

Instruction and Operation Manual

S415

Compact Thermal Mass Flow Meter (Eco-Inline)



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.

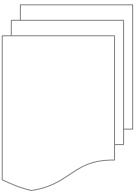
The device is destined exclusively for the described application.

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.

Table of Contents

1 Safety Instructions.....	4
2 Registered Trademarks.....	6
3 RF Exposure Information and Statement.....	7
4 Application.....	8
5 Features.....	8
6 Technical Data.....	9
6.1 General Data.....	9
6.2 Electrical Data.....	10
6.3 Output Signals.....	10
6.4 Accuracy	10
7 Dimensional Drawing.....	11
8 Installation.....	14
8.1 Installation Considerations.....	14
8.2 LED Indicators.....	15
8.3 Electrical Connection	15
9 Signal Outputs.....	17
9.1 Analog Output.....	17
9.2 Pulse Output.....	17
9.3 Modbus Interface.....	18
9.3.1 Modbus Information.....	18
9.3.2 Connect Several S415 to Modbus Master.....	19
9.3.2.1 Modbus/RTU Cable Length.....	19
9.3.2.2 Modbus/RTU Wiring and Cable Type.....	20
9.3.2.3 Create Daisy-Chain using RS-485 Splitter.....	21
9.3.2.4 Topology of Modbus/RTU Daisy-Chain.....	22
9.4 M-Bus Output.....	23
9.5 Connection between S415 Outputs and Customer Equipment....	23
10 Configuration.....	25
11 Calibration.....	26
12 Disposal or Waste.....	26
13 Appendix A - Specifications.....	27
13.1 Flow Ranges.....	27
13.2 Error Code.....	28
13.3 Order Table.....	28

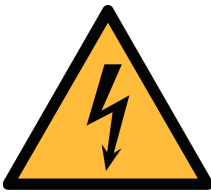
1 Safety Instructions



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 meter 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 device. 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 device.
- Make sure that storage temperature of the device 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

Trademark	Trademark owner
SUTO®	SUTO iTEC
MODBUS®	Modbus Organization, Hopkinton, USA
Android™, Google Play	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 a Thermal Mass Flow Meter 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 m³. Other units can be configured using the mobile App S4C-FS, which can be downloaded from the Google Play store or SUTO website. For more information, see chapter [10](#) on page 25.

5 Features

- Inline thermal mass flow meter virtually independent of pressure and temperature changes
- Process connection G-type thread, DN8, DN15, DN20, DN25 and DN32
- Integrated flow conditioner, no need of straight inlet sections
- Very short response time
- Particularly suitable for measuring at point-of-use flow and consumption of compressed air or N₂
- Integrated display showing volumetric flow
- Choices of output signals:
 - Analogue 4 ... 20 mA and pulse output
 - Modbus interface
 - M-Bus interface
- Bluetooth interface for device settings
- Configurable through the mobile phone App S4C-FS

6 Technical Data

6.1 General Data

 FCC ID: 2ASK2-SUTO-002	
Parameters	Standard unit flow: l/min (default) Consumption units: m ³ (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 ... 1.6 MPa
Pressure drop	Maximum pressure drop at the maximum flow of the Standard (S) flow range: <ul style="list-style-type: none"> • DN8 type : 30 hPa • DN15 type: 100 hPa • DN20 type: 100 hPa • DN25 type: 200 hPa • DN32 type: 170 hPa
Casing	Process connection: aluminum alloy Wetted parts: aluminum alloy Top casing: PC + ABS
Protection class	IP54
Dimensions	See dimensional drawing on page 11 .
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 ³ , isolated switch, max. 30 VDC, 200 mA (pulse length: 10 ... 120 ms, depends on flow rate)
Modbus output	See section 9.3 on page 18.

6.4 Accuracy

Accuracy*	± (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 27.

