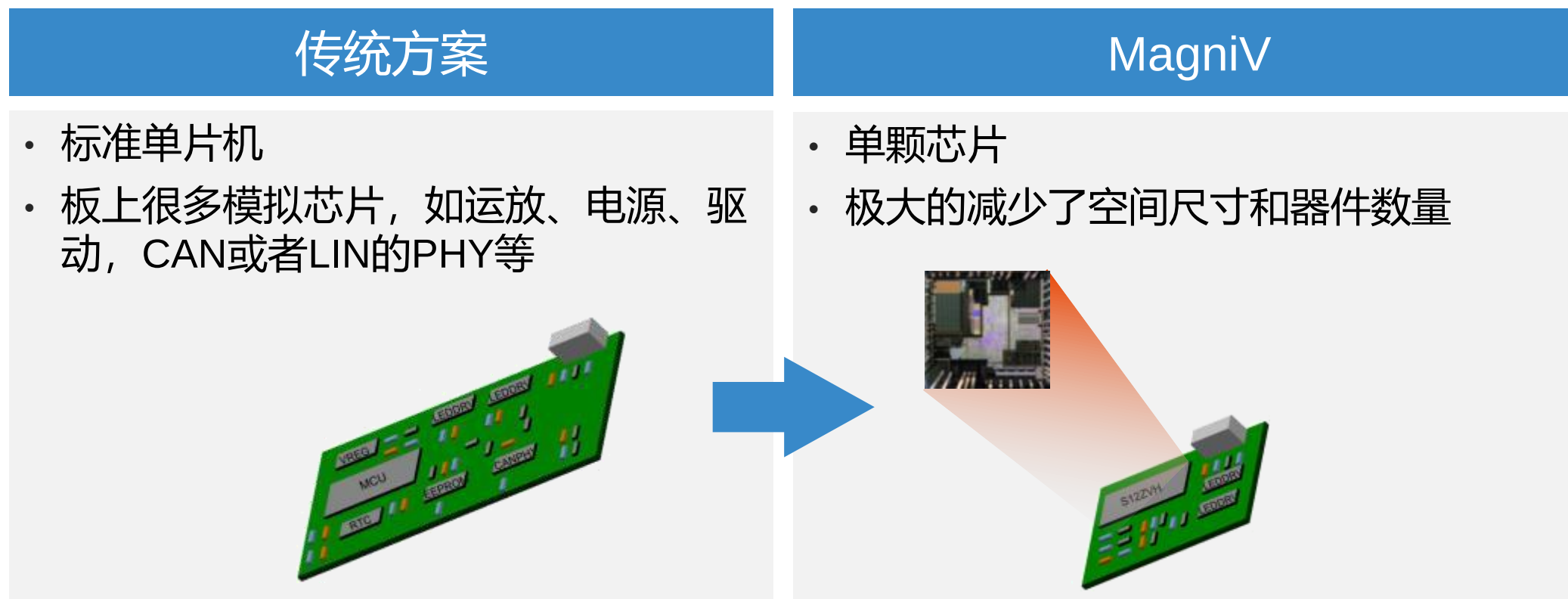
- 什么是MagniV
- NXP MagniV家族产品特性
- MagniV生态系统详解
- 基于MagniV的车身电子方案



什么是MAGNIV

MagniV Concept: Shrink Your Application

Integration of High-Voltage (HV) Analog Features into a Standard Automotive MCU



MagniV 是恩智浦注册的一个商标，是集成标准汽车单片机和高压模拟组件的芯片家族。

S12 MagniV - Integrated Solutions

Technology Sweet-spot for Actuators, Sensors & User Interfaces

ACT 

电机控制

传感器接口

 SENSE

Digital Logic
Processor, PWMs, Timers,
SRAM, SPI, SCI, GPIO,
Watchdogs, etc.

**High-Voltage
Analog**

12V-Voltage Regulator,
Physical Interfaces for
CAN or LIN
Low Side & High Side
Drivers for
Power MOS-FET
or Relays

**Non-Volatile
Memory**
Flash, EEPROM

MagniV

标准的CMOS工艺

(LL18 Low Leakage 180nm)

UHV 工艺

NXP

S12 MagniV: Product Families



Motorcontrol

Sensor Interface



SENSE

S12VR

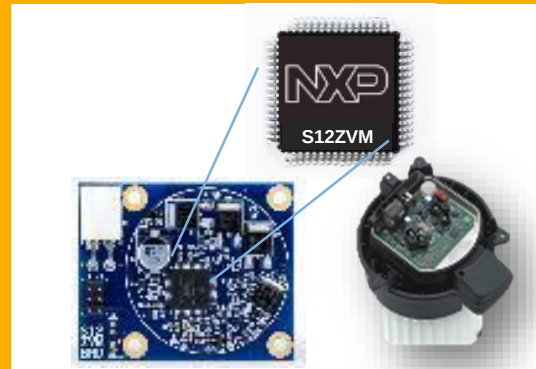
Relay driven motors



- Window lift
- Sunroof
- Power doors

S12ZVM

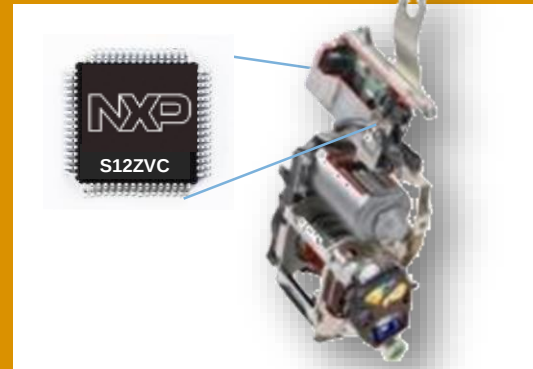
BLDC/DC motors



- Fuel pump
- Oil pump
- Fans
- Wipers

S12ZVC

CAN nodes



- Safety sensors
- Emission sensors
- Gear shift

S12ZVL

LIN Nodes



- Sensors
- Door modules
- Steering wheel switches



Reduced PCB Space



Reduced Bill of Material



Improved manufacturing efficiency and quality



Simplified development

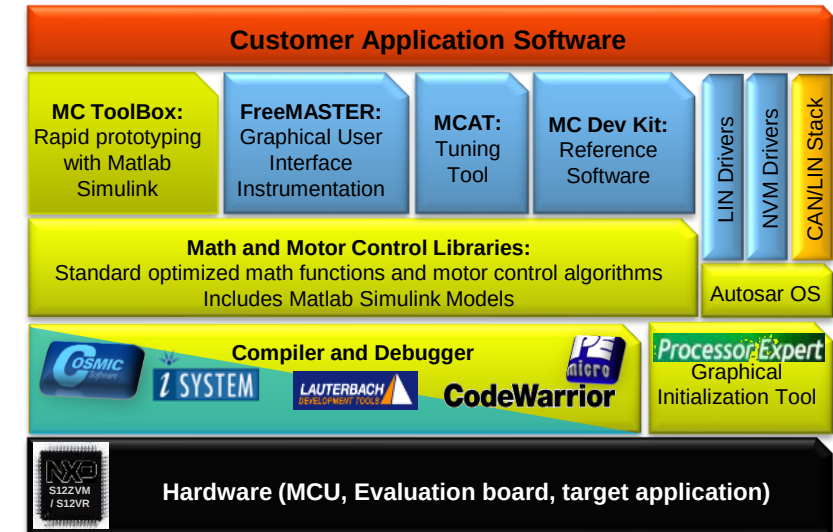
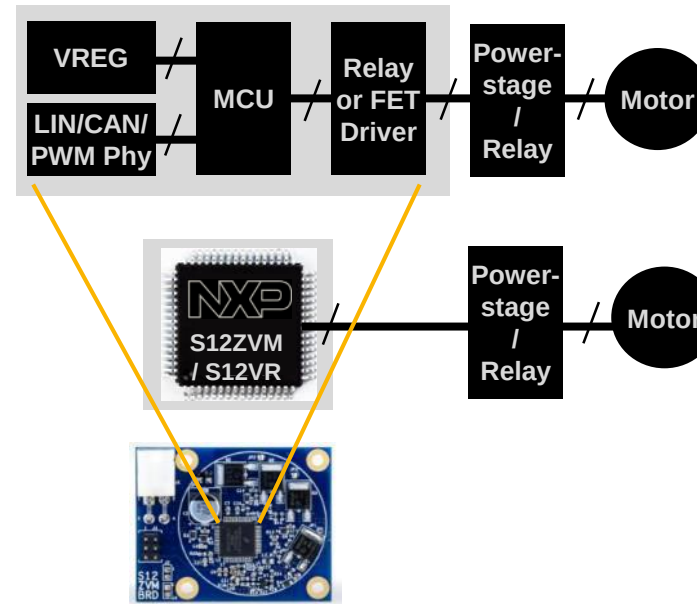
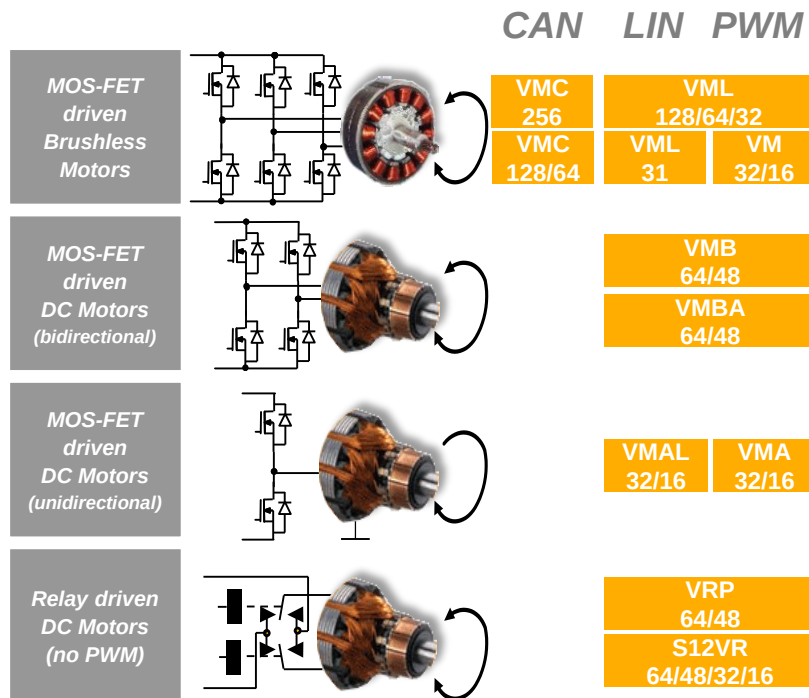
Industry's broadest portfolio of integrated solutions for motor control and interface nodes

- Broadest memory range – up to 256K
- Industry's only integrated CAN Phy
- True AEC-Q100 Grade 0 Temperature performance (up to 150C Ta)
- ASIL-A-compliant, ASIL-B-capable (S12Z Devices)
- Unmatched tools and software ecosystem
- Conforms to global robustness standards and OEM requirements



MagniV Solutions for Every Motor

Broadest MC Portfolio... to save space and time-to-market



Interface Solutions for Sensors, Actuators, or Switches

CAN and LIN Portfolio... to save space and time-to-market

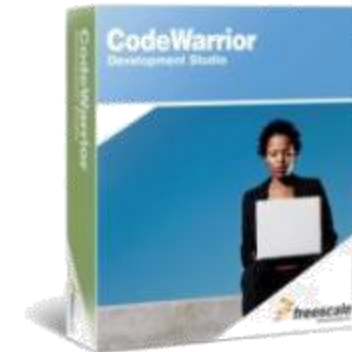
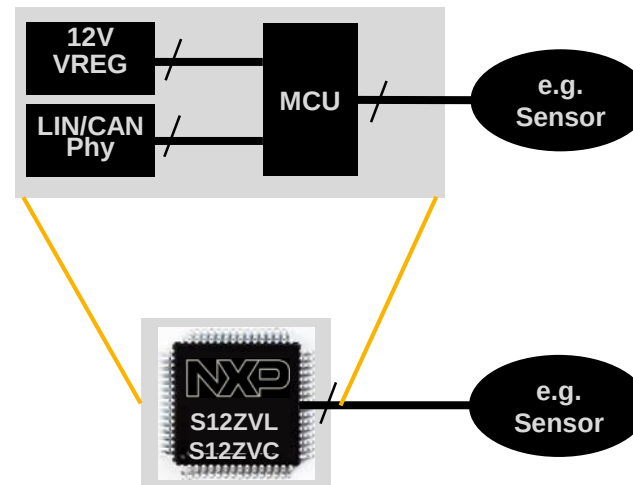
	64 EP LQFP	48 LQFP	48 LQFP	32 QFP	32 EP QFN
192K	●	●			
128K	●	●	●	●	●
96K	●	●	●	●	●
64K	●	●	●	●	●
32K			●	●	●
16K			●	●	●
8K			●		
	S12ZVC		S12ZVL		

