

## Instruction and operation manual

# S415

## Thermal mass flow sensor



Dear Customer,

Thank you for choosing our product.

Before you start up the device please read the operating instructions in full and carefully observe them. 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 canceled and the manufacturer is exempt from liability.

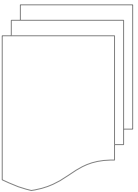
The device is destined exclusively for the described application.

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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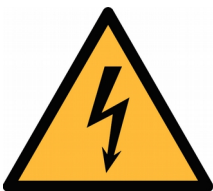
## 1 Safety instructions



**Please check if this instruction manual matches 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.

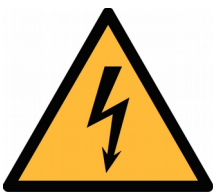


**WARNING!**

**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 might 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 might 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 operating 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 might lead to wrong measurement values, which can result in 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 operating 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.
- 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% with 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

Registered 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 S415 is the thermal mass flow sensor that is designed to measure the volumetric flow and consumption of compressed air and nitrogen within the permitted operating parameters. (See [Technical data](#) on the next page.)

The default unit settings are: volumetric flow in l/min and total Consumption in m<sup>3</sup>. Other units can be configured using the service app S4C-FS, which can be downloaded from the Google Play store or our website. For more information, see chapter [10](#) on page 18.


## 5 Features

- Inline thermal mass flow sensor virtually independent of pressure and temperature changes
- Process connection G-type thread, DN8, DN15, DN20, DN25 and DN32.
- Very short response time
- Particularly suitable for measuring at point-of-use flow and consumption of compressed air or N<sub>2</sub>
- Integrated display showing volumetric flow
- Choices of output signals:
  - Analogue 4 ... 20 mA and pulse output
  - Modbus interface
  - M-Bus interface
- Bluetooth interface for sensor settings
- Configurable through Android devices



## 6 Technical data

### 6.1 General data

 FCC ID: 2ASK2-SUTO-002	
Parameters	Standard unit flow: l/min Consumption units: m <sup>3</sup> (default)
Reference conditions	ISO1217 20°C, 1000 hPa (Standard-Unit) DIN1343 0°C , 1013.25 hPa (Norm-Unit)
Principle of measurement	Thermal mass flow
Sensor	Glass coated resistive sensor
Ambient temperature /Transport temperature	0 ... +50°C / -30 ... +70°C
Medium conditions	0 ... +50°C, rH<90% no condensation
Operating pressure	0 ... 1.0 MPa
Pressure drop	Maximum pressure drop at the maximum flow of the Standard (S) flow range: <ul style="list-style-type: none"> <li>• DN8 type : 30 hPa</li> <li>• DN15 type: 100 hPa</li> <li>• DN20 type: 100 hPa</li> <li>• DN25 type: 200 hPa</li> <li>• DN32 type: 170 hPa</li> </ul>
Casing	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, and DN32
Process connection	G inner thread ISO 228-1
Weight	0.45 kg (DN8), 0.44 kg (DN15) 0.97 kg (DN20), 0.94 kg (DN25) 1.7 kg (DN32)

## 6.2 Electrical data

Power supply	15 ... 30 VDC, 120 mA @ 24 VDC
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## 6.3 Output signals

Analogue output	Signal: 4 ... 20 mA, isolated Scaling: 0 to max flow Max load: 250R
Pulse output	1 pulse per m <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="#">9.4</a> on page 17.

