



# SFS01 EvaKit



## Thermal mass flow sensor



## Optimal for demonstration and evaluation of the SFS01



### Benefits & characteristics



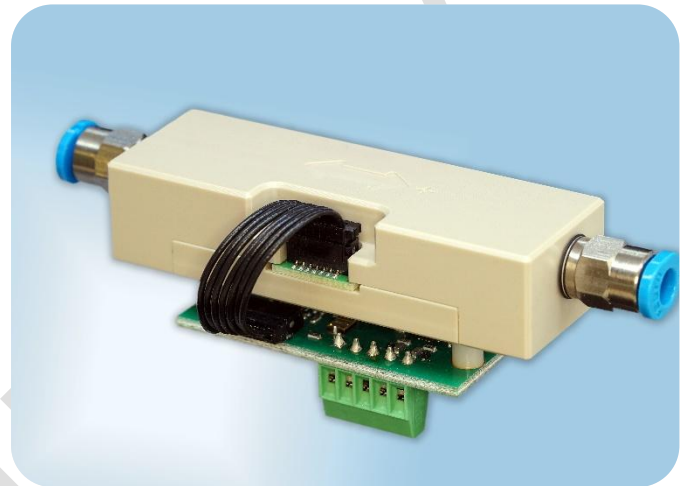
- Measurement from 0 to 200 sccm
- Detection of flow direction
- Analog and digital (I<sup>2</sup>C) connection
- Pneumatic connections for gas



### Applications

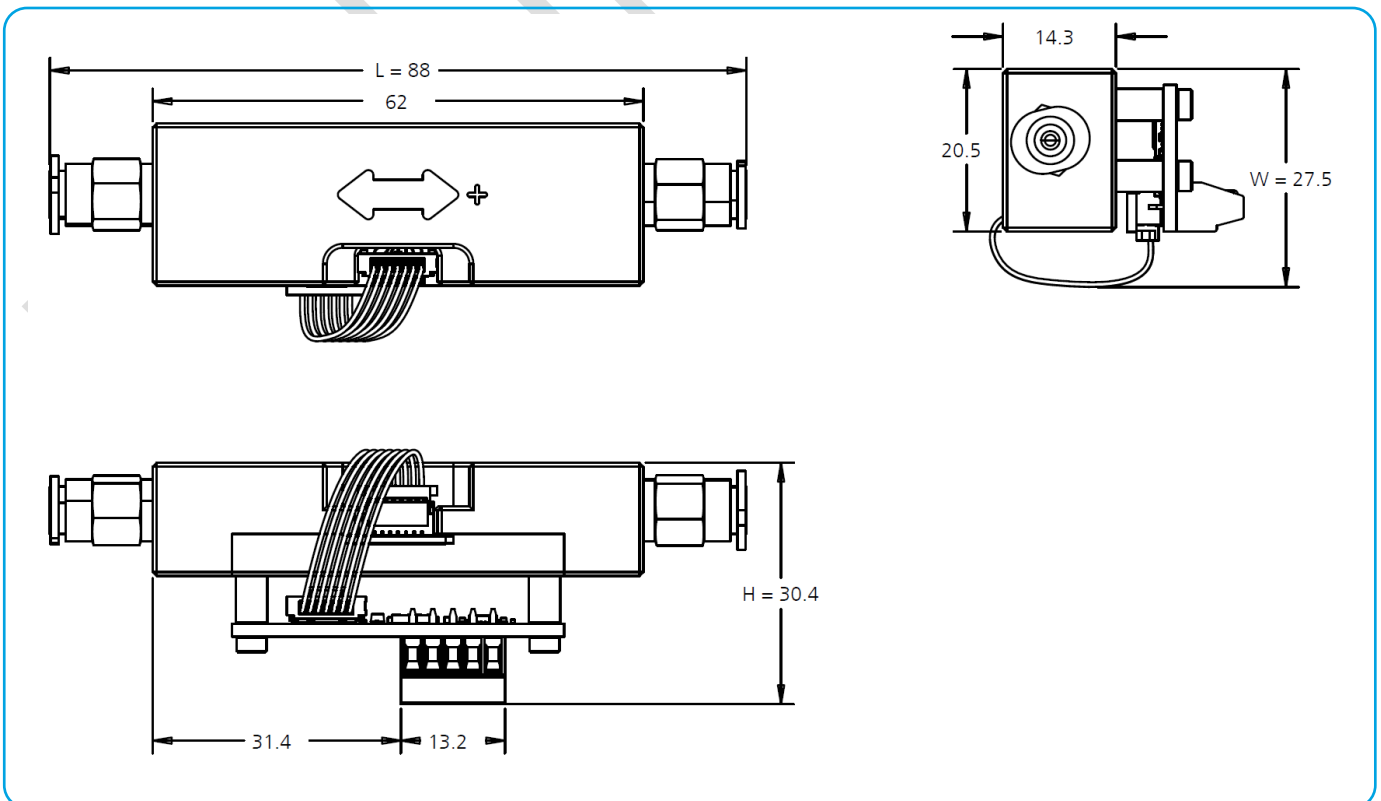


- Automation technology
- Process and regulation technology
- Medical and biological technology
- Air conditioning
- Battery-operated applications in portable devices



