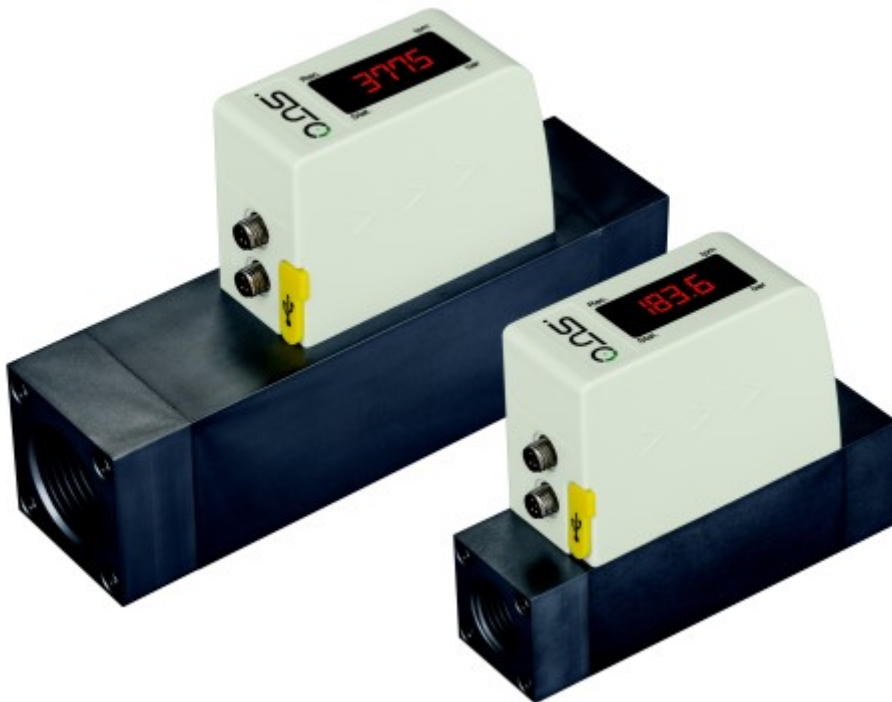


## Instruction and operation manual

# S418-V

## Vacuum Flow Meter (With Data Logger)



Dear Customer,

Thank you for choosing our product.

Before you start up the device please read this manual in full and carefully observe instructions stated in this manual. The manufacturer cannot be held liable for any damage which occurs as a result of non-observance or non-compliance with this manual.

Should the device be tampered with in any manner other than a procedure which is described and specified in the manual, the warranty is void and the manufacturer is exempt from liability.

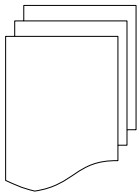
The device is designed exclusively for the described application.

SUTO offers no guarantee for the suitability for any other purpose. SUTO is also not liable for consequential damage resulting from the delivery, capability or use of this device.

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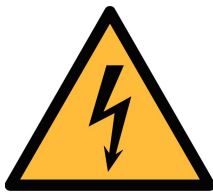
## 1 Safety instructions



**Please check if this instruction manual matches with the product type.**

Please observe all notes and instructions indicated in this manual. It contains essential information which must be observed before and during installation, operation and maintenance. Therefore this instruction manual must be read carefully by the technician as well as by the responsible user / qualified personnel.

This instruction manual must be available at the operation site of the flow sensor at any time. In case of any obscurities or questions, regarding this manual or the product, please contact the manufacturer.

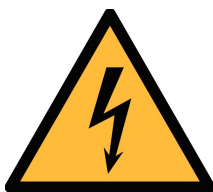


### **WARNING!**

#### **Compressed air!**

**Any contact with quickly escaping air or bursting parts of the compressed air system can lead to serious injuries or even death!**

- Do not exceed the maximum permitted pressure range (see sensors label).
- Only use pressure tight installation material.
- Avoid that persons get hit by escaping air or bursting parts of the instrument.
- The system must be pressureless during maintenance work.



### **WARNING!**

#### **Voltage used for supply!**

**Any contact with energized parts of the product, may lead to an electrical shock which can lead to serious injuries or even death!**

- Consider all regulations for electrical installations.
- The system must be disconnected from any power supply during maintenance.
- Any electrical work on system is only allowed by authorized qualified personal.

**ATTENTION!****Permitted operating parameters!**

**Observe the permitted operating parameters, any operation exceeding this parameters can lead to malfunctions and may lead to damage on the instrument or the system.**

- Do not exceed the permitted operating parameters.
- Make sure the product is operated in its permitted limitations.
- Do not exceed or undercut the permitted storage and operation temperature and pressure.
- The product should be maintained and calibrated frequently, at least annually.

**General safety instructions**

- It is not allowed to use the product in explosive areas.
- Please observe the national regulations before/during installation and operation.

