FS8600_SDS

Fail-safe system basis chip with multiple SMPSs and LDOs

Rev. 3.0 — 4 October 2024 Product short data sheet

1 General description

The FS86 device family, which is software compatible with the FS84/85 family, expands the power capability, the safety integration and the system scalability of domain controller applications to address the multiple MCU requirements present in ADAS, radar and electrification applications.

The FS86 includes multiple switch mode and linear voltage regulators and enhanced safety features with Fail-safe outputs. The latest NXP HV buck architecture features a 15 A capability with e-fuse protection to shut down the system power, to prevent any damage in case of a harmful event. The ability to monitor ten voltages with ±1 % accuracy extends the system safety concept by allowing QM rails from non-NXP components to be monitored.

With its innovative synchronization feature, the FS86 is part of the BYLink system power platform, enabling a new smart approach to designing safe system power management. It provides power, safety and system scalability to ease platform development strategies. Cascaded system SBC/PMICs behave as one with safety and sequencing synchronization.

The FS86 is part of a complete family of devices that offer scalability in power and safety and provide pin-to-pin and software compatibility. It is developed in compliance with the ISO 26262 standard and is qualified according to AEC-Q100 requirements.

2 Features and benefits

Operating Range

- 60 V DC maximum input voltage for 24 V battery network applications
- 36 V DC maximum input voltage for 12 V battery network applications
- Supports operating voltage range down to 4.5 V battery voltage with V_{PRE} = 3.3 V
- Low power OFF mode with low sleep current (10 µA typ.)

Power Supplies

- VPRE: Synchronous high voltage buck controller with external FETs
  - Configurable output voltage from 3.3 V to 5.0 V and current capability up to 15 A DC
  - Selectable switching frequency in force PWM with APS
- BOOST: Low voltage boost converter with integrated low-side FET
  - Configurable output voltage from 5 V to 6 V and current capability up to 1 A DC
- BUCK: Low-voltage integrated synchronous BUCK converter
  - Configurable output voltage from 1.0 V to 3.3 V and current capability up to 2.5 A DC
- LDO1: Low voltage LDO regulator for MCU I/O and system peripheral support with load switch capability
  - Configurable output voltage from 1.5 V to 5.0 V and current capability up to 400 mA DC
- LDO2: Medium voltage LDO regulator for MCU I/O and system peripheral support
  - Configurable output voltage from 1.1 V to 5.0 V and current capability up to 400 mA DC

System support

- 2x input pins for wake-up detection, 3.3 V compatible and battery voltage sensing capability
- Analog multiplexer with full system voltages monitoring
- Enhanced leader/follower power-up sequencing management through XFAILB pin
- 10 ms optional RSTB release delay during power up for certain MCU compliancy
- Device control via 32-bit I^2C interface with 8-bit CRC

Compliancy

- EMC optimization features on switching regulators including spread spectrum, slew rate control and manual frequency tuning
- EMI robustness supporting various automotive EMI Test standards
- Conducted emission: IEC 61967-4
- Conducted immunity: IEC 62132-4
- Radiated emission: FMC1278 rev. 3 from 2018
- Radiated immunity: FMC1278 from 2018 and ISO11452-4

Functional Safety

- Scalable portfolio to fit ASIL B to ASIL D automotive safety systems
- Independent voltage monitoring circuitry
- Up to 10 voltage monitoring inputs for FS86 and external PMIC voltage rails with 1 % target accuracy
- Dedicated interface for MCU monitoring with simple or challenger watchdog monitoring
- MCU hardware failure monitoring with PWM monitoring capability (FCCU)
- External IC failure monitoring (ERRMON)
- Logical and analog built-in self-test (LBIST, ABIST)
- Safety outputs with latent fault detection mechanism (PGOOD, RSTB, FS0B)

Configuration and Enablement

- QFN 48 pins with exposed pad for optimized thermal management

- OTP programming for device customization

3 Applications

- Domain controller (ADAS, electrification, infotainment, etc.)
- Radar (radar, imaging radar)
- Vision (mono camera, stereo camera, night vision, etc.)
- 24 V battery network (60 V maximum): truck, bus, transportation
- 12 V battery network (36 V maximum): automotive

