NewTec NTBMS Reference Design Battery Management System

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Automotive Microcontroller and Processor

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SECURE CONNECTIONS FOR A SMARTER WORLD

Agenda

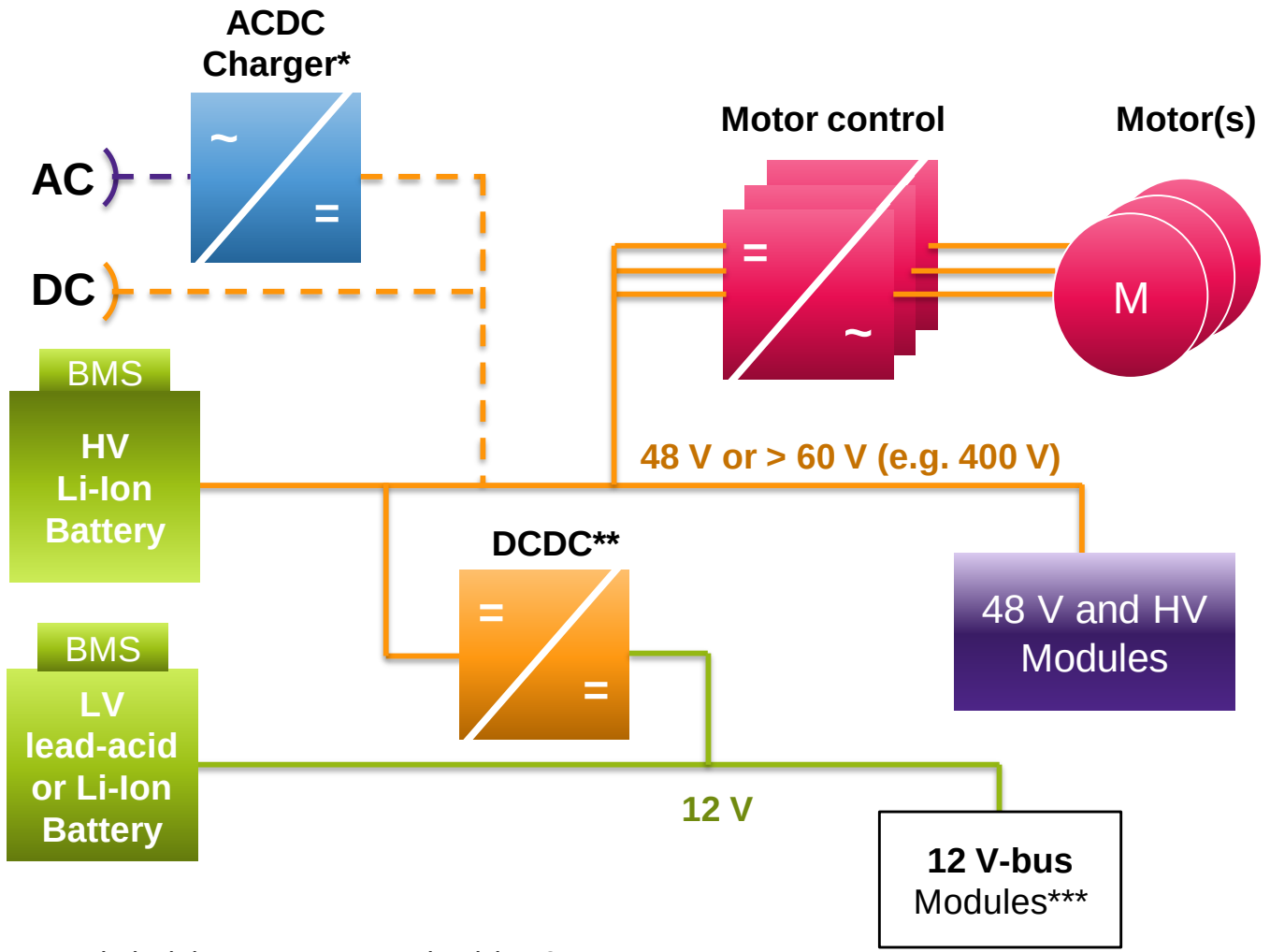
- Electrification Trend
- Why is Battery Management System Needed
- NewTec NTBMS introduction
- NTBMS Enablement
- More about NewTec
- Summary

Electrification

New Applications Driving Electrification Market Growth

Major components

- Battery management system
- Motor control (inverters, HCUs)
- 48 V eMachine (BSG, ISG, HVAC)
- DC/DC voltage domain converter
- On-board charger AC/DC converter



* only in (P)HEVs, BEVs, omitted in 48 V MHEV systems
** bidirectional in 48 V systems
*** as in exisiting ICE-based vehicles

Battery Management System (BMS) Target Markets

E-mobility:

- cars, trucks, light-trucks, postal and delivery trucks
- e-scooters, e-bikes

Energy Stationary Storage:

