

TLF35584QVHSx OPTIREG™ PMIC for Safety-Relevant Applications

November 2022

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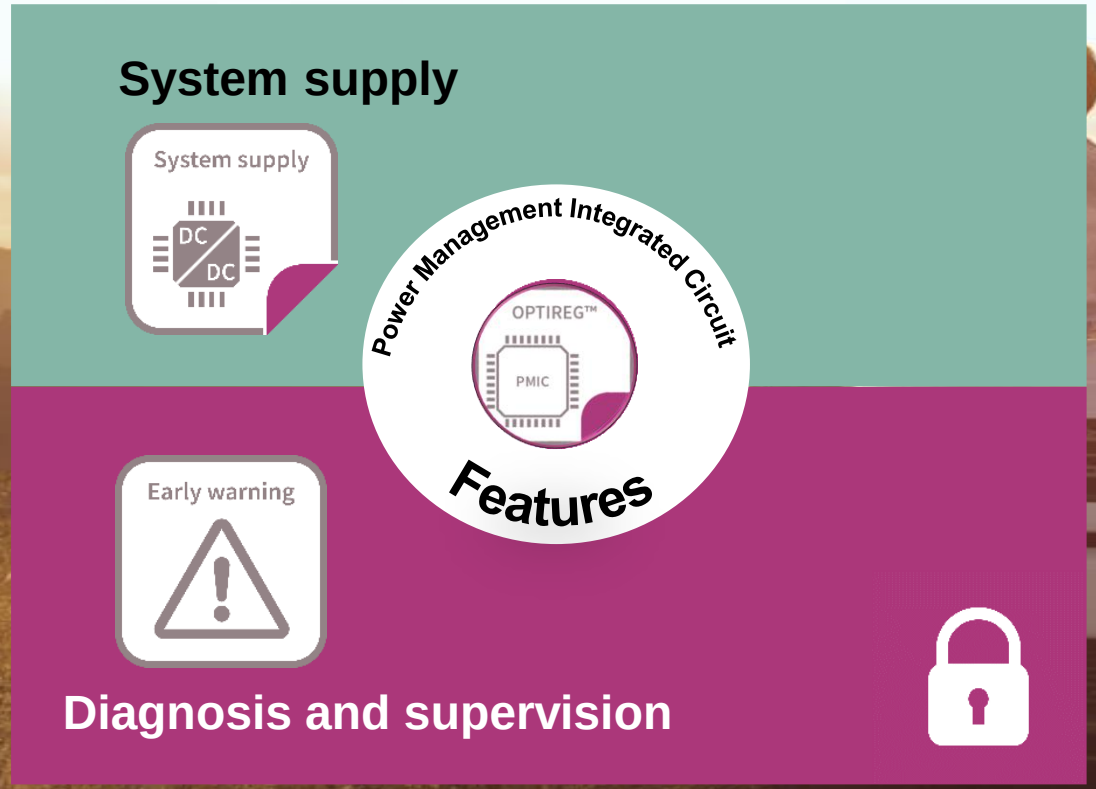
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The OPTIREG™ PMIC
An integrated power supply including system safety functions



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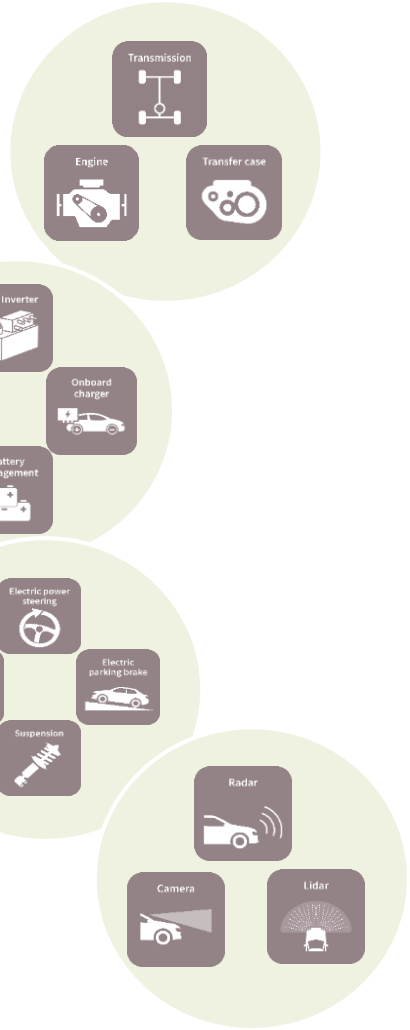
TLF35584QVHSx OPTIREG™ PMIC: Strong commitment to General Purpose and Application Specific PMIC solutions

Conventional Powertrain

xEV

Chassis

ADAS





PRO SIL ISO 26262 compliant

AURIX™ TC2x
In Prod.

AURIX™ TC3x
In Prod.

AURIX™ TC4x
In Dev.

Competitors

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TLF35584QVHSx
OPTIREG™ PMIC Functional Safety with extended lifetime

Key Features

- Buck/Boost-Pre-Regulator
  - IQ = 1.25A; f: 300kHz-2.5MHz
- µC-Supply: 3.3V/5V @ 600mA
- Reference-LDO: 5V @ 150mA (±1%)
- 2x Tracker: 5V @ 150mA
- Communication-Supply: 5V @ 200mA
- StandBy-LDO: 3.3V/5V @ 10mA
- Vin: 3V .. 40V



PG-VQFN-48

New Grade 0

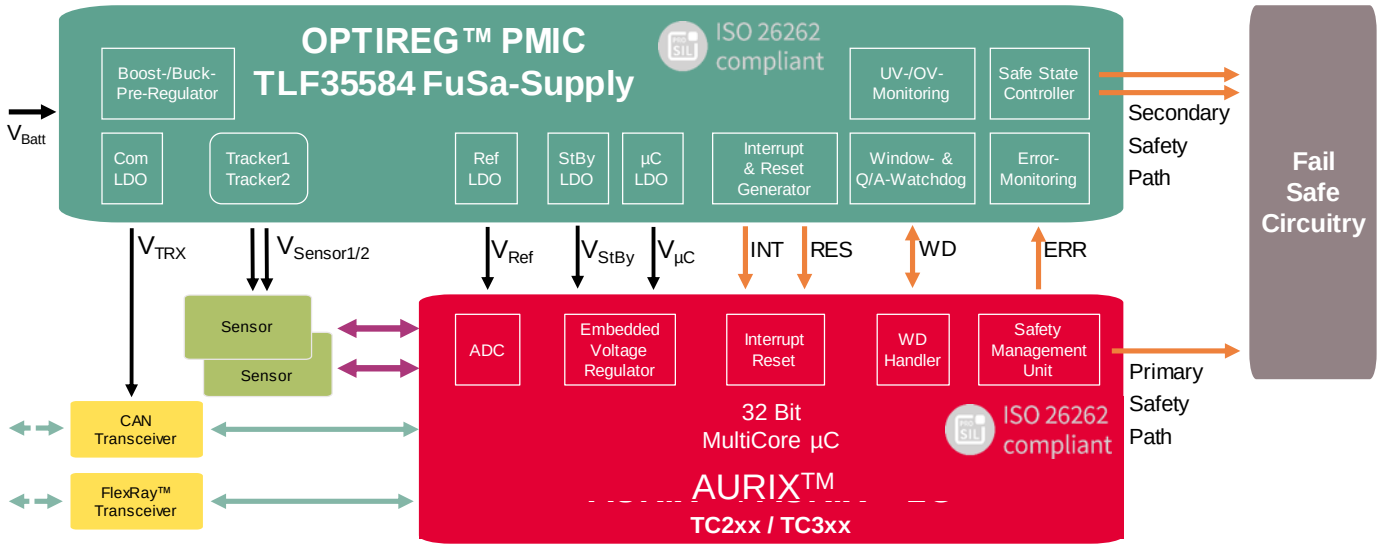
AEC Qualified

RoHS

ISO 26262 compliant

- EN/Wake (T15 and CAN/FlexRay)
- SPI
- Safety Features
  - Multiple bandgap (supply vs V-monitoring)
  - UV/OV-Monitoring, ERR-Monitoring
  - Functional-WD & Window-WD
  - Safe State Control, Secondary Safety Path
  - Protected safety area
  - Built In Self Test