4 Simplified Application Diagram

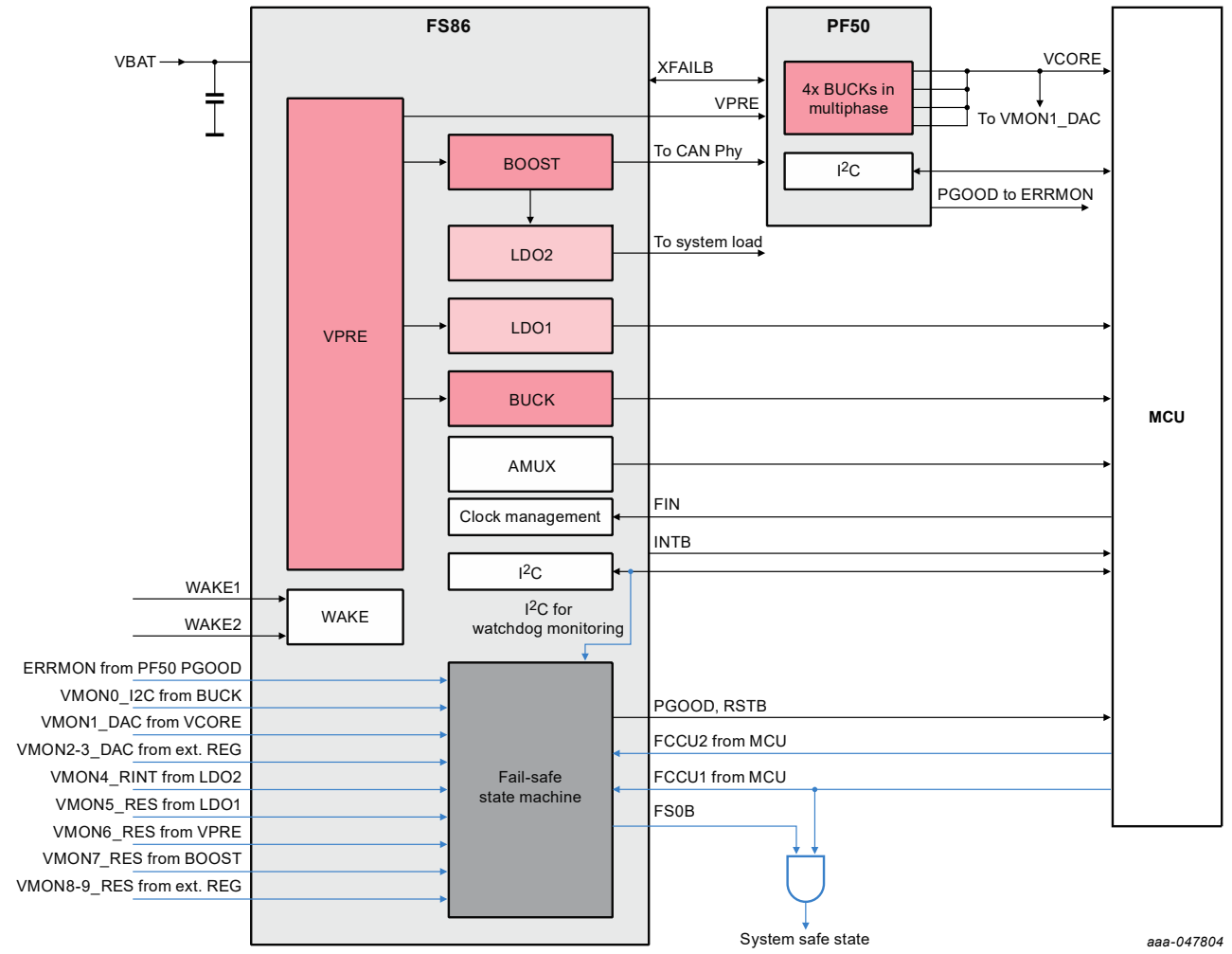

Figure 1. Simplified application diagram

5 Ordering information

5.1 Device family

The FS8600 device family (called FS86 hereafter) provides selectable features based on part numbering and OTP configuration.