- Smart grid balancing, renewable energy storage
- Home energy storage
- Interruptible Power Supply (UPS)

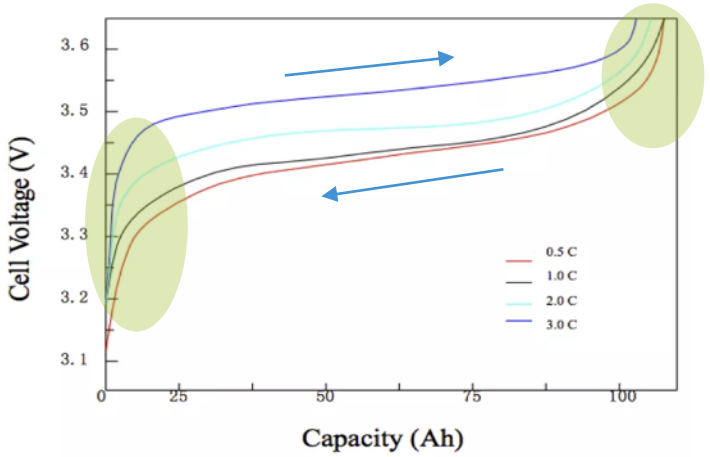
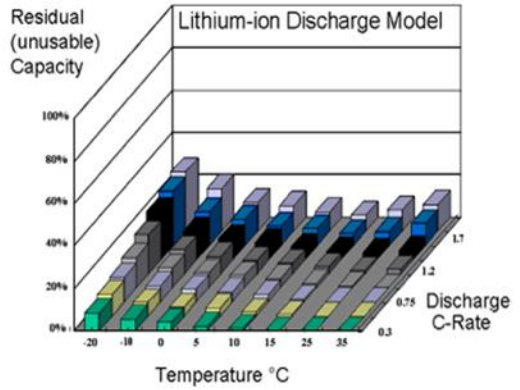
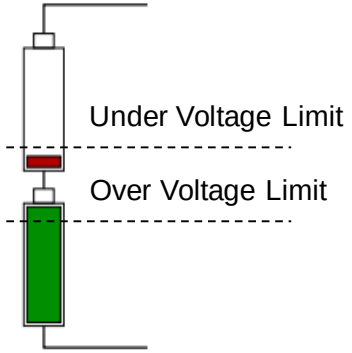
Industrial:

- robot, autonomous guided vehicles, forklift, agricultural applications, …

Consumer:

- vacuum cleaner, garden tooling, E-wheelchair

Main Functions of BMS systems

	Safety	Performance	Multi-Cell function
			
	Danger: • Over voltage • Extra heat • Unstable chemical stage • Thermal runaway=>fire/explosion • Low temperature charge	**Requirements:** • Safe & fast charging • Discharge optimization • State of charge (SOC) estimation • State of health (SOH) estimation	**Challenges:** • Up to hundreds of cells • Manufacture mismatch • Capacity degradation • Lifetime degradation
Key BMS Functions	V/I/T measurement	V/I/T measurement Coulomb counting Internal resistance calculation	Cell balancing

Why Safety is Critical for Lithium-Ion Battery Applications

- Battery over-voltage (**OV**)
  - Secondary chemical reactions triggered: **battery overheating**, smoke emission, **inflaming or explosion** are very likely. OV typically close to 4 V
- Thermal runaway (**OT**):
  - Can start a positive temperature feedback mechanism, with the **same consequences as an OV**. OT **typically close to 60 °C**
- Battery under-voltage (**UV**):
  - Results in progressive **breakdown of the electrodes** substances. With LFP cells this may happen over a few cycles. UV typically close to 2 V
- Battery over-current (**OC**):
  - May result in the **melting of the battery contactors**. **Major safety issue**: **impossibility** to open the contactors and inability to drive the system to the disabled safe state
- Battery under-temperature (**UT**):
  - Loss of robustness of the contactors, **reduction of the battery capability to provide current**, dendrites. Need to limit current to avoid damage
- Need to comply with stringent safety standards – ISO 26262 for Automotive

NewTec NTBMS Introduction

Safety reference design in compliance to ISO 26262 ASIL C

NTBatteryManagementSystem (NTBMS)

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With passion.

