English

Instruction and operation manual

S452

Thermal mass flow sensor for heavy duty industries

Dear Customer,

Thank you for choosing our product.

Please read the operating instructions in full and carefully observe them before starting up the device. 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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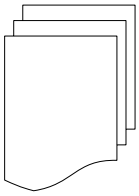
1 Safety instructions



Please check if this instruction manual matches 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 or 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 a 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 work.
- Any electrical work on the 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 allowed to use the product in explosive areas. Please contact the manufacturer.
- Please observe the national regulations before/during installation and operation.

Remarks

- It is not allowed to disassemble the product.
- Always use spanner to mount the product properly.

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 the accuracy enormously.

Storage and transportation

- Make sure that the transportation temperature of the sensor without display is between -30 ... +70°C and with display between -10 ... +60°C.
- For transportation it is recommended to use the packaging which comes with the sensor.
- Please make sure that the 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
Android™, Google Play	Trademarks of Google LLC

3 Application

The S452 flow sensor is designed for the explosive areas and is mainly used to measure compressed air and process gases in industrial environments.

The S452 can measure the following parameters for the compressed air or gases:

- Velocity
- Volume flow
- Total consumption

The default factory settings are: Velocity in m/s, Volume flow in m^3/h and Total Consumption in m^3. Other units can be programmed by the optional display or the service kit.

4 Features

- Direct measurement of mass flow and standard flow without the need of pressure and temperature compensation.
- In-line types for smaller pipes.
- No moving parts, no clogging.
- All sensor parts which come into contact with the measurement medium are made of stainless steel 316L.
- Robust metal enclosure suitable for outdoor applications in harsh environments.
- Wireless Bluetooth interface for sensor settings onsite
- Optional display on the sensor, showing flow rate, consumption, medium temperature and diagnostic result.

5 Technical data

5.1 General data

CE	
Measuring range	0.4 ... 92.7 sm/s (standard range calibration) 0.8 ... 185 sm/s (max range calibration) 1.0 … 224 sm/s (high speed calibration) (See section 4.5 for flow measurement ranges in different tube diameters) * sm/s: standard meter per second
Parameters	Standard unit flow: m^3/h Available units: m^3/min, l/min, l/s, cfm, kg/h, kg/min, kg/s Standard velocity unit: m/s
Reference conditions	ISO1217, 20°C, 1000 mbar (Standard-Unit) DIN1343, 0°C, 1013.25 mbar (Norm-Unit)
Principle of measurement	Thermal mass flow
Sensor	Resistive sensor
Measured medium	Air, gas (non corrosive gas)
Operating temperature	-40 ... +100°C (medium temperature) -40 ... +65°C (ambient temperature)
Humidity of the measured medium	< 90%, no condensation
Operating pressure	0 ... 4.0 MPa
Housing material	Al alloy
Material of the probe tube, sensor head and the screwing	Stainless steel 1.4404 (SUS 316L)
Protection class	IP67
Dimensions	See Chapter Dimensional drawing.
Display (optional)	Graphic display, 128 x 64
Tube diameter	DN15 … DN80
Screwing thread	M32 x 1.5

Weight	1.25 kg (instrument only, and the measuring section is not included)

5.2 Electrical data

Power supply	16 ... 30 VDC, 5 W

5.3 Output signals

Analog output	See section 10.1.1
Pulse output	See section 10.1.2
HART output	See section 10.2
Modbus output	See section 10.3
M-Bus output	See section 10.4

5.4 Accuracy

Accuracy*	±(1.5% of reading + 0.3% full scale)
Stated accuracy at:	Ambient/process temperature +23°C ±3°C Ambient/process humidity <90%, no condensation Process pressure at 0.6 MPa
Repeatability	0.25% of reading

* The specified accuracy is valid only within the minimum and maximum flow rates that are stated in Section 5.5.

