

PF81/82 PMICs for High-Performance Application Processors

Vincent Lagardelle
SPM Business Development

October 2019 | Session T3697



SECURE CONNECTIONS
FOR A SMARTER WORLD

Autonomy



Electrification



Connectivity



Safe and Secure Mobility

Autonomy



AMF-AUT-T3628
Safety Power Management for
Automotive Radar and ADAS
Applications

Yasuomy Sakyu
Tuesday 4:00 PM
Samuel (Lower Level)

Electrification



AMF-AUT-T3832
Electrification—Functional Safety
Backbone Solutions to Attach with S32

Tuesday 11:00 AM Galilee (Main Floor)

David Lopez

Connectivity



AMF-AUT-T3833
Power Management for Connectivity
and Infotainment Solutions

Wednesday 9:10 AM
Kings I & II (Lower Level)

Vincent Lagardelle

AMF-AUT-T3697
PF81/PF82 PMICs for High-
Performance Applications Processors

Wednesday 1:30 PM
Samuel (Lower Level)

Visit us at the
TechLab

Safety PMIC Demo



One System = Multi
PMIC Solution



AMF-AUT-T3832
Functional Safety in Power
Management (Safety PMICs) and
System Considerations

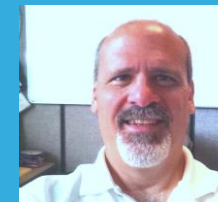
JP Meunier
Wednesday 10:00 AM
Judith (Upper Level)



AMF-AUT-T3631
Scalable & Safe Power
Management Solutions Overview

Tuesday 10:00 AM

Vincent Lagardelle



AMF-AUT-T3884
SPM Tool Overview

Wednesday 4:00 PM
Sarah (Upper Level)

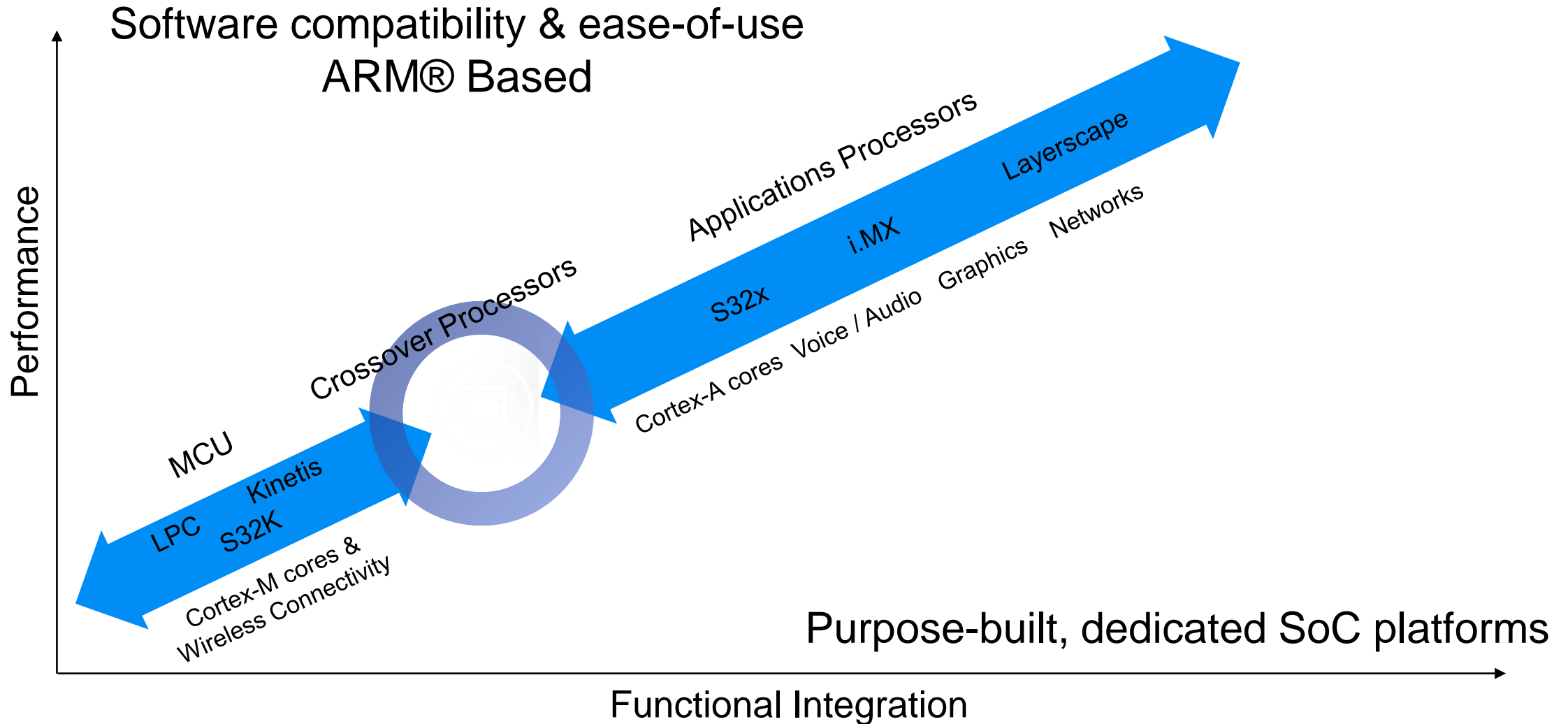
Jeff Reiter

AGENDA

- Portfolio overview
- Solutions for S32
- Solutions for iMX8
- Solutions for Layerscape
- Tools Overview

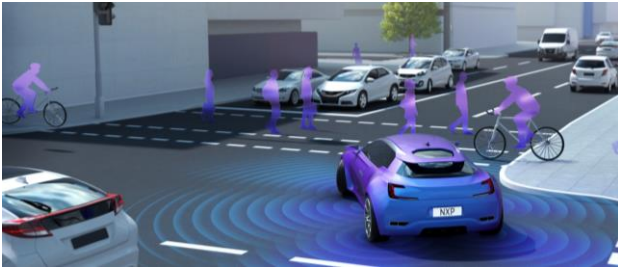


NXP Scalable Processing Continuum



Safety PMIC Overview

S32



MC33907/8
FS6500,FS8500,PF8200

i.MX



PF0100, PF3000
PF8200

Layerscape



VR500,
PF8200

BENEFITS:

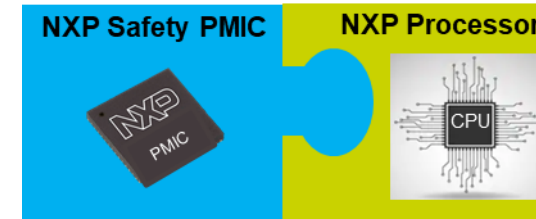
- Support MCU's power and safety scalability platform requirement
- Co-developed and validated with the MCU for an optimized solution

