MFS2401AVMAFES − NXP Standard

Configuration report for QM OTP program ID: AF rev A

Rev. 1.0 - 11/30/2023   **Report**

1 General description

FS2400 is a family of automotive safety system basis chip (SBC) devices with multiple power supply designed to support secure car access application using ultra-wide band (UWB), near-field communication (NFC) and Bluetooth Low Energy (BLE) devices while maintaining flexibility to fit other small applications requiring low power and CANFD communication.

This family of devices supports a wide range of applications, offering choice of output voltage setting, physical interface, integrated system-level features to address low-power and noise-sensitive applications with Automotive Safety Integrity Levels (ASIL) up to ASIL B.

The FS2400 integrates a battery-connected switched-mode regulator (V1) and a battery-connected linear regulator (V3) to supply microcontroller, communication devices and others. V1 offers a high-performance switching regulator capable of operating in pulse frequency modulation (PFM) mode and force pulse width modulation (FPWM) mode. The mode of operation can be changed using WAKE pins to optimize noise management.

The FS2400 is developed in compliance with the ISO 26262:2018 standard. It includes enhanced safety features, with Fail-safe output, becoming part of a full safety-oriented system, covering ASIL B safety integrity level.

The FS2400 is offered in a 5mm x 5mm 32-Ld HVQFN package with wettable flanks.

2 Features and benefits

Operating range

- 40 V DC maximum input voltage
- Low power OFF mode with very low sleep current and multiple wake-up sources
- Low power ON mode with HVBUCK (V1) active, HVLDO (V3) selectable by OTP and multiple wake-up sources

Power supplies

• V1: High-voltage synchronous buck converter with integrated FETs. Configurable output voltage (1.9 V to 5 V) and switching frequency, output DC current capability up to 400 mA and PFM mode for low power ON mode operation

• V3: High-voltage LDO regulator for microcontroller I/O support with selectable output voltage between 3.3 V or 5 V and up to 150 mA current capability

System support

• One CAN FD 5M following IEC 62228-3 2019 edition

• Four wake-up inputs (40 V capable): WAKEx pins, HVIO pins, CANFD or SPI activity

• Hardware ID detection capability

• One high-voltage I/O with wake-up capability (40 V capable)

• Device control via 32 bits SPI interface, with CRC

• Integrated long duration timer (LDT) and analog multiplexer (AMUX)

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 software failure

• Analog built-in self-test (ABIST) on demand

• Safety outputs (RSTB, LIMP0)

• Safety input to monitor external IC state (ERRMON)

Configuration and enablement

• HVQFN32: QFN, thirty-two pins with exposed pad for optimized thermal management, wettable flanks, 5 x 5 x 0.85 mm, 0.5 mm pitch

• Permanent device customization via one time programmable (OTP) fuse memory

• OTP emulation mode for system development and evaluation

3 Applications

• UWB anchors

• NFC anchors

• BEL anchors

• Combo anchors (UWB + BEL)

- UWB radar
- All small applications requiring low power and CAN FD
- UWB master anchors

4 Ordering information

Table 1. Ordering information

| Type number[1]	Package			
	Name	**Description**		**Version**
MFS2401AVMAFES	HVQFN32	HVQFN32: QFN, thirty-two pins with exposed pad for optimized thermal management, wettable flanks, 5 x 5 x 0.85mm, 0.5 mm pitch		SOT617-26(D)

[1] To order parts in tape and reel, add the R2 suffix to the part number.