**Remarks**

- It is not allowed to disassemble the product.

**ATTENTION!****Measurement values can be affected by malfunction!**

**The product must be installed properly and frequently maintained, otherwise it may lead to wrong measurement values, which can lead to wrong results.**

- Always observe the direction of the flow when installing the sensor. The direction is indicated on the housing.
- Do not exceed the maximum operation temperature at the sensors tip.
- Avoid condensation on the sensor element as this will affect accuracy enormously.

**Storage and transportation**

- Make sure that the transportation temperature is between -30 ... +70°C.

- For storage and transportation it is recommended to use the packaging which comes with the sensor.
- Please make sure that storage temperature of the sensor is between -10 ... +50°C.
- Avoid direct UV and solar radiation during storage.
- For the storage the humidity must be <90%, no condensation.

## 2 Registered trademarks

SUTO®

Registered trademark of SUTO iTEC

MODBUS®

Registered trademark of the Modbus Organization, Hopkinton, USA

HART®

Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®

Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

Bluetooth® word mark and logos

Registered trademarks of Bluetooth SIG, Inc.

Android™, Google Play

Trademarks of Google LLC

### 3 RF exposure information and statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**NOTE:** The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

**NOTE:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help
- This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

## 4 Application

The S418-V is a thermal mass flow sensor that is designed to measure the actual flow at the low pressure side of vacuum pumps within the permissible operating parameters (in chapter [6 Technical data](#)).

The S418-V can measure the following values:

- Absolute volumetric flow (default unit: al/min)
- Total consumption (default unit: m<sup>3</sup>)
- Absolute pressure (default unit: bar)

Other units are configurable using the service app S4C-FS, which can be downloaded from the Google Play store or our Website. For more information, see chapter [10](#).


## 5 Features

- Inline thermal mass flow sensor virtually independent of pressure and temperature changes.
- Process connection of G-type thread with DN8, DN15, DN20 and DN25 available
- Very short response time.
- Particularly suitable for measuring at the point-of-use at the low pressure side of vacuum pumps.
- Integrated display showing actual volumetric flow and absolute pressure.
- Options for output signals:
  - Analogue 4 ... 20 mA and pulse output
  - Modbus interface
  - M-Bus interface
- Bluetooth interface for remote sensor settings
- Configurable through Android devices
- Embedded data logger capable of recording 5-million measurement samples



## 6 Technical data

### 6.1 General data

 FCC ID: 2ASK2-SUTO-003	
Parameters	Flow: Actual volumetric flow: l/min, m <sup>3</sup> /h, m <sup>3</sup> /min, cfm Consumption: m <sup>3</sup> , ft <sup>3</sup> Medium pressure: bar, psi
Principle of measurement	Thermal mass flow
Sensor	Glass coated resistive sensor
Measuring medium	Air
Ambient temperature /Transport temperature	0 ... +50°C / -30 ... +70°C
Medium conditions	0 ... +50°C, rH<90% no condensation
Pressure range	0.01 ... 1.60 bar(a)
Material	Process connection: aluminum alloy Wetted parts: aluminum alloy Top casing: PC + ABS
Protection class	IP54
Dimensions	See dimensional drawing on page <a href="#">11</a> .
Display	4-digit LED display
Tube diameter	DN8, DN15, DN20, DN25
Process connection:	G inner thread ISO 228-1
Weight	0.43 kg (DN8), 0.46 kg (DN15) 0.96 kg (DN20), 0.97 kg (DN25)

### 6.2 Electrical data

Power supply	15 ... 30 VDC, 120 mA @ 24 VDC
--------------	--------------------------------

### 6.3 Data logger

Memory size	Up to 8,000,000 samples.
Recording channels	Up to 3 channels: Flow, consumption, and pressure.
Logger programming	Through mobile app S4C-FS (Free for download on Google Play Store and SUTO Website)
Logger readout	Through the software S4A via USB (Downloadable on the SUTO website)

### 6.4 Output signals

Analogue output	Signal: 4 ... 20 mA, isolated Scaling: 0 to max flow Max load: 250R
Pulse output	1 pulse per consumption unit (m <sup>3</sup> or ft <sup>3</sup> ) isolated switch, max. 30 VDC, 200 mA (pulse length: 10 ... 120 ms, depends on flow rate)
Modbus output	See section <a href="#">9.3</a> .