Strategy & Portfolio Overview



Automotive Safety Power Management Solutions Strategy

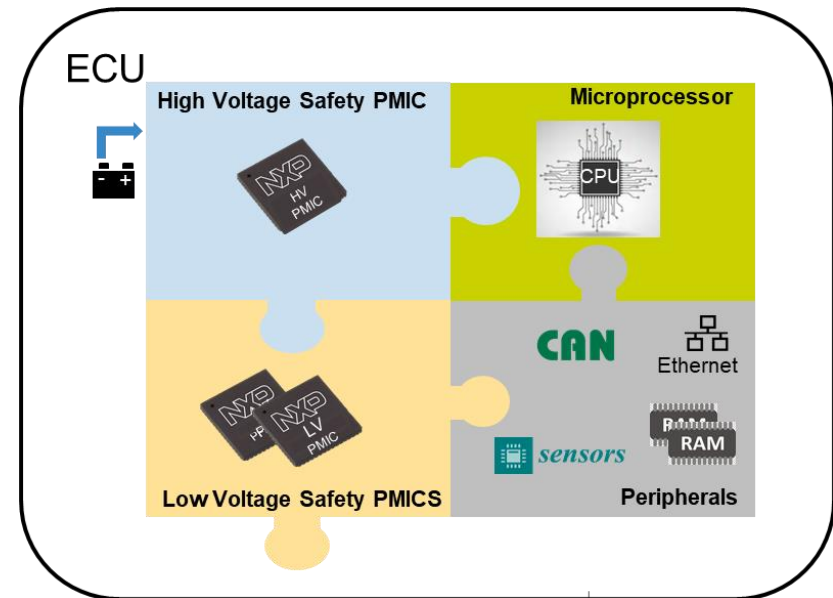
1 100% Processor Attach



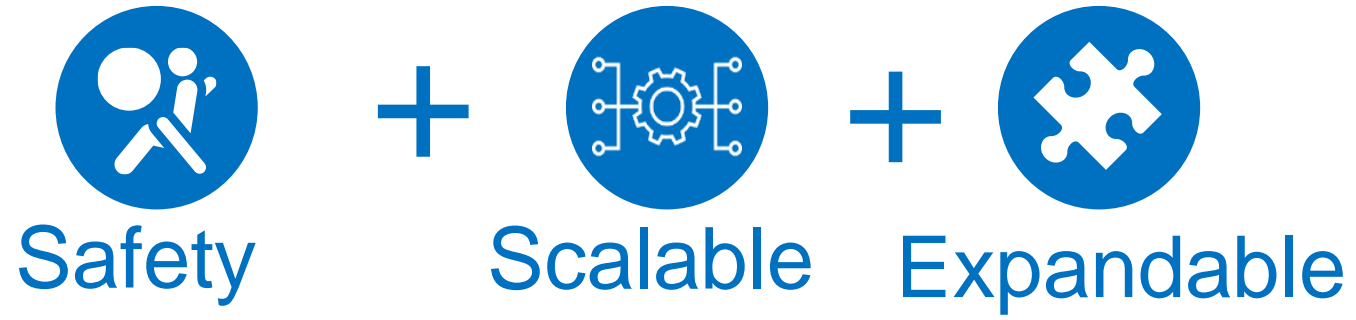
2 System Power Solutions



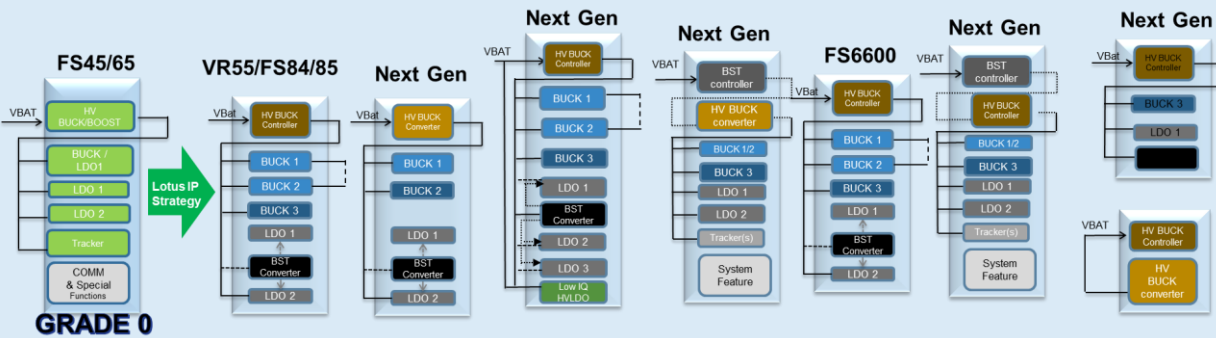
SAFETY PMIC “building blocks” Portfolio



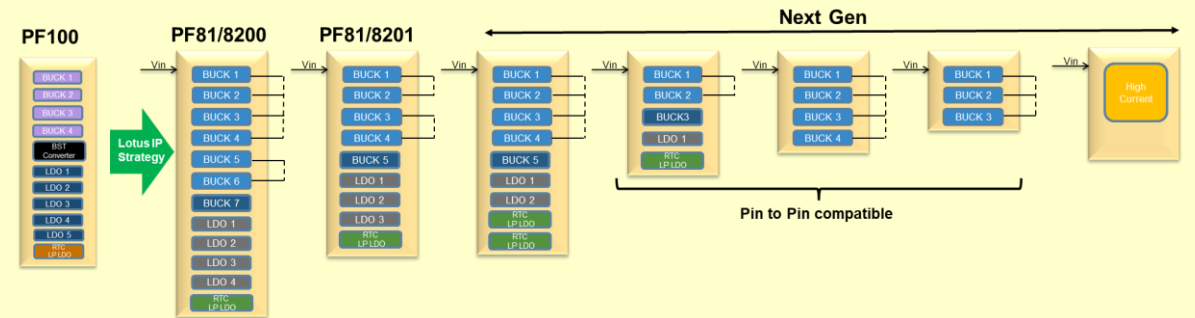
NXP Safety PMIC's DNA



Automotive PMIC 12V/24V Battery Connected

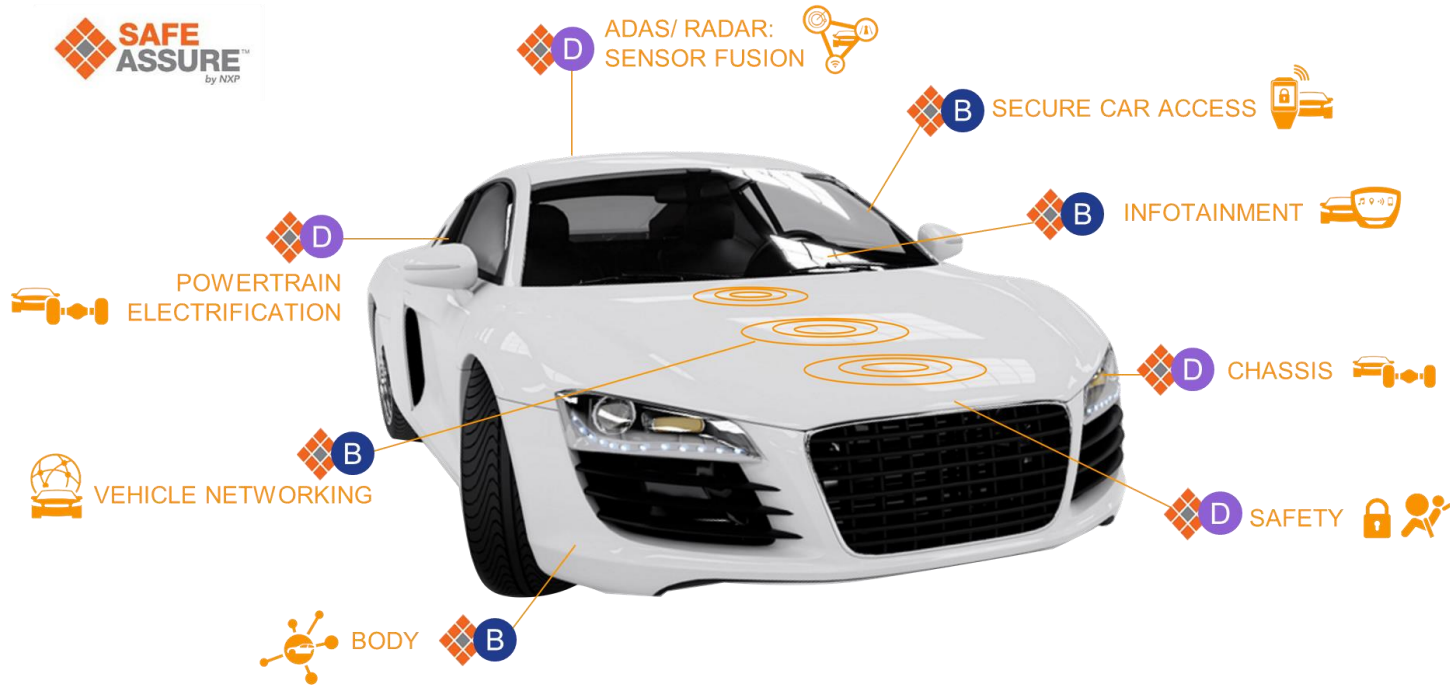


Automotive PMIC <5V Low Vin Connected





NXP Functional Safety System Solutions



Dedicated session

AMF-AUT-T3832

Functional Safety in Power Management (Safety PMICs) and System Considerations

Wednesday 10:00 AM
Judith (Upper Level)

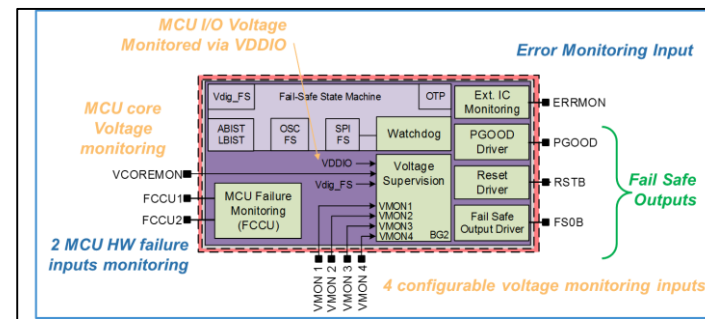
3rd Generation of SAFETY PMICs

PROCESS



ISO26262

SAFETY ARCHITECTURE



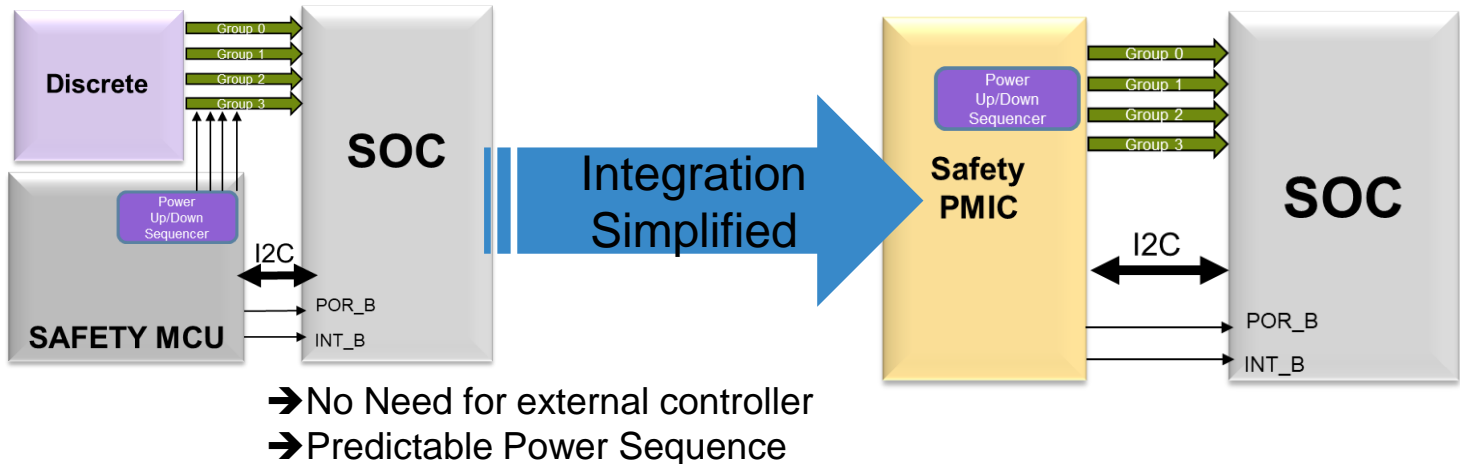


Scalability

- **Flexible product** through OTP configuration
 - ✓ Buck / LDO/ Boost value setting
 - ✓ Embedded & configurable Power up /down sequencer

Sequencing

	i MX 8Dx	S32xx
Group 0	SNVS	3.3V Standby GPIO's
Group 1	Main & SCU	All 3.3V GPIO's
Group 2	I/O's and DDR interface	All 1.8V Domains
Group 3	consists of the remaining portions of the SOC	Main Core and Standby Core



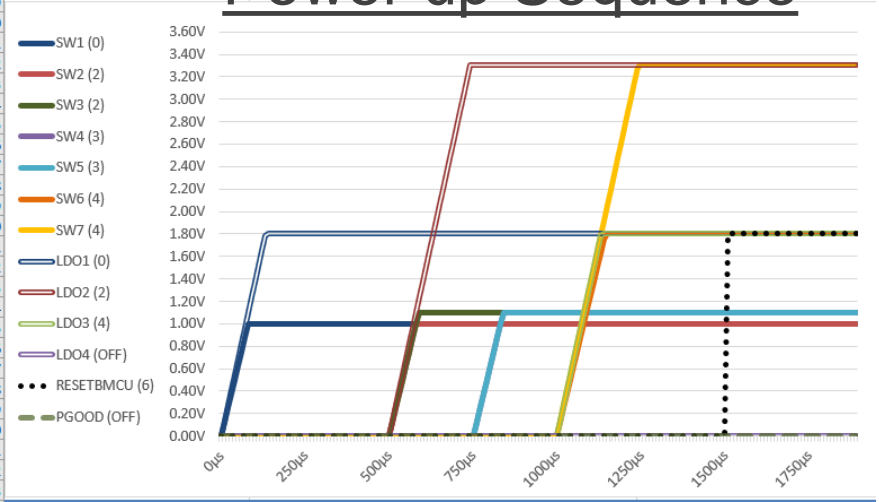
- ✓ Safety reaction
- ✓ Some functionality



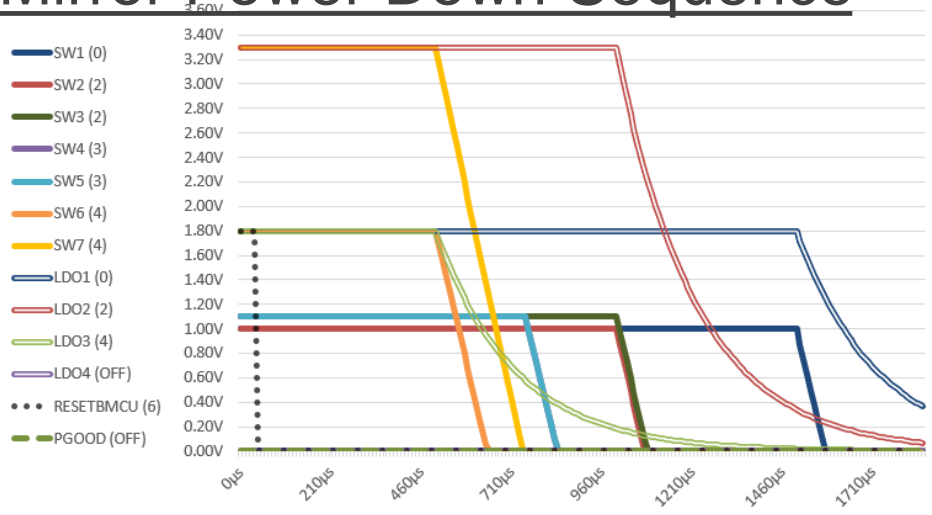


Configurable & Predictable Power Sequence via OTP Bits

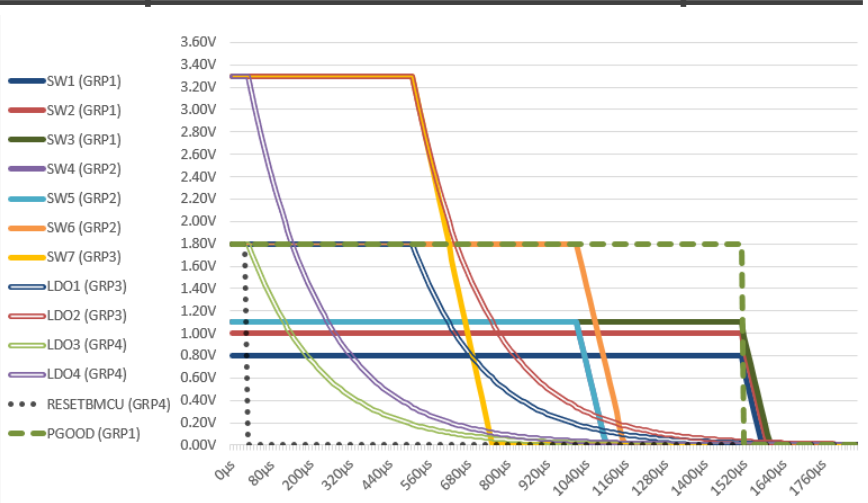
Power up Sequence



Mirror Power Down Sequence



Group Power Down Sequence



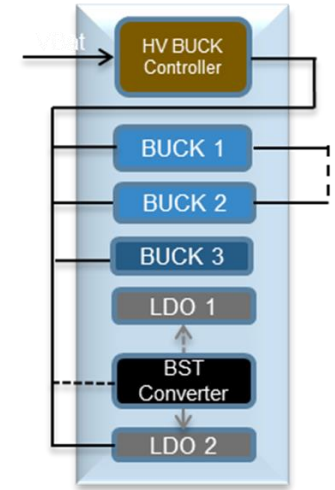
OTP configuration list example

PF8100	PF8200	Customer	Target
A0	A0	General	Non-OTP part
CC		General	i.MX8QXP MEK with LPDDR4
CD		General	i.MX8QM MEK with LPDDR4, PMIC1 with VDD_MIAN
CE		General	i.MX8QM MEK with LPDDR4, PMIC2 with VDD_GPU
CF		General	i.MX8QXP with DDR3L
CG		General	i.MX8QM with DDR4, PMIC1 with VDD_MIAN
CH		General	i.MX8QM with DDR4, PMIC2 with VDD_GPU
	CX	General	LS1043A
	D2	General	S32V2 reference board
	DA	General	i.MX8QM with LPDDR4, PMIC1 with VDD_MIAN
	DB	General	i.MX8QM with LPDDR4, PMIC2 with VDD_GPU
	DE	General	i.MX8QXP with LPDDR4
	DF	General	i.MX8QXP with DDR3L
	DG	General	i.MX8QM with DDR4, PMIC1 with VDD_MIAN
	DH	General	i.MX8QM with DDR4, PMIC2 with VDD_GPU
	DM	General	S32V reference board
	DN	General	S32R reference board

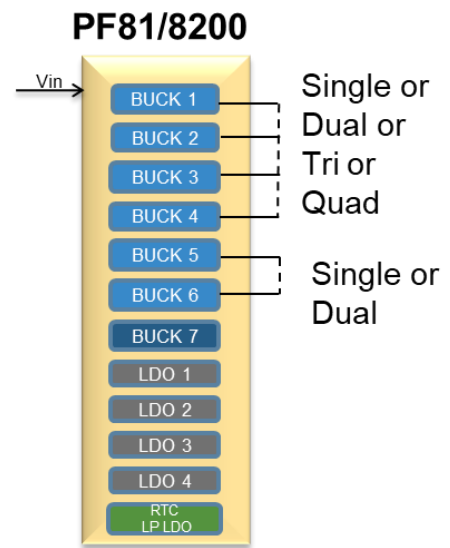
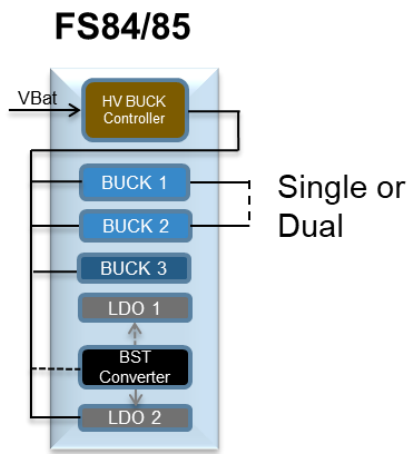
Scalability

