FS23_PB

Safety system basis chip (SBC) with power management, CAN FD and LIN transceivers

Rev. 3.0 — 26 February 2024 **Product brief**

1 General description

The FS23 system basis chip (SBC) offers an expandable family of devices that is pin-to-pin and software compatible. The FS23 SBC is scalable from the linear voltage regulator version to the DC-DC regulator version, as well as from QM to ASIL B. The FS23 SBC includes CAN and LIN transceivers, along with a number of system and safety features for the latest generation of automotive electronic control units (ECU).

The FS23 SBC provides a high level of integration in order to optimize the bill of material (BOM) cost for the body and comfort market.

The FS23 device is highly flexible. It is suitable for S32K processor-based applications, as well as multivendor processors because of its high level of flexibility.

Several device versions are available, offering choice in output-voltage settings, operating frequency, power-up sequencing, and inputs/outputs configuration to address multiple applications.

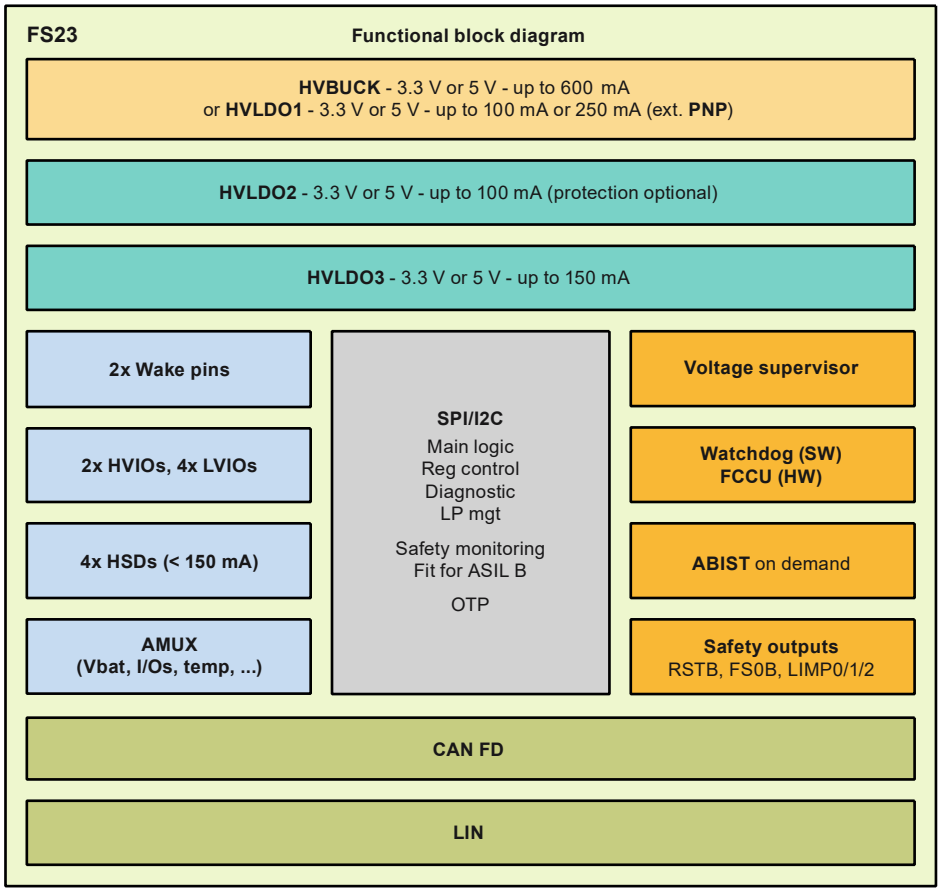

Figure 1. Functional block diagram

2 Features and benefits

Operating modes

- Normal mode with all power management and functional safety features available
- Stop mode: Low-power OFF mode with multiple wake-up sources (LPOFF)
- Standby mode: Low-power ON mode with HVBUCK or HVLDO1 active and multiple wake-up sources (LPON)