5 Power-up sequence summary
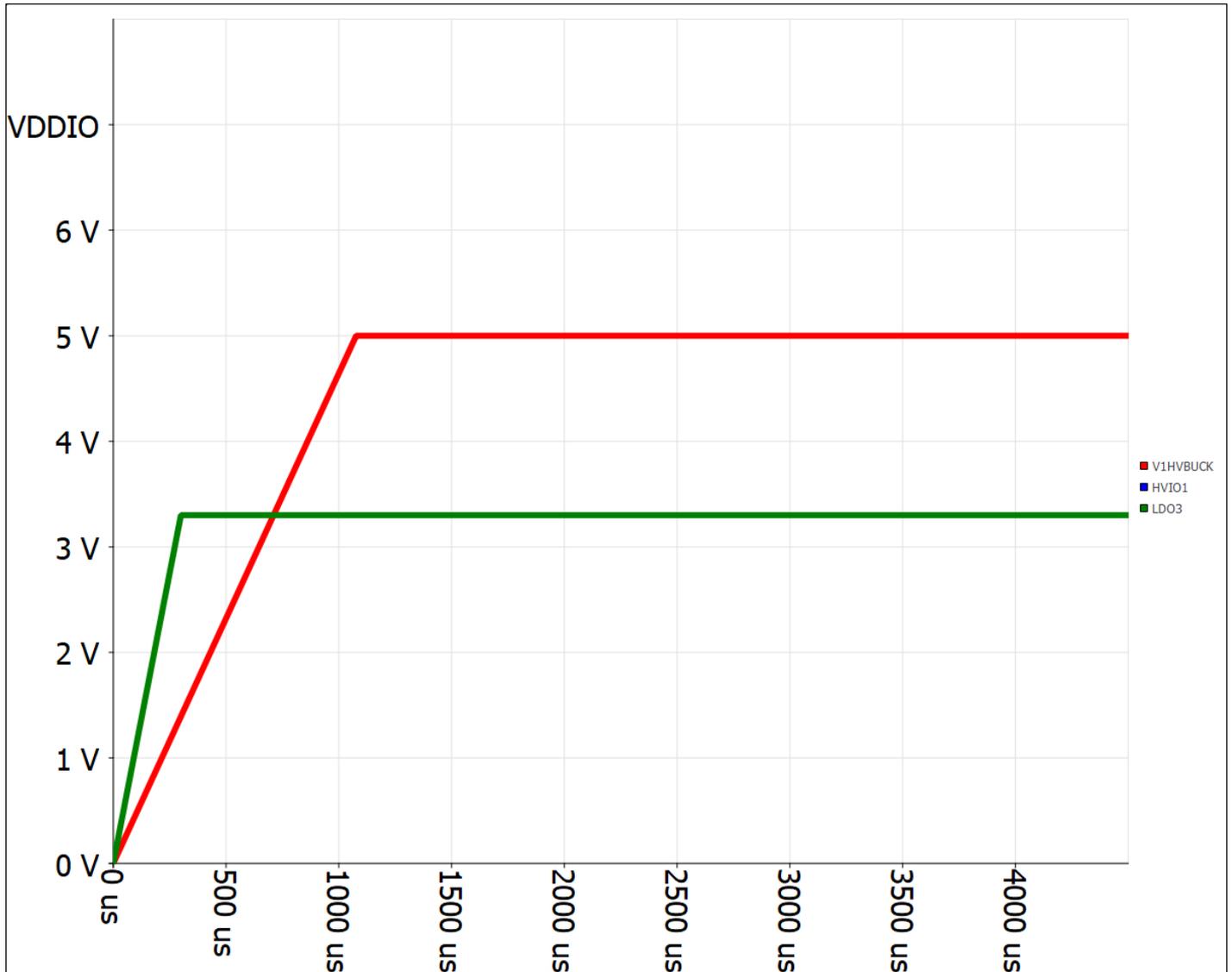
The signals depicted above are enable signals for each regulator. They don't represent the actual ramp voltage.

