

# Portfolio Public Presentation Business Line AAA Advanced Analog Products

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Distribution Business Development

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October 2018 | EUF-AUT-T3487



SECURE CONNECTIONS  
FOR A SMARTER WORLD

# Analog Enablement Tools



# Analog Freedom/S32K Shield & Tower boards HW alignment

Sigfox SoC Modem Functional Safety SBC

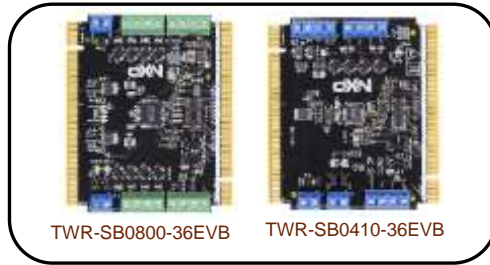


OM2385



FRDMFS6523CAEVM

Valves Controller SoC



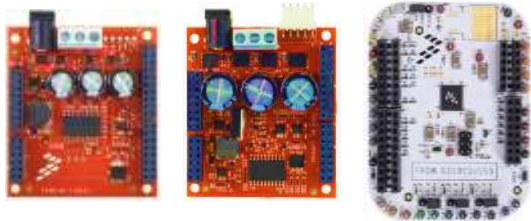
TWR-SB0800-36EVB TWR-SB0410-36EVB

Valve Controller



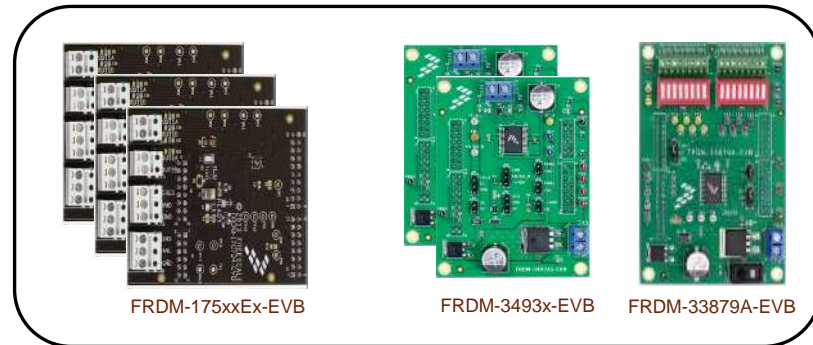
FRDM-SB0410

3-phase BLDC and PMSM Gate Driver



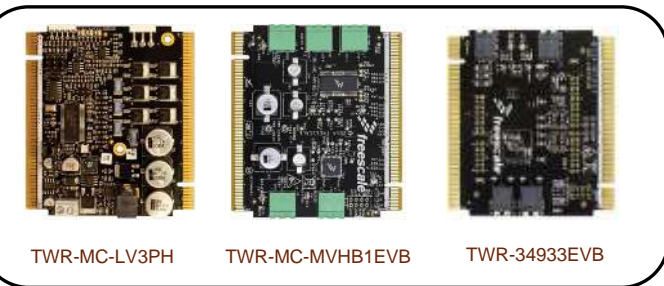
FRDM-MC-LVBLDC FRDM-MC-LVPMSM FRDM-GD3000EVB

Brushed-DC and Stepper Motor H-Bridge Driver



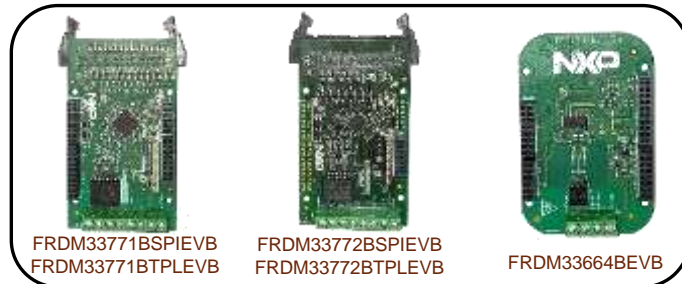
FRDM-175xxEx-EVB FRDM-3493x-EVB FRDM-33879A-EVB

DC & BLDC Motor Control



TWR-MC-LV3PH TWR-MC-MVHB1EVB TWR-34933EVB

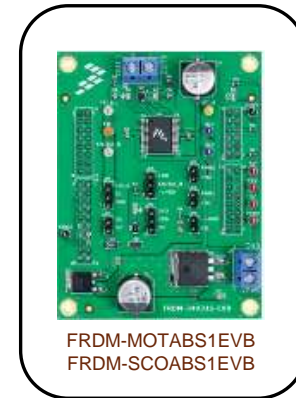
Li-Ion Battery Cell Controller



FRDM33771BSP1EVB FRDM33772BSP1EVB FRDM33772BTP1EVB FRDM33664BEVB

## S32 DEVKIT

Motorbike ABS



FRDM-MOTABS1EVB FRDM-SCOABS1EVB

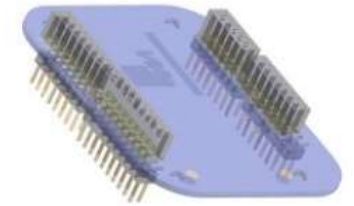
BLDC motor control



DEVKIT-MOTORGD



FRDM – S32 DEVKIT Translator Board



X-DEVKIT-TRANSLT

S32 Communication Kit



DEVKIT-COMM (4 CAN / 6 LIN)

DC motor control



FRDM-HB2000-EVM

**FREEDOM / TOWER**

# Analog Expert Software & Tools – New SW Web Page

Support
Sample & Buy
Training & Events
Developer Resources
Run-time Software
PEG® Graphics Software
Automotive Software and Tools
Intelligent Sensing Framework
Professional Services Software Technology
<b>Analog Expert Software and Tools</b>

SDK Analog Expert Drivers

Configuration and System Evaluation  
Analog Expert Tools



Get started on your embedded software development with the extensive selection of software development tools from NXP and our partners.

### Software and Tools

<b>S32 SDK Analog Drivers (Arm and Power Architecture MCUs)</b> Project examples for Analog ICs SW drivers with Automotive S32 SDK.	<b>System Evaluation GUI tools</b> GUI tools for MCU + Analog system evaluation using FreeMASTER, mbed or other tools.	<b>Kinetis SDK Analog Drivers</b> Project examples for Analog ICs SW drivers with Kinetis® SDK.
<b>Analog EVBs Configuration GUI tools</b> GUI tools for Analog ICs configuration and testing on evaluation boards.	<b>Processor Expert Analog Components</b> Project examples for Analog ICs SW components with Processor Expert Software.	<b>BSP SW for PMICs</b> PMIC SW drivers included inside i.MX or QorIQ Board Support Packages for Linux, Android and QNX.

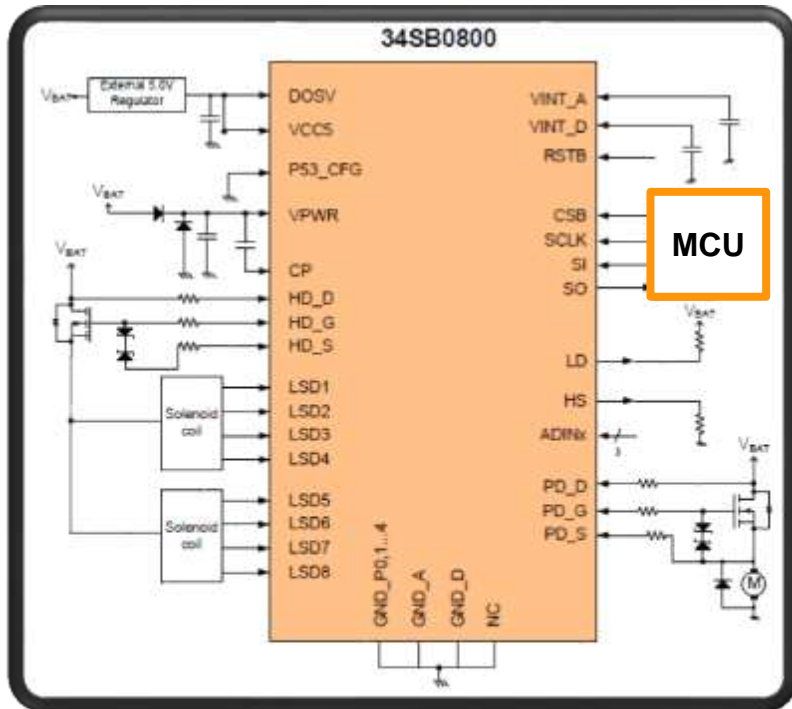
**1 unique Link:**  
**[www.nxp.com/Analog-Expert-SW-Tools](http://www.nxp.com/Analog-Expert-SW-Tools)**



# One Ex: VALVE DRIVER, SW COMPONENT OVERVIEW



MC44SB0800  
MC44SB0400



- Direct Valves Controller **MCU agnostic** Analog software component
  - Supported technology: Processor Expert – **AML** (KSDK 2.0, S32K SDK)
- **MCU cross-sell enablement tools**
  - KL25Z CW10.6 project examples
  - KL25Z, **KL43Z** Freemaster project examples
  - KL25Z, K20, KV31, **KL43Z** KDS project examples
  - KL25Z IAR project example
  - Compatible with KV10, K64, K22, K70
  - Projects Compatible with **TWR-SB0800-36EVB** & **TWR-SB0410-36EVB**
- **Fast & Easy customer complex system enablement**
  - Control and monitoring up to 12 outputs
  - Safety features (watchdog w/ challenger, protections & diagnostics)
  - Flutter frequency to prevent valves friction

# Discover the Device with FreeMASTER

The screenshot displays the FreeMASTER software interface for a Valve controller. The main window is titled "Valve controller" and shows the following components:




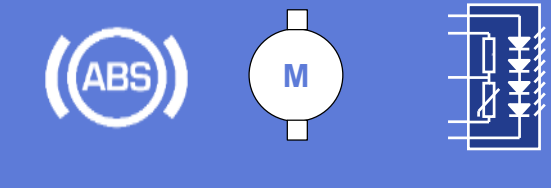
- Supervision Status:** A grid of status indicators for various faults, including Reset Pin (Fault Indication), DOSV Undervoltage, VPWR overvoltage, VCCS Undervoltage, VPWR undervoltage, Vint\_D and Vint\_A Undervoltage, GND\_D loss detection, Internal Clock Fault, Overtemperature warning, External Reset, Monitoring Fault, and Watchdog Fault. A "Clear Faults" button is located at the bottom of this section.
- Low-side Drivers for inductive Loads:** A section with tabs for LSD 1, LSD 2, LSD 3, and LSD 4. It includes a "Control Mode: Current Regulation" dropdown, a "Target Current" slider set to 0 mA, and a "Converted PWM Duty" gauge set to 100% (255/255). Below these are status indicators for Overcurrent, Open Load, Overtemperature, VDS Detection, and Current Regulation Error.
- HS for Fail-safe Switch (LSD Main Switch):** A section with "On" and "Off" buttons and status indicators for Overcurrent and Leakage Detected.
- PI Regulator Settings:** A section with dropdown menus for P Characteristic (1.0), I Characteristic (0.125), and Integrator Limit (1023).
- Measurements:** A row of five gauges labeled Vcp\_vpwr, Vint D, Vint A, Vpre 10, and Vpre 12.

The interface also features a Project Tree on the left, an Application Console at the bottom left showing a list of commands, and a Variable Watcher at the bottom right. The Freescale Semiconductor logo is visible in the top right corner of the main window.

# Advanced Analog Portfolio Summary



# Advanced Analog Distribution Portfolio

Networking	Connectivity	Energy & Power Mgmt	Smart Power Driver
<ul style="list-style-type: none"> <li>• CAN FD / PN</li> <li>• Isolated CAN</li> <li>• LIN, quad LIN SPI Bridge</li> <li>• Networking SBC</li> <li>• FlexRay PHY*</li> <li>• 100BASE-T1 Ethernet PHY</li> <li>• Gigabit Ethernet switch</li> </ul>	<ul style="list-style-type: none"> <li>• Switch monitoring Interface</li> <li>• Wireless IoT sub-GHz Xceiver – Sigfox, ZigBee*</li> <li>• Audio codec</li> <li>• RKE/PKE secure car access*</li> <li>• Automotive NFC*</li> </ul>	<ul style="list-style-type: none"> <li>• System PMICs ➤ i.MX, Layerscape, FPGA</li> <li>• Safety SBC</li> <li>• Single cell Li-Ion charger</li> <li>• Intelligent battery sensor</li> <li>• Li-Ion battery cell AFE</li> <li>• Alternator regulator*</li> </ul>	<ul style="list-style-type: none"> <li>• DC/stepper motor driver</li> <li>• BLDC motor gate driver</li> <li>• Smart Hi/Lo switches</li> <li>• Valve/Pump controller SoC</li> <li>• Auto LED buck/boost</li> <li>• Motorcycle braking SoC</li> <li>• Prog. solenoid controller</li> <li>• Small engine EFI controller</li> </ul>
			

## MCU Cross Selling Enablement Tools

FRDM & TWR HW boards	Analog Expert MCU/MPU SDK SW drivers	Evaluation GUI & SW example code
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\* Selective Engagement



# Networking



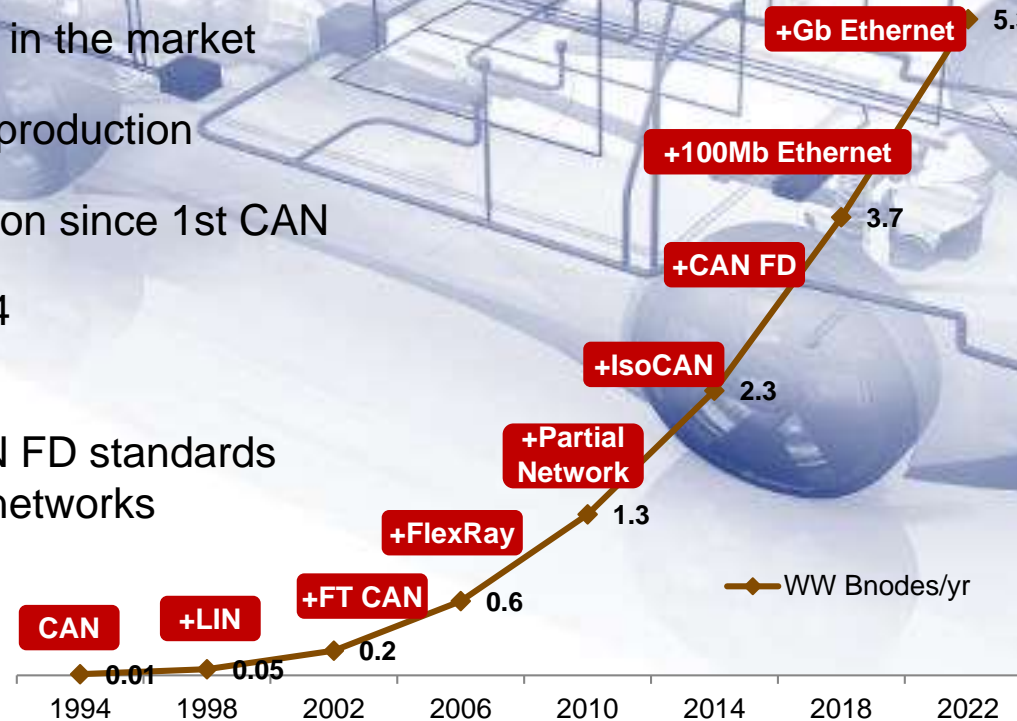
# The In-Vehicle Network enables innovation in cars

## NXP driving a growing market

- +15%** Node CAGR from 2006 to 2022
- 10** NXP nodes in each new car
- 6B** Total NXP nodes in the market
- 50** Part numbers in production
- 20** Years of production since 1st CAN
- <<1** PPM during 2014

### Unique competence

- Driving Ethernet, CAN FD standards
- Co-developing OEM networks



## Enabling new systems

- High bus speed -> autonomous drive, consumer connectivity
- High bus voltage -> electrification, energy efficiency

## More than communication

- Power configuration
- End-of-line programming
- Safety and Security

## Allowing efficiency

- Saving components
- Saving energy
- Simplifying manufacturing
- Allowing scalability, re-usability

# CAN in non-Automotive applications



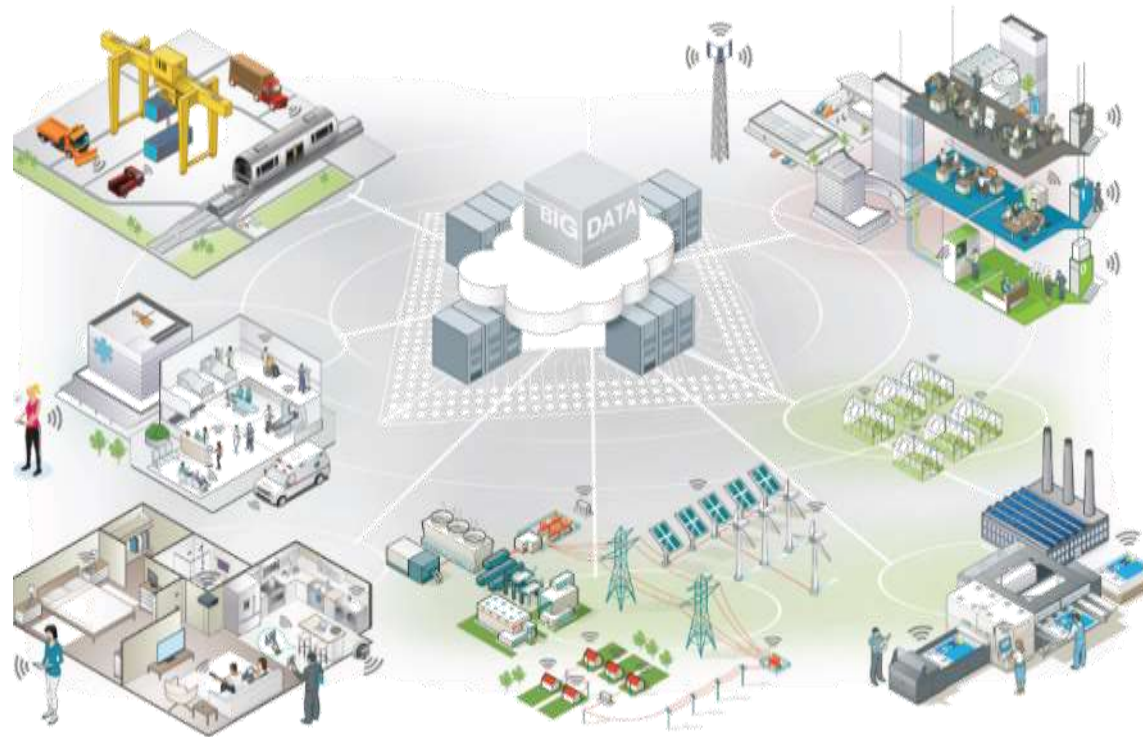
## Industrial Transportation

Heavy Machinery  
Forklifts  
Farm Equipment  
Trains  
Buses

SAE J1939

## Connected Consumer

Wearables  
ePOS  
Drones  
Medical devices  
eBikes  
Asset tracking



## Building Control

HVAC  
Elevators  
Access / Security  
Automation  
Surveillance

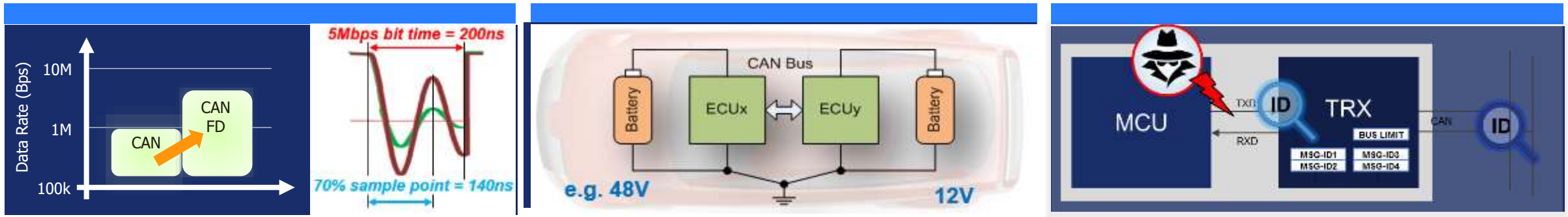
## Factory Automation

PLC I/O  
Safety Systems  
Robotics  
Motor Drives

## Energy Conservation

Energy Storage  
Converters  
Smart metering  
Tools & Appliances





**Mainstream CAN Transceiver** | **Future-proofing CAN modules of today**  
 where CAN remains dominant bus

Analog innovation Digital innovation

Design freedom @2Mbps and 5Mbps

Simplify mild-hybrid and BMS

Drop-in, basic cyber-protection

# CAN Portfolio 1/2

## NXP HS-CAN PORTFOLIO - STANDARD FUNCTIONS:

Battery System	MCU voltage	Basic	Standby	Dual-Standby
12V Optimised <i>Passenger Vehicles</i>	5V	TJA1057G IN PRODUCTION	TJA1044G IN PRODUCTION	TJA1046 IN PRODUCTION
	3V3 Pin 5: VIO	TJA1057G/3 IN PRODUCTION	TJA1044G/3 IN PRODUCTION	
Full 24V Support <i>Commercial Vehicles</i>	5V	TJA1051 IN PRODUCTION	TJA1042 IN PRODUCTION	TJA1059 IN PRODUCTION
	3V3 Pin 5: VIO	TJA1051/3 IN PRODUCTION	TJA1042/3 IN PRODUCTION	