### Illustration

Illustration and dimensions (in mm) of the SFS chip





## Technical sensor data



Integrated sensor: SFS01  
Dimensions (L x W x H) : 88.0 (±0.5) x 27.5 (±1.0) x 30.4 (±0.5)



Channel dimensions (L x W x H) : 35.0 (±0.15) x 1.0 (±0.05) x 1.0 (±0.05)



Pneumatic connections: QSM M5-4  
Temperature range: 0 °C to +80 °C



Storage temperature: -20 °C to +80 °C



Pressure load: Up to 1 bar (one-sided on membrane over 10 years)



## Electrical sensor data

Supply voltage: 5 ± 5% V

Power: Typ 30 mW

Output voltage: 0 to 5 V, ca. 2.5 ±0.2 V at 0 sccm

Digital connection: 3.3 V I<sup>2</sup>C (pull up resistors on board)

Digital signal: Calibrated signal (up to ±200 sccm)  
Raw signal (digits)

Analog output load: < 1 mA

## Flow performance

The following values are viewed as typical and achieved in laboratory conditions. The gas used was nitrogen.

Medium: Non-aggressive gases (5-95 % rel. humidity, non-condensing)

Measurement range: 0 to ±200 sccm

Sensitivity: 0.1 sccm

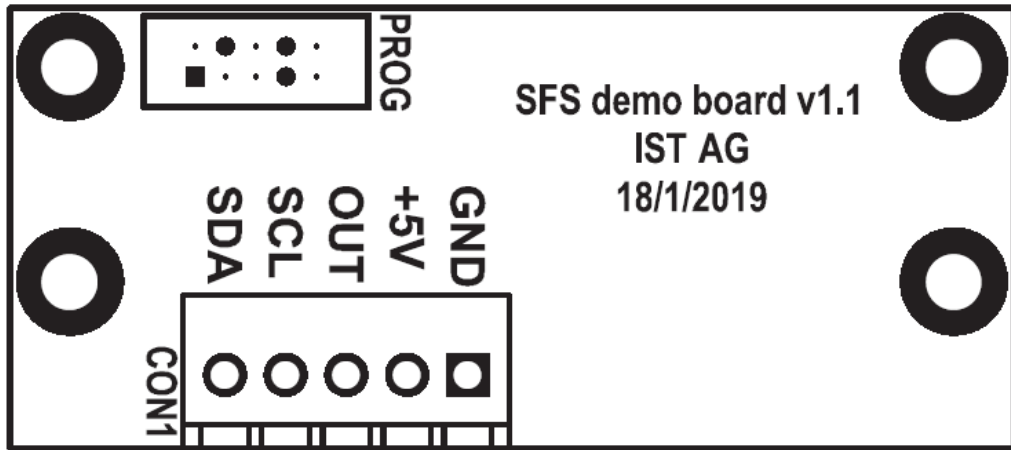
Response time  $t_{63}$ : 10 ms

Accuracy: 3.0 % F.S.

Temperature sensitivity: < 0.25 %/K F.S.



## Pin Assignment



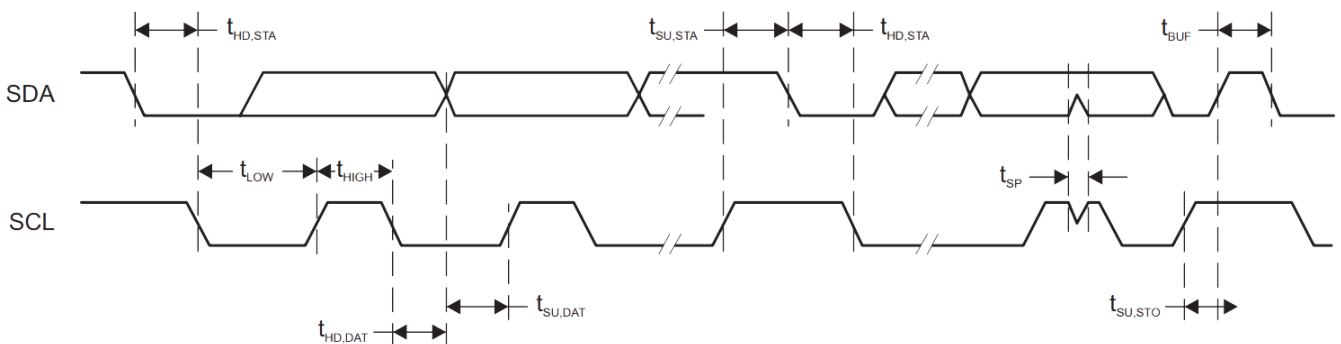
1	2	3	4	5
SDA Serial Data	SCL Serial Clock	OUT Output	+5V Supply voltage	GND Ground

## I<sup>2</sup>C Protocol

### I<sup>2</sup>C Protocol description

For integration with a micro-controller, the SFS Demo Board has an I<sup>2</sup>C-compatible interface which supports both 100 kHz and 400 kHz bit rates. The default I<sup>2</sup>C slave address is programmed on 0x28 and can be adjusted in the entire 7-bit address range (0x00 to 0x7F).