5.5 Flow ranges

The stated flow ranges are valid under the following conditions: Standard flow in air; Reference pressure: 1000 hPa; Reference Temperature: +20°C

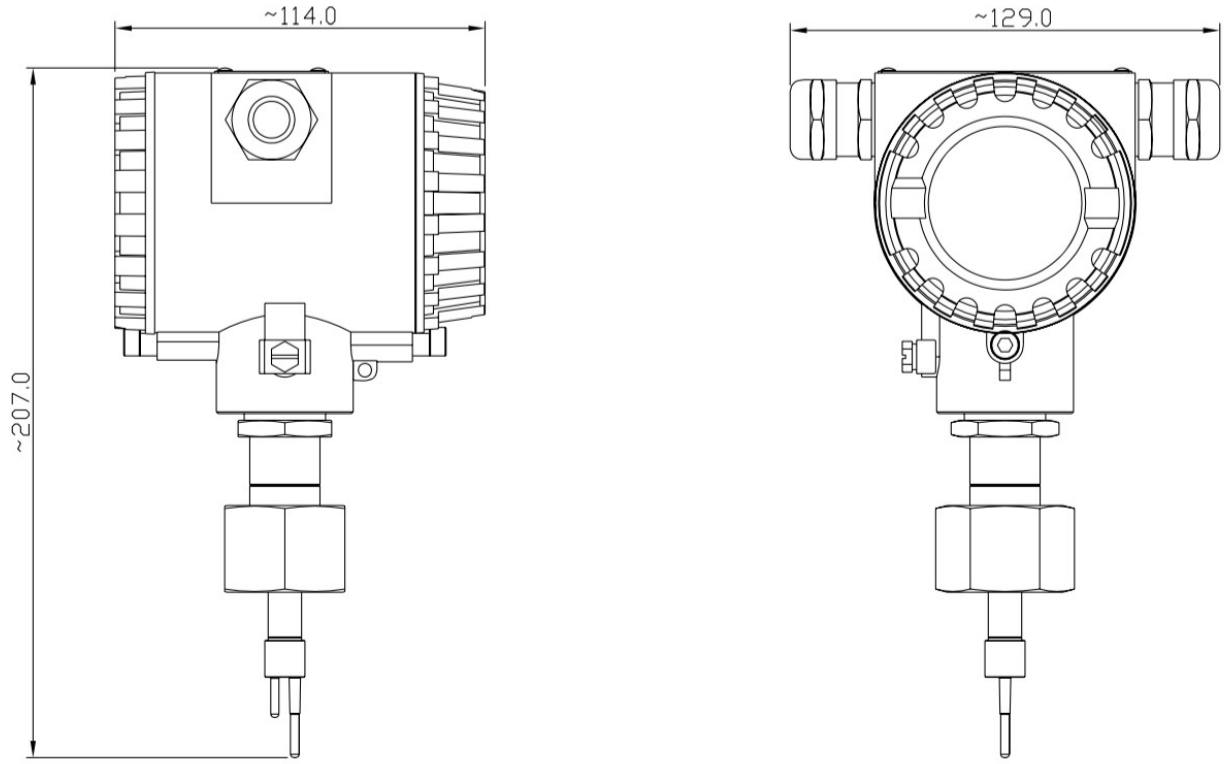
Inch	DN	S-Range (m^3/h)	M-Range (m^3/h)	HS-Range (m^3/h)
1/2”	DN15	0.2 ... 45.6	0.4 ... 91.0	0.48 ... 110.16
3/4”	DN20	0.4 ... 89.1	0.9 ... 177.8	1.09 ... 215.3
1”	DN25	0.6 ... 147.7	1.2 ... 294.7	1.82 ... 356.85
1 1/2”	DN40	1.5 ... 366.7	2.9 ... 731.9	4.36 ... 886.18
2”	DN50	2.4 ... 600	4.8 ... 1198	7.26 ... 1450.04
2 1/2”	DN65	4.1 ... 1027	8.2 ... 2049	12.1 ... 2480.44
3”	DN80	5.7 ... 1424	11.4 ... 2841	16.94 ... 3441.91

Remarks:

To calculate flow ranges based on pipe and reference conditions in your site, download and install the "Flow range calculator" tool for free from http://www.suto-itec.com.

To fast access the tool download page, enter "flowrange" (without spaces) in the search field and click the search result.

6 Dimensional drawing



Unit: mm

7

8 Determining the installation point

To maintain the accuracy stated in the technical data, the sensor must be inserted in the centre of a straight pipe section with unhindered flow characteristics.
Unhindered flow characteristics are achieved if the section in front of the sensor (inlet) and behind the sensor (outlet) are sufficiently long, absolutely straight and free of obstructions such as edges, seams, curves and so on.
Please consider that enough space exists at your site for a adequate installation as described in this manual.