## NXP HS-CAN PORTFOLIO - ADVANCED POWER MODES:

	Sleep	Partial Networking	FD-Passive
12V and 24V Support	TJA1043 IN PRODUCTION	TJA1145 IN PRODUCTION	TJA1145/FD IN PRODUCTION

**ADVANTAGES:**

- Parts internally dual sourced
- Chokeless EMC performance
- HVSON package option available
- Max 1Mbps bit rate for HS-CAN
- Supports max 2 / 5Mbps CAN FD



# CAN Portfolio 2/2

New Releases

## NXP HS-CAN PORTFOLIO - VeLIO COMPLIANT HS-CAN:

12V Optimised  
Passenger Vehicles

Standby (PIN 5: n.c.)	Standby (PIN 5: VIO)	Dual-Standby
<b>TJA1044V</b> IN PRODUCTION	<b>TJA1044V/3</b> IN PRODUCTION	<b>TJA1046V</b> IN PRODUCTION

Full 24V Support  
Commercial Vehicles

Standby (PIN 5: SPLIT)	Standby (PIN 5: VIO)	
<b>TJA1049</b> IN PRODUCTION	<b>TJA1049/3</b> IN PRODUCTION	<b>TJA1059</b> IN PRODUCTION

## ISOLATED HS-CAN:

### ISO CAN

<b>TJA1052i</b> IN PRODUCTION
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## LEGACY CAN FUNCTIONS:

Fault-Tolerant CAN	Single Wire CAN	CAN Controller
<b>TJA1055</b> IN PRODUCTION	<b>MC33897</b> IN PRODUCTION	<b>SJA1000</b> IN PRODUCTION

### ADVANTAGES:



Parts internally dual sourced



Chokeless EMC performance



HVSON package option available



Max 1Mbps bit rate for HS-CAN



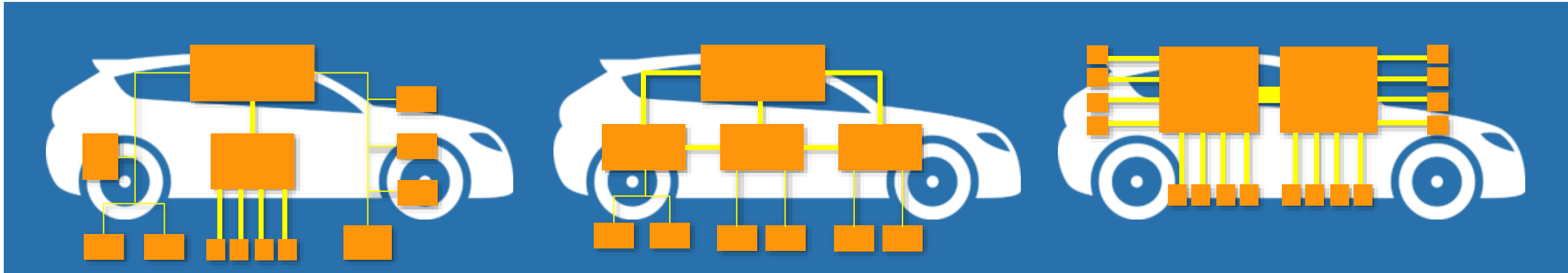
Supports max 2 / 5Mbps CAN FD

# FUTURE IVN ARCHITECTURES TO ENABLE AUTONOMOUS DRIVING

(a) Enhanced Multi-Branch

(b) Processor Backbones

(c) Centralized (Service)



## Bigger Central Module(s)

- Most ECUs still **app-specific**
- **Gateway** adding **processing tasks**
- Evolutionary approach: “plug-in” ADAS network on traditional car

## Hierarchy on Processing Duties

- **Smaller** sensor/actuator modules
- **Multi-app** or Proximity controllers
- **Central MPUs** for Deep Learning
- Extended **cross-domain backbone**

## Highly Virtualized System

- Redundant central servers
- **Unprocessed data** highways
- **Real-time** cloud interaction
- AI-based autonomous vehicle

# NXP Ethernet Portfolio: The Auto-Native Portfolio

## Flexible, Scalable Solution

### TJA1101

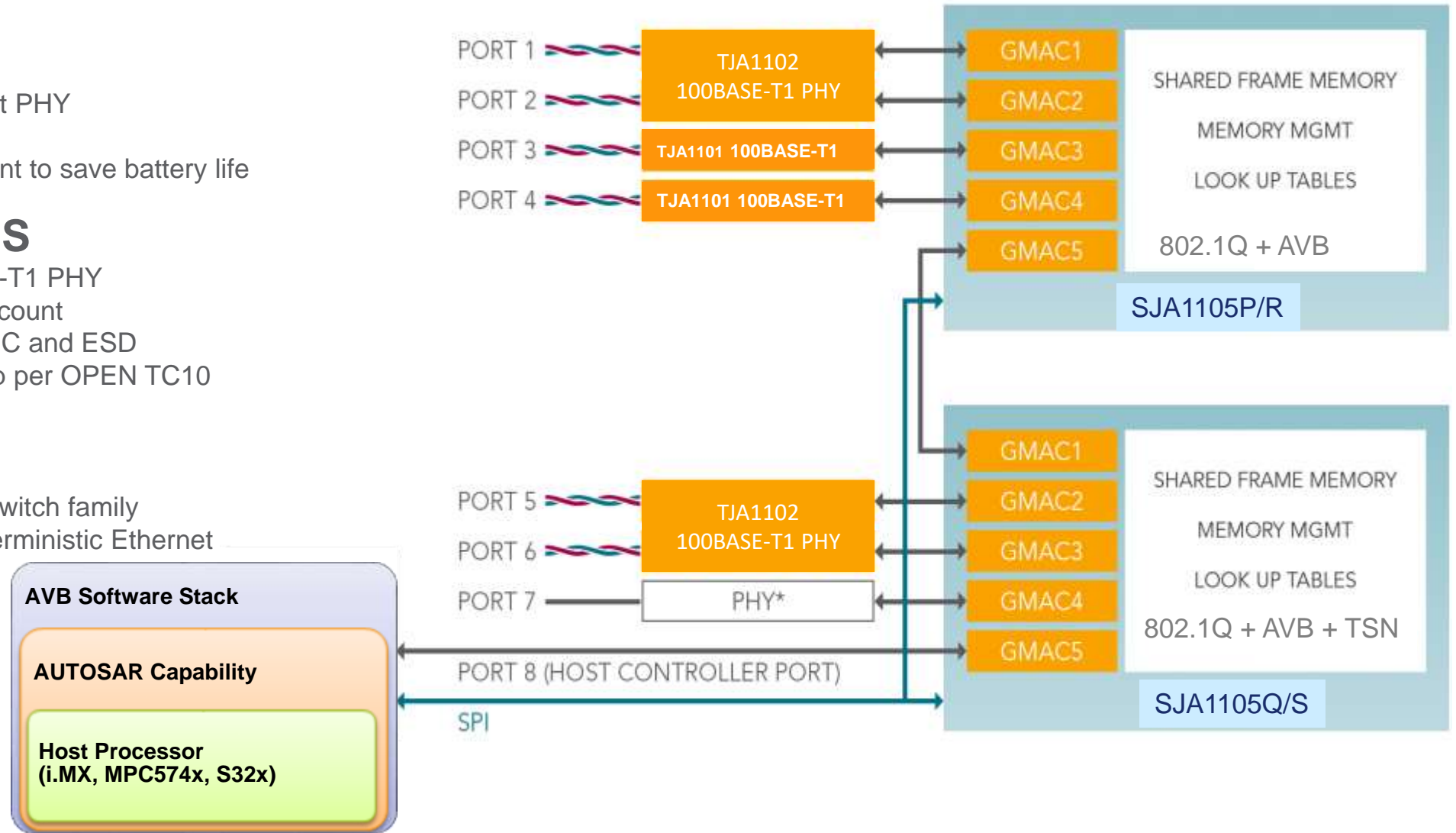
- IEEE 100BASE-T1 Compliant PHY
- Fully automotive qualified
- Enhanced Power Management to save battery life

### TJA1102 / TJA1102S



- Dual / Single IEEE 100BASE-T1 PHY
- Minimal external component count
- Robust automotive grade EMC and ESD
- Standardized Sleep/Wake-Up per OPEN TC10

### SJA1105P/Q/R/S

- Layer 2 Store and Forward Switch family
- Supports AVB, TSN and Deterministic Ethernet
- 10/100/1000 Mbps interfaces
- MII/RMII/RGMII/SGMII Interface
- Port Mirroring and VLAN support (IEEE 802.1Q and IEEE 802.1P)



# TC-10 enabled 100BASE-T1 PHYs: TJA1102 & TJA1101

Features	TJA1102 / S Production	TJA1101 Production 
PHY	<ul style="list-style-type: none"> <li>• <b>Dual or Single</b> 100BASE-T1 PHY</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Single</b> 100BASE-T1 PHY</li> </ul>
Package	<ul style="list-style-type: none"> <li>• HVQFN56 <b>8x8mm<sup>2</sup></b> 0,5mm pitch, wettable flanks</li> </ul>	<ul style="list-style-type: none"> <li>• HVQFN36 <b>6x6mm<sup>2</sup></b> 0,5mm pitch, wettable flanks</li> <li>• <b>HLQFP48 – 7x7mm<sup>2</sup> variant</b></li> </ul>
Supply	<ul style="list-style-type: none"> <li>• Single 3.3V supply operation</li> <li>• <b>optional ext. 1,8V supply</b></li> <li>• <b>Improved power consumption</b></li> </ul>	<ul style="list-style-type: none"> <li>• Single 3.3V supply operation</li> <li>• <b>optional ext. 1,8V supply</b></li> <li>• <b>Improved power consumption</b></li> </ul>
Low Power modes	<ul style="list-style-type: none"> <li>• <b>OPEN TC10 compliant Low-power sleep mode &amp; wake-up</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>OPEN TC10 compliant Low-power sleep mode &amp; wake-up</b></li> </ul>
Unique features		<ul style="list-style-type: none"> <li>• <b>Designed to support ASIL-A</b> </li> </ul>
MDI Port Filtering	<ul style="list-style-type: none"> <li>• <b>No external EMC filter and ESD diode</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>No external EMC filter and ESD diode</b></li> </ul>
Interface	<ul style="list-style-type: none"> <li>• MII and RMII support</li> <li>• <b>Digital Reference Clock Input</b></li> <li>• Polarity Detection &amp; Correction</li> </ul>	<ul style="list-style-type: none"> <li>• MII and RMII support</li> <li>• <b>Digital Reference Clock Input</b></li> <li>• Polarity Detection &amp; Correction</li> </ul>

All NXP PHYs are qualified for AEC Q-100 Automotive Grade1

The OPEN Alliance spec supports the controlled link shutdown to selectively deactivate parts of the network and a global wake-up within an Ethernet network.

First ISO26262 compliant PHY in the market!  
Safety manual available on DocStore

# NXP Ethernet Switches

Features	Production SJA1105/ SJA1105T	Production SJA1105P/ SJA1015Q	Production SJA1105R/ SJA1105S
Package	LFBGA159 12x12mm2 0,8mm pitch		
Ports	<ul style="list-style-type: none"> <li>• 5x MII/ RMII / RGMII</li> <li>• RGMII <b>2v5</b> IO (no internal delay line)</li> </ul>	<ul style="list-style-type: none"> <li>• RGMII <b>1.8/2.5/3.3V IO</b>, with integrated <b>delay line</b></li> </ul>	<ul style="list-style-type: none"> <li>• 4x MII/ RMII / RGMII</li> <li>• 1x <b>SGMII</b></li> </ul>
AVB/ TSN	<ul style="list-style-type: none"> <li>• Full AVB Hardware Spec</li> <li>• TSN/Scheduled Traffic (SJA1105T only)</li> <li>• TSN/Per-stream policing* (*pre standard)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>TSN</b> features on SJA1105Q only</li> </ul>	<ul style="list-style-type: none"> <li>• <b>TSN</b> features on SJA1105S only</li> </ul>
Configuration	Via SPI and external host controller		
Other Features	<ul style="list-style-type: none"> <li>• Hash-based look-up table (LUT)</li> <li>• Port/priority BW policing</li> <li>• Full VLAN support VLAN tag editing</li> <li>• Frame mirroring and diagnostic Features</li> </ul>	<ul style="list-style-type: none"> <li>• Non-conflicting address Look-up table (LUT)</li> <li>• LUT with extended security features</li> <li>• MAC address <b>white &amp; black-listing</b></li> <li>• <b><u>Double VLAN</u></b> tag support</li> </ul>	

## Features Delta Comparison



# SJA1105P/Q/R/S vs SJA1105 and SJA1105T

	Features	SJA1105	SJA1105T	SJA1105P	SJA1105Q	SJA1105R	SJA1105S	Benefits
Package and Interfaces	Operating temperature range: -40°C to +105°C (Automotive Grade 2)	●	●	●	●	●	●	Flexible ECU design by: <ul style="list-style-type: none"> <li>support for any type of Ethernet PHY such as <b>100/1000BASE-T1</b> and <b>1000BASE-TX</b></li> <li>up to four cascaded switches controlled by a single host</li> </ul>
	LFBGA159 12x12mm <sup>2</sup> , 0,8mm pitch	●	●	●	●	●	●	
	MII (3V3)/RMII (3V3)/RGMII (3V3) interfaces	●	●	●	●	●	●	
	MII/RMII/RGMII (all 1V8, 2V5, 3V3) interfaces			●	●	●	●	
	RGMII internal delay line			●	●	●	●	
	SGMII interface					●	●	
	Pin compatibility	●	●	●	●	○	○	
Software compatibility	●	●	○	○	○	○		
Switching	Hash based L2 look up table	●	●	●	●	●	●	<ul style="list-style-type: none"> <li>Fine-grained control forwarding decisions in the network</li> <li>Powerful debugging and diagnostic capabilities</li> </ul>
	TCAM-based frame filtering			●	●	●	●	
	Double VLAN tagging support			●	●	●	●	
	RMON RFC 2819 Ethernet counters			●	●	●	●	
	VLAN-based egress tagging/un-tagging	●	●	●	●	●	●	
Frame mirroring and diagnostic features	●	●	●	●	●	●		
AVB/TSN	Credit-based shaping blocks for IEEE802.1Qav	10	10	16	16	16	16	Key hardware features to enable the implementation of fully synchronized network for: <ul style="list-style-type: none"> <li>lip-synched playback of audio and video streams</li> <li>data-transmission scheduling for TSN networks</li> </ul>
	IEEE802.1AS time stamping support	●	●	●	●	●	●	
	TSN IEEE802.1Qbv: time aware shaping		●		●		●	
	TSN IEEE802.1Qci* (pre-standard): per-stream policing		●		●		●	
Security	Ingress rate limiting on a per-port and per-priority basis for unicast/multicast and broadcast traffic	●	●	●	●	●	●	Provisions for: <ul style="list-style-type: none"> <li>authentication of the nodes connected to the network</li> <li>limit the data generated by one or more connected devices.</li> </ul>
	Port reachability limitation and disabling address learning setting	●	●	●	●	●	●	
	MAC address white & black listing			●	●	●	●	
	Support for IEEE 802.1X-based authentication mechanism	●	●	●	●	●	●	
	Learn process with "one-shot" option			●	●	●	●	

# Connectivity



# OI2385 / OL2361

## Sigfox soc



# OL2385 - System-on-Chip Sigfox Solution

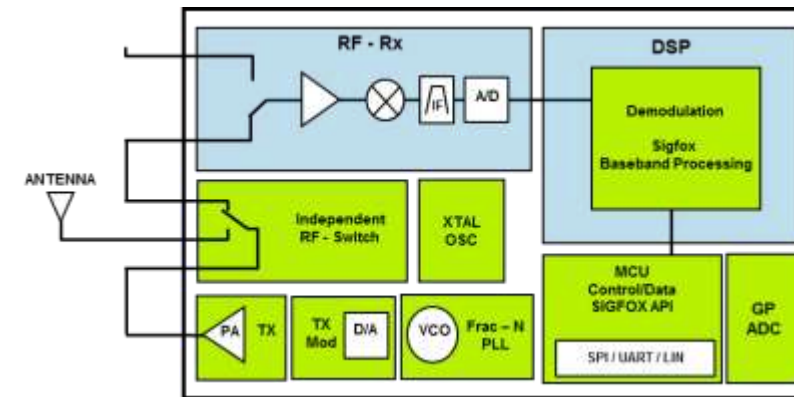
System-on-Chip Sigfox Solution with best RF performances, low BOM cost and ultra low-power

## Differentiation

- Best in class **RF performance** and **low BOM cost**
  - -128 dBm FSK sensitivity @ 600 bps
  - Excellent Phase Noise allows easy add-on of external PA
  - Good blocking performance and strong image rejection (**no SAW filter**)
  - Reference design **with TCXO**
- Ultra **low-power**
  - Tx current at 14 dBm: **29 mA** / receive mode: 10 mA

## Features

- **System-on-Chip** HW and SW solution
  - **Pre-loaded Sigfox modem** SW with ID & PAC numbers
  - 16-bit RISC integrated  $\mu$ C & DSP core
  - Multiple ISM zones support (ETSI, FCC, LATAM, JPN,...)
- Sigfox approved **reference design**
- HVQFN48 package; temperature range: -40 °C to + 85 °C



IC: 7x7mm



module: 15x15mm

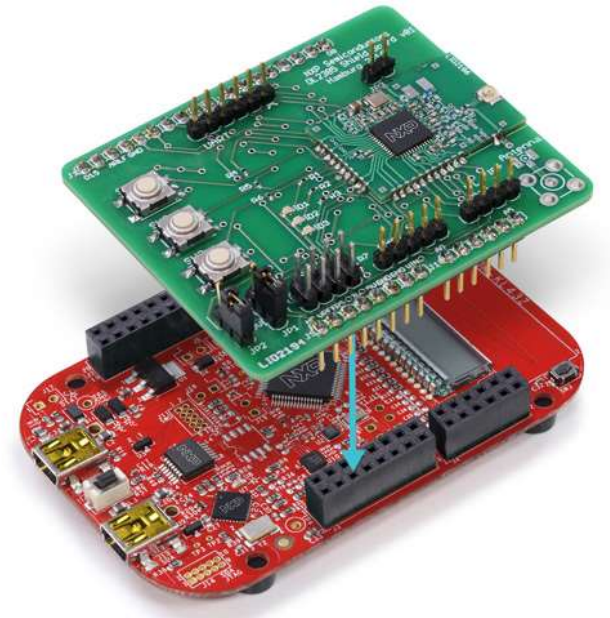


## Applications

- Water metering, electricity metering, smart building management, renewable energy monitoring
- Automotive & fleet management
- Smart irrigation, weather stations, wind monitoring
- Road side management, parking slot monitoring
- Home alarm system, smoke detector
- Smart button, connected defibrillators