Table 1. Device options

FS + Core ID	Application	V_{SUP} max rating	VPRE	BOOST	BUCK	LDOs	VMONs	Watchdog	FCCU	ERRMON	FIN
FS8600	24 V battery network	60 V	Yes	Yes	No	2	4[1]	Yes[2]	Yes	Yes	Yes
FS8601							6[1]				
FS8602							8[1]				
FS8603							10[1]				No[3]
FS8610		60 V	Yes	Yes	Yes	2	4[1]		Yes	Yes	Yes
FS8611							6[1]				
FS8612							8[1]				
FS8613							10[1]				No[3]
FS8620	12 V battery network	36 V	Yes	Yes	No	2	4[1]		Yes	Yes	Yes
FS8621							6[1]				
FS8622							8[1]				
FS8623							10[1]				No[3]
FS8630		36 V	Yes	Yes	Yes	2	4[1]		Yes	Yes	Yes
FS8631							6[1]				
FS8632							8[1]				
FS8633							10[1]				No[3]

[1] Maximum number allowed. Any VMONx can be enabled up to this limit.
[2] ASIL B: watchdog simple. ASIL D: watchdog challenger.
[3] FIN and VMON9 cannot be used at the same time (same pin)

5.2 Part numbering

M	FS	8600	B	M	B	A0	ES
P: prototype M: standard S: custom	HV PMIC	FS86 Core ID[1]	Silicon revision A: A0 B: A1	Ambient temperature (T_A) M: –40 °C to 125 °C	ASIL B: ASIL B D: ASIL D	OTP code A0: OTP A0 xx: OTP xx	Package type ES: dimple wettable flank

[1] See Table 1

Table 2. Ordering information

Part Number[1]	Application	Fit for ASIL	Package		
			Name	Description	Version
MFS8600BMBA0ES	24 V battery network	B	HPQFN48eP	HPQFN48, plastic, thermally enhanced very thin quad flat package, no lead, wettable flanks	SOT619-26
MFS8601BMBA0ES					
MFS8602BMBA0ES					
MFS8603BMBA0ES					

Table 2. Ordering information...*continued*

Part Number[1]	Application	Fit for ASIL	Package		
			Name	Description	Version
MFS8610BMBA0ES	12 V battery network				
MFS8611BMBA0ES					
MFS8612BMBA0ES					
MFS8613BMBA0ES					
MFS8600BMDA0ES		D			
MFS8601BMDA0ES					
MFS8602BMDA0ES					
MFS8603BMDA0ES					
MFS8610BMDA0ES					
MFS8611BMDA0ES					
MFS8612BMDA0ES					
MFS8613BMDA0ES					
MFS8620BMBA0ES		B			
MFS8621BMBA0ES					
MFS8622BMBA0ES					
MFS8623BMBA0ES					
MFS8630BMBA0ES					
MFS8631BMBA0ES					
MFS8632BMBA0ES					
MFS8633BMBA0ES					
MFS8620BMDA0ES		D			
MFS8621BMDA0ES					
MFS8622BMDA0ES					
MFS8623BMDA0ES					
MFS8630BMDA0ES					
MFS8631BMDA0ES					
MFS8632BMDA0ES					
MFS8633BMDA0ES					
MFS8620BMDA8ES					
PFS8613AMDA0ES[2]	12 V or 24 V battery network	B or D			
PFS8613BMDA0ES[3]					

[1] To order parts in tape and reel, add the R2 suffix to the part number.
[2] Superset part number that can cover all features for prototype ordering (A0 silicon pass/obsolete).
[3] Superset part number that can cover all features for prototype ordering (A1 silicon pass).

Part numbers ending with the A0 OTP code are non-programmed OTP configuration. Pre-programmed OTP configurations are managed through part number extension. For a custom OTP configuration, contact your local NXP sales representative.