## 6.4 Accuracy

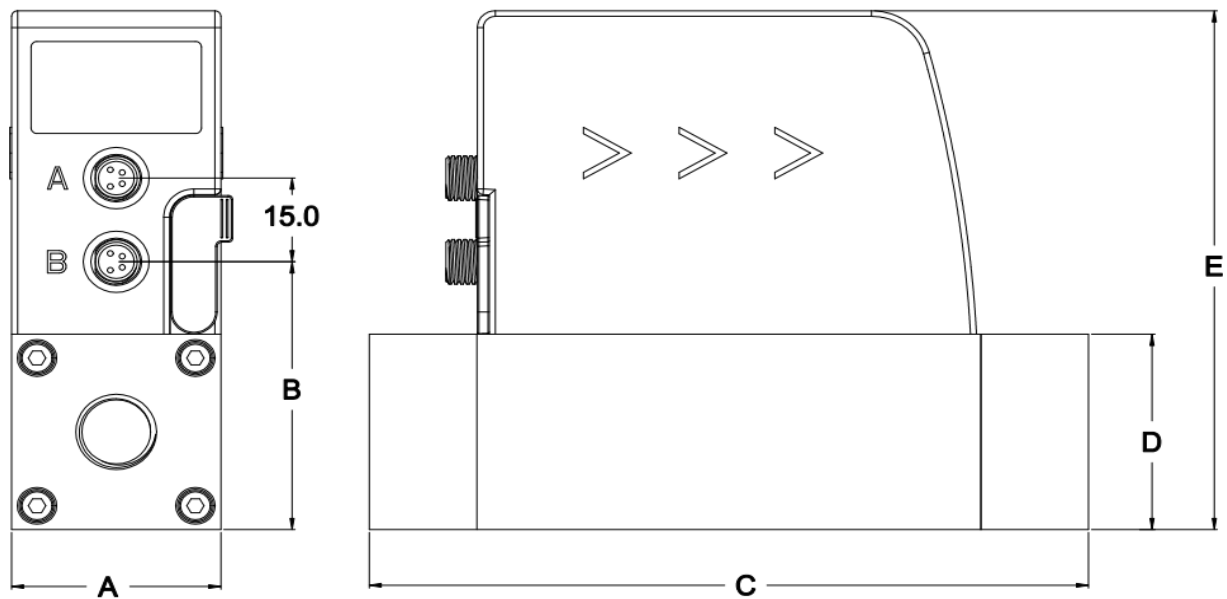
Accuracy* (at 6 bar, 20°C, rH<40%)	± (3.0% of reading + 0.3% Full Scale)
Temperature coefficient	< 0.1%/K Full Scale
Pressure coefficient	<5% / 1 MPa
Turndown ratio	50 : 1
Stated accuracy at	Ambient/process temperature 23°C ± 3°C Ambient/process humidity <90% Process pressure at 0.6 MPa
Repeatability	± 1% of reading
Sampling rate	3 samples per second

\* The specified accuracy is valid only within the minimum and maximum flow rates that are stated in section [13.1](#) on page 20.

### Remark:

The total consumption value is saved to the permanent memory every 5 minutes. If within these 5 minutes the device is powered off, it will restore the last consumption value which was saved in the last cycle.

## 7 Dimensional drawing



	<b>A (mm)</b>	<b>B (mm)</b>	<b>C (mm)</b>	<b>D (mm)</b>	<b>E (mm)</b>
DN8/15	35.0	48.0	120.4	35.0	93.0
DN20/25	48.0	61.0	178.0	48.0	106.0
DN32	60.0	118.0	222.0	60.0	73.0

## 8 Installation

The S415 is delivered with following components:

Qty.	Description	Item no.
1	S415 Thermal mass flow meter	S695 4150
		S695 4151
		S695 4152
		S695 4153
		S695 4154
1	5 m cable with M8 connector and open ends	A553 0136
1	Instruction manual	No P/N
1	Calibration certificate	No P/N

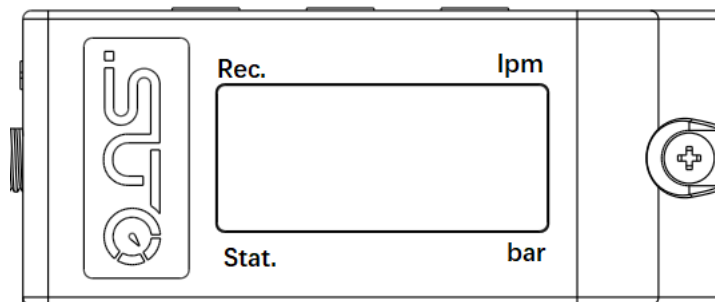
### 8.1 Installation considerations

To maintain the accuracy stated in the technical data, the sensor must be installed inline and fitted to tubes with the same diameter. Please note the following:

- The sensor is for indoor use only! At an outdoor installation, the sensor must be protected from solar radiation and rain.
- It is strongly recommend not to install S415 permanently in wet environment which exists usually right after a compressor outlet.