CAN

lin
LOCAL INTERCONNECT NETWORK

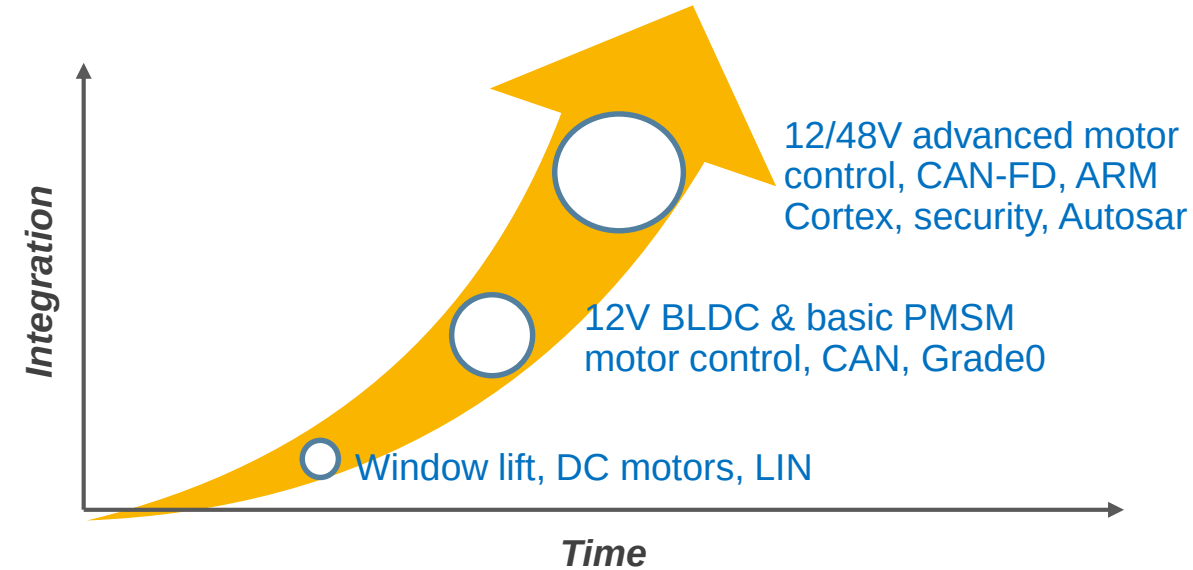


Grade0 for Power
Train Sensors

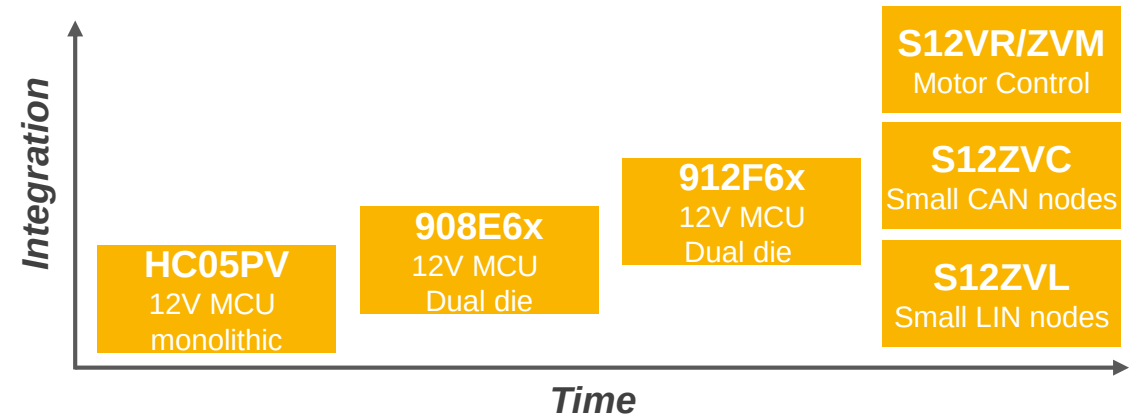


Integrated Solutions: S12 MagniV

- Application focused **Integration**:
 - Saves **20%** PCB/module size
 - Improves **manufacturing efficiency**
 - **Simplifies** system design
- **Scalability** across General Purpose & Integrated Solutions



>20 Years of Experience in Integrated Solutions



车辆的电气化

尺寸越来越紧凑

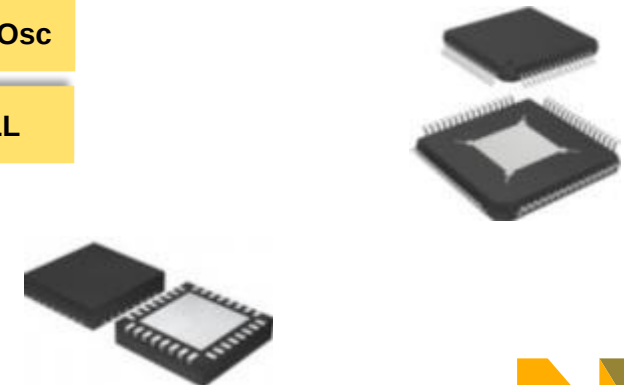


NXP MAGNIV 家族产品特性

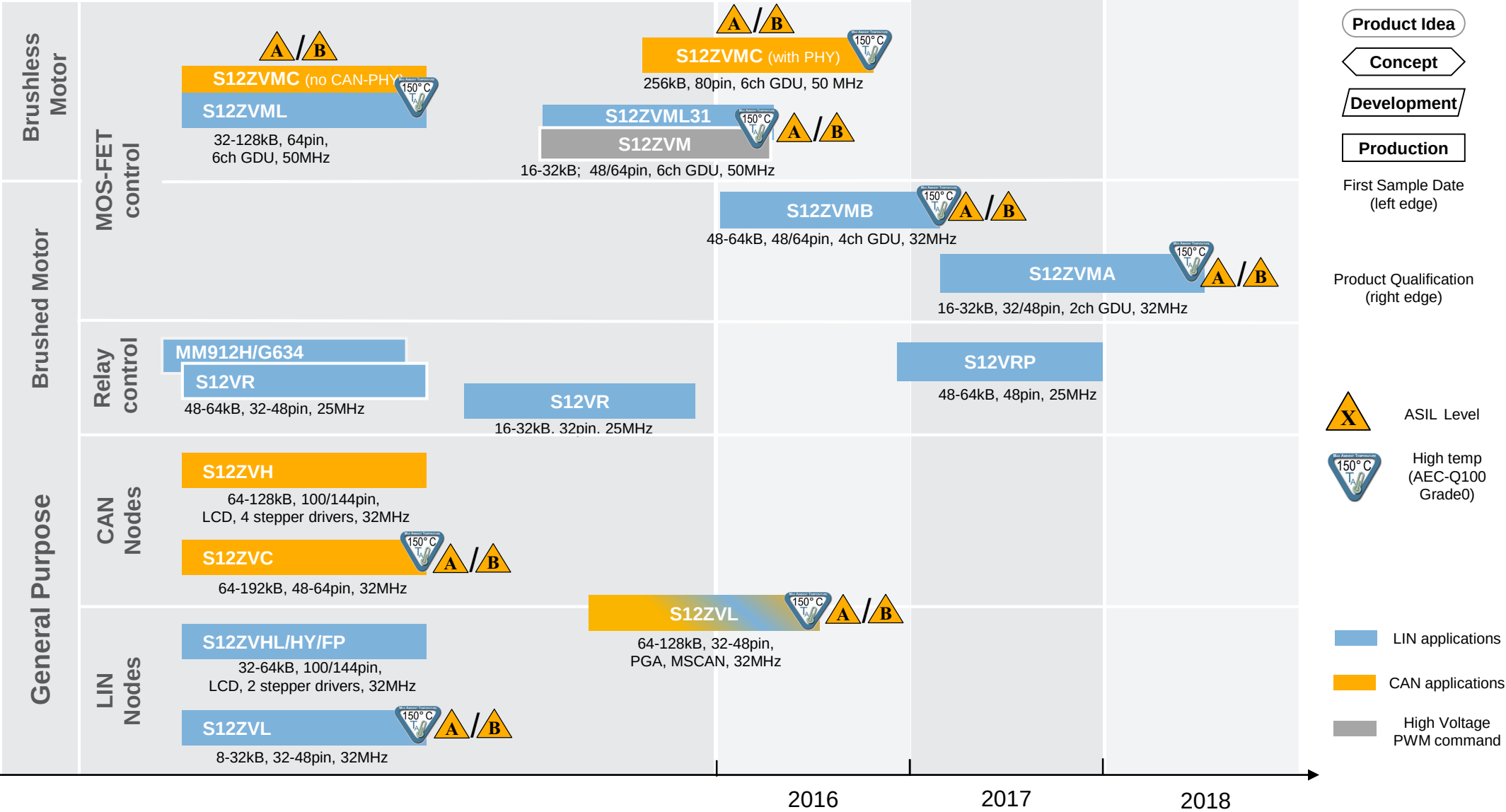


MagniV Building Blocks

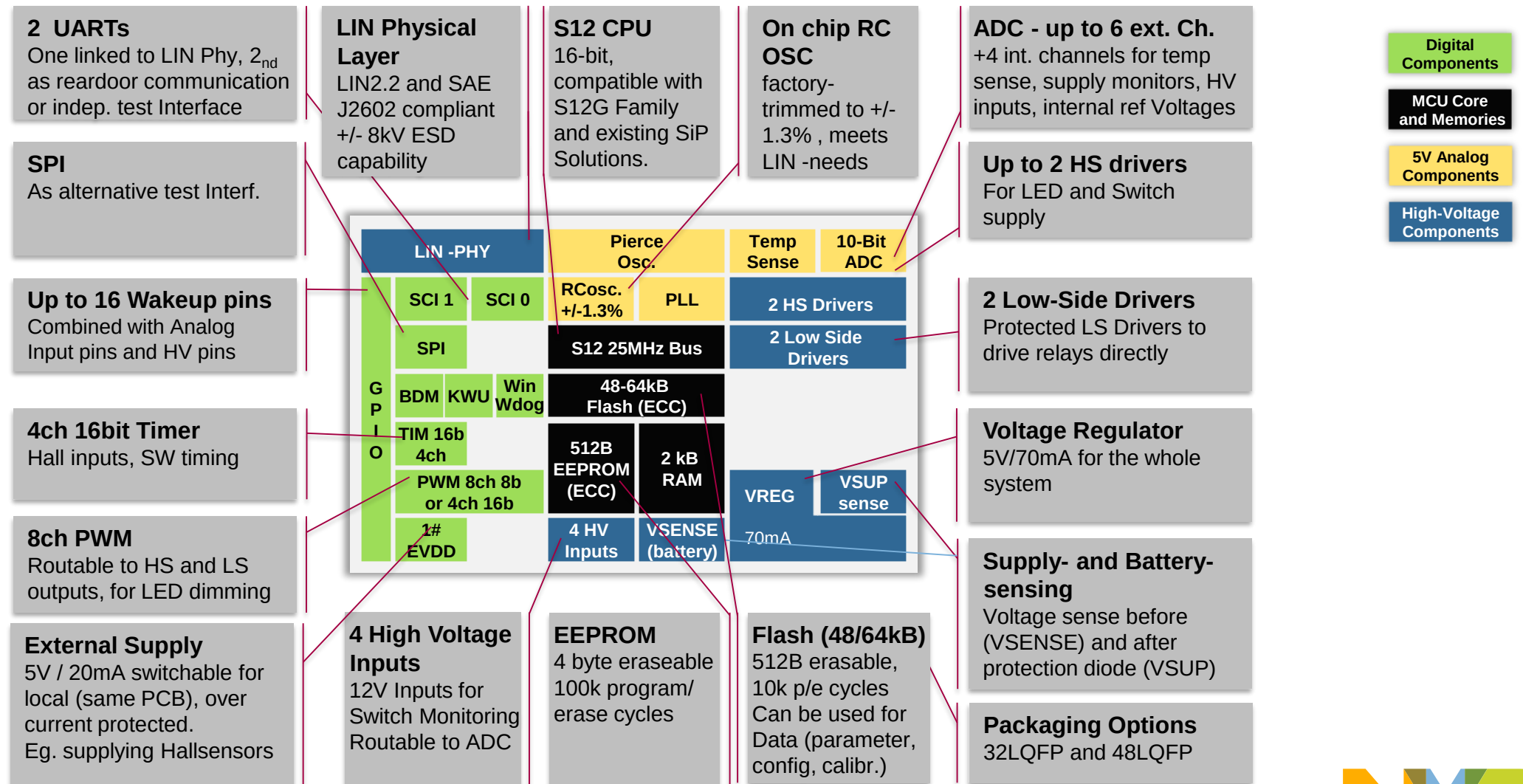
High-Voltage Components	Digital Components	MCU Core and Memories	5V Analogue Components	Packaging
VREG for tot. supply: •70mA w/o ext comp. or •170mA with ext. ballast	MSCAN Sent	S12- or S12Z-CPU 25/32/50MHz bus	List Based ADC 10-12Bit resolution 1-2 S/H-units Up to 16ch total	LQFP: 32/48/64/80-pin
LIN-PHY CAN-PHY	SCI SPI IIC	Flash (ECC) 8kB – 192kB	Temp Sense	LQFP-EP: 48/64-pin 
V-BAT SENSE V-SUP SENSE	GPIO PGPIO 20mA NGPIO 25mA	EEPROM (ECC) 128B – 4kB	Current Sense (2 x Op-Amp)	QFN: 32-pin (5x5mm)
1-4ch HVI (12V-input with wake-up and ADC)	BDM/BDC	RAM (ECC) 512B - 8kB	2ch ACMP With 1x6-Bit-DAC	
LS-drivers HS-drivers	Key Wakeups Win Wdog		Pierce Osc.	
Charge Pump	RTC		32kHz low power Osc	
4-6ch Gate Drive Unit for FET Qg=50-150nC	Timer 16Bit (25-64MHz) PWM 8/16Bit (25-64MHz)		RCosc. +/-1.3% PLL	
	Motorcontrol PWM With Fault protection			
	Programmable Trigger Unit			
	Sound Generator			
	Segment LCD (4x40)			
	Stepper Motor Driver with SSD			