Power management

- HVBUCK: Synchronous buck converter with integrated FETs. Configurable Normal mode output voltage and LPON mode output voltage (3.3 V or 5.5 V). Output DC current capability of 600 mA in Normal mode, and 100 mA current capability in Low-power ON mode
- HVLDO1: High-voltage LDO instead of the HVBUCK for MCU supply with selectable output voltage (3.3 V or 5.5 V) and up to 100 mA DC current capability with internal PMOS and 250 mA with external PNP
- HVLDO2: High-voltage LDO regulator for system loads, with optional external protection for off-board sensors, selectable output voltage (3.3 V or 5.0 V) and up to 100 mA DC current capability
- HVLDO3: High-voltage LDO regulator for CAN FD block supply or other with selectable output voltage (3.3 V or 5.0 V) and up to 150 mA current capability

System features

- One CAN FD supporting up to 5 Mbps communication following ISO 11898-2:2016 and SAE J2284 standards
- One LIN following LIN 2.2, ISO 17987-4 and SAE-J2602-2 standards
- Two wake-up inputs (40 V capable)
- Two high-voltage I/Os with wake-up capability (40 V capable)
- Up to four low-voltage I/Os with wake-up capability
- Four configurable high-side drivers with 150 mA drive capability, to supply LEDs or enable external devices (INH), and cyclic-sense capability
- Multiple wake-up sources: WAKE pins, HVIO pins, LVIO pins, CAN FD, LIN or dedicated SPI / I^2C command
- Device control via 32 bits SPI interface or via I^2C interface, with CRC
- Integrated long duration timer (LDT) for system shutdown and wake-up control, programmable up to 194 days
- 16-channel analog multiplexer (AMUX) for system monitoring (temperature, battery voltage, internal voltages)

Functional safety

- Developed following ISO 26262:2018 standard to fit for ASIL B applications
- Internal monitoring circuitry with its own reference
- Additional input for external voltage monitoring
- Window or timeout watchdog function to monitor the MCU failures by software
- FCCU inputs to monitor MCU failures by hardware
- Analog built-in self-test (ABIST) on demand
- Safety outputs (RSTB, FS0B, LIMP0 and LIMP1/2 with 1.25 Hz or 100 Hz PWM capability)

EMC compliance

- The FS23 EMC tests are performed according to ZVEI Generic IC EMC Test Specification version 2.1 (2017) and FMC1278 Electromagnetic Compatibility Specification for Electrical/Electronic Components and subsystems version 3.0 (2018).
- CAN EMC performances certified against IEC62228-3:2019 and SAE J2962-2:2019
- LIN EMC performances certified against IEC62228-2:2016 and SAE J2962-1:2019

Configuration and enablement

- QFN48EP: QFN 48 pins with exposed pad for optimized thermal management, wettable flanks, 7 x 7 x 0.85 mm, 0.5 mm pitch, 48 pins
- One-time programmable (OTP) memory for scalability, expandability and device customization
- OTP emulation mode for system development and evaluation

3 Applications

- Body control module
- HVAC
- Lighting
- Steering column lock
- Seat module
- Roof module
- Door control module
- Car access
- Gearshift
- Seat belt pre-tension
- Tail gate
- Alarm

4 Ordering information

This section describes the part numbers available to be purchased, along with their main differences. It also describes how the part number reference is built.

4.1 Part numbers definition

Two FS23 part numbering types can be found: a full part number reference and a simplified part number.

Figure 2 and Figure 3 describe how the FS23 part numbers are built.

FS23
Product numbering scheme

M	FS	23 X Y	B	M	Z	zz	EP
Release type	Family	Family	Release version	Release type	ASIL level	OTP version	Package
M Production	FS High voltage power management	2300 to 2325 Core	A Initial release	M -40 °C to 125 °C	M QM level	A0 Not programmed	EP QFN48EP
P Pre-release			B Second release		B ASIL B level	A1-zz Other versions	
S Customer special			C-Z Further release				

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Figure 2. Full FS23 part numbers breakdown

MFS 23 X Y BM Z A0EP

Z	ASIL level
M	QM level (timeout WD, OV/UV, VMON)
B	Fit for ASIL B (window WD, OV/UV, ABIST, VMON, FCCU)

Y	CAN	LIN	LDT	Use case
0	Yes	No	No	CAN
1	Yes	Yes	No	CAN, LIN
2	Yes	No	Yes	CAN, LDT
3	Yes	Yes	Yes	CAN, LIN, LDT
4	No	Yes	No	LIN
5	No	Yes	Yes	LIN and LDT

X	Power management solution
0	3 x HVLDOs
2	1 HVBUCK, 2 HVLDOs

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Figure 3. Simplified FS23 part numbers breakdown

Figure 4 maps FS23 part numbers versus the selectable product features.