- **Scalable product:**

- ✓ Safety scalability
- ✓ Portfolio scalability
- ✓ Power scalability: 2 to 4 Buck in multiphase



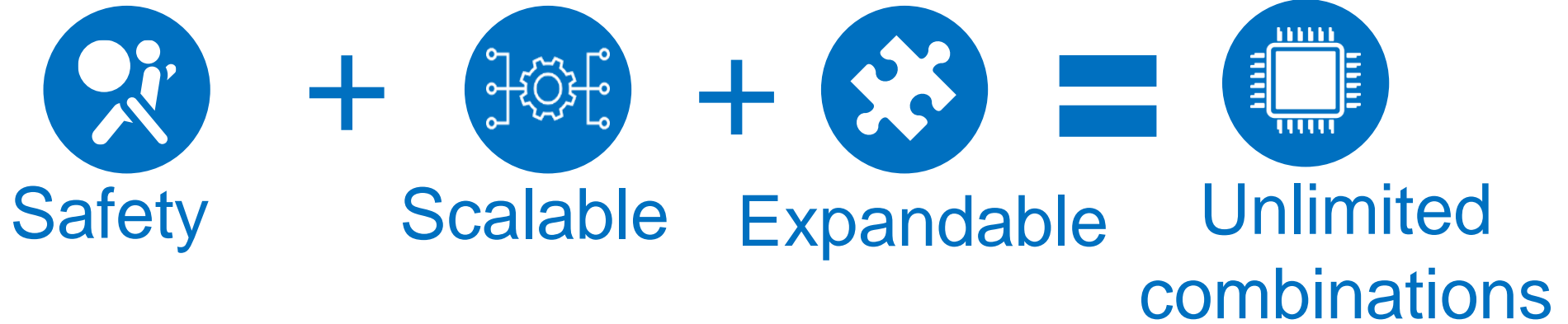
	ASIL B ready	ASIL D Ready
BUCK 1 BUCK 2 BUCK 3	FS8430	FS8530
BUCK 1 BUCK 2	FS8420	FS8520
BUCK 1 BUCK 3	FS8410	FS8510
BUCK 1	FS8400	FS8500



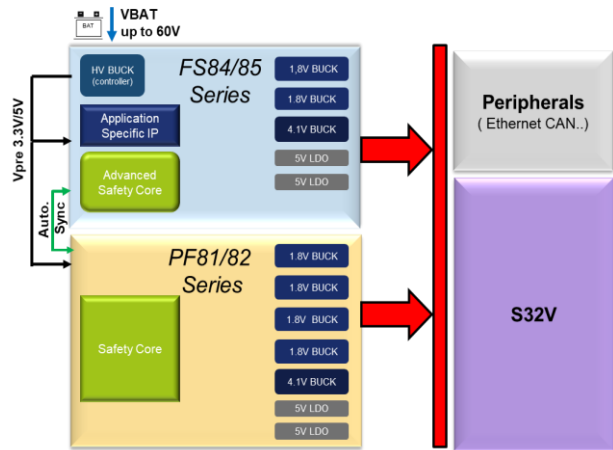
Board Performance & Size

	Input Pi filter	Output filter
Single-phase		
Multi-phase		

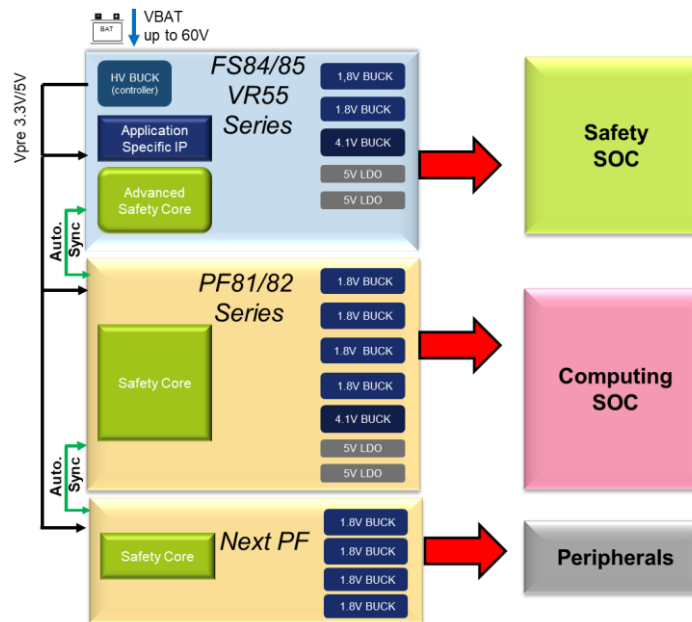
ONE SYSTEM = MULTI PMIC SOLUTION



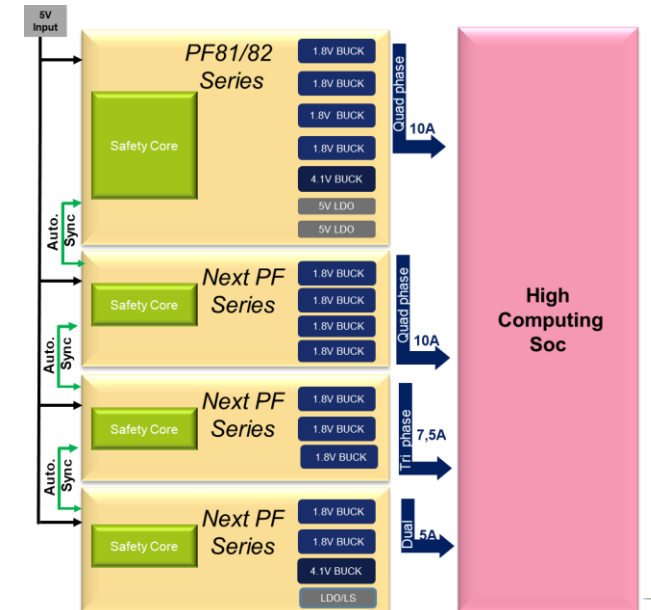
Global System Solution



Multi Processor System



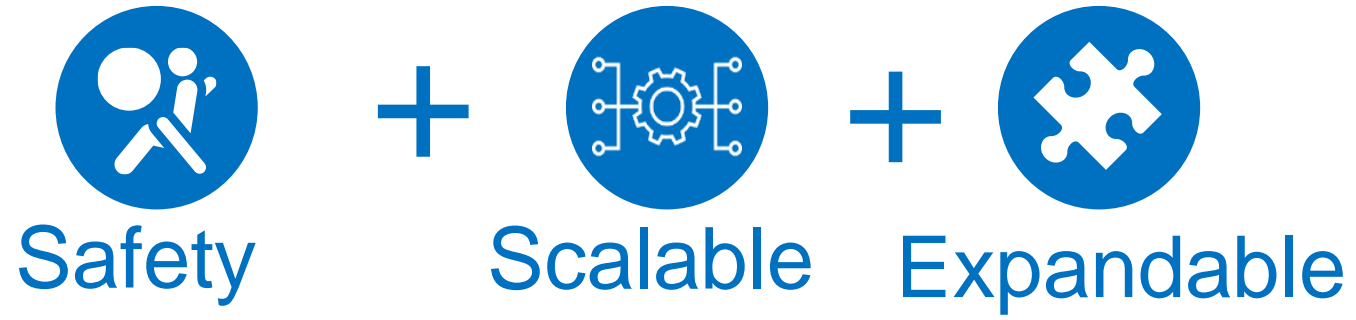
High Computing Soc



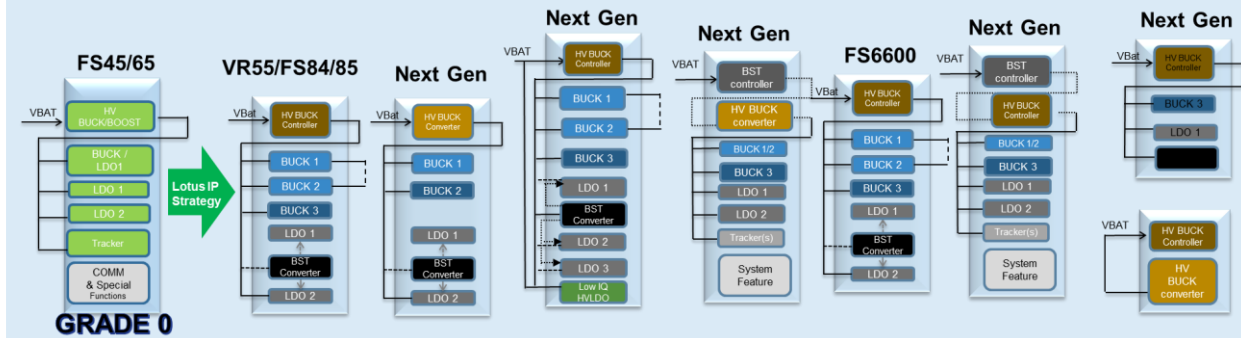
PF8100/PF8200 Overview



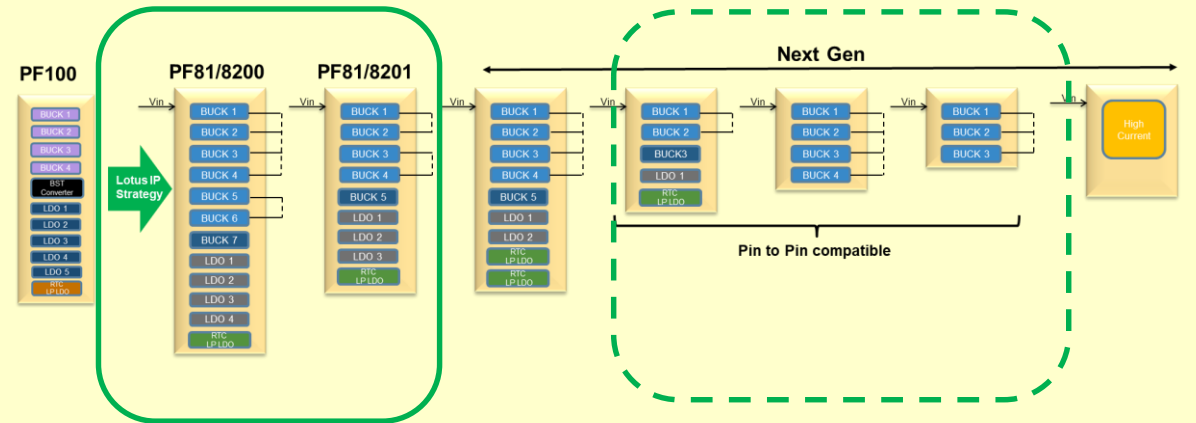
NXP Safety PMIC's DNA



Automotive PMIC 12V/24V Battery Connected



Automotive PMIC <5V Low Vin Connected



Automotive Low Vin PMIC

PF81/82x Automotive High Integration 5.5V PMIC



Differentiating Points

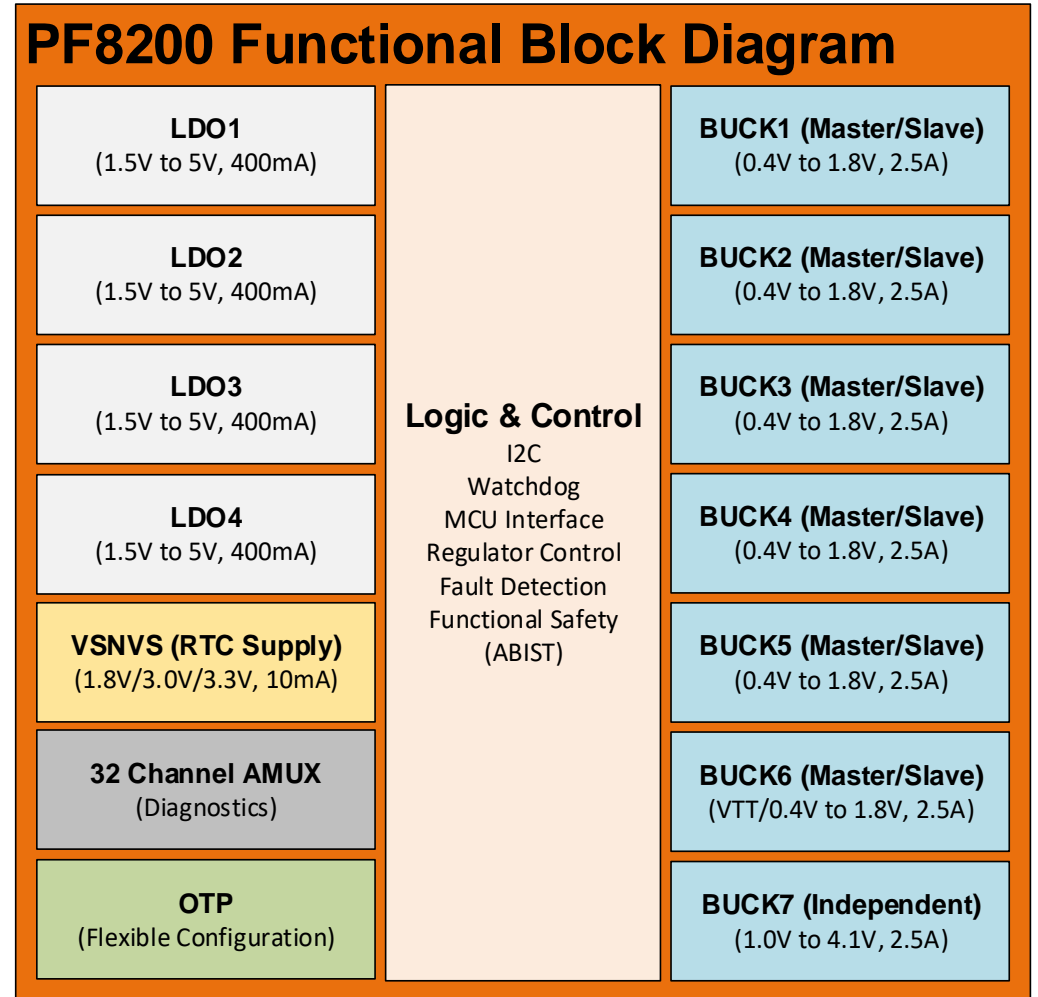
- **High Power, High Efficiency** up to 10 A Core supply and > 19A total output power with **tight accuracy** and advanced thermal management
- **Proven & Robust** solution co-developed with MCU. BSP and reference designs provided.
- **Scalable** supply for MCU family with OTP configurability options
- **Minimize EMC with** Spread spectrum, frequency tuning, frequency synchronization and multi-phase operation
- **Optimized Size** through advanced architecture, < 200mm² component area
- Fit for for **ASIL-B** Application (PF8200)

