AN13798

NXP PMIC solution for TI Sitara AM2x series MCU

Rev. 1 — 21 February 2023   **Application note**

Document information

Information	Content
Keywords	Power solution, PMIC, FS84, FS85, TI Sitara AM2x, MCU, automotive, functional safety
Abstract	This application note presents an NXP FS84/FS85 PMIC solution for TI Sitara AM2634-Q1 and AM2732-Q1 MCUs. It introduces key FS85 features and functions that work with TI MCUs, including power trees, software initialization, and functional safety. Detailed connections between Sitara devices and NXP PMICs are also highlighted.

Revision history

Revision	Date	Description
v. 1	20230221	Initial version.

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1   Introduction

This application note presents an NXP FS84/FS85 PMIC solution for TI Sitara AM2634-Q1 and AM2732-Q1 MCUs. It introduces key FS85 features and functions that work with TI MCUs, including power trees, software initialization, and functional safety. Detailed connections between Sitara devices and NXP PMICs are also highlighted.

2　FS85 PMIC family

The FS85 PMIC family is a group of automotive, functionally safe multi-output power supply integrated circuits. It includes multiple switch-mode and linear-voltage regulators, and enhanced safety features with fail-safe outputs. These features qualify each FS85 family PMIC (power management integrated circuit) for use as a full part of a safety-oriented system, up to ASIL (automotive safety integrity level) D.

FS84 and FS85 PMICs offer scalability in power and safety. These devices are developed in compliance with the ISO (International Organization for Standardization) 26262 standard and are qualified according to AEC-Q100 requirements. FS84 is fit for ASIL B level systems, and FS85 is for ASIL D systems.

The FS85 family PMICs support customized OTP (one-time programmable) definition to fit power and safety requirements for processors and peripherals.

Key features:

- 60 V maximum input voltage for automotive and truck markets
- Multiple SMPs and LDOs
- Standby OFF mode with very low sleep/Low-power OFF mode current (10 μA)
- 32-bit SPI and IDC interfaces with CRC (cyclic redundancy check)
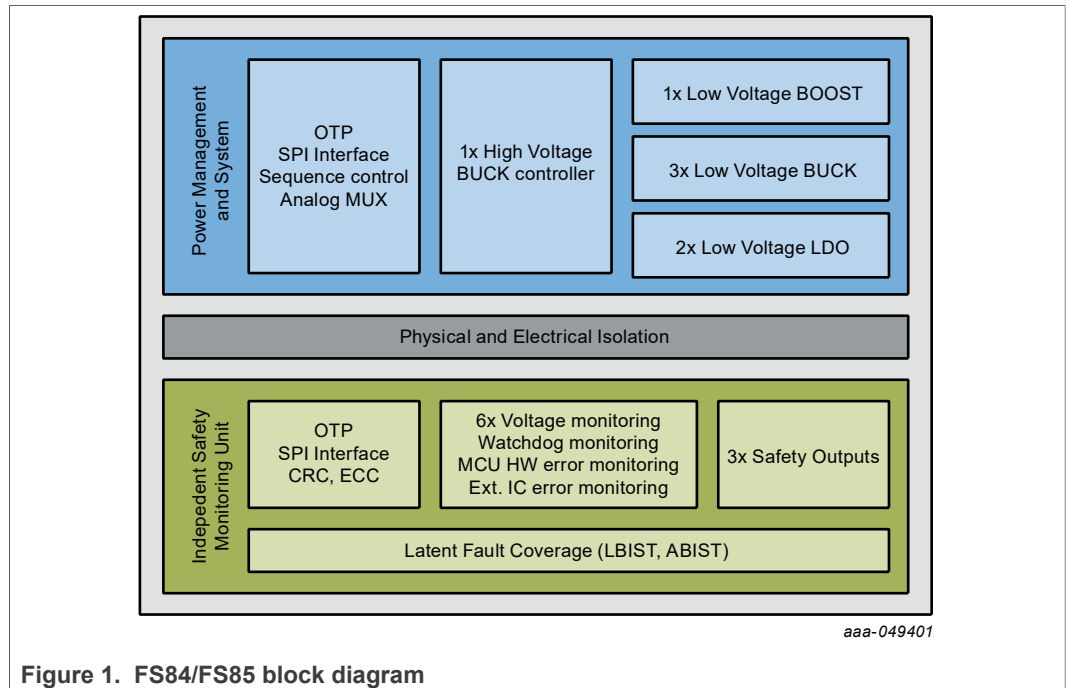- Fit for ASIL D / ASIL B with independent safety monitoring unit

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Figure 1.　FS84/FS85 block diagram

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3   TI Sitara AM2634-Q1 and AM2732-Q1 MCU

TI Sitara AM2634-Q1 and AM2732-Q1 MCUs are Arm-based microcontrollers targeted for automotive applications.