ATTENTION!

Wrong measurement is possible if the sensor is not installed correctly.

- Pay attention to the design of the inlet and outlet section. Obstructions can cause counter-flow turbulence as well as turbulence in the direction of the flow.
- It is strongly recommended not to install S452 permanently in wet environment which exists usually right after a compressor outlet.

8.1 Additional inlet and outlet sections

The S452 with tube diameters from DN15 to DN25 already has the required inlet and outlet sections. No additional straight sections are needed.

For the S452 with diameters from DN32 to DN80, the S452 has a shortened inlet section and requires additional straight sections at the inlet and outlet. The additional length for the particular diameters are listed in the table below.

Flow obstructions before the measurement section	Additional length for DN32 [mm]		Additional length for DN40 [mm]		Additional length for DN50 [mm]		Additional length for DN65 [mm]		Additional length for DN80 [mm]	
	inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet
Slight curve (bend <90°C)	175	-	227.8	9.5	362.2	65.5	551.8	144.5	760.8	204.5
Reduction (Tube narrows towards measurement section)	265	-	353.5	9.5	521,5	65.5	758.5	144.5	938.5	204.5
Expansion (Tube expands towards measurement section)	265	-	353.5	9.5	521.5	65.5	758.5	144.5	938.5	204.5
90°C bend or T piece	265	-	353.5	9.5	521.5	65.5	758.5	144.5	938.5	204.5
2 x 90°C bends on one level	445	-	563	9.5	787	65.5	1103	144.5	1343	204.5
2 x 90°C bends 3 dimensional change of direction	985	-	1191.5	9.5	1583.5	65.5	2136.5	144.5	2556.5	204.5
Shut-off valve	1345	-	1610.5	9.5	2114.5	65.5	2825.5	144.5	3365.5	204,5

9 Sensor installation

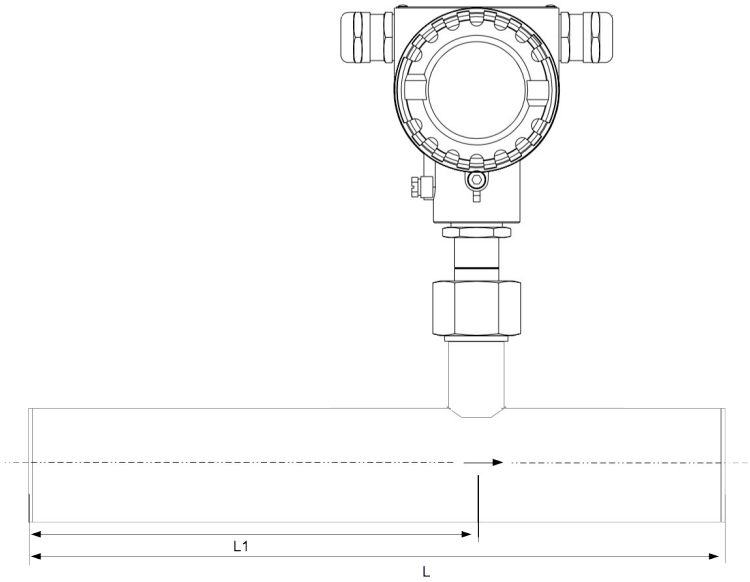
Before installing the sensor, please make sure that all components listed below are included in your package.

Qty	Description	Part no.
1	Sensor	S695 0452
1	Sealing ring	No P/N
1	Measuring section	A1301 ... A1306 (R thread) A1321 … A1328 (Flange, EN-1092-1) A1341 … A1348 (Flange, ANSI 16.5)
1	Bluetooth dongle	No P/N
1	USB disk (with the service Software stored)	No P/N
1	Instruction manual	No P/N
1	Calibration certificate	No P/N

9.1 Installing the flow sensor

The S452 is shipped with the mounted measurement section. When installing the device, please make sure the following:

- The flow direction indicated on the S452 housing is consistent with the flow direction of the compressed air or gas.
- The gas flows from the inlet (long pipe section) to the outlet (short pipe section) as illustrated in the picture below.



9.2 Removing the flow sensor

The following steps explain the procedure of an appropriate removal of the sensor.

ATTENTION!

Only remove the sensor if the system is in a pressure-less condition.