OTP emulation and programming performed by the customer is allowed during engineering development using NXP's latest graphical user interface and socketed evaluation board.

Customer is not allowed to perform OTP programming for production purposes. Only NXP or a recommended third party are allowed to program the device for production purposes.

6 Internal block diagram

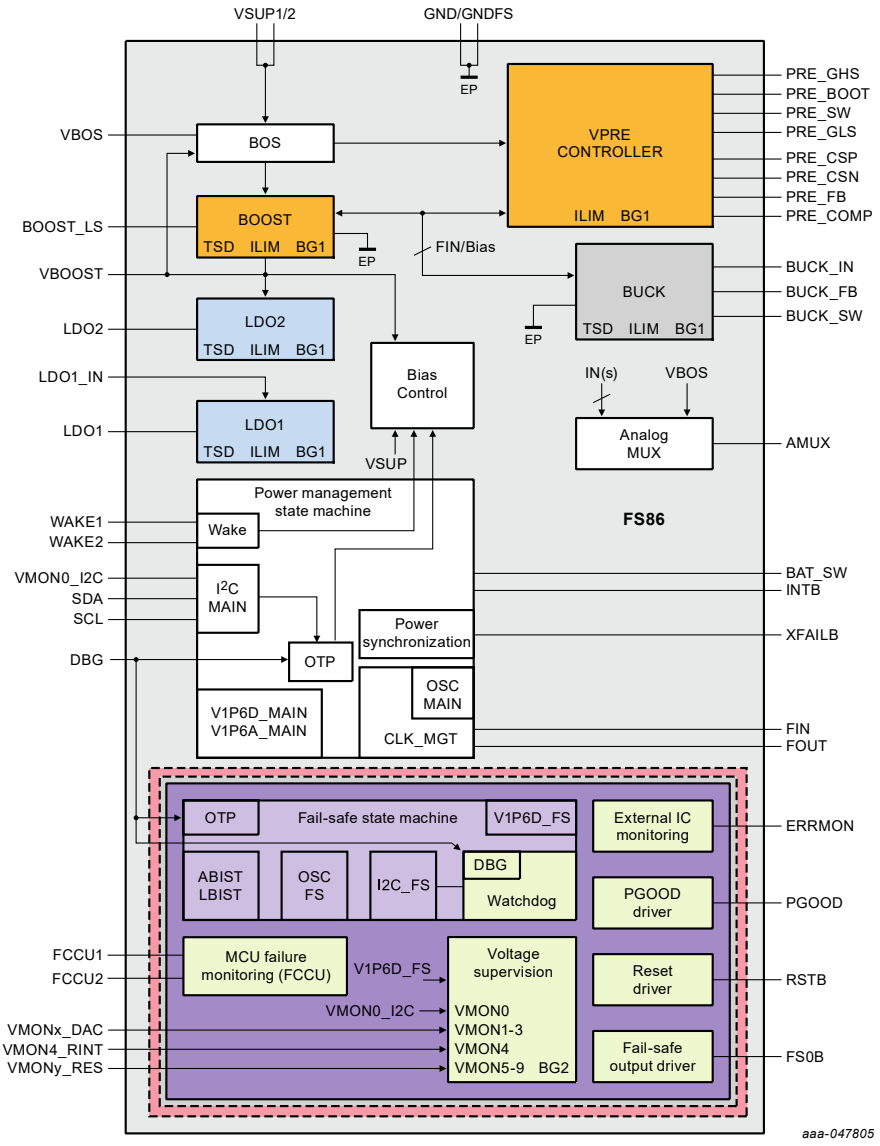

Figure 2. Block diagram

7 Pinout information

7.1 Pinout

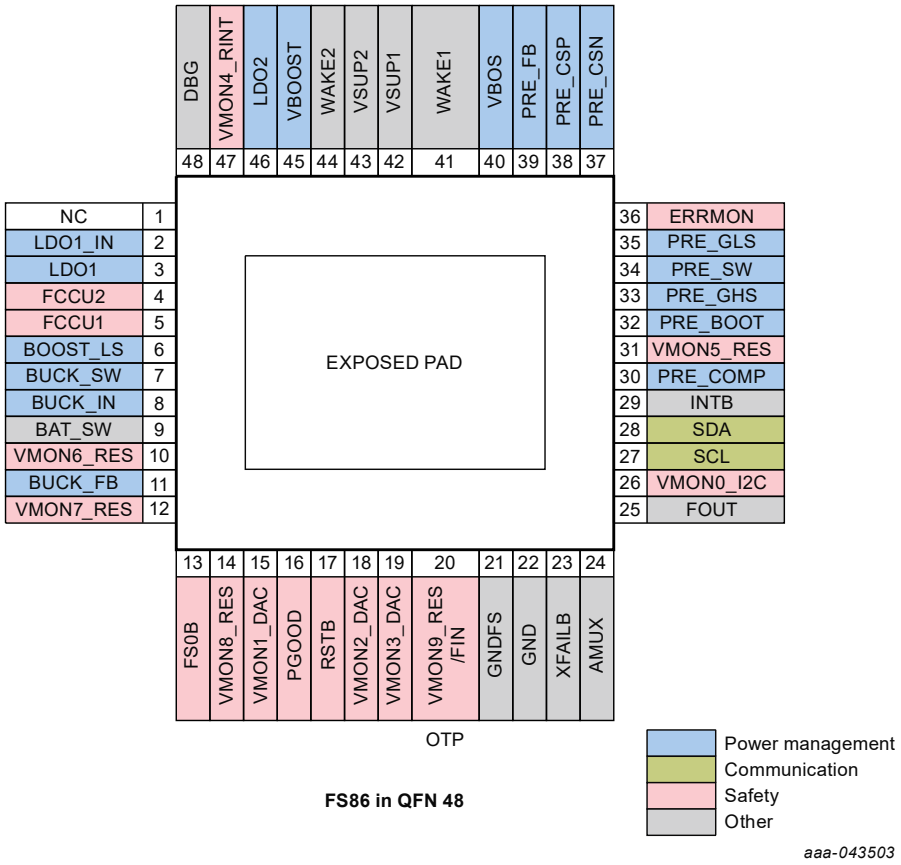

Figure 3. Pin configuration

7.2 Pin description

Table 3. Pin description

Pin	Name	Type	Description
1	N/C	N/C	Not connected pin
2	LDO1_IN	Analog input	Linear regulator #1 input voltage
3	LDO1	Analog output	Linear regulator #1 output voltage
4	FCCU2	Digital input	MCU Error Monitoring input 2
5	FCCU1	Digital input	MCU Error Monitoring input 1
6	BOOST_LS	Analog input	BOOST Low Side Drain of internal MOSFET
7	BUCK_SW	Analog output	Low voltage buck switching node
8	BUCK_IN	Analog input	Low voltage buck input voltage
9	BAT_SW	Digital output	Battery switch control output. Active low. Open drain structure.
10	VMON6_RES	Analog input	External resistor bridge voltage monitoring input #6

