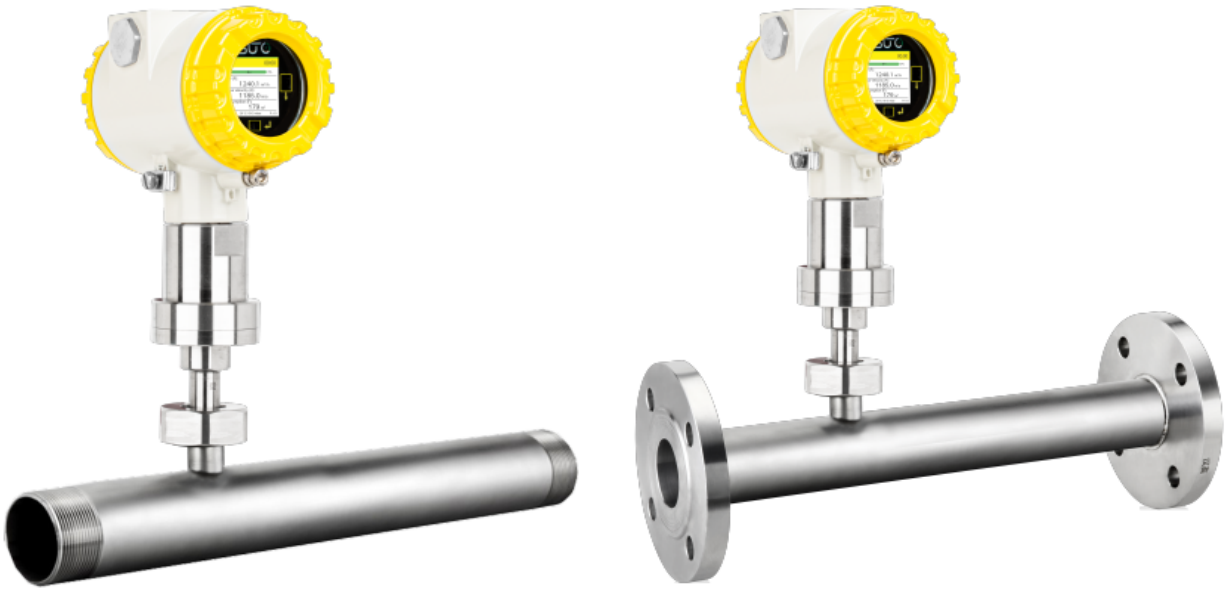
English

Instruction and Operation Manual

S453

Thermal Mass Flow Meter for Heavy Duty and Ex Applications (Inline)



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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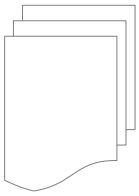
1 Safety Instructions



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 tip 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.
- For transportation it is recommended to use the packaging which comes with the sensor.
- 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
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 S453 Thermal Mass Flow Meter is designed for harsh and hazardous environments is mainly used to measure compressed air and process gases.

The S453 can measure the following parameters:

- Volumetric flow or mass flow
- Velocity
- Consumption
- Pressure
- Temperature

The default factory settings are: Velocity in m/s, Volumetric flow in Sm^3/h and Consumption in Sm^3, pressure in bar and temperature in °C. Other units can be programmed through the local display or the service application S4C-FS.

5 Features

- Mass flow measurements to determine mass flow, standard flow, consumption, pressure and temperature
- Rugged metal housing for use in outdoor areas and hazardous environments
- Easy access to the stored measurement data via the integrated data logger using the free S4C-FS smartphone app
- All components in contact with the medium are made of stainless steel or nickel-plated metal
- Mechanical design with no moving parts for clog-free operation
- Wireless interface to mobile app S4C-FS for onsite sensor settings.
- Display showing actual measurement values and status information

6 Technical Data

6.1 Measurement

Contains FCC ID: RF-BM-BG22B1

Flow	
Accuracy*	±(1.5% of reading + 0.3% full scale) * The specified accuracy is valid only within the minimum and maximum flow rates that are stated in section 6.4.
Selectable unit	Standard flow unit: Sm^3/h
	Available units: Sm^3/min, Sl/min, Sl/s, Scfm, kg/h, kg/min, kg/s, Nm^3/min, Nl/min, Nl/s, Ncfm
	Standard velocity unit: m/s
Measuring range	0 ... 30 m/s (low range calibration) 0 ... 120 m/s (standard range calibration) 0 ... 240 m/s (max range calibration) (See section 6.4 for flow measurement ranges in different tube diameters) * m/s: standard meter per second
Repeatability	0.25% of reading
Principle of measurement	Thermal mass flow
Sensor	Resistive sensor
Sampling rate	3 samples/sec
Turndown ratio	200:1
Response time (t_{90})	0.5 sec
Consumption	
Selectable units	Sm^3, Sl, Scf, kg, Nm^3, Nl, Ncf
Pressure	
Accuracy	0.5% FS
Selectable unit	bar, psi, kPa, MPa
Measuring range	0 ... 1.6 MPa(g) (option A1558) 0 ... 4.0 MPa(g) (option A1559)

Sensor	Piezzo resitive sensor
Temperature	
Accuracy	0.5°C
Selectable unit	°C, °F
Measuring range	-40 … +140°C
Sensor	Pt1000
Reference conditions	
Selectable conditions	ISO1217, 20°C, 1000 mbar (Standard-Unit) DIN1343, 0°C, 1013.25 mbar (Norm-Unit) Freely adjustable