The AM2634-Q1 is built to meet complex real-time processing needs. It consists of four 400 MHz Arm Cortex-R5F cores. The multiple Arm cores can be optionally programmed to run with a lock-step option to meet system requirements up to ASIL D. It can address automotive applications such as traction inverters, onboard chargers, DC-DC converters, and battery management systems.

The AM2732-Q1 is a highly integrated, high-performance microcontroller based on two Arm Cortex-R5F cores and a C66x floating-point DSP core. The AM2732-Q1 targets automotive audio, traffic monitoring, and machine vision applications, with hardware integrity up to ASIL B.

AM2634-Q1 and AM2732-Q1 MCU have similar power supply requirements that call for 1.2 V, 1.8 Vv and 3.3 V. The AM2634-Q1 integrates on-die LDOs to generate 1.8 V.

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Table 1. AM2634-Q1 and AM2732-Q1 power supply requirements

Power rail	AM2634-Q1		AM2732-Q1	
	Relevant powered domain	Current requirement / mA(max)	Relevant powered domain	Current requirement / mA(max)
1.2 V	core digital and SRAMs	2500	core digital and SRAMs	2390
1.8 V	digital I/O, PLL, ADC, analog	Supplied by on-die LDO	APLL, crystal oscillator, ADC, CSI2, LVDS	114
3.3 V	digital I/O	200	digital I/O	74

4 System power solution

The FS85 family PMICs can fully meet the power supply and functional safety requirements of the AM2634-Q1 and the AM2732-Q1 MCU. Table 2 contains recommended FS85/FS84 part numbers for the listed Sitara devices. FS8510DK and FS8410G6 are pin-to-pin compatible. For detailed OTP configurations, refer to the FS84/FS85 data sheet. If needed, contact a local NXP representative to obtain the data sheet.

A customer could define their own FS84 or FS85 OTP configuration, if the part listed in Table 2 does not meet their requirements.

Table 2. *Power solution selection table*

PMIC	FS85	FS84	
Part number	SC33FS8510DK	MC33FS8410G6	MFS8416AMBP5
ASIL	ASIL D	ASIL B	ASIL B
Watchdog	challenger WD	simple WD	simple WD
Voltage monitoring (VMONx)	4	2	4
Battery support	12 V and 24 V	12 V and 24 V	12 V
Package	HVQFN56	HVQFN56	HVQFN48
Fit for Ti Sitara MCU	AM2634-Q1	AM2732-Q1	

4.1 Power tree

FS85 devices have a wide input voltage range to allow support of 12 V battery and 24 V battery systems. Figure 2 shows the FS8510DK power solution for an AM2634-Q1 based system. Both MCU and peripherals could be fully powered by FS85, simplifying system design and saving PCB space. V_{pre} is a battery-connected buck that needs an external MOSFET to generate the 5 V needed for inputs of other low-voltage regulators.
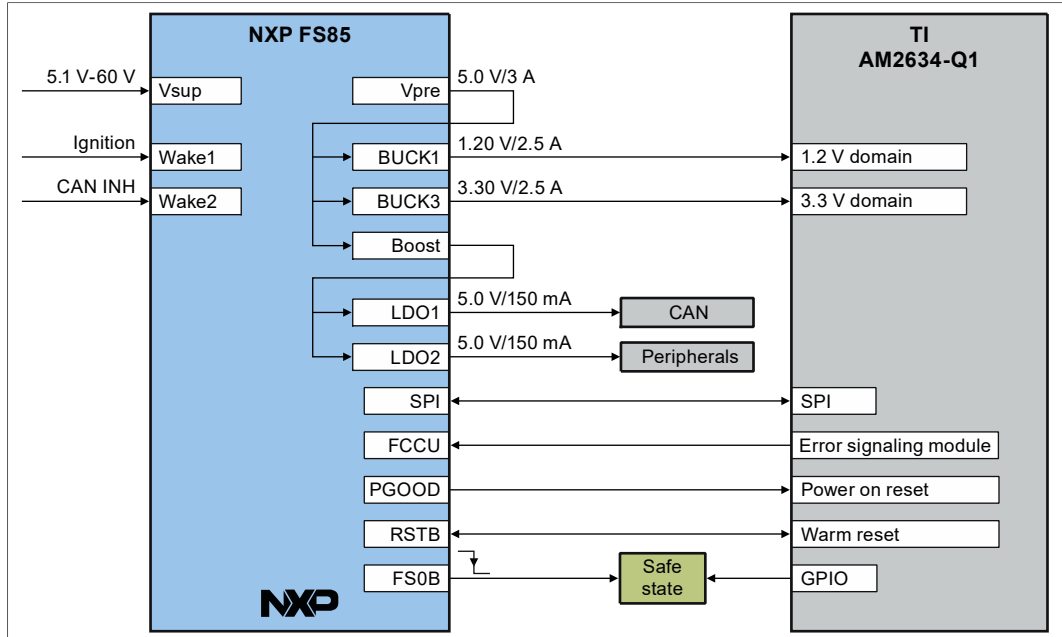
Figure 2. SC33FS8510DK design for AM2634-Q1