V1 regulator	HVLDO		HVBUCK	
ASIL level	QM	ASIL B	QM	ASIL B
Base	FS2300M	FS2300B	FS2320M	FS2320B
LIN	FS2301M	FS2301B	FS2321M	FS2321B
LDT	FS2302M	FS2302B	FS2322M	FS2322B
LIN + LDT	FS2303M	FS2303B	FS2323M	FS2323B

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Figure 4. Part numbers mapping versus base feature sets

4.2 Part numbers list

Table 1. Device segmentation

Generic part number	V1 type	HV LDO2	HV LDO3	CAN	LIN	LDT	SPI / I²C	AMUX	HVIOs	LVIOs	Wake pins	High-side drivers	Fit for ASIL	FS0B	LIMPx	VMON_ EXT	FCCU	Watchdog	Cyclic CRC check	RSTB 8 s timer	ABIST on demand
FS2300M	HVLDO	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2301M	HVLDO	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2302M	HVLDO	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2303M	HVLDO	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2304M	HVLDO	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2305M	HVLDO	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2300B	HVLDO	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2301B	HVLDO	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2302B	HVLDO	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2303B	HVLDO	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2304B	HVLDO	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2305B	HVLDO	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2320M	HVBUCK	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2321M	HVBUCK	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2322M	HVBUCK	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2323M	HVBUCK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2324M	HVBUCK	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2325M	HVBUCK	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	QM	No	Opt	No	No	Opt.	Opt.	No	No
FS2320B	HVBUCK	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2321B	HVBUCK	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2322B	HVBUCK	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2323B	HVBUCK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2324B	HVBUCK	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes
FS2325B	HVBUCK	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ASIL B	Yes	Opt	Yes	Yes	Yes	Yes	Yes	Yes

Note: *Additional part numbers will exist with different features and parametric settings. The device segmentation is also available on nxp.com.*

Table 2 is an example of orderable part number list.