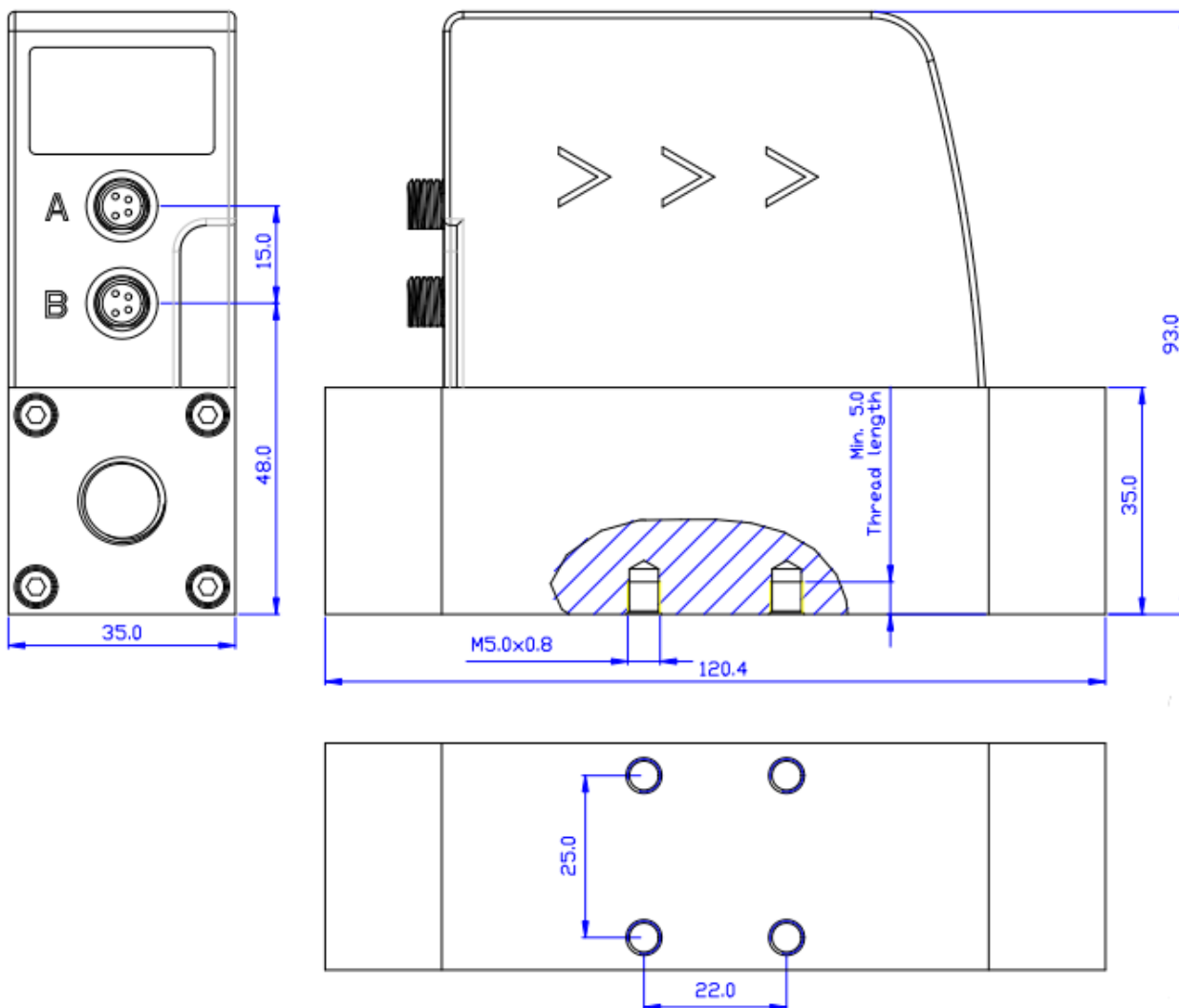
Remark:

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.