Application Diagram



Applications

Powertrain

xEV

Chassis

Safety



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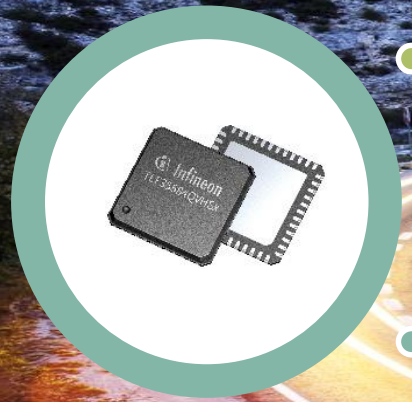
4 TLF11251LD for higher performance with high-end AURIX™ 28

5 Support Material 31

6 Appendix: Automated Optical Inspection 38

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Benefits of Infineon **OPTIREG™ PMIC** TLF35584QVHSx



High efficiency & smaller size
- System power supply functions and system safety functions integrated into a single package
- Pre-/Post-Regulator architecture
- Reduces external components and PCB space

Extended Lifetime in harsh environments
- Supporting extreme harsh environments thanks to AEC-Q100 Grade 0 qualified (T_J = -40°C to 175°C)
- Boost capability to ensure operation in cold cranking condition

Ease of design & interoperability
- TLF35x family members developed to be SW and pin-to-pin compatible (leadless packages)
- TLF35x as the perfect companion for AURIX™ , compatible with all TC1x, TC2x, and TC3x members
- Software offering provided by Infineon partners and rich ecosystem, e.g. Hitex and Vector

Long term availability and business continuity plan
- Long term production plans to support automotive production cycles
- Mixed in-House and Sub-Con production site strategy

Usage in applications with ASIL-requirement
- Developed according to ISO 26262
- Developed as SEooC to be used in various automotive safety critical applications
- Strong in-house FuSa support via regional techical experts, documentation and online resources

ISO 26262 compliant

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The new OPTIREG™ PMIC TLF35584QVHSx offers unique advantages along AURIX™ TC2/3x family

OPTIREG™ PMIC TLF35584QVHSx Key features

- System power supply functions and system safety functions integrated into a single package
- Pre-/Post-Regulator architecture

- VQFN TLF35x family members developed to be SW and pin-to-pin compatible
- TLF35x as the perfect companion for AURIX™ , compatible with all TC1x, TC2x, and TC3x members
- SW offering provided by Infineon partners and rich ecosystem, e.g. HITEX, Vector

ISO 26262 compliant

- Developed according to ISO 26262
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- Supporting extreme harsh environments thanks to AEC-Q100 Grade 0 qualified (TJ = -40°C to 175°C)
- Boost capability

- Long term production plans to support automotive production cycles
- Mixed in-House and Sub-Con production site strategy

Customer advantages

- ✓ Optimized Bill of Material
- ✓ Ease of use
- ✓ Smaller PCB size
- ✓ Centralized power management

- ✓ Unique fit to TC2/3x
- ✓ Ease of use
- ✓ Hardware reuse
- ✓ Lower R&D effort

- ✓ System protection against critical voltage surges and misbehavior
- ✓ Usage in applications with ASIL-requirement

- ✓ Extended Lifetime in harsh environments
- ✓ Ensure operation in cold cranking condition

- ✓ Long term availability and Business Continuity Plan

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OPTIREG™ PMIC TLF35584QVHSx unique features

Integration

System **power supply** functions and system **safety functions integrated** into a single package**, optimizing space** and **time to market** as of the high hardware and software reuse

Interoperability

Product-to-System development ensures full digital and power **interoperability between OPTIREG™ TLF35x PMIC & AURIX™ TC2/3x**

FuSa

ISO 26262 compliant

ASIL D compliant devices, development according to **ISO26262** establishing **safe operating conditions** for the MCU and peripherals

Application Fit

General Purpose PMIC tailored for **Safe Computing** and **Safe Control** Applications enabling **extended lifetime** in **harsh automotive environments**

Availability

Long term production plans to support automotive production cycles and **mixed production site strategy**

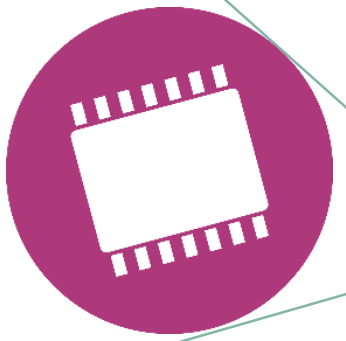
Dependability

Infineon Automotive Dependability

We go **beyond the standards** with **highest quality criteria, customer service level** and proven **track record of high quality achievements**

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OPTIREG™ PMIC
Integration



OPTIREG™ PMIC TLF35584QVHSx: System **power supply** and **safety functions integrated** into a **single package**



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TLF35584 – OPTIREG™ FuSa-PMIC
Features - Benefits



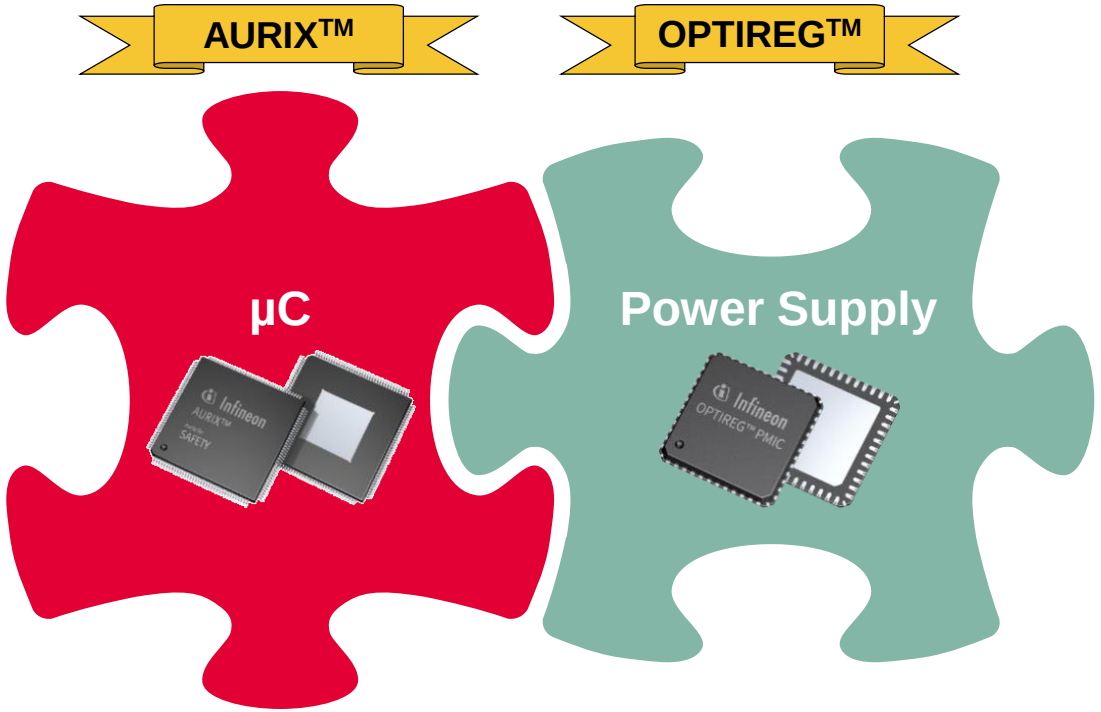
Features	Benefits
ISO 26262-compliant	Usage in applications with ASIL-requirement
Boost capability	Ensure operation in cold cranking condition
Pre-/Post-Regulator architecture	High Efficiency
Multiple voltage supplies	System supply: µC, communication, sensors
Dedicated reference voltage supply	ADC-supply independent of µC-load
Bandgap for both safety and supply plus electrical isolation	Avoid common cause failures
WWD & Q/A-WD	Flexible WD to achieve proper ASIL-level
BIST (analog & logic)	Ensuring “safe” operation
UV/OV-monitoring	Flexible RESET/interrupt management
Flexible safe state control	Ensuring “safe” operation
Enable/Wake	Flexible wake-up management

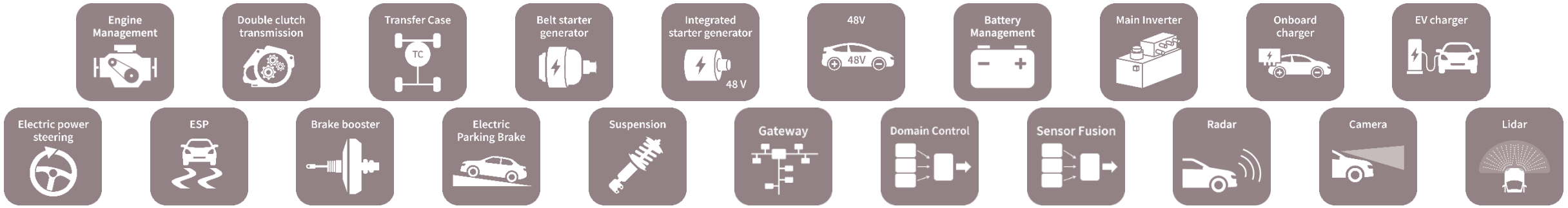
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OPTIREG™ PMIC
Interoperability