1. Hold the sensor.
2. Release the terminal nut at the connection thread.
3. Pull out the shaft slowly.
4. The measuring section can be closed with the optional closing cap so the system can work normally during maintenance.

9.3 Re-installation after maintenance

- The re-installation of the measurement device is simple because the sensor unit fits into the pipe section only in one position.
- Please make sure that the O-shaped sealing ring is installed.
- Tighten the terminal nut to secure the sensor.

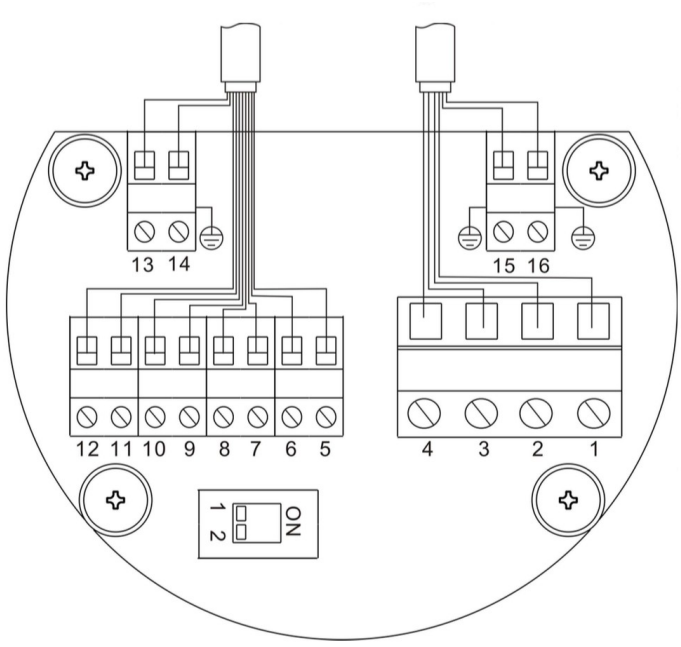
9.4 Electrical connection

When installing the cables please consider following points:

- Keep the stripped and twisted length of cable shield as short as possible.
- Screen and ground the signal lines.
- Unused cable entries must be closed with closers.
- Cable outer diameter should be between 6 and 8 mm.
- Single wire cross section area should be between 0.25 ... 0.75 mm^2.
- The thread size for the cable glands is M20 / 1.5.

9.4.1 Connection diagram

Remove the back cover from the S452, and the pin layout is shown below.



9.4.2 Pin assignment

S452 provides four output options. The pin assignment of these options are given in the following table.

Pin	Output options			
	Pulse and analog	**Modbus**	**M-Bus**	**HART**
1	GND_{SDI}	GND_{SDI}	GND_{SDI}	GND_{SDI}
2	$+V_B$	$+V_B$	$+V_B$	$+V_B$
3	$-V_B$	$-V_B$	$-V_B$	$-V_B$
4	SDI	SDI	SDI	SDI
5	DIR	DIR	DIR	DIR
6	DIR	DIR	DIR	DIR
7	SW	SW	SW	NA
8	SW	SW	SW	NA
9	$-I_1$	$-I_1$	$-I_1$	$-I_1$ / -HART
10	$+I_1$	$+I_1$	$+I_1$	$+I_1$ / +HART
11	$-I_2$	+D	M1	NA
12	$+I_2$	-D	M2	NA
13	NA	GND_M	NA	NA
14	Earth	Earth	Earth	Earth
15	Earth	Earth	Earth	Earth
16	Earth	Earth	Earth	Earth

Legend to pin assignment

SDI	= Digital signal (internal use)	SW	= Isolated pulse output
GND_{SDI}	= Ground for SDI	DIR	= Flow direction input
$+V_B$	= Positive supply voltage	+D	= Modbus data+
$-V_B$	= Negative supply voltage	-D	= Modbus data -
$+I_1$	= Positive signal output (analog 1)	M	= M-Bus data
$-I_1$	= Negative signal output (analog 1)	NA	= Not applicable
$+I_2$	= Positive signal output (analog 2)		
$-I_2$	= Negative signal output (analog 2)		

10 Signal outputs

10.1 Analog and pulse outputs

If the S452 is purchased with the output option of analog and pulse signals, it provides 2 analog outputs and 1 pulse output. All signals are electrically isolated.