Product Features

- Vin 2.7 – 5.5 V
- 6 Buck 0.4- 1.8 V, 2.5A Master/Slave;1 Buck 1.2- 4.5V Independent
- 4 LDO 1.5 - 5 V
- -40°C to 105°C Operating Ambient Temperature (150°C Tj)
- Prog Freq, Dynamic Freq Spread Spectrum , Ext Clock Synch
- 32 Channel AMUX, OV,UV
- Qualified for QM level (PF8100) or ASIL-B Safety Level (PF8200)
- 8x8mm 56-LD QFN-EP
- Automotive and Industrial grades available

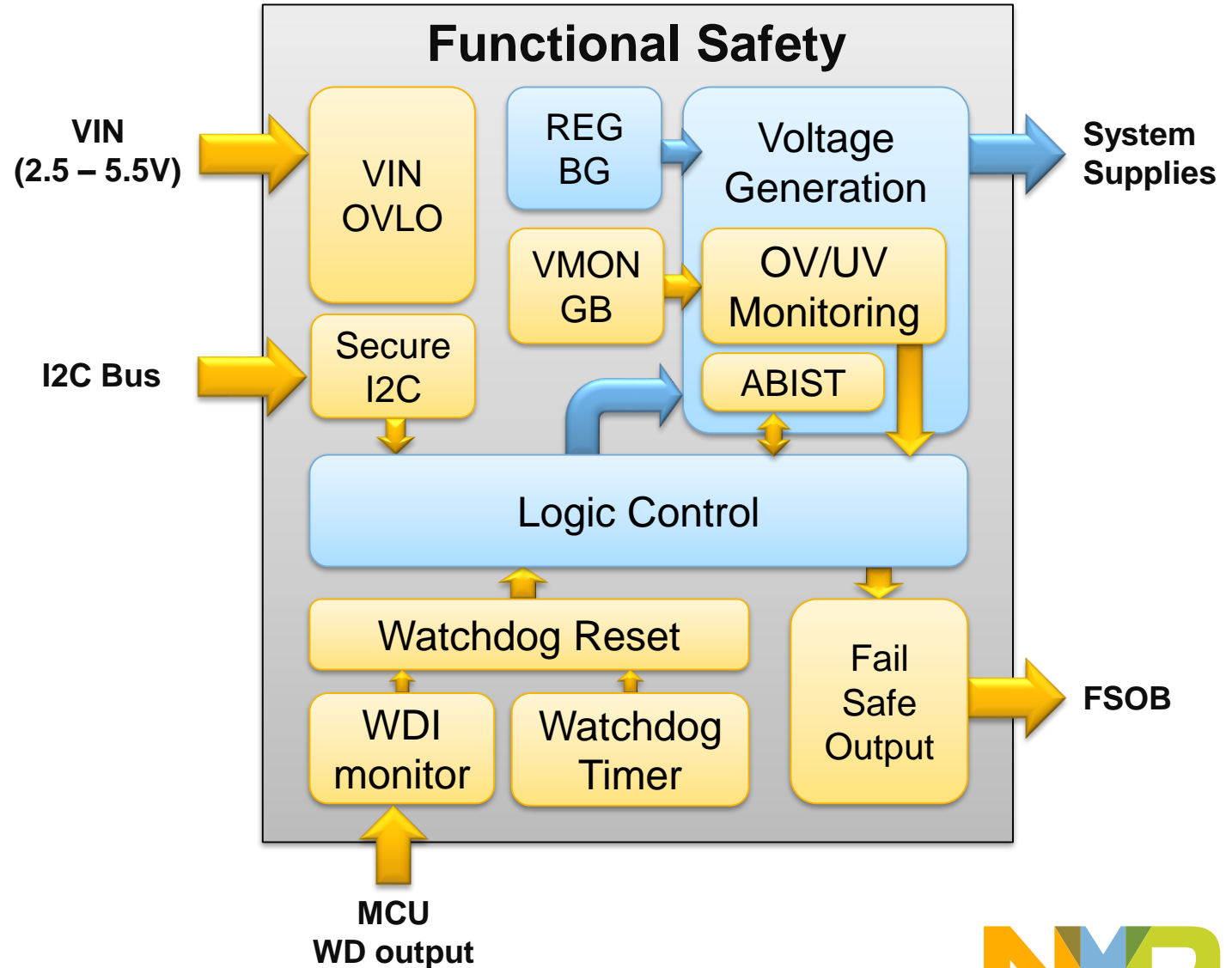
Applications

- Infotainment / Cluster
- Driver Awareness
- Vision
- Cable/Internet Stream Boxes
- Industrial/Consumer



PF8200 – Functional Safety

- **Input Overvoltage Lockout**
- **Regulator Output Monitoring**
 - Programmable OV/UV monitoring
 - Independent Bandgap
- **Analog built in Self-test**
 - ABIST on Output monitoring Blocks
- **Watchdog Reset**
 - WDI monitoring
 - Internal WD Timer
- **Secure I2C Communication**
 - CRC verification
 - I2C Secure Write
- **Programmable Safety Output**



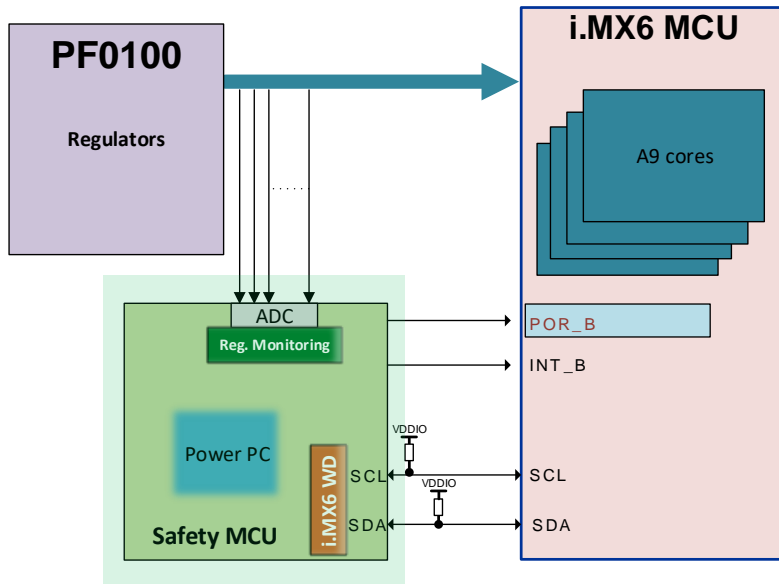


System Safety Integration

i.MX 6 solution

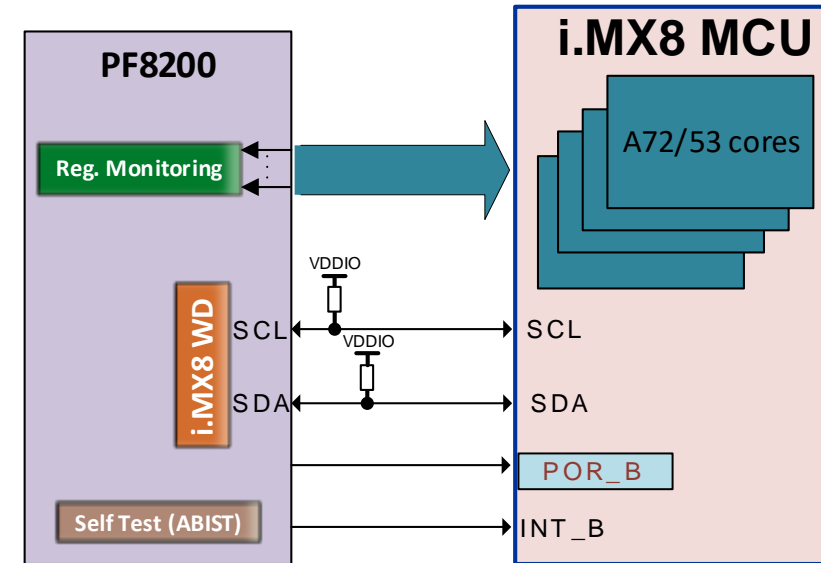


i.MX 8 + PF82 solution



PMIC + i.MX 6 monitoring

- PCB layout and integration highly simplified
- No need of external MCU to endorse the safety of the system
- System BOM reduced
- Higher latent failure coverage on PMIC thanks to the ABIST

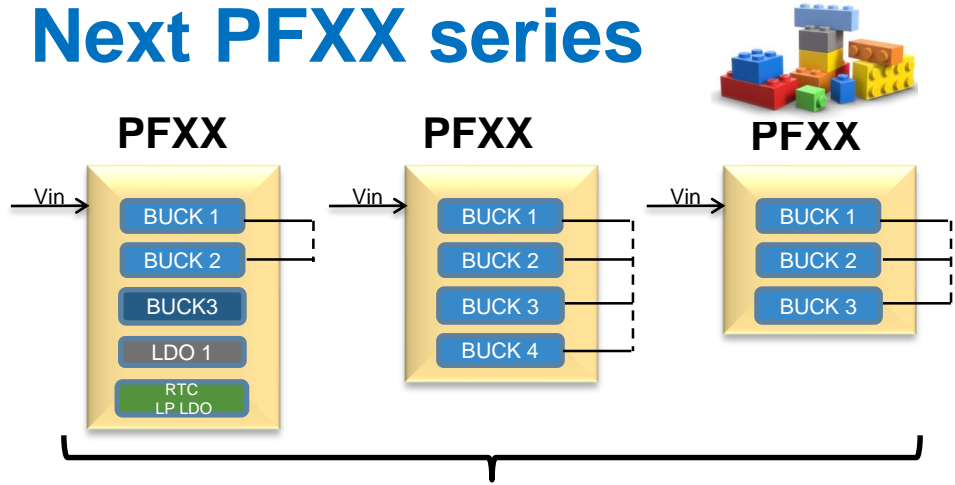




Scalability

Function	PF8100	PF8200
Buck regulator w/ DVS	6ch	6ch
Buck regulator w/o DVS	1ch	1ch
LDO	4ch	4ch
VSNVS regulator	1ch	1ch
AMUX output	1ch	1ch
Communication I/F	I2C with CRC	I2C with CRC
Watchdog	Yes	Yes
MCU I/F	PWRON, STANDBY, INTB, RESETBMCU, EWARNB, PGOOD, WDI	PWRON, STANDBY, INTB, RESETBMCU, EWARNB, PGOOD, WDI
OV/UV monitoring	Yes	Yes
OTP program	Yes	Yes
ABIST	No	Yes
20MHz CLK check	No	Yes
OTP CRC check	No	Yes
Fail-Safe state	No	Yes
Sequire I2C write protection	No	Yes
Target ASIL class	Non-ASIL or QM	ASIL-A or B
Package	56-QFN w/ WF	56-QFN w/ WF

Next PFXX series



Product Features

- Up to 10A Core/GPU supply and advanced thermal management
- Reduced noise: Spread spectrum, manual frequency tuning, frequency synchronization and dual-phase operation
- Reduced solution size through internal compensation, Total Component size of < 100mm²
- Fit for ASIL-B
- OTP configurability for scalable/flexible solutions
- -40°C to 125°C Operating Ambient Temperature
- 6mmx6mm 40LD QFN-EP Package
- Automotive and Industrial grades available



- **Safety Feature** available:
 - WD
 - Diagnosis feature : UV/OV, CRC.....
- Higher latent failure coverage compared to discrete thanks to ABIST