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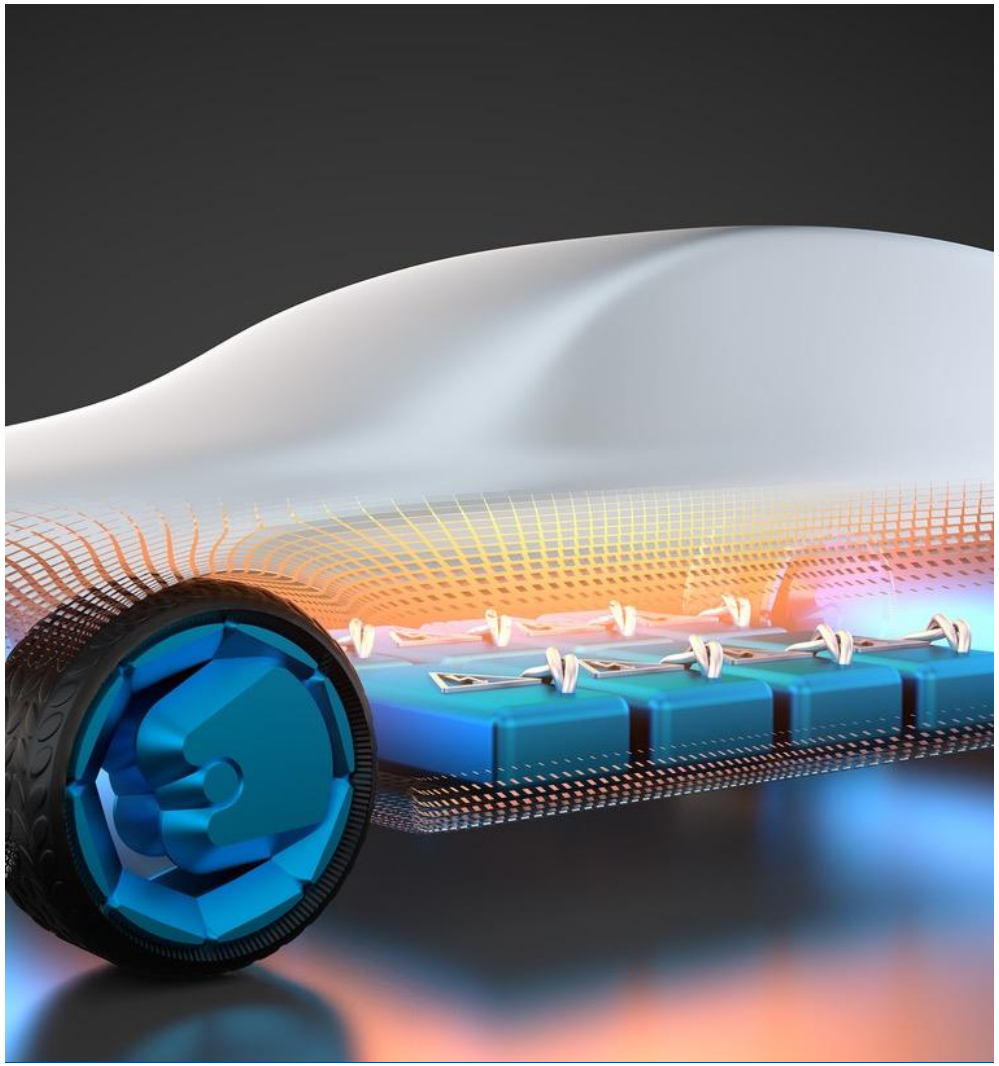

Courtesy of NewTec

NTBMS is a generic e-mobility Battery Management System based on NXP chips for producers of Lithium-ion battery systems in automotive applications with a high degree of reliability and safety requirements (ASIL C).

Currently, it supports usage is in auxiliary and starter batteries.

Components:

- Baseboard NTBMS
- NTSafeSOM

Key Features & System Overview

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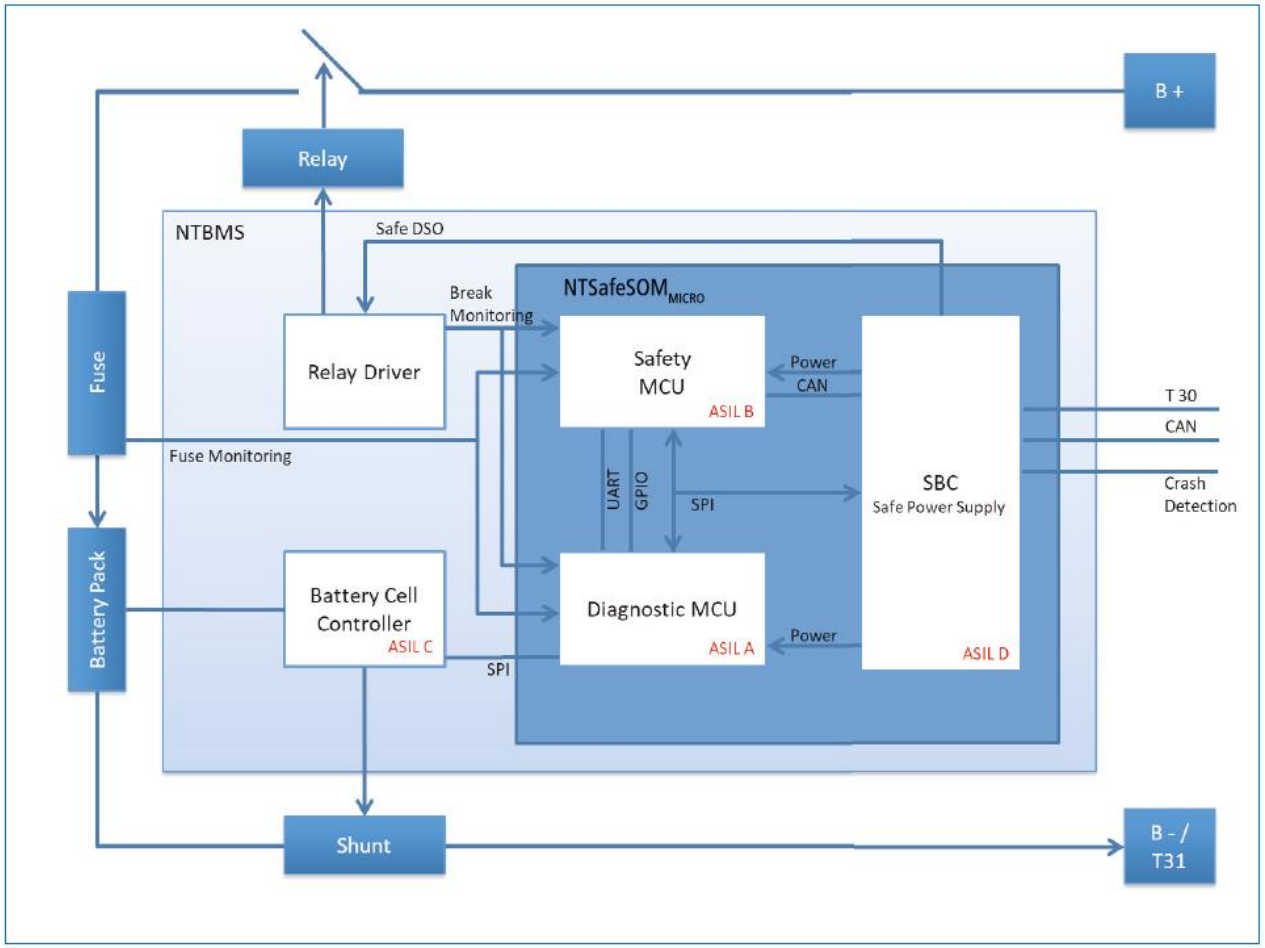
- Permanent measurement of cell voltages
- Over-temperature protection
- Overcurrent / overvoltage detection
- Safe relay (breaker) control (ASIL C)
- Various definable Safe States
- LIN and CAN bus interface
- Crash detection
- Overcurrent control fuse
- Power supply with watchdog protection
- Control of up to 6 Lithium-ion battery cells



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NXP

BMS Safety System-On-Module: NTSafeSOM

Ready to use safety computer reference design

Features

- Target ISO26262 ASIL-C and IEC 61508 SIL 2 System level certification
- Dual MCU and safety PMIC architecture
  - ✓ S32K144 – Cortex M4F MCU
  - ✓ KEA – Cortex M0+ MCU
  - ✓ FS45 – Safety & Power Management System IC
- Different support package options from NXP and Newtec
  - ✓ Free-of-charge reference documents
  - ✓ Development kit hardware with application software
  - ✓ up to complete system development with safety certification
- First application designed for 6 cells Li-Ion BMS using MC33772 battery cell controller