Table 2. Orderable part numbers

Part number	Description	Main properties						Package
		V1 regulator type	V1 voltage	V2 voltage	V3 voltage	SPI or I²C	Safety grade	
MFS2323BMBA1EP	Superset for HVBUCK version, ASIL B, CAN, LIN and LDT enabled.	HVBUCK	5 V	3.3 V	5 V	SPI	ASIL B	QFN48EP
MFS2323BMMA2EP	Superset for HVBUCK version, QM, CAN, LIN and LDT enabled.	HVBUCK	5 V	3.3 V	5 V	SPI	QM	
MFS2303BMBA3EP	Superset for HVLDO version, ASIL B, example for S32K1xx MCU, CAN, LIN and LDT enabled.	HVLDO	5 V	3.3 V	5 V	SPI	ASIL B	
MFS2303BMMA4EP	Superset for HVLDO version, QM, CAN, LIN and LDT enabled.	HVLDO	5 V	3.3 V	5 V	SPI	QM	
MFS2323BMBA5EP	Configuration used for S32K311 + FS23 EVB, S32K31X-Q100, CAN, LIN and LDT enabled.	HVBUCK	5 V	3.3 V	5 V	SPI	ASILB	
MFS2303BMMA9EP	Configuration example for door control unit (DCU), CAN, LIN and LDT enabled, external PNP enabled.	HVLDO + ext. PNP	3.3 V	3.3 V	5 V	SPI	QM	
MFS2301BMBACEP	Configuration example for park lock actuator (PLA), CAN and LIN enabled, LDT disabled.	HVLDO	5 V	5 V	5 V	SPI	ASIL B	
MFS2320BMBB1EP	Configuration example for S32K312 MCU, CAN enabled, LIN and LDT disabled.	HVBUCK	5 V	5 V	5 V	SPI	ASIL B	
MFS2321BMBB2EP	Configuration example for S32K324 MCU, CAN and LIN enabled, LDT disabled.	HVBUCK	5 V	5 V	5 V	SPI	ASIL B	
MFS2323BMBBFEP	Configuration example for battery management system (BMS)	HVBUCK	5 V	5 V	5 V	SPI	ASIL B	
MFS2300BMMA0EP	Superset covering FS2300M devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	QM	
MFS2301BMMA0EP	Superset covering FS2301M devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	QM	
MFS2302BMMA0EP	Superset covering FS2302M devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	QM	
MFS2303BMMA0EP	Superset covering FS2303M devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	QM	
MFS2304BMMA0EP	Superset covering FS2304M devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	QM	
MFS2305BMMA0EP	Superset covering FS2305M devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	QM	
MFS2300BMBA0EP	Superset covering FS2300B devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2301BMBA0EP	Superset covering FS2301B devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2302BMBA0EP	Superset covering FS2302B devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2303BMBA0EP	Superset covering FS2303B devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2304BMBA0EP	Superset covering FS2304B devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2305BMBA0EP	Superset covering FS2305B devices.	HVLDO	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2320BMMA0EP	Superset covering FS2320M devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	QM	
MFS2321BMMA0EP	Superset covering FS2321M devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	QM	
MFS2322BMMA0EP	Superset covering FS2322M devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	QM	
MFS2323BMMA0EP	Superset covering FS2323M devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	QM	
MFS2324BMMA0EP	Superset covering FS2324M devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	QM	
MFS2325BMMA0EP	Superset covering FS2325M devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	QM	
MFS2320BMBA0EP	Superset covering FS2320B devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2321BMBA0EP	Superset covering FS2321B devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2322BMBA0EP	Superset covering FS2322B devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2323BMBA0EP	Superset covering FS2323B devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2324BMBA0EP	Superset covering FS2324B devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	ASIL B	
MFS2325BMBA0EP	Superset covering FS2325B devices.	HVBUCK	Configurable	Configurable	Configurable	Configurable	ASIL B	