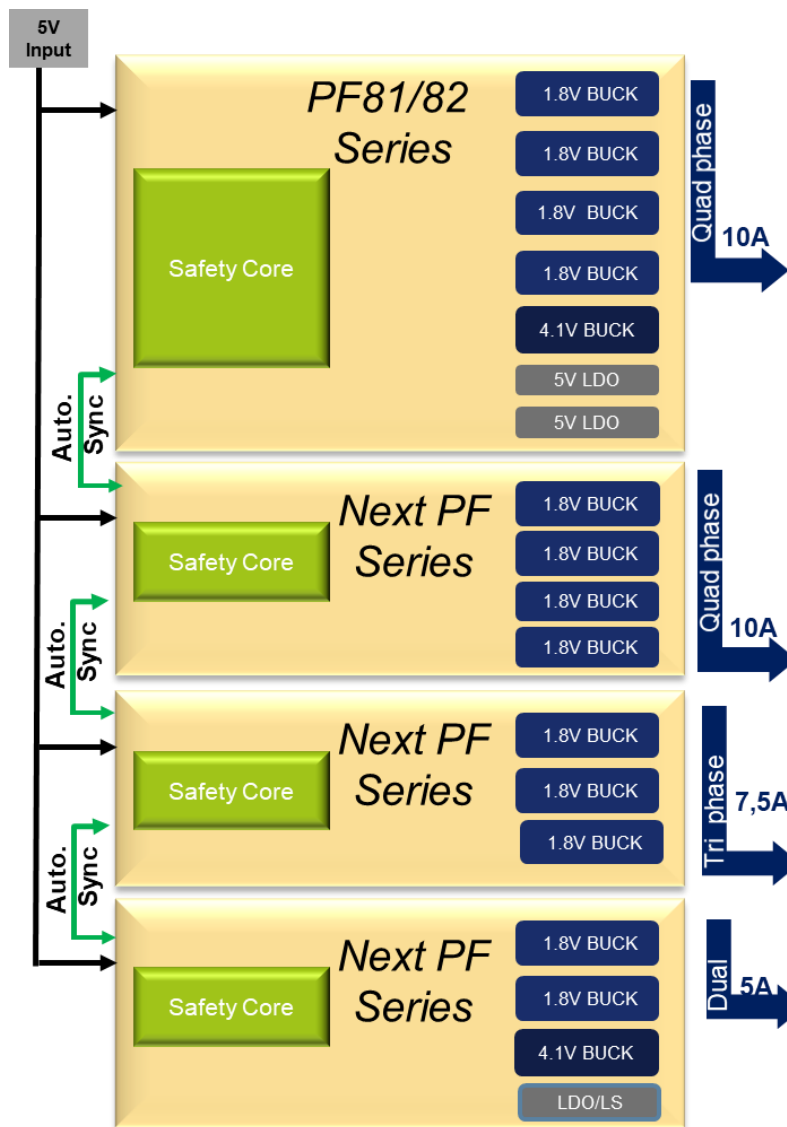
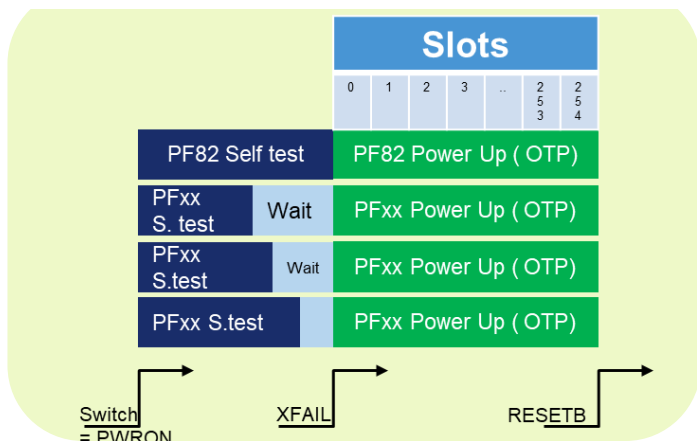
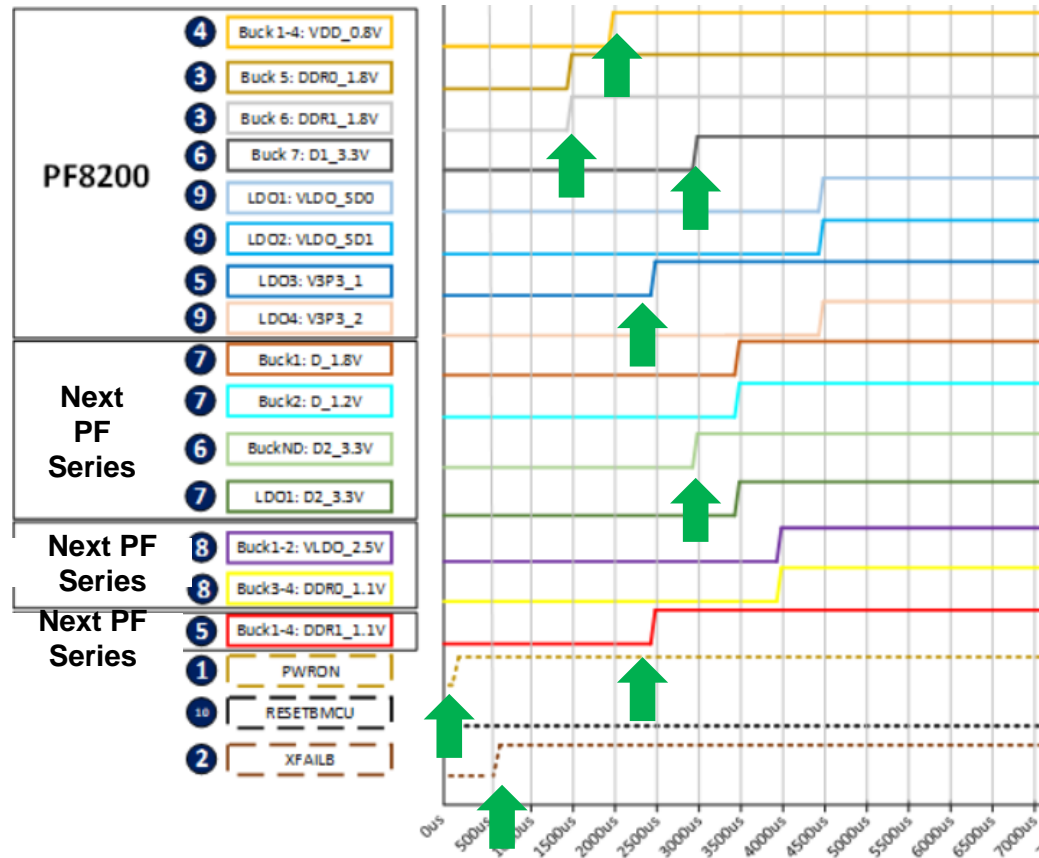


- **Scalability :**
 - Embedded power up sequencer
 - Hardware Control as well as I2C control
 - Multiphase operation



- **Expandable**
 - “LEGO BLOCK” Approach
 - Expandable solution
 - Several PMIC acting like one PMIC
 - no need for external MCU
 - Advanced Thermal Management Approach
 - One common SW family based on I2C

Multiple PF DEVICE : "Smart Companion" configuration



- ➔ One Box System through Sync.
- ➔ Better Thermal Approach
- ➔ Ensure Signal integrity