### 8.2 LED indicators

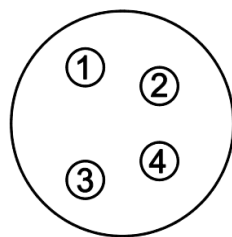
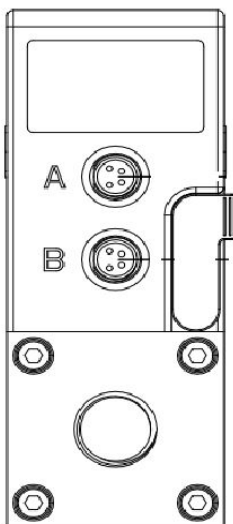
The S415 provides four LED indicators on the display panel, which indicate the status of the data logger, display, and Bluetooth connection separately.



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: The 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 comes with two connector plugs "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 S415 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.

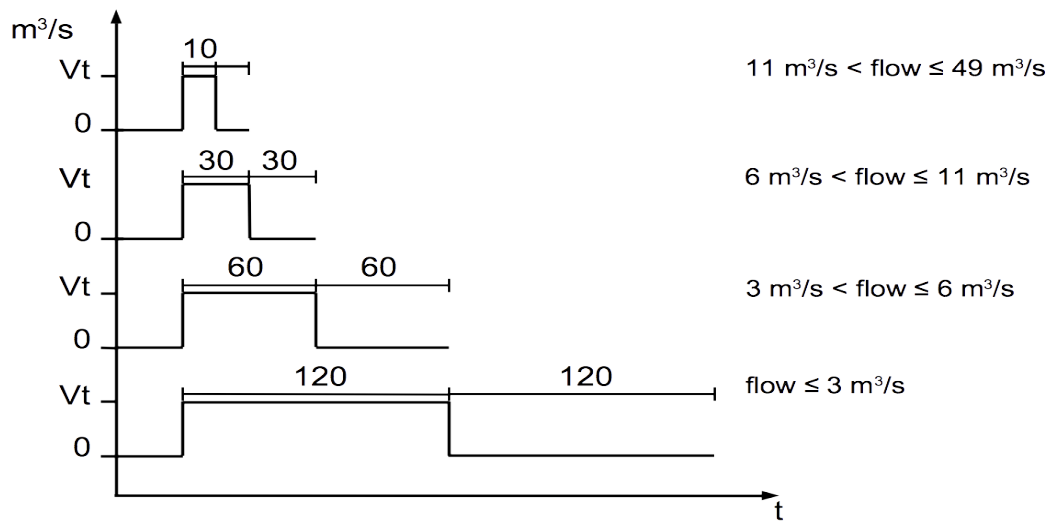
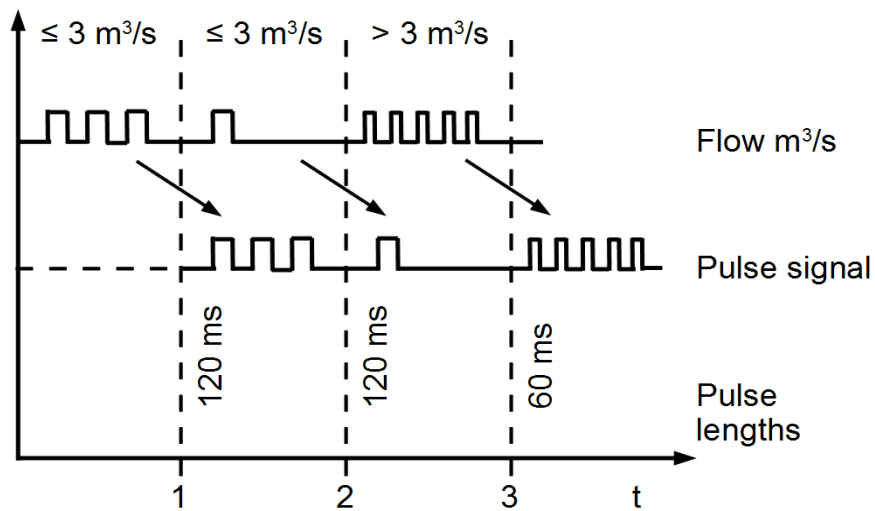
## 9 Sensor signal outputs

### 9.1 Analog output

The sensor has 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 section [13.1](#) on page 20.