6.2 Output Signal/ Interface and Supply

Analog output	
Signal	2 x 4 ... 20 mA (4-wire), isolated
Scaling	0 ... max flow, freely adjustable
Load	Max. 400 Ohm
Update rate	Value updated every 1 sec
Pulse/Alarm output	
Signal	Switch output, normally open, max. 30 VDC, 200 mA
Scaling	1 pulse per consumption unit (selectable)
Alarm	Channel and threshold freely setable
Fieldbus	
Protocol	Modbus/RTU Modbus/TCP over Ethernet/APL or Modbus/TCP over single pair Ethernet
Power supply	
Voltage, current, consumption	16 ... 30 VDC, 200 mA, 5 W

6.3 General Data

Configuration	
Wireless	S4C-FS App for Android and iOS
Others	3 optical keys at display
Display	
Integrated	Color graphics display
Material	
Process connection	Stainless steel 1.4404 (SUS 3 16L)
Housing material	Al alloy
Sensor	Stainless steel 1.4404 (SUS 3 16L), 4J50 nickel plated, glass
Metal parts	Stainless steel 1.4404 (SUS 3 16L)
Miscellaneous	
Electrical connection	Screw terminals
Protection class	IP67, IP65 (Ex version)
Approvals	CE, RoHS, FCC, Ex-Options
Process connection	Measuring section with R-thread or Flange
Weight	1.86 kg
Operating conditions	
Measured medium	Air, N_2, O_2, CO_2 and other non corrosive gases
Medium humidity	< 90%, no condensation
Operating pressure	0 ... 1.6 MPa(g) (option A1558) 0 ... 4.0 MPa(g) (option A1559)
Ambient temperature	-40 ... +65°C
Storage temperature	-40 ... +70°C
Transport temperature	-40 ... +70°C
Medium temperature	-30 ... +90°C (Ex Version) -30 … +140°C
Tube diameter	DN25 ... DN80

6.4 Flow Ranges

The flow ranges are stated under the following conditions:

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

Diameter			Low	Standard	Max
		(mm)	(Sm^3/h)	(Sm^3/h)	(Sm^3/h)
DN25	1”	27.3	0.2 ... 48	0.8 ... 191	1.5 ... 382
DN32	1¼”	36.0	0.3 ... 86	1.4 ... 345	2.8 ... 689
DN40	1½”	41.9	0.5 ... 119	1.9 ... 475	3.8 ... 949
DN50	2”	53.1	0.8 ... 194	3.1 ... 777	6.2 ... 1,554
DN65	2½”	68.9	1.3 ... 332	5.3 ... 1,329	N/A
DN80	3”	80.9	1.8 ... 461	7.4 ... 1,843	N/A

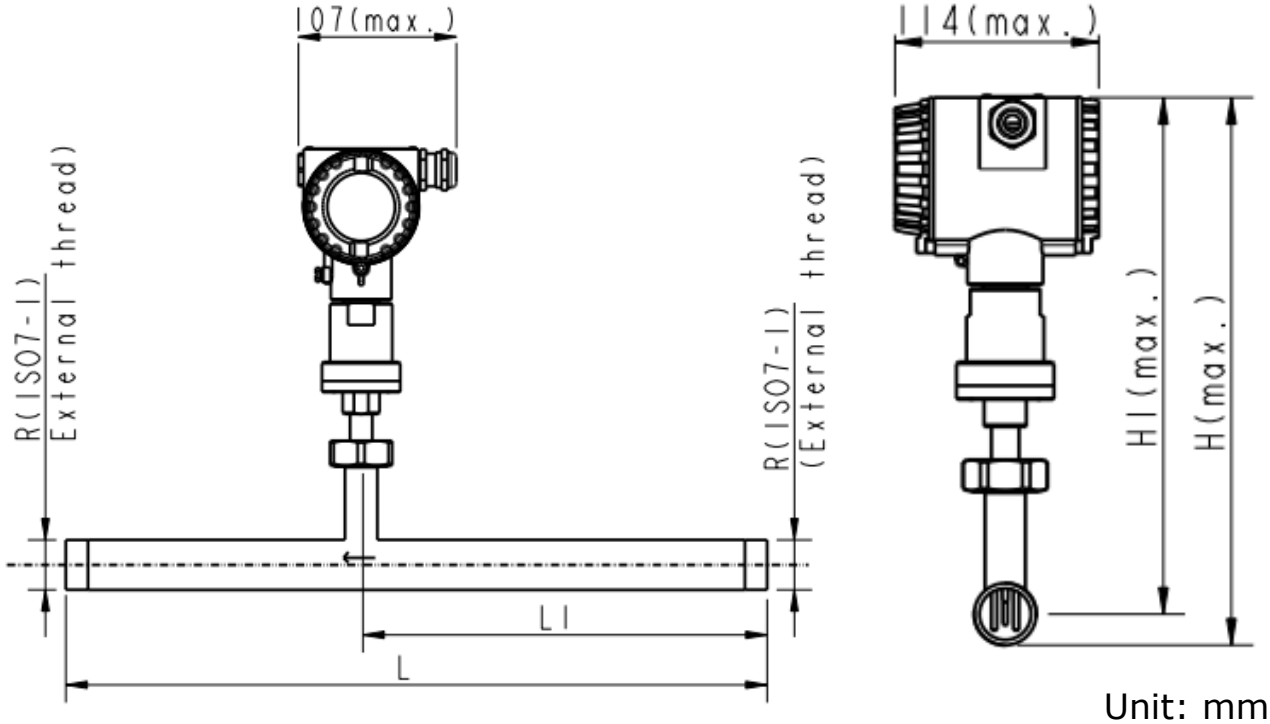
Remarks:

- 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.