### 6.5 Accuracy of flow

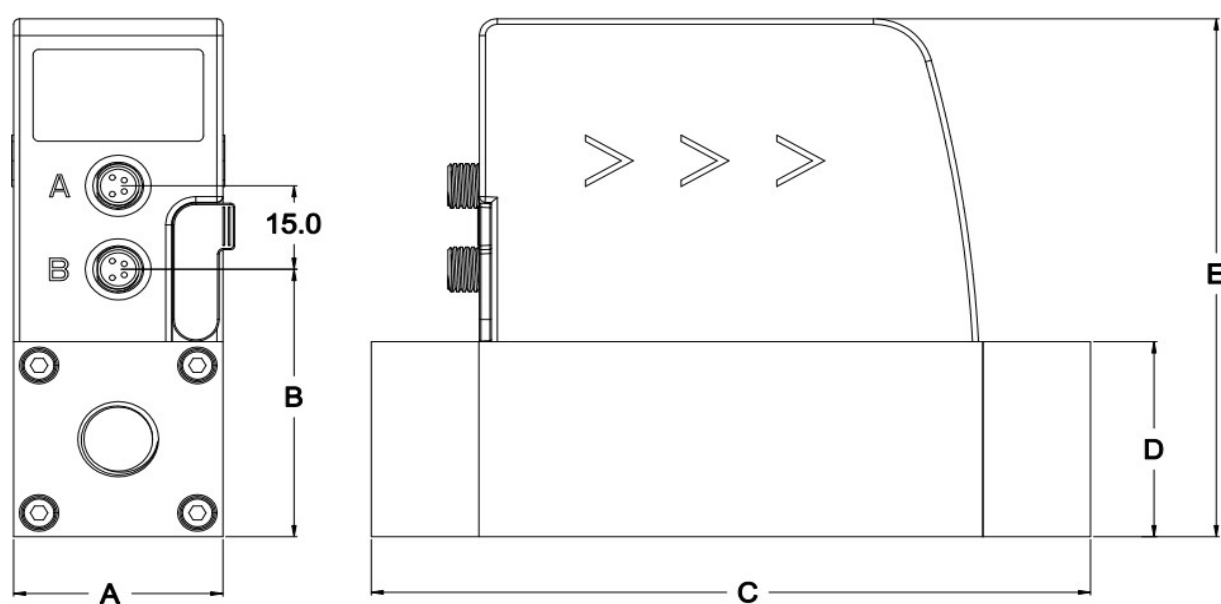
Accuracy*	$\pm(1.5\% \text{ of reading} + 0.3\% \text{ FS})$
Temperature coefficient	$< 0.1\%/K \text{ FS}$
Pressure coefficient	$<0.5\% / \text{bar}$
Turndown ratio	100:1
Stated accuracy at	Ambient/process temperature $23 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$ Ambient/process humidity $<90\%$ Process pressure at 0.6 MPa
Repeatability	$\pm 0.5\% \text{ of reading}$
Sampling rate	10 samples / second

\* The specified accuracy is valid only within the minimum and maximum flow rates that are indicated in section [14.1](#).

## 6.6 Accuracy of pressure

Accuracy	$\pm 0.5\%$ FS
Parameters	Pressure: bar (default) or psi
Sensor	Piezzo-resistive sensor
Measuring range	0.01 ... 1.60 bar(a)

## 7 Dimensional drawing



	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
DN 8/15	35.0	48.0	120.4	35.0	93.0
DN 20/25	48.0	61.0	178.0	48.0	106.0

## 8 Installation

S418-V is delivered with following components:

Qty.	Description	Order no.
1	S418-V Thermal mass flow sensor, DN8 / S418-V Thermal mass flow sensor, DN15 / S418-V Thermal mass flow sensor, DN20 / S418-V Thermal mass flow sensor, DN25	S695 4190 S695 4191 S695 4192 S695 4193
1	5 m cable with M8 connector and open ends	A553 0136
1	USB cable	A553 0130
1	Instruction and operation manual	No
1	Calibration certificate	No

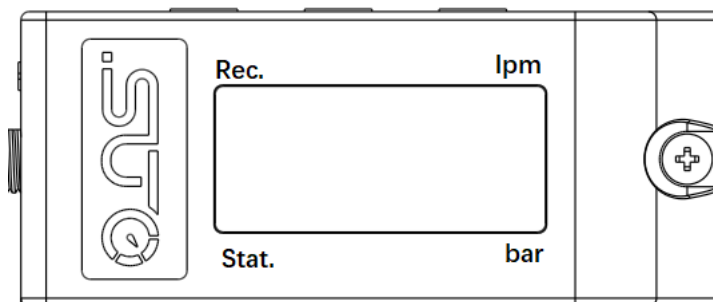
### 8.1 Installation considerations

In order to maintain the accuracy stated in the technical data, the sensor must be installed inline and fitted to a tube with the same diameter.

- The sensor is for indoor use only! At an outdoor installation, the meter must be protected from solar radiation and rain.
- It is strongly recommend not to install S418-V permanently in wet environment.