### 9.2 Pulse output

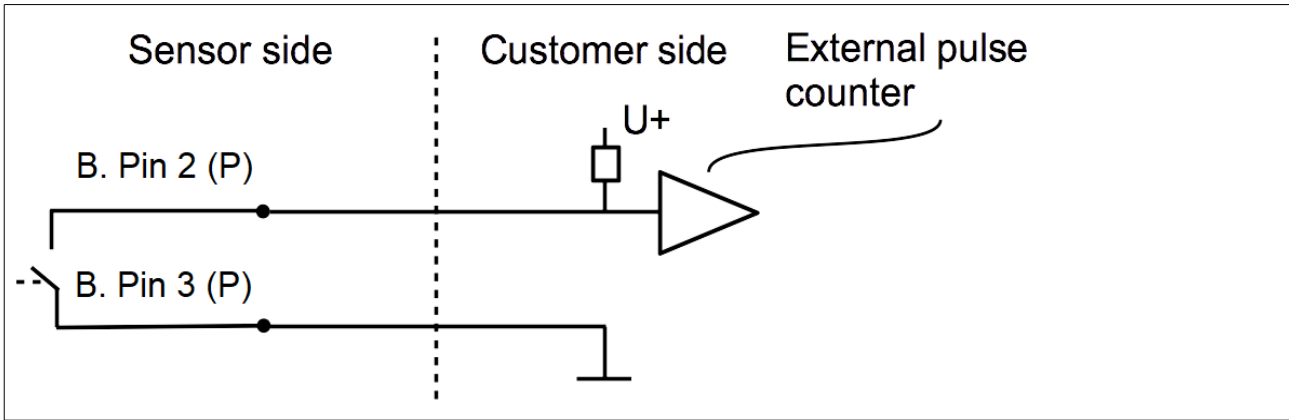
The sensor outputs one pulse per a consumption unit. This pulse output can be connected to an external pulse counter to count the total consumption. The number of m<sup>3</sup> per second are summed up and indicated after one second. Pulse length depends on flow rate.



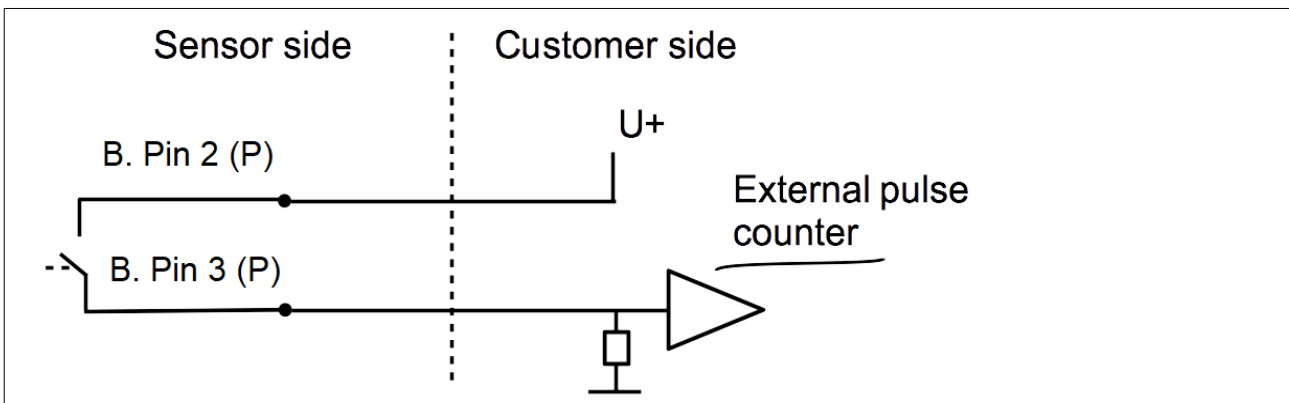
Volumetric flow [m³/s]	Volumetric flow [m³/h]	Pulse length [ms]	Max. pulse output per hour
$\leq 3$	$\leq 10800$	120	1080
$> 3$	$> 10800$	60	2880
$> 6$	$> 21600$	30	3960

### 9.3 Pulse Connection Diagram

Variant 1:



Variant 2:





## 9.4 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

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

Channel description	Resolution	Format	Length	Register address
Flow	0.1	FLOAT	4-Byte	6
Consumption	1	UNIT32	4-Byte	8