10.1.1 Analog output

The analog output can be used as an active output (current is sourced through the positive connection pin) or passive output. In the passive configuration a current signal is modulated into the external signal voltage.

Active	:	4 to 20mA, RL < 400 Ω
Passive	:	4 to 20mA, supply voltage 18... 30 VDC, RL < 500 Ω
For HART	:	RL ≥ 250 Ω
Uncertainty	:	< 0.3 % of reading
Resolution	:	0.005 mA

10.1.2 Pulse output

No switch, no polarity required, galv. Isolate

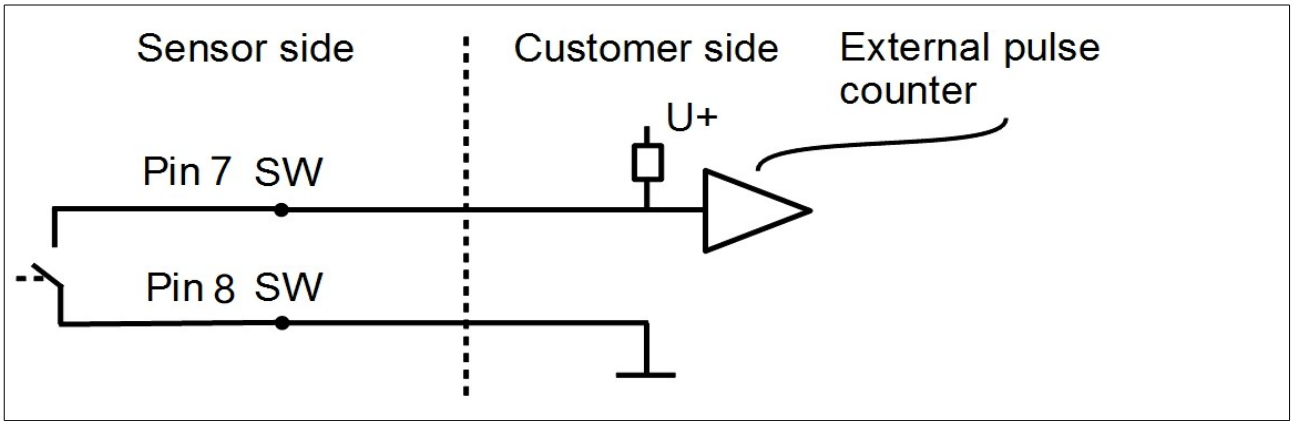
Max. rating	:	30 VDC, 200 mA
Pulse width	:	10 ... 100 msec (depending on flow rate)

The maximum number of pulse per second is limited to 45 pulse per second. As a result depending on the flow rate and the selected consumption unit the maximum flow rate is limited to the values in the table below.

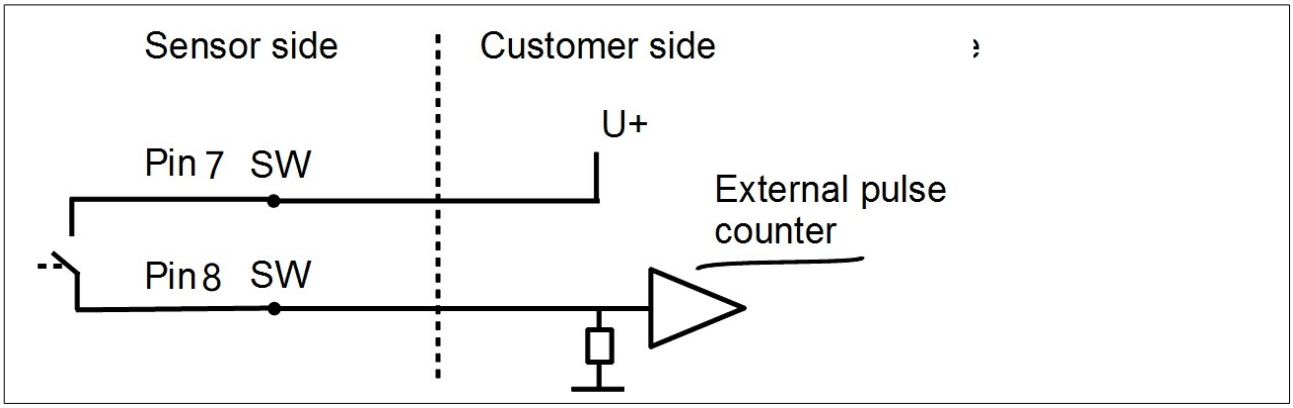
Pulse / consumption unit	Max flow		
	1/1	**1/10**	**1/100**
m^3/h	162,000	1,620,000	16,200,000
m^3/min	2,700	27,000	270,000
l/min	2,700	27,000	270,000
cfm	2,700	27,000	270,000
Kg/h	162,000	1,620,000	16,200,000
Kg/min	2,700	27,000	270,000
Kg/s	45	450	4,500
	Default	Configurable by service software	