AURIX™ microcontroller & OPTIREG™ PMIC teaming up for Functional Safety in the focus automotive applications

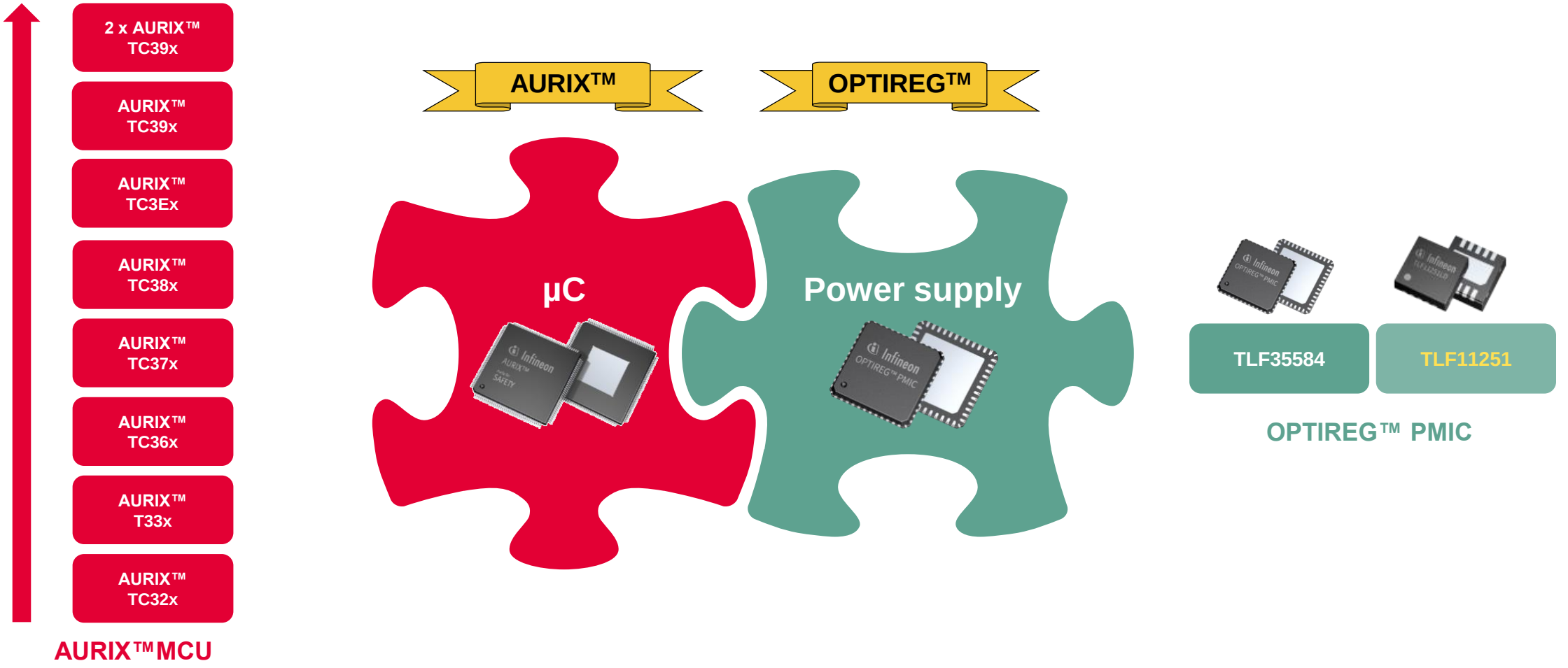




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OPTIREG™ PMIC together with OPTIREG™ TLF11251 for a **safe** and **optimized** multi-channel **power supply** of Infineon **µC families**

IFX offers a scalable PMIC portfolio which can cover the complete AURIX™ TC2x/TC3x portfolio



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AURIX™ and OPTIREG™ PMIC
Functional Safety
Internal and external safety measures



OPTIREG™ PMIC powers up your automotive system while supervising the microcontroller and the power supply

*Safe State Control





AURIX™ MCU

- Supply
- SPI
- Interrupt
- SMU

ISO 26262 compliant

OPTIREG™ PMIC

- Supply
- SPI
- Sensors
- V-MON
- WD
- ERR
- SSC*

ISO 26262 compliant

PMIC internal

- Internal supplies
- SPI error
- Thermal sensors
- BIST

Voltage Monitoring

- Over voltage
- Under voltage
- Over current

Watchdog

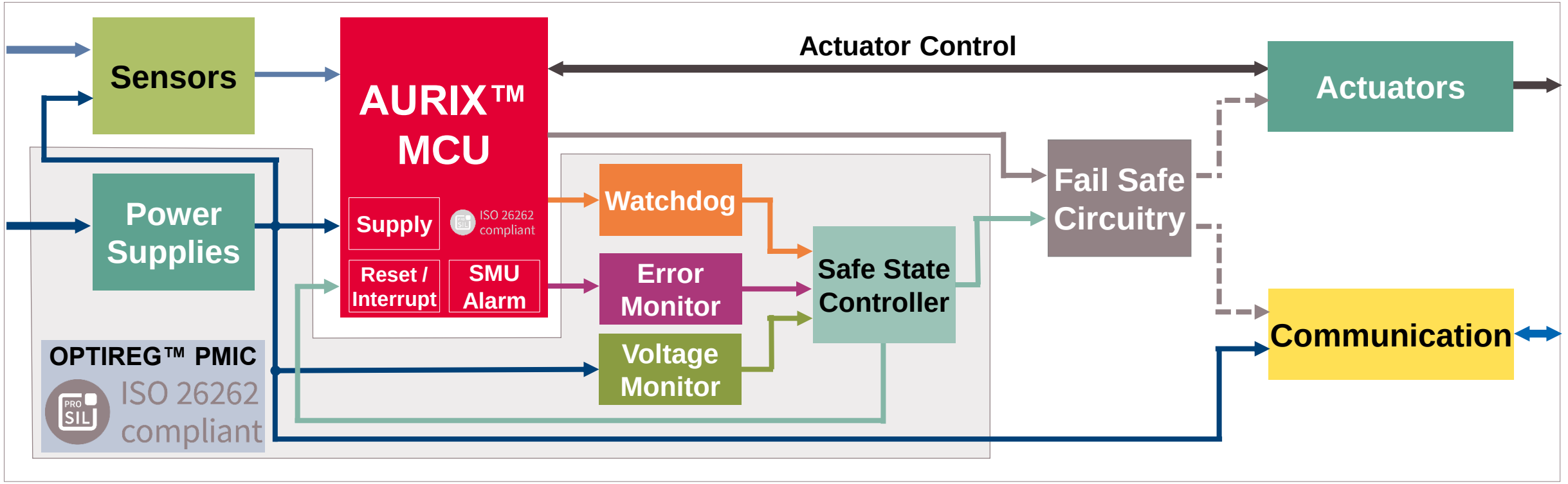
- Timing error
- Software execution error

Error monitor

- React on MCU Alarm

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Safety relevant systems
PMIC safety concept



Safety MCU :
System level hardware requirements

Safety path activated by microcontroller as main decision maker

Secondary safety path for faults that may lead to an unreliable MCU

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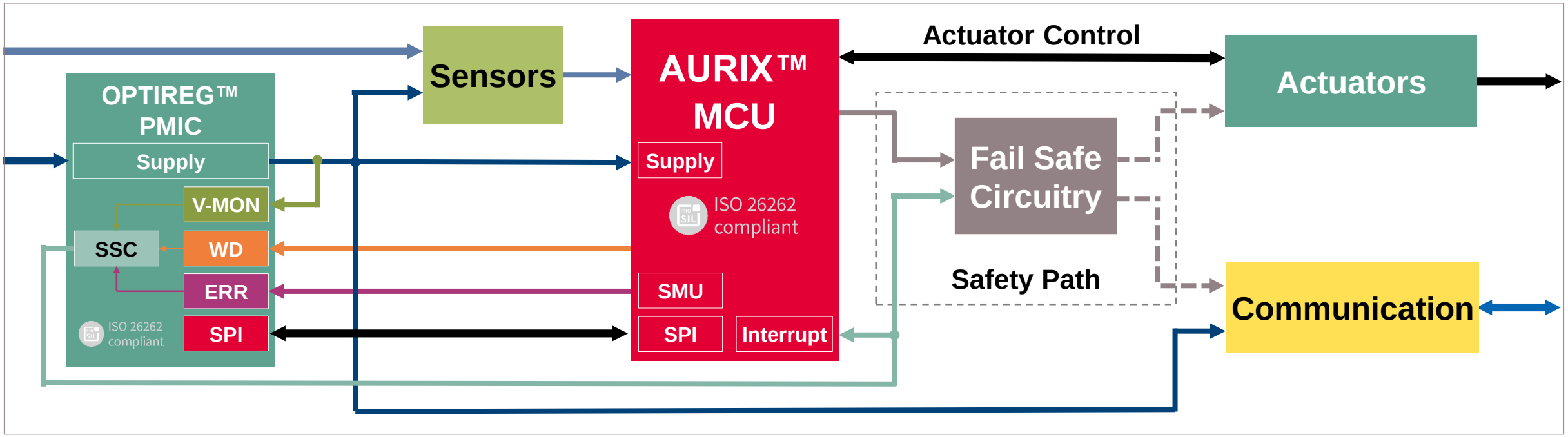
PMIC supervision
Monitoring of fault events