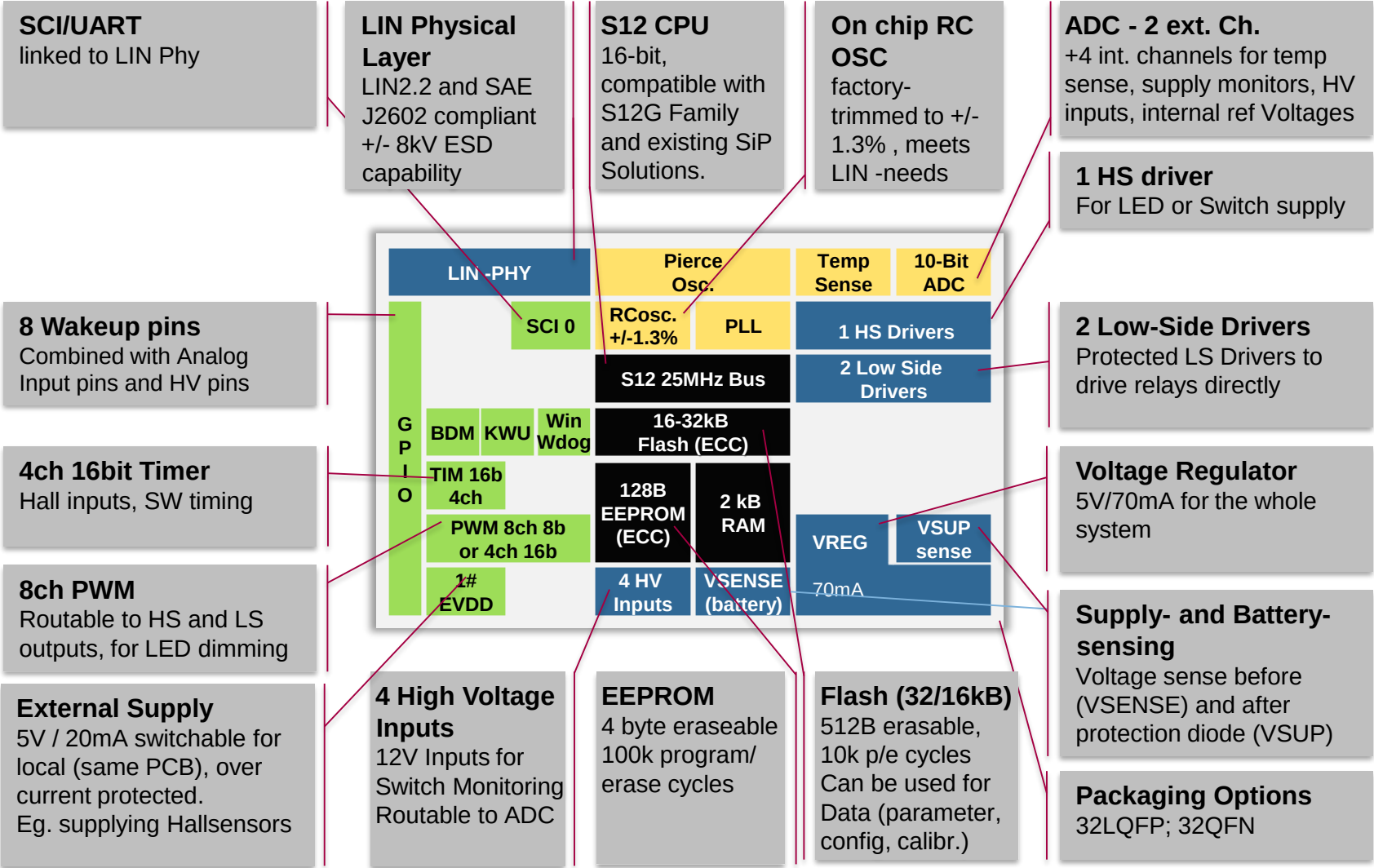
S12 MagniV Integrated Solutions Roadmap



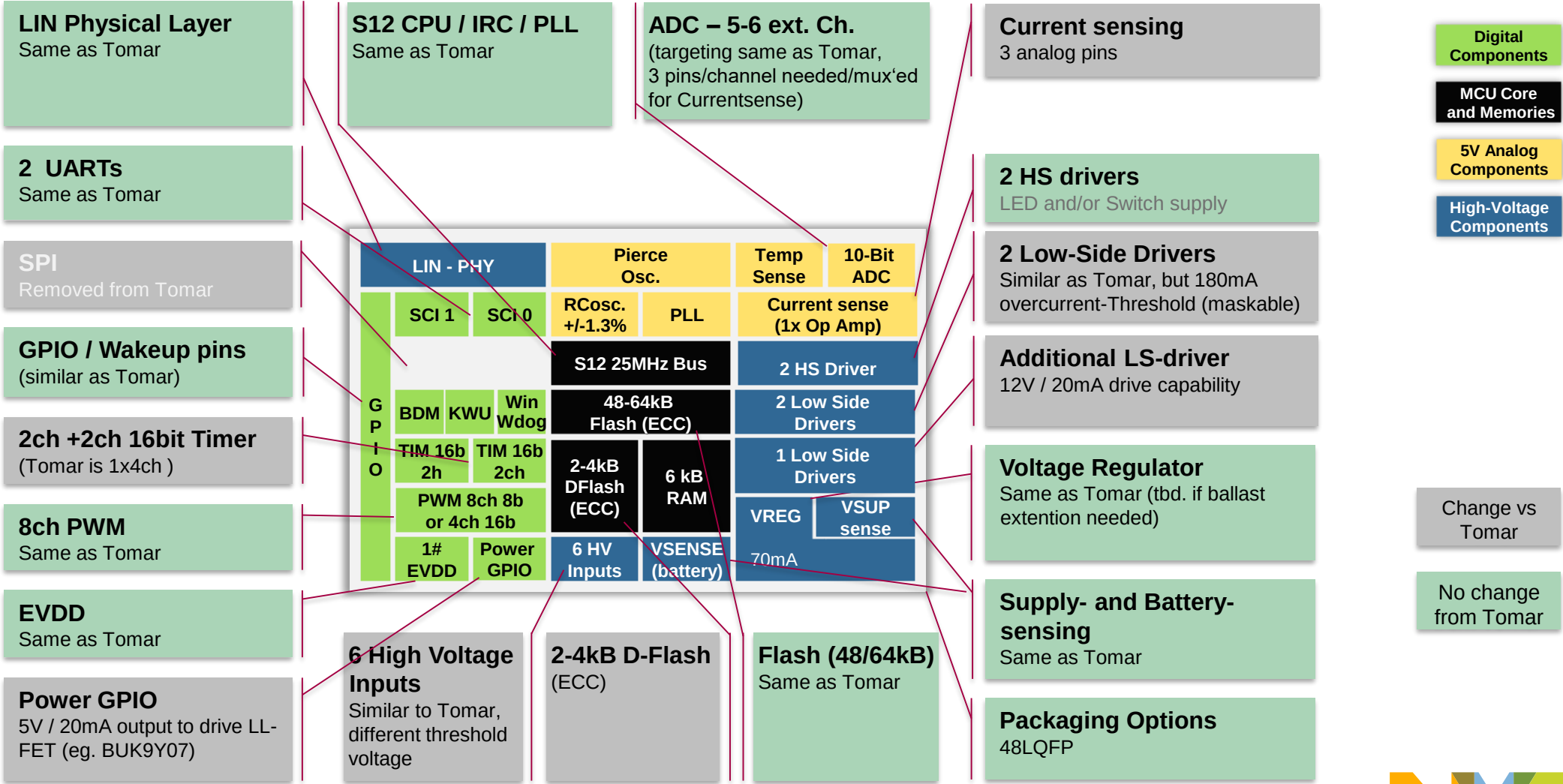
S12VR64/48



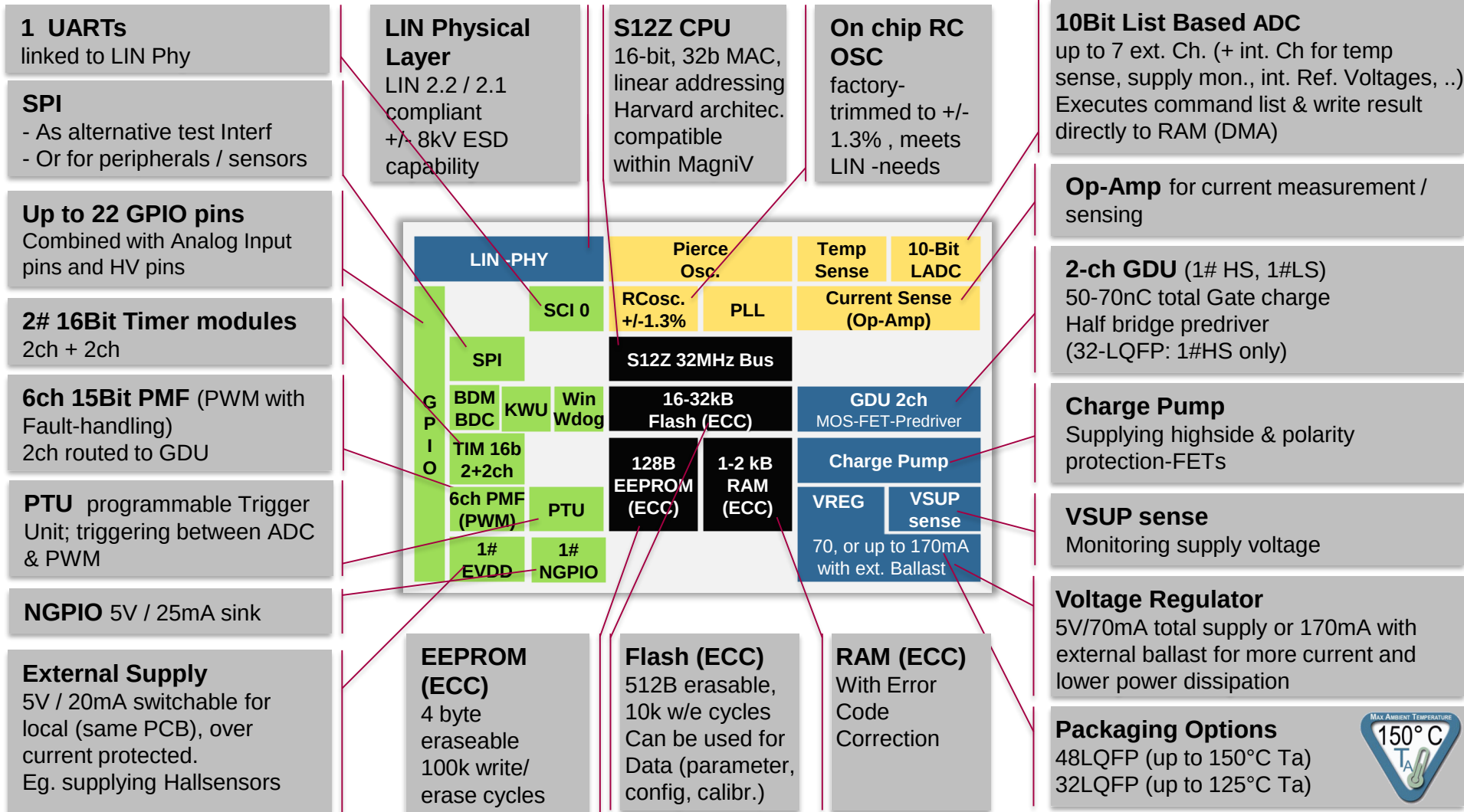
S12VR32/16



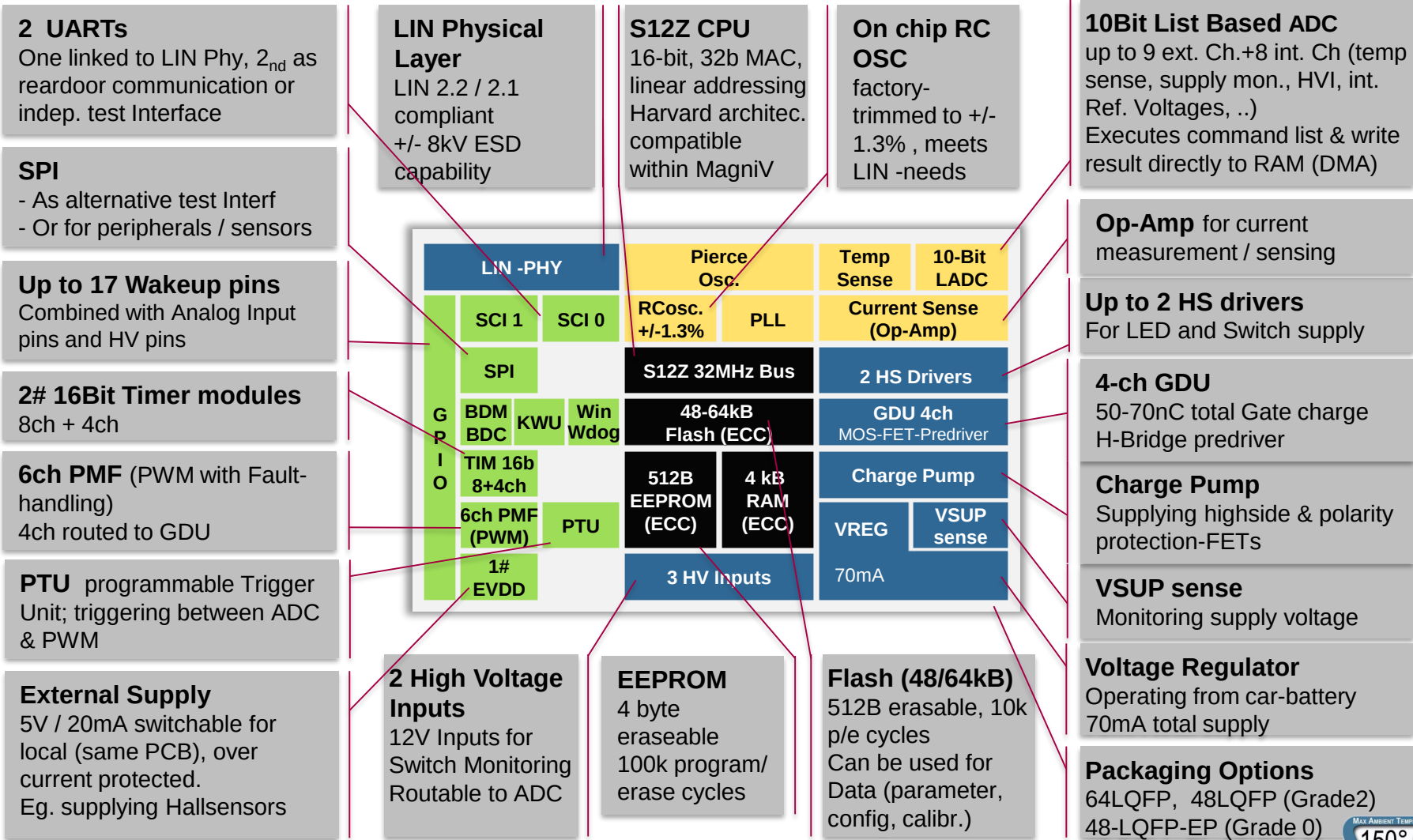
S12VRP64



S12VMAx



S12VMBx (Toledo)