Pulse connection diagram

Variant 1:



Variant 2:



10.2 HART output

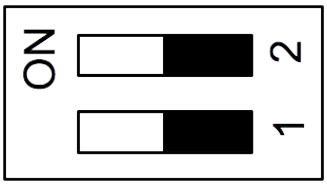
If the S452 is purchased with the output option of HART, the HART signal is modulated on analog output 1. In case S452 is used in a multi-drop configuration (more than 1 slave on the 4-20 mA line) the analog output cannot be used.

Device type	: Slave
Polling address	: 1 to 15 Bus address can be set through software
Physical interface	: BELL 202
Protocol version	: V 5.2
Tag	: S452
Tag description	: Flow meter
Frame/parity/Stop	: 8, 0, 1

10.3 Modbus output

If the S452 is purchased with the output option of Modbus, it provides one analog output and one pulse output.

The Modbus communication requires to activate terminal resistors at the last device on the bus system. If the S452 is the last device on the bus system, the DIP switches on the connector board should be set to “ON” position.



Termination resistor network switch

Device type	: Slave
Address rage	: 1 to 251 Bus address can be set through software
Physical interface	: RS485 in accordance with EIA/TIA-485 standard
Baud rates	: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Transm. mode	: ASCII, RTU
Response time	: Direct data access = 0 to 255 ms (can be configured)

Remark: Modbus communication settings can be changed by the service software.

Modbus holding register table

Channel description	Unit	Resolution	Format	Length	Modbus register address
Velocity	m/s	0.1	FLOAT	4-Byte	0
Flow	m^3/h	0.1	FLOAT	4-Byte	6
Consumption	m^3	1	UNIT32	4-Byte	12
Reverse consumption	m^3	1	UNIT32	4-Byte	18
Medium temperature	°C	0.1	FLOAT	4-Byte	24
Ambient temperature	°C	0.1	FLOAT	4-Byte	36

Remarks:

Resolutions vary with the units, which you can configure using the service software.

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 for different byte orders are shown in the table:

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

10.4 M-Bus output

If the S452 is purchased with the output option of M-Bus, it provides one analog output and one pulse output besides the M-bus output.

Device type	:	Slave
Address rage	:	1 ... 251 Bus address can be set through software
Physical interface	:	Meter-Bus, EN1434-3
Baudrates	:	300, 2400, 9600
Frame/parity/Stop	:	8, E, 1

11 Configuration

S452 enables you to configure parameter settings according to on-site requirements.

The following table gives an overview about the available settings.

Parameters	Available settings	Default
Measurement	Tube diameter Flow unit Consumption unit Reference conditions Gas type selection Consumption counter Operation pressure Flow direction	According to the ordered section m^3/h m^3 P_s = 1000 hPa; T_s = 20°C Air 0 m^3 0.6 MPa Standard
Analogue output 1	Measurement channel Scaling Active / passive	Flow 4 mA: 0 m^3/h 20 mA: max flow Active
Analogue output 2	Measurement channel Scaling Active / passive	Medium Temperature 4 mA: -50°C 20 mA: 200°C Active
Pulse output	Pulse / Alarm	Pulse

Parameters	Available settings	Default
	Pulses per consumption unit	1
HART	Fieldbus address Manufacturer ID Device type code	0 255 0
Modbus	Device address Baudrate Framing/parity/Stop bit Transmission mode	1 19200 8, N, 1 RTU
M-Bus	Address Manufacturer code Baudrate Access number	0 END 300 0