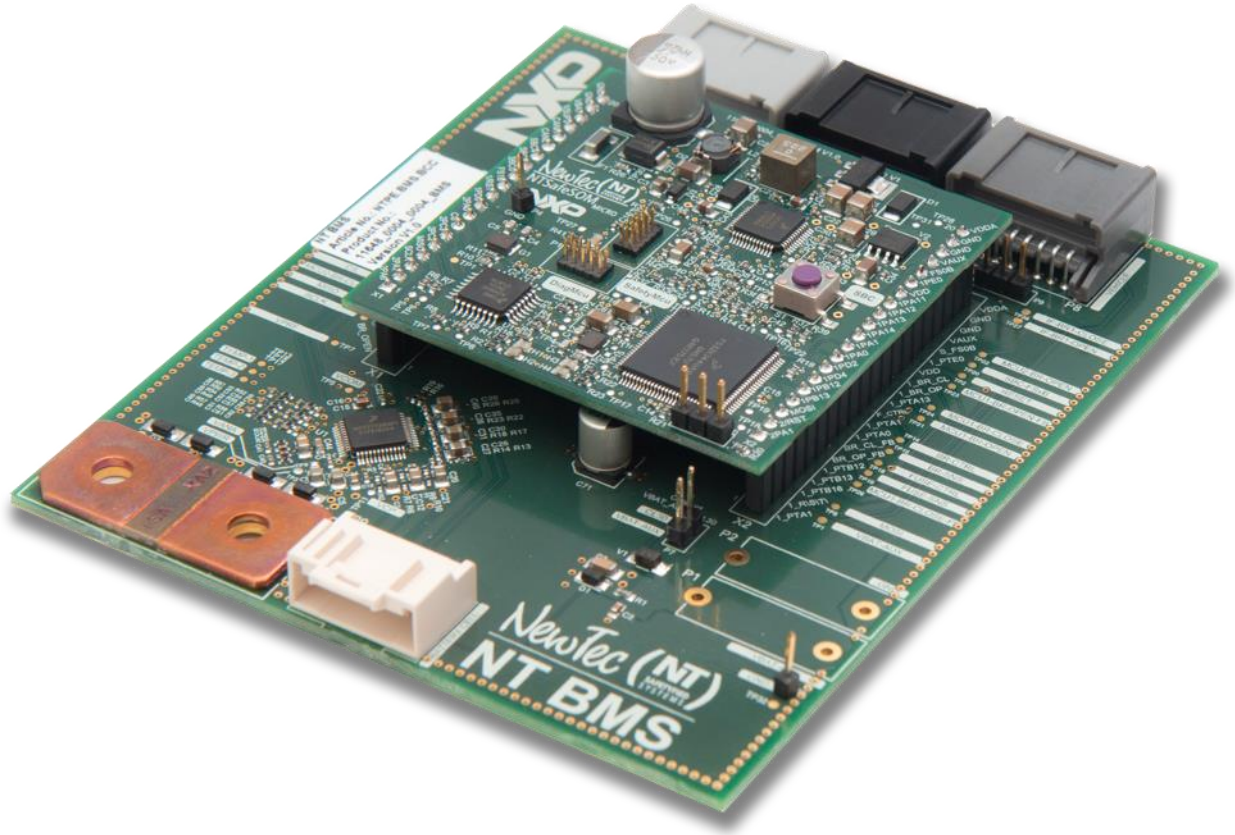
Applications

- Industrial, medical or automotive system requiring functional safety certification

Ready to use MC33772 based safety BMS

Features

- 4 to 6 cell Li-ion battery
- Cell balancing circuit
- Intrusive diagnostics (MCU)
- Battery disconnecting switch control circuit
- 200 A perm/ 800A for 300ms
- Low power self-power consumption
- Cell voltage/ current/ temperature monitoring
- CAN bus interface



Customer Benefits

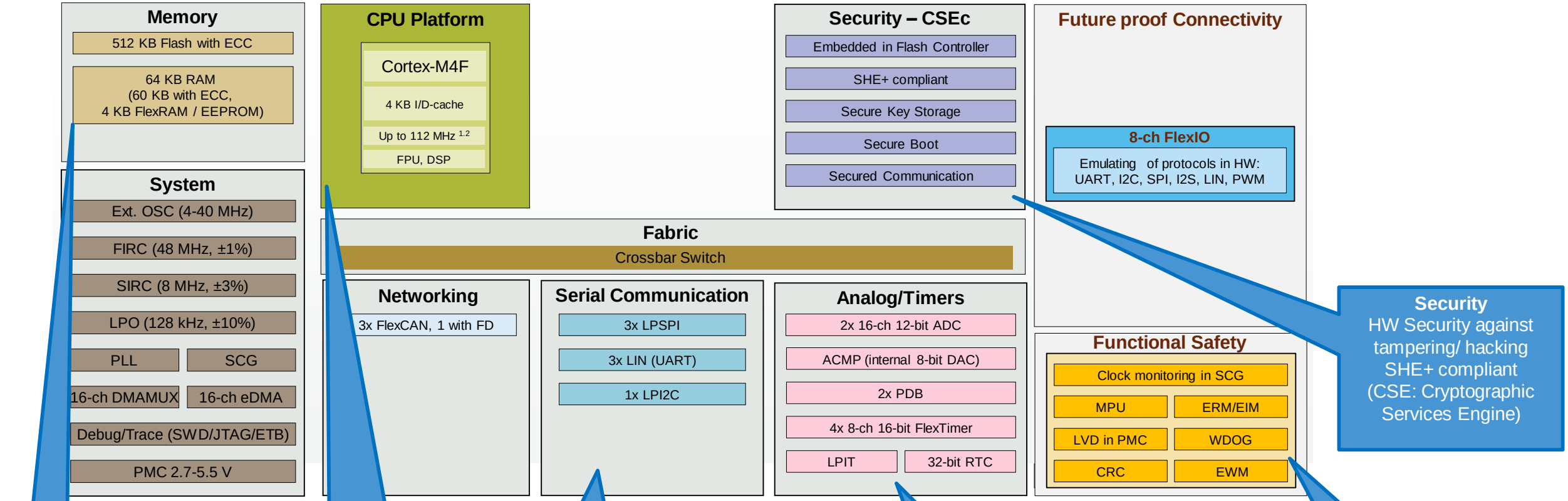
- Off the shelf 14V BMS ref design
- Application level safety concept
- NewTec professional Service