5 Block diagram

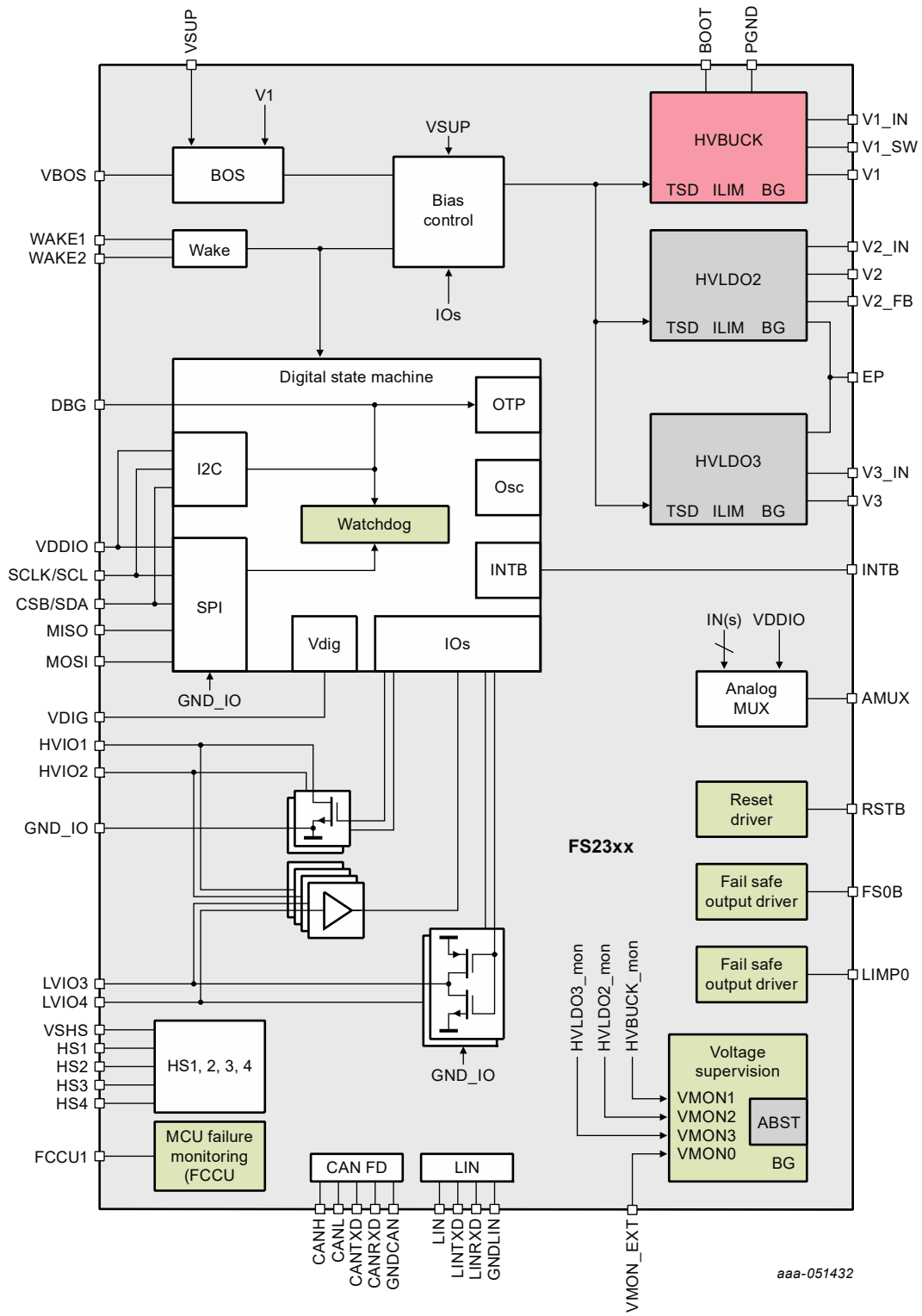


Figure 5. FS2320 block diagram (HVBUCK)