Solutions for S32



High-performance Vision Sensors

Improve Safety on the Road



Front View



Surround View



Driver Monitor



Perception

48
mph



NXP

S32V

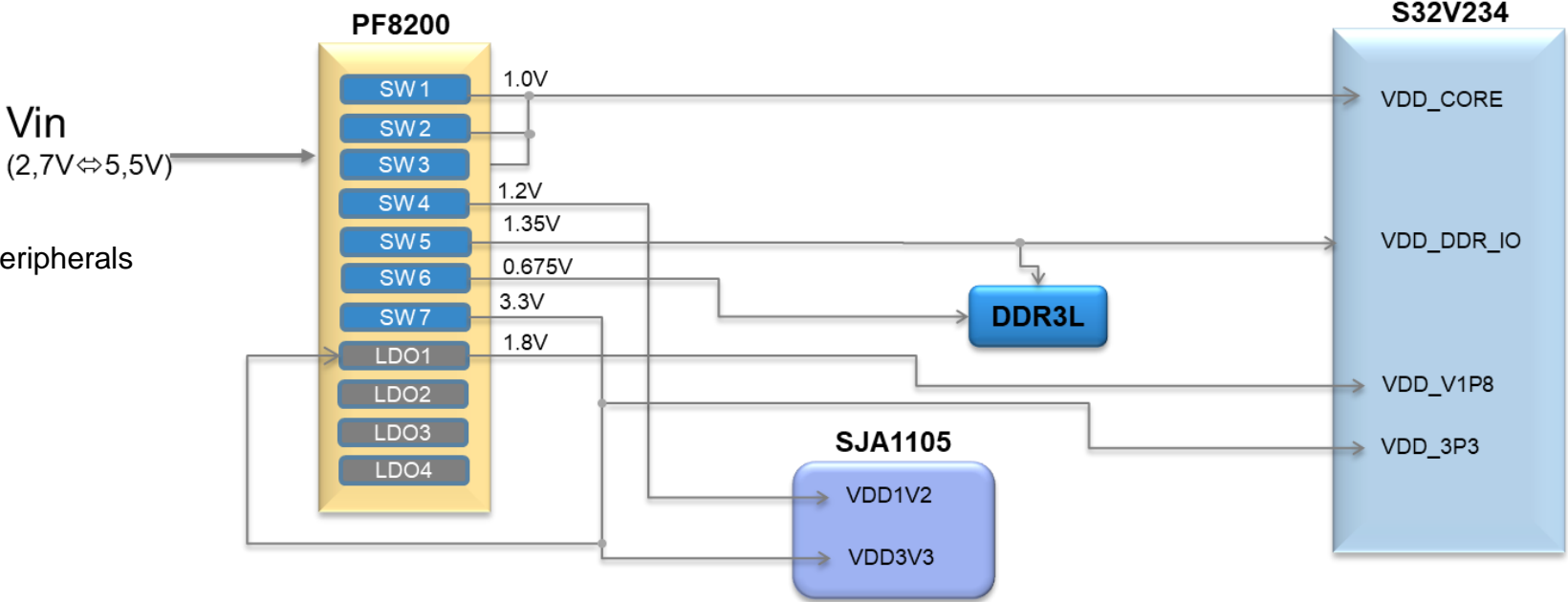
NXP S32V

Supports demand for
open, safe, scalable solutions, and AI

System Solution for S32V + Ethernet

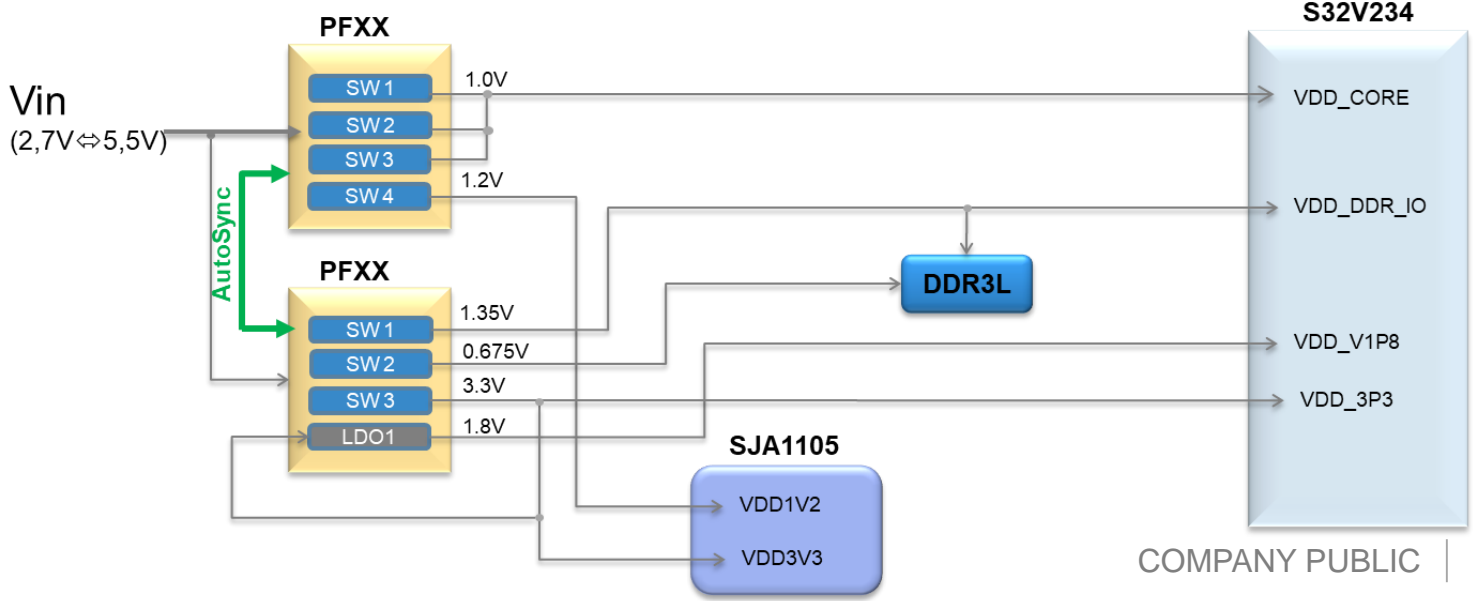
PF8200

Some rails available for peripherals

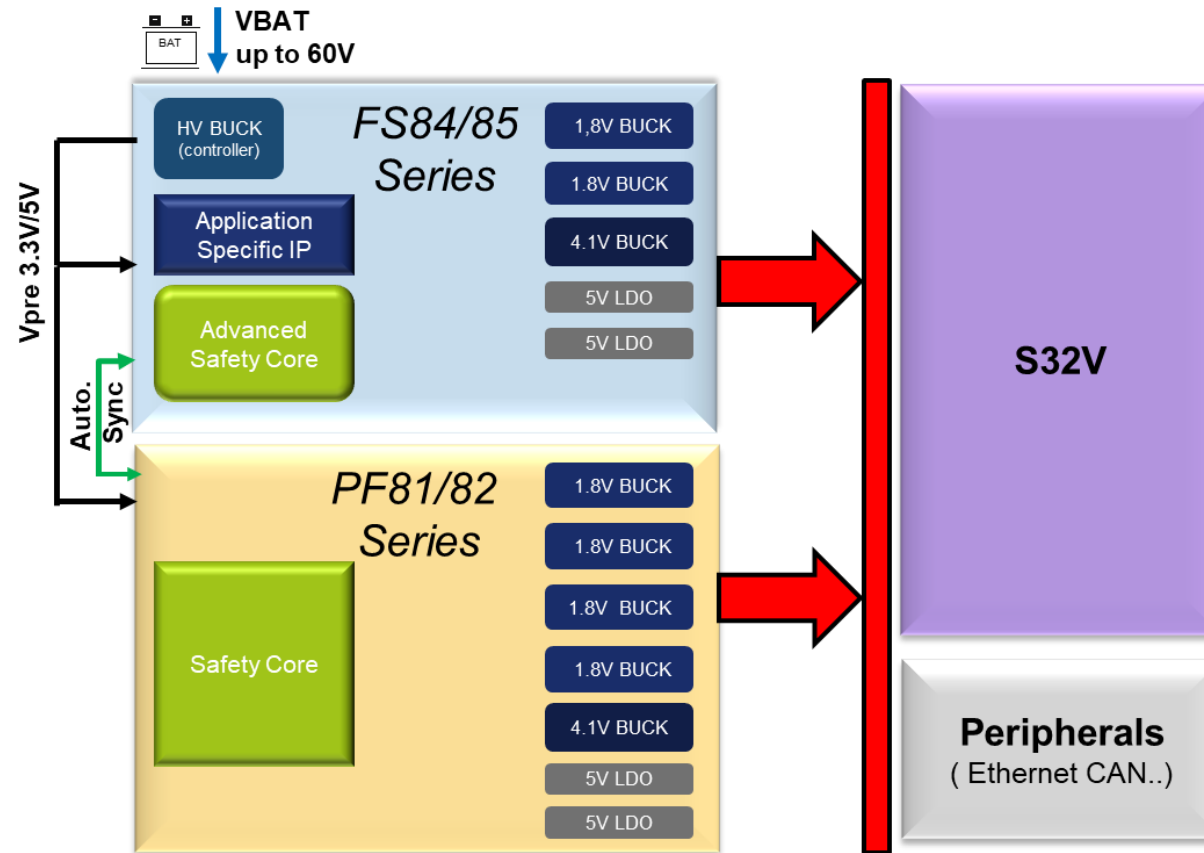


Next Gen PF

2 PFXX acting like one PMIC



System Solution for S32V + Ethernet FROM VBAT

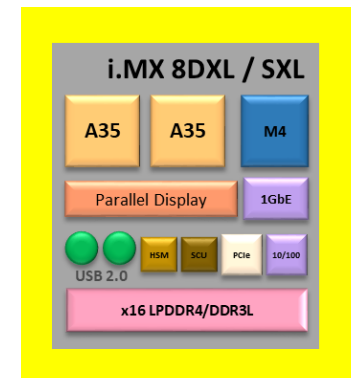
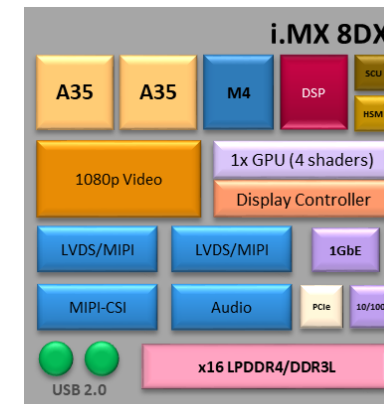
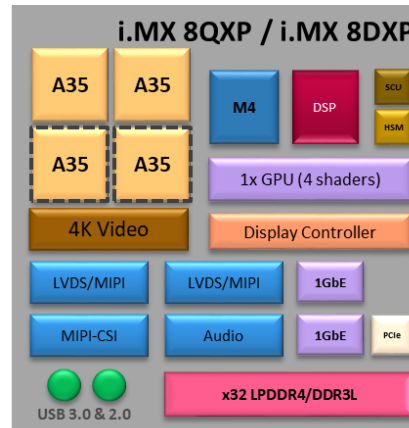
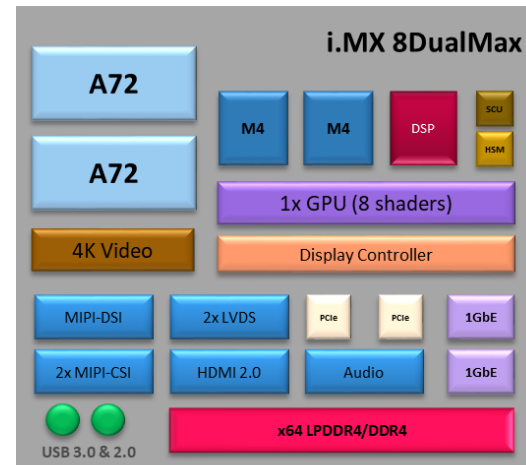
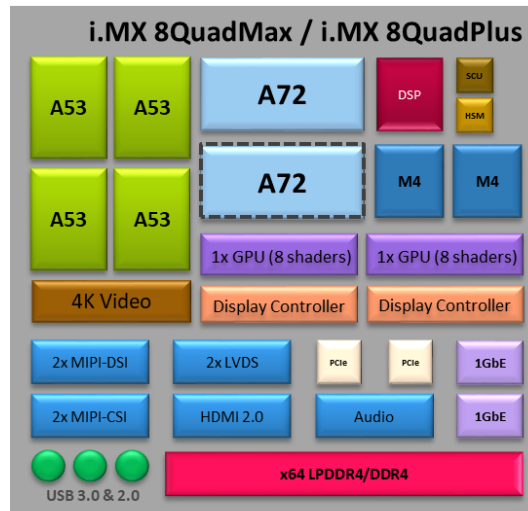


Solutions for iMX8



i.MX 8 & 8X Subsystem Reuse

Maximize Scalability of Embedded Processing to Reduce Design Complexity



Auto HMI, Vision, Audio and Voice Enabled with i.MX

DSP, Vision Acceleration, Real Time Domain, Safe Camera/Display/Audio, Simplified eCockpit

New Telematics / V2X / Smart Antenna Optimization

i.MX 8DXL / i.MX 8SXL

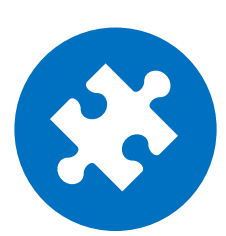


Scalability

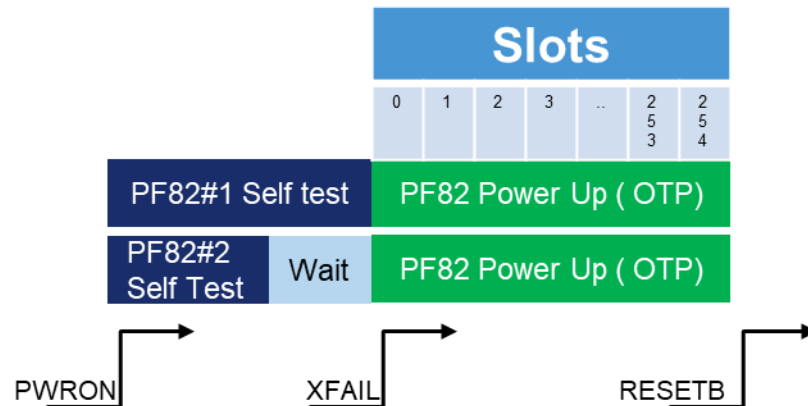
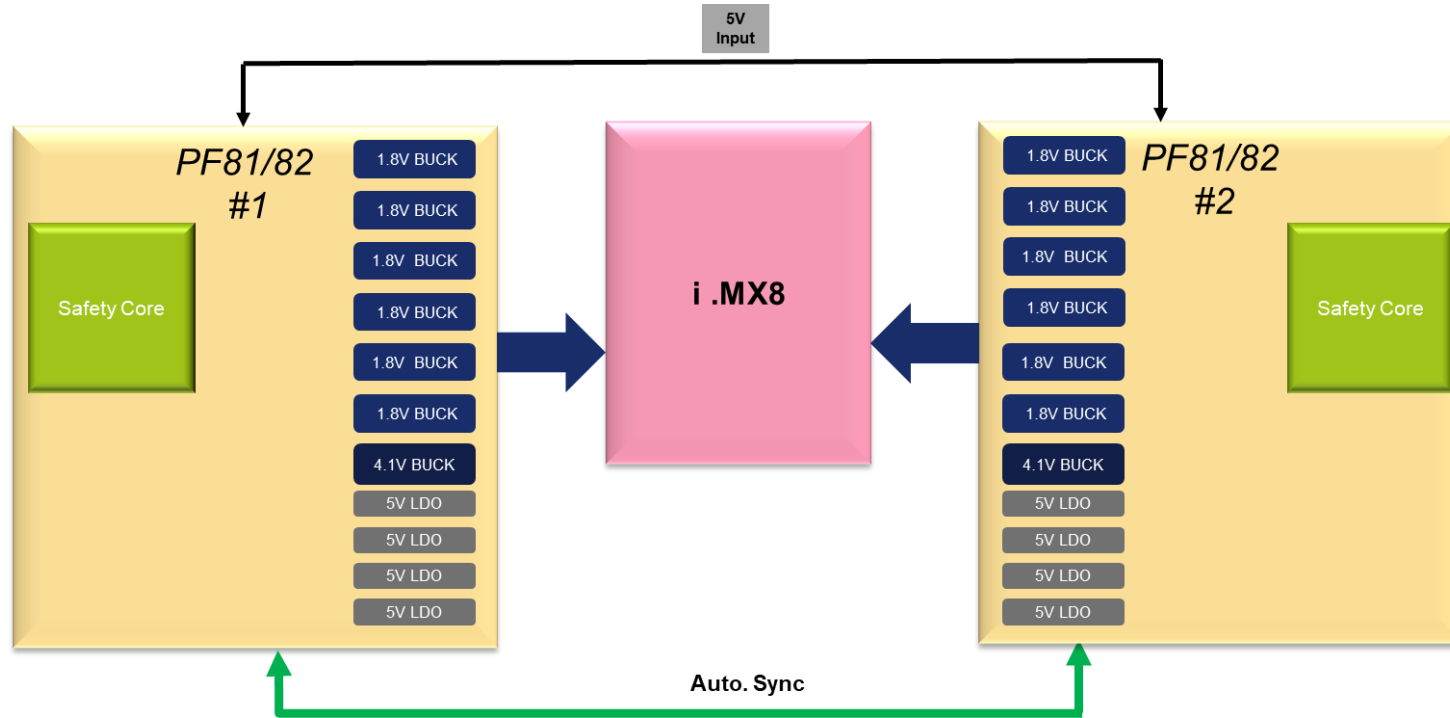
i. MX8 Processor

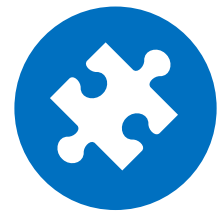
	i.MX 8QuadMax	i.MX 8QuadPlus	i.MX 8DualMax	i.MX 8QuadXPlus	i.MX 8DualXPlus	i.MX 8DualX	i.MX 8DXL	i.MX 8SXL
Safety PMIC PF81/8200 (X2)	✓							
PF81/8200 + PF81/8201		✓						
PF81/8200 + Next PF			✓					
PF81/8200				✓	✓	✓		
PF81/8201				✓	✓	✓		
Next PF						✓	✓	✓