[Figure 3](#) illustrates an FS84 design for AM2732-Q1. FS8410G6 and MFS8416AMBP5 have the same power rails and output voltage, but their packages are different. FS84/FS85 supports an external clock synchronization function for switching regulators. This could help with noise reduction when used with a software algorithm in radar applications.
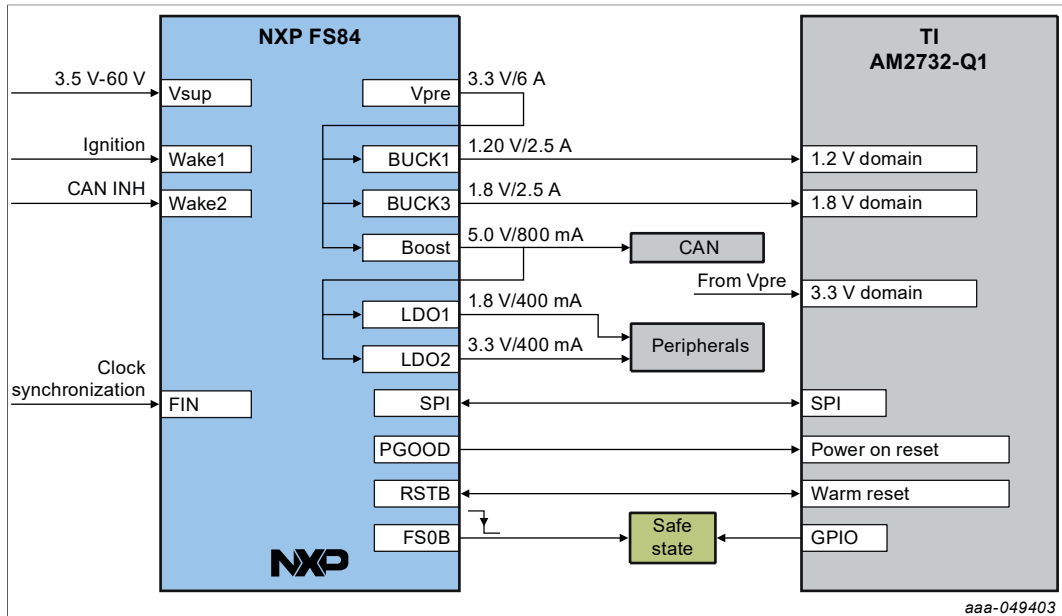

Figure 3. MC33FS8410G6 and MFS8416AMBP5 design for AM2732-Q1

4.2 PMIC and Sitara MCU connections

Table 3. FS85 / FS84 and Sitara MCU connections

Domain	Sirata MCU	FS85	FS84	Function
Power supply	1.2 V	BUCK1	BUCK1	1.2 V power domain
	1.8 V	NA	BUCK3	1.8 V power domain
	3.3 V	BUCK3	Vpre	3.3 V power domain
Functional safety	Error signaling	FCCU	NA	FS85 monitors Sitara fault through FCCU pin
	Power-on reset	PGOOD	PGOOD	FS84 / FS84 PGOODindicates power good from regulators
	Warm reset	RSTB	RSTB	Warm reset connection
	GPIO	FS0B	FS0B	ECU system safe sate control
Digital I/O	NA	Wake1	Wake1	PMIC wake-up signal that connects to ignition signal
	NA	Wake2	Wake2	PMIC wake-up signal that connects to external CAN transceiver INH signal

4.3 FS84 / FS85 initialization

See Figure 4 for the FS84/FS85 initialization process. During initialization, the Sitara MCU can write to registers in FS85/FS84, or read their configurations through SPI or I^{2}C. All FS85 and FS84 devices are software compatible.