- 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

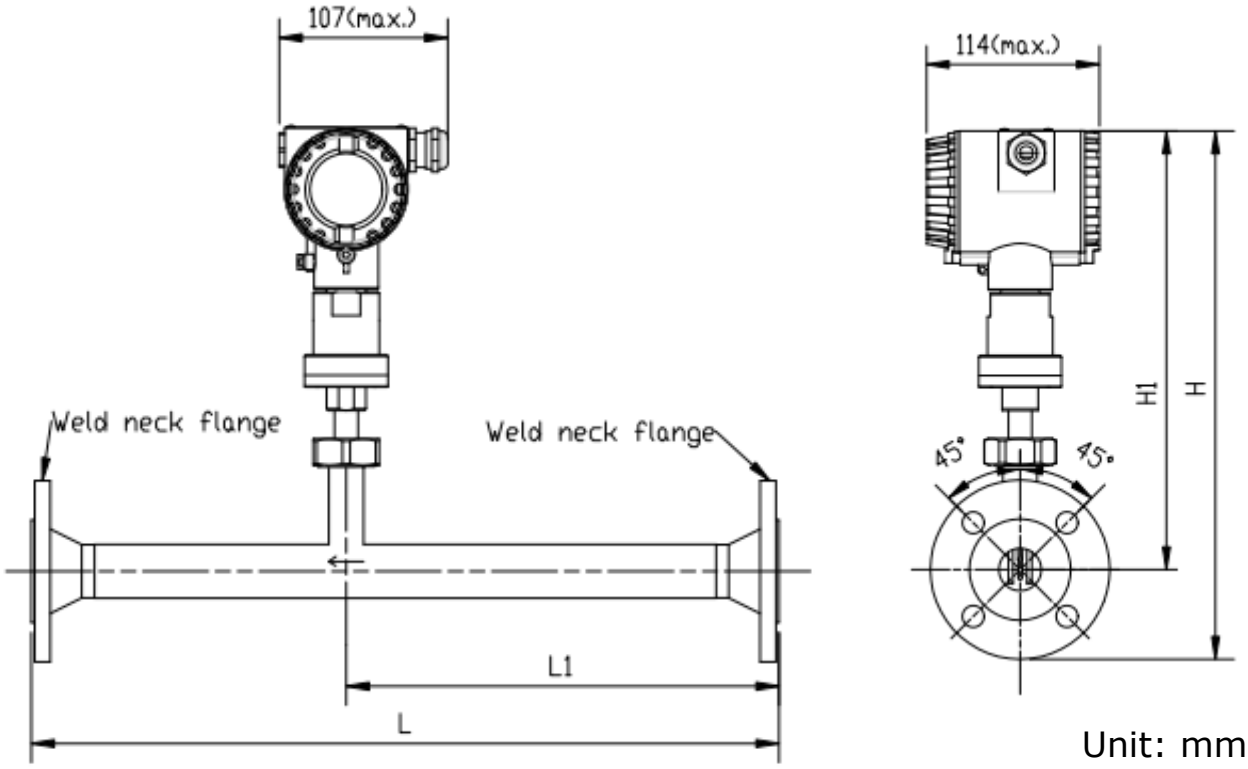
7.1 Thread Type



Unit: mm

Pipe nominal size inch (DN)	L total length (mm)	L1 inlet length (mm)	H total height (mm)	H1 from pipe center to casing top (mm)	R External Thread
1” (DN25)	475	275	299	282	R 1”
1¼”(DN32)	475	275	303	282	R 1¼”
1½”(DN40)	475	275	306	282	R 1½”
2” (DN50)	475	275	312	282	R 2”
2½”(DN65)	475	275	320	282	R 2½ ”
3” (DN80)	475	275	326.5	282	R 3”

7.2 Flange Type



Unit: mm

Pipe nominal size inch (DN)	L total length (mm)	L1 inlet length (mm)	H total height (mm)	H1 from pipe center to casing top (mm)	Flange (EN 1092-1 PN40)		
					ØD (mm)	ØK (mm)	nx ØL (mm)
1” (DN25)	475	275	339.5	282	115	85	4xØ14
1¼”(DN32)	475	275	352	282	140	100	4xØ18
1½”(DN40)	475	275	357	282	150	110	4xØ18
2” (DN50)	475	275	364.5	282	165	125	4xØ18
2½”(DN65)	475	275	374.5	282	185	145	8xØ18
3” (DN80)	475	275	382	282	200	160	8xØ18

Pipe nominal size inch (DN)	L total length (mm)	L1 inlet length (mm)	H total height (mm)	H1 from pipe center to casing top (mm)	Flange (ANSI/B16.5 Class 300)		
					ØD (mm)	ØK (mm)	nx ØL (mm)
1” (DN25)	475	275	339.5	282	123.9	88.9	4xØ19
1¼”(DN32)	475	275	352	282	133.3	98.5	4xØ19
1½”(DN40)	475	275	357	282	155.4	114.3	4xØ22.3
2” (DN50)	475	275	364.5	282	165.1	127	4xØ19
2½”(DN65)	475	275	374.5	282	190.5	149.3	8xØ22.3
3” (DN80)	475	275	382	282	209.5	168.1	8xØ22.3

8 Determine the Installation Point

To maintain the accuracy stated in the technical data, the flow meter must be inserted in the center of a straight pipe section with unhindered flow characteristics.
Unhindered flow characteristics are achieved if the section in front of the flow meter (inlet) and behind the flow meter (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 flow meter 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 S453 permanently in wet environment which exists usually right after a compressor outlet.