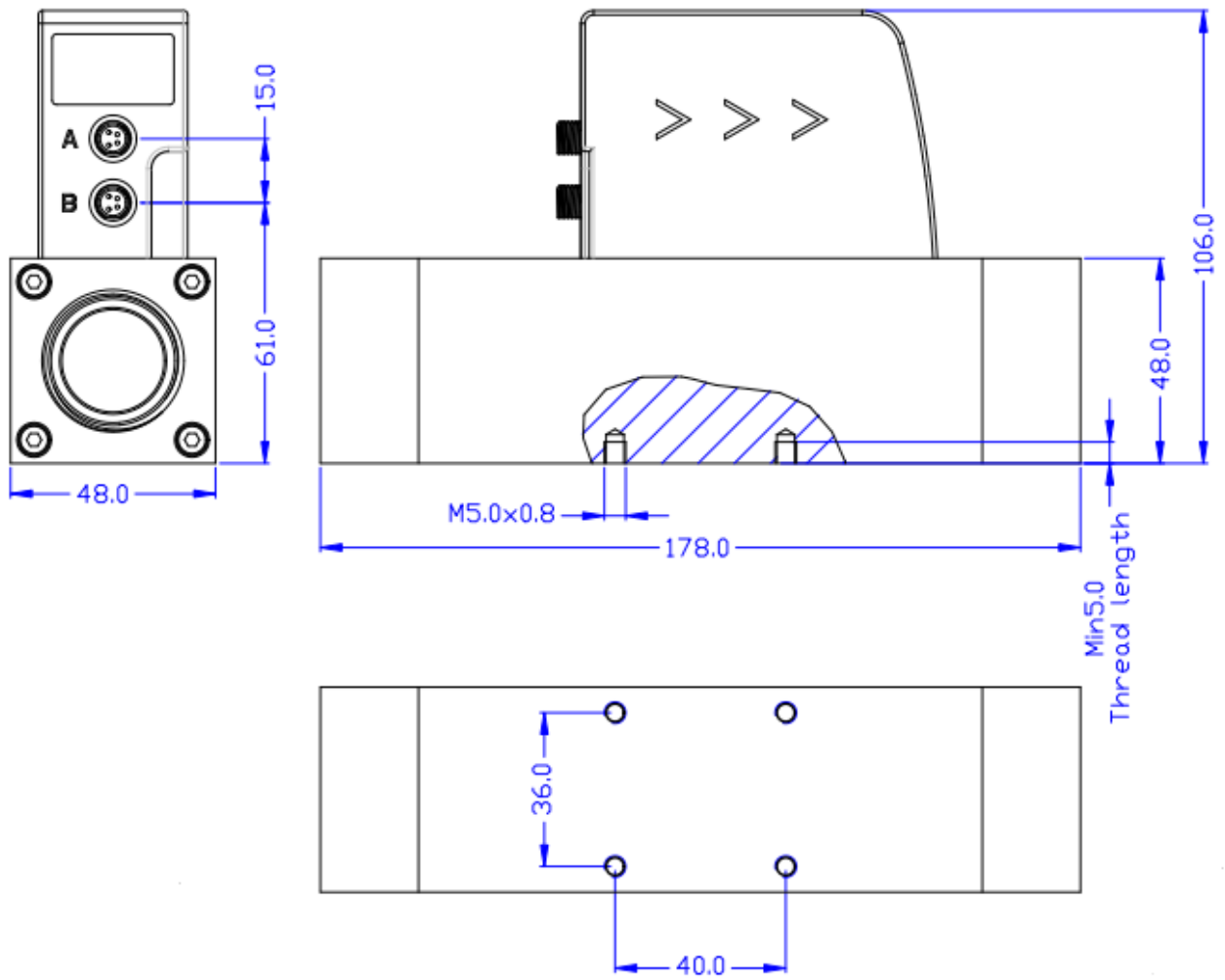
7 Dimensional Drawing

Unit: mm

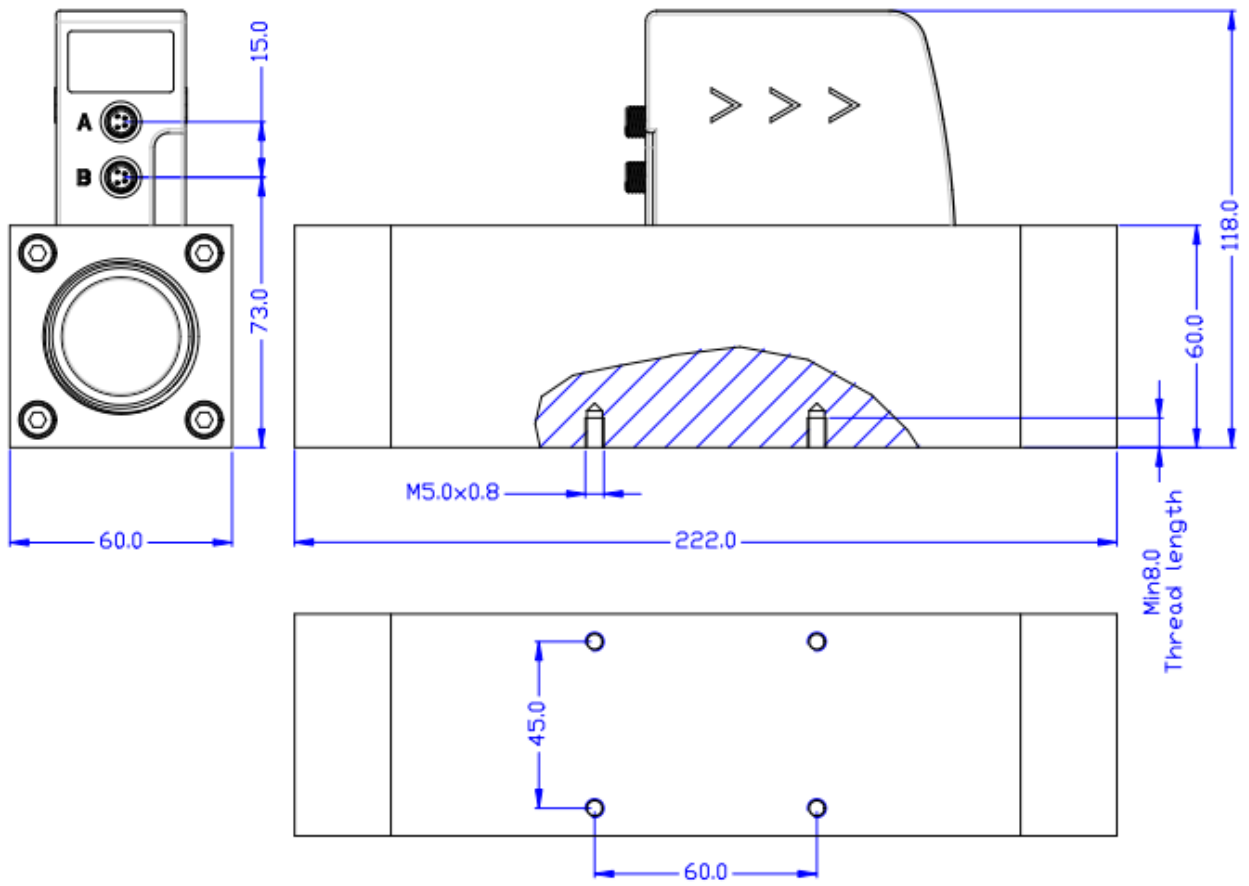
DN8/DN15



DN20/DN25



DN32



8 Installation

The S415 is delivered with following components:

Qty.	Description	Item no.
1	S415 Compact 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

- When installing the flow meter, always observe the arrows on the housing showing the flow direction. The air/gas flow direction must always be in line with the arrows on the housing.



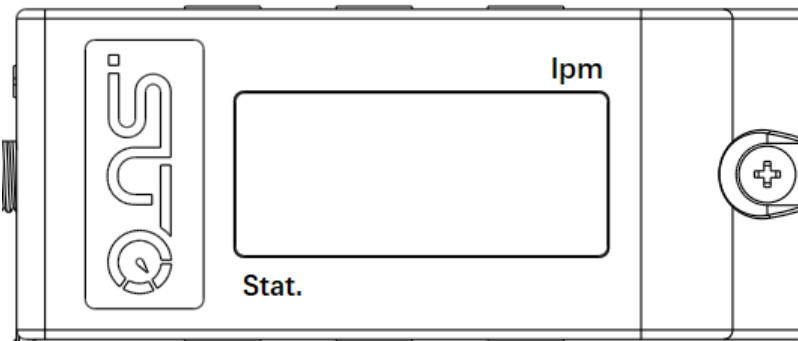
- Due to the integrated flow conditioner, there are no additional straight pipe requirements for good measurement. However for best measurement, it is recommended 3-5 times inner diameter straight pipe at the inlet.
- The S415 can be installed in horizontal or vertical pipes.