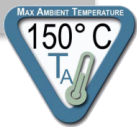


Digital Components

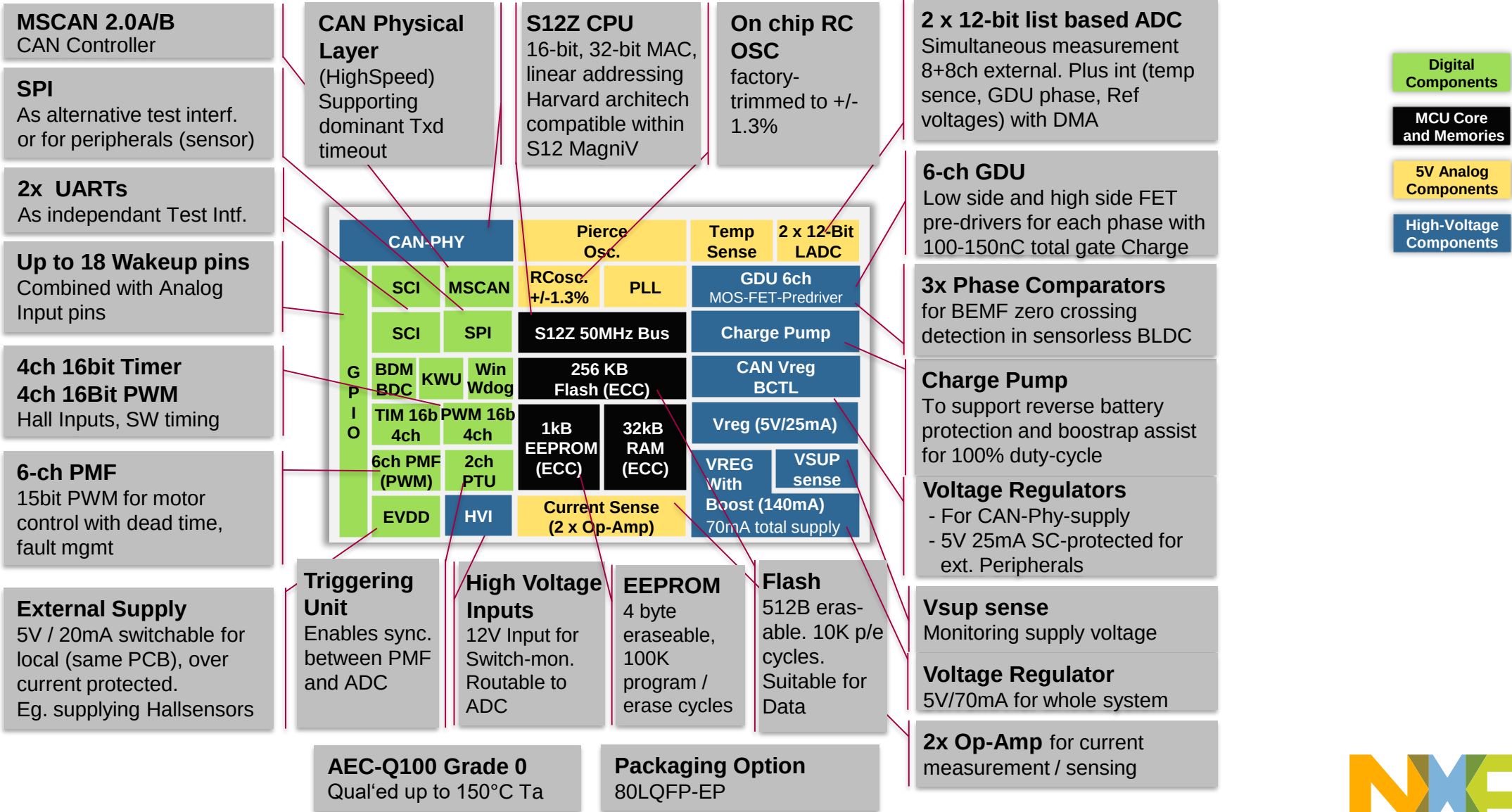
MCU Core and Memories

5V Analog Components

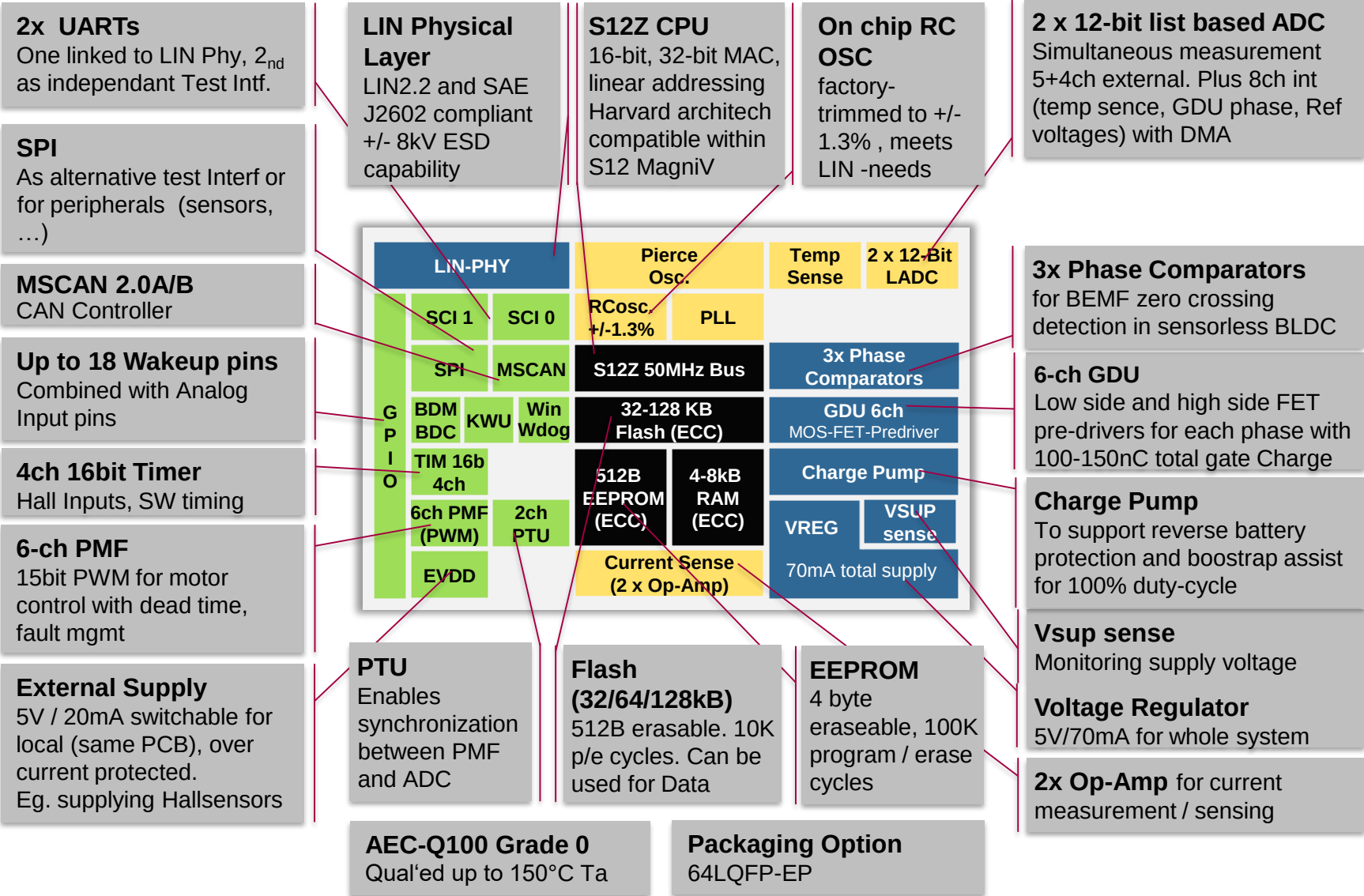
High-Voltage Components



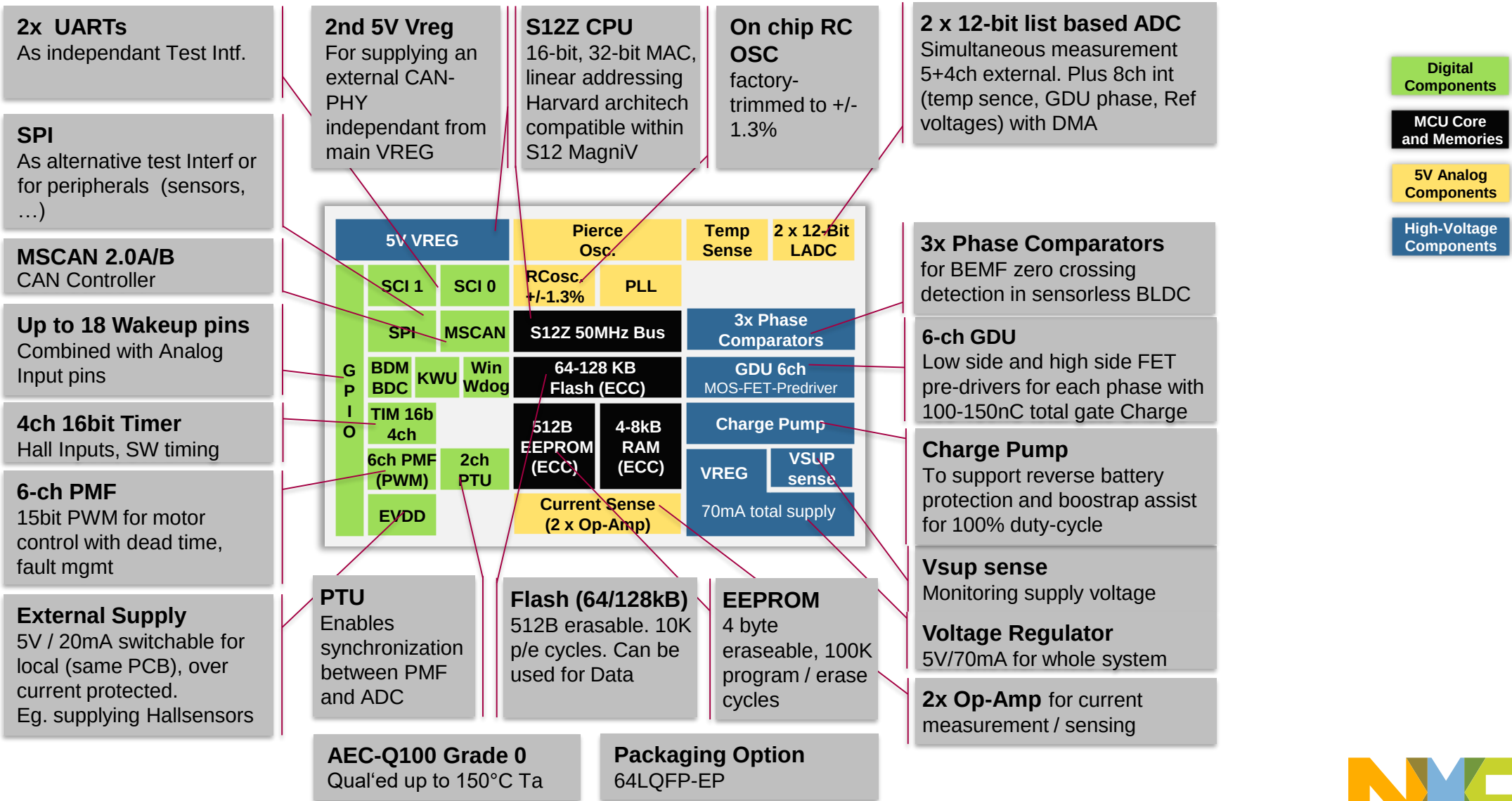
S12ZVMC (CAN version 256kB) - Details



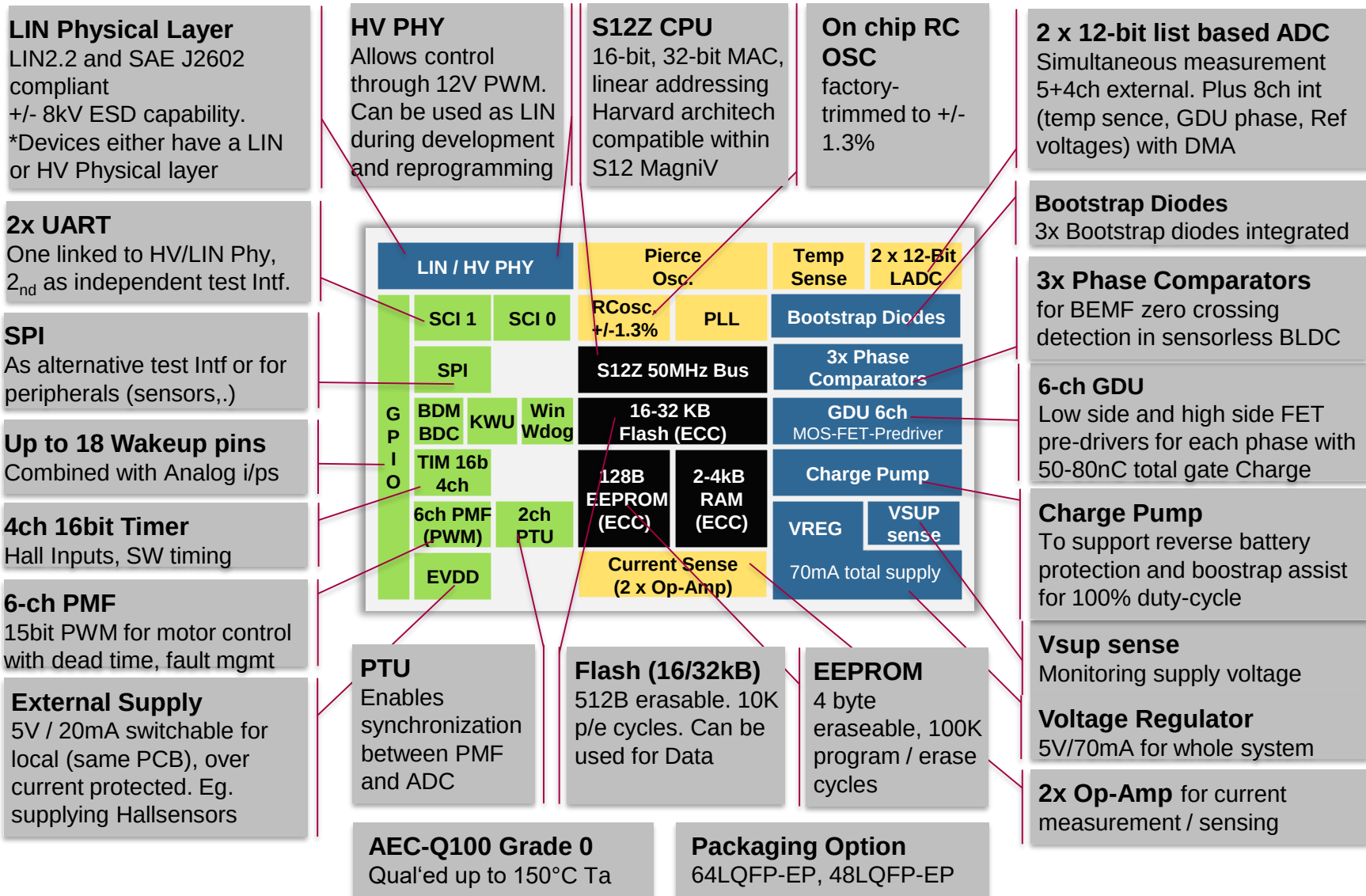
S12ZVML (128/64/32kB – LIN version) – Details