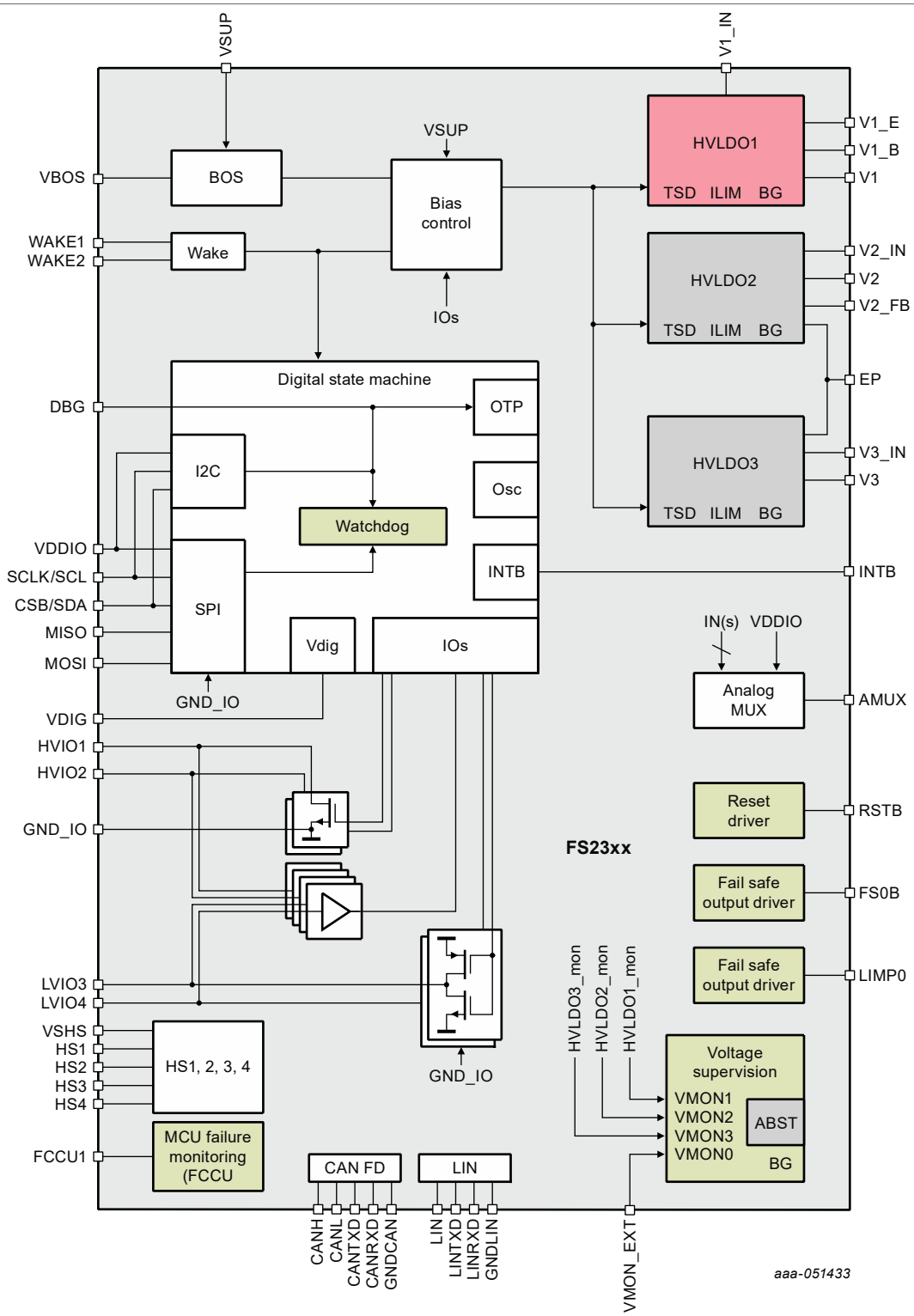
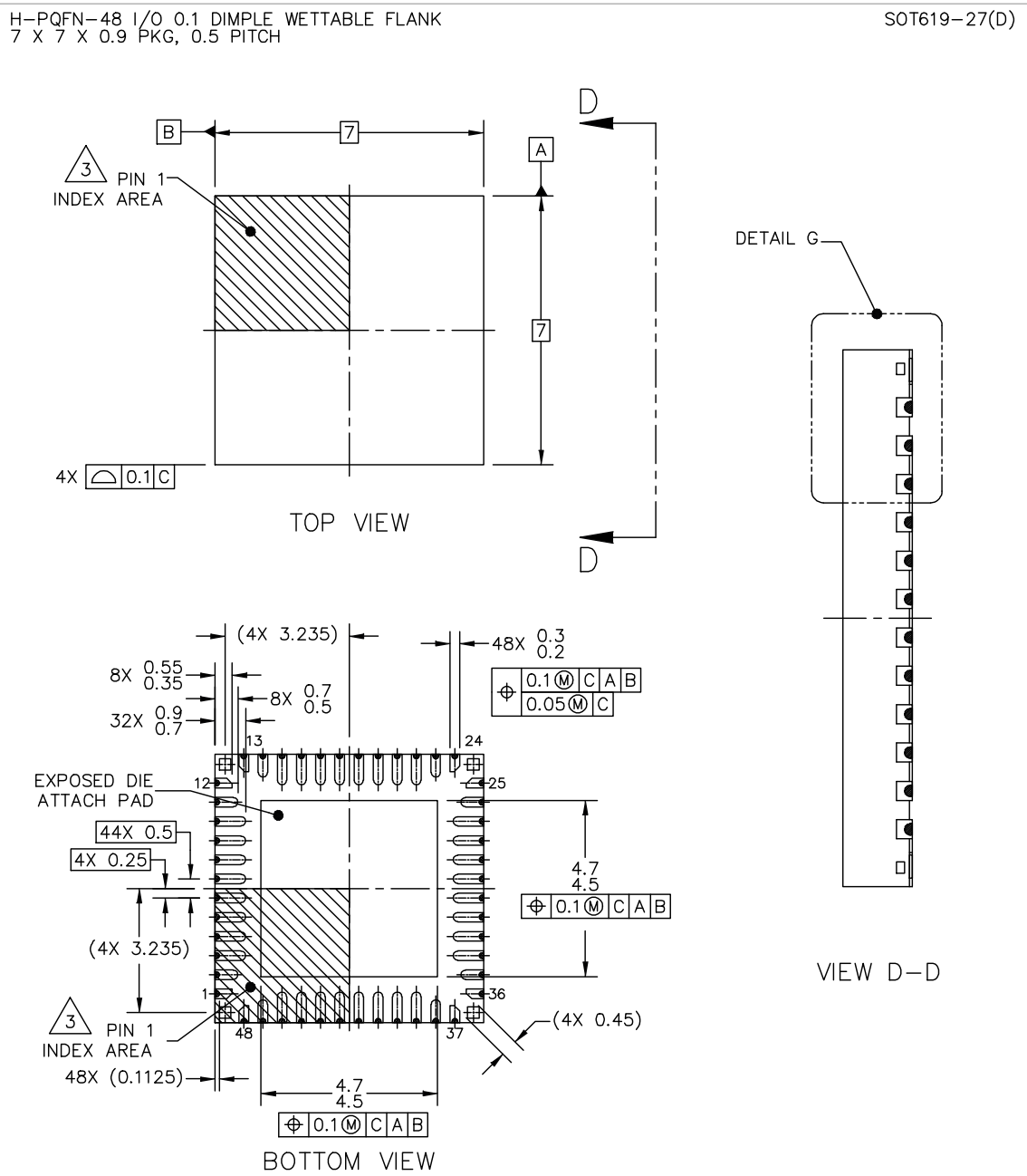