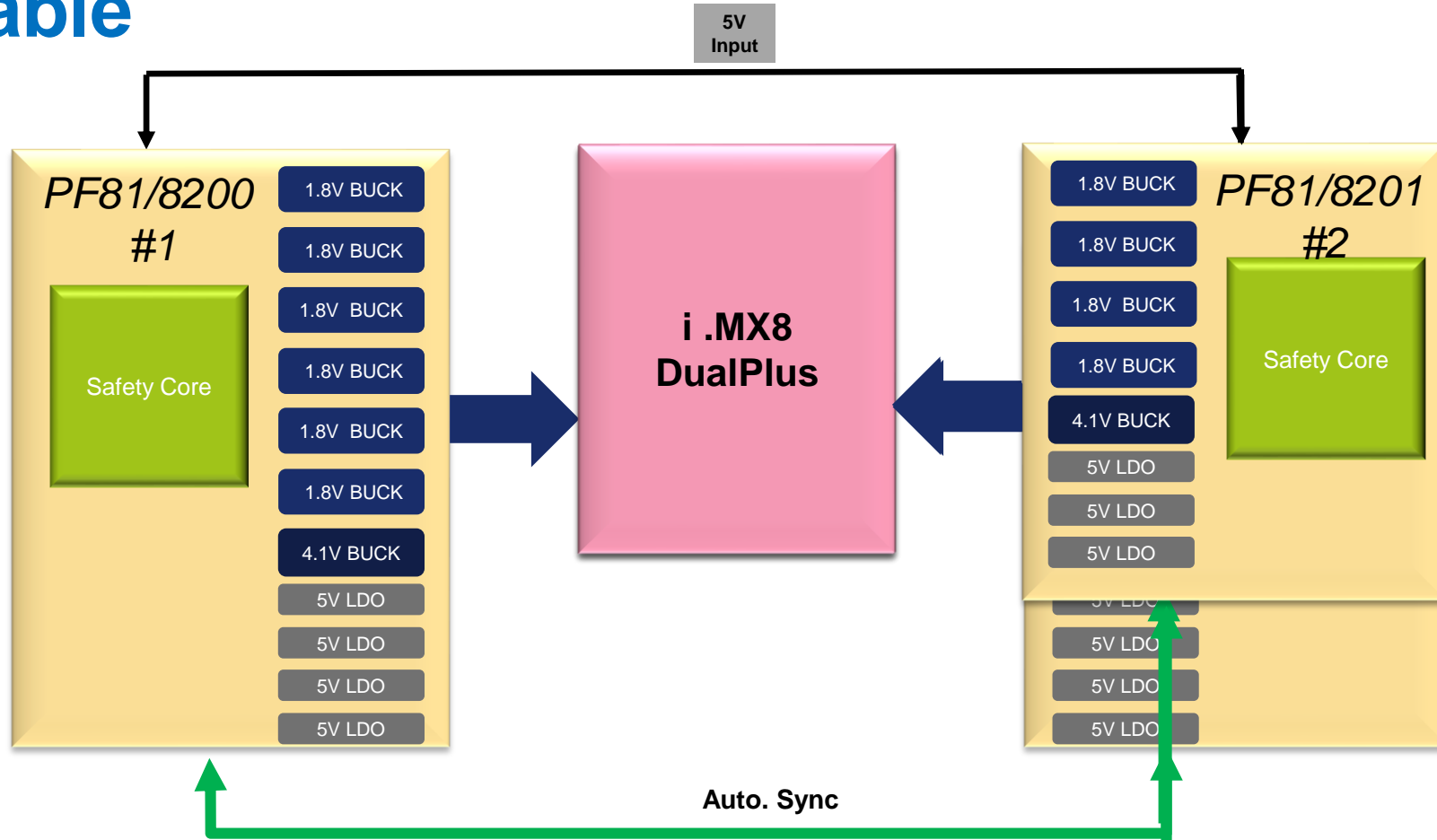


Expandable





Expandable



i.MX8 Processor

	i.MX 8QuadMax	i.MX 8QuadPlus	i.MX 8DualMax	i.MX 8QuadXPlus	i.MX 8DualXPlus	i.MX 8DualX	i.MX 8DXL	i.MX 8SXL
PF81/8200 (X2)	✓							
PF81/8200 + PF81/8201		✓						
PF81/8200 + PF5020			✓					
PF81/8200				✓	✓	✓		
PF81/8201				✓	✓	✓		
PF7100							✓	✓

Safety PMIC

i. MX8QuadMax / QuadPlus / DualMax

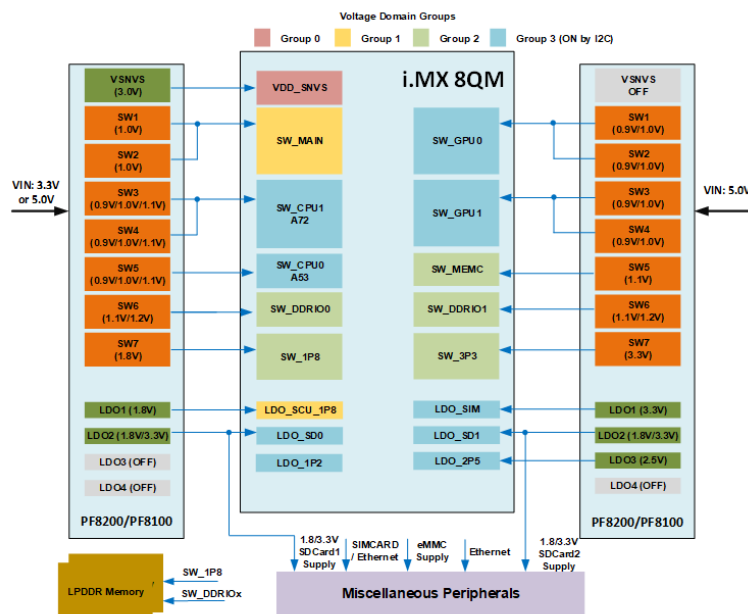
Compatible Design

i.MX8QuadMax

i.MX8QuadPlus

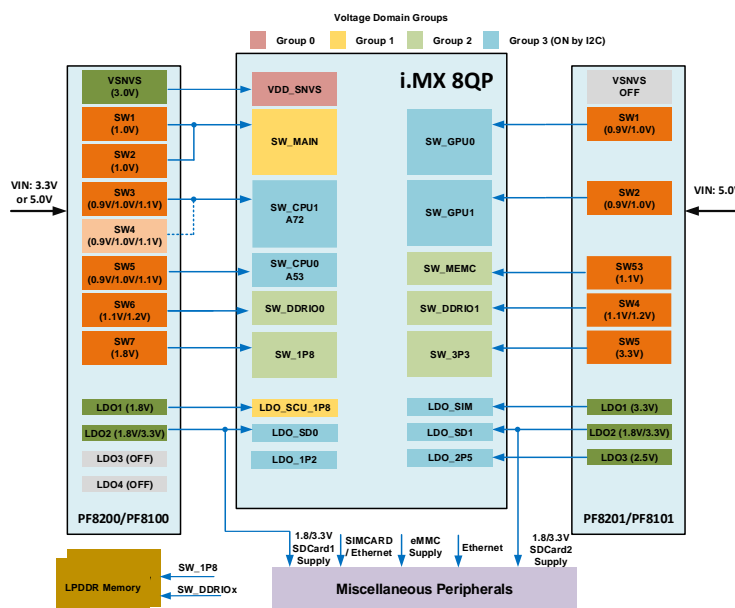
i.MX8DualMax

2 x PF8100/8200



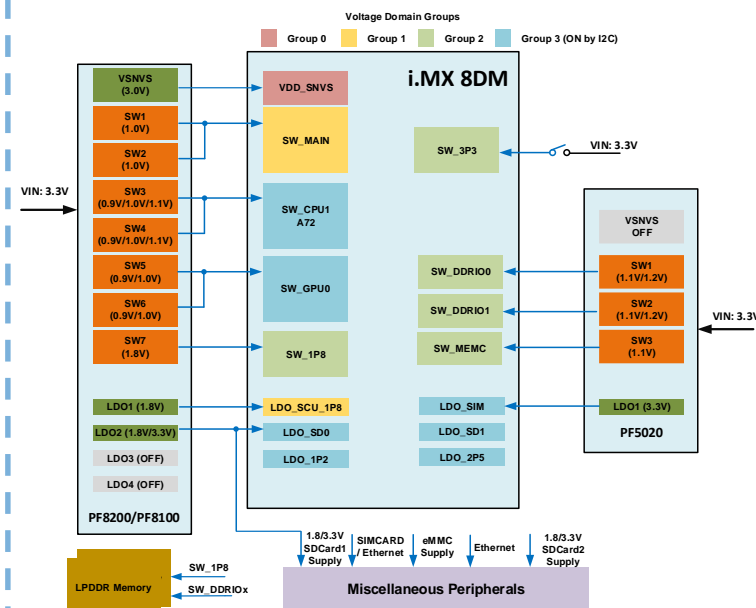
Optimized i.MX8QuadPlus

PF81/8200 +
PF81/8201 (or Next PF)



Optimized I. MX8DualMax

PF81/8200 +
Next PF



i. MX8QuadXPlus / DualXPlus / DualX

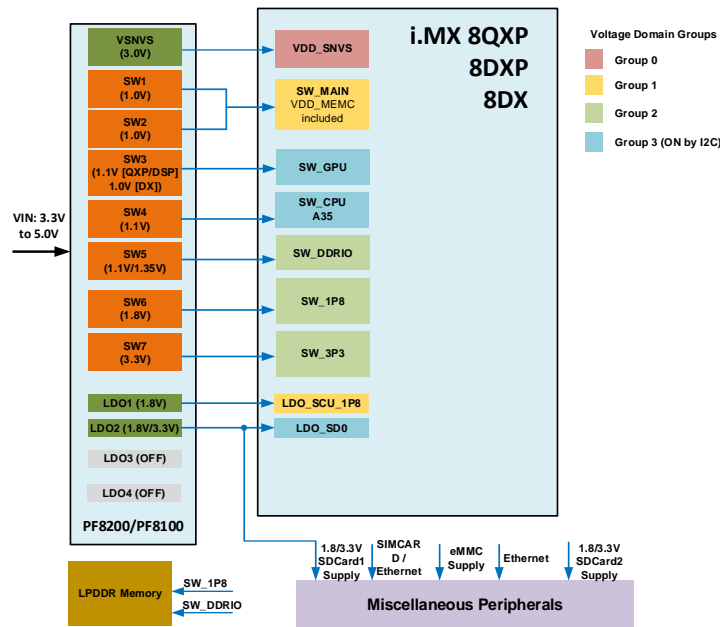
Compatible Design

i.MX 8QuadXPlus

i.MX 8DualXPlus

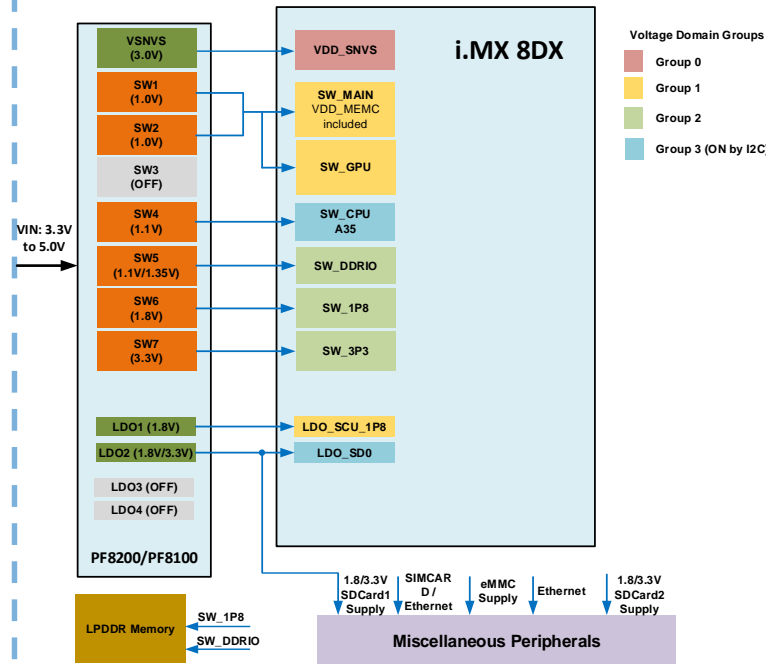
i.MX 8DualX

PF8100/8200



Optimized i.MX 8DualX

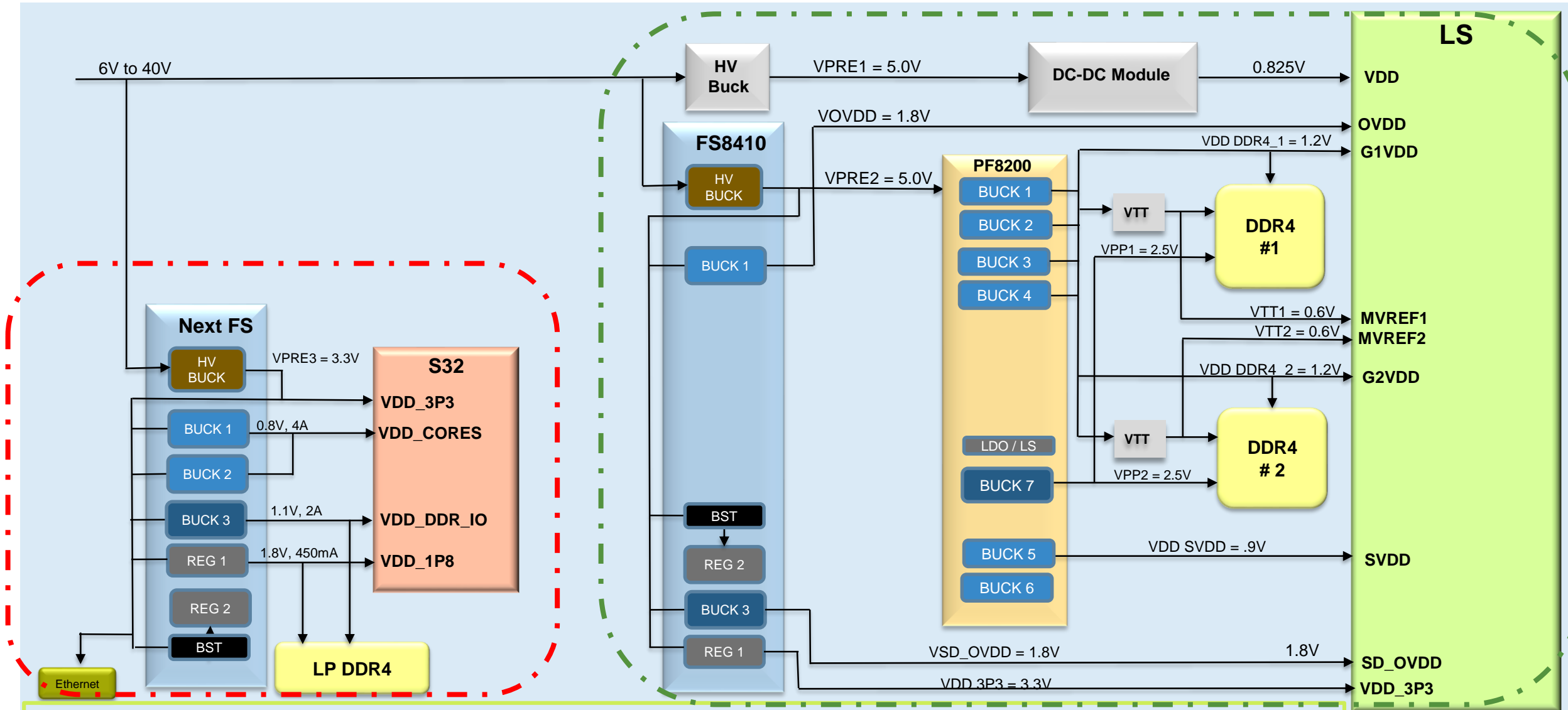
PF81/8200



Solutions for Layerscape



NXP Power Solution of Safety ADAS Module with Layerscape



S32 is ASIL-D MCU along with **Next FS** SBC would provide **ASIL-D** System Solution