Note:

- The device is for indoor use only! For outdoor applications, ensure a protection from solar radiation and rain. Always observe operating temperature and humidity as stated in the the technical data.
- It is strongly recommend not to install S415 permanently in wet air/gas conditions, which exists usually right after a compressor outlet.

8.2 LED Indicators

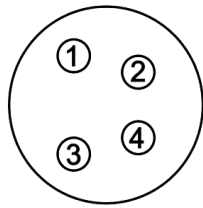
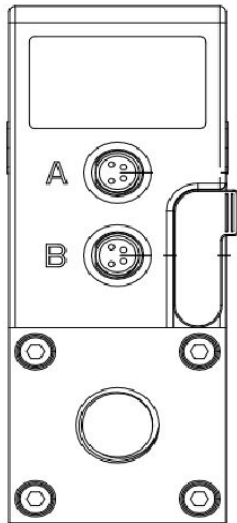
The S415 provides two LED indicators on the display panel, which indicate the status of display and Bluetooth connection separately.



LED	Function	Status
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

8.3 Electrical Connection

The flow meter comes with two connector plugs "A" and "B". By default the flow meter 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 _M	Ground for Modbus
-V _B	Negative supply voltage
+V _B	Positive supply voltage
+I	Positive 4 ... 20 mA signal (isolated)
-I	Negative 4 ... 20 mA signal (isolated)
D+	Modbus data +
D-	Modbus data -
SW	Isolated pulse output (switch)
M-Bus	M-Bus data
NA	Not Applicable

Pin assignment connector plug M8

Output type	Connector	Pin 1	Pin 2	Pin 3	Pin 4
Modbus	A	D-	-V _B	+V _B	D+
	B	D-	GND _M	NA	D+
Pulse and analog	A	-I	-V _B	+V _B	+I
	B	-I	SW	SW	+I
M-Bus	A	M-Bus	-V _B	+V _B	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.

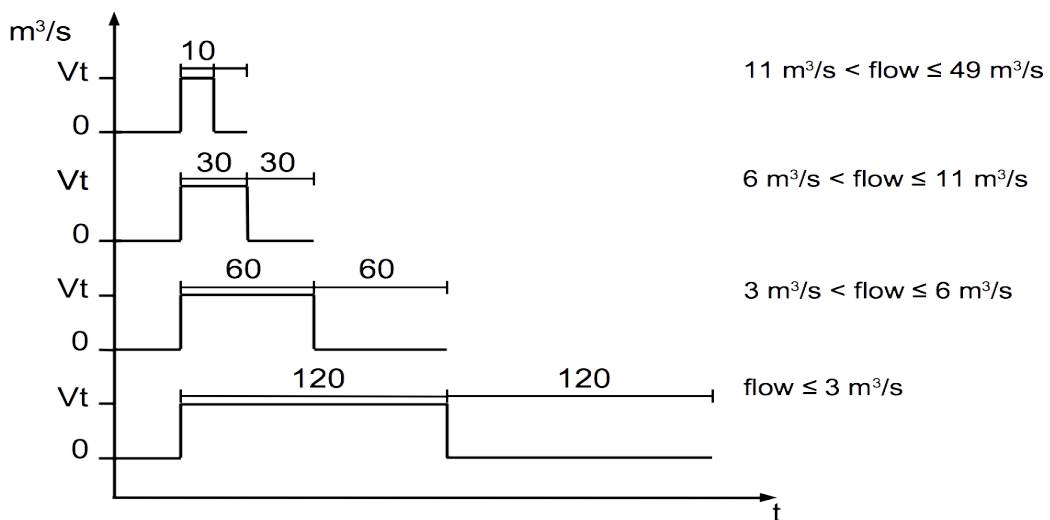
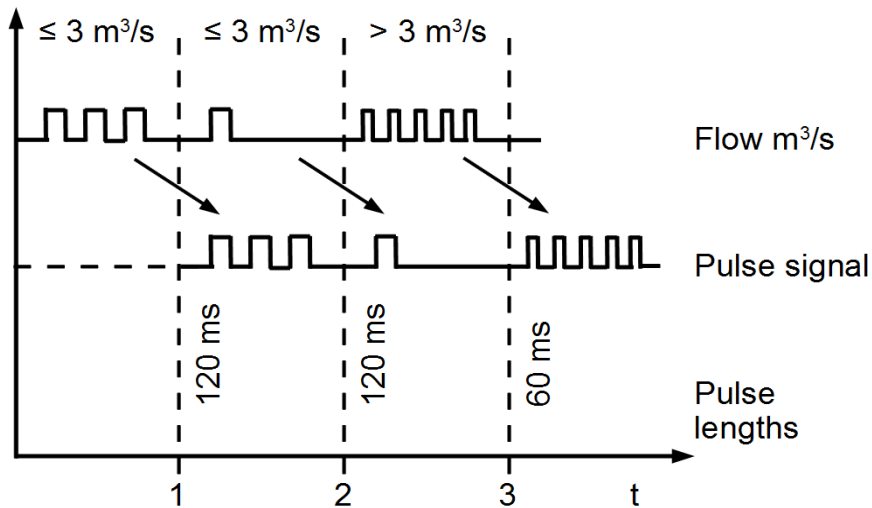
9 Signal Outputs

9.1 Analog Output

The flow meter 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 27.