From a functional safety point of view, FS84/FS85 have integrated hardware-ready safety mechanisms. The MCU need not participate in fault diagnosis, but needs only to check the PMIC diagnosis from a PMIC register and report the fault.

NXP provides free generic software drivers for FS84/FS85. Vector also provides qualified FS85 Autosar drivers. Contact an NXP representative for details.
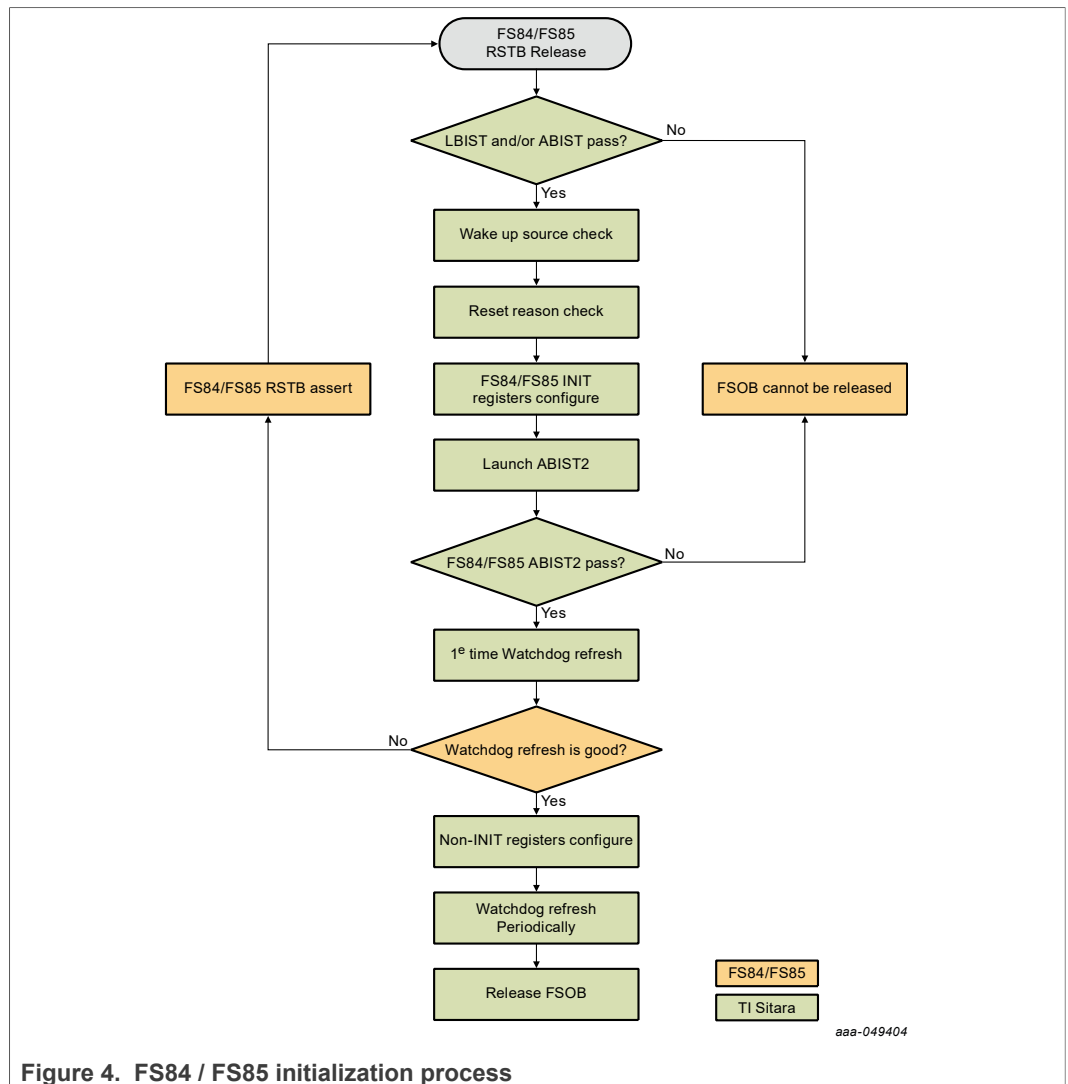
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Figure 4. FS84 / FS85 initialization process