Tools Overview



Customer Support



- Device documentation
- Safety Documentation
- PCB Schematic & guidelines



- Thermal Tool
- OTP Programming Tool
- EVB Boards



- External Sharepoint for customer

PF81/82– Documentation & Application Support

<p>✓ Data Sheet</p> <p>Preliminary Version Available</p>	<p>✓ EVKIT User Manual</p> <p>Available</p>	<p>✓ Safety Manual</p> <p>Preliminary Version Available</p>	<p>✓ FMEDA</p> <p>Preliminary Version Available</p>	
<p>✓ HW Design Guidelines</p> <p>Available</p>	<p>✓ EVKIT GUI</p> <p>Available</p>	<p>✓ Thermal Tool</p> <p>Available</p>	<p>✓ OTP Prog. Tool</p> <p>Available</p>	<p>✓ Models - SIMPLIS</p> <p>Under Development Dual-Phase Available</p>

COMPANY PUBLIC | 66



PF81/82 Customer Boards

OTP Programming
KITPF8200FRDMPGM PROGRAMMING BOARD
Available

Description / Purpose:

- **OTP Programming**

Soldered
KITPF8200FRDMEVM EVALUATION BOARD
Available

Description / Purpose:

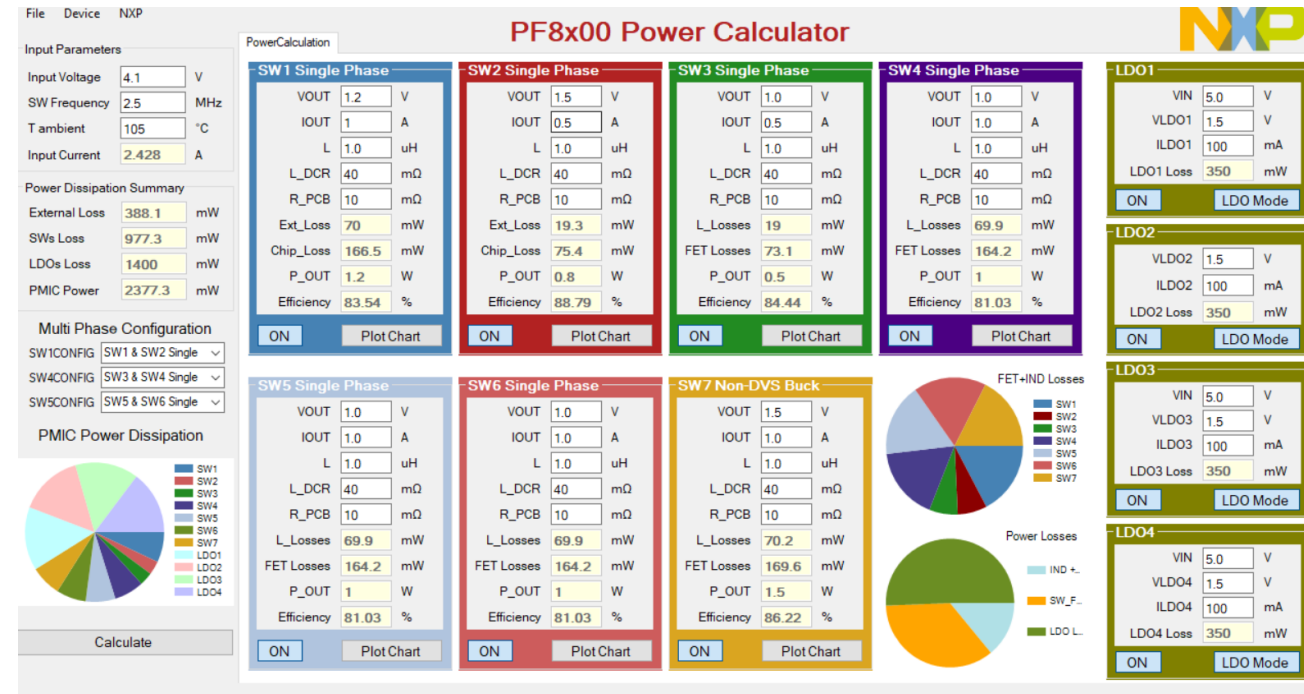
- **Performance Validation**
- OTP Programming (Populated part)
- Highly flexible

COMPANY PUBLIC | 67



Thermal Tool

- Thermal tool available to assess IC power dissipation and external component power losses.
- Modeling validated with lab measurement
- Easy to use tool:
 - External component configurable
 - Multiphase mode



OTP Tool

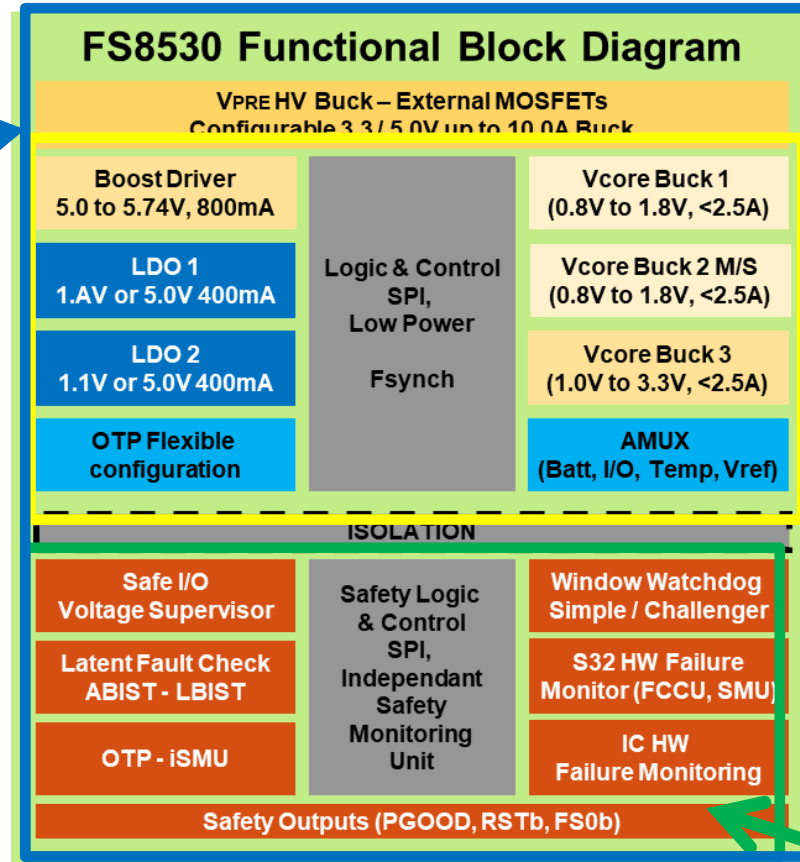
MAIN OTP CONFIGURATION

DEVICE CONFIGURATION

Main I2C Address	0x20
UVLockout Threshold	VSUP > 4.9V
Auto Retry Enable	Disabled
Auto Retry Timeout	4s
Number of Retries	15 times
PLL Enable	Disabled
Clock 1 Divider	2.85 MHz
Clock 2 Divider	2.5 Mhz
Thermal Warning TH	75°C
Deep Sleep Enable	Disabled

LO CONFIGURATION

PWRON2 Control	Not Required
AMUX / FOUT Select	AMUX Enabled
PSYNC Enable	PSYNC Disable
PSYNC Mode	Sync 2x VRS510
PSYNC Power Down Cnt	Ignore for PwrDown
Standby Transition Timer	Disabled
Standby Discharge TH	75 mV
Standby Polarity	Active Low
Standby PGOOD Enable	Disabled
VDDIO Supply Selection	External Regulator
Multiphase Configuration	Single Phase



REGULATORS OTP CONFIGURATION

VPRE CONFIGURATION

VPRE Voltage	Reserved
Slope Compensation	0 mV/us
VPRE STBY Output Cnt	Set by VPRE_OTP
ILIM Sense Voltage	50 mV
HighSide Slew Rate Cnt	11D/130mA - 6.8D/130mA
LowSide Slew Rate Cnt	11D/130mA - 6.8D/130mA
Soft Start Ramp	1 mV/us
VPRE Off Time	80 ns
TON in PFM	120 ns
VPRE OFF delay	250 us

BUCK1 - Single Phase

BUCK1 VOLT	0.4000V
ILIM	2.1 A
L Select	1.0 uH
Gain Margin	65 GM
DVS Ramp	Slow Ramp

BUCK2 - Single Phase

BUCK2 VOLT	0.4000V
ILIM	2.1 A
L Select	1.0 uH
Gain Margin	65 GM

BUCK3 Non-DVS

BUCK3 VOLT	1.00V
ILIM	2.1 A
L Select	1.0 uH
Gain Margin	65 GM
R Comp	56 kΩ

BOOST CONFIGURATION

VBOOST Voltage	4.50 V
Slope Compensation	2400 mV/us
VBOOST On Time	60 ns
Current Limit	1.0 A
Slew Rate Control	50 V/A
Comp Capacitor	50 pF
Comp Resistor	750 kΩ
Input Protection	Enabled

LDO1 - Regulator mode

LDO1 VOLT	1.1V
Current Limit	400 mA

LDO2 - Regulator mode

LDO2 VOLT	1.5V
Mode	Regulator Mode

LDO3 - Regulator mode

LDO3 VOLT	1.5V
Mode	Regulator Mode

HVLDO Regulator

HVLDO Voltage	0.8 V
Transition mode	LDO mode only
Sequence Control	Start always first

FUNCTIONAL SAFETY

SAFETY CONFIGURATION

Safety I2C Address	0x21
8 sec Timer to LPM	Timer Disabled
Fault Recovery Mode	Disabled
ABIST to RSTB delay	No Delay
VCOREMON SVS Change Limit	No SVS
VCOREMON SVS Offset Type	Negative offset
PGOOD assert with RSTB	PGOOD not Asserted with RSTB
HVLDO Mode Select	Switch mode from BUCK1

I/O CONFIGURATION

WD Selection	Simple WD
WD Monitoring	WD Enabled
WDI Polarity	Falling Edge
FCCU / WDI select	FCCU1 in FCCU Mode
FCCU Monitoring	FCCU Disabled
STANDBY State Enable	STANDBY Disabled
STANDBY Polarity	Active Low
STANDBY Control	Software STANDBY request
STANDBY Request Timeout	STBY Window disabled

VOLTAGE MONITORING

	VMON_EN	Voltage	UV TH	OV TH	UV Debounce	OV Debounce	PGOOD CTRL	ABIST CTRL
VCOREMON	<input checked="" type="checkbox"/>	0.4000V	95.5%	104.5%	5 us	25 us	Not Assigned	No ABIST at PWRUP
VDDIOMON	<input type="checkbox"/>	1.8 V	95.5%	104.5%	5 us	25 us	Not Assigned	No ABIST at PWRUP
HVLDOMON	<input type="checkbox"/>	0.8 V	95.5%	104.5%	5 us	25 us	Not Assigned	No ABIST at PWRUP
VMON1	<input type="checkbox"/>	0.8 V	95.5%	104.5%	5 us	25 us	Not Assigned	No ABIST at PWRUP
VMON2	<input type="checkbox"/>	0.8 V	95.5%	104.5%	5 us	25 us	Not Assigned	No ABIST at PWRUP
VMON3	<input type="checkbox"/>	0.8 V	95.5%	104.5%	5 us	25 us	Not Assigned	No ABIST at PWRUP
VMON4	<input type="checkbox"/>	0.8 V	95.5%	104.5%	5 us	25 us	Not Assigned	No ABIST at PWRUP

- OTP tool available to configure device during debug phase
- Easy to use tool

Other Sessions of Interest



Autonomy



AMF-AUT-T3628
Safety Power Management for Automotive Radar and ADAS Applications

Yasuomy Sakyu
Tuesday 4:00 PM
Samuel (Lower Level)

Electrification



AMF-AUT-T3832
Electrification—Functional Safety Backbone Solutions to Attach with S32

Tuesday 11:00 AM Galilee (Main Floor)

David Lopez

Connectivity



AMF-AUT-T3833
Power Management for Connectivity and Infotainment Solutions

Wednesday 9:10 AM
Kings I & II (Lower Level)

Vincent Lagardelle

AMF-AUT-T3697
PF81/PF82 PMICs for High-Performance Applications Processors

Wednesday 1:30 PM
Samuel (Lower Level)

Visit us at the
TechLab

Safety PMIC Demo



One System = Multi
PMIC Solution



AMF-AUT-T3832
Functional Safety in Power Management (Safety PMICs) and System Considerations

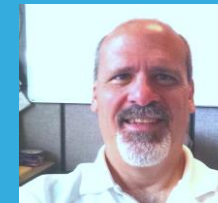
JP Meunier
Wednesday 10:00 AM
Judith (Upper Level)



AMF-AUT-T3631
Scalable & Safe Power Management Solutions Overview

Tuesday 10:00 AM

Vincent Lagardelle



AMF-AUT-T3884
SPM Tool Overview

Wednesday 4:00 PM
Sarah (Upper Level)

Jeff Reiter

NXP SAFETY PMIC DNA



Safety



Scalable



Expandable

NXP PMIC's: Your Functional Safety Partner

Delivering safety and power scalable solutions to enable a platform strategy



**SECURE CONNECTIONS
FOR A SMARTER WORLD**