8.1 Additional Inlet and Outlet Sections

The S453 with tube diameters of DN25 already has the required inlet and outlet sections. No additional straight sections are needed.

For the S453 with diameters from DN32 to DN80, the S453 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 Installation

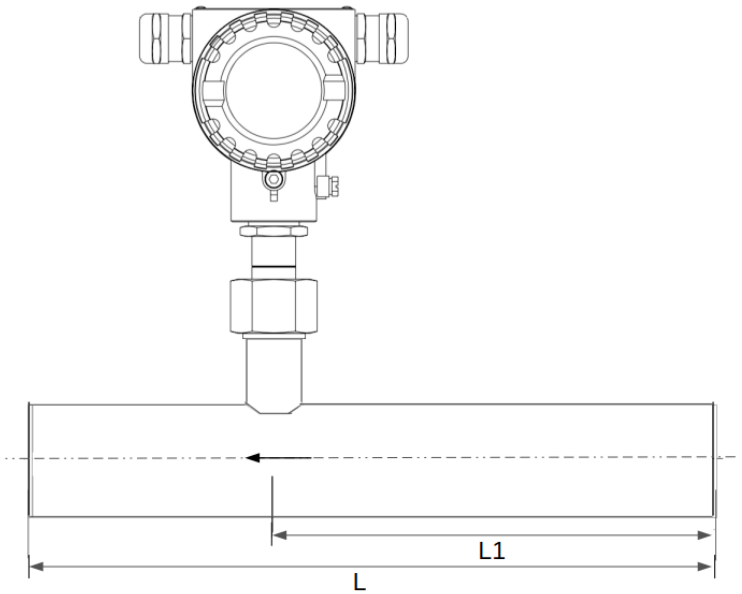
Before installing the flow meter, make sure that all components listed below are included in your package.

Qty	Description	Part no.
1	S453 Thermal Mass Flow Meter (Inline Type), including Display, Data Logger, Flow Medium 1: Air	S695 4530
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	Instruction manual	No P/N
1	Calibration certificate	No P/N

9.1 Install the S453

The S453 is shipped with the mounted measurement section. When installing the device, please make sure the following:

- The flow direction indicated on the S453 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.



Note: The S453 can be installed in any orientation (horizontal, vertical, side and upside-down). Please consider the needed straight inlet and outlet sections described in section 8.1 Additional Inlet and Outlet Sections .

9.2 Remove the S453

ATTENTION!

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

1. Hold the S453.
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-install After Maintenance

- The re-installation of the measurement device is simple because the S453 fits into the pipe section only in one position.
- Make sure that the O-shaped sealing ring is installed.
- Tighten the terminal nut to secure the S453.

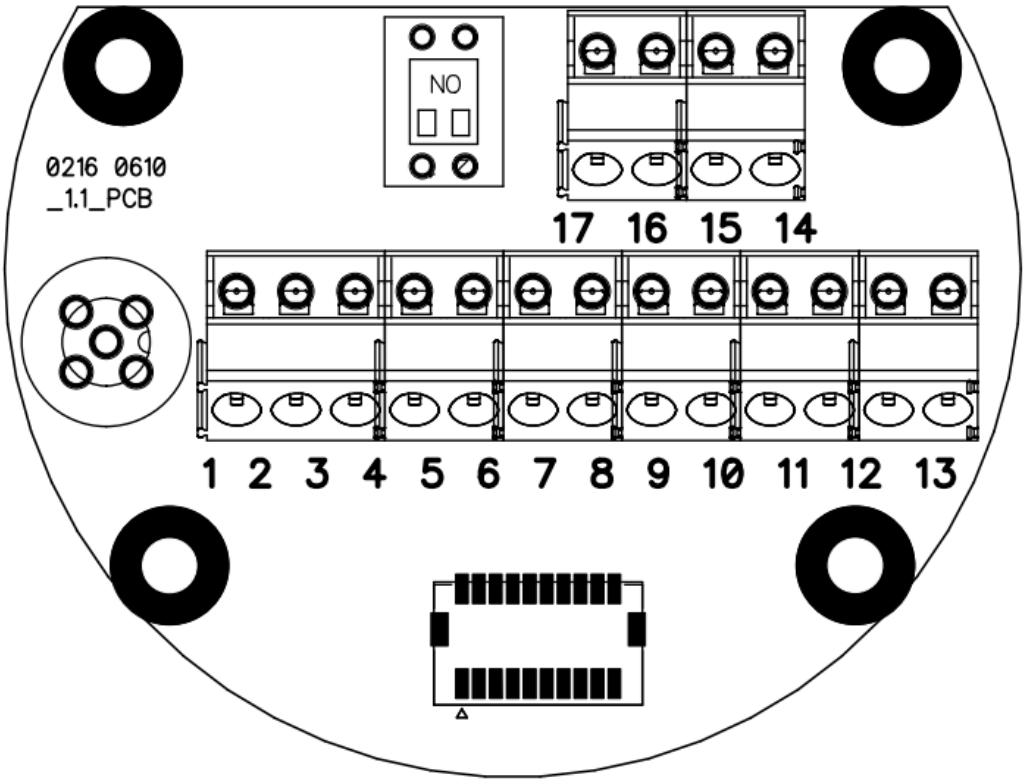
9.4 Electrical Connection

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 must 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 S453, and the pin layout is shown as below.