# OM2385: SIGFOX Development Kit with KL43Z MCU

- Orderable on-line for \$99 at [nxp.com](https://www.nxp.com)  
[order here](#)
- Kit Contains
  - OL2385 Arduino shield board
  - Freedom KL43Z MCU board (*pre-loaded with demo application SW sending accelerometer sensor data, temperature and luminance*)
  - Quick reference card (*how to activate kit*)
  - USB A-to-MiniB cable
  - Antenna
- On-line resources
  - Instructions to activate Sigfox account with ID and PAC (two years pre-paid platinum subscription)
  - Hardware and software user guides
  - Downloadable example demo code to be used with Kinetis Design Studio IDE tool (free)
  - Printed Circuit Board, bill of material and design files





# Energy & Power Management

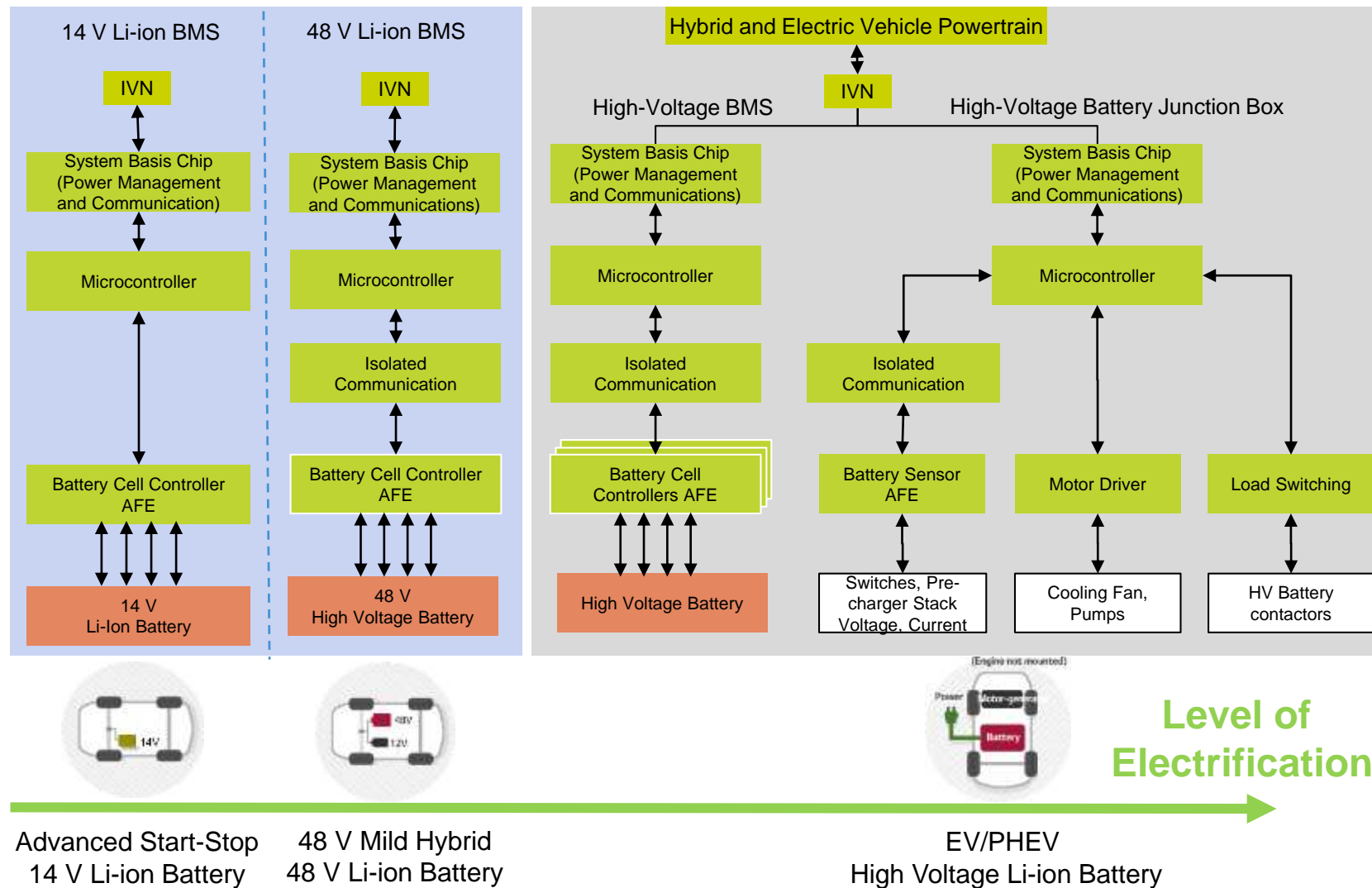


# Li-ion Battery Cell Controller



# Automotive Li-ion BMS Application Overview

- MC33664
- MC33771B
- MC33772B



# Battery Cell Controllers – Main Features Overview

- **Cell Voltage Monitoring**
  - MC33772 - 3 to 6 cells
  - MC33771 - 7 to 14 cells
- Total **stack** voltage measurement
- **Current Measurement and Coulomb Counter**
  - From some  $\mu\text{A}$  to several 1000A (shunt resistor)
- **Synchronized** Cell Voltage/Current measurement
- **Temperature Sensing**
  - 1 internal temperature, up to 7 external temperatures
- **Cell Balancing**
  - Onboard 300mA passive cell balancing with diagnostics
- **Functional Verification and Diagnostics**
  - Designed to support **ISO26262**, up to **ASIL-D** safety capability
- **4.0 Mbps SPI** or **Isolated 2.0 Mbps** Communication for Daisy Chain capability
- **Significant Reduction in BOM & Overall System Cost**



**Automotive Qualification** in compliance with **AEC-Q100**

# NXP MC33771/2B Battery Cell Controller Solution

## Differentiating Points

### Battery Topology Flexibility

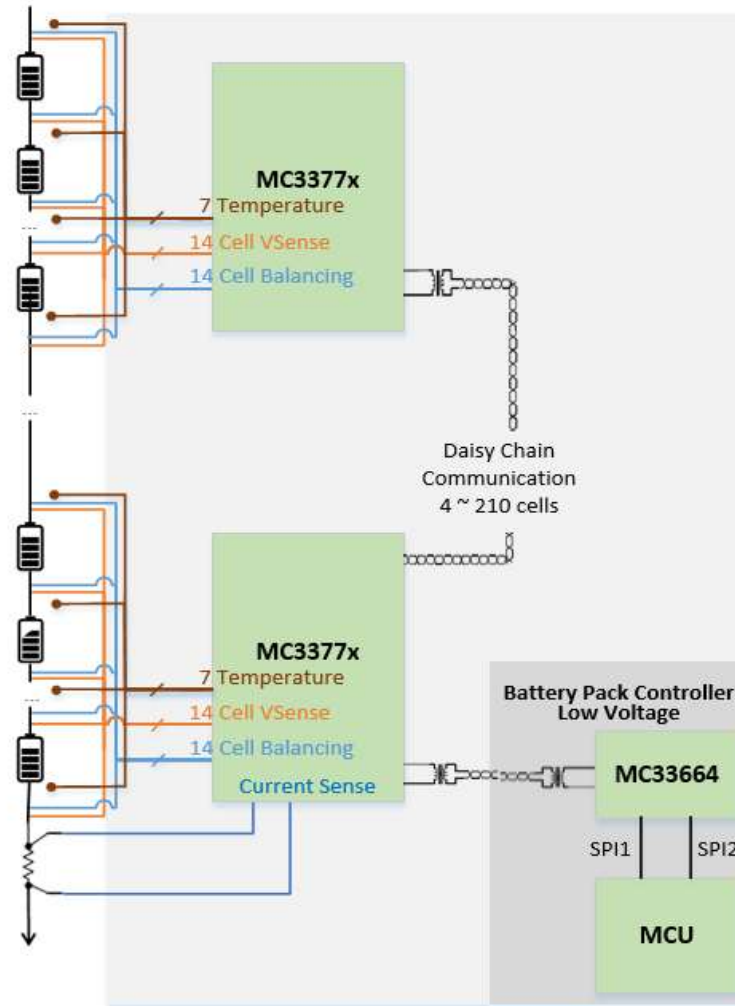
- Scalable SW & HW compatible BMS solution supporting **3 to 210 cells** per **daisy chain**
- MC33771B (7 to 14 cells) & MC33772B (3 to 6 cells) fully compatible
- Supporting Centralized, Distributed Daisy Chain, Distributed CAN

### High integration level

- **Synchronized** on-chip current sensor
- Synchronized on-chip coulomb counter
- Integrated passive **balancing** (**300mA** per ch)
- Integrated Power Supply

### Fast & robust communication & DAQ

- **4.0Mbps** SPI or isolated **2.0Mbps** differential communication with transformer
- 3.6 ~ 4.1ms for sending command and read back **96** cell 16-bit voltage data



### High measurement accuracy

- Voltage measurement accuracy **after soldering and aging within full operation Voltage & Temperature range**
- $\pm 0.5\%$  total stack voltage measurement
- $\pm 0.5\%$  accuracy integrated current sensor

### Diagnosis and functional safety supporting ISO26262 w/ single chip

- Single chip **ASIL C / D** capable
- Sleep mode OV/UV and temperature monitor
- **>40** integrated **safety mechanisms** detecting internal and external faults

### Automotive robustness

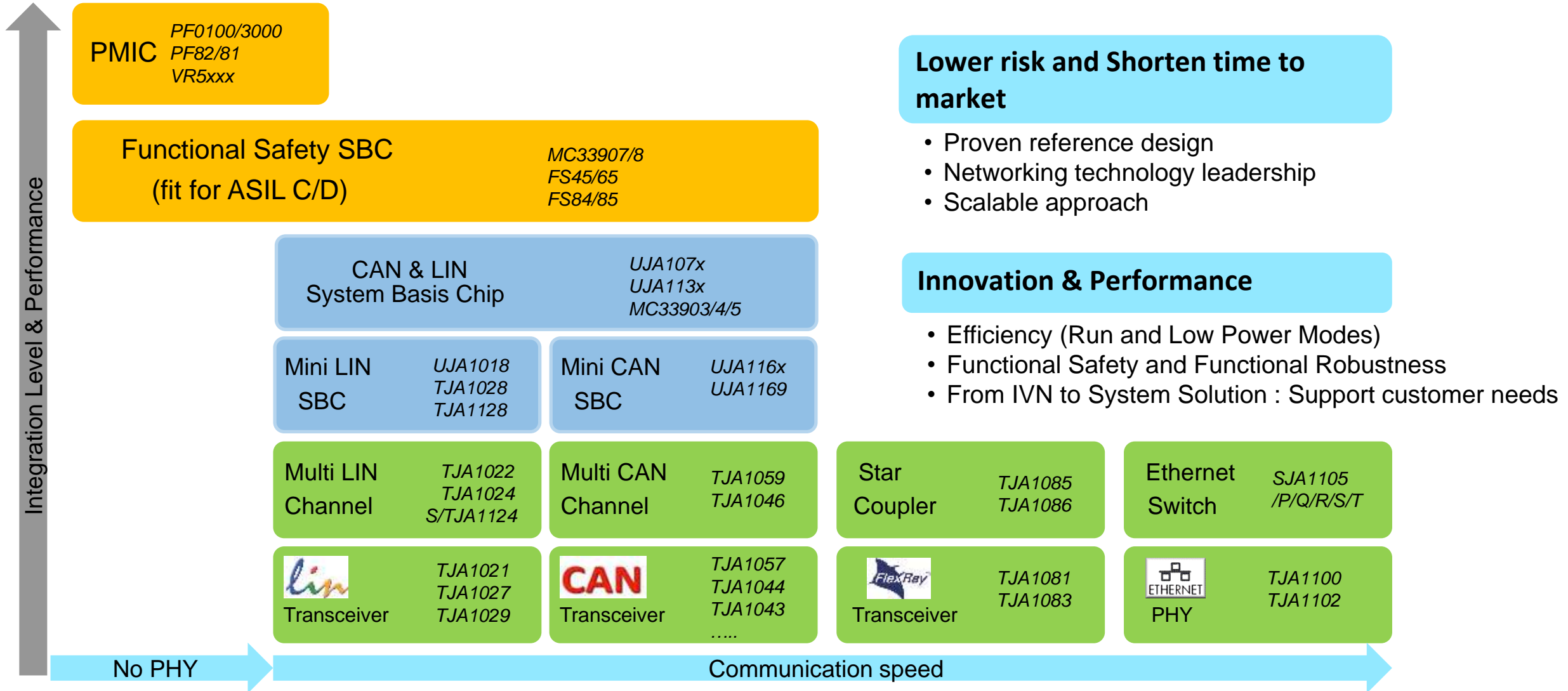
- ESD, EMC; Hot Plug, AEC-Q 100
- Temp range:  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$
- Operational Low Power Mode

# System Basis Chips IC





# CAN Leadership to Safe System Power Management



**Lower risk and Shorten time to market**






- Proven reference design
- Networking technology leadership
- Scalable approach

**Innovation & Performance**

- Efficiency (Run and Low Power Modes)
- Functional Safety and Functional Robustness
- From IVN to System Solution : Support customer needs



# Body Peripherals/General purpose SBC Selection

 <b>Mini SBC CAN or LIN</b> 	 <b>Mid Range SBC CAN &amp; LIN</b>	 <b>Power SBC CAN&amp;LIN</b>
<div style="display: flex; justify-content: space-around;"> <div data-bbox="191 521 300 592"> </div> <div data-bbox="522 456 794 621"> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div data-bbox="71 635 412 731" style="background-color: #90EE90; padding: 5px; text-align: center;"> <b>TJA1028 Family</b> </div> <div data-bbox="479 635 820 731" style="background-color: #90EE90; padding: 5px; text-align: center;"> <b>UJA116x(A) Family</b> </div> </div> <ul style="list-style-type: none"> <li>• <b>LIN only</b></li> <li>• 5V <b>LDO</b>, 70mA</li> <li>• HVSON8</li> </ul> <ul style="list-style-type: none"> <li>• <b>CAN only</b></li> <li>• 5V <b>LDO</b>, 100mA</li> <li>• HVSON14</li> </ul>	<div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div data-bbox="917 471 1108 578"> </div> <div data-bbox="1159 471 1375 585"> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div data-bbox="891 621 1133 721" style="background-color: #90EE90; padding: 5px; text-align: center;"> <b>UJA107xA Family</b> </div> <div data-bbox="1159 621 1388 721" style="background-color: #90EE90; padding: 5px; text-align: center;"> <b>UJA1169 Family</b> </div> <div data-bbox="1414 621 1656 721" style="background-color: #90EE90; padding: 5px; text-align: center;"> <b>MC33903/4/5 Family</b> </div> </div> <ul style="list-style-type: none"> <li>• CAN only or CAN &amp; LIN</li> <li>• 5V or 3,3V <b>LDO</b>, 250mA</li> <li>• Ext. PNP option</li> <li>• HTSSOP32 or HVSON20 or SOIC32EP</li> </ul>	<div style="display: flex; justify-content: center; margin-top: 10px;">  </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div data-bbox="1732 621 2076 721" style="background-color: #FFD700; padding: 5px; text-align: center;"> <b>UJA113x(FD) Family</b> </div> <div data-bbox="2102 621 2446 721" style="background-color: #90EE90; padding: 5px; text-align: center;"> <b>MC33909 Family</b> </div> </div> <ul style="list-style-type: none"> <li>• CAN &amp; LIN</li> <li>• 5V or 3,3V <b>SMPS</b>, 500mA</li> <li>• Several add-on features</li> <li>• HTQFP48 or LQFP48EP</li> </ul>
<div style="display: flex; align-items: center; margin-top: 10px;"> <div data-bbox="191 1092 529 1192" style="background-color: #000080; color: white; padding: 10px; text-align: center;"> <b>TJA1128 Family</b> </div> <div data-bbox="547 1085 751 1235"> </div> </div>		

**In Production**

Available for ordering

**In Development**

Project and timing committed.

**Approved Concept**

Product concept committed internally.  
Indicative timing only

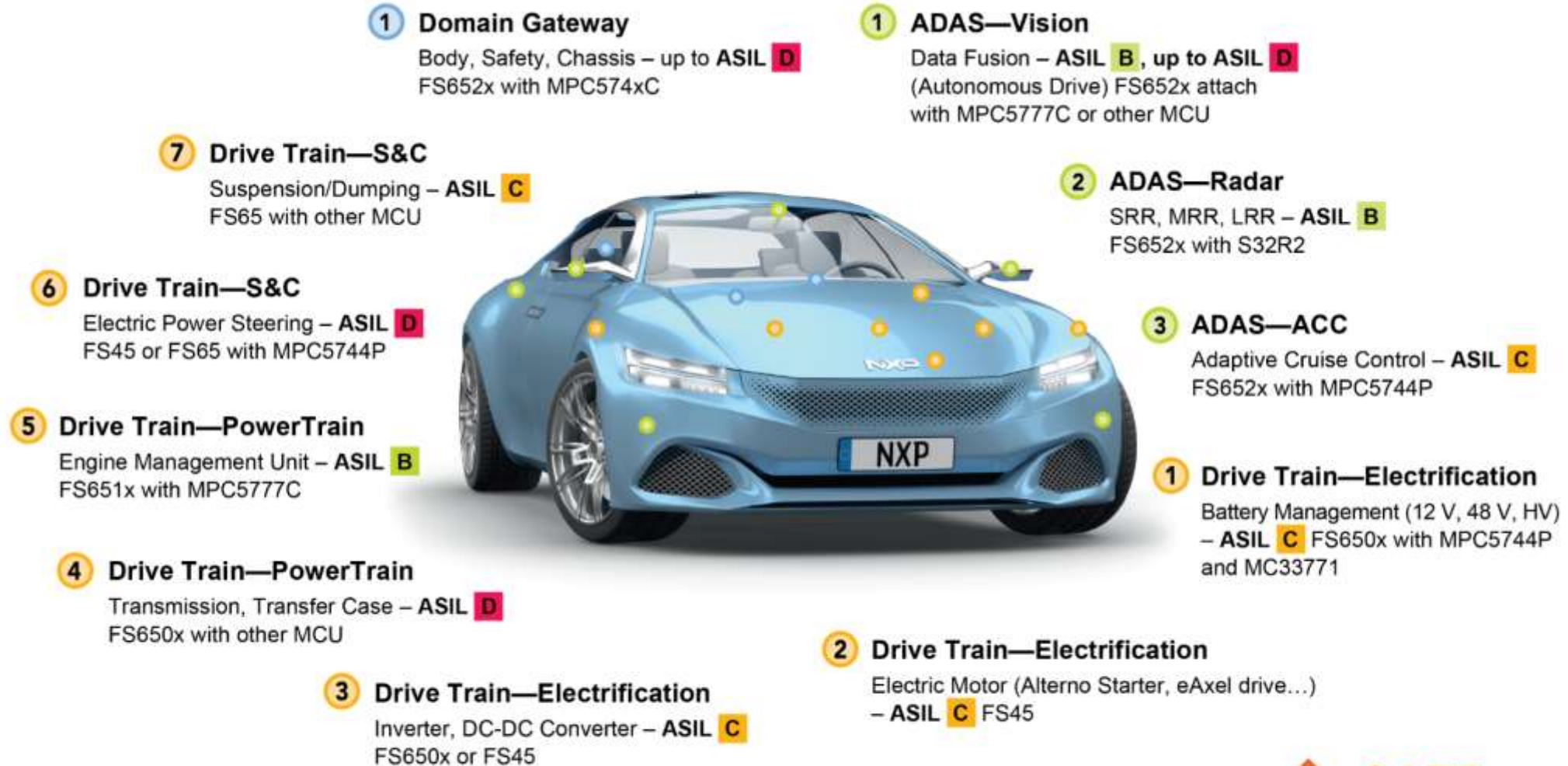
# Body Applications SBC Overview

Types	Features & Options																
	Sleep Mode	Iq $\mu$ A	Vbatt Sense	MCU Supply internal	Supply with ext PNP	VIO	External 5V Supply	AMUX	CAN PHY	Partial Networking	LIN	SPI	Watch Dog	INH	LIMP	WAKE	Package size
<b>UJA107xA</b>	Y			250mA 5V or 3.3V	250 mA	-	-	-	t.b.d.	-	up to 2	Y	O		Y	2	HTSSOP32 6.1 x 11 mm
<b>MC33903</b>	Y	15	Y	150 mA 5V or 3.3V	400 mA	P/N	-	Y	Y (std)	-	up to 2 (P/S/D)	Y	Timeout Window Random		Y Safe	up to 4	SOIC32 7.5 x 11 mm
<b>MC33904/5</b>	Y	15	Y	150 mA 5V or 3.3V	400 mA	P/N	Yes Ext PNP	Y	Y (std)	-	0 or 1 (904/5)	Y	Timeout Window Random		Y Safe	up to 4	SOIC32 7.5 x 11 mm
<b>UJA1161 / UJA1162</b>	O			-	-	Y	-	-	FD Active 2 Mbps	-	-	-	-	O	-	1	HVSON14 3 x 4.5 mm
<b>UJA1163 / UJA1164</b>	-			100mA 5V	-	-	-	-	FD Active 2 Mbps	-	-	O	O	-	-	1	HVSON14 3 x 4.5 mm
<b>UJA1167 / UJA1168</b>	Y			100mA 5V	-	-	30 mA (option)	-	FD Active 2 Mbps	O	-	Y	Y	O	-	1	HVSON14 3 x 4.5 mm
<b>UJA1169</b>	Y			250mA 5V or 3.3V	250 mA	O	100mA (option)	-	FD Active 2 Mbps	O	-	Y	Y	-	Y	1	HVSON20 5.5 x 3.5 mm
<b>UJA113x</b>	Y		Y	500 mA 5V or 3.3V	-	-	100mA	-	FD Active 2 Mbps	O	up to 2	Y	Y	-	Y	1	HTQFP48 10 x 10 mm

