FS04_PB

High-voltage safety PMIC with SMPS and LDO

Rev. 1.1 — 4 September 2024 **Product brief**

Document information

Information	Content
Keywords	FS04, PMIC, central compute, ASIL D, gateway, in-vehicle network, domain controller, telematics
Abstract	The FS04 is an automotive multi-output power management IC that focuses on central compute, gateway, in-vehicle network, and domain controller applications. The device includes a high-voltage buck converter, multiple high-efficiency switch modes and linear voltage regulators.

1 Overview

The FS04 is an automotive multi-output power management IC that focuses on central vehicle controller, gateway, in-vehicle network, and domain controller applications. The device includes a high-voltage buck converter, multiple high-efficiency switch modes and linear voltage regulators.

The FS04 includes enhanced safety features with fail-safe outputs and dedicated safety pins for the processor S32N. The device covers ASIL B and ASIL D safety integrity levels. It complies with the ISO 26262 standard and is qualified in accordance with AEC-Q100 rev H (Grade1, MSL3). The FS04 can be fully utilized in safety-oriented system partitioning and can also be configured to operate as a non-safety QM-version part.

The FS04 is available in several versions that support a variety of safety applications and offer numerous choices with respect to the number of output rails, output voltage settings, operating frequencies, and power-up sequencing.

2 Features

- A high-voltage synchronous buck controller, driving external MOSFETs:
  - Input voltage, 3 V to 60 V
  - Output voltage from 3.3 V to 5.3 V
  - Up to 1.5% DC accuracy in pulse width modulation (PWM) mode and 3% DC accuracy in pulse frequency modulation (PFM) mode
  - 50 mA gate drive capability, up to 20 A DC output current capability
  - Switching frequencies 312 kHz to 455 kHz
- Five buck regulators with internal power stage
  - BUCK1 single-phase operation, 1 V to 1.8 V @ 2.5 A DC with up to 1.0 % DC accuracy
  - BUCK2 single-phase operation, 1 V to 1.8 V @ 2.5 A DC with up to 1.0 % DC accuracy
  - BUCK3 single-phase operation, 0.4 V to 1.8 V @ 2.5 A DC with up to 1.0 % DC accuracy
  - BUCK4 single-phase operation, 0.4 V to 1.8 V @ 2.5 A DC with up to 1.0 % DC accuracy
  - BUCK5 / switch mode, 0.6 V to 1.8 V @ 70 mA in buck mode and 150 mA in switch mode
- One low-power linear regulator
  - LDO1: LDO/load Switch with output voltage from 1.1 V to 3.3 V @ 400 mA DC
- One boost regulator with integrated low-side switch
  - Output voltage, 4.5 V to 5.5 V @ 1 A DC with up to 2.0 % DC accuracy
- Advanced frequency management, including frequency spread spectrum, slew rate control, manual frequency tuning.
- Functional safety architecture to target ASIL D applications.
- ABIST and LBIST for latent fault detection
- Optimized low-power architecture
- High-speed I^2C interface with up to 3.4 MHz operation
- Advanced thermal monitoring and thermal shutdown protection
- 64-pin QFN package with exposed pad and 0.5 mm pitch
- Automotive qualified AEC-Q100 up to Grade 1

3 Applications

- Central vehicle controller
- Gateway
- In-vehicle networks
- Domain controllers

4 Ordering information

Table 1. Ordering information

Type number	Package		
	Name	Description	Version
FS0400	QFN64	QFN64 package with exposed pad, thermally enhanced wettable flanks, 64 terminals, 0.5mm pitch, 9 mm x 9 mm.	SOT804-8(DD)

Table 2. Ordering part number and OTP version

Part number	NXP processor	Safety grade	OTP ID
PFS0400AMDA3ES	S32N	ASIL D	DA3

5 Device description

5.1 Functional block diagram

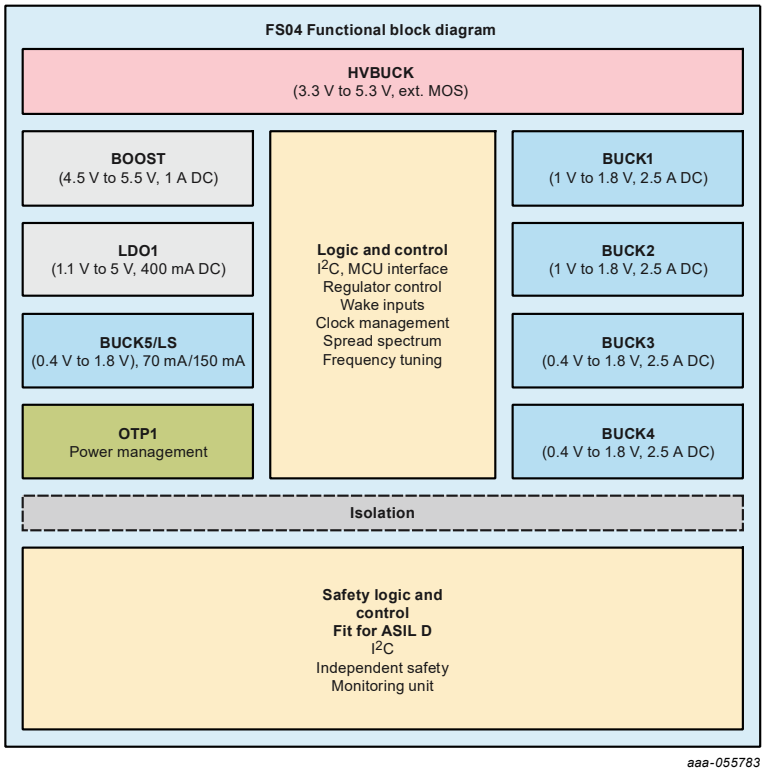

Figure 1. FS04 functional block diagram

5.2 Power rail summary

Table 3. Voltage regulator summary

Regulator	Type	Input Supply	Output Range	Output current
HVBUCK	High-voltage buck controller	2.7 V to 60 V	3.3 V to 5.3 V	20 A DC
BUCK1	Single-phase buck regulator	2.5 V to 5.5 V	1 V to 1.8 V	2.5 A DC
BUCK2	Single-phase buck regulator	2.5 V to 5.5 V	1 V to 1.8 V	2.5 A DC
BUCK3	Single-phase buck regulator	2.5 V to 5.5 V	0.4 V to 1.8 V	2.5 A DC
BUCK4	Single-phase buck regulator	2.5 V to 5.5 V	0.4 V to 1.8 V	2.5 A DC
BUCK5	Single-phase buck regulator with load switch mode	0.6 V to 5.5 V	0.6 V to 1.8 V	70 mA / 150 mA DC
LDO1	LDO with load switch	2.5 V to 5.5 V	1.1 V to 3.3 V	400 mA DC
BOOST	Boost regulator	2.7 V to 6 V	4.5 V to 5.5 V	1 A DC

5.3 Thermal characteristics

Table 4. Thermal characteristics

Symbol	Description	Min	Typ	Max	Units
T_A	Ambient operating temperature • Grade 1[1]	-40		125	°C
T_J	Junction temperature	-40		150	°C
T_{ST}	Storage temperature range	-55		150	°C

[1] Maximum T_A will depend on the overall power dissipated on the device.

6 Revision history

Table 5. Revision history

Document ID	Release date	Description
FS04_PB v1.1	4 Sept 2024	• Section 2: corrected definitions of PWM and PFM abbreviations • Section 5.2: inserted *with load switch mode* in BUCK5 type column • Updated legal information
FS04_PB v.1.0	11 June 2024	Initial version

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