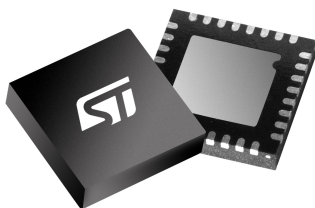


## 1x10 W digital input class-D automotive audio amplifier with advanced diagnostics, wide voltage operating range for telematics and e-Call application



QFN32 (exposed pad down)

### Features

- AEC-Q100 qualified 
- Integrated 100 dB D/A conversion
- I<sup>2</sup>S and TDM digital input (up to 16CH TDM)
- Selectable input sample rate frequency (8/16/32/44.1/48/96)
- Wide supply operating range: 3.3 V - 18 V
- PWM frequency switching selectable by I<sup>2</sup>C
  - 352.8 kHz, 384kHz, 411.6 kHz, 448 kHz
- 2 I<sup>2</sup>C addresses
- MOSFET power outputs
  - Typ 10 W 4 Ω @ 14.4 V, 1 kHz THD = 1 %
  - Typ 5 W 8 Ω @ 14.4 V, 1 kHz THD = 1 %
- Noise: 80 μV A-weighted: 20 kHz
- 8 Ω, 4 Ω driving capability
- Input amplitude limiter (configurable through I<sup>2</sup>C)
- I<sup>2</sup>C full configurability and diagnostic
  - Startup diagnostic
  - Input voltage amplitude limiter function (configurable through I<sup>2</sup>C)
  - 4 x Thermal warning
  - DC diagnostic
  - OCP protection scheme configurable
  - Mute time configuration
  - DAM (Digital-Admittance-Meter)
- Capability to run complete diagnostic in play
  - Configurable Clipping Detector
  - One of the Thermal Warnings
  - Over Current Protection
  - Open Load detection
  - High voltage mute
- Load current monitor
- 2 CD/Diag pin
- Integrated ESD and short circuit protection
- QFN32 wettable flanks
- Tested according to CISPR 25 - Class V (Fourth edition)

| Product status link |                       |
|---------------------|-----------------------|
| FDA903S             |                       |
| Product summary     |                       |
| Order code          | FDA903S-6DY           |
| Package             | QFN32 (exp. pad down) |
| Packing             | Tray                  |

### Description

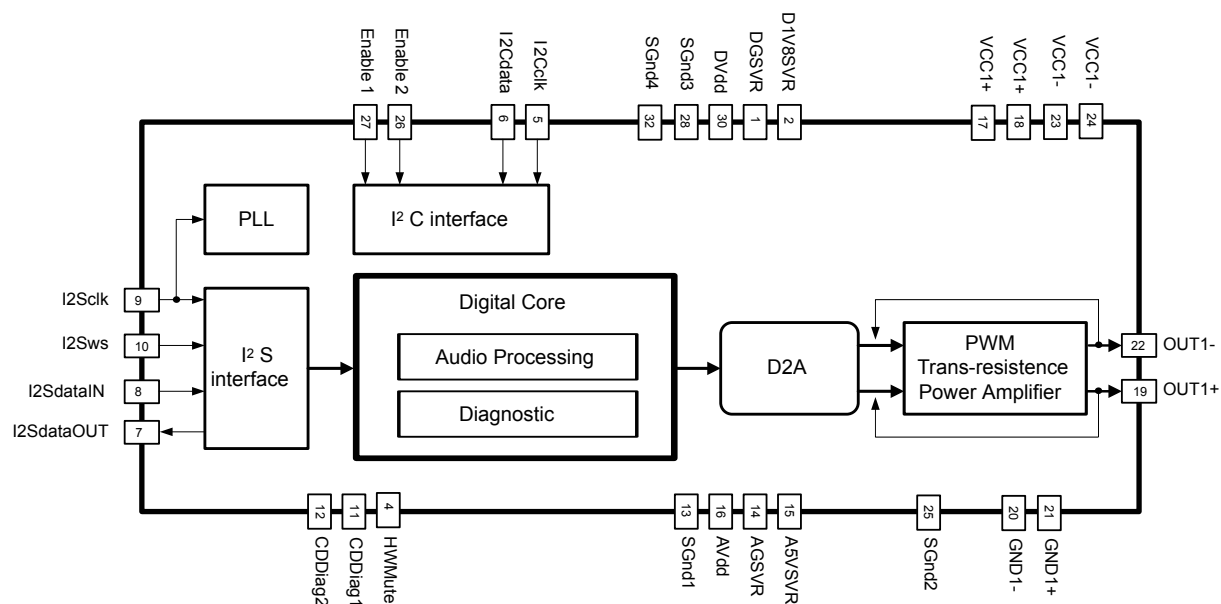
The FDA903S is the new ST single channel class-D audio amplifier, specifically designed for automotive applications. The FDA903S integrates a 24-bit, 100 dB DAC conversion and PWM class-D output stage with feedback before LC filter. This configuration enables the design of a compact and inexpensive application.