S12ZVMC (128/64kB – CAN version) – Details



S12ZVM32/VML31 (PWM/LIN version) – Details



Digital Components

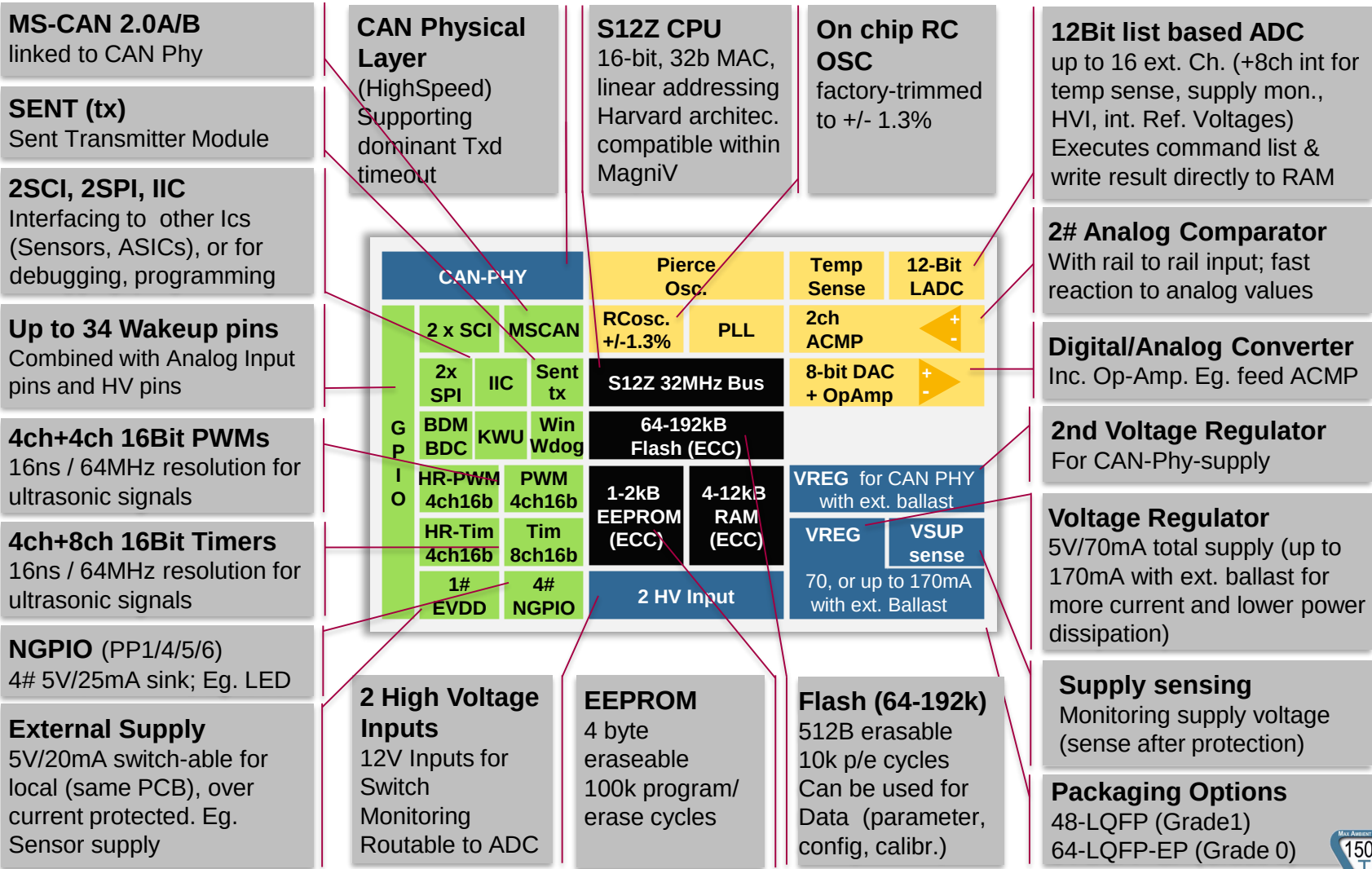
MCU Core and Memories

5V Analog Components

High-Voltage Components



S12ZVCA (fully featured) – key features



Digital Components

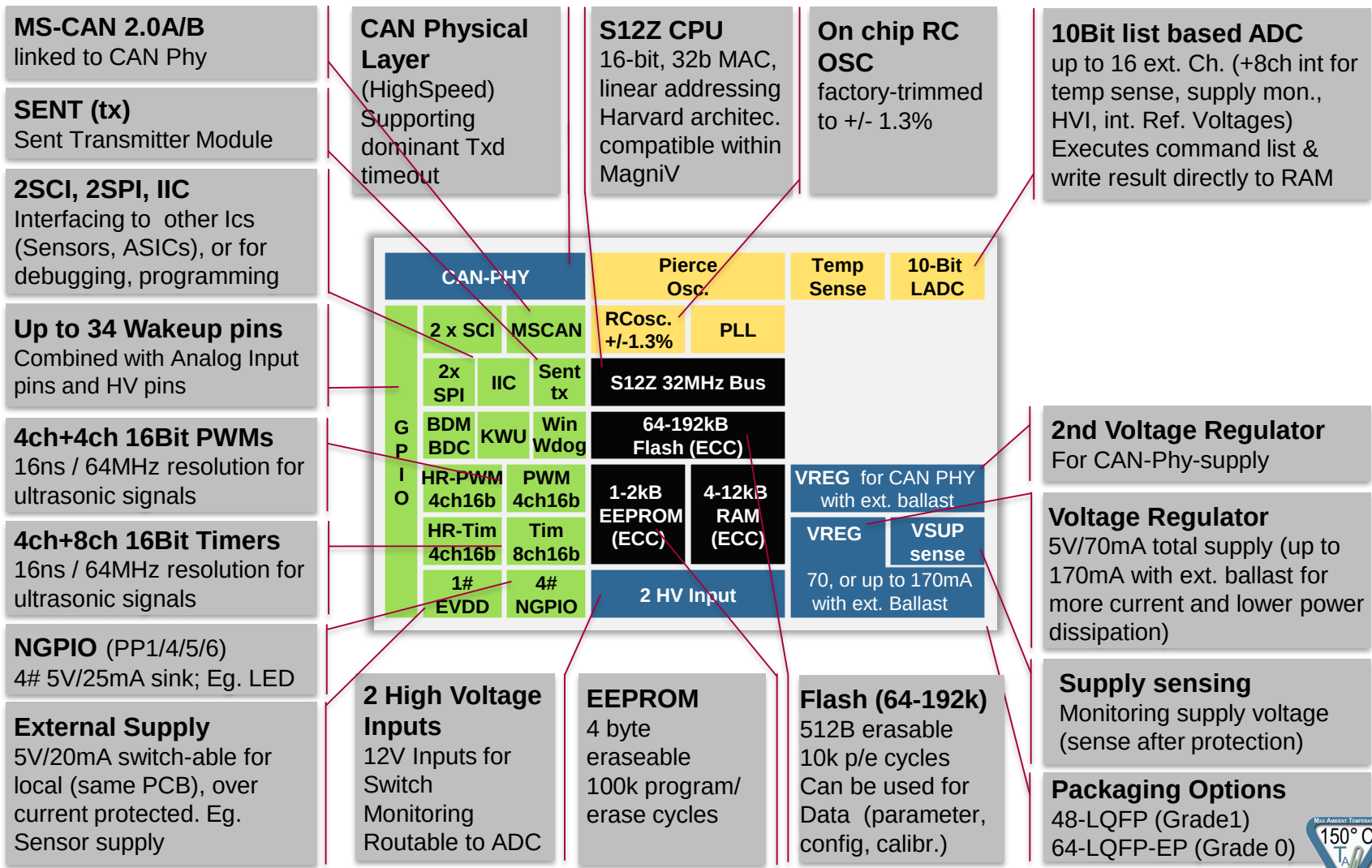
MCU Core and Memories

5V Analog Components

High-Voltage Components



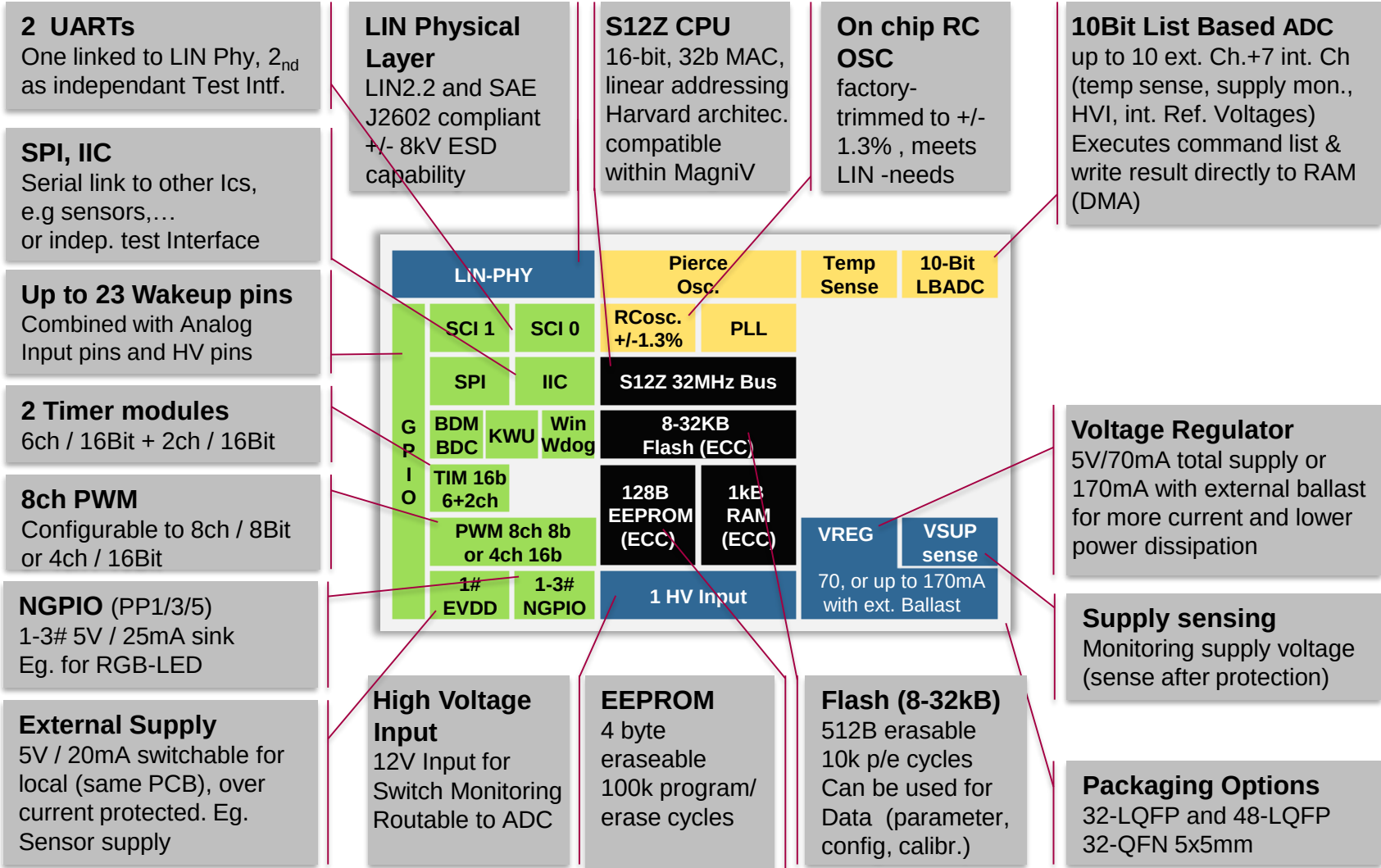
S12ZVC (Reduced feature set) - Details



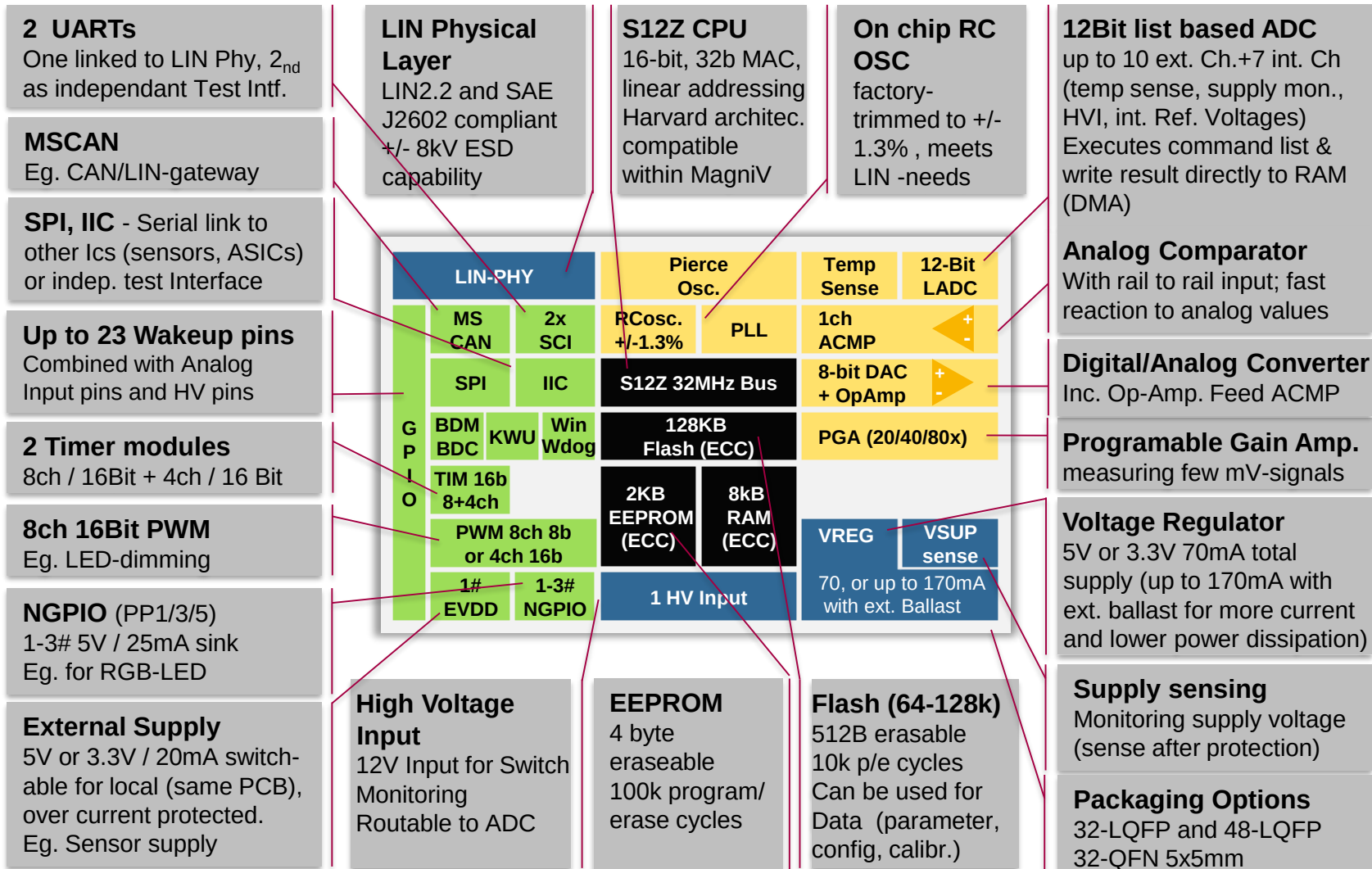
- Digital Components
- MCU Core and Memories
- 5V Analog Components
- High-Voltage Components



S12ZVL8/16/32 (Knox) – Details



S12ZVL64/96/128



SafeAssure™ Program Applied to S12 MagniV

Safety Hardware

Common safe hardware platform for application software:

- ✓ Voltage/clocks monitoring
- ✓ Memories w/ error correction
- ✓ Window Watchdog...

Safety Process

- ✓ ISO26262 development process for most products
- ✓ Safety-Element-Out-Of-Context



Safety Support

- ✓ FIT rates
- ✓ Dynamic FMEDA
- ✓ Safety manual
- ✓ Technical support as required

Safety Software

- ✓ Enhanced S12Z core self-test is available (90% Diagnostic coverage for ASIL B)

Product families	Part Codename	Component Development Process	FMEDA (SPMF, LFM, PHFM), FMEDA Report	Dependent Failure Analysis	Safety Manual	Core Self-test and User Guide
S12ZVL	Knox	ISO26262:ASIL A	Architecture Matrix up to ASIL-B	Yes, included in FMEDA Report	Yes	Yes
S12ZVC	Hearst	ISO26262:ASIL A				
S12ZVM	Carcassonne	Standard				
S12ZVM	Obidos	ISO26262: ASIL A				
S12ZVM	Carcassonne+	ISO26262: ASIL A				
S12ZVMB	Toledo	ISO26262: ASIL A				
S12ZVMA	VMA32	ISO26262: ASIL A				
S12ZVH/VHY	Lumen2W	Standard	Upon request	Upon request	No	No
S12ZVH	Lumen4W					
S12VR	Tomar					