9.4.2 Pin Assignment

The S453 provides 2 connection options. The pin assignment of these options are given in the following table.

Pin	Output options		Remarks
	Modbus/RTU	**Modbus/TCP**	
1	Earth	Earth	
2	GND_SDI	GND_SDI	
3	$+V_B$	$+V_B$	24 VDC power supply
4	$-V_B$	$-V_B$	
5	SDI	SDI	Digital interface SUTO sensor
6	D+	SPE_P	Modbus/RTU or Ethernet/APL connection
7	D-	SPE_N	
8	GND	SPE_E	
9	$+I_1$	$+I_1$	4 … 20 mA output 1
10	$-I_1$	$-I_1$	
11	$+I_2$	$+I_2$	4 … 20 mA output 2
12	$-I_2$	$-I_2$	
13	Earth	Earth	
14	+Pulse/Alarm	+Pulse/Alarm	Pulse / Alarm output
15	-Pulse/Alarm	-Pulse/Alarm	
16	DIR	DIR	Flow Direction input
17	DIR	DIR	

10 Signal Outputs

10.1 Analog and Pulse Outputs

The S453 comes with 2 analog outputs and one pulse/alarm output. All signals are electrically isolated.

10.1.1 Analog Output

The analog output is an active output.

Signal and load	:	4 to 20mA, RL < 400 Ω
Uncertainty	:	< 0.3 % of reading
Resolution	:	0.005 mA

The output can be scaled to match the desired measuring range. Standard scaling is from 0 to max flow.

If the S453 is ordered with the bi-directional calibration the correspondence between the analog output and standard scaling is as follows:

Analog	Output standard scaling
4 mA	Maximum flow reverse
12 mA	Zero flow
20 mA	Maximum flow forward

10.1.2 Pulse /Alarm Output

The pulse / alarm output is a Normal Open (NO) isolated switch. Please consider the right polarity.

Max. rating: 30 VDC, 200 mA

Pulse width: 10 ... 100 msec (depending on the flow rate)

Pulse output

The maximum number of pulse per second is limited to 49.

In case that the flow rate is too high, the S453 cannot output the pulses with default settings (one pulse per consumption unit). In this case, you can set the pulse to 1 pulse per 10 consumption units or 1 pulse per 100 consumption units, using the S4C-FS service app.

Example: With the setting of 1 pulse per 10 m^3, the device sends one pulse each 10 m^3.

Alarm output

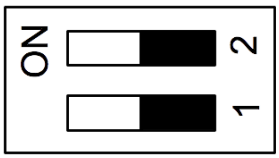
You can set alarms for the following channels:

- Flow(F)
- Actual Velocity(F)
- Temperature
- Flow(R)
- Actual Velocity(R)
- Pressure

For detailed settings, see section 12.2 Alarm Settings.

10.2 Modbus Interface

The Modbus communication requires to activate terminal resistors at the last device on the bus system. If the S453 is the last device on the bus system, the DIP switches on the connector board should be set to “ON” position.



Termination resistor switch

Device type	**Slave**
Address range	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 Baud
Transm. mode	ASCll, RTU
Response time	Direct data access = 0 to 255 ms (configurable)

The default Modbus communication settings are shown as below.

Mode	RTU
Baud rate	19200
Device address	Last two digits of serial number
Framing / parity / stop bit	8, N, 1
Response time	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 for 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.

Remarks: Modbus communication settings as well as other settings can be changed by **mobile app S4C-FS**.

10.2.1 Modbus Holding Registers

Register address	Data type	Data Length	Channel description	R/W
System information				
2000	INT16U	2-Byte	Group ID: **1** (Occupying higher 4 bits in the 2-byte long data, the rest is reserved for future)	R
2001	INT16U	2-Byte	Device ID S451: 0x1013, S453 0x1014	R
2002	INT32U	4-Byte	Serial number	R
2004	INT16U	2-Byte	High byte FW version, Low byte HW version	R
2005	DOUBLE	8-Byte	Calibration date Format: BCD code, first byte is date, the second byte is month, the third byte is the first two digits of year, the forth byte is last two digits of year. For example, 09.01.2024. the data is arranged as: 0x09, 0x01, 0x20, 0x24	R
2007	INT16U	2-Byte	Valid days from calibration date	R
2008	INT16U	2-Byte	Number of measuring channels	R
2009	string	16-Byte	Device name: “S451” or “S453”	R
Settings				
2100			Settings (max 50 holding register)	R/W
Channel value information				
2200	INT16U	2-Byte	Unit+Resolution+type of channel 1	R
2201	INT16U	2-Byte	Unit+Resolution+type of channel 2	R
...	...	...		
2207	INT16U	2-Byte	Unit+Resolution+type of channel 8	
...	...	...	Max 50 channels, depend on sensors	
Status and Channel value				
2300	INT16U	2-Byte	Status	R
2301	FLOAT / INT32U	2-Byte	Channel 1 Value	R
...	...	...		
2315	FLOAT / INT32U	2-Byte	Channel 8 value	R

10.2.2 Channel value information

Unit+Resolution+type

- First byte is for unit. The unit and its code are as below.