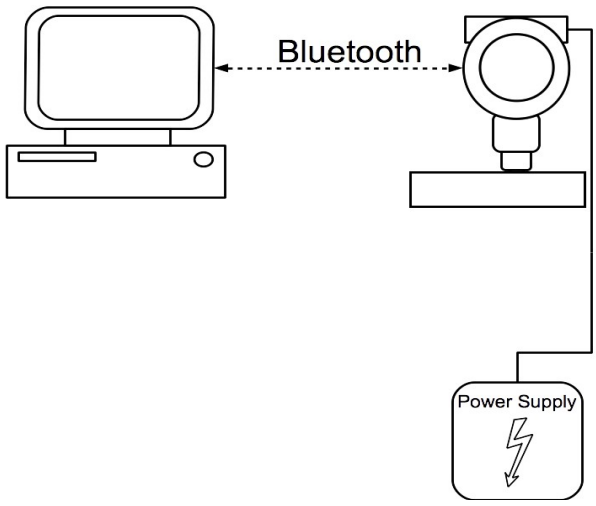
To configure S452 settings, use the service software stored in the USB disk that comes with the delivery package.

1. On a Windows® PC, insert the USB disk provided in the delivery package, and copy the service software file (Service Software.EXE) to the PC and install it.
2. Power up the S452.
3. If the PC does not provide the Bluetooth interface, insert the USB Bluetooth dongle provided in the delivery package to the PC.
4. Pair the Bluetooth of the PC and the S452.
5. On the PC, run the service software and follow the onscreen instructions configure the S452. You can also refer to the online help file for more information.

Remarks:

To enable a stable Bluetooth connection, ensure the following:

- The distance between S452 and PC is not more than 5 meters.
- The PC Bluetooth antenna points roughly towards the direction of the display (front part).



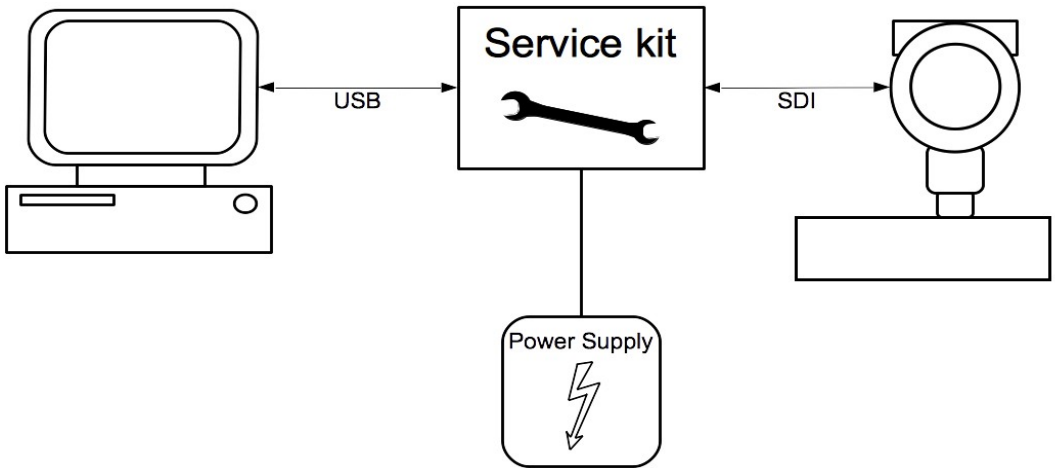
12 Optional accessories

12.1 Sensor display

The sensor display shows the values of velocity, flow rate, consumption and error messages.

12.2 Service kit

The service kit is designed to enable the wired communication between the PC and an S452.
The diagram below shows the cable connection between an S452 and a PC through the service kit. Please ensure that S452 or the service kit is connected with the power supply because the USB port cannot provide enough power to both of them.



13 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, and parameters like oil, high humidity or other impurities can affect the calibration and furthermore the accuracy. However, we recommend you calibrate the instrument at least once per year. The calibration is excluded from the instruments warranty. For the calibration service, please contact the manufacturer.

14 Maintenance

To clean the sensor, it is recommended to use distilled water or isopropyl alcohol only.

ATTENTION!

Do not touch the surface of the sensor plate.

Avoid mechanical impact on the sensor (e.g with a sponge or a brush).

If the contamination can not be removed, you must have the sensor inspected and maintained by the manufacturer.

15 Disposal or waste

Electronic devices are recyclable material and do not belong in the household waste.
The device, 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. Please contact the manufacturer for details.

16 Appendix A - 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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