9.2 Pulse Output

The flow meter 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 m³ per second are summed up and indicated after one second. Pulse length depends on flow rate.



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

9.3 Modbus Interface

9.3.1 Modbus Information

The default settings of the Modbus interface are as follows:

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

Response message that the device returns to the master:

- Function code: 03

The information of the byte order is shown in the table below:

Byte Order	Sequence				Data Type
	1st	2nd	3rd	4th	
1-0-3-2	Byte 1 (MMMMMMMM*)	Byte 0 (MMMMMMMM *)	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM *)	FLOAT
1-0-3-2	Byte 1	Byte 0 LSB	Byte 3 MSB	Byte 2	UINT32 INT32
1-0	Byte 1 MSB	Byte 0 LSB	---	---	UINT16 INT16
1-0	Byte 1 XXX *	Byte 0 DATA	---	---	UINT8 INT8

* S: Sign, E: Exponent, M: Mantissa, XXX: no value

Explanations of MSB and LSB

MSB MSB refers to Most Significant Byte first, which follows the Big-Endian byte order.
For example, if the main system follows the MSB first order:
When the 4-byte floating number, in the order of Byte1-Byte0-Byte3-Byte2, is received from the slave (sensor), the master must change the byte order to Byte3-Byte2-Byte1-Byte0 for the correct display of the value.

LSB LSB refers to Least Significant Byte first, which follows the Little-Endian byte order.
For example, if the main system follows the LSB first order:
When the 4-byte floating number, in the order of Byte1-Byte0-Byte3-Byte2, is received from the slave (sensor), the master must change the byte order to Byte0-Byte1-Byte2-Byte3 for the correct display of the value.

Note: Modbus communication settings as well as other settings can be changed by the service App **S4C-FS** or through the windows based **Service Software**.

Available measurement channels

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

9.3.2 Connect Several S415 to Modbus Master

The S415 with Modbus/RTU interface can be easily daisy-chained to a Modbus Master device. This master can be either SUTO displays and gateways or any third-party Modbus/RTU master.

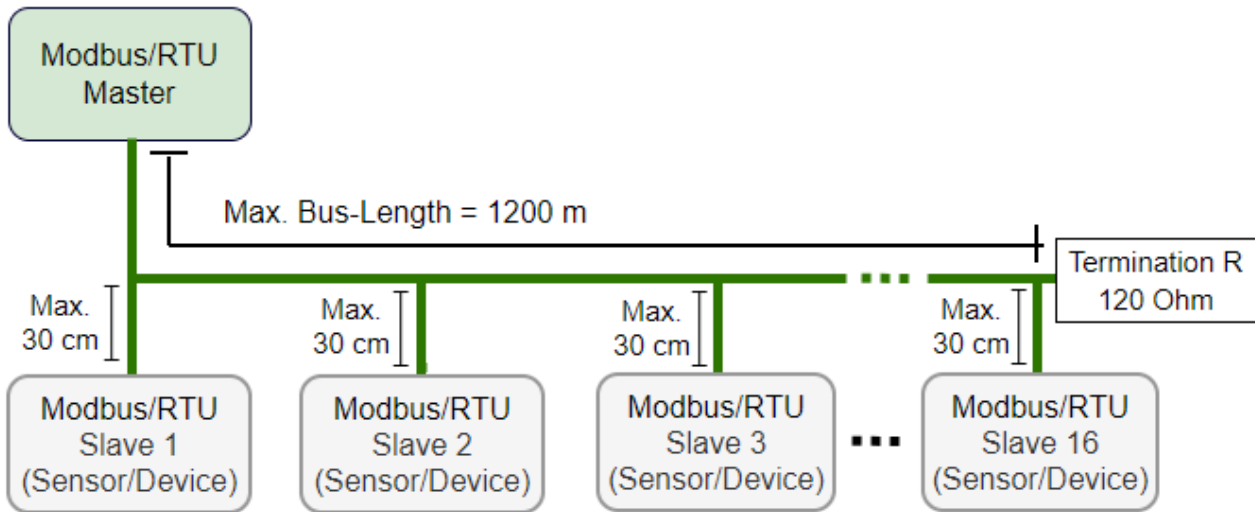
Through this method you can add up to 16 flow meters to the master device.

9.3.2.1 Modbus/RTU Cable Length

A Modbus/RTU bus line has limitations which shall not be exceeded, otherwise the communication might not be stable.

- The maximum total bus length must not exceed 1200 m.
- The stub length to each node must not exceed 30 cm.

See the picture below for details.