Y = Supported  
O = Optional (support on some variants)

# Safety USE CASES & ASSOCIATED ASIL Level

Defined by car OEM, supported at HW and SW level by Tier1



ASIL QM A B C D

**SAFE  
ASSURE**  
by NXP

**NXP**

# FS65/FS45 – Functional safety SBC

## Advanced Power Management

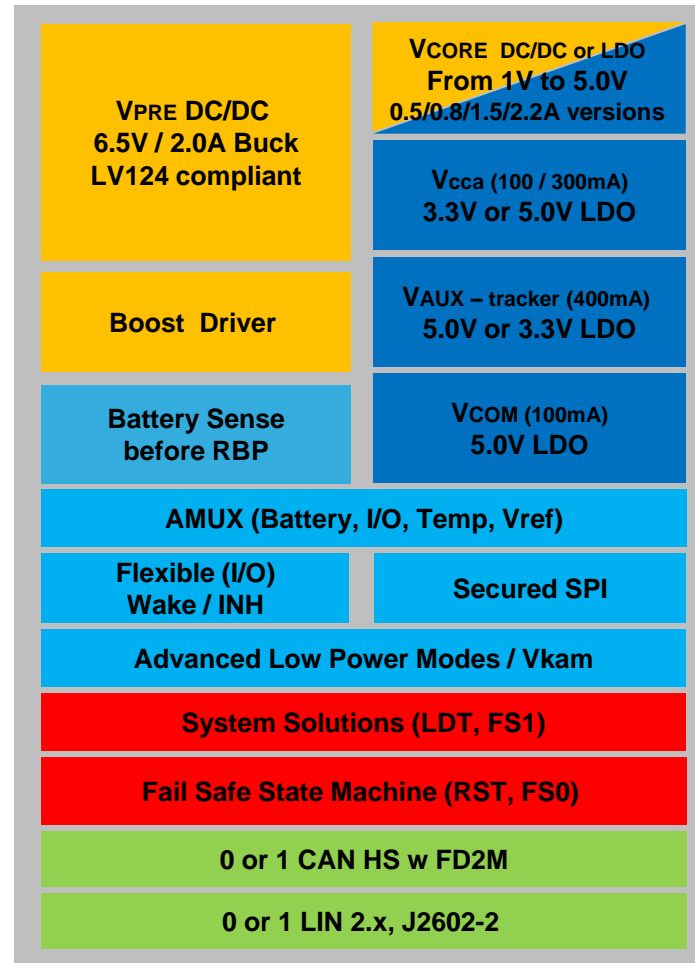
- Buck/Boost Vpre from 2.7 to 36V
- 2.0A / 6.5V Vpre capable
- FS65xx with Vcore 2.4MHz SMPS 0.8/1.5/2.2A
- FS450x with Vcore LDO 0.5A
- Configurable Vcore (external resistor bridge)
- Multiple LDO and Tracker
- Ultra Low Standby Current 30µA

## System Solution

- Analog Multiplexer to sense multiple critical signal
- Small package size :49 mm<sup>2</sup>
- Robust CAN PHY FD 2M
- Configurable I/Os
- Long Duration Timer, Keep Alive memory supply

**SCALABLE**  
Family concept

**PROVEN**  
Designed at OEMs



**SAFE**  
Flexible Fail Silent

**ROBUST**  
PASS 4200h HTOL

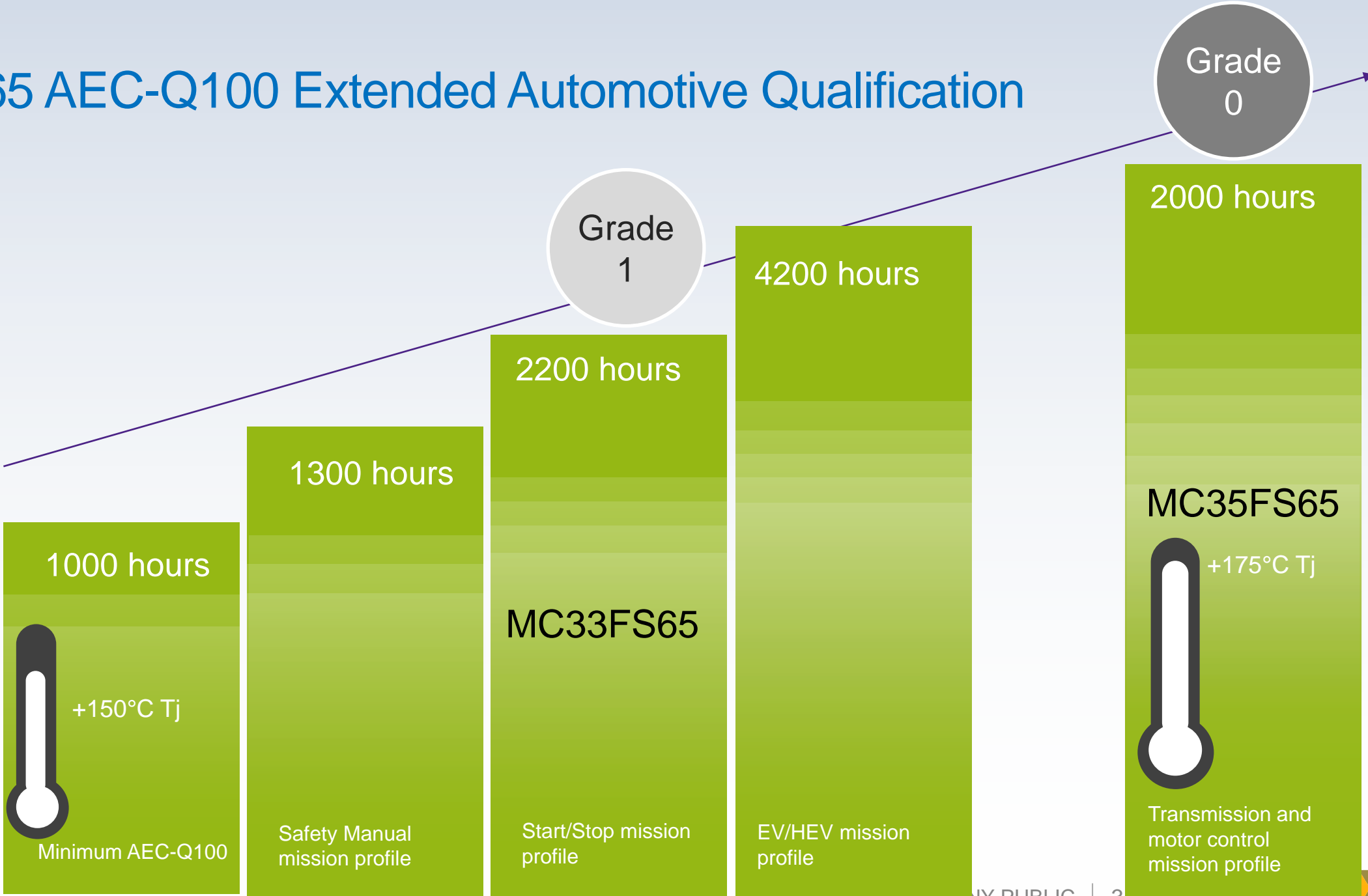
**SIMPLIFIED**  
Tools & Documents

## Independent Safety Monitoring

- **Single Point Failure** : UV/OV Monitoring Unit
- **Latent Failure** : ABIST & LBIST
- **Common Cause Failure** : Independent electrical and physical fail safe circuitry and state machine
- **Reset, Fail Safe** pin to set system in predictive state when system is failing.
- **Configurable Fail Safe State**, while allowing system availability, diagnostic and possible recovery.
- Optional **Fail Silent** operation
- **Second Fail Safe** pin to manage safe delay after failure event
- **Advanced SafeAssure documentation** to fit for safety assessment
- **BOM cost savings** : No need for external MCU challenger
- MCU & external IC **Safety Monitoring**

# FS45/65 AEC-Q100 Extended Automotive Qualification

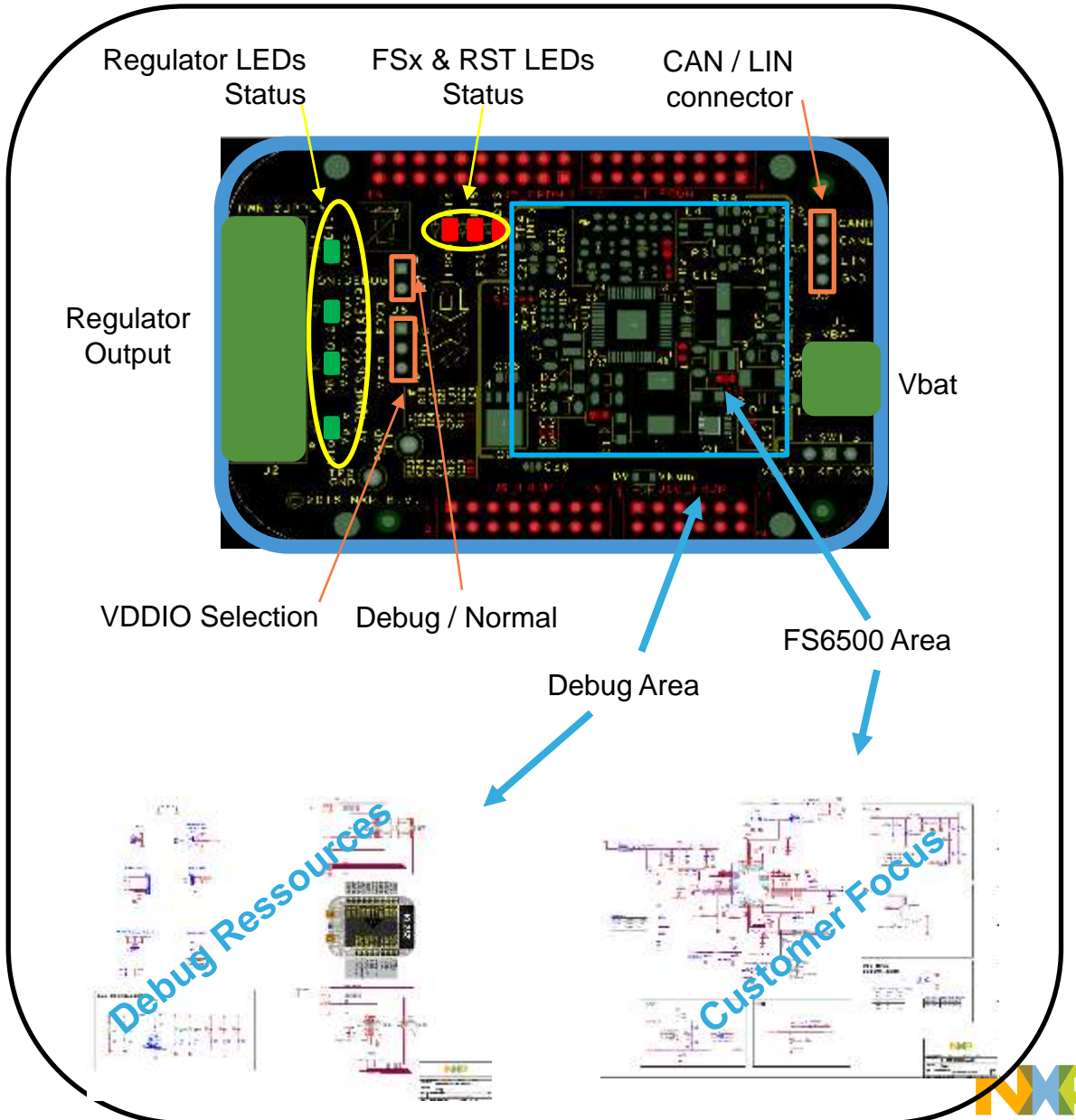
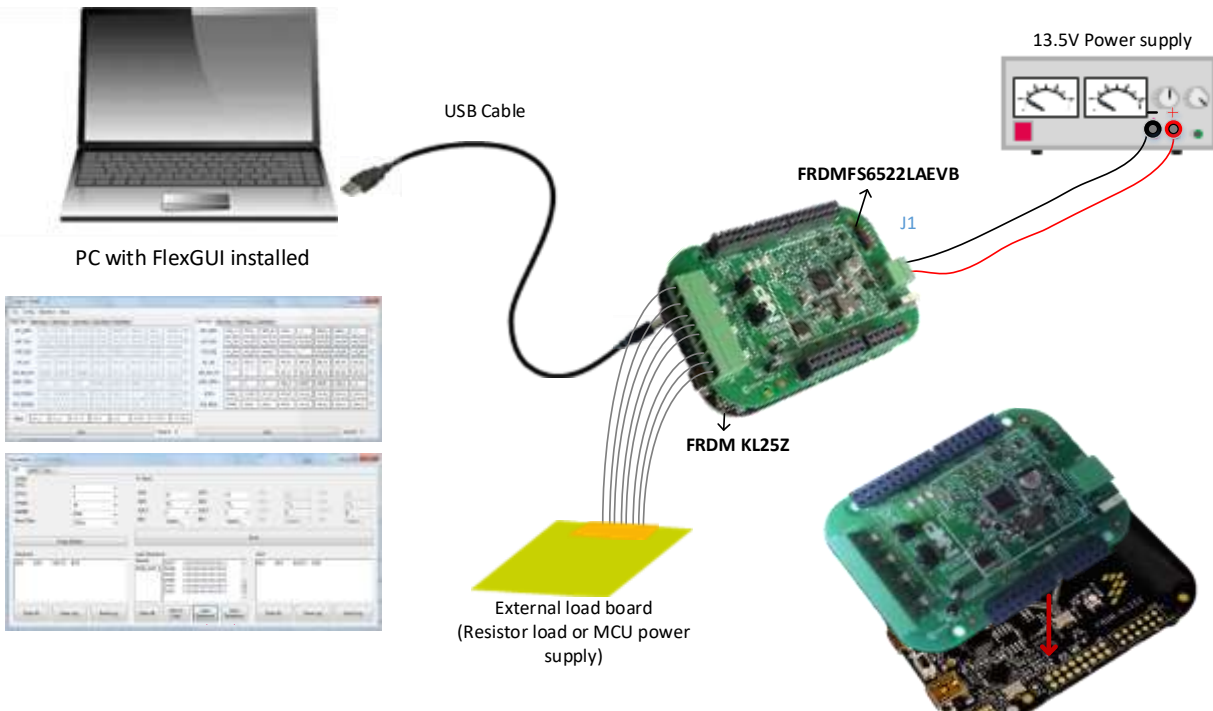
ROBUSTNESS





# FS6500 / FS4500 **NEW** FREEDOM Board

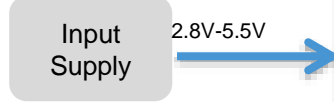
- ❑ FS65 size 33mm x 33mm
- ❑ Support wide range of FS65xx / FS45xx family
- ❑ Close partnership with best in class passive components suppliers (Coil, Capacitor, Diode, Transistor)
- ❑ Low cost evaluation board
- ❑ Arduino compatible



# System Power Management IC



# PMIC Typical Application Diagram with i.MX

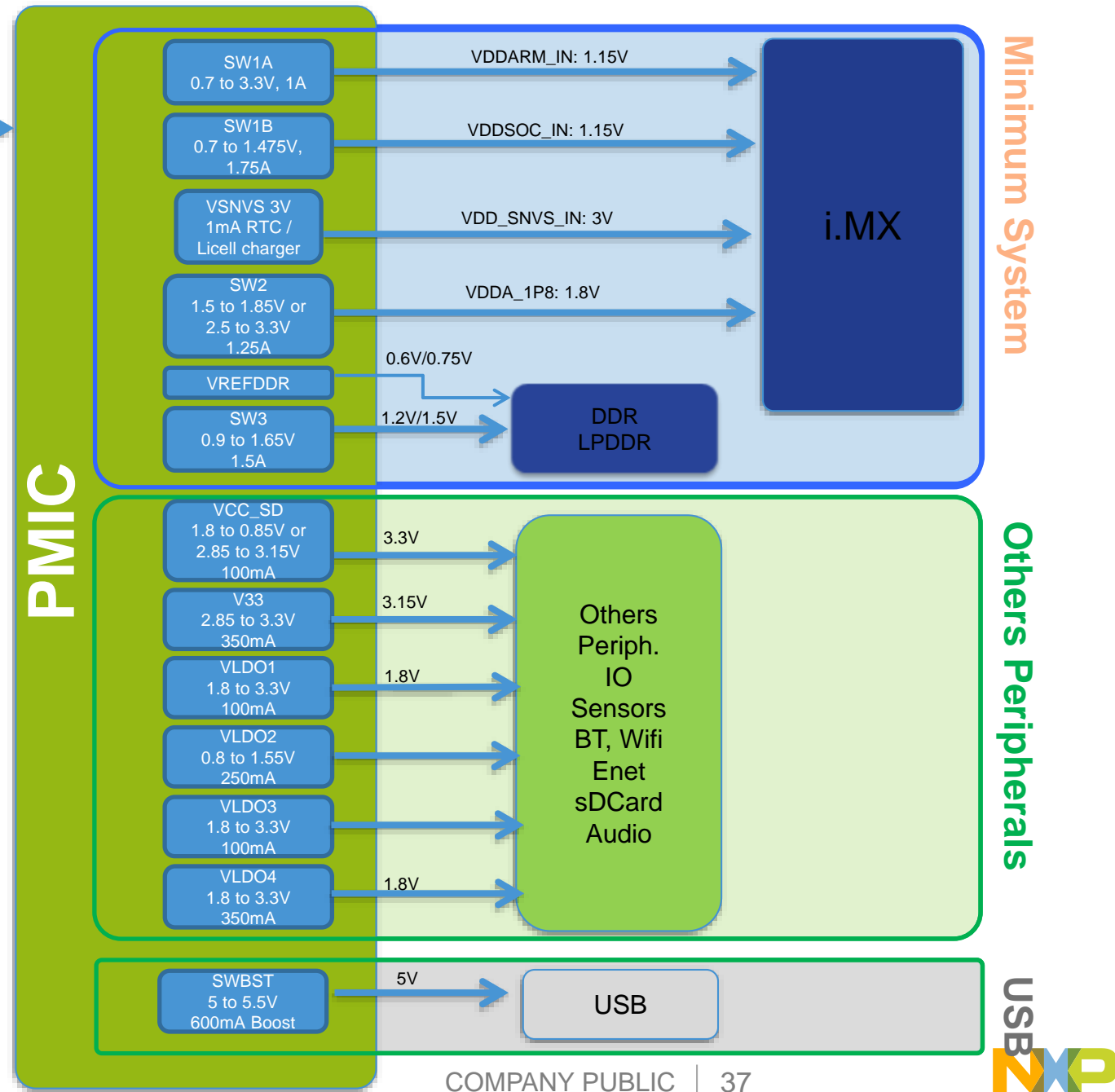


**PMIC supplies all i.MX typical application domain supplies:**

- **MPU + DDR**
  - Manage Low Power mode (DVFS\*)
- **Peripherals:**
  - Radios, memories, sensors
- **USB** which might require BOOST to 5V when input Voltage drop