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6 Hardware configuration diagram
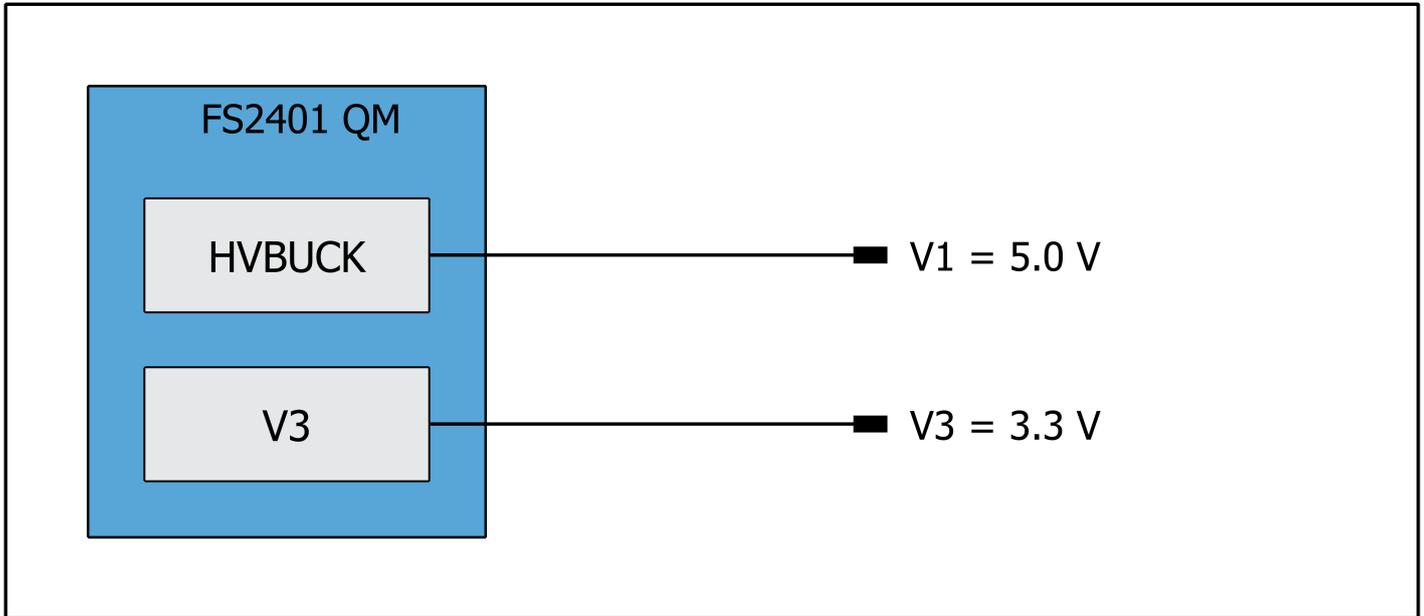
7 OTP configuration

See FS2400 datasheet for parametric details. The OTP configuration summary for AF sequence ID is provided in Tables below.

Table 2. Device OTP configuration

Functional block	Feature	OTP selection
System configuration	Enable CAN	CAN is enabled
	Bypass Slots	Enabled
	VSUP_UV Threshold	VSUP_UVTH high threshold selected (5.7 V)
	V1UVLP Threshold	V1UVLP threshold is typical 3.07 V
Clock configuration	Enable Clock Modulation	Modulation is disabled
	Clock Modulation Configuration	Triangular modulation is selected
WAKEs configuration	WAKE2 Pull Down	WAKE2 internal pull down and pull up are disabled
	WAKE3 Pull Down	WAKE3 internal pull down and pull up are disabled
HVIO1 configuration	HVIO1 Configured As Output	HVIO1 is configured as an input
	HVIO1 Pull-up/Pull-down	HVIO1 internal pull down is disabled and pull up is enabled
	HVIO1 Pull-up Source	Pull up to VDDIO
	HVIO1 Output Default State	HVIO1 default state is ON (asserted)
	HVIO1 Power-up Slot (output)	HVIO1 polarity is changed in slot 0
	HVIO1 Polarity When Activated By a Slot	HVIO1 is turned OFF on an active slot

Table 3. Regulators

Functional block	Feature	OTP selection
V1 HVBUCK configuration	V1HVBUCK Power-up Slot	Slot 0
	V1HVBUCK Soft Start Ramp	Soft start is 1077 us
	V1HVBUCK Behaviour In Case Of TSD	V1 is disabled in case of TSD
	V1 BUCK Regulator Voltage In Normal Mode	5.0 V
	V1 BUCK Regulator Voltage In LPON Mode	5.0 V
	BUCK Switching Frequency	Switching frequency is 2.25 MHz
	BUCK Compensation Resistor	975 kOhm
	BUCK Compensation Capacitor	33.5 pF
	BUCK Slope Compensation	573 mV/us
	BUCK HS Slew Rate When ON	HS raising slew rate is 10 ns
	BUCK HS Slew Rate When OFF	HS falling slew rate is 10 ns
	PWM Mode Average Current Detection Threshold	Average current detection threshold is 600 mA
	PWM Mode High Side Peak Current Detection Threshold	Overcurrent (peak) threshold is 800 mA
	PFM Mode High Side Peak Current Detection Threshold	Overcurrent (peak) threshold is 700 mA
	BUCK TON Time In PFM	TON time in PFM is 305 ns
	BUCK TOFF Time In PFM	TOFF time in PFM is 250 ns
	BUCK DVS Ramp Rate	5.625 mV/us