Voltage Monitor
- Over voltage
- Under voltage
- Over current

Watchdog
- Timing error
- Software execution error

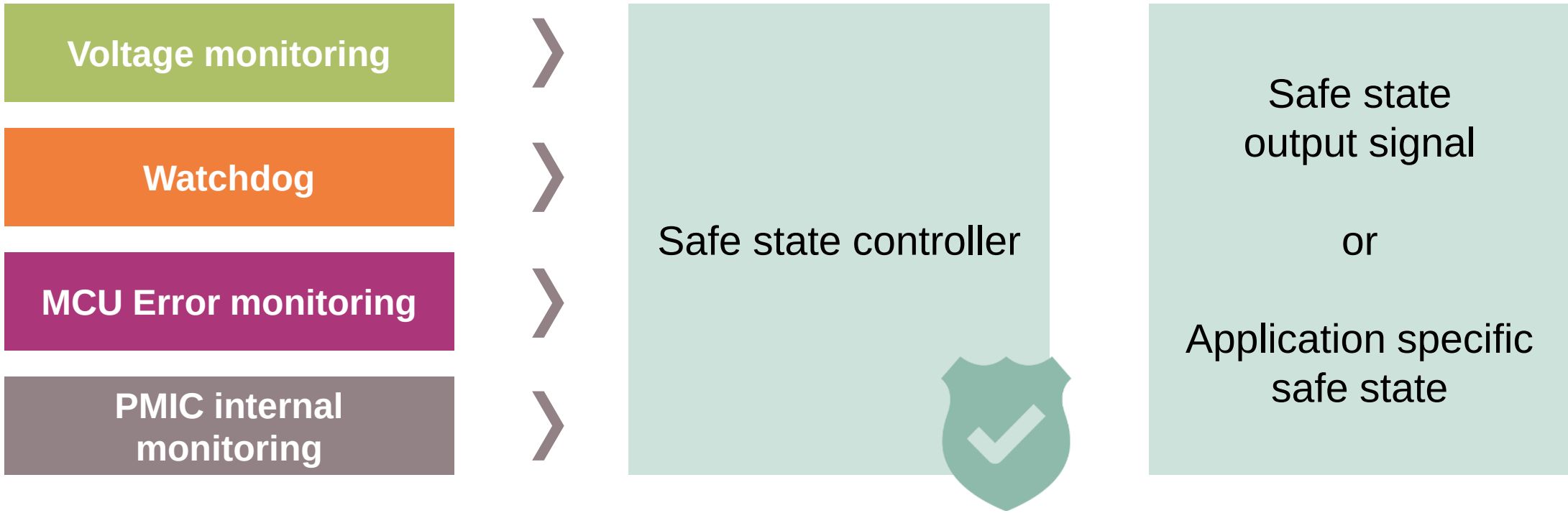
Error monitor
- React on MCU Alarm

PMIC internal
- Internal supplies
- SPI error
- Thermal sensors
- BIST



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Safe state controller



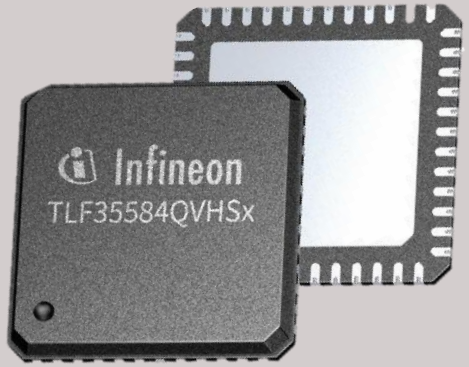
- Collects fault reports from all monitoring functions
- Handle the configurability of safety mechanisms
- Electrical separation and isolation from rest of the PMIC
  - Support safe state handling independent of internal faults

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OPTIREG™ PMIC
Application Fit



OPTIREG™ PMIC TLF35584QVHSx support extreme harsh environments thanks to AEC-Q100 Grade 0



Why Grade 0 qualification:

- Electronic within the transmission system operates at T_A = 150°C
- Grade 1 qualified devices cannot be used if the ambient temperature is 150°C
- PCB layout flexibility: in PCB hot-spot areas Grade 1 cannot be place
- xEV requires extended lifetime up to 30k h due to the additional operating modes to driving, e.g. charging and pre-conditioning
- Sensor fusion requires extended lifetime up to 30k h due to new driving profiles, e.g. Mobility-as-a-service, Transportation-as-a-service

Grade Classification	Junction Operating Temperature Range	
	MIN	MAX
Grade 0	-40°C	175°C
Grade 1	-40°C	150°C

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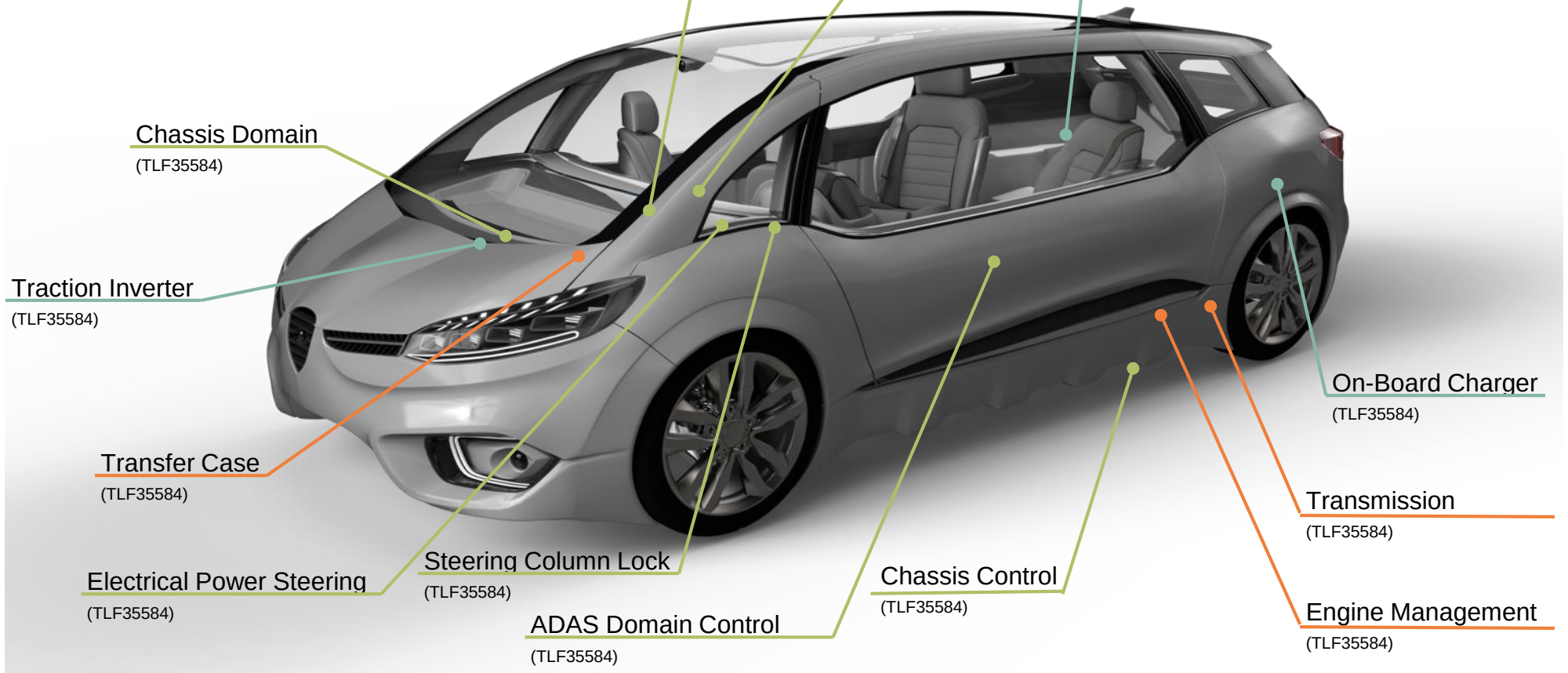
OPTIREG™ PMIC TLF35584QVHSx supports ASIL-D applications, enabling extended lifetime in harsh automotive environments