**PMIC benefits & features:**

- **Proven Robustness lower risk & shorten time to market** (i.MX scalability, BSP)
- **Reduce functional safety development effort** (scalable system level functional safety)
- **Reduce system cost** (OTP try before buy, BOM optimized, scalable architectures)
- **Minimize EMC radiations** (multiple frequency tuning optimization)

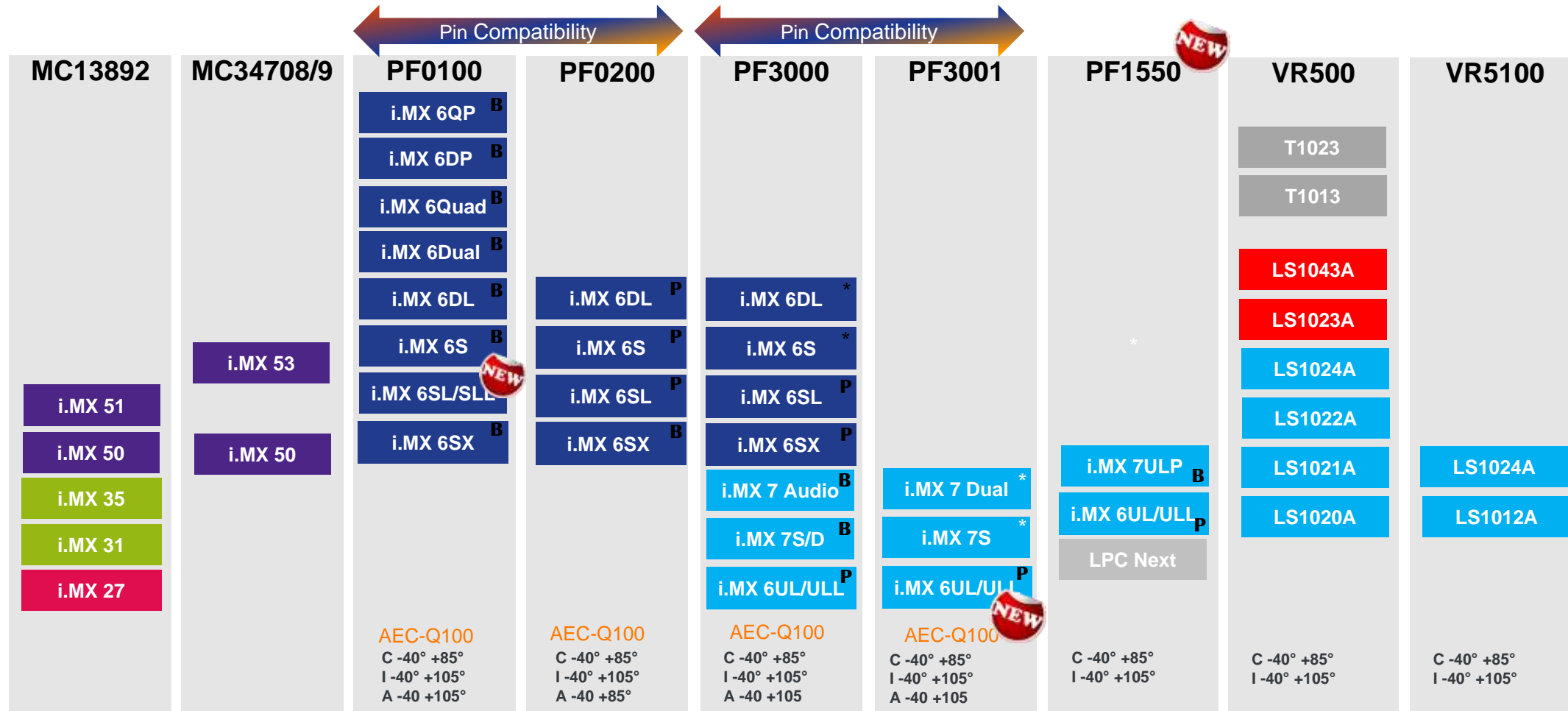


\*DVFS: Dynamic Voltage and Frequency scaling

# Advantages of PMIC vs. Discrete Implementation

Feature	PMIC Benefit	PMIC Implementation	Discrete Implementation
Startup sequence control with BSP support	Total solution (CPU + Power), easy for customer to set up system, <b>shorten the time to market.</b>	<b>Internally programmed by OTP, <u>proven BSP</u></b> and schematic with processors.	Daisy chained or I/O control
Dynamic Voltage Scaling	Easy dynamic power management for <b>low power application case</b> , save BOM.	Internally <b>controlled ramp up and ramp down</b> of voltages. <b>Programmable slew rates.</b>	Needs external components to switch resistor divider. Generally results in large transients during transitions
Heavy & Light load efficiency enhancement	Easy design for <b>low quiescent current</b> application case, <b>better efficiency on the entire load range.</b>	Implemented via <b>different switching modes:</b> <ul style="list-style-type: none"> <li>- Automatic PFM, Pulse Skip selection</li> <li>- Processor selects switching mode depending on system state</li> </ul>	Some discretes have pulse skip modes. Not available in cheaper discretes
Synchronization	Better anti-interference performance, <b>improve EMC</b> performance.	All <b>switching regulators synchronized</b> , while switching frequency and phasing can be optimized.	Available in higher end discretes
PCB area and external components	<b>Save</b> board space	<b>Lower PCB area</b> Very <b>low number of external components</b>	Larger area than PMIC solution 5-6 additional components per regulator
Fault protection	<b>System</b> power <b>protection</b> , as overvoltage, overcurrent, thermal alert <b>Interrupts and status report via I2C.</b>	Available	Not available
Scalability	Fast tailored system (Processor + Memory + PMIC) selection for customers, <b>easy peripherals change, such as memory</b> , etc.	PF0100/PF0200/PF3000 scale with processor power levels	Generally means redesign of power solution
Auto grade support	Reliable qualification.	<b>AEC-Q200</b> Test pass	-
Coin cell input	For application case with coin cell	<b>Available</b>	Not available

# PMICs for i.MX & QorIQ Processors



**B** = BSP Available or Under Development

**P** = Patch Available or under Development

**\*** = i.MX Support in Some Use Cases, Contact NXP

C = Consumer  
I = Industrial  
A = Automotive

ARM11

Cortex-A8

Cortex-A7

ARM9

Cortex-A9

Cortex-A5x

# PF3000 Optimized Power Management Solution

Quick-turn programmable 12-ch/7.2A system power management solution enabling Low Power applications

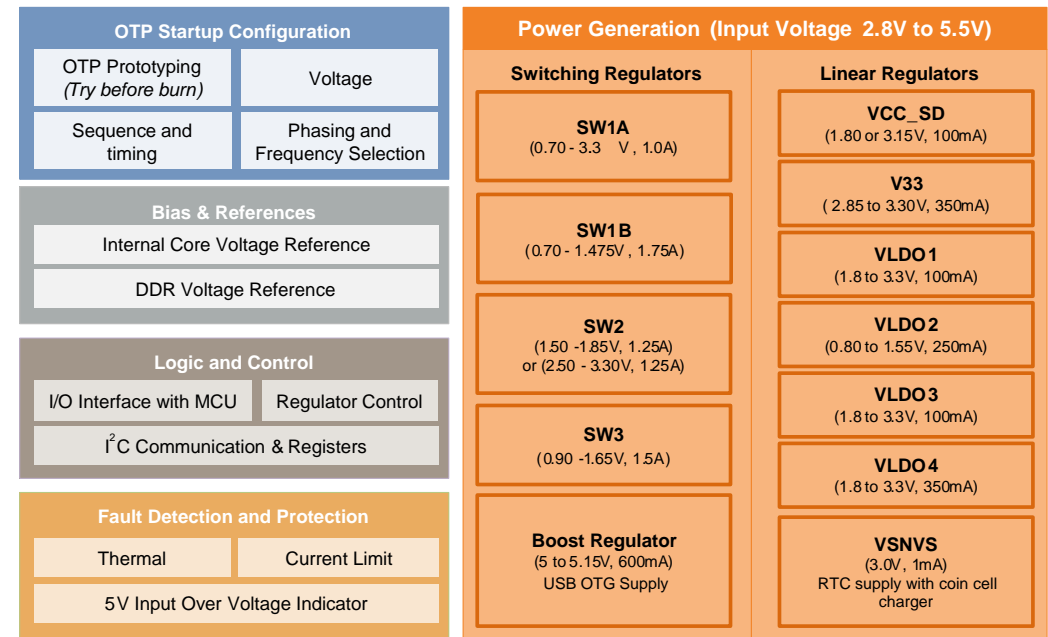
## Differentiating Points

- **Proven** compatibility with i.MX 6/7 processor applications for **reduced** time to market
- Supports **Low power** State Retention Mode for enhanced power performance
- Integrated High-Speed SD Card Dual Voltage Support eliminating the need for external switches
- **23% reduction** in package size over PF0100/PF0200

## Product Features

- Vin **2.8 V** to **5.5 V** Supply. 5 V supply via front End LDO.
- **4** Channel configurable **buck** converters with DVS
- Forced PWM or automatic, PSM operation
- **6** User programmable LDO with Low Power State Retention (LPSR) and Coin cell charger
- Boost regulator & **DDR** reference
- **Programmable** output voltage, current limit, soft-start, Fsw, fault interrupt
- **OTP** with try before Buy mode
- Consumer, Industrial Grades. & **Auto** grades with Wettable flank
- High power 7x7 mm, 48 E-QFN

PF3000 Functional Internal Block Diagram



Support for i.MX 7S/D, i.MX6 SL; SX, & UL  
Patch for i.MX 6SL & SLX  
BSP for i.MX 7: Ready  
BSP for i.MX 6UL: Ongoing



Production: Now  
10Ku price: starting 1.83 \$



# PF3001 Optimized Power Management Solution

Most economical, ready to go 10-ch/6.6A system power management solution enabling **Always ON** application

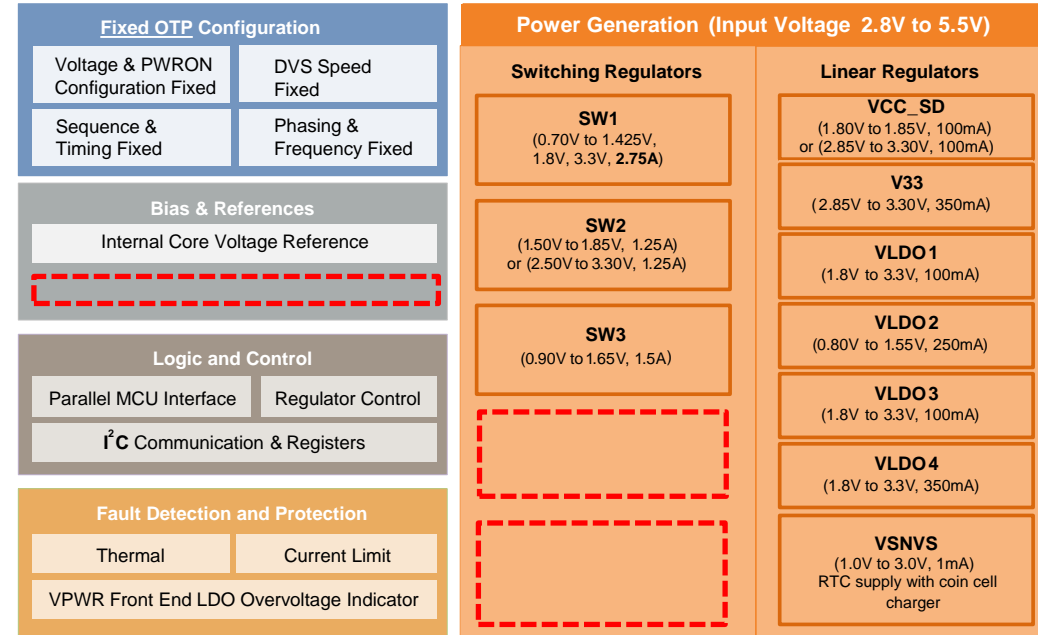
## Differentiating Points

- **Optimized solution for Price sensitive Always ON** application competing with discrete solution
- **Pin to pin compatible** with PF3000
- Integrated High-Speed SD Card Dual Voltage Support eliminating the need for external switches
- Proven compatibility with i.MX6 processor applications. **BSP** for i.MX6UL Under dev.
- Dynamic Voltage Scaling

## Product Features

- Vin **2.8V** to **5.5V** Supply. 5V supply via front End LDO.
- **3** Channel configurable **buck** converters
- Forced PWM, PFM or automatic PSM operation
- **Dynamic Voltage Scaling in Run** mode only
- **6** User programmable **LDO** & Coin Cell Charger
- **Programmable** output voltage, fault interrupt
- **Defined** Start up **Sequence** and **timing**
- Consumer, Industrial Grades. & **Auto** grades with Wetable flank
- High power **7x7mm, 48 E-QFN**

PF3001 Functional Internal Block Diagram



Support for i.MX7S/D, 6SL,6SX, & 6UL  
BSP for 6UL under dev by Third party (4Q)  
BSP Patch under planning



Sample: Use PF3000  
10Ku resale: starting 1.45 \$

# PF3000/1 PMIC EcoSystem

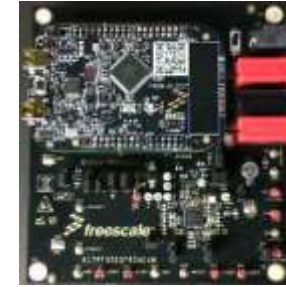
## Fast Evaluation of PMIC's performance

- **Boards for PF3000/1**
  - Generic Family Evaluation & programming Platform based on Freedom KL25Z
  - Friendly Graphical Interface
  - USB interface
- **KITPF3000EVM** board contains Evaluation board + KL25 (Support PF3000 or PF3001. Use appropriate GUI)
- **KITPF3000PGM** board contains programming board + KL25 (PF3000 only)
- **SABRE i.MX 7 + PF3000 + BSP**: Available
- **i.MX 6UL SOM + PF3000**: Orderable on NPI catalog or iWave partner site (Sept)
- **i.MX 6UL SOM+ PF3001**: Orderable on NPI catalog or iWave partner site (Sept)
- **BSP patch** available for i.MX 6SL, i.MX 6SLX i.MX 6UL on AAA internal site

## Complete Technical Documentation available to ease Design

- Datasheets
- EVM GUI and installation documentation
- i.MX 6SL and 6SoloX Apps note with Schematic, Gerber, and config SW
- i.MX 6UL SOM Schematic, Gerber and SW Patch

Eval Board with KL25



Programming board with Socket



i.MX 6UL SOM



i.MX 7 SABRE board

# PF1550 PMIC

Ultra low power and small size optimized for power sensitive i.MX and Kinetis/LPC system applications

## Differentiating Points

- Highly Integrated Solution
  - 6-Supply Rails, Charger, USB PHY LDO, LED Driver, JEITA Temp Control, DPM (Digital Power Management), Fully Programmable
- Efficient power delivery for extended battery life,
  - Ultra Low Power Quiescent Current Mode
  - Ship mode – 400nA
  - Standby Mode (3-SW, 3-LDO on) – 23uA
- Clean Transition between various Operating modes
- Total Solution Size - 38mm<sup>2</sup> (including 5x5mm PMIC)
- Fully proven solution with BSP and reference designs

PF1550 + 6UL SOM



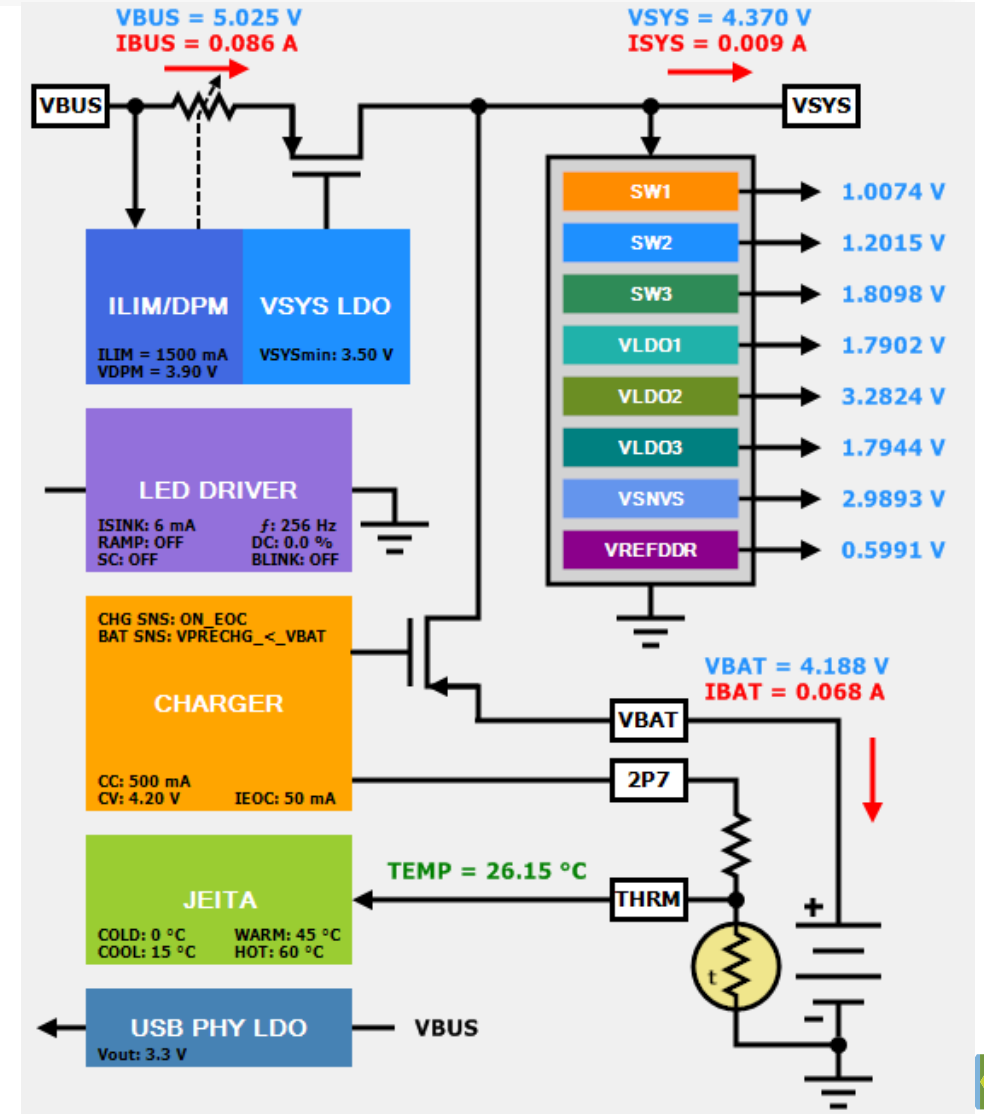
## Product Features

- 3x 1A Buck Regulators, 2x 300mA & 1x 400 mA LDOs
- 1A Li+ Linear battery charger
- RTC Supply, DDR voltage reference
- I2C Interface
- 40°C to 105°C Operating Ambient Temperature
- 5x5mm 40-LD 0.4mm pitch, QFN-EP