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5   Functional safety

The FS85 family PMIC development rules, processes, and tools are certified to be compliant with the ISO 26262 standard. They have the same functional safety architecture and safety mechanisms for single-point-fault and latent-fault diagnosis and reaction. A dedicated functional safety state machine that controls all safety aspects is integrated into these NXP PMICs. This is called the fail-safe state machine. See Figure 2 for functional safety interconnections between the PMIC and the Sitara MCU. The voltage monitor provides independent supervision for undervoltage and overvoltage detection by FS85/FS84 regulators. Analog built-in self-test and logic built-in self-test (ASIL D only) are implemented within the PMIC for latent-fault diagnosis. These features remove any need for Sitara to take part in PMIC fault diagnosis, which can save Sitara MCU resources and reduce system complexity.
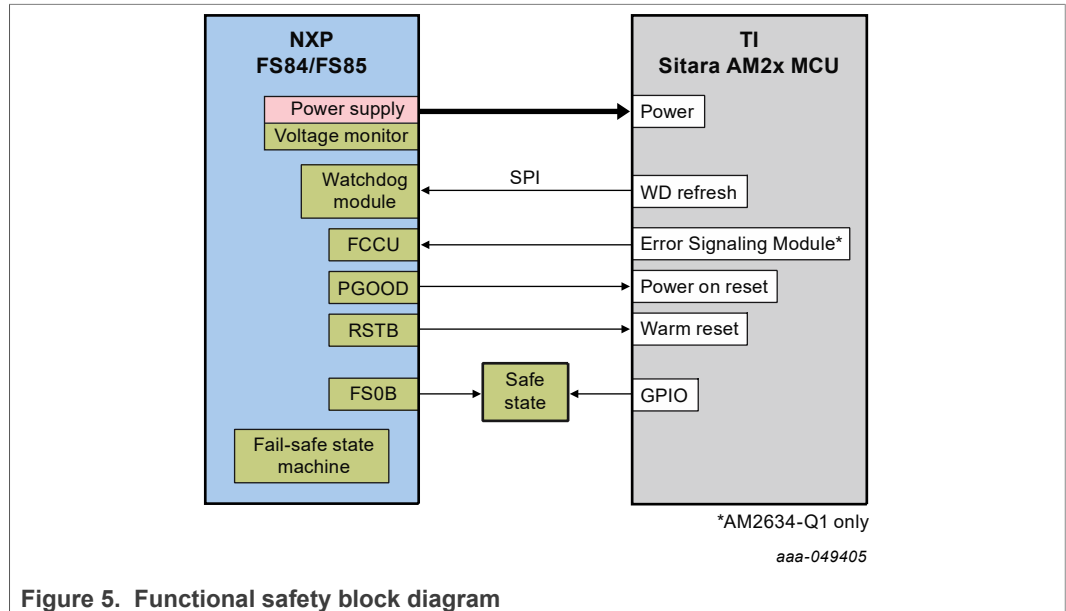

Figure 5. Functional safety block diagram

FS84/FS85 devices integrate watchdog functionality, which can monitor the Sitara MCU through the SPI interface. The PMIC FCCU pins can be connected to the error signaling output from the Sitara MCU. See Figure 6 for recommended FCCU connections. When the PMIC detects an AM2634 watchdog failure or error signal, it can reset the MCU with the RSTB pin and/or set the system into safe state through the FS0B pin.
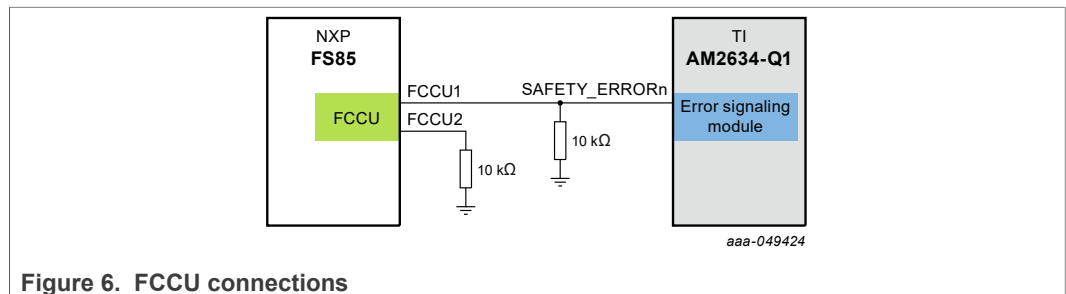

Figure 6. FCCU connections

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6   Reference resources

[1] **FS84 webpage includes documentation and tools (Datasheet,Safety Manual, FMEDA, SW driver)**

[2] **FS85 webpage includes documentation and tools (Datasheet,Safety Manual, FMEDA, SW driver)**

[3] **Power Management Community**

[4] **BYLink System Power Platform**

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