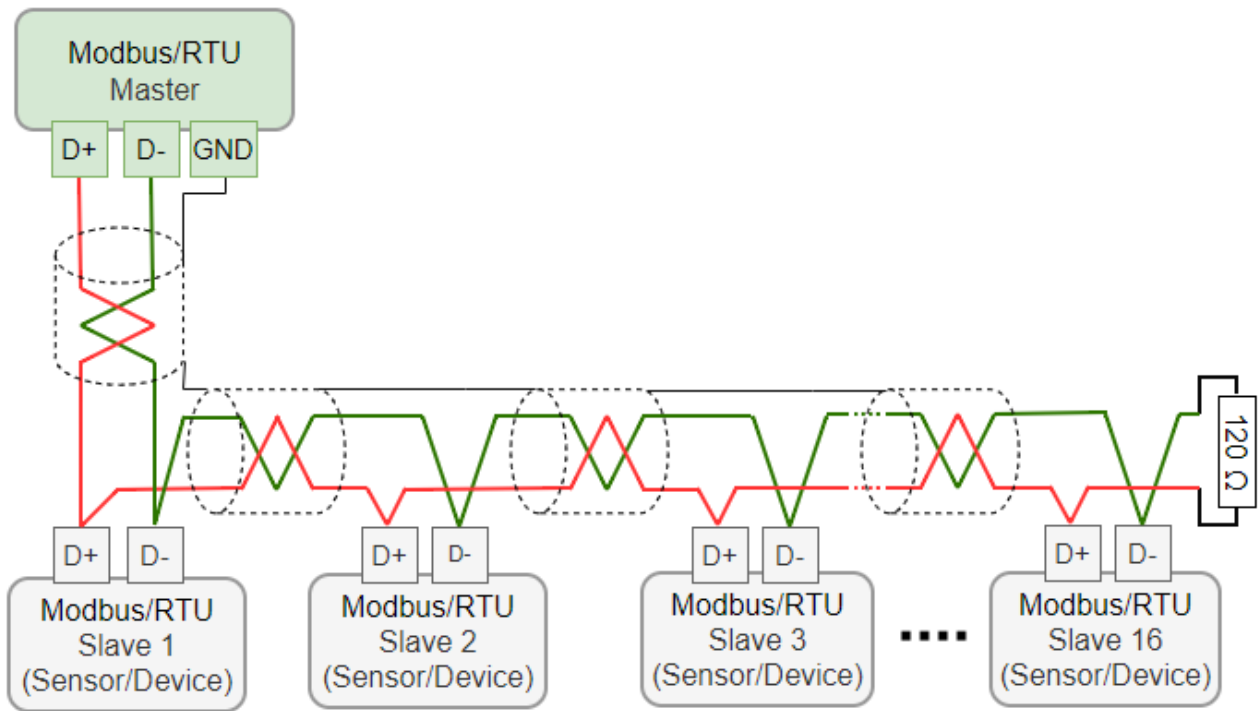


9.3.2.2 Modbus/RTU Wiring and Cable Type

To ensure a stable communication a twisted-pair bus cable must be chosen to set up the Modbus/RTU communication.

- Bus-cable specifications must follow the EIA485 Standard, must be twisted pair and shielded, for example 2 x 2 x 0.22 mm², Li-2YCY (A553 0123).
- The shield must be connected at one end to the master GND connection.
- At the end of the bus, a 120 Ohm resistor should be placed a termination resistor.

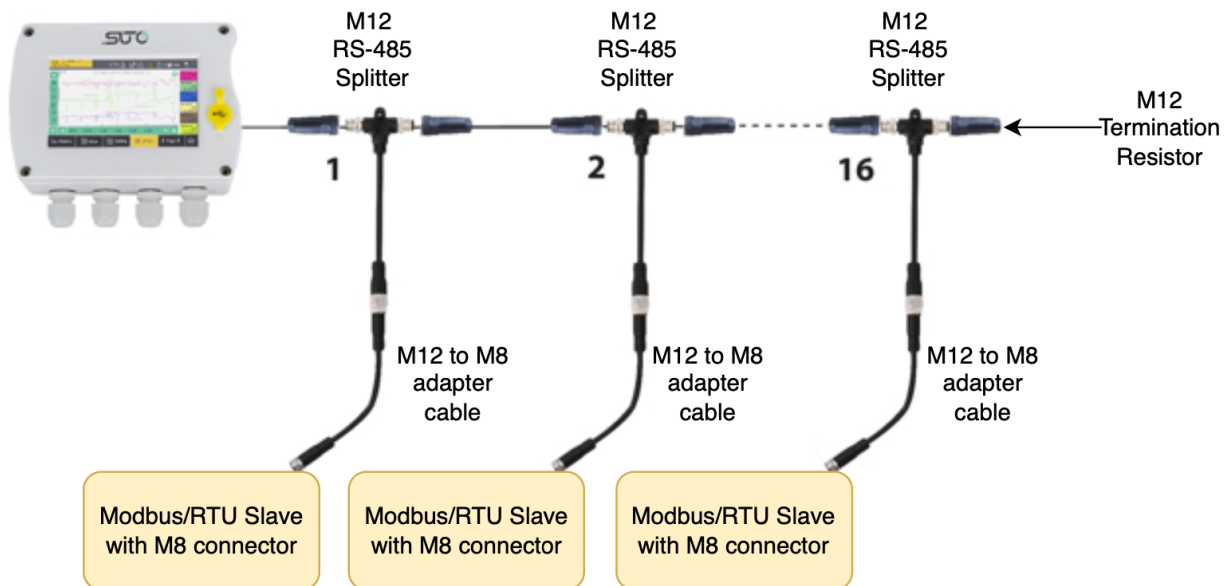
See the below picture for details.



9.3.2.3 Create Daisy-Chain using RS-485 Splitter

To connect the S415 to the daisy-chain, the RS-485 splitter (A554 3310) and the M8 to M12 converter cable (A553 0161) are needed.