Table 3. Pin description...*continued*

Pin	Name	Type	Description
11	BUCK_FB	Analog input	Low voltage buck voltage feedback.
12	VMON7_RES	Analog input	External resistor bridge voltage monitoring input #7
13	FS0B	Digital output	Fail-safe output 0. Active low. Open drain structure.
14	VMON8_RES	Analog input	External resistor bridge voltage monitoring input #8
15	VMON1_DAC	Analog input	DAC voltage monitoring input #1
16	PGOOD	Digital output	Power good output
17	RSTB	Digital input/output	Reset output. Active low. The main function is to reset the MCU. Reset input voltage is monitored in order to detected external reset and fault condition.
18	VMON2_DAC	Analog input	DAC voltage monitoring input #2
19	VMON3_DAC	Analog input	DAC voltage monitoring input #3
20	VMON9_RES	Analog input	External resistor bridge voltage monitoring input #9. Exclusive with FIN (OTP)
20	FIN	Digital input	Frequency synchronization input. Exclusive with VMON9_RES (OTP)
21	GNDFS	Ground	Fail-safe ground
22	GND	Ground	Main ground
23	XFAILB	Digital input/output	Power synchronization input/output with NXP low voltage PMIC
24	AMUX	Analog output	Multiplexed output to be connected to an MCU ADC with selection of the analog parameter thru I^2C.
25	FOUT	Digital output	Frequency synchronization output or digital output (OTP)
26	VMON0_I2C	Analog input	Input voltage for FIN, AMUX, I^2C, INTB, FCCU, ERRMON. Internal resistor bridge voltage monitoring input #0
27	SCL	Digital input	I^2C Bus. Clock input
28	SDA	Digital input/output	I^2C Bus. Bidirectional data line
29	INTB	Digital output	Interrupt output
30	PRE_COMP	Analog input	VPRE compensation network and negative current sense input
31	VMON5_RES	Analog input	External resistor bridge voltage monitoring input #5
32	PRE_BOOT	Analog input/output	VPRE bootstrap capacitor
33	PRE_GHS	Analog output	VPRE high-side gate driver for external MOSFET
34	PRE_SW	Analog output	VPRE switching node
35	PRE_GLS	Analog output	VPRE low-side gate driver for external MOSFET
36	ERRMON	Digital input	External IC error monitoring input
37	PRE_CSN	Analog input	VPRE negative current sense input
38	PRE_CSP	Analog input	VPRE positive current sense input
39	PRE_FB	Analog input	VPRE voltage feedback.
40	VBOS	Analog output	Best of supply output voltage
41	WAKE1	Digital/Analog input	Wakeup input 1 (thru ext. serial resistor)

Table 3. Pin description...*continued*

Pin	Name	Type	Description
42	VSUP1	Power Analog Input	Power supply of the device #1. An external reverse battery protection diode in series is mandatory
43	VSUP2	Power Analog Input	Power supply of the device #2. An external reverse battery protection diode in series is mandatory
44	WAKE2	Digital/Analog input	Wake up input 2 (thru ext. serial resistor)
45	VBOOST	Analog output	Boost output voltage
46	LDO2	Analog output	Linear regulator #2 output voltage
47	VMON4_RINT	Analog input	Internal resistor bridge voltage monitoring input #4
48	DBG	Analog input	DEBUG Mode entry and OTP input supply
EP	EP	Ground	Exposed pad must be connected to GND

8 Maximum ratings

Table 4. Maximum ratings

All voltages are with respect to ground, unless otherwise noted. Exceeding these ratings may cause a malfunction or permanent damage to the device.

Symbol	Conditions	Parameter	Min	Max	Unit
Voltage ratings of 24 V network application part numbers (see Table 2)					
VSUP1/2	DC voltage	VSUP1,2 pins	−0.3	60	V
WAKE1/2	DC voltage	WAKE1,2 pins (external series resistor mandatory)	−1.0	60	V
FS0B	DC voltage	FS0B pin	−0.3	60	V
BAT_SW	DC voltage	BAT_SW pin	−0.3	60	V
PRE_SW	DC voltage	PRE_SW pin	−2.0	60	V
	Transient voltage < 20 ns		−3.0	60	
PRE_GHS, PRE_BOOT	DC voltage	PRE_GHS, PRE_BOOT pins	−0.3	65.5	V
Voltage ratings of 12 V network application part numbers (see Table 2)					
VSUP1/2	DC voltage	VSUP1,2 pins	−0.3	36	V
WAKE1/2	DC voltage	WAKE1,2 pins (external series resistor mandatory)	−1.0	36	V
FS0B	DC voltage	FS0B pin	−0.3	36	V
BAT_SW	DC voltage	BAT_SW pin	−0.3	36	V
PRE_SW	DC voltage	PRE_SW pin	−2.0	36	V
	Transient voltage < 20 ns		−3.0	36	
PRE_GHS, PRE_BOOT	DC voltage	PRE_GHS, PRE_BOOT pins	−0.3	41.5	V
Voltage ratings of general pins					
BOOST_LS	DC voltage	BOOST_LS pin	−0.3	8.5	V
VBOOST	DC voltage	VBOOST pin	−0.3	6.5	V
BUCK_IN	DC voltage	BUCK_IN pin	−1.0	5.5	V
	Transient voltage < 3 µs		−1.0	6.5	
BUCK_SW	Transient voltage < 20 ns	BUCK_SW pin	−0.3	6.5	V
VMONx	DC voltage	VMONx_DAC 1-3, VMONy_RES 5-9	−0.3	36	V
DBG	DC voltage	DBG pin	−0.3	10	V
All other pins	DC voltage	at all other pins	−0.3	5.5	V