## Applications

- Enterprise / Industrial / Medical
- IoT / Home Automation & Control
- Wearables
- Gaming & Accessories

Samples: now  
Production: **Now**



# PF1510 PMIC

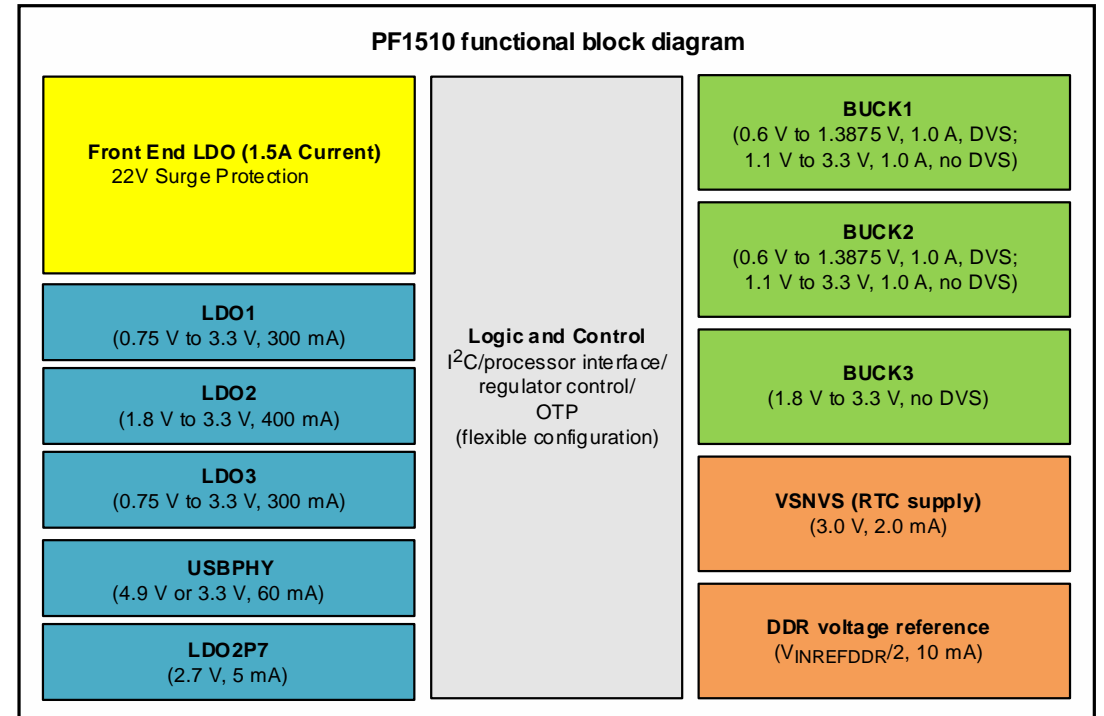
Ultra low cost system solution i.MX and Kinetis system applications

## Differentiating Points

- Highly Integrated Solution
  - 6-Supply Rails, USB PHY LDO, DPM (Digital Power Management), Fully Programmable
- Efficient power delivery for extended battery life,
  - Ultra Low Power Quiescent Current Mode
  - Standby Mode (3-SW, 3-LDO on) – 23uA
- Clean Transition between various Operating modes
- Total Solution Size - 38mm<sup>2</sup> (including 5x5mm PMIC)
- Fully proven solution with BSP and reference designs

## Product Features

- 5Vin Operation w/ Front end LDO
- Three 1A Buck Regulators, Two 300mA LDOs, One 400mA LDO
- RTC Supply, DDR voltage reference
- I2C Interface
- -40°C to 105°C Operating Ambient Temperature
- Pin compatible with PF1550
- 5x5mm 40-LD 0.4mm pitch, QFN-EP



aaa-02.3xxx

## Applications

- Enterprise / Industrial / Medical
- IoT / Home Automation & Control
- POS
- Gaming & Accessories

Samples: now  
Production: **Now**

# PF1550 EcoSystem

## Fast Evaluation of PMIC's performance

- **Boards for PF1550**
  - Generic Family Evaluation & programming Platform based on Freedom KL25Z
  - Friendly Graphical Interface
  - USB interface
- **KITPF1550EVM board contains Evaluation board + KL25**
- **KITPF1550PGM board contains programming board + KL25 (For Internal Use)**

## i.MX + PMIC Reference board

- **i.MX 7ULP Validation Mother Board + SOM (PF1550 daughter board) + BSP: Available**
- **i.MX 7ULP + PF1550 EVK + BSP: Available**
- **i.MX 6UL/ULL + PF1550 EVK + BSP patch: Available**

## Complete Technical Documentation available to ease Design

- Datasheets
- EVM GUI and installation documentation
- i.MX 7ULP and 6UL Apps note with Schematic, Gerber, and config SW

## Third-party tool

- **i.MX6ULL + PF1550 Brillo form factor board from our partner - VVDN**



**KITPF1550EVM board with KL25**



**KITPF1550PGM board  
(PF1550 Programming board  
with Socket)**



**X-ULPLPDDR314IPG  
(i.MX7ULP 14x14 Validation Board  
+ PF1550 daughter board)**



**i.MX 7ULP + PF1550 EVK  
(i.MX7ULP-EVK-SOM)**



**i.MX 6UL/ULL + PF1550 EVK  
(KIT6UL-1550EVM or  
KIT6ULL-1550EVM)**



# PF4210 PMIC Solution for i.MX 8M Processor Systems

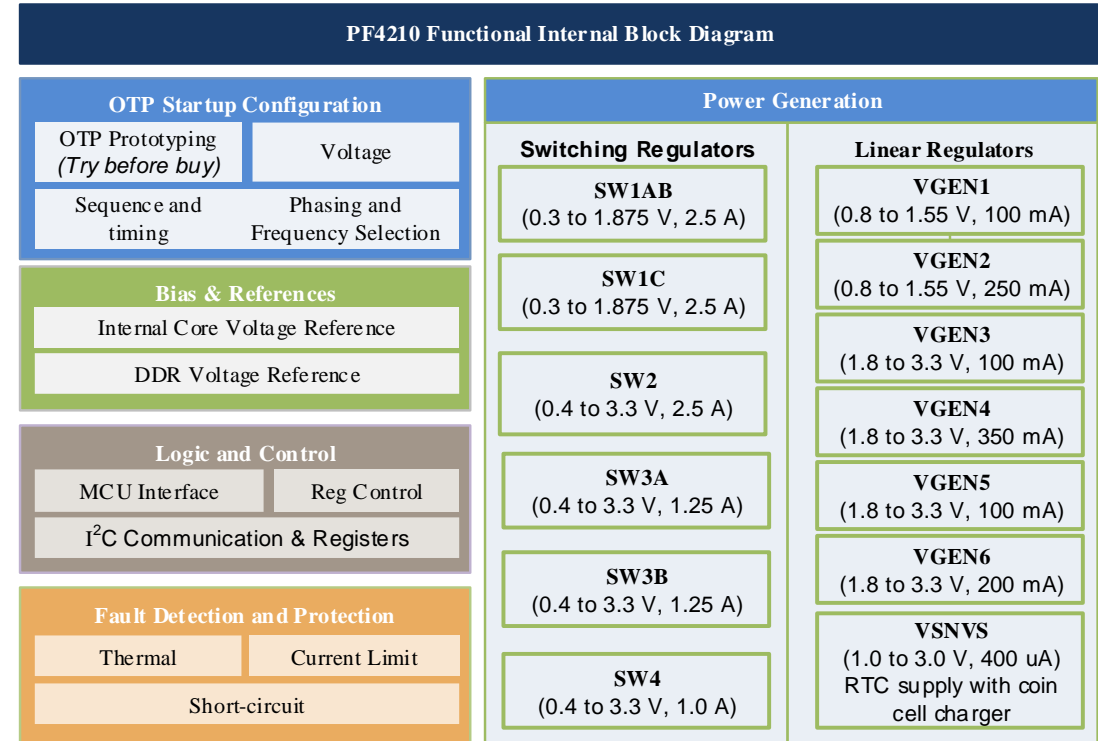
6-High Efficiency Buck Regulators, 6-LDOs with “Always-ON” Output for Low Power Mode Operation

## Differentiating Points

- Optimized to work with Dual, Quad core i.MX 8M (mScale ) processor systems
- >90% peak, >80% light-load efficiency to meet low power mode specs
- Selectively Turn-on/off of rails for low-power mode
- Pre-programmed output voltages, sequencing, and timing to meet i.MX 8M applications need
- Dynamic regulator control via I2C
  - Voltage, Current Limit, Frequency

## Product Features

- $V_{in} = 3.3V_{bus}$  Supply (Target 3V to 4.5V)
- 6 independent buck converters
- 6 user programmable LDOs
- Forced PWM/PFM or APS operation
- DDR reference, LiCell Charger
- 0 to +85°C (Consumer) -40 to +105°C (Industrial) Operating Temp Range Versions available
- High power 8x8 mm 56 QFN package



## APPLICATIONS

- OTT STB
- Wireless Audio
- General Embedded
- Industrial Logic Controller

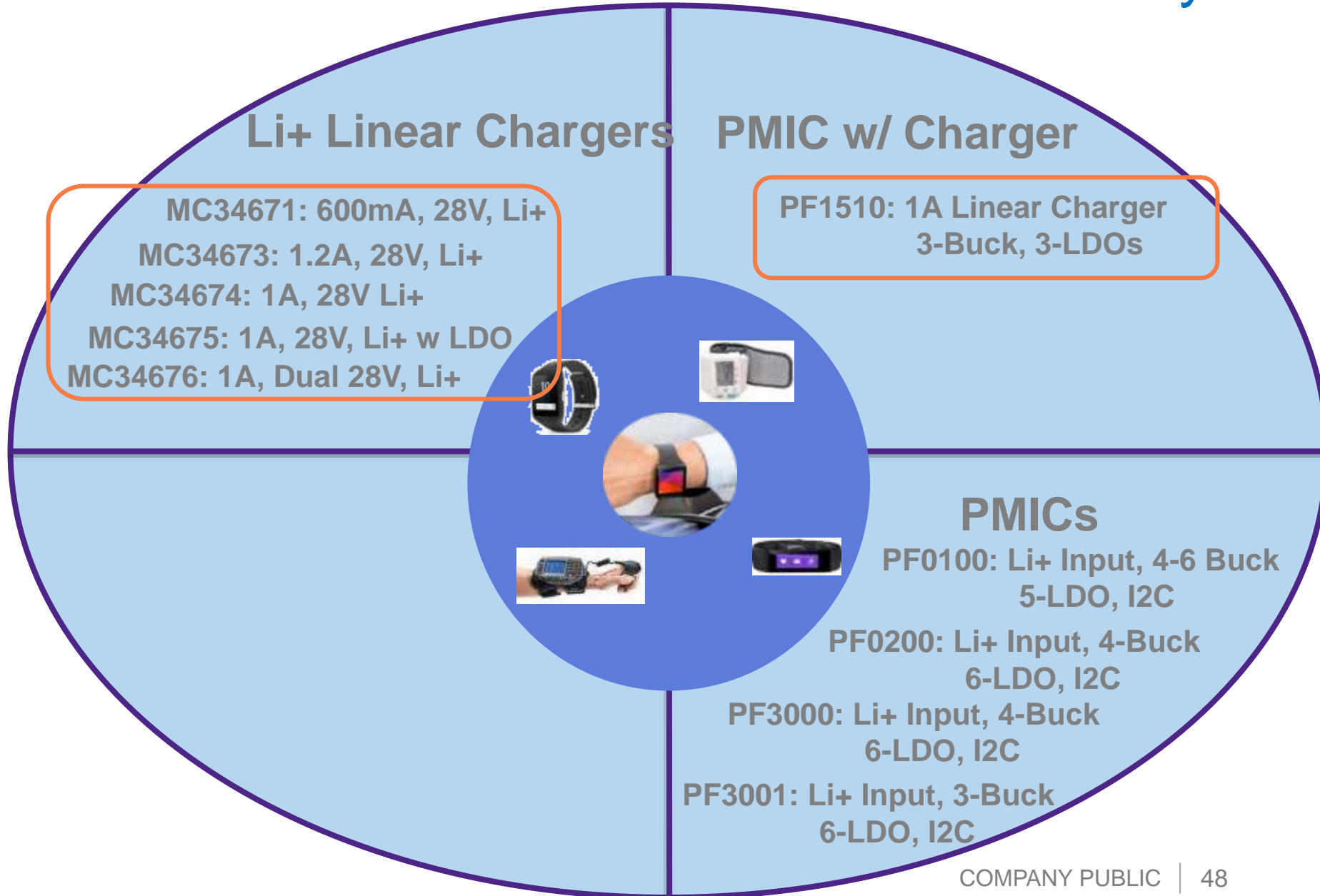
Samples: Now  
Production: **Now**



# Single Cell Battery Charger



# NXP Power Solution for Portable / Home Gateways



# Smart Power Drivers

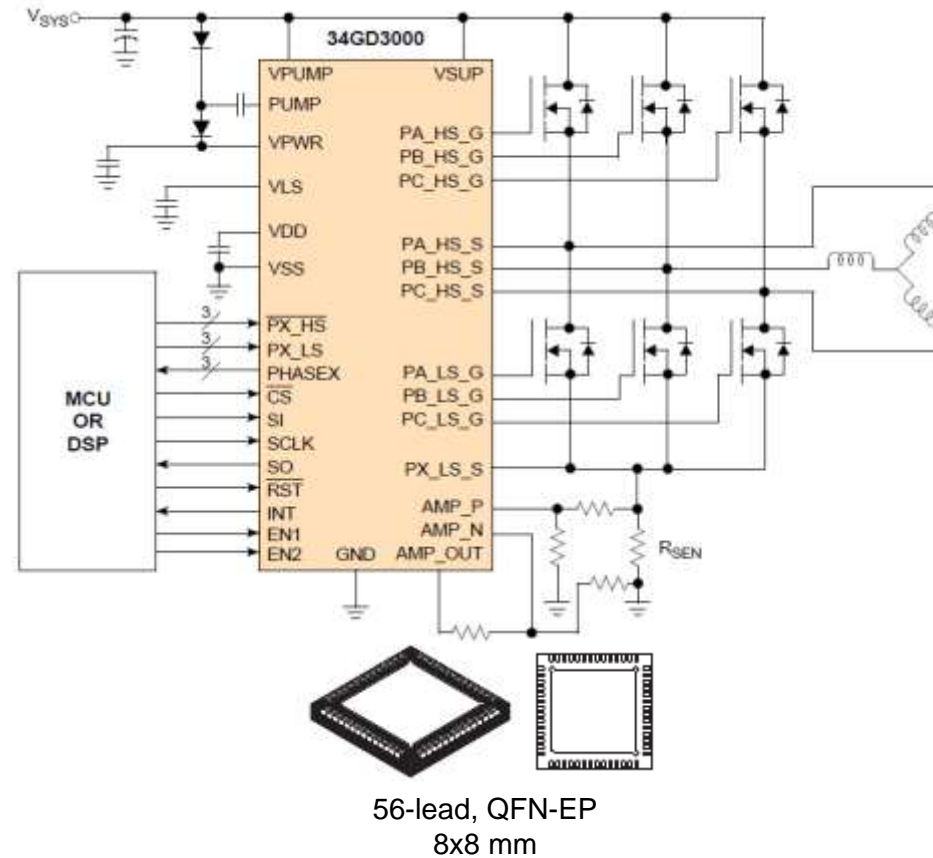


# GD3000 Brushless DC Motor MOSFET Gate Driver



## Features

- Small package: 8 x 8 mm with 6.75 x 6.75 mm exposed pad
- Up to 60 V operating voltage range
- PWM > 50 kHz
- 1.0 to 2.5A peak gate drive current
- Wide SPI programmable dead time
- Protection against transient spikes and reverse charge injection



## Typical Applications

- Electronic Power Steering
- ABS / Water / Oil / Fuel Pumps
- Transmission Pumps
- Air Conditioning Compressors
- Fans
- Quadcopters / UAVs / Drones

Base Part #	Temp Range (°C)	Package Footprint (LxW mm)	Release
MC33GD3000EP	-40 to 125	QFN 56 (8X8)	Now
MC34GD3000EP	-20 to 105	QFN 56 (8X8)	Now

# Enablement Tools

- Kits
  - Development board
  - User guide
  - Schematic
  - Bill of Material
  - Design files
- Development tools
  - [SPIGen](#) graphical user interface
  - [Processor Expert](#) components



**TWR-MC-LV3PH**



**KIT-3PHLV-REF**



**KIT33937AEKEVBE**



**FRDM System**



**FRDM-GD3000-EVB**



**FRDM-PWRSTG1EVB**

Base Part #	Kit Name	Associated Boards	Release Date
<a href="#">MC33GD3000</a>	FRDM-GD3000AEVB	<a href="#">FRDM-PWRSTG1EVB</a> <a href="#">FRDM-KV10Z</a> <a href="#">FRDM-KV31F</a> Others (partial functionality)	Jun '16
<a href="#">MC34GD3000</a>	<a href="#">FRDM-GD3000EVB</a>	<a href="#">FRDM-PWRSTG1EVB</a> <a href="#">FRDM-KV10Z</a> <a href="#">FRDM-KV31F</a> Others (partial functionality)	Now
<a href="#">MC34GD3000</a>	<a href="#">TWR-MC-LV3PH</a> (new rev)	Various, see web	Jun '16
<a href="#">PSMN4R2-30MLD</a>	<a href="#">FRDM-PWRSTG1EVB</a>	<a href="#">FRDM-GD3000EVB</a>	Now
TBD	FRDM-PWRSTG2EVB	<a href="#">FRDM-GD3000EVB</a>	Coming Soon
<a href="#">MC33937A</a>	<a href="#">KIT33937AEKEVBE</a>	<a href="#">KITUSBSPIDGLEVME</a>	Now
<a href="#">MC33937A</a>	<a href="#">3PHASELV-KIT</a>	Various, see web	Now
<a href="#">MC33937A</a>	<a href="#">TWR-MC-LV3PH</a>	Various, see web	Now

# H-Bridge Drivers

Low and Medium Voltage

Consumer and Automotive/IMM Applications





# H-Bridge DC Motor Drivers

## Product Summary

MC34931EK & MC34931SEK (SOIC) Single  
MC34932EK & MC34932SEK (SOIC) Dual



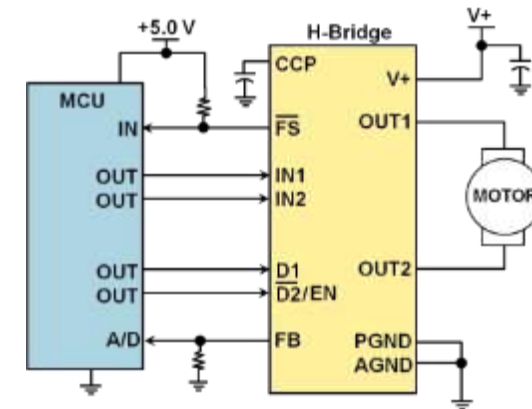
Thermally efficient 36V/5A H-Bridge DC motor driver featuring real-time load current monitoring and automatic thermal back-off ensures high availability operation in demanding high current, high temperature industrial applications