Furthermore place a M12 termination resistor (C219 0055) at the last splitter in the daisy-chain, as show in the figure below.

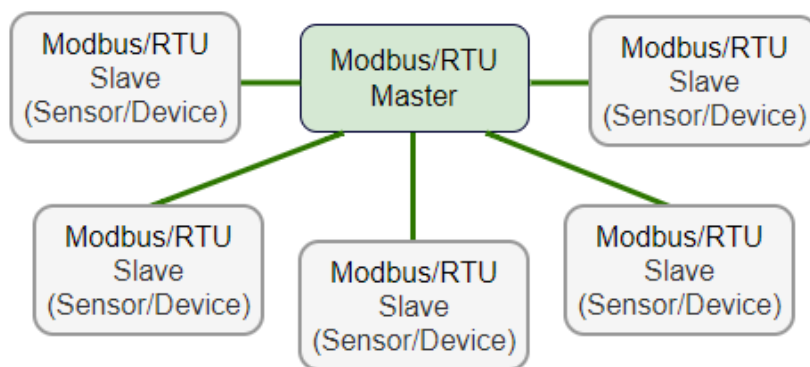


Remark: The S331 can maximum provide 10 W power to the connected devices. If more power is required a separate power supply is needed.

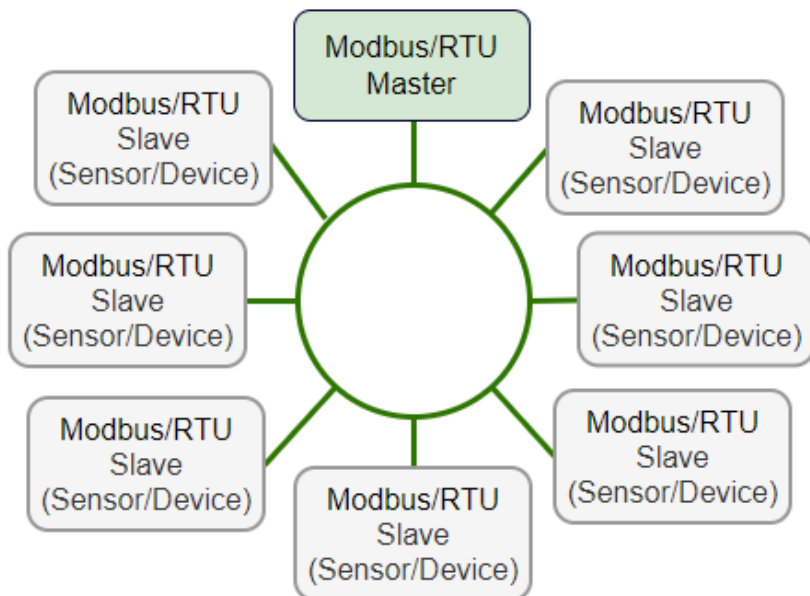
9.3.2.4 Topology of Modbus/RTU Daisy-Chain

The recommended bus topology is to connect devices as a daisy-chain, as shown in the figure in section 9.3.2.1 Modbus/RTU Cable Length. Other connection topologies are not recommended and should be avoided.

Avoid a connection of slaves to the master in ring or star topology.



Avoid a star topology



Avoid a ring topology

9.4 M-Bus Output

Communication parameters

Primary Address	: 1
Secondary Address	: 8-digit serial number of the device
Manufacturer Code	: 0x15C4
M-Bus version	: 1
Baud rate	: 2400
Response delay (ms)	: 7
Response timeout (ms)	: 100
Receive timeout (ms)	: 500

Value register

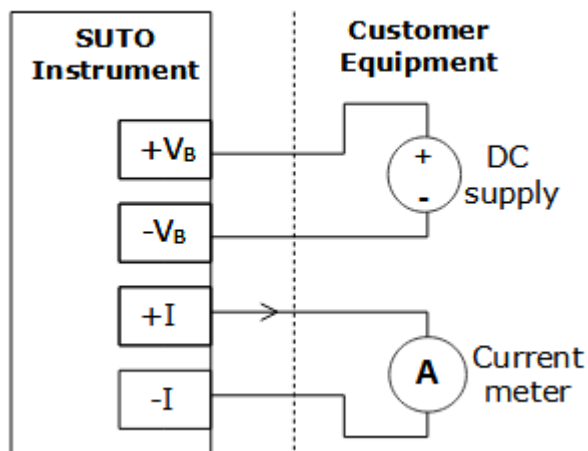
M-Bus Addr.	Description	Data bytes
1	Total consumption	4-byte
2	Flow	4-byte
3	M-Bus status	4-byte

9.5 Connection between S415 Outputs and Customer Equipment

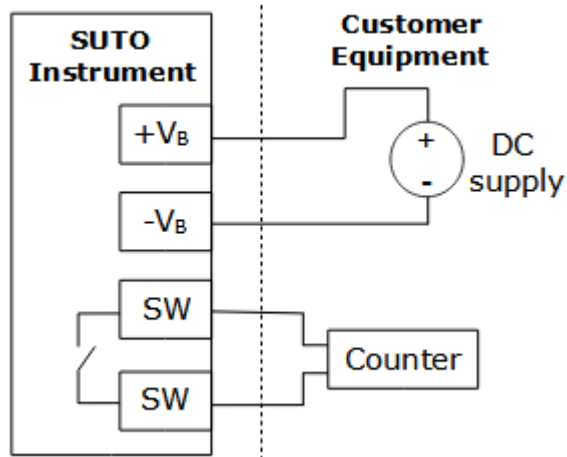
This section provides figures to show how outputs supported by the S415 connect with the customer equipment.