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	VBOS To V1 Switch In LPON Mode	VBOS to V1 switch is closed in LPON mode
	V1 BUCK Regulator Voltage Range	Range high, 3.2 V to 5.5 V, step = 0.05 V
	PFM TON Depending On Vout Settings	Select if VV1_LP greater than 4 V
	Low Side Reverse Recovery Delay	LS reverse recovery delay is 12 ns
	HS Current Sense Blanking Time	40 ns (2.2 MHz only)
	LDO Mode Detect Comparator Threshold	LDO mode detect falling threshold is 8.2 V
	BUCK Overcurrent Deglitcher Time	overcurrent deglitcher is 250 us
V3 configuration	LDO3 Power-up Slot	V3 starts and stops in slot 0
	LDO3 Behaviour In Case Of TSD	V3 is disabled in case of TSD
	V3 LDO Regulator Voltage	V3 = 3.3 V

Table 4. Functional Safety

Functional block	Feature	OTP selection
System configuration	LIMP0 Enable	LIMP0 is disabled
	LDTIM Enable	LDTIM is enabled
	ERRMON Enable	ERRMON is disabled
	ABIST Enable	ABIST checks are disabled
	First Fault Enable	DoNot GoTo FS at first fault
	Disable RSTB 8s Timer	RSTB 8s timer is disabled
	RSTB Pulse Duration	10 ms

	Lock The Watchdog	Watchdog is enabled normally
	FS Duration	FS state duration is 100 ms
	FS LPOFF	Automatic restart after FS state
	Disable INIT CRC	CRC is disabled
	CRC Invert	CRC calculation result is not inverted
	Disable SPI CRC Check In Debug Mode	SPI CRC is enabled while DEBUG mode
	Disable SPI CRC Check	SPI CRC is enabled
	Enable V1 Pre-warning Monitor	Monitor disabled
	V1 Overvoltage Detection	The V1 is disabled in case of OV
	V3 Overvoltage Detection	The V3 is disabled in case of OV
V0MON_RES configuration	V0MON Enable	Disabled
	V0MON Voltage Configuration	1.0 V
	V0MON Undervoltage Threshold	62 %
	V0MON Overvoltage Threshold	102.5 %
	V0MON Undervoltage Deglitcher Time	5 us
	V0MON Overvoltage Deglitcher Time	25 us
	Configure V0 UV Impact On RSTB	VMON_EXT UV Does not assert RSTB
	Configure V0 OV Impact On RSTB	VMON_EXT OV Does not assert RSTB

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V1MON_DAC configuration	V1MON Enable	Enabled
	V1MON Undervoltage Threshold	62 %
	V1MON Overvoltage Threshold	110 %
	V1MON Undervoltage Deglitcher Time	25 us
	V1MON Overvoltage Deglitcher Time	25 us
	Configure V1 UV Impact On RSTB	V1 UV asserts RSTB
	Configure V1 OV Impact On RSTB	V1 OV Asserts RSTB
V3MON_DAC configuration	V3MON Enable	Enabled
	V3MON Undervoltage Threshold	91.5 %
	V3MON Overvoltage Threshold	110 %
	V3MON Undervoltage Deglitcher Time	25 us
	V3MON Overvoltage Deglitcher Time	25 us
	Configure V3 UV Impact On RSTB	V3 UV asserts RSTB
	Configure V3 OV Impact On RSTB	V3 OV asserts RSTB

Table 5. Program ID

Functional block	Feature	OTP selection
Program ID	Program ID High	A
	Program ID Low	F

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