# FLS110 Miniature Gas Flow Sensor Short Form Datasheet

## Highlights

- Digital mass flow sensing solution
- Fully temperature-compensated
- Small footprint 3.5 mm x 3.5 mm
- Repeatability 0.5 sccm + 0.5 % of measured value
- Measures flow to 500 slm or more
- Configurable operational modes and features
- Fully compatible with SMD assembly processes

6-pin DFN package
3.5 x 3.5 mm footprint
3 mm overall height

FLS110 is suitable for high-volume consumer applications and high-precision medical or industrial applications. It will add value to your product whether you are trying to detect a pipe blockage or monitor a flow profile in detail. The FLS110 is very versatile and our digital integration solution gives you the flexibility to optimise its performance-cost ratio for your application.

## Digital Flow Sensing Solutions with FLS110

The FLS110 measures mass flow using the principle of hot wire anemometry. A micro-heater and a temperature sensor are integrated in the FLS110 MEMS. Firmware provided by Flusso, which runs on standard microcontrollers, drives the sensing elements, digitises their outputs and calculates temperature compensated mass flow measurements.

Figure 1 illustrates a system with the FLS110 in a bypass configuration and the firmware running on a dedicated microcontroller. Application software on the host processor controls the flow sensing firmware and obtains flow and temperature readings over a serial interface ($I^2C$-bus® or SPI, for example).

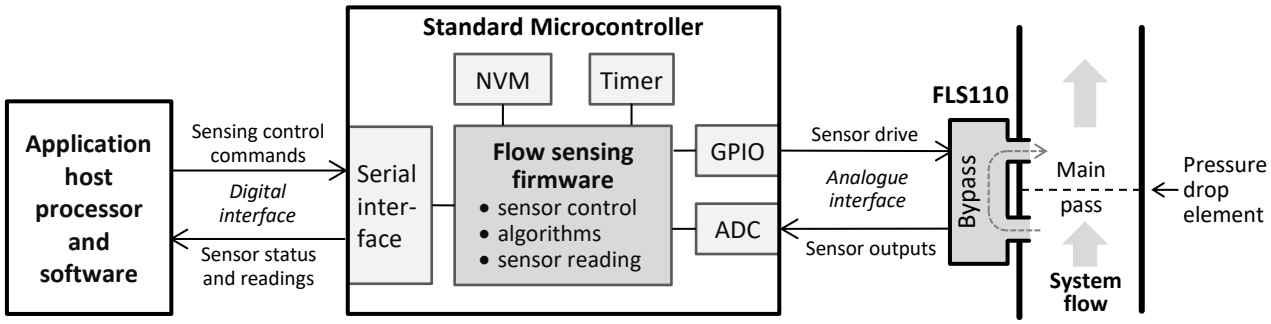


**Figure 1:** FLS110 Flow Sensing System

Application code can also be compiled and linked with the Flusso flow sensing firmware and run on a single microcontroller using application programming interface (API) calls instead of serial interface transactions.

By virtue of system-level flow characterisation during end-product development, FLS110 flow sensing firmware calculates and reports **system flow**, not just the flow through the bypass and FLS110 itself.

Options supported in the firmware enable straightforward optimisation of FLS110 sensing algorithms to your system characteristics and sensing accuracy requirements.

# 1 System Flow Configurations

The FLS110 can be applied in through-flow or bypass system configurations, as illustrated in Figure 2.

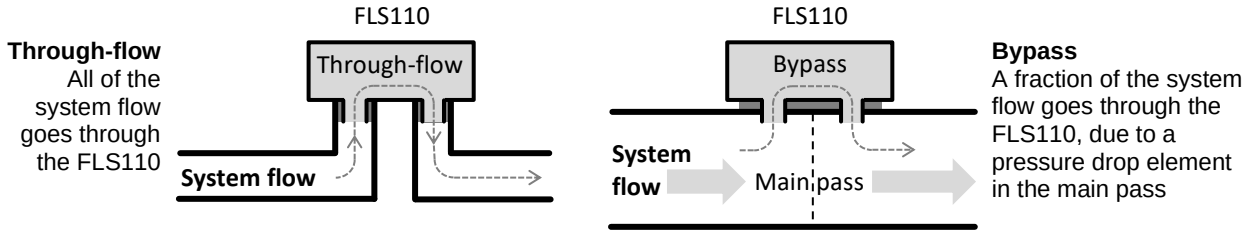


**Figure 2:** Through-flow and Bypass System Configurations

FLS110 flow sensing solution performance is specified in section 2 for a through-flow configuration. Corresponding performance can readily be achieved in bypass configurations with a system flow of 500 slm or higher, depending on design of the flow path and the pressure drop element. FLS110 flow sensing firmware reports the magnitude of **system flow**.