### 8.2 LED indicators

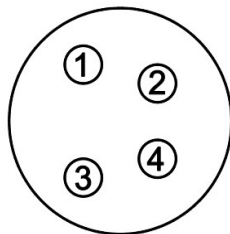
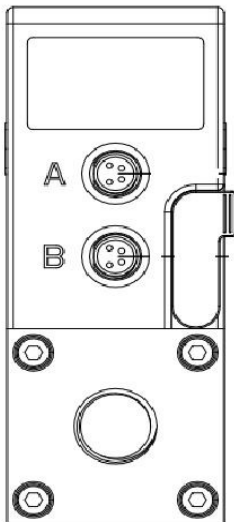
The S418-V provides four LED indicators on the display panel, which indicate the status of the data logger, display, and Bluetooth connection separately.



LED	Function	Status
Rec	Indicator for the logger state	On: NAND flash is formatting. Flashing: Data logger is working.
lpm	Indicator for the display state (volumetric flow)	On: The display is showing the volumetric flow rate. Flashing: N/A
stat.	Indicator for the Bluetooth state	On: Bluetooth is connected. Flashing: N/A
bar	Indicator for the display state (pressure)	On: The display is showing the pressure value. Flashing: N/A

### 8.3 Electrical connection

The flow sensor is equipped with two connectors “A” and “B”. By default the sensor is delivered with one 5 m cable with a M8 connector on one side and open wires on the other side. To make the S418-V work, one cable connection is sufficient. However, if the pulse output is to be used or the supply and the signal need to be on separate cables, a second connection cable must be ordered.



#### Legend to pin assignment

GND:	Ground for Modbus
-VB:	Negative supply voltage
+VB:	Positive supply voltage
I+:	Positive 4...20 mA signal
I-:	Negative 4... 20 mA signal
D+:	Modbus data +
D-:	Modbus data -
P:	Pulse signal
M-Bus:	M-Bus data
NA:	Not Applicable

**Pin assignment connector plug M8**

Output Version	Connector	Pin 1	Pin 2	Pin 3	Pin 4
Modbus	A	D-	-VB	+VB	D+
	B	D-	GND	NA	D+
Pulse and analog	A	I-	-VB	+VB	I+
	B	I-	P	P	I+
M-Bus	A	M-Bus	-VB	+VB	M-Bus
	B	M-Bus	NA	NA	M-Bus
Wire color		brown	white	blue	black