S12VR	Tomarino					
S12VRP	Tomar+					

MagniV家族产品特性

- 内核 – 大部分家族采用的是S12Z，而S12VR采用的是S12内核
- 主频 – S12ZVM内核的主频最高也可以到100MHz，具体每个系列有差异
- 除了S12VR, 大部分产品都能满足AEC Q100 Grade0，也就是Ta=150度应用
- 整个MagniV家族产品特别全，flash从小到大都能覆盖，选择很多，性价比高，适合作为平台来开发
- MagniV家族产品非常成熟，有广泛的客户基础，绝大部分的Tier 1都有采用
- 开发环境和开发工具对于熟悉NXP产品的工程师来说，从S08,S12转到MagniV是感觉不到差异的
- MagniV产品有非常成熟的参考软件，包括开发板、软件支持包等可以显著的缩短开发时间和开发难度

MAGNIV 生态系统详解



AUTOSAR 微控制器抽象层(MCAL)

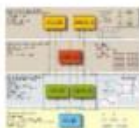
- AUTOSAR MCU abstraction layer drivers.
- AUTOSAR 4.0 versions for QM.
- AUTOSAR 4.0 compliant operation system (OS)
- **Free of charge**

S12Z 内核自测试 (功能安全)

- Library of tests for S12Z core.
- Provides Diagnostic Coverage up to 90% in runtime.
- Developed according to ISO26262 ASIL-B.
- **Free of charge**

Bootloader引导程序

- Unified bootloader based on UDS and TP protocol.
- High-quality reference SW.
- Efficiency to implement by reusing existing stack.
- **Free of charge**

汽车电机控制算法库(AMMCLib)

- Precompiled software library containing building blocks for wide range of motor control applications.
- Both binary and source code available.
- Production ready SW (SPICE Level 3, CMMI and ISO9001/TS16949)
- Control loop modeling with Matlab/Simulink® models.
- **Free** for evaluation (90-days license)

触摸感应软件函数库

- Reference SW library for self-capacitance sensing.
- 1D Capacitive Touch Library
- Single chip solution for automotive TS.
- Passed water, glove, temp and EMI tests.
- **Free of charge**

FreeMASTER调试工具

- Graphical user interface debugger for real-time applications.
- Support MCAT (Motor Control Application Tuning Tool).
- **Free of charge**

模块化设计工具

- Simulink™ Toolbox for configuring and generating software.
- Support to execute motor control algorithms.
- **Free of charge**