Parameter	Unit	Code
Temperature	°C	1
	°F	2
Velocity	m/s	10
	ft/min	11
Volumetric Flow	Sm^3/h	14
	Sm^3/min	15
	Sl/min	16
	Sl/s	17
	Scfm	18
	Nm^3/h	19
	Nm^3/min	20
	Nl/min	21
	Nl/s	22
	Ncfm	23

Parameter	Unit	Code
Consumption	Sm^3	24
	Sl	25
	Scf	26
	Nm^3	27
	Nl	28
	Ncf	29
Pressure	kPa	35
	MPa	36
	bar	38
	psi	39
Consumption mass	kg	47
Mass Flow	kg/h	52
	kg/min	53

- Second byte:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Data type: 0 float, 1 4-byte unsigned integer 2 double				**Resolution:** 0 0 1 0.0 2 0.00 3 0.000 4 0.0000			

Status

It is defined at holding register address 2300. The highest bit (Bit15) is used for indicating if sensor settings have changed by user. When this register is read by the master, the Bit15 is reset to zero. The other bits are used for indicating whether the measuring channel is OK not not.

Bit	Description
Bit15	0: sensor setting is never changed since last reading from master 1: sensor setting is changed since last reading from master
Bit0	0: measuring channel 1 is OK 1: measuring channel 1 is not OK
Bit1	0: measuring channel 2 is OK 1: measuring channel 2 is not OK
….	…
Bit7	0: measuring channel 8 is OK 1: measuring channel 8 is not OK

Channel value

Channel value is arranged from channel 1 to channel 50 (Max), The length and data type is defined in section of Unit+Resolution+type. Maximum 50 channel is supported.

Register address	Data type	Channel No.	Description	R/W
2301	FLOAT	Channel 1	Flow	R
2303	FLOAT	Channel 2	Actual Velocity	R
2305	INT32U	Channel 3	Consumption	R
2307	FLOAT	Channel 4	Flow (R)	R
2309	FLOAT	Channel 5	Actual Velocity (R)	R
2311	INT32U	Channel 6	Consumption (R)	R
2313	FLOAT	Channel 7	Pressure	R
2315	FLOAT	Channel 8	Temperature	R

Channel, unit, resolution and type

Register address	Channels	Unit	Resolution	Type
2200	Flow	Sm³/h, Scfm, Sl/min, kg/h, Nm³/h, Ncfm, Nl/min	0.1	Float
		Sm³/min, Sl/s, kg/min, Nm³/min, Nl/s	0.01	
		Kg/s	0.001	
2201	Velocity	ft/min	0	Float
		m/s	0.1	
2202	Consumption	Sm³, Sl, kg, Scf, Nm³, Nl, Ncf	0	INT32U
2203	Flow(R)	Sm³/h, Scfm, Sl/min, kg/h, Nm³/h, Ncfm, Nl/min	0.1	Float
		Sm³/min, Sl/s, kg/min, Nm³/min, Nl/s	0.01	
		Kg/s	0.001	
2204	Velocity(R)	ft/min	0	Float
		m/s	0.1	
2205	Consumption(R)	Sm³, Sl, kg, Scf, Nm³, Nl, Ncf	0	INT32U
2206	Pressure	psi	0.1	Float
		bar, MPa	0.01	
2207	Temperature	°C, °F	0.1	Float

10.2.3 Specific Settings for Gas Flowmeters

Register address	Data type	Description	R/W
2100	Float	Inner diameter in millimeter (Read only for inline type)	R/W
2102	INT16U	Gas type	R/W
2103	INT16U	Calibration gas 1, always air	R
2104	INT16U	Calibration gas 2, alternative gas	R
2105	Float	Reference temperature	R/W

2107	Float	Reference pressure	R/W
2109	Float	End range in m/s or ft/min (read only)	R
2111	Float	User slope (limit range from 0.5 to 1.5)	R
2113	Float	Cutoff velocity in m/s or ft/min	R
2115	INT16U	Filter grade	R/W
2116	INT16U	Flow unit	R/W
2117	INT16U	Consumption unit	R/W
2118	INT16U	Pressure unit	R/W
2119	INT16U	Temperature unit	R/W
2120	INT16U	Routing of analog channel 2 (pressure or temperature) 0 pressure, 1 temperature Analog channel 1 is always for flow	R/W
2121	Float	4-20 mA scaling of channel 1 lower value	R/W
2123	Float	4-20 mA scaling of channel 1 Higher value	R/W
2125	Float	4-20 mA scaling of channel 2 lower value	R/W
2127	Float	4-20 mA scaling of channel 2 Higher value	R/W

Coding of Calibration/Operation gas type

Gas type	Code
Air	0
N_2	1
Ar	2
CO_2	3
He	4
H_2	5
CH_4	6

Gas type	Code
Propane	7
Butane	8
O_2	9
N_2O	10
Nat. gas	11
Mixed gas	12

Notes:

1. Scaling adjustment analog output

   When flow units or reference conditions change, the scaling of analog output will be changed automatically by the flow meter. The relevant unit might be also changed; see next note for details.

2. Unit relationship

   When changing the flow unit the relevant consumption and velocity unit is automatically also changed. The same applies if velocity unit or consumption units are changed.

Flow unit	**Consumption unit**	**Velocity unit**
Sm^3/min, Sm^3/h; Nm^3/min, Nm^3/h	Sm^3 Nm^3	m/s
Scfm Ncfm	Scf Ncf	ft/min
kg/h, kg/min, kg/s	kg	m/s
Sl/min, Sl/s Nl/min, Nl/s	Nl Sl	m/s

3. Pressure / Temperature units change and Analog Scaling

   When pressure or temperature units are changed, the corresponding scaling will also be changed automatically.