9 Electrostatic discharge

9.1 Human body model (JESD22/A114)

The device is protected up to ±2 kV, according to the human body model standard with 100 pF and 1.5 kΩ. This protection is ensured at all pins.

9.2 Charged device model

The device is protected up to ±750 V on corner pins and up to ±500 V on all other pins, according to the AEC Q100 - 011 charged device model standard.

9.3 Discharged contact test

The device is protected up to ±8 kV, according to the following discharged contact tests.

- Discharged contact test (IEC61000-4-2) at 150 pF and 330 Ω
- Discharged contact test (ISO10605.2008) at 150 pF and 2 kΩ
- Discharged contact test (ISO10605.2008) at 330 pF and 2 kΩ

This protection is ensured at the VSUP1, VSUP2, WAKE1, WAKE2, and FS0B pins.

10 Thermal ratings

Table 5. Thermal ratings

Symbol	Description (Rating)	Min	Max	Unit
Thermal ratings				
T_A	Ambient temperature (Grade 1)	−40	125	°C
T_J	Junction temperature (Grade 1)	−40	150	°C
T_{STG}	Storage temperature	−55	150	°C
Thermal resistance (per JEDEC JESD51-2 and JESD51-8)				
$R_{\theta JA}$	Thermal resistance junction to ambient (2s2p)	—	31	°C/W
$R_{\theta JA}$	Thermal resistance junction to ambient (2s6p)	—	23	°C/W
$R_{\theta JB}$	Thermal resistance junction to board (2s2p)	—	15	°C/W
$R_{\theta JB}$	Thermal resistance junction to board (2s6p)	—	10	°C/W
$R_{\theta JC\_BOT}$	Thermal resistance junction to case bottom (between the die and the solder pad on the bottom of the package)	—	1	°C/W
$R_{\theta JP\_TOP}$	Thermal resistance junction to package top (between package top and the junction temperature)	—	3	°C/W

11 Revision history

Document ID	Release date	Description
FS8600_SDS v3.0	4 October 2024	• This revision synchronizes the short data sheet with the v3.0 full data sheet • Product data sheet • Global: corrected capitalization of *Fail-safe* • Global: corrected formatting of I^2C, applying superscript when it is not part of another name • Updated Table 1 • Updated Table 2 • Updated Section 5.2: added statement about OTP emulation and programming • Updated Figure 2 • Updated legal information
FS8600_SDS v2.0	7 December 2022	• Product data sheet • CIN 202212001I • Updated Section 1 • Updated Section 2 • Updated Table 1 footnotes • Updated Figure 2 • In the VMONx row of Table 4, changed VMON_RES to VMONy_RES
FS8600_SDS v1.1	23 November 2021	• Initial release of product data sheet

Legal information

Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL https://www.nxp.com.

Definitions

Draft — A draft status on a document indicates that the content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included in a draft version of a document and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at https://www.nxp.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

HTML publications — An HTML version, if available, of this document is provided as a courtesy. Definitive information is contained in the applicable document in PDF format. If there is a discrepancy between the HTML document and the PDF document, the PDF document has priority.