# 2 Sensing Performance

Unless otherwise stated, performance is mean ± 3σ, under normal operating conditions, with

- The FLS110-STM32 Reference Design, VDD set to +3.3 V, averaging set to 8 measurements
- Temperature offset correction, zero flow offset correction and flow optimisation applied
- Clean dry air (0% RH) in flow at 25 °C ($T_{FLOW}$) and 102 kPa ± 1% absolute pressure ($P_{FLOW}$)

Refer to the full datasheet for further information.

## 2.1 Mass Flow Measurement

| Parameter | Max | Units | Note |
|---|---|---|---|
| Zero point repeatability | 0.5 | sccm | |
| Zero point accuracy | 0.6 | sccm | |
| Span repeatability | 0.5 | % | Of measured value (m.v.) |
| Span accuracy | ±5 | % | Of measured value (m.v.) |
| Temperature dependence | (0.1% f.s. + 0.05% m.v.) per °C | | |

**Table 1:** Mass Flow Sensing Performance

## 2.2 Flow Temperature Measurement

| Parameter | Max | Units | Note |
|---|---|---|---|
| Accuracy at $T_{OSC}$ | ±2 | °C | $T_{OSC}$ is the temperature at which offset correction was done |
| Span accuracy | ±3 | % | Of the absolute difference between $T_{FLOW}$ and $T_{OSC}$ |
| Repeatability | 0.5 | °C | |

**Table 2:** Flow Temperature Measurement Performance

## 3 Normal Operating Conditions

Unless otherwise stated, FLS110 sensing performance is defined over the range of operating conditions specified in Table 3. Functionality and performance are not defined outside these ranges and device reliability might be compromised.

| Parameter | Symbol | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|---|
| Flow range | $\dot{m}$ | | | ±200 | sccm | Readings are magnitude. |
| Differential pressure range | $P_{DIFF}$ | | | ±500 | Pa | Across the ports. |
| Flow pressure | $P_{FLOW}$ | 75 | | 125 | kPa | Absolute pressure. |
| Ambient temperature | $T_{AMB}$ | -20 | | +85 | °C | |
| Flow temperature | $T_{FLOW}$ | -20 | | +85 | °C | |
| Humidity in the flow | | | | 90 | %RH | Non-condensing. |
| Gas in flow | Air. Contact Flusso for information about sensing flow of other gases. | | | | | |

**Table 3:** Normal Operating Conditions

## 4 Absolute Maximum Ratings

Permanent damage might result from exposure to conditions in excess of those specified in Table 4.

| Parameter | Symbol | Min | Max | Units | Notes |
|---|---|---|---|---|---|
| Storage temperature | $T_{STORE}$ | -40 | +85 | °C | |
| Storage humidity | | | 90 | %RH | |
| Ambient temperature | $T_{AMB}$ | -40 | +85 | °C | |
| Flow temperature | $T_{FLOW}$ | -40 | +85 | °C | |
| Ambient humidity | | | 90 | %RH | Non-condensing |
| Humidity in the flow | | | 90 | %RH | Non-condensing |
| Mass flow rate | | -5 | +5 | slm | |
| Flow pressure | $P_{FLOW}$ | | 2 | bar(g) | Relative to ambient pressure |
| Electrostatic discharge | | | 2 | kV | Human body model, JESD22-A114 |

**Table 4:** Absolute Maximum Ratings

## 5 Additional information

More information on the FLS110-STM32 Reference Design and guidance for design integration of the FLS110 into your application can be found in the following documents, available at www.flussoltd.com:

- *Working with the FLS110*
- *FLS110 Miniature Gas Flow Sensor Datasheet*
- *FLS110 Mechanical and Fluidic Integration*
- *FLS110 Hardware and Firmware Integration*
- *FLS110 System Characterisation and Optimisation*

## Datasheet Status

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| Datasheet Status | Product Status | Datasheet Content |
|---|---|---|
| Preview | Development | Target specifications for development of the product. Specifications, designs and descriptions provisional and subject to confirmation.<br>Flusso reserves the right to change specifications or discontinue development of the product without notice. |
| Preliminary | Qualification | The product is undergoing testing to confirm datasheet specifications for functionality, performance, quality and reliability.<br>Flusso reserves the right to change specifications or discontinue development of the product without notice. |
| Product | Production | Information and specifications for the product.<br>Flusso reserves the right to make changes without notice for product improvement. |

## Version History

| Issue | Changes | Date |
|---|---|---|
| 1 | First issue (preliminary) | 2020-10-15 |
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| | | |

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