Parameter		Min	Max	unit
$f_{SCL}$	SCL clock frequency	100	400	kHz
$t_{HD,STA}$	Hold time (repeated) START	0.6		$\mu$ s
$t_{SU,STA}$	Setup time for a repeated START	0.6		$\mu$ s
$t_{HD,DAT}$	Data hold time	0		$\mu$ s
$t_{SU,DAT}$	Data setup time	250		$\mu$ s
$t_{SU,STO}$	Setup time for STOP	0.6		$\mu$ s
$t_{SP}$	Pulse duration of spikes suppressed by input filter	50	600	ns







0x04:	read Flow's Range
0x05:	read I <sup>2</sup> C_address – own address on I <sup>2</sup> C bus
0x06:	read Serial Number
0x07:	read Firmware Revision
0x20:	write Flow_A calibration's parameter (do not change!)
0x21:	write Flow_B calibration's parameter (do not change!)
0x22:	write Flow_C calibration's parameter (do not change!)
0x23:	write Flow_D calibration's parameter (do not change!)
0x24:	write Flow's Range
0x25:	write I <sup>2</sup> C_address – own address on I <sup>2</sup> C bus
0xa1:	exit command mode (without reset)
0xa2:	reboot

### Reading parameters from the module

After successful read instruction the module fills the I<sup>2</sup>C buffer with the selected parameter. All parameters read from the module, except I<sup>2</sup>C\_address, Serial Number and Firmware Revision, are in signed fixed-point long IQ22 format (4 bytes). To convert them to decimal format the read value has to be divided by  $2^{22} = 4\,194\,304$ . The minimum value is -512, the maximum value is 511.999 999 762. The resolution of each parameter is  $1/2^{22} = 0.000\,000\,238$ . I<sup>2</sup>C\_address, Serial Number and Firmware Revision parameters are read in unsigned long format. Additionally, I<sup>2</sup>C\_address is internally masked with 0x3ff.

Start	Address	R	ACK	Data[3]	ACK	Data[2]	ACK	...	Data[0]	ACK	Stop
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Data		Parameter
Data [3]	1 <sup>st</sup> byte (highest)	Parameter
Data [2]	2 <sup>nd</sup> byte	
Data [1]	3 <sup>rd</sup> byte	
Data [0]	4 <sup>th</sup> byte (lowest)	

After transmitting 4 bytes, the module resets the internal timer and waits in command mode for the next command. The module will reboot automatically after 0.5 second of idle or unsuccessful transmission.

### Exit command code

After receiving this command, the module returns to normal operation, taking the new parameters' values except the I<sup>2</sup>C address.

Start	Address	W	ACK	Data = 0xA1	ACK	STOP
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## Reboot

After receiving this command, the module reboots.



Start	Address	W	ACK	Data = 0xA2	ACK	STOP
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## Typical parameter's read sequence

To read parameter(s) from the flash memory please follow steps:

1. Write 0xA0 to the module – start the command mode
2. Wait 1 ms
3. Write 0x00...0x07 to the module – an address of the parameter
4. Wait 1 ms
5. Read 4 bytes from the module
6. If needed repeat steps 3-5 for another parameter
7. Write 0xA1 to the module – exit command mode



## Typical parameter's read sequence

To read parameter(s) from the flash memory please follow steps:

1. Write 0xA0 to the module – start the command mode
2. Wait 1 ms
3. Write 0x20...0x25 to the module – an address of the parameter
4. Wait 1 ms
5. Write 4 bytes to the module
6. Wait 1 ms
7. If needed repeat steps 3-6 for another parameter
8. Write 0xA1 to the module – exit command mode or 0xA2 – reboot the module

## Parameter's description

Parameters: Flow A, Flow B, Flow C, Flow D are used to calculate flow from heater's power, and fluids temperature using equation:

$$flow = A + B \frac{RAW}{2^{10}} + C \left( \frac{RAW}{2^{10}} \right)^2 + D \left( \frac{RAW}{2^{10}} \right)^3$$

Where:

A: flow_A	B: flow_B	C: flow_C	D: flow_D
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RAW:	Raw flow value
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Parameter Flow's Range limits the maximum and minimum calibrated flow's readout from the module. It should be written as the last calibration point (or slightly higher). It prohibits the user to measure the flow outside the calibration's range.



## Order information



Product name	Order code	Description
SFS01 EvaKit	105059	Evaluation kit for SFS01 Silicon flow sensor



## Additional Documents



### Document name:

Data sheet:	DFSFS01_E
Application Note:	AFSFS01_E



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