Application examples

EDT/ xEV

Chassis & Safety

Powertrain



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AURIX™ and OPTIREG™ PMIC Dependability



Infineon Zero Defect Mentality
We Do what we promise



We reduced our ppm rate significantly to sub ppm levels



We are able to deliver Zero Defect for all but 3.4 seconds last year



87% of our products are already Zero Defect



Regional network of failure analysis labs and strong localized competencies



Zero delamination approach



Average FAR TAT 17 days (60% <14 days)

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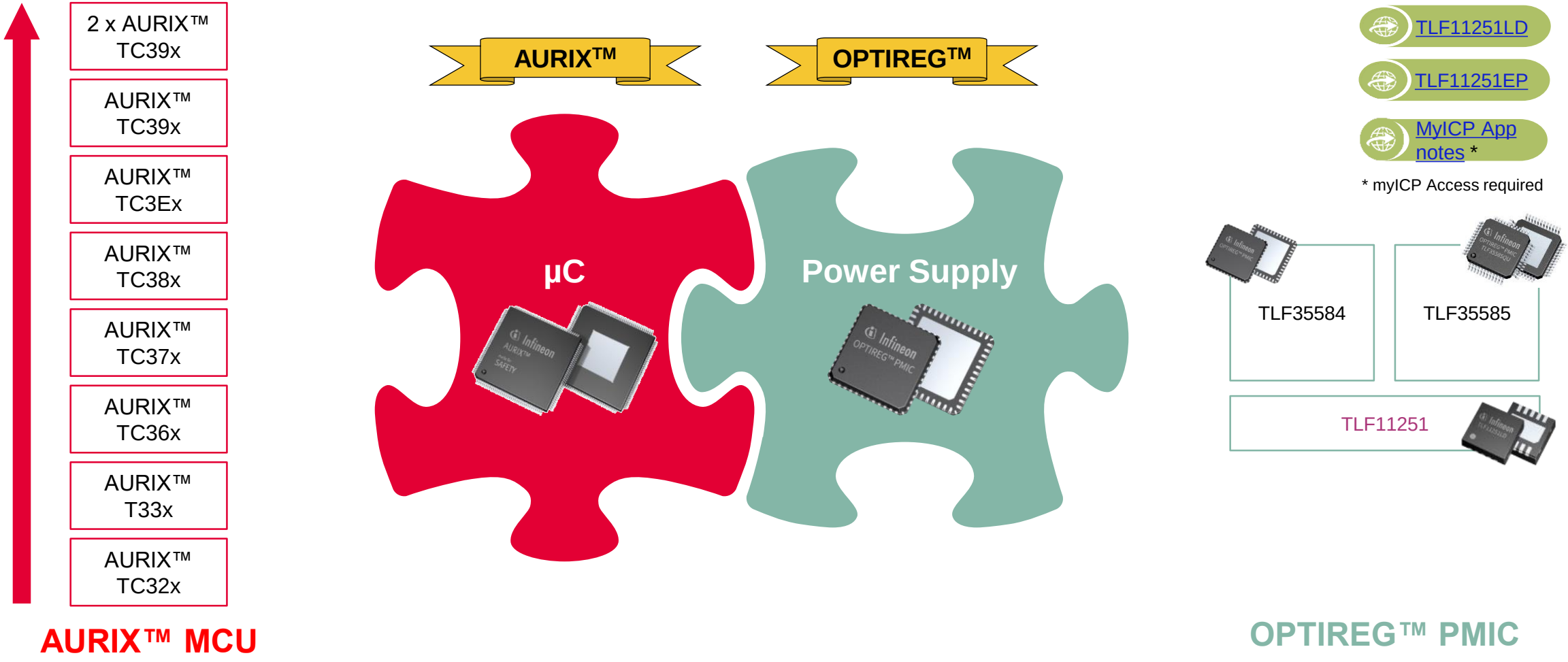
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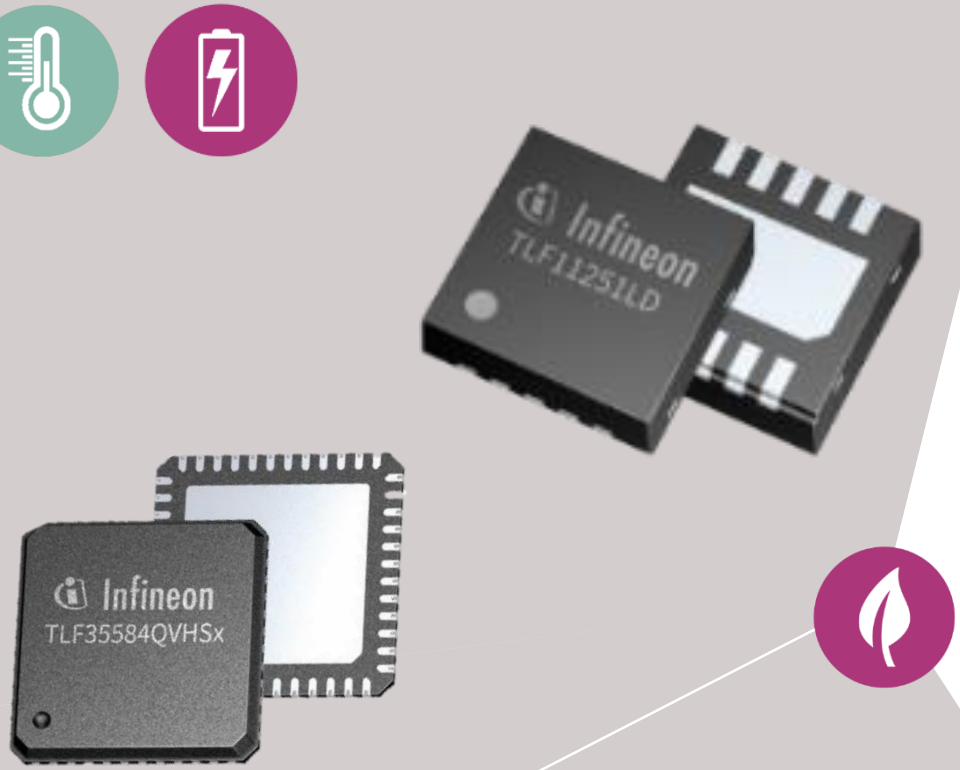
OPTIREG™ PMIC together with OPTIREG™ TLF11251 for a safe and optimized multi-channel power supply of Infineon µC families

IFX offers a scalable PMIC portfolio which can cover the complete AURIX™ TC2x/TC3x portfolio



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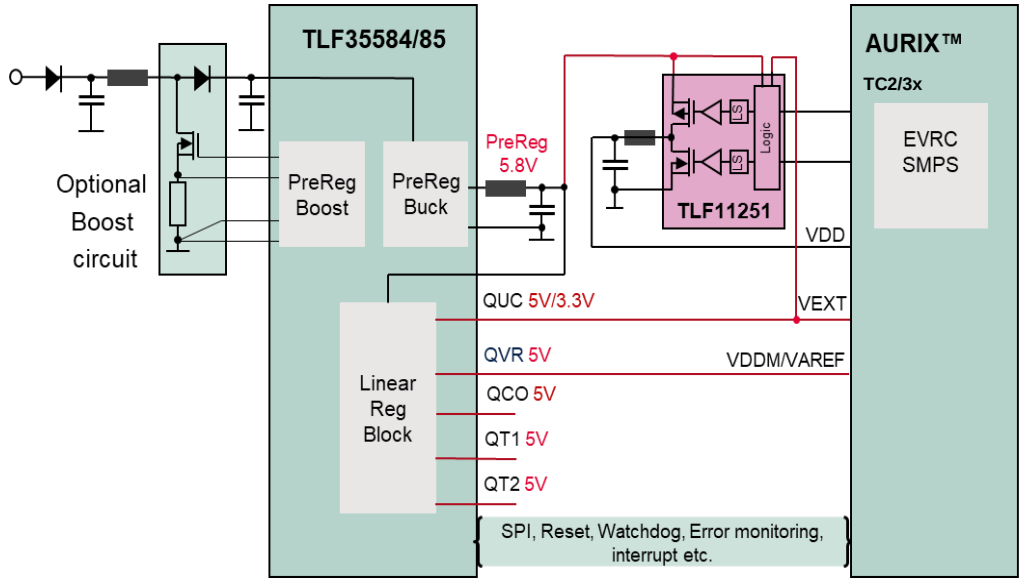
OPTIREG™ PMIC TLF35584QVHSx and OPTIREG™ LINEAR TLF11251LD to gain efficiency and reduce losses