4. Flow units change and reference conditions

   When flow units are changed the reference condition will not be change automatically, they need to be changed manually.

5. Error handling of commands

   If there is any invalid setting performed the flow meter will respond the function code with MSB set to 1. In the data field there is error code: 01 illegal function code, 02 illegal data address, 03 illegal data value.

10.3 Modbus/TCP Interface

The S453 supports two Modbus/TCP communication modes:

- Modbus/TCP over Ethernet/APL
- Modbus/TCP over single pair Ethernet.

They are applied for S453 explosion proof version and non-explosion proof version separately.

The Modbus/TCP uses the same holding registers as described in section 10.2.

10.3.1 Modbus/TCP over Ethernet/APL

The output is 10Base-T1L physical layer standard for 10 Mb/s Ethernet communication over a single balanced twisted pair copper cabling without provision of power. The S453 provides an external DC supply for the interface.

The 10Base-T1L operates in the 1.0Vpp mode and the cable length can be up to 200 m and applicable for explosion-protected environments (hazardous areas).

ATTENTION!

This is a communication port only and shall not be connected to power source port of an Ethernet APL Field Switch.

10.3.2 Modbus/TCP over Single Pair Ethernet

The output is 10Base-T1L physical layer standard for 10 Mb/s Ethernet communication over a single balanced twisted pair copper cabling with provision of power.

The 10Base-T1L operates in the 2.4 Vpp mode and the cable length can be up to 1000 m. The power provision of the S453 supports 24V DC Power Class 11 (IEEE 802.3 cg) with integrated PoDL (Power Over Data Line) controller.

ATTENTION!

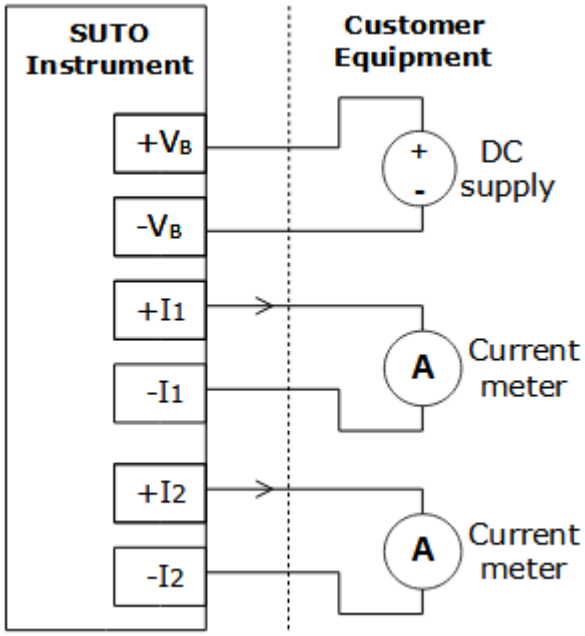
The power provision of S453 is not applicable for explosion-protected environments (hazardous areas).

10.4 Connection between S453 Outputs and Customer Equipment

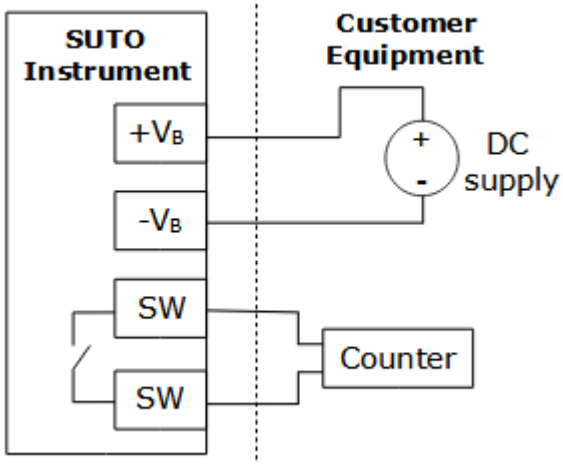
This section provides figures to show how outputs supported by the S453 connect with the customer equipment.

In the following figures, the **SUTO Instrument** indicates the S453.

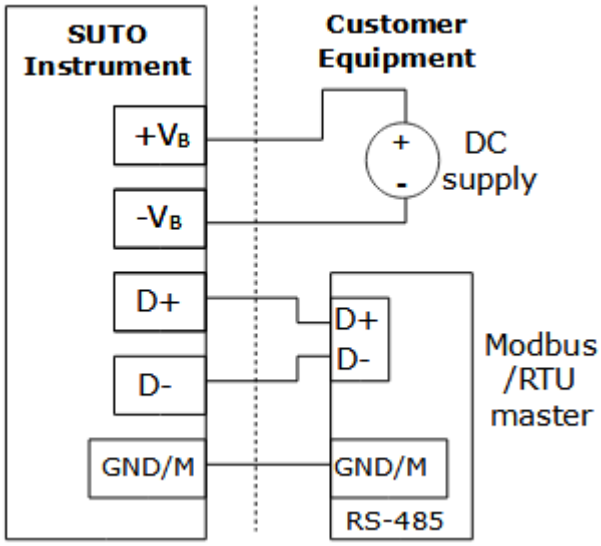
Two analog outputs (Isolated)