MC33772 – ASIL C Battery Cell Controllers

- Cell Voltage Monitoring
- MC33772 - 3 to 6 cells
- Total stack voltage measurement
- Current Measurement and Coulomb Counter
- From some µA to several 1000A (shunt resistor)
- Synchronized Cell Voltage/Current measurement
- Temperature Sensing / other voltage measurements
- 1 internal temperature, up to 7 external temperatures/voltages
- 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

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

S32K144 – ASIL B 512K General Purpose MCU



Memory
Robust internal Flash
OTA support

CPU Platform
Powerful high speed ARM CPU
Optimized for Real-time system

Advanced Automotive Peripherals
Fast auto comm. support by CAN FD
Emulation of various protocols by FlexIO

Motor Control
On-chip motor control sub-system
Offloading CPU

Security
HW Security against tampering/ hacking
SHE+ compliant
(CSE: Cryptographic Services Engine)

Safety
Core Self-test SW
Clock monitoring & voltage monitoring
ECC on memory

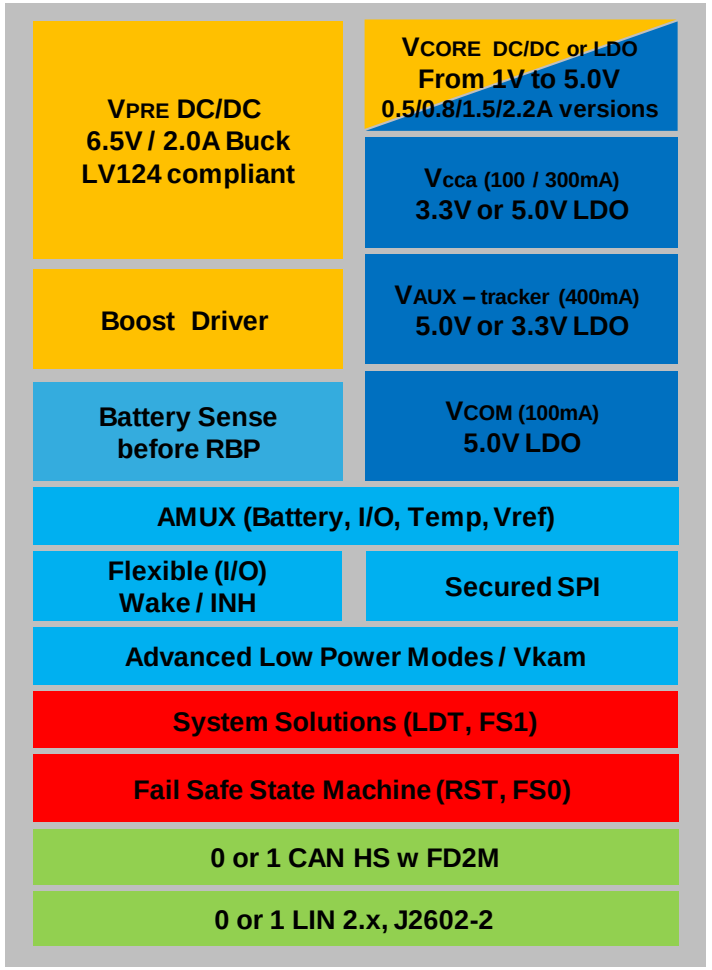
FS45 – Functional Safety SBC

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 mm²
- Robust CAN PHY FD 2M
- Configurable I/Os
- Long Duration Timer, Keep Alive memory supply



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 availibility, diagnostic and possible recovery.
- Optional **Fail Silent** operation
- **Second Fail Safe** pin to manage safe delay after failure event
- **Advanced SafeAsssure documentation** to fit for safety assessment
- **BOM cost savings :** No need for external MCU challenger
- MCU & external IC **Safety Monitoring**

NTBMS Enablement

HW + SW Enablement

Board Package

- Reference Design plus
- Hardware Board
- Small How-to-Guide for ASIL C BMS design
- Detailed FMEDA results
- Application SW (Object Code) and Low Level Driver (functionally safe)

Packages and Services NewTec NTBMS Battery Management System						
		Packages				
		Reference Design Package	Board Package	Software Package	Safety Package	Certification Package
Hardware	Evaluation Board Battery Management		✓	✓	✓	✓
Software	Application Software with Drivers (non-safe)	✓	✓	✓	✓	✓
	Safety Software (Object Code)		✓	✓	✓	✓
	Safety Software (Source Code)			✓		✓
Documentation	Schematic	✓	✓	✓	✓	✓
	Layout with Gerber Files	✓	✓	✓	✓	✓
	Introduction Guide for ASIL C	✓	✓	✓	✓	✓
	Functional Safety Templates	✓	✓	✓	✓	✓
	FMEDA Results	✓	✓	✓	✓	✓
	How-to-Guide for ASIL C		✓	✓	✓	✓
	Complete Safety Documentation for Certification				✓	✓
Tools	IAR/S32DS	✓	✓	✓	✓	✓
	FreeMASTER	✓	✓	✓	✓	
Services	ISO 26262 Certification					✓
	Trainings (customer-specific)					
	Support			✓	✓	✓
Price	Price (EUR)	0.-	€750	€35.000	€45.000	€98.000
	Price (USD)	0.-	$875	$40,000	$53,000	$115,000
*To purchase Software, Safety or Certification Package, please follow this link.						