Using TLF11251 along with TLF35584VHSx:

› Up to 30% power loss savings on the µC core supply

Additional info on test conditions : 384mW less power dissipation and 13K lower junction temperature Tj*



*Ta= =125°C, JEDEC 2s2p Rth(jA)=37K/W, System input voltage = 12.5V, TLF35584Q_VVS2/KVS2□3.3V and Boost enabled

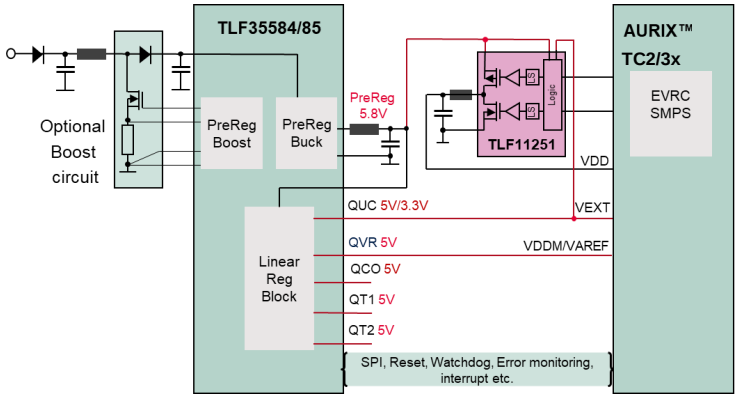
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TLF11251LD/EP - Integrated Half-Bridge for Embedded Voltage Regulator Core Controller (EVRC)

Key Features

- Integrated PMOS and NMOS complementary output bridge with 2.5 A current capability
- Integrated gate drivers
- Integrated level shifter
- Single control input with an integrated dead-time logic allows for optimized control and high efficiency
- Output current sensing and limitation
- Over-temperature protection
- Low quiescent current
- No external dead-time adjustment required

Application Diagram



- Overall system efficiency increase
- Power losses reduction

Package

RoHS

AEC Qualified

Grade 1



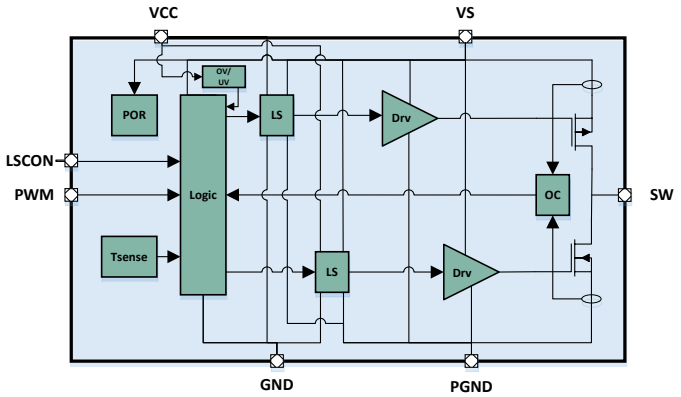
PG-TSON-10

Grade 0



PG-TSDSO-14

Block Diagram



Applications

- Core-Supply Switch for Embedded Core Controller

Visit the website

TLF11251LD

TLF11251EP

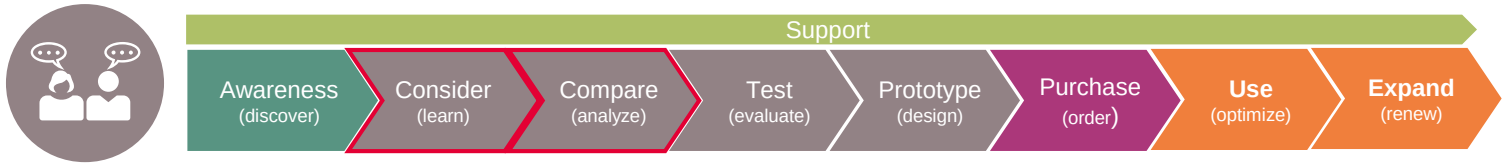
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Joint support for OPTIREG™ and AURIX™ across the entire customer journey – **Consider & Compare**

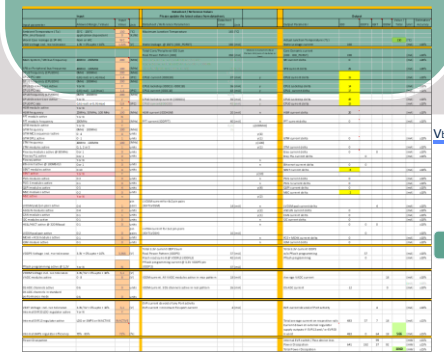


Consideration

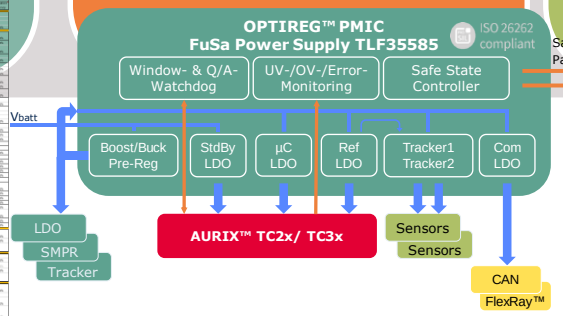
Choose AURIX™ µC



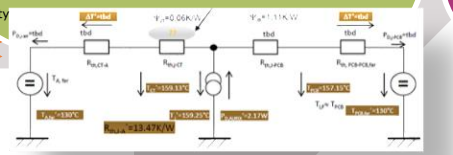
Perform AURIX™ Loading Calculation



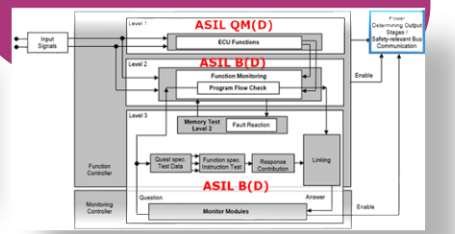
Determine Additional Loads in Application (IVN, Sensors, etc.)



Identify Environmental Conditions (temperature, PCB data, cooling concept)



Identify ASIL Decomposition of Functional Safety Requirements



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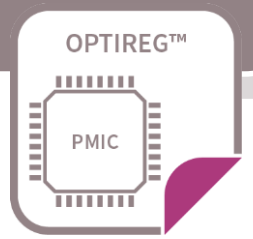
Joint support for OPTIREG™ and AURIX™ across the entire customer journey – **Test**

Support

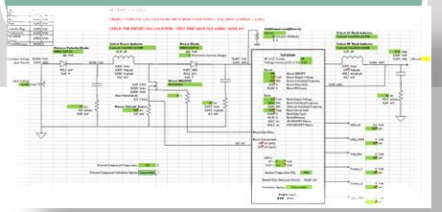
Awareness (discover) | Consider (learn) | Compare (analyze) | **Test (evaluate)** | Prototype (design) | Purchase (order) | **Use** (optimize) | **Expand** (renew)

Design-In

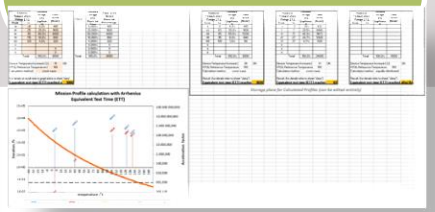
Choose the right OPTIREG™ PMIC



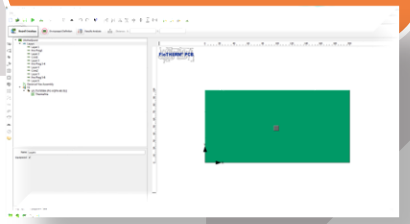
Power Loss Calculation



Lifetime Requirements / Mission profile Check



Thermal Simulation (TTM, Ansys® Icepak™, Mentor® FloTHERM™)