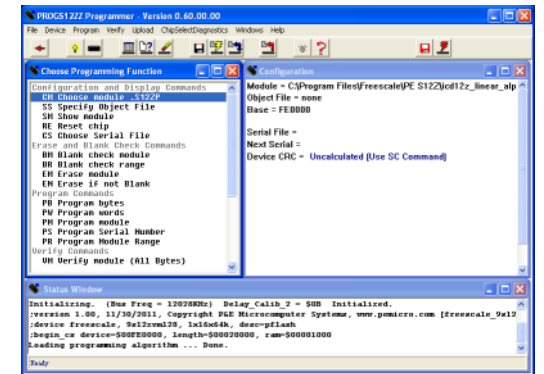
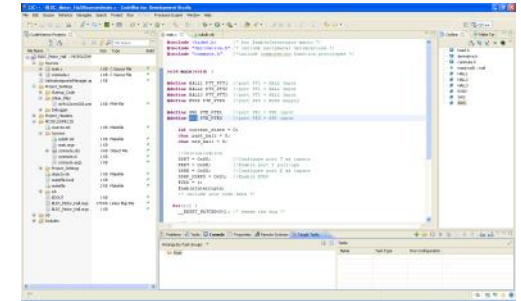
合作伙伴

标准开发板+参考设计



编译环境和调试器

- **Compilers**
 - Codewarrior S12Z (CW 11.0 or higher)
 - Cosmic
- **IDE**
 - Codewarrior 11.0 (eclipse based)
- **Programmers**
 - P&E PROGS12Z
- **Debugger**
 - CW & P&E S12Z Debugger
- **Freemaster Run time debugger**
- **Debug Interface**
 - P&E USB Multilink Debug Interface
 - Cyclone Universal Programmer



基于MAGNIV的车身电子方案



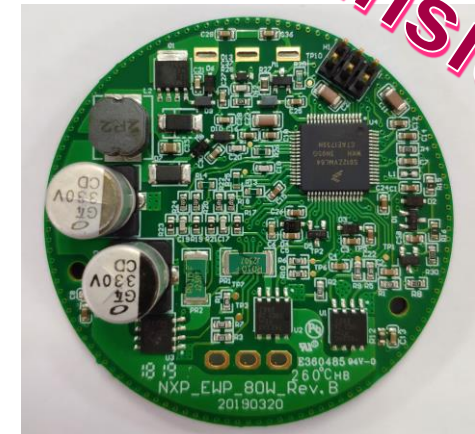
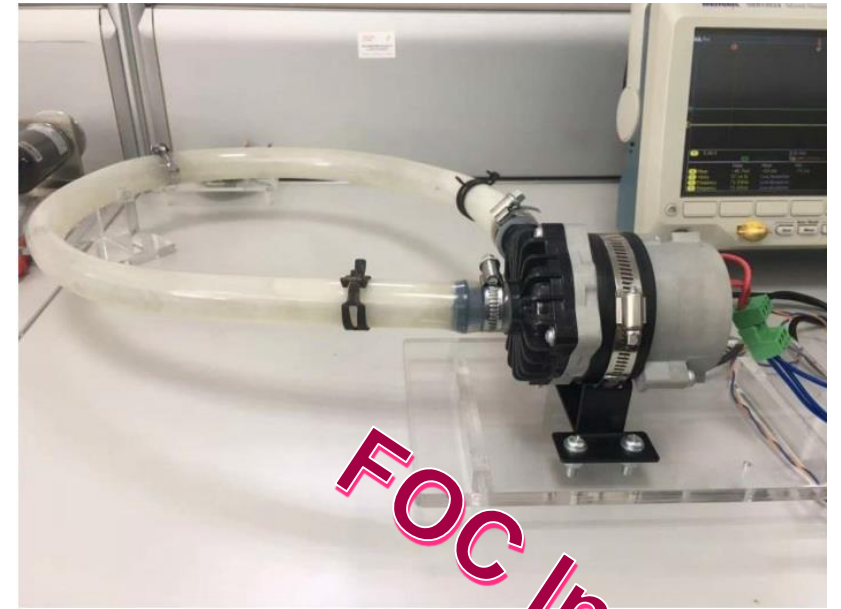
电机类 – 车窗升降

- 基于S12ZVMB设计的车窗升降控制，可以实现升降的速度调节
- Smallest possible, of 2 or 4 layer PCB with components only on the top.
- DC motor current range between 8 to 10A with stall currents that could go up to 20A.
- BDM Interface .
- Hall Sensor/SPI.
- LIN based communication.
- Mosfet H-bridge functionality with the possibility of ramping up/down
- Overcurrent protection via an external current sense resistor
- Ant pinch functionality enabled with the combination of both the hall-effect sensor feedback and the current sensing feedback.



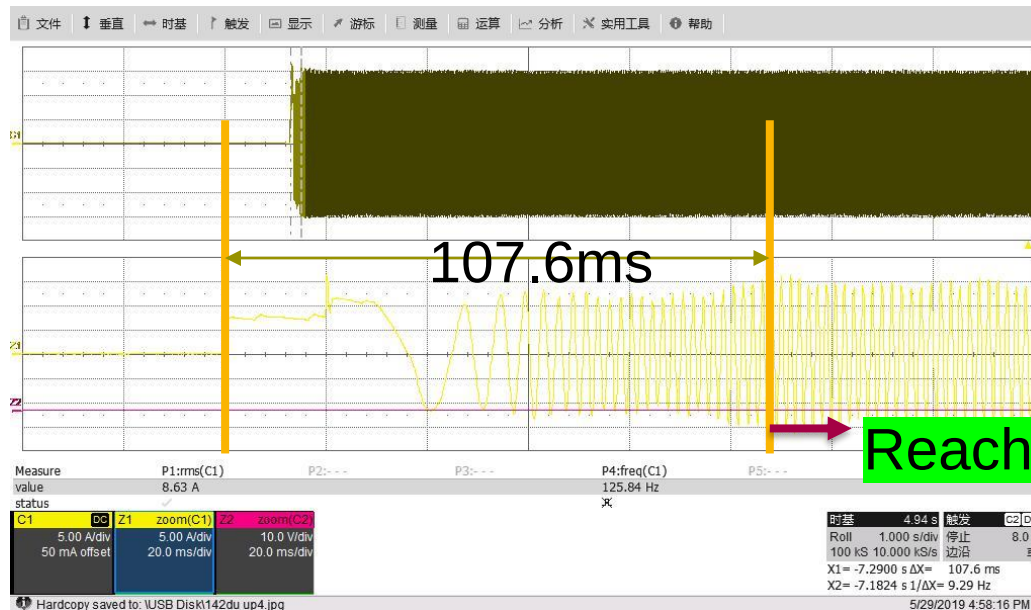
电机类 – 无刷直流电子水泵

- 基于S12ZVML64的无刷直流电机水泵方案目前已经发布在恩智浦官方网站。型号S12ZVM-EWP软硬件资料都已经开放
- 水泵控制采用FOC Sensorless双电阻方案，恩智浦也可以提供单电阻方案，请联系你的代理商
- 硬件功率80W@12V
- 提供完善的诊断和保护机制，包括过流保护，短路保护，过压保护，过温保护以及堵转保护等
- 接口支持LIN或者PWM，以及支持FreeMASTER直接控制

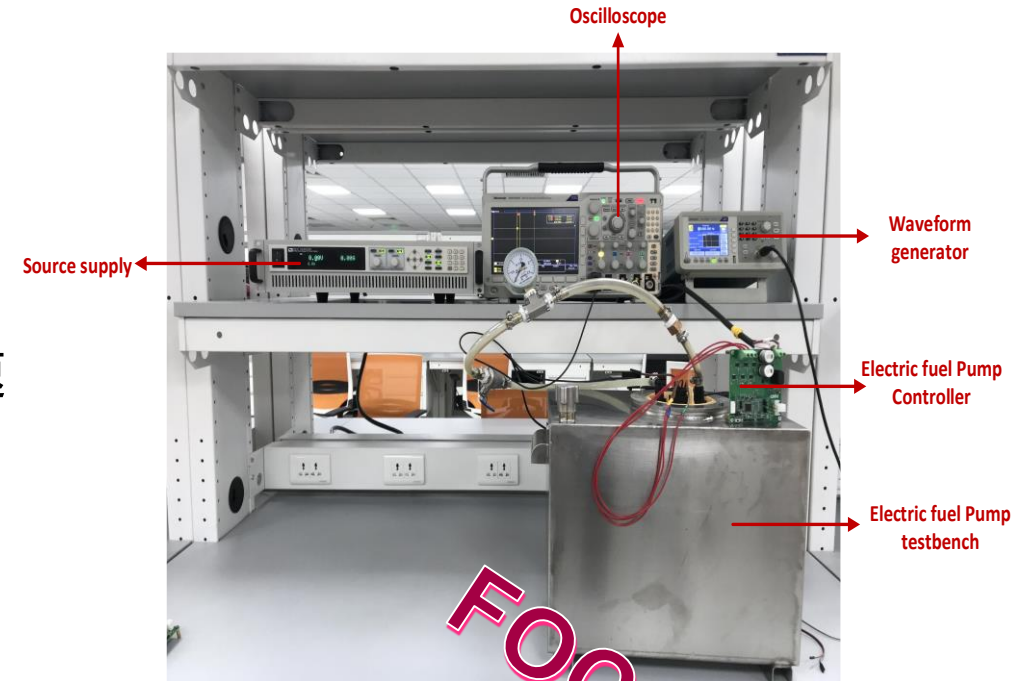


电机类 – 无刷直流电机燃油泵

- 基于S12ZVML128的无刷直流电机燃油泵方案目前已经上市。型号S12ZVM-EFP
- 采用IF电流交换法以及IPD初始位置检测法解决燃油泵快速可靠启动的要求，<150ms达到额定转速
- 硬件功率大于250W@12V

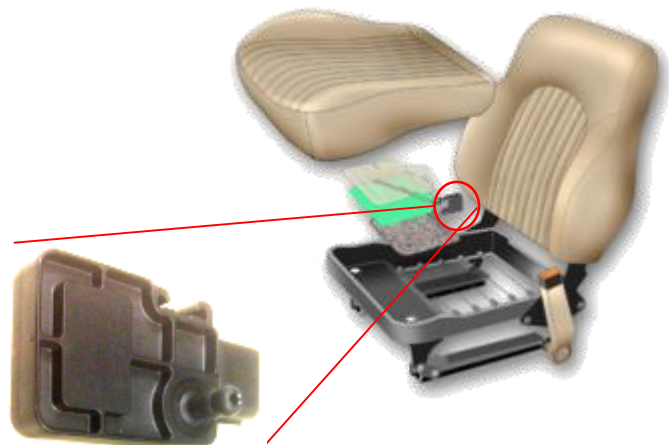


Reach 8000rpm



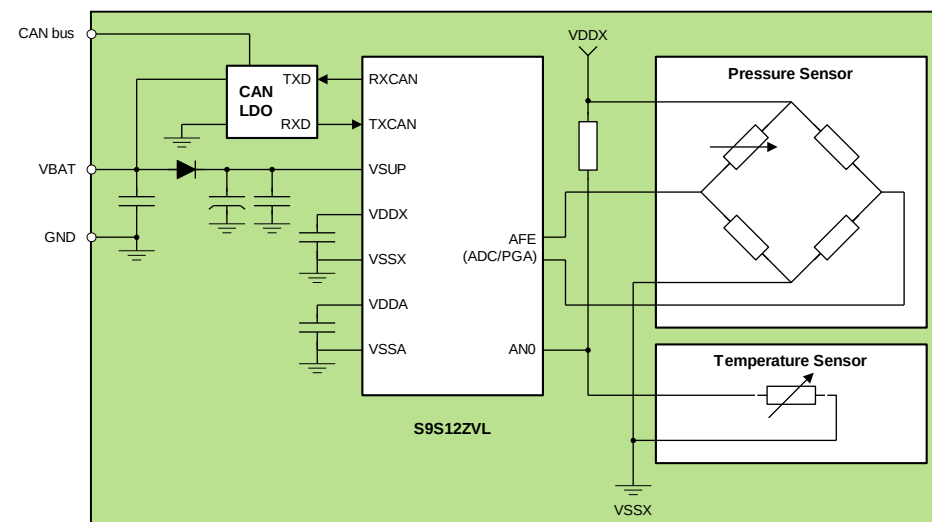
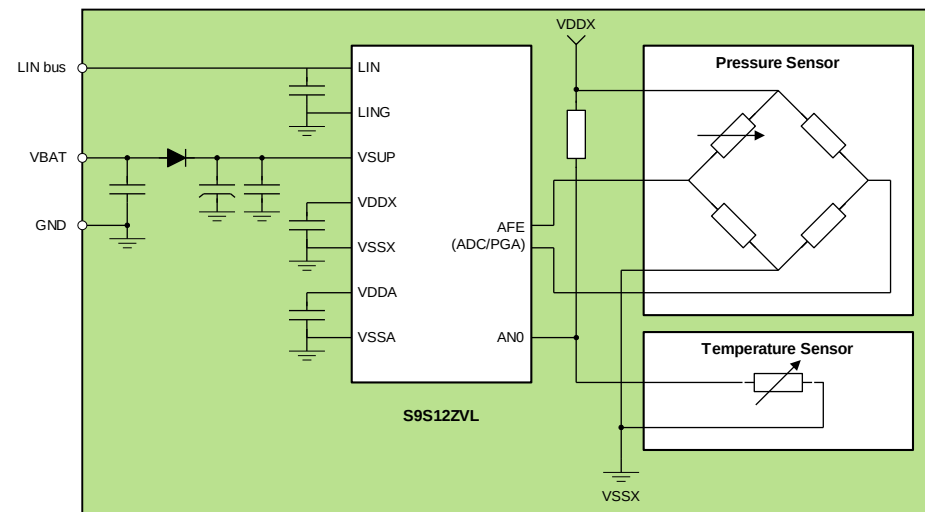
传感器类 – 座椅乘客检测