Translations — A non-English (translated) version of a document, including the legal information in that document, is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Security — Customer understands that all NXP products may be subject to unidentified vulnerabilities or may support established security standards or specifications with known limitations. Customer is responsible for the design and operation of its applications and products throughout their lifecycles to reduce the effect of these vulnerabilities on customer's applications and products. Customer's responsibility also extends to other open and/or proprietary technologies supported by NXP products for use in customer's applications. NXP accepts no liability for any vulnerability. Customer should regularly check security updates from NXP and follow up appropriately.

Customer shall select products with security features that best meet rules, regulations, and standards of the intended application and make the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP.

NXP has a Product Security Incident Response Team (PSIRT) (reachable at PSIRT@nxp.com) that manages the investigation, reporting, and solution release to security vulnerabilities of NXP products.

Suitability for use in automotive applications (functional safety) — This NXP product has been qualified for use in automotive applications. It has been developed in accordance with ISO 26262, and has been ASIL classified accordingly. If this product is used by customer in the development of, or for incorporation into, products or services (a) used in safety critical applications or (b) in which failure could lead to death, personal injury, or severe physical or environmental damage (such products and services hereinafter referred to as "Critical Applications"), then customer makes the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, safety, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP. As such, customer assumes all risk related to use of any products in Critical Applications and NXP and its suppliers shall not be liable for any such use by customer. Accordingly, customer will indemnify and hold NXP harmless from any claims, liabilities, damages and associated costs and expenses (including attorneys' fees) that NXP may incur related to customer's incorporation of any product in a Critical Application.

NXP B.V. — NXP B.V. is not an operating company and it does not distribute or sell products.

Trademarks

Notice: All referenced brands, product names, service names, and trademarks are the property of their respective owners.

NXP — wordmark and logo are trademarks of NXP B.V.

Tables

Figures

Contents

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

NXP:

MFS8600BMBA0ES MFS8600BMBA0ESR2 MFS8600BMDA0ES MFS8600BMDA0ESR2 MFS8601BMBA0ES MFS8601BMBA0ESR2 MFS8601BMDA0ES MFS8601BMDA0ESR2 MFS8602BMBA0ES MFS8602BMBA0ESR2 MFS8602BMDA0ES MFS8602BMDA0ESR2 MFS8603BMBA0ES MFS8603BMBA0ESR2 MFS8603BMDA0ES MFS8603BMDA0ESR2 MFS8610BMBA0ES MFS8610BMBA0ESR2 MFS8610BMDA0ES MFS8610BMDA0ESR2 MFS8611BMBA0ES MFS8611BMBA0ESR2 MFS8611BMDA0ES MFS8611BMDA0ESR2 MFS8612BMBA0ES MFS8612BMBA0ESR2 MFS8612BMDA0ES MFS8612BMDA0ESR2 MFS8613BMBA0ES MFS8613BMBA0ESR2 MFS8613BMDA0ES MFS8613BMDA0ESR2 MFS8620BMBA0ES MFS8620BMBA0ESR2 MFS8620BMDA0ES MFS8620BMDA0ESR2 MFS8621BMBA0ES MFS8621BMBA0ESR2 MFS8621BMDA0ES MFS8621BMDA0ESR2 MFS8622BMBA0ES MFS8622BMBA0ESR2 MFS8622BMDA0ES MFS8622BMDA0ESR2 MFS8623BMBA0ES MFS8623BMBA0ESR2 MFS8623BMDA0ES MFS8623BMDA0ESR2 MFS8630BMBA0ES MFS8630BMBA0ESR2 MFS8630BMDA0ES MFS8630BMDA0ESR2 MFS8631BMBA0ES MFS8631BMBA0ESR2 MFS8631BMDA0ES MFS8631BMDA0ESR2 MFS8632BMBA0ES MFS8632BMBA0ESR2 MFS8632BMDA0ES MFS8632BMDA0ESR2 MFS8633BMBA0ES MFS8633BMBA0ESR2 MFS8633BMDA0ES MFS8633BMDA0ESR2 MFS8620BMDA8ES MFS8620BMDA8ESR2