Choose the right Package



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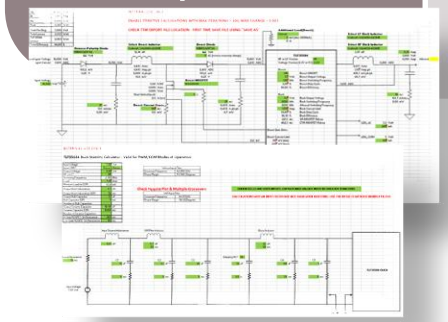
Joint support for OPTIREG™ and AURIX™ across the entire customer journey – **Prototype**

Support

Awareness (discover) | Consider (learn) | Compare (analyze) | Test (evaluate) | **Prototype (design)** | Purchase (order) | **Use** (optimize) | **Expand** (renew)

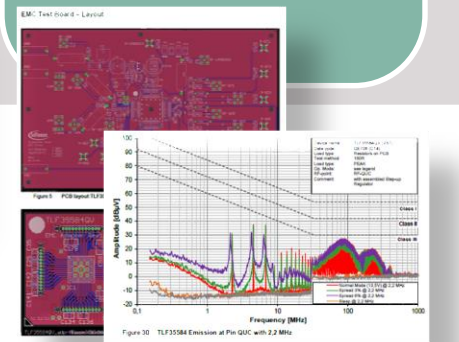
Design-In

Stability Analysis and Choice of External Components

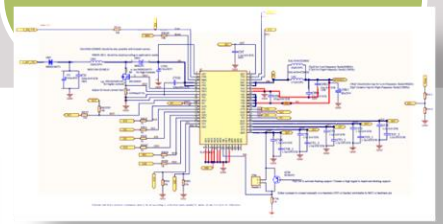


EMC Analysis and Improvement

EMC report

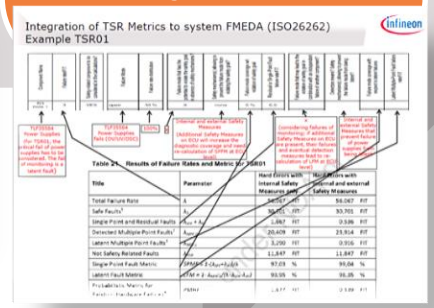


Layout & Schematic Review



FMEDA Adjustment and Implementation

Safety Manual



Completed OPTIREG™ PMIC Design

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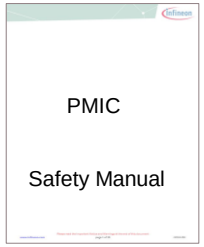
Learn more about OPTIREG™ PMIC TLF35584QVHSx support material

Collaterals and Brochures	› Product briefs › Selection guides › Application brochures › Presentations › Press releases
Technical Material	› Application notes › Technical articles › Simulation models › Datasheets, MCDS Files › PCB Design Data
Evaluation Boards	› Evaluation boards › Demoboards › Reference designs
Further Info	› Technical videos › Product videos

TLF35584QVHS1 Webpage

TLF35584QVHS2 Webpage

Datasheet*





Technical Material*

TLF35584 MC Board

PMIC Boards

TLF35584QVxS1 Board

TLF35584QVxS2 Board

Evaluation Board



Companion Board



AURIX™

› Why Infineon's OPTIREG™ PMIC family is relevant for safety-related automotive applications (E1)

› ATV: OPTIREG™ PMIC - Technical safety requirements and goals (E2)





* Accessible only via myICP

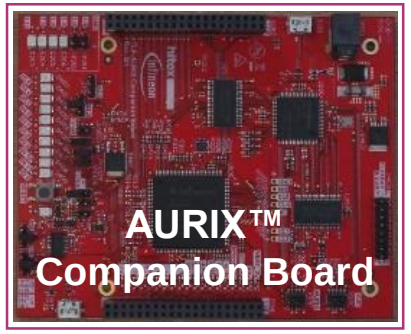
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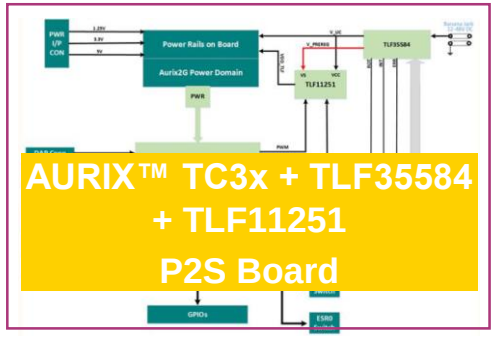
OPTIREG™ TLF35584 PMIC Evaluation Boards

PMIC Evaluation Boards

Sales Name of Demo board	Description
TLF35584QVxSx Board	*PMIC Evaluation Board*
TLF35584MC BOARD	*Microcontroller Companion Board*
A2G P2S TC3x9	*Application Board*

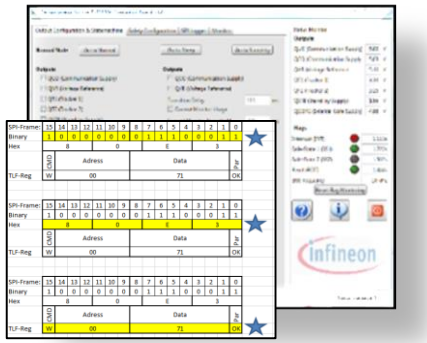


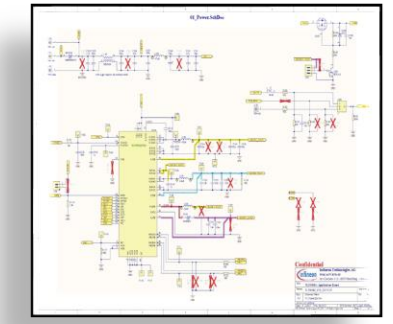


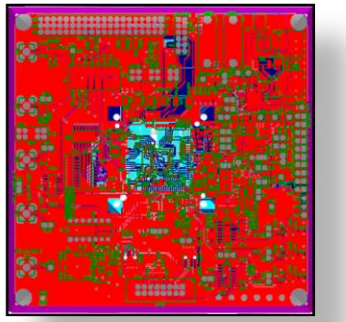


Additional Evaluation Board Tools

- Graphical User Interface (GUI)
- SPI Configurator
- User Manual
- Schematics and Layout







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OPTIREG™ TLF35584 PMIC
Evaluation Boards and their functionality

Evaluation Board

Analog Performance

- Analog testing of TLF35x power supply performance w/o the need of a MCU



Evaluation Board + MC Board

Analog & Digital Performance

- Analog testing of TLF35x power supply performance
- Digital testing of TLF35x functionalities (e.g. WWD, FWD, SPI, …) through the GUI



Triboard Manual TC3X9

SW Development

- Eval. Board for SW development and pre-test, e.g. to develop SW drivers for the TLF35x
- TLF11251 is used to power TC38x/9x: see the reference schematics
- Hyso Triboard Manuals myICP folder