Figure 6. FS2300 block diagram (HVLDO1)

6 Package drawing



H–PQFN–48 I/O 0.1 DIMPLE WETTABLE FLANK
7 X 7 X 0.9 PKG, 0.5 PITCH

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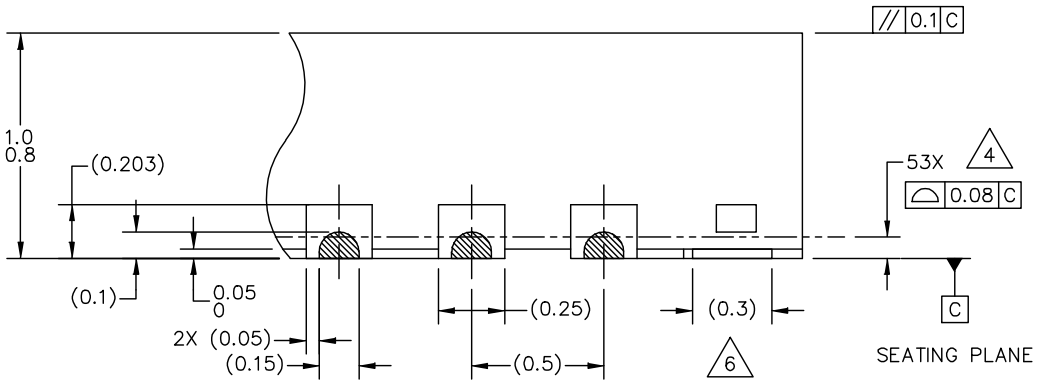

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H-PQFN-48 I/O 0.1 DIMPLE WETTABLE FLANK
7 X 7 X 0.9 PKG, 0.5 PITCH

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7 Revision history

Revision	Date	Description of changes
FS23_PB v 3	26 February 2024	• Global editing for NXP style and grammar • Updated Document title and DocID • Updated Section 2 • Updated Table 1, Table 2 • Updated Figure 1, Figure 3, Figure 4,
FS23_PB v 2.1	30 October 20223	• Updated Document title
FS23_PB v 2	20 October 2023	• Updated appearance of Revision history • Updated Document title and identifier • Updated Section 1; Section 2; Section 3; Section 4; Legal information • Removed section titled "Data sheet status"
FS23_PB v 1	08 June 2022	Initial version

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