### • Differentiating Points

- **Best thermal efficiency:** 2X lower thermal impedance, <math><1^\circ\text{C}/\text{Watt}</math> SOIC package, to remove heat out of die
- **Real-time load current monitoring:** Analog feedback current mirror feature used for motor control saving cost by eliminating discrete components
- **Internal PWM switching** for over current regulation
- **Automatic thermal back-off:** Temperature regulated, peak current limiting ensures continuous high availability operation
- **Design-in simplicity:** Integrated H-Bridge with charge pump, control, protection and four MOSFETs

### • Product Features

- **Single and Dual** H-Bridge configurations
- **MC34931 & MC34932** = 11 kHz Max PWM frequency
- **MC34931S & MC34932S** = 20 kHz Max PWM frequency
- **High efficiency** 125 m $\Omega$  typical  $R_{\text{DS(on)}}$  (235m $\Omega$  max)
- **5.0 V to 36 V** continuous operation, 45 V transient
- **5.0 A** peak current
- **3 & 5 V** TTL/CMOS compatible
- **Status Flag** output reports **under-voltage**, **over-current**, and **over-temperature** fault conditions



Single H-Bridge Application

### • Applications

- Factory Automation
- POS, ATM, Vending Kiosks
- Medical
- Robotics

# MC33HB2000 & MC33HB2001 Motor Driver

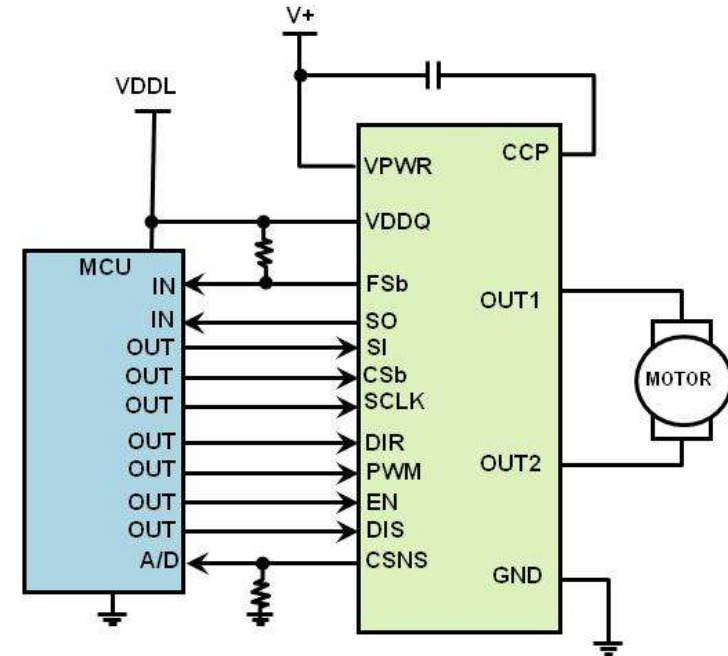
High availability 10 Amp H-Bridge driver with enhanced ISO26262 safety features, flexible SPI control, and patented thermal management for continuous operation

## Differentiation

- ISO26262 qualifiable – **ASIL-B certified** (FMEDA / Safety M.)
- Current feedback with 5% real time accuracy
- Lowest  $R_{DS(ON)}$  of 65 m $\Omega$  (typical)
- Lowest thermal resistance < 1°C/W
- Smallest package with 6 x 6mm QFN
- Patented thermal protection current limiting

## Features




- 4.5 – 36V supply, 40V transient
- Pin compatible  $R_{DS(ON)}$  options (65 / 120 m $\Omega$ )
- SPI selectable 4x current limits (5.4 - 10.7 A)
- SPI selectable 8x slew rates (0.25 - 16 V/ $\mu$ s)
- Optional 10 x 11mm SOIC-EP & 8 x 8mm PQFN



## Applications




- Electronic throttle control (ETC)
- Electronic gas recirculation (EGR)
- Multi-port injection (MPI) flaps control
- Gasoline direct injection (GDI) swirl & whirl flaps
- Industrial, commercial & medical motor control

# Medium Voltage Motor Driver Feature Products

Base Part #	Out	Op Volt (V)	RDS(ON) MAX(mΩ)	Peak Current (A)	SPI	Sleep (μA)	Freq (kHz)	Temp Range °C	Package (mm)	Samples/Release
MC33926ES 	2	5-28	235	5	-	50	11/20	-40 to 125	HVQFN 28 (6X6)	Now / Q1'19
MC33926PNB	2	5-28	235	5	-	50	11/20	-40 to 125	PQFN 32 (8x8)	Now
MC33931EK	2	5-28	235	5	-	50	11	-40 to 125	HSOP 32 (11x10.3)	Now
MC34931SEK	2	5-36	235	5	-	18	20	-40 to 85	HSOP 32 (11x10.3)	Now
MC33932EK	4	5-28	235	5	-	50	11	-40 to 125	HSOP 54 (18x10.3)	Now
MC34932SEK	4	5-36	235	5	-	18	20	-40 to 85	HSOP 54 (18x10.3)	Now
MC33HB2000ES 	2	5-36	235	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	HVQFN 28 (6X6)	Now / Q1'19
MC33HB2000FK	2	5-36	235	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	PQFN 32 (8x8)	Now
MC33HB2000EK	2	5-36	235	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	HSOP 32 (11x10.3)	Now
MC33HB2001EK	2	5-36	125	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	HSOP 32 (11x10.3)	Now
MC33HB2001FK	2	5-36	125	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	PQFN 32 (8x8)	Now
MC33HB2002ES	2	5-36	235	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	HVQFN 28 (6X6)	Q1 / Q1'19
MC33HB2002FK 	2	5-36	235	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	PQFN 32 (8x8)	Q1 / Q1'19
MC33HB2002EK	2	5-36	235	5/7/9/11	Y	50	2-50/ 8 div	-40 to 125	HSOP 32 (11x10.3)	Q1 / Q1'19

# Low Voltage Motor Driver Selector Guide

Targeting: Battery / 5 V / 12 V Applications

Base Part #	Motor type	Out	Operation Voltage (V)	Peak Current (A)	LL (V)	Sleep ( $\mu$ A)	Freq (kHz)	Temp Range ( $^{\circ}$ C)	Package (LxW mm) Footprint
MPC17510AEJ*	Brushed DC	2+1	2.0-15	3.8	4.0-5.5	-	200	-30 to 65	TSSOP20-EP (6.6x6.4) 
MPC17511EP	Brushed DC	2+1	2.0-6.8	3.0	2.7-5.7	-	200	-20 to 65	QFN 24 (4x4)
MPC17529EJ*	Stepper	4	2.0-6.8	1.4	2.7-5.6	-	200	-20 to 65	TSSOP20-EP (6.6x6.4) 
MPC17531ATEJ*	Stepper	4	2.0-8.6	1.4	2.7-3.6	2	200	-20 to 65	TSSOP20-EP (6.6x6.4) 
MPC17531ATEP	Stepper	4	2.0-8.6	1.4	2.7-3.6	2	200	-20 to 65	QFN 24 (4x4)
MC34933EP	Stepper	4	2.0-7.0	1.4	2.7-5.5	-	200	-20 to 85	QFN 16 (3x3)
MPC17C724EP	Stepper	4	2.7-5.5	0.8	2.7-5.5	1	200	-20 to 85	QFN 16 (3x3)

# Smart High Side Switches



# MC24XS4 (Auto) – MC36XSD (IMM) eXtreme Switches



Scalable, programmable family of 24A/36V SPI-driven, dual-channel, smart high-side switches with lowest RDSon for up to a 30% board reduction



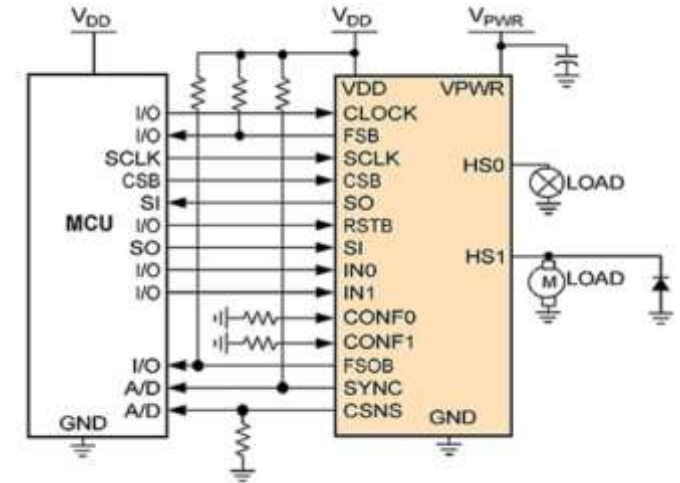
## Differentiating Points

- **Robustness:** Unique over-current latch-off protection, full digital & analog diagnostic and protection features
- **Integration:** 6 mΩ / 10 mΩ / 20 mΩ / 22 mΩ / 50 mΩ outputs in Dual configuration
- **Accuracy:** 5X better current sensing accuracy with unique accurate temperature sensing capability
- **Flexibility:** lighting or DC motor mode up to 1kHz
- **Scalability:** SW driver compatible family & pin compatibility



## Product Features

- Normal operating range: 8 -36 V, (ext range: 6 -58 V) Sleep mode current < 10 μA
- 3.3 V and 5.0 V compatible 16-bit Daisy chainable SPI control
- Parallel output operating modes
- Full diagnostic and protection including programmable over-current profiles, output-ON and -OFF open load detections, thermal shut-down, pre-warning, and fault reporting
- ±5°C temperature and synchronous / asynchronous current (±10%) sensing
- Individually programmable internal/external signals with 8 bit duty cycle control & slew rate
- Watchdog and failsafe mode



## Typical Applications

Transportation 12 / 24V

- o 24V Lighting and capacitive loads
- o Valves
- o DC motors

Industrial

- o High current / highly inductive loads (solenoids)
- o DC motor control
- o Factory automation



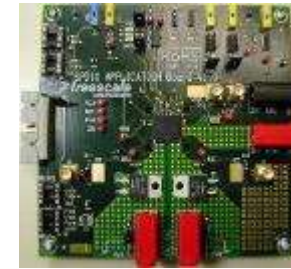
24-pin PQFN package  
32-pin eSOIC package



# eXtreme switch - EcoSystem

## • Evaluation kits & Reference design

- Lighting reference design 4 eXtreme Switch devices (Gen4), MCU: S12G SBC: 33903
- Light Control Module 1 eXtreme Switch device (Gen3) MCU: KEA
- 16-bit MCU S12G, 4 eXtreme Switch devices, CAN Physical Layer, 5V regulator



## • Freedom board

- FRDM-12XSF-EVB: MC17XSF500, Freedom shield PeX component/ Freemaster GUI /Spigen compatible.
- FRDM-32XSF-EVB: MC17XSG500 (30V version). Freedom w/ Arduino compatibility (Resale through PremierFarnell Element14). Launch in Q4 2016



## • Tower board

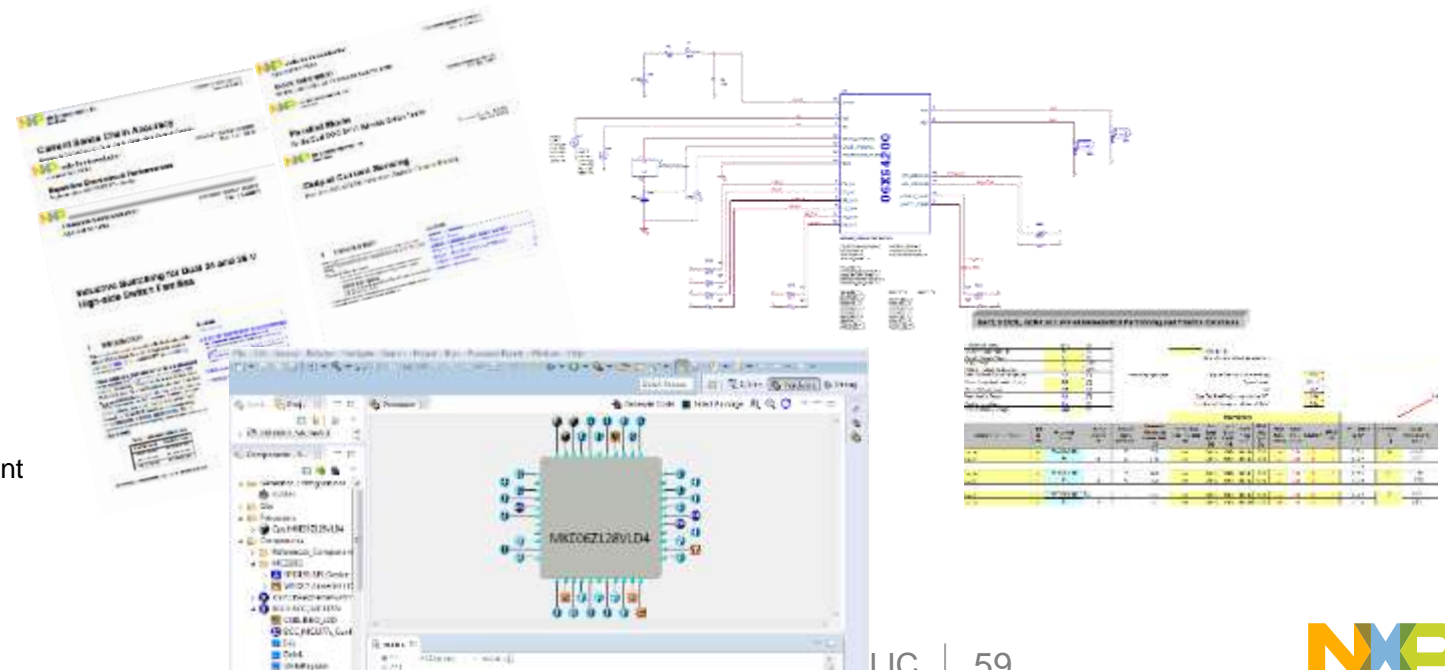
- TWR-MC36XSDEVB: Tower System for 36VeXtreme Switch

## • Application Notes and tools

- Application notes
- Training package
- Microsoft Excel© Thermal Calculator
- Cadence Orcad© Behavioral models

## • Software development:

- Analog software component for APPLICATION / SYSTEM enablement
- Components are MCU agnostic



# eXtreme Switch Automotive Portfolio

## 12V multiple HSS

Family	Part Number	Outputs # and On-Resistance	Total Outputs #	Operating Voltage (V)	Max continuous current (A)	Max PWM frequency	Package	Pin to Pin Compatibility	SW Compatibility
MC12XS3	MC07XS3200EK	Dual 7mΩ	2	6-20	21	800Hz	32-pin SOICEP	-	√
	MC10XS3425EK	Dual 10mΩ, Dual 25mΩ	4	6-20	19-9	800Hz	32-pin SOICEP	-	
	MC10XS3412DHFK	Dual 10mΩ, Dual 12mΩ	4	6-20	19	1kHz	24-pin PQFN	√	
	MC10XS3435DHFK	Dual 10mΩ, Dual 35mΩ	4	6-20	19-9	1kHz	24-pin PQFN		
	MC15XS3400DHFK	Quad 15mΩ	4	6-20	19	1kHz	24-pin PQFN		
	MC35XS3400DHFK	Quad 35mΩ	4	6-20	9	1kHz	24-pin PQFN		
	MC09XS3400AFK	Quad 9mΩ	4	6-20	21	800Hz	24-pin PQFN		
MC12XS3	MC10XS3535HFK	Triple 10mΩ, Dual 35mΩ	5	7-20	12-6	400Hz	24-pin PQFN	√	√
	MC35XS3500HFK	Penta 35mΩ	5	7-20	6	400Hz	24-pin PQFN		
	MC06XS3517AFK	Triple 6mΩ, Dual 17mΩ	5	7-20	17-9	400Hz	24-pin PQFN		
MC12XS6	MC07XS6517BEK	Triple 7mΩ, Dual 17mΩ	5	7-18	18-9	400Hz	54-pin SOICEP	√	√
	MC17XS6500BEK	Penta 17mΩ	5	7-18	9	400Hz	32-pin SOICEP		
	MC40XS6500EK	Penta 40mΩ	5	7-18	6	400Hz	32-pin SOICEP		
	MC08XS6421EK	Dual 08mΩ, Dual 21mΩ	4	7-18	18-9	400Hz	32-pin SOICEP		
	MC17XS6400EK	Quad 17mΩ	4	7-18	9	400Hz	32-pin SOICEP		
	MC25XS6300EK	Triple 25mΩ	3	7-18	8	400Hz	32-pin SOICEP		
	MC10XS6325EK	Dual 10mΩ, Single 25mΩ	3	7-18	16-8	400Hz	32-pin SOICEP		
	MC10XS6200EK	Dual 10mΩ	2	7-18	16	400Hz	32-pin SOICEP		
	MC10XS6225EK	Single 10mΩ, Single 25mΩ	2	7-18	16-8	400Hz	32-pin SOICEP		
<b>Main Switches</b>									
MC12XS2	MC33981ABHFK	Single 4mΩ	1	6-27	75	60kHz	16-pin PQFN	-	-
	MC33982CHFK	Single 2mΩ	1	6-27	41	1kHz	16-pin PQFN	√	√
	MC33984CHFK	Dual 4mΩ	2	6-27	21	1kHz	16-pin PQFN		
	MC33988CHFK	Dual 8mΩ	2	6-27	10.5	1kHz	16-pin PQFN		

## 24V dual HSS

Family	Part Number	Outputs # and On-Resistance	Total Outputs #	Operating Voltage (V)	Max continuous current (A)	Max PWM frequency	Package	Pin to Pin Compatibility	SW Compatibility
MC24XS4	MC06XS4200BFK	Dual 6mΩ	2	8-36	15	1kHz	24-pin PQFN	√	√
	MC10XS4200BFK/BAFK	Dual 10mΩ	2	8-36	9	1kHz	24-pin PQFN		
	MC20XS4200BFK/BAFK	Dual 20mΩ	2	8-36	4.5	1kHz	24-pin PQFN		
	MC22XS4200BEK	Dual 22mΩ	2	8-36	4	1kHz	32-pin SOICEP	√	√
	MC50XS4200BEK	Dual 50mΩ	2	8-36	1.5	1kHz	32-pin SOICEP		

# eXtreme Switch industrial Portfolio

Family	Part Number	Outputs # and On-Resistance	Total Outputs #	Operating Voltage (V)	Max continuous current (A)	Max PWM frequency	Package	Pin to Pin Compatibility	SW Compatibility
MC12XSC	MC07XSC200EK	Dual 7mΩ	2	6-20	21	800Hz	-	√	32-pin SOICEP
	MC10XSC425EK	Dual 10mΩ, Dual 25mΩ	4	6-20	19-9	800Hz	-		32-pin SOICEP
MC12XSF	MC07XSF517BEK	Triple 7mΩ, Dual 17mΩ	5	7-18	18-9	400Hz	√	√	54-pin SOICEP
	MC17XSF500BEK	Penta 17mΩ	5	7-18	9	400Hz			32-pin SOICEP
	MC40XSF500EK	Penta 40mΩ	5	7-18	6	400Hz			32-pin SOICEP
	MC08XSF421EK	Dual 08mΩ, Dual 21mΩ	4	7-18	18-9	400Hz			32-pin SOICEP
	MC17XSF400EK	Quad 17mΩ	4	7-18	9	400Hz			32-pin SOICEP
30V Family Devices									
MC32XSG	MC07XSG517EK	Triple 7mΩ, Dual 17mΩ	5	7-30	18-9	400Hz	√	√	54-pin SOICEP
	MC17XSG500EK	Penta 17mΩ	5	7-30	9	400Hz			32-pin SOICEP
36V Family Devices									
MC36XSD	MC06XSD200FK	Dual 6mΩ	2	8-36	15	1kHz	√	√	24-pin PQFN
	MC10XSD200FK	Dual 10mΩ	2	8-36	9	1kHz			24-pin PQFN
	MC16XSD200FK	Dual 16mΩ	2	8-36	4.5	1kHz			24-pin PQFN
MC36XSD	MC22XSD200BEK	Dual 22mΩ	2	8-36	4	1kHz	√	√	32-pin SOICEP
	MC50XSD200BEK	Dual 50mΩ	2	8-36	1.5	1kHz			32-pin SOICEP
Main Switch Devices									
MC12XSB	MC34981ABHFK	Single 4mΩ, 60KHz	1	6-27	75	60kHz	√	√	16-pin PQFN
	MC34982CHFK	Single 2mΩ	1	6-27	41	1kHz			16-pin PQFN
	MC34984CHFK	Dual 4mΩ	2	6-27	21	1kHz			16-pin PQFN
	MC34988CHFK	Dual 8mΩ	2	6-27	10.5	1kHz			16-pin PQFN