S12ZVL128 in Passive Occupant Detection System

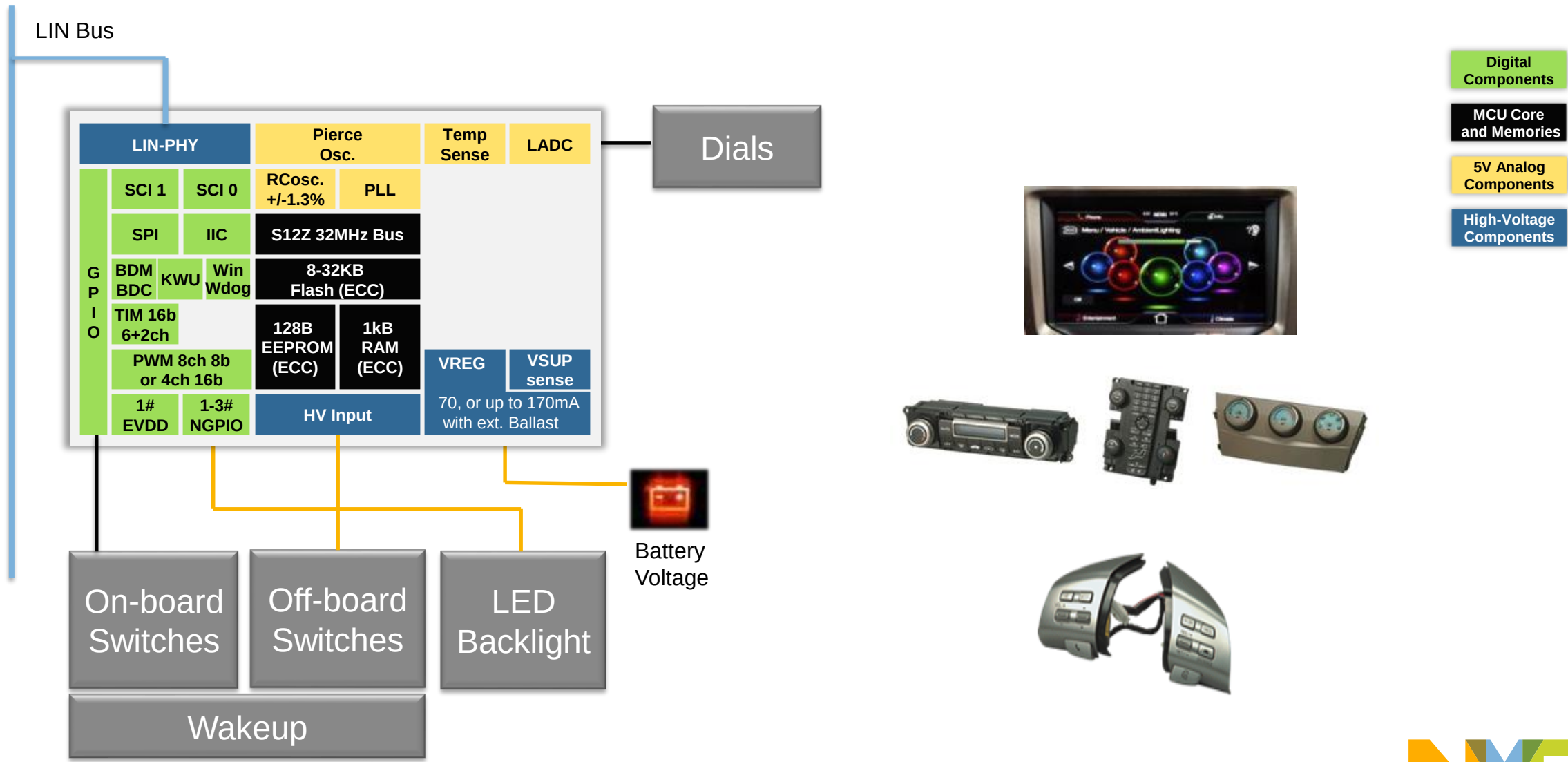


压力传感器

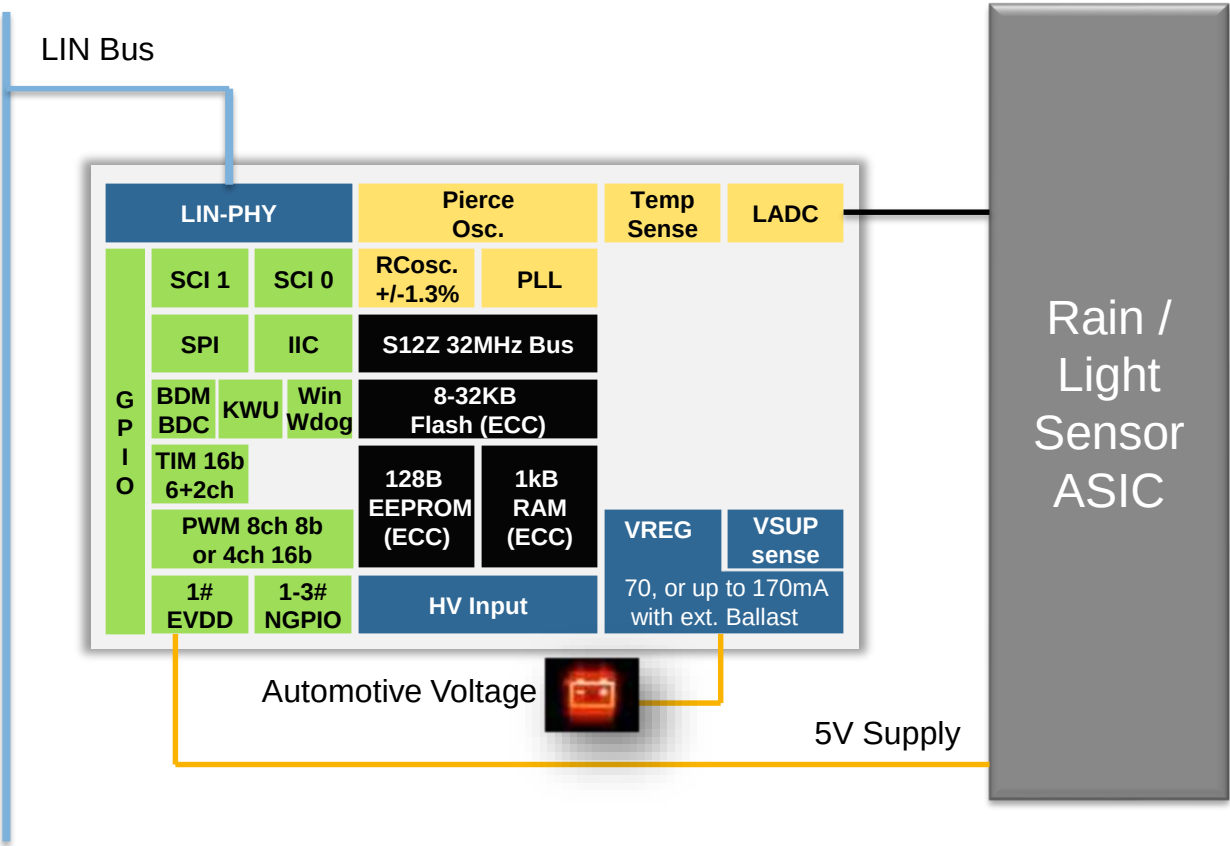
MCU主要用于信号的处理以及LIN (CAN) 通信



传感器类 – S12ZVL用于开关面板应用

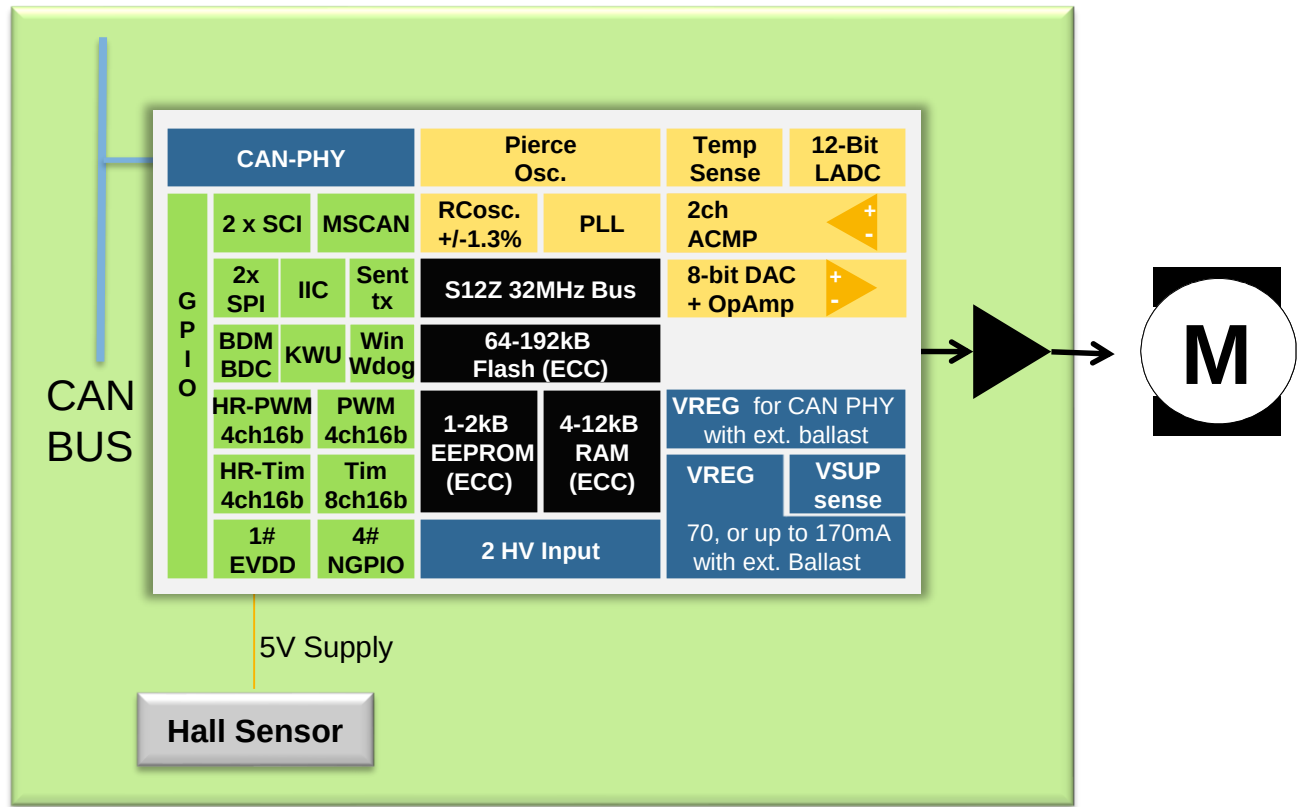


传感器类 – S12ZVL用于雨量传感器



http://www.bmw.com/com/en/insights/technology/technology_guide/articles/rain_sensor.html

传感器类 – S12ZVC用于安全带预紧



S12ZVC benefits:

- CAN-based (LIN too slow)
- Limited PCB-space
- ASIL-requirements

总结

总结

- MagniV家族 – 集成了高压模拟组件和单片机的一种高度集成方案。主要用于电机控制和传感器的接口，只支持12V系统
- MagniV家族特点 – 减少BOM，减少尺寸，减少成本！不减性能！
- MagniV家族包含S12VR, S12ZVMx, S12ZVMA, S12ZVMB, S12ZVC, S12ZVL系列，是一个庞大的家族，可以满足各种不同的需求
- MagniV的开发环境很友善，各种工具和资源非常丰富，可以显著缩短开发时间。比如FreeMASTER, AMMCLIB, MBD, Bootloader, LIN Stack等
- 恩智浦目前有很多基于MagniV的方案，但更多偏向电机部分，包括车窗，各种泵类控制，风扇类控制等，可以覆盖功率从80w一直到1000w。支持单电阻，双电阻FOC控制，以及方波控制等
- 欢迎选择恩智浦，欢迎选择MagniV！