**ATTENTION!**

**Do not screw the M8 plug using force. Otherwise, it may damage the connecting pins.**

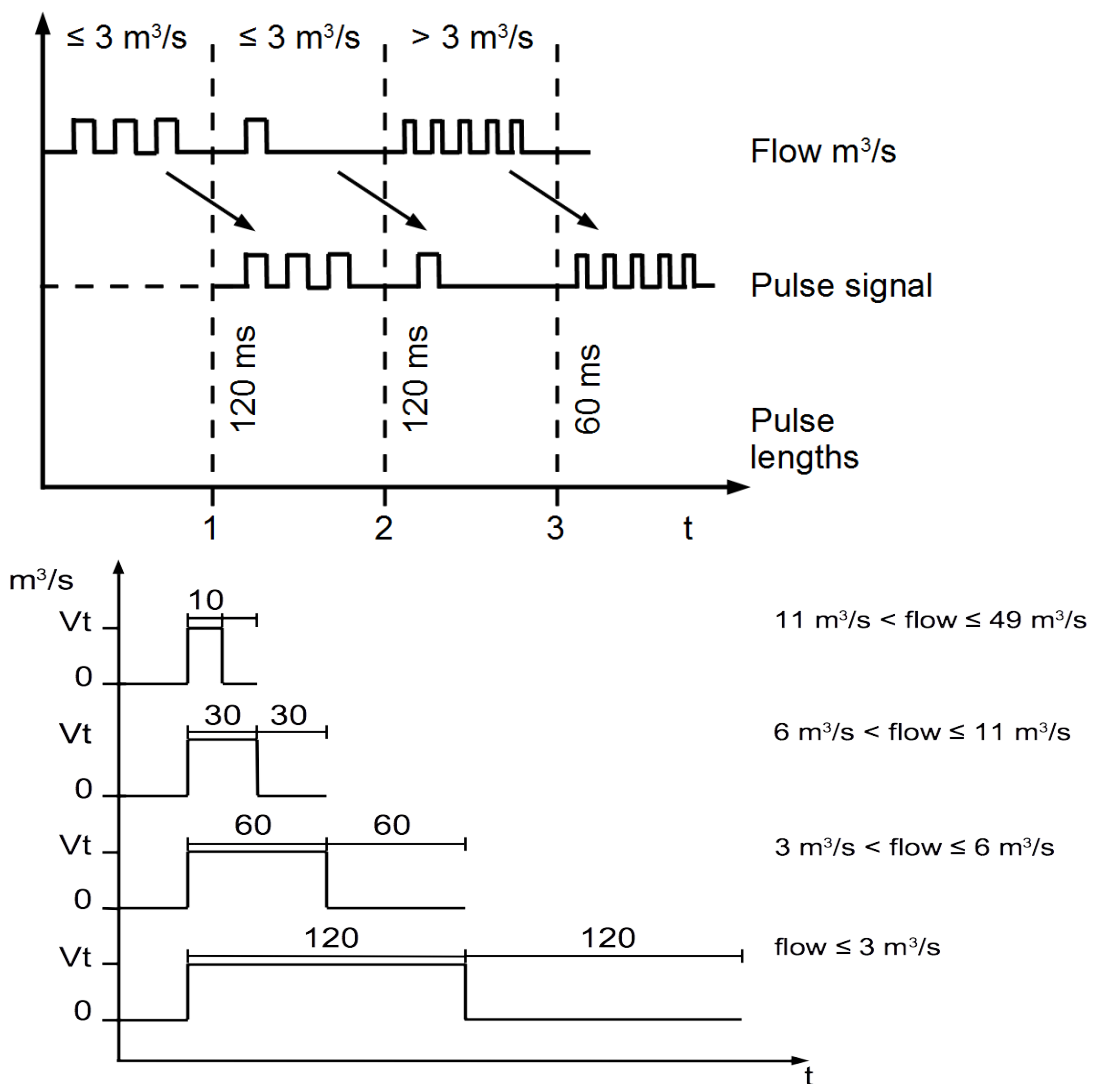
## 9 Sensor signal outputs

### 9.1 Analog output

The sensor provides an analog output of 4 ... 20 mA. This output can be scaled to match a desired measuring range. Standard scaling is from 0 to the max flow. The corresponding flow in different pipe sizes can be found in chapter [14](#).

### 9.2 Pulse output

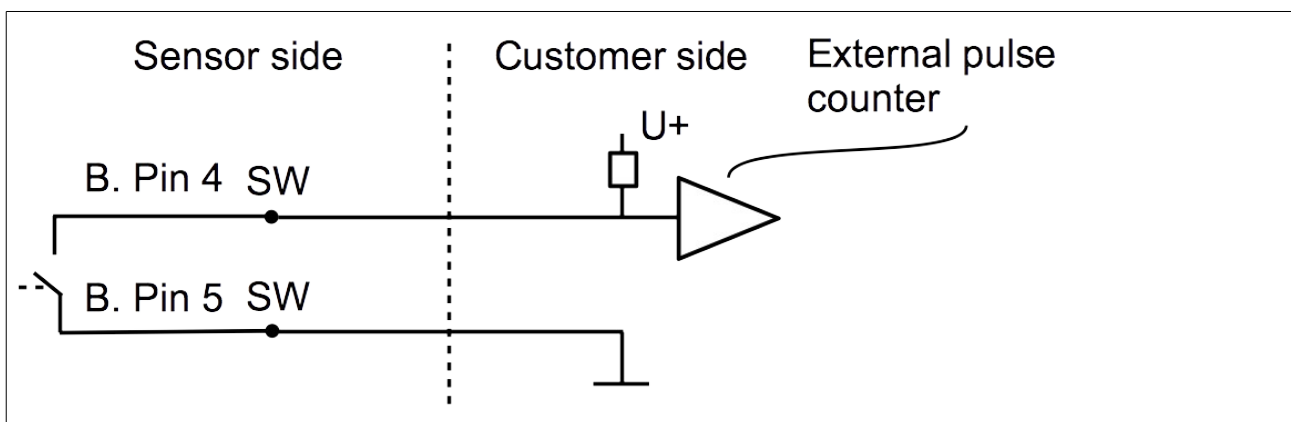
The sensor outputs one pulse per consumption unit. This pulse output can be connected to an external pulse counter to count the total consumption. The number of m<sup>3</sup> per second are summed up and indicated after one second. Pulse length depends on flow rate.