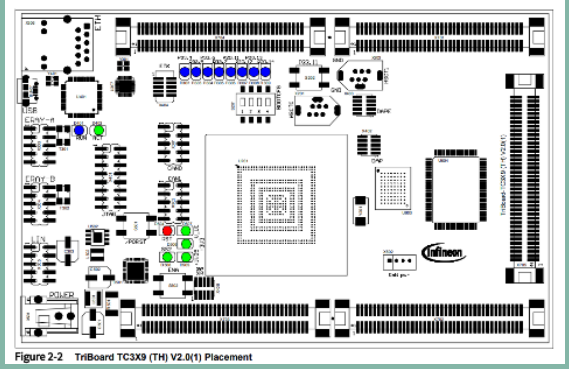


Figure 2-2 TriBoard TC3X9 (TH) V2.0(1) Placement

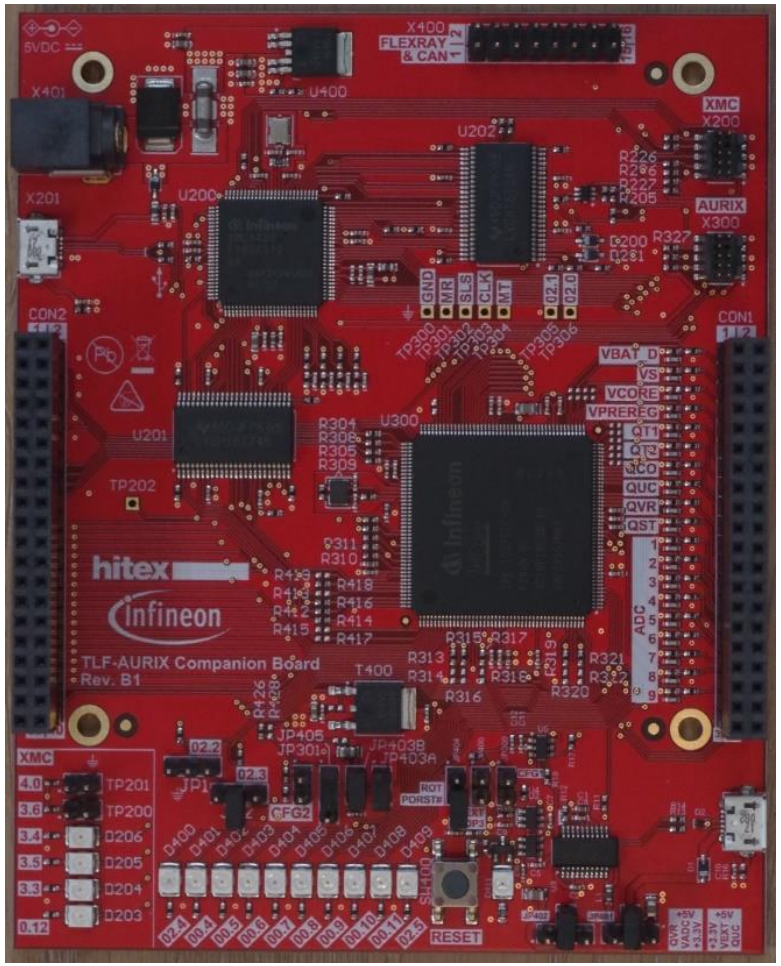
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OPTIREG™ TLF35584 PMIC
Boards - Overview

› TLF35584 Evaluation Board



› AURIX™ Companion Board

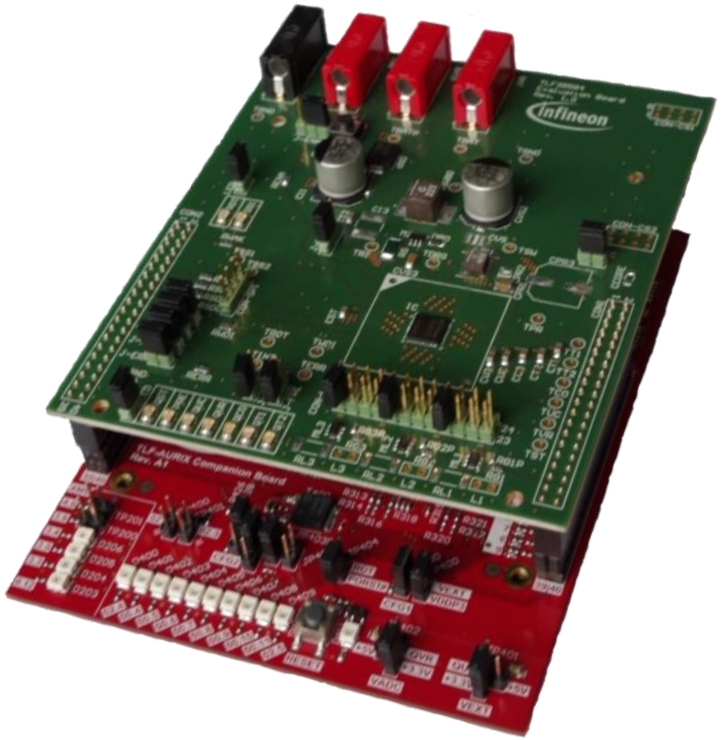


* Changes to the topology, appearance and concept are possible!

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OPTIREG™ TLF35584 PMIC Evaluation Environment

- TLF35584-Evaluation-Boards (Green)
  - Equipped either with 3V3- or 5V-variant
  - Can be adapted to high- and low-switching frequency
- µC-Companion-Board (Red)
  - For TLF35584-configuration
  - Stack-concept
  - GUI
    - Setting parameter
    - Monitoring functions
    - Logging SPI-communication
    - Writing registers
    - Reading flags









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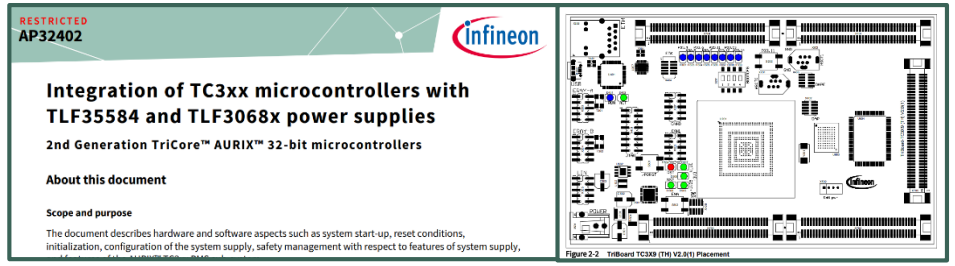
OPTIREG™ TLF35584 PMIC
Tools & Software

Prototype (design) → Purchase (order)

OPTIREG™ PMIC

Learn how to integrate AURIX™ TC3xx microcontrollers with Infineon system power supplies of the TLF family and check out existing HW

- Application Note*
- Triboard Manuals *



Find out more on AURIX™ support

Get software support from the wide partners ecosystem of Infineon

- Hitex SafeTpack TC3x
- Vector vSBC
- AURIX ™ SafeTlibTC2x





More info on the power supply partners

* myICP Access required

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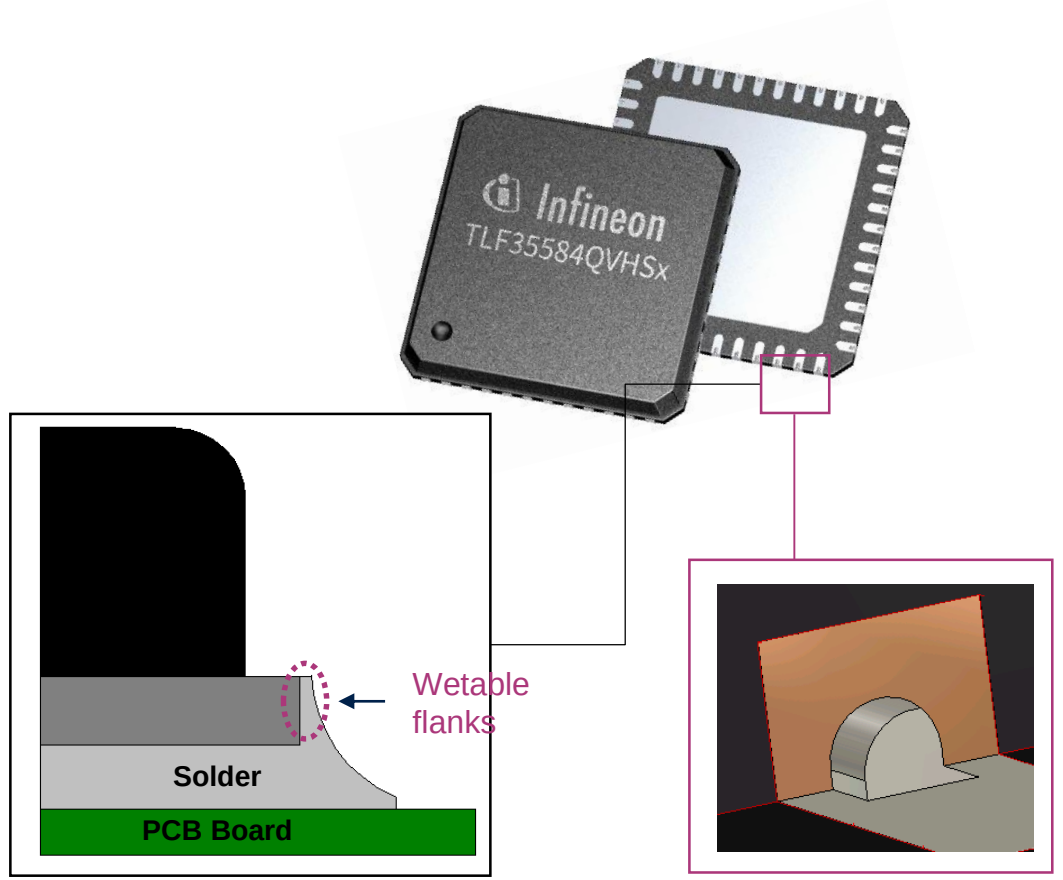
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OEMs/ Tier1s can skip one step in the manufacturing

Providing a solder-able sidewall on lead tip of the VQFN leadless package to enable Automated Optical Inspection (AOI)



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Part of your life. Part of tomorrow.