# Valve Controllers

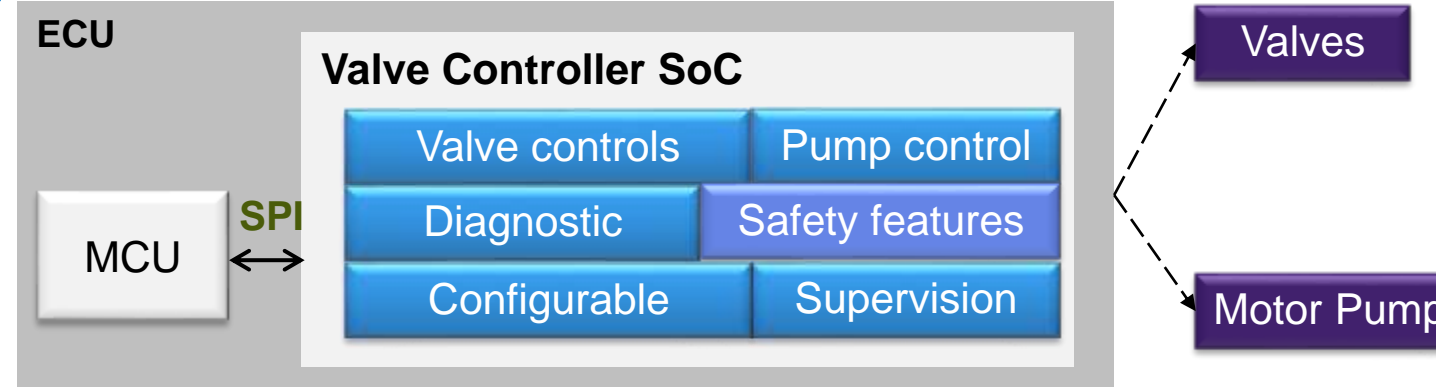


# MC34SB0410/0800 Valve Controller SoC – System Architecture & Applications

NXP Valve Controller SoC – Unique market solution

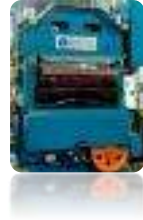
- **Target applications**

- Oxygen concentrators
- Dialysis machines
- Blood pressure monitoring
- 3D printers
- Soda dispensers
- High end showers and baths: water temperature control
- Heavy Equipment and Construction Machinery
- Forklifts
- Water control system for irrigation
- Food control in animal farms
- Cooling systems
- Hydraulic Press
- Petrol Pump
- ATM



One single analog device to manage the overall **Hydraulic / Pneumatic** systems with safety features

- BOM cost reduction
- Design-in simplicity thanks to SPI interface to speed time to market
- Safe switching off mode for safety and robustness



Video using magnetic field instead of the valves:

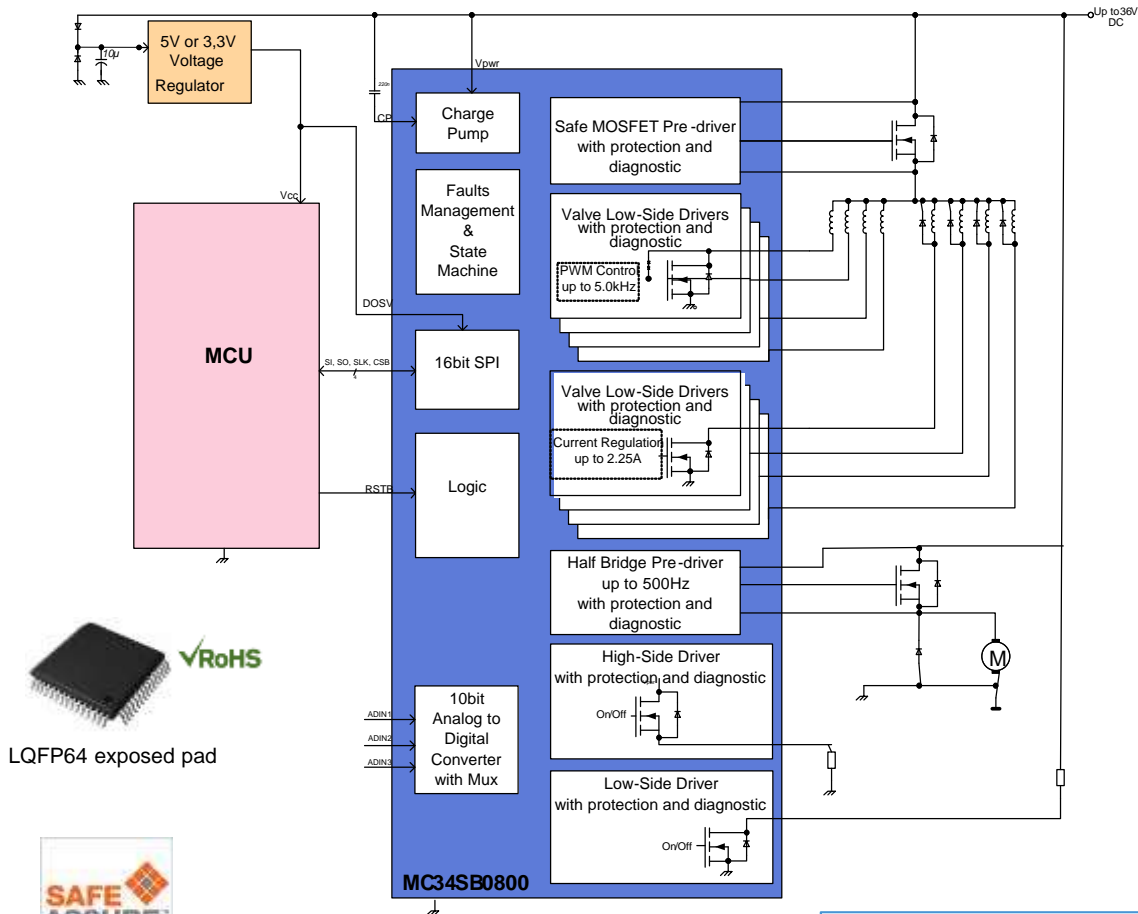
<http://www.nxp.com/video/valve-controller-soc:VALVE-CONTROLLER-SOC>

Valve controller system web page:

<http://www.nxp.com/products/discretes-and-logic/mosfets/low-side-switches/hydraulic-pneumatic-valves-controller-system-with-safety-and-monitoring:VALVE-CONTROLLER-SYSTEM?fsrch=1&sr=3&pageNum=1>

# Valves Controller SoC: MC34SB0800 / MC34SB0410

Thermally efficient, Valve Controller with SPI for driving compressor motors, PWM & proportional valves leveraging integrated Safe Assure functional safety features



Typical Application Diagram

Samples: Available  
EVM: Available  
Production: Now  
TWR-SB0800-36EVB: Now  
TWR-SB0410-36EVB: Now

## Differentiating Points

- Best thermal efficiency due to exposed pad ( $<2^{\circ}/W$ ) and low  $R_{ds(on)}$  ( $<300m\Omega$ )
- Design-in simplicity thanks to **SPI** interface
- **Real-time valve current regulation**
- Robust and secure solution thanks to **safe MOSFET** switching off all the valves in case of issue

## Key Characteristics

- **8x valve drivers**
  - 4x current regulated  $\pm 2\%$  up to 2.25A (300m $\Omega$ )
  - 4x PWM up to 5 kHz, 5A (225m $\Omega$ )
- Integrated valve protection including **HS pre-driver**
- Integrated **DC pump motor pre-driver** controller 500Hz PWM
- Self protected high-side driver (1.0 $\Omega$ )
- Self protected low-side drivers (14 $\Omega$ )
- Die temperature warning
- Fault management & State Machine
- **5.3V to 36V** continuous operation, 40V transient
- **10-bit Analog-to-Digital Converter**
- **16-bit SPI interface with watchdog & challenger (octal only)**
- **MC34SB0800: LQFP64** package
- **MC34SB0410: LQFP48** package





# Motorcycle Braking SoC

## Differentiation

- HW & SW compatible solution for 1W & 2W
- Low system BOM w/ integrated safety functions
- Small footprint 7x7mm 48 pin QFN package

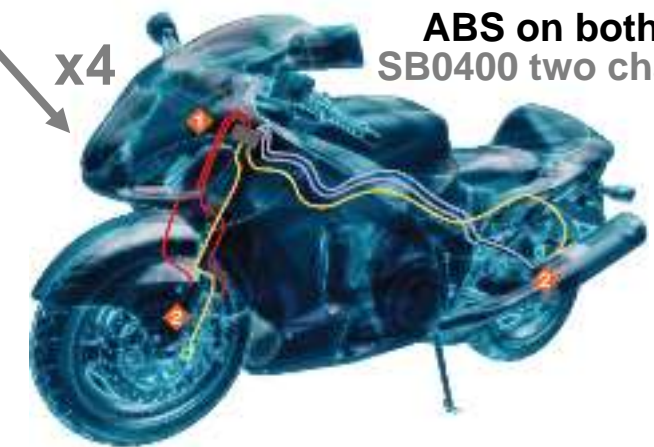


Motorcycle Braking Demo

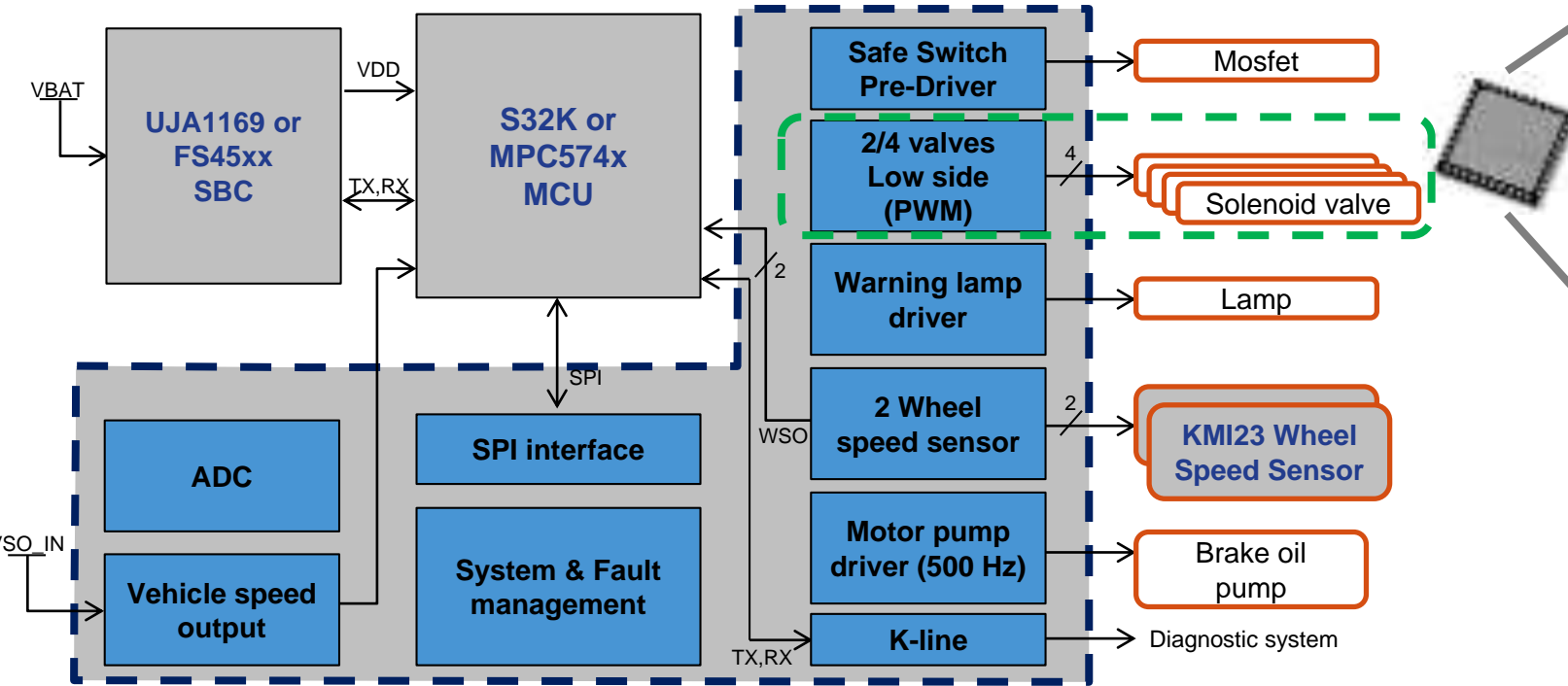


ABS on front wheel only  
SB0401 one channel ABS

ABS adoption driven by regulatory mandates in Europe, America, & Asia



ABS on both wheels  
SB0400 two channel ABS



Highly Integrated Motorcycle Braking SoC

# PT2000 / MC33816 Programmable Solenoid Controller

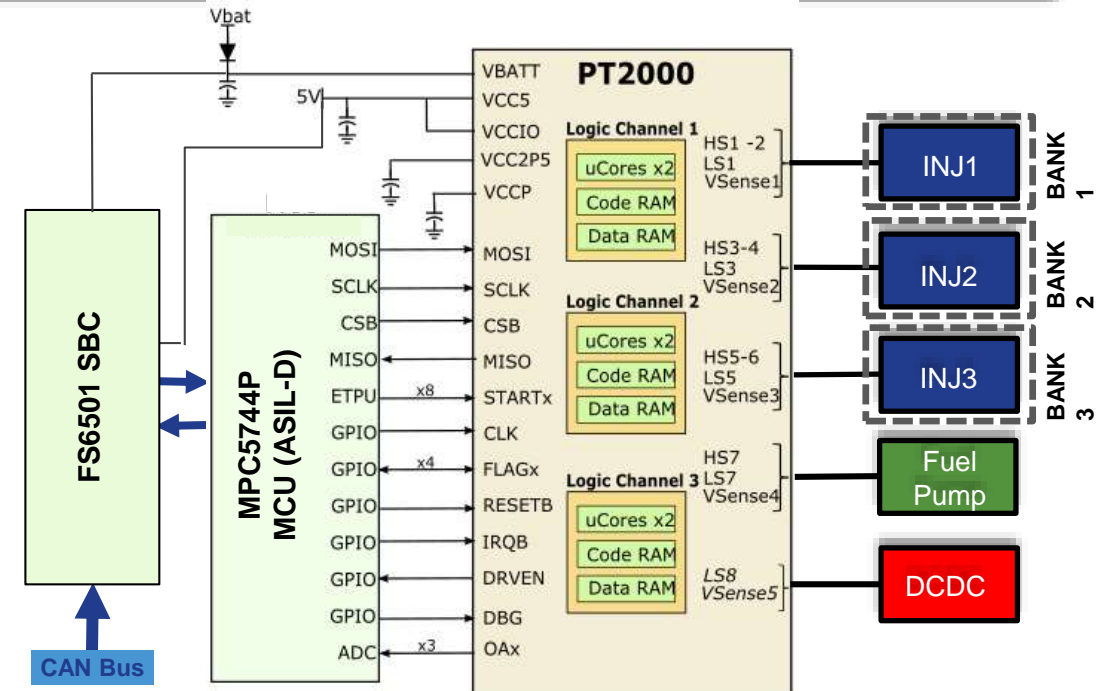
Programmable DFI controllers with 72V high & low side pre-drivers for driving up to 8 solenoids with precision output current profiles in dynamic load environments targeting 3, 4 & 6 cylinder engines

## Differentiation

- High precision drive in dynamic load environments
- Low latency feedback with <900 ns response time
- Flexible current profiles through programmable  $\mu$ Cores
- Redundant drive disable for functional safety compliance
- Programmable End-of-Injection measurement (PT2000)

## Features

- 5 – 72V operation w/ 12 – 72V DC/DC boost converter
- Supports 2 or 3 bank Vboost configurations w/ full overlap
- Programmable diagnostics: OV, UV, OC, OT, Open Load
- 16-bit SPI control with IRQB and interrupt flags
- Integrated microcode encryption for enhanced security
- LQFP with exposed pad (PB-free):
  - PT2000 6 channel: 12 x 12 mm 80 pin
  - MC33816 4 channel 10 x 10 mm 65 pin



## Typical Applications

- Gasoline direct injection (GDI) for 3, 4 & 6 cylinders
- Diesel direct injection (DDI)
- CNG / LNG engines & variable valve actuators (VVA)
- Active suspension & transmissions (CVT, DCT, AT)

# Multi-Channel Auto LED drivers

Flexible, scalable and high efficiency 70V multi-channel boost / buck LED driver platform with >1.5A per channel drive capability

## Differentiation

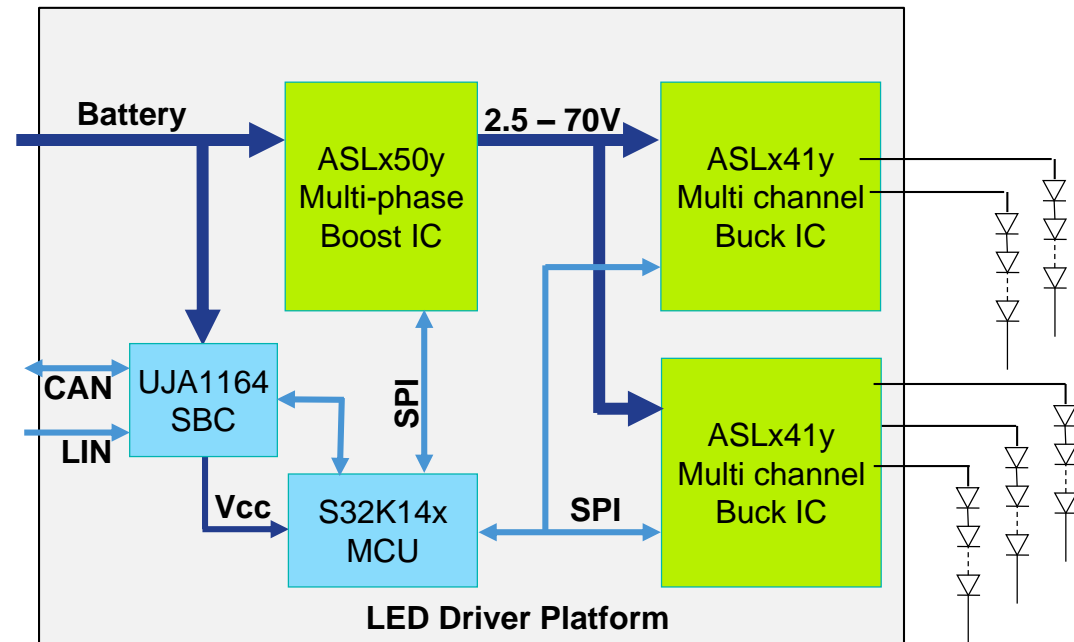
- >1.5A LED current drive per channel
- Dual voltage, multi-phase 70V boost
  - Low ripple, low system cost and high efficiency
- 87% system efficiency

## Features

- 2.5V – 70V buck outputs
- Drives 2 – 12+ LED channels w/ 30 - 140W
- Flexibility to drive external FETs
  - Thermal, power, & EMC optimization
- SPI Interface for configurability, control & diagnostics
- Supports segment or matrix switching

## Part Numbers

- ASL1500SHN/2500SHN/4501SHN – Boost Converter
- ASL1507SHN/2507SHN – Boost Converter with Limp Home Mode
- ASL2416SHN/3416SHN – Buck Converter
- ASL2417SHN/3417SHN – Buck Converter with Limp Home Mode



## Typical Application

### 6-channel headlamp





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FOR A SMARTER WORLD

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