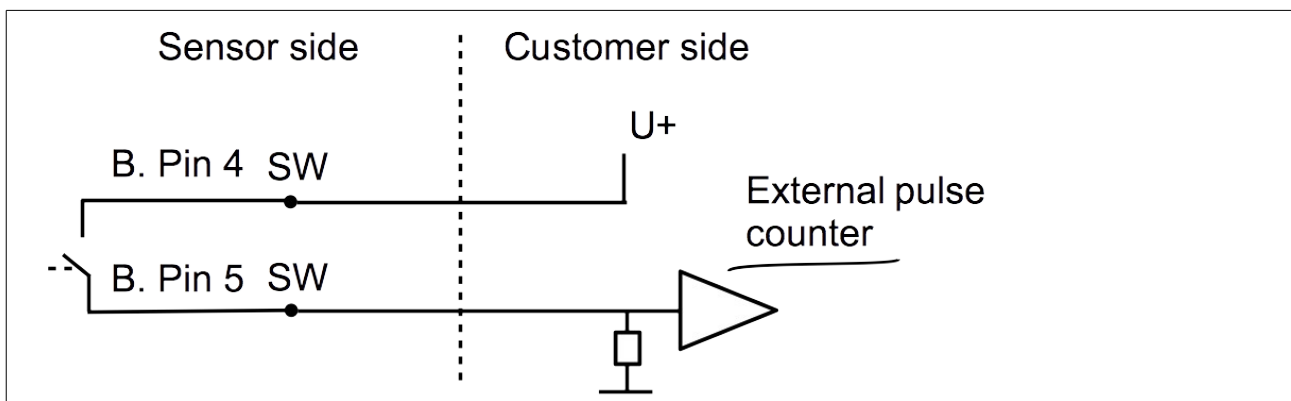
Volumetric flow [m <sup>3</sup> /s]	Volumetric flow [m <sup>3</sup> /h]	Pulse length [ms]	Max. pulse output per hour
≤ 3	≤ 10800	120	1080
> 3	> 10800	60	2880
> 6	> 21600	30	3960

**Pulse connection diagram**

Variant 1:



Variant 2:





### 9.3 Modbus output

Mode : RTU  
 Baud rate : 19200  
 Device address : Last two digits of the serial number  
 Framing / parity / stop bit : 8, N, 1  
 Response timeout : 1 second  
 Response delay : 0 ms  
 Inter-frame spacing : 7 char

**Remarks:** Modbus communication settings can be changed by the service app **S4C-FS**.

Channel description	Resolution	Format	Length	Modbus Register address
Flow	0.1	FLOAT	4-byte	6
Consumption	1	UNIT32	4-byte	8
Pressure	0.01	FLOAT	4-byte	2

**Remark:** The physical units of measurement channels can be configured using the service APP S4C-FS.

In the response message that the device returns to the master:

- Function code: 03
- Byte order (32-bit data): MID-LITTLE-ENDIAN.

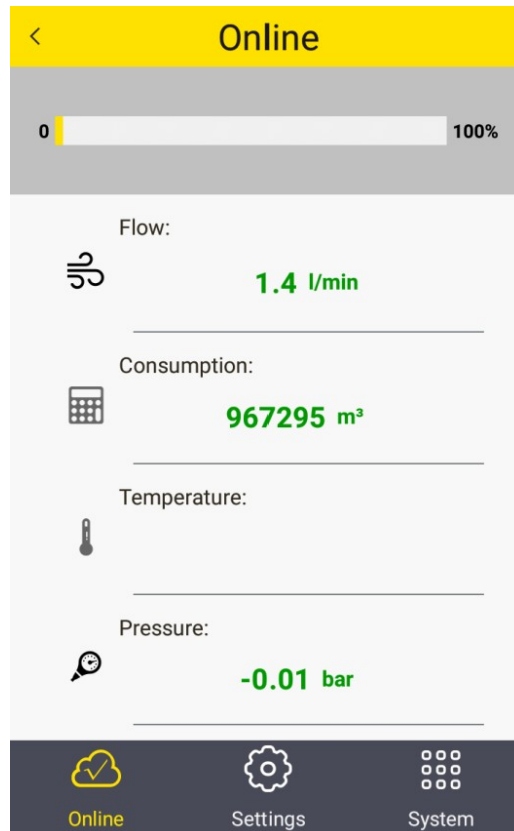
To properly decode the 4-byte float and unsigned integer data in the response message, the master must change the byte order from MID-LITTLE-ENDIAN to the order that it is using (LITTLE-ENDIAN or BIG-ENDIAN).

#### Byte sequencing of byte orders

Byte order	Byte sequencing (HEX)	Example
MID-LITTLE-ENDIAN (Read from the device)	A B C D	0x 0A 11 42 C5
LITTLE-ENDIAN	B A D C	0x 11 0A C5 42
BIG-ENDIAN	C D A B	0x 42 C5 0A 11

## 10 Configuration

To change any settings on the S418-V, please download and install the service App **S4C-FS** from the Google Play store or our Website. This App works on any Android system with Bluetooth supported.



To be allowed to change settings, the App needs to scan the QR code on the calibration certificate. This ensures that only authorized users can access the sensor settings. For more information about instructions, see the *S4C-FS Instruction and operation manual*.



### ATTENTION!

**Changes on the settings may lead to wrong measurement results! Contact manufacturer in case you are not familiar with the settings.**

## 11 Read and analysis of measurement data

The S418-V embeds the data logger to record measurement data. You can read out the data from the data logger, and analyze the data using the free analysis software S4A.