More about NewTec

NXP & NewTec Strong Partnership

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- NewTec is one of the worldwide leading Safety and Security Development and Consulting Expert
- NXP has a very big variety of safety certified or certifiable components
- Together we offer complete safety solutions

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NTSafetySolutions

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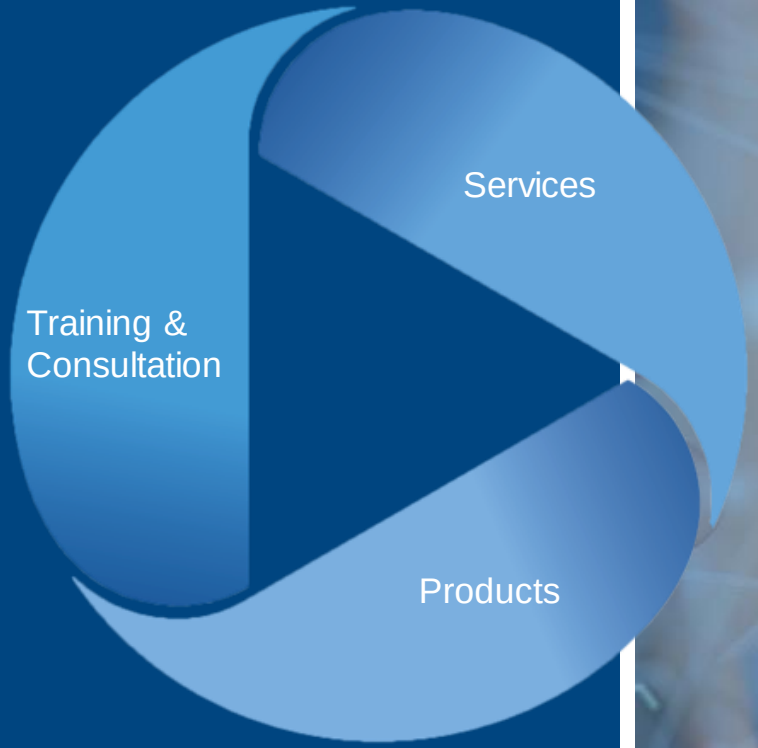
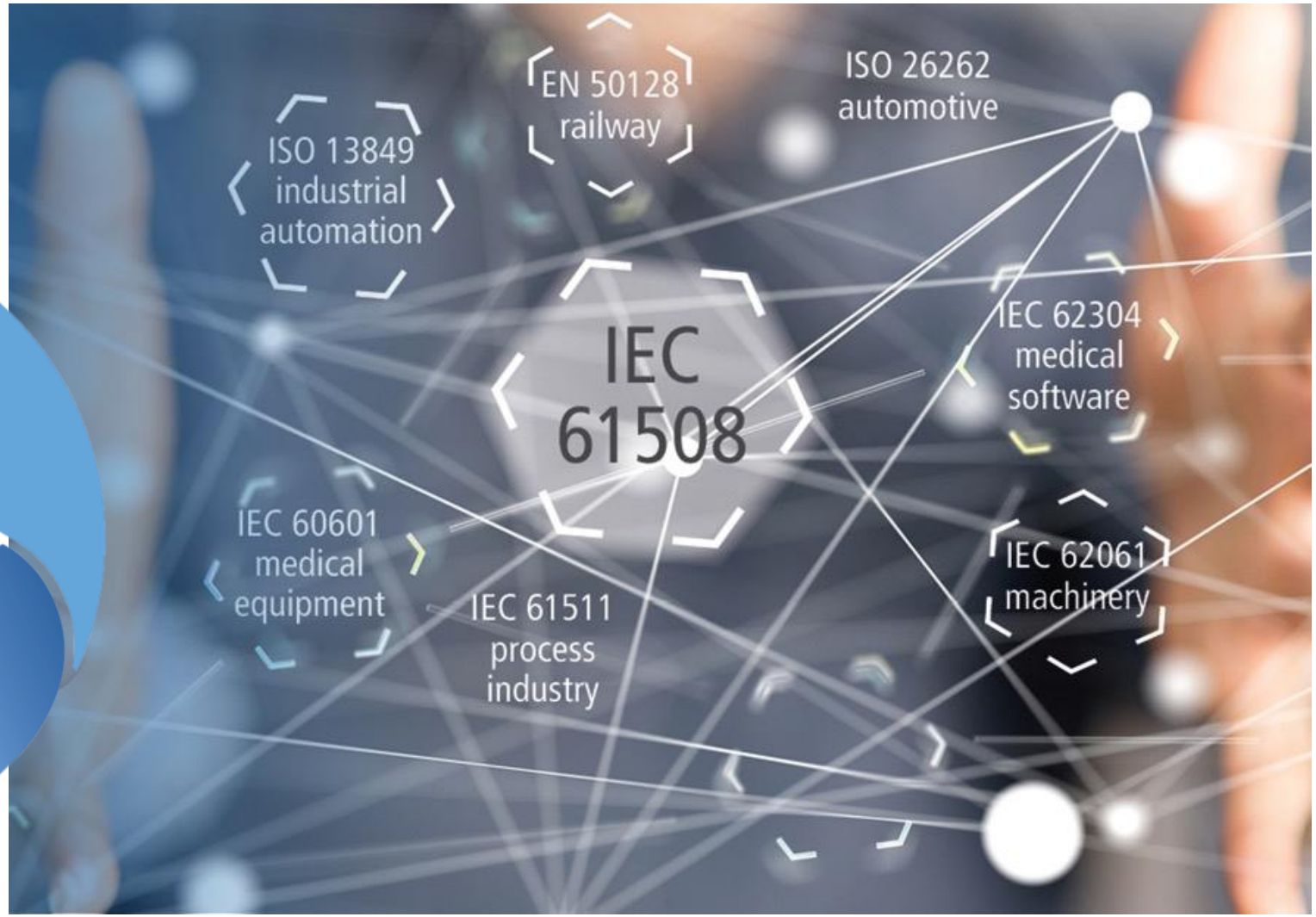
Safe Products – fast and efficient:
Risk management, ensure safety,
managing SIL