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

### Response message

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

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

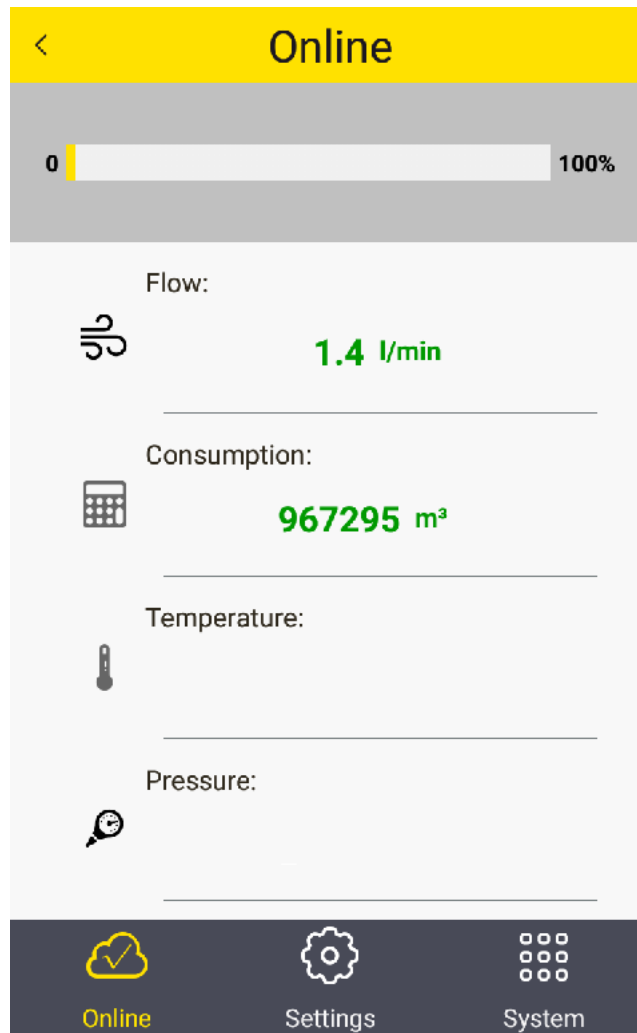
To properly decode the 4-byte float and unsigned integer data in the response message, the master must change the byte order from MID-LITTLE-ENDIAN to the order that it is using (LITTLE-ENDIAN or BIG-ENDIAN).

### Byte sequencing

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 S415, 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 attached on the side of the sensor head or on the calibration certificate. This ensures that only authorized users can access the sensor settings. For more information about parameter settings and operating 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 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.

## 12 Disposal or waste



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

The sensor, the accessories and its packing 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.

## 13 Appendix A - Specifications

### 13.1 Flow ranges

The measuring ranges of air are stated under the following conditions:

- Standard flow in air
- Reference pressure: 1000 hPa
- Reference Temperature: +20°C

Unit: **l/min**

	<b>DN8</b>		<b>DN15</b>		<b>DN20</b>		<b>DN25</b>		<b>DN32</b>	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
<b>Standard range (S)</b>	50	250	20	1000	40	2000	70	3500	120	6000
<b>Low range (L)</b>	1	50	4	200	8	400	14	700	24	1200

The measuring ranges of **N<sub>2</sub>** are stated under the following conditions:  
0°C and 1013.25 hPa

Unit: **l/min**

	<b>DN8</b>		<b>DN15</b>		<b>DN20</b>		<b>DN25</b>		<b>DN32</b>	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
<b>Standard range (S)</b>	4.44	222	17.8	890	35.6	1780	62.2	3110	107	5335
<b>Low range (L)</b>	0.89	44.5	3.56	178	7.12	356	12.4 4	622	21	1067

## 13.2 Error code

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

<b>Error code</b>	<b>Description</b>
Er. 01	Real time clock failure
Er. 02	ADC failure
Er. 04	EEPROM failure
Er. 08	NAND flash failure
Er. 20	Flow sensor failure
Er. 30	Temperature sensor failure
Er. 40	Bluetooth failure

## 13.3 Order table

<b>Order Table (Air and N<sub>2</sub> only)</b>				
<b>Order no.</b>	<b>Size</b>	<b>Range</b>	<b>Output</b>	<b>Description</b>
S695 415				S415, thermal mass flow meter, 3% o.RDG., 24 VDC
	0			DN8 G inner thread
	1			DN15 G inner thread
	2			DN20 G inner thread
	3			DN25 G inner thread
	4			DN32 G inner thread
		S		Standard range version of S415
A1453		L		Low range version of S415
A1450			A	Analogue 4 ... 20 mA, pulse
A1451			B	Digital Modbus/RTU
A1452			C	Digital M-Bus
A1460				Reverse display direction

## 14 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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