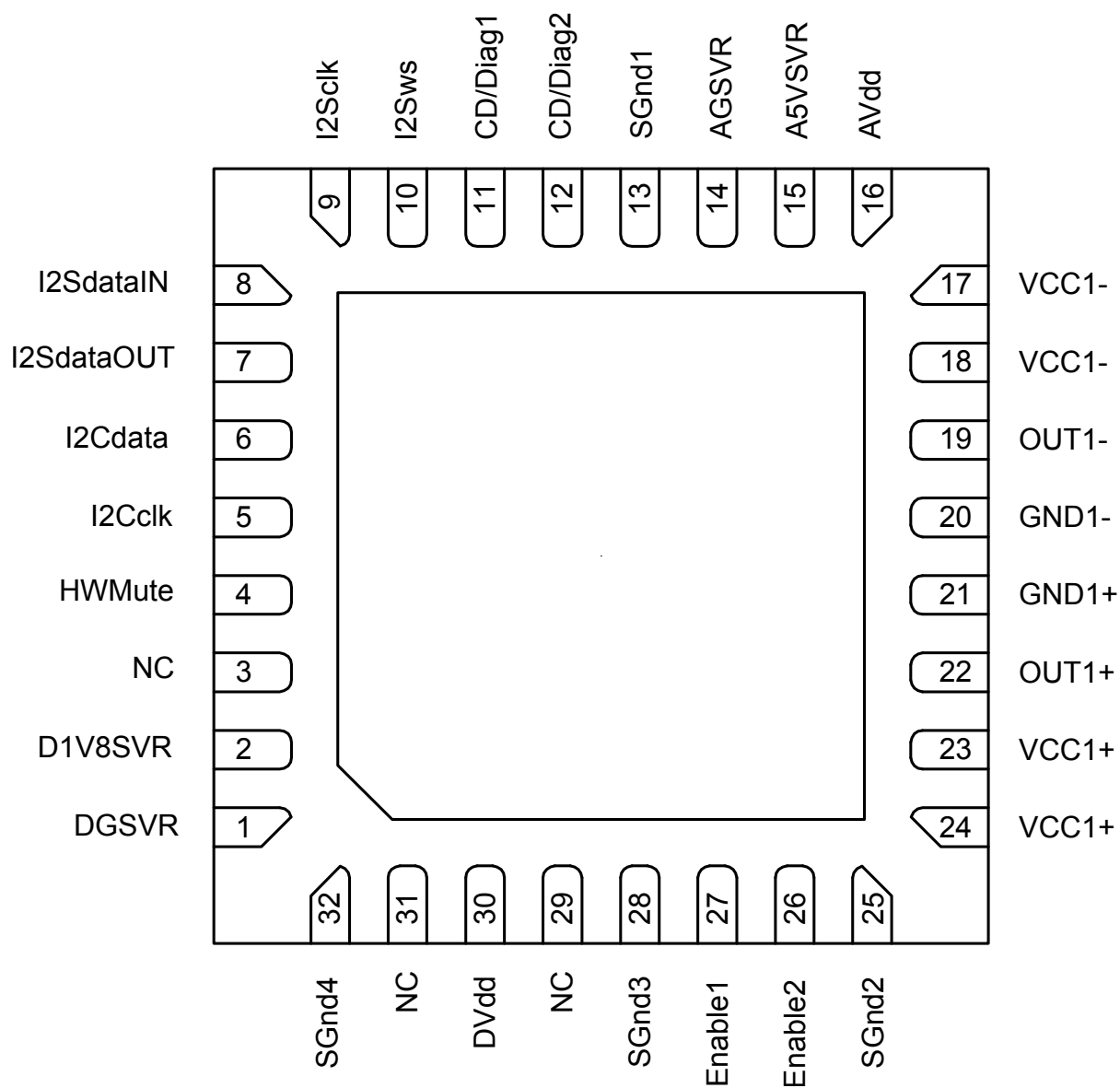
The FDA903S supports I<sup>2</sup>S and TDM digital bit stream up to 16CH with several sampling frequencies from 8 kHz up to 96 kHz. FDA903S embeds a complete diagnostic in play, including real-time load-current monitoring and digital admittance meter, to support the most demanding OEM requirements in terms of speaker control and system robustness/ reliability.