### 11.1 Features

Before you use the data logger, learn about how it works:

- You can use the Android App S4C-FS to enable or disable the data logger function and set a sampling rate as needed.
- By default the data logger is disabled. Once you enable the data logger, the S418-V starts logging data. Once you disable the data logger, the S418-V stops logging.
- The S418-V saves all sampled data records into one file. Each record includes a time stamp and all measurement data sampled at this time point, such as flow, consumption, and pressure.
- The S418-V log file supports up to 5.6 million records due to its memory size, which is equivalent to 64-day data at the one-second sampling rate.
- When the S418-V runs out of memory, the new record will replace the oldest one.
- To read out the logs recorded in the S418-V memory, install S4A (1.1.2 or later versions), which is a specialized log analysis software from SUTO, on a Windows-based computer. Meanwhile, connect the PC with the S418-V through the USB port.
- Data records are saved in one file in the S418-V, and usually S4A reads them out in one file. But in the following situations, S4A reads the records out into multiple log files :
  - When the sampling rate is changed, S4A reads out the data records into a different file.
  - When the S418-V stops logging (for example, when the power is shut off.) and resumes in less than 24 hours, S4A still reads out the data records into one file; However, if the time gap is larger than 24 hours, S4A reads out the new data records to a different file.

- S4A enables you to have a graphic view on measurement data recorded in a log file.

## 11.2 Operations

### 11.2.1 Logger configuration

You can control and configure the S418-V data logger using the S4C-FS App. Detailed steps are as follows.

1. Install and launch the **S4C-FS** App.

For more information, see the *S4C-FS Instruction and Operation Manual*.

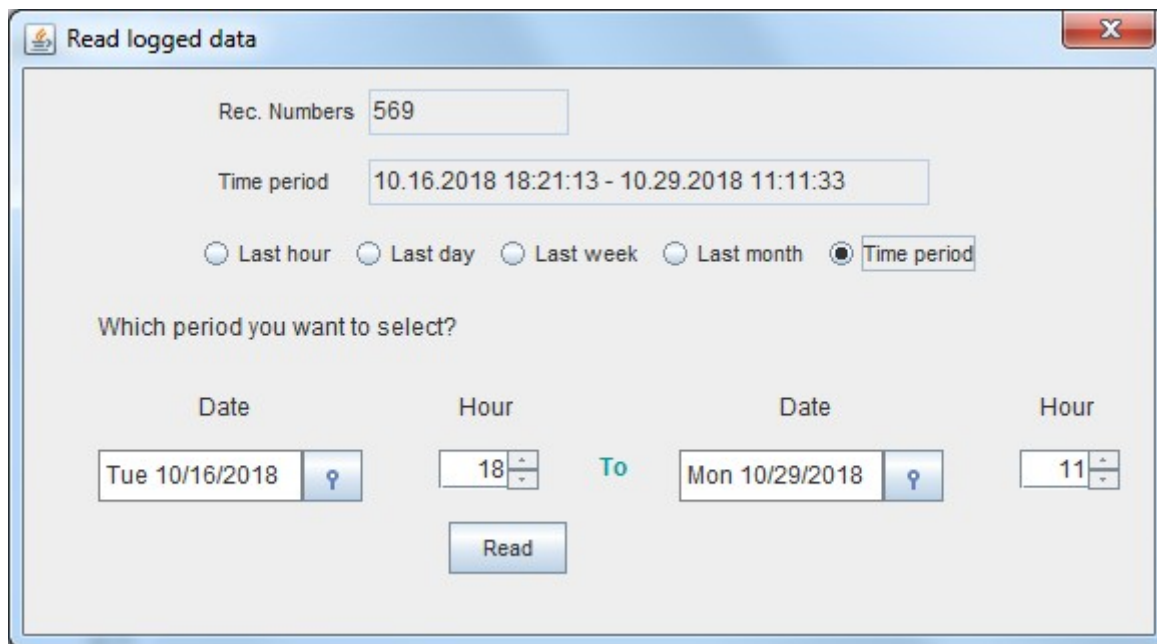
2. On the S4C-FS App, access **Settings** > **Logger Settings** and then perform all logger-related operations as described below.

Parameter	Description
Logger Status	To start or stop the logger.
Start Date & Time	To view the time stamp of the first log recorded.
Stop Date & Time	To view the time stamp of the last log recorded.
Number of Samples	To view the number of log records in the S418-V data logger.
Sampling Rate(mm:ss)	To specify the sampling rate.

### 11.2.2 Data read-out and analysis

To read, analyze and export the measurement data recorded in the S418-V, download and use the free data analysis software S4A:

1. Download the S4A software from **Support** > **Downloads** > **Apps** on the SUTO Website (<http://www.suto-itec.com>).
2. Install the software on your computer by double clicking the downloaded EXE file.
3. Launch the S4A software.
4. Click the **Detect** menu to detect and build the communication with the S418-V.
5. Click the **Read** menu to read out data records logged during a time period that you specify.