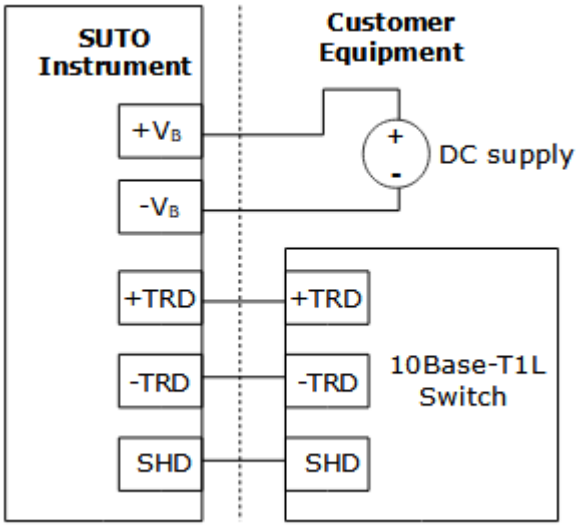
Pulse / Alarm output



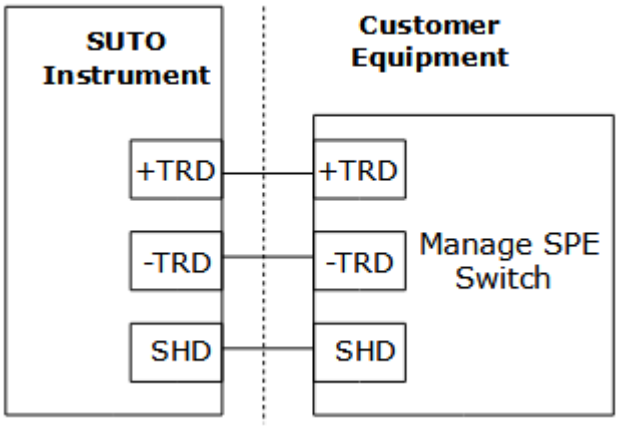
Modbus/RTU



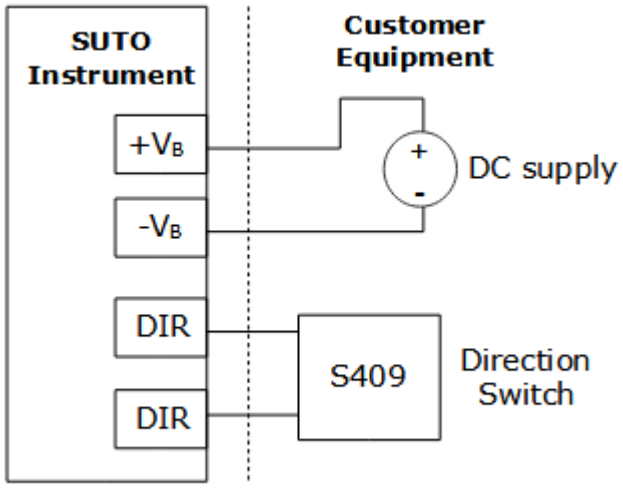
Ethernet/APL over Ethernet/APL



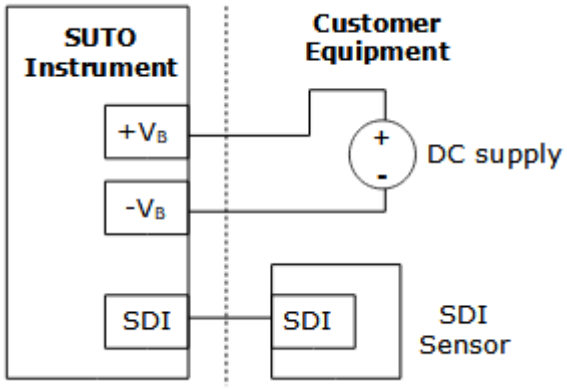
Modbus/TCP over single pair Ethernet



Direction input



SDI Sensor



11 Operation Using the Display

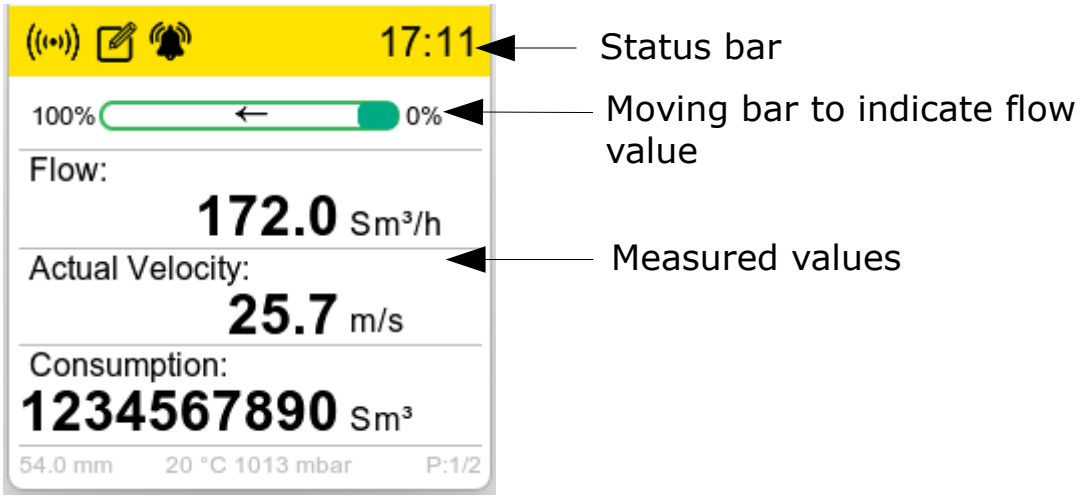
Using the display, you can do the following:

- View all available measurement channels.
- View error / status information.