Courtesy of NewTec

NTSafetySolutions

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Training & Consultation

- Varied range of seminars for functional safety in practice
- Safety workshops for individual customers

Products, e.g.

- SafeFlex – Reference platform for safety development
- NTSafeDrive – Safety module for drives
- NTSafeBMS – Safety reference design for Battery Management Systems

Expert services to do with all aspects of product development

- Safety management assessment
- Safety risk assessment
- Safety requirement analysis
- Licensing strategy
- Safety planning
- Safety concept
- Concept examination
- Functional safety management

Managed Services in Product Lifecycle

- Safety system development
- Safety engineering
- Safety software development
- Safety hardware development
- Integration, verification & validation
- Documentation & traceability

Courtesy of NewTec

Summary

More Detailed Product Info at nxp.com/NTBMS

Overview

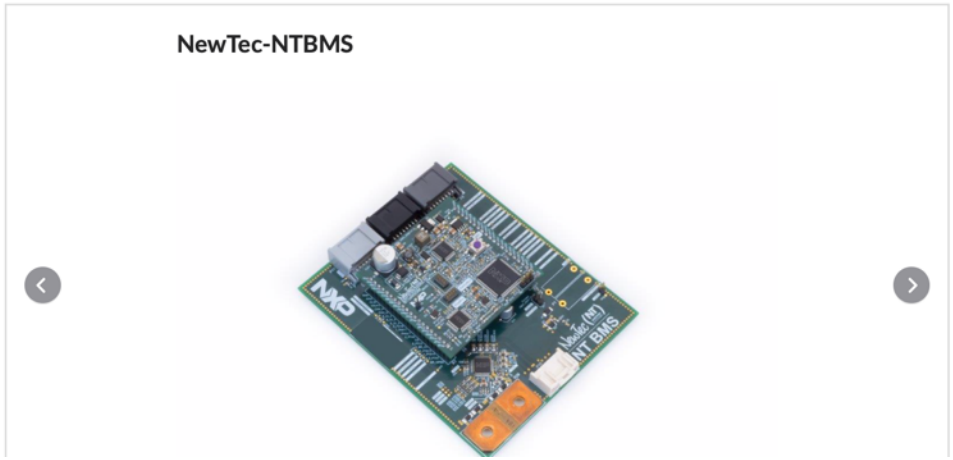
NewTec NTBMS is an e-mobility reference design and complete safety support package for Battery Management Systems. It is constructed with a two boards approach a functional safety System-on-Module (Safety SoM) board and a Battery Management System (BMS) application board. The Safety SoM is based on NXP's S32K144 and KEA microcontrollers, and FS4503C safety power system. The BMS application board is based on NXP's MC33772B battery cell controller IC. The support package includes the necessary safety documentation and software for certification purposes. It is intended for device manufacturers with Lithium-Ion batteries and suppliers

Features

- Permanent measurement of cell voltages
- Over-temperature protection
- Overcurrent / overvoltage detection
- Undervoltage detection (short circuit)
- Safe relay (breaker) control (ASIL C)
- Unintended relay close
- Unintended relay open
- Various definable Safe States
- LIN and CAN bus interface
- Crash detection

More

Data Sheets | User Guide | Buy



Broad applications

Automotive and Industrial
Low Voltage BMS Applications

Benefits to you

NewTec and NXP
Functional Safety expertise

Ready to go

Rich set of Free collaterals
&
Ref HW and SW available today

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