In the following figures, the **SUTO Instrument** indicates the S415.

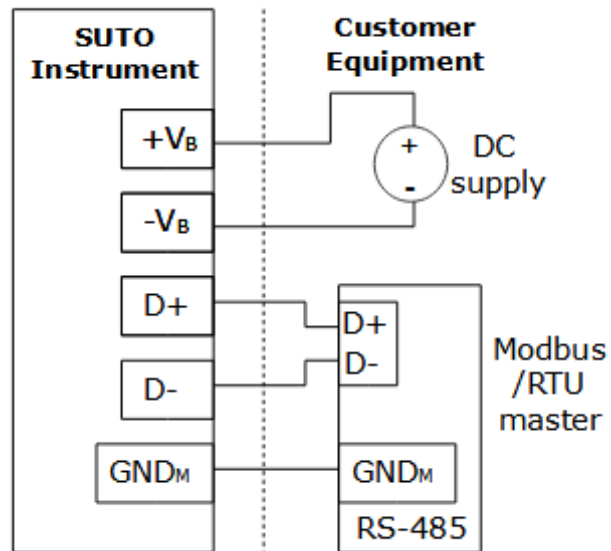
Analog output (Isolated)



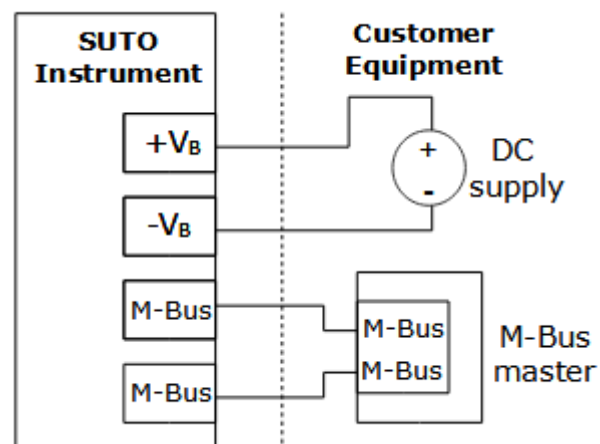
Pulse output (passive)



Modbus/RTU output

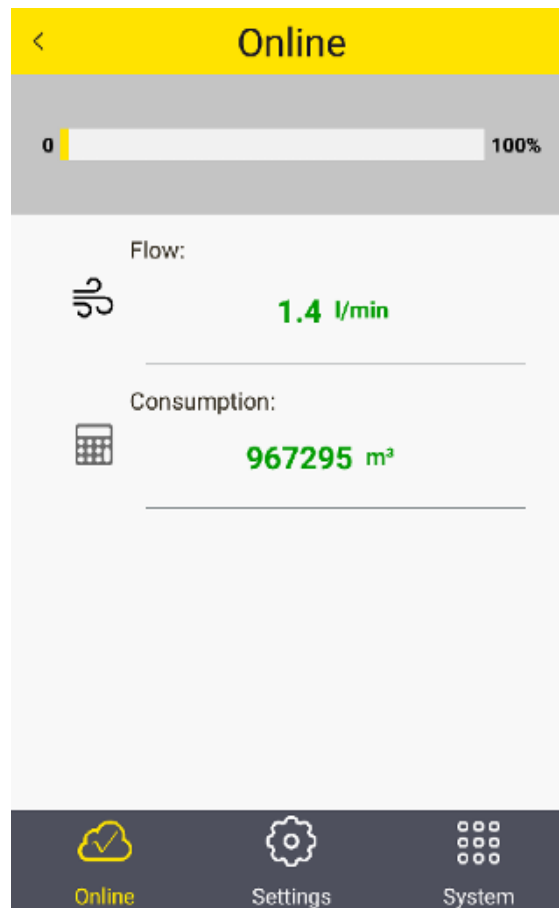


M-Bus output



10 Configuration

To change any settings on the S415, download and install the mobile App **S4C-FS** from the Google Play store or the SUTO website. This App works on any mobile phone with Bluetooth supported.



To be allowed to change settings, the App needs to scan the QR code attached on the side of the device head or on the calibration certificate. This ensures that only authorized users can access the device 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 instrument is calibrated ex work. The exact calibration date is printed on the certificate which is supplied together with the instrument. The accuracy of the instrument 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 device, 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**

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

The measuring ranges of **N₂** are stated under the following conditions:
0°C and 1013.25 hPa

Unit: **l/min**

	DN8		DN15		DN20		DN25		DN32	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Standard range (S)	4.44	222	17.8	890	35.6	1780	62.2	3110	107	5335
Low range (L)	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.

Error code	Description
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

Order Table (Air and N ₂ only)				
Order no.	Size	Range	Output	Description
S695 415				S415 Compact 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

Accessories	
Order no.	Description
A553 0161	M8 female to M12 male converter cable, 10 cm
A554 3310	RS-485 splitter T, with 3 x M12 connectors to connect RS-485 devices to a bus.
A554 0109	Mains power supply 100-240 VAC / 24 VDC, 0.5 A, 2 m cable with M8 connector
A553 0137	Connection cable S415/S418 to S551, 5 m

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