Read logged data

Rec. Numbers 569

Time period 10.16.2018 18:21:13 - 10.29.2018 11:11:33

Last hour  Last day  Last week  Last month  Time period

Which period you want to select?

Date Hour Date Hour

Tue 10/16/2018 18 To Mon 10/29/2018 11

Read

6. Click the **File** menu to have graphic views on measurement data in a log file; and if needed, to export this log file to the Excel or CSV format.

For more information about operations on S4A, click the **Help** button on the top right corner.

## 12 Calibration

The sensor is calibrated ex work. The exact calibration date is printed on the certificate which is supplied together with the sensor. The accuracy of the sensor is regulated by the on site conditions, parameters like oil, high humidity or other impurities can affect the calibration and furthermore the accuracy. However we recommend to calibrate the instrument at least once per year. The calibration is excluded from the instruments warranty. For this please contact the manufacturer.

## 13 Disposal or waste



Electronic devices are recyclable material and do not belong in the household waste.

The sensor, the accessories and its packings must be disposed according to your local statutory requirements.

The dispose can also be carried by the manufacturer of the product, for this please contact the manufacturer.

## 14 Appendix A - Specifications

### 14.1 Vacuum flow ranges

Process connection	DN8	DN15	DN20	DN25	Absolute Pressure (hPa)
Standard flow in l/min	50	200	400	700	1000

The following table is used to find the appropriate flow meter size depending on the vacuum flow.

*Example:*

Absolute line pressure = 300 hPa Vacuum flow = 750 l/min

Process connection	DN8	DN15	DN20	DN25	Absolute Pressure (hPa)
Vacuum flow in l/min	56	222	444	778	900
	63	250	500	875	800
	71	286	571	1000	700
	83	333	667	1167	600
	100	400	800	1400	500
	125	500	1000	1750	400
	167	557	1333	2333	300
	250	1000	2000	3500	200
	500	2000	4000	7000	100

Stated measuring ranges under the following conditions:

- Air at +20°C

### 14.2 Order table

Order no.	Code	Description
S695 419	S418-V	S418-V, thermal mass flow sensor, 1.5% o.RDG., 24 VDC

### Connection thread

S695 419	0	DN8 G inner thread
	1	DN15 G inner thread
	2	DN20 G inner thread
	3	DN25 G inner thread

### Output

A1455	A	Analogue 4 ... 20 mA, pulse
A1456	B	Digital Modbus/RTU
A1457	C	Digital M-Bus

	A	With SI units
A1459	B	With imperial units instead of SI units

### Accessories

Order no.	Description
A554 3315	T-BOX for S418-V Modbus/M-Bus systems, including 2 m cable with a M8 connector
A554 0109	Main power supply 100-240 VAC / 24 VDC, 0.5 A, 2 m cable with M8 connector
A553 0137	Connection cable S418-V to S 551, 5 m

## 14.3 Error codes

When an error code shows on the LED display, use the following table to identify the error cause.

Error code	Description
Er. 01	Real time clock failure
Er. 02	ADC failure
Er. 04	EEPROM failure
Er. 08	NAND flash failure
Er. 10	Pressure sensor failure
Er. 20	Flow sensor failure
Er. 40	Bluetooth failure
Er. 50	Logger failure



## 15 Appendix B - Modbus communication example

### 03 (0x03) Read holding register

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Byte count	1 byte
Starting address Lo	1 byte	Register Hi	1 byte
No. of points Hi	1 byte	Register Lo	1 byte
No. of points Lo	1 byte	:	:
CRC	2 bytes	Register Hi	1 byte
		Register Lo	1 byte
		CRC	2 bytes

### 05 (0x05) Write single coil

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Coil address Hi	1 byte	Coil address Hi	1 byte
Coil address Lo	1 byte	Coil address Lo	1 byte
Data Hi	1 byte	Data Hi	1 byte
Data Lo	1 byte	Data L	1 byte
CRC	2 bytes	CRC	2 bytes

## 16 (0x10) Write multiple registers

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Starting address Hi	1 byte
Starting address Lo	1 byte	Starting address Lo	1 byte
No. of registers Hi	1 byte	No. of registers Hi	1 byte
No. of registers Lo	1 byte	No. of registers Lo	1 byte
Byte count	1 byte	CRC	2 bytes
Data Hi	1 byte		
Data Lo	1 byte		
:	:		
Data Hi	1 byte		
Data Lo	1 byte		
CRC	2 bytes		

## 17 (0x11) Report slave ID

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
CRC	2 bytes	Byte count	1 byte
		Slave ID	2 bytes
		Device run indicator	2 bytes
		Product code	2 bytes
		Product name	20 bytes
		CRC	2 bytes



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