The FDA903S supports start stop cranking down to 3.3 V and it is available in a very compact and thin QFN 5x5 package. Thus the FDA903S is suitable for any level of automotive application especially e-Call and Telematics.

# 1 Block diagram and pins description

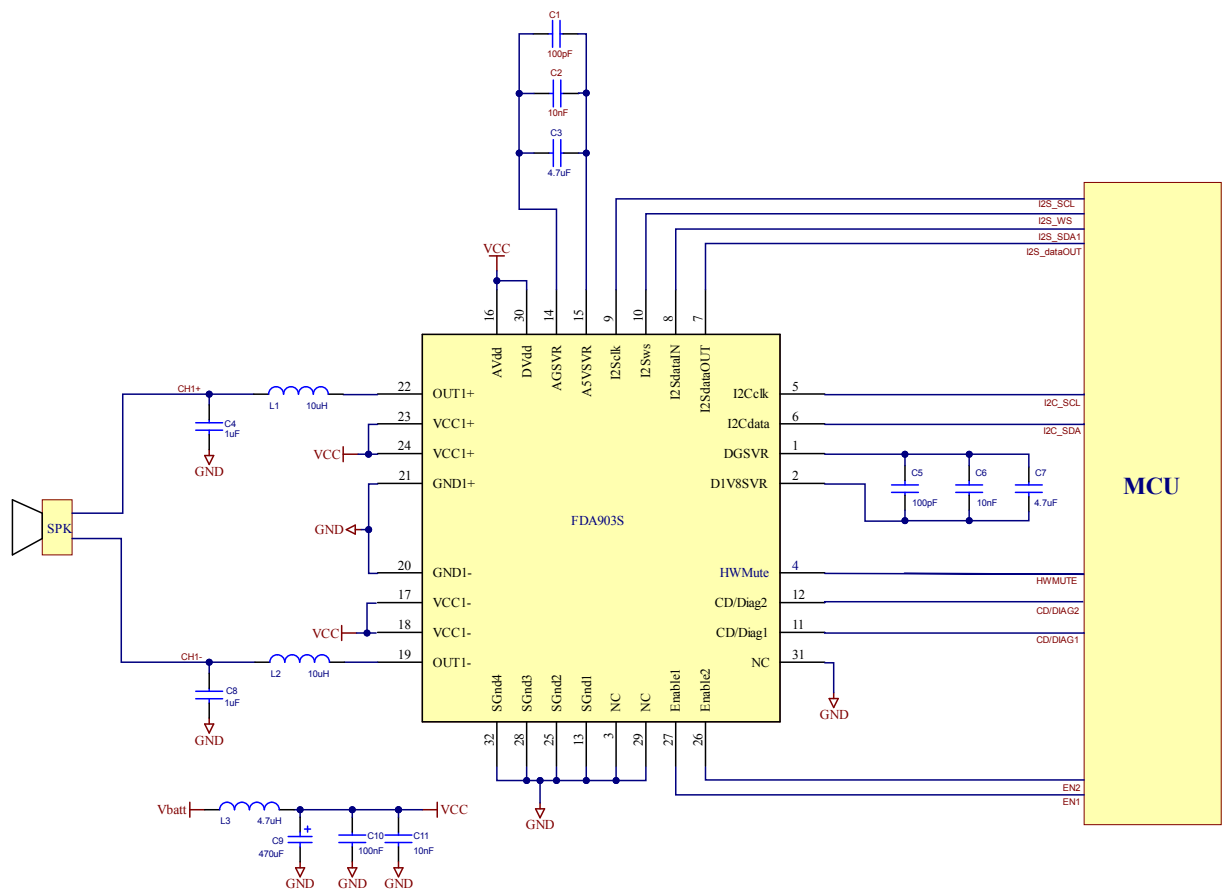
**Figure 1. Block diagram**



**Figure 2. Pin connection diagram (bottom view)**


**Table 1. Pins description**

| N# | Pin                     | Function                                          | Definition         | Internal structure |
|----|-------------------------|---------------------------------------------------|--------------------|--------------------|
| 1  | DGSVR                   | Negative digital supply (Internally generated)    | Internal Regulator | -                  |
| 2  | D1V8SVR                 | Positive digital supply (Internally generated)    | Internal Regulator | -                  |
| 3  | NC                      | Connected to GND                                  | -                  | -                  |
| 4  | HWMute                  | Hardware mute pin                                 | Input              | -                  |
| 5  | I <sup>2</sup> Cclk     | I <sup>2</sup> C Clock                            | Input              | -                  |
| 6  | I <sup>2</sup> Cdata    | I <sup>2</sup> C Data                             | Input/Output       | Open-Drain         |
| 7  | I <sup>2</sup> SdataOUT | I <sup>2</sup> S/TDM Data                         | Output             | Push-Pull          |
| 8  | I <sup>2</sup> SdataIN  | I <sup>2</sup> S/TDM Data                         | Input              | -                  |
| 9  | I <sup>2</sup> Sclk     | I <sup>2</sup> S/TDM Clock                        | Input              | -                  |
| 10 | I <sup>2</sup> Sws      | I <sup>2</sup> S/TDM Sync                         | Input              | -                  |
| 11 | CD/Diag1                | Clipping detector and diagnostic                  | Output             | Open-Drain         |
| 12 | CD/Diag2                | Clipping detector and diagnostic                  | Output             | Open-Drain         |
| 13 | SGnd1                   | Ground of lower side of circuit, connected to GND | Supply             | -                  |
| 14 | AGSVR                   | Negative digital supply (Internally generated)    | Internal Regulator | -                  |
| 15 | A5VSVR                  | Positive digital supply (Internally generated)    | Internal Regulator | -                  |
| 16 | AVdd                    | Analog supply                                     | Supply             | -                  |
| 17 | VCC1-                   | Channel 1, half bridge minus, Power Supply        | Supply             | -                  |
| 18 | VCC1-                   | Channel 1, half bridge minus, Power Supply        | Supply             | -                  |
| 19 | OUT1-                   | Channel 1, half bridge minus                      | Output             | -                  |
| 20 | GND1-                   | Channel 1, half bridge minus, Power Ground        | Supply             | -                  |
| 21 | GND1+                   | Channel 1, half bridge plus, Power Ground         | Supply             | -                  |
| 22 | OUT1+                   | Channel 1, half bridge plus                       | Output             | -                  |
| 23 | VCC1+                   | Channel 1, half bridge plus, Power Supply         | Supply             | -                  |
| 24 | VCC1+                   | Channel 1, half bridge plus, Power Supply         | Supply             | -                  |
| 25 | SGnd2                   | Ground of upper side of circuit, connected to GND | Supply             | -                  |
| 26 | Enable2                 | Enable pin                                        | Input              | -                  |
| 27 | Enable1                 | Enable pin                                        | Input              | -                  |
| 28 | SGnd3                   | Ground of upper side of circuit, connected to GND | Supply             | -                  |
| 29 | NC                      | Connected to GND                                  | -                  | -                  |
| 30 | DVdd                    | Digital supply                                    | Supply             | -                  |
| 31 | NC                      | Connected to GND                                  | -                  | -                  |
| 32 | SGnd4                   | Ground of upper side of circuit, connected to GND | Supply             | -                  |

**Figure 3. Application diagram**


## 2 Electrical specifications

### 2.1 Thermal data

**Table 2. Thermal resistance**

| Symbol              | Parameter                                          | Value | Unit |
|---------------------|----------------------------------------------------|-------|------|
| $R_{th\ j-a-2s2pv}$ | Thermal resistance junction-to-ambient (2s2p+vias) | 32.4  | °C/W |

Note:

- 2s2p is referred to a board with 2 layers dedicated to the signals and 2 layers dedicated to the power signals and supplies.
- from simulation according to Jedec best practice guidelines (JESD51-12)  $T_{AMB} = 25\text{ °C}$  Infinite Heat Sink.

### 3 General information

The FDA903S is a fully digital single channel class-D audio amplifier with feedback before LC filter, designed for compact and low-cost Application, such as Telematics and eCall. The feedback before LC architecture has been chosen for allowing smaller components for the demodulator filter, saving cost and space occupation.

The I<sup>2</sup>S interface is used to provide the audio bit stream, with several sampling frequency from 8 kHz up to 96 kHz. The standard format is used for 4 channels applications, while the TDM allows to work up to 16 channels. The I<sup>2</sup>C interface is used to communicate and control the state of the power amplifier, perform the diagnostic and other features.

The FDA903S embeds an internal 24 bits DAC with 100 dB of resolution. Thanks to interpolation and noise shaping, the digital signal processing allows to reach up a good audio performance in a small device area. The internal PLL uses the clock frequency of the bit stream to generate the internal clock for the digital part and PWM for the outputs.

The innovative self-diagnostic algorithm, available also in play, allows the automatic detection of wrong load connections or variation of the load and provides this information through the I<sup>2</sup>C bus to an external microcontroller.

The amplifier signals full in-play diagnostics including real-time load-current monitoring through I<sup>2</sup>S or I<sup>2</sup>C interfaces, enabling ASIL-A certification of safety-related applications like warning-tone generators and acoustic vehicle alerting systems (AVAS). A digital admittance meter is also provided, ensuring systems containing the FDA903S can meet the most demanding requirements of automotive OEMs.

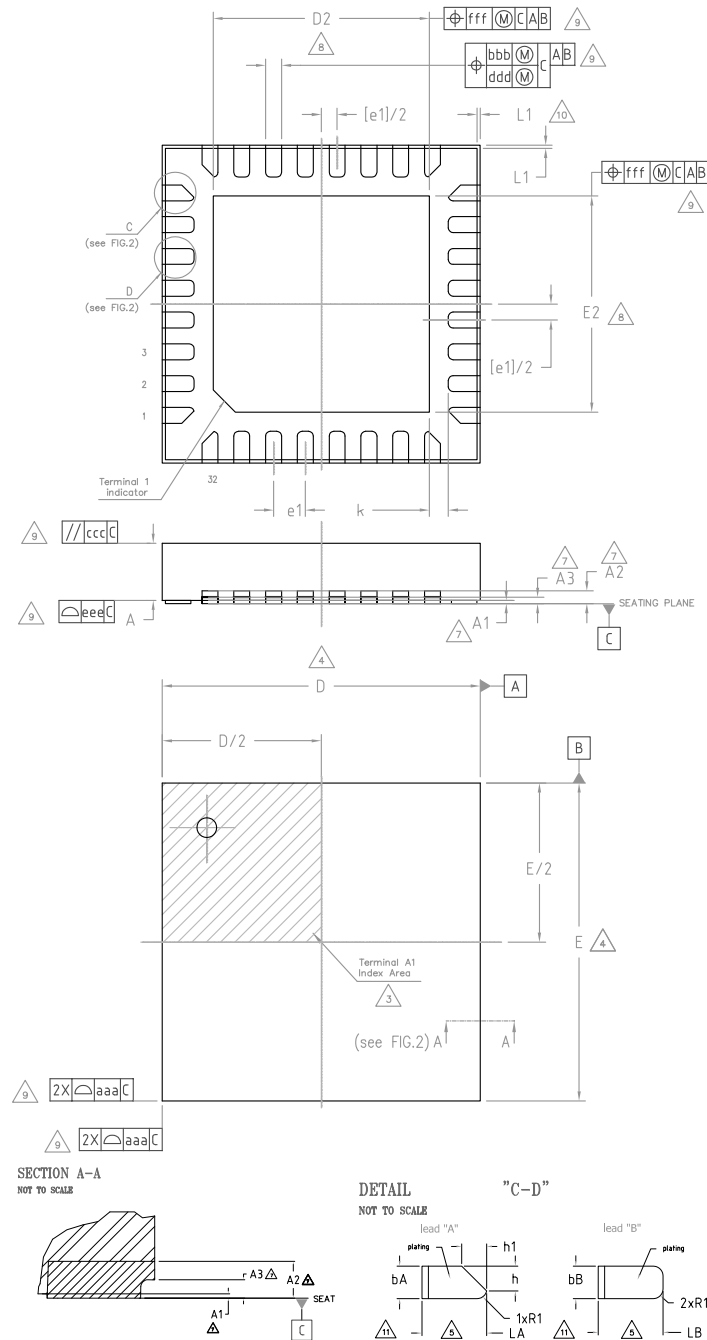
The communication to the microcontroller is improved by two dedicated CD/Diag. All the useful information, such as thermal warnings, input and output offset detection, and some more can be selected by the I<sup>2</sup>C setting and addressed to the one of the CD/Diag pins. Furthermore, one of these pins could be used to synchronize other devices on the platform for better EMC management.

## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 QFN32 5x5x1 (3.5x3.5 32L exp. pad down) package information

Figure 4. QFN 5X5 EP 3.5x3.5 32L WITH WETTABLE FLANKS package outline



**Table 3. QFN 5X5 EP 3.5x3.5 32L WITH WETTABLE FLANKS mechanical data**

| Symbol                         | Dimension in mm |          |      |
|--------------------------------|-----------------|----------|------|
|                                | Min.            | Typ.     | Max. |
| A                              | 0.80            | 0.90     | 1.00 |
| A1                             | 0               | -        | 0.05 |
| A2                             | -               | 0.2 REF  | -    |
| A3                             | 0.10            | -        | -    |
| D                              | 5.00 BSC        |          |      |
| D2                             | 3.40            | 3.50     | 3.60 |
| E                              | 5.00 BSC        |          |      |
| E2                             | 3.40            | 3.50     | 3.60 |
| e1                             | 0.50 BSC        |          |      |
| k                              | 0.20            | -        | -    |
| L1                             | -               | -        | 0.05 |
| La                             | 0.40            | 0.50     | 0.60 |
| bA                             | 0.20            | 0.25     | 0.30 |
| h                              | -               | 0.19 REF | -    |
| h1                             | -               | 0.19 REF | -    |
| LB                             | 0.45            | 0.50     | 0.55 |
| bB                             | 0.20            | 0.25     | 0.30 |
| N                              | 32              |          |      |
| R1                             | -               | -        | 0.10 |
| Tolerance of form and position |                 |          |      |
| aaa                            | -               | 0.15     | -    |
| bbb                            | -               | 0.10     | -    |
| ccc                            | -               | 0.10     | -    |
| ddd                            | -               | 0.05     | -    |
| eee                            | -               | 0.08     | -    |
| fff                            | -               | 0.10     | -    |

## Revision history

Table 4. Document revision history

| Date        | Version | Changes                                    |
|-------------|---------|--------------------------------------------|
| 07-Mar-2022 | 1       | Initial release.                           |
| 29-Jun-2022 | 2       | Updated <a href="#">Section Features</a> . |

## Contents

|          |                                                                   |           |
|----------|-------------------------------------------------------------------|-----------|
| <b>1</b> | <b>Block diagram and pins description.....</b>                    | <b>3</b>  |
| <b>2</b> | <b>Electrical specifications .....</b>                            | <b>7</b>  |
| 2.1      | Thermal data .....                                                | 7         |
| <b>3</b> | <b>General information .....</b>                                  | <b>8</b>  |
| <b>4</b> | <b>Package information.....</b>                                   | <b>9</b>  |
| 4.1      | QFN32 5x5x1 (3.5x3.5 32L exp. pad down) package information ..... | 9         |
|          | <b>Revision history .....</b>                                     | <b>11</b> |

## List of tables

|                 |                                                                       |    |
|-----------------|-----------------------------------------------------------------------|----|
| <b>Table 1.</b> | Pins description . . . . .                                            | 5  |
| <b>Table 2.</b> | Thermal resistance. . . . .                                           | 7  |
| <b>Table 3.</b> | QFN 5X5 EP 3.5x3.5 32L WITH WETTABLE FLANKS mechanical data . . . . . | 10 |
| <b>Table 4.</b> | Document revision history . . . . .                                   | 11 |

## List of figures

|                  |                                                                       |   |
|------------------|-----------------------------------------------------------------------|---|
| <b>Figure 1.</b> | Block diagram . . . . .                                               | 3 |
| <b>Figure 2.</b> | Pin connection diagram (bottom view) . . . . .                        | 4 |
| <b>Figure 3.</b> | Application diagram. . . . .                                          | 6 |
| <b>Figure 4.</b> | QFN 5X5 EP 3.5x3.5 32L WITH WETTABLE FLANKS package outline . . . . . | 9 |

**IMPORTANT NOTICE – READ CAREFULLY**

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to [www.st.com/trademarks](http://www.st.com/trademarks). All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2022 STMicroelectronics – All rights reserved

# Mouser Electronics

Authorized Distributor

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

[STMicroelectronics:](#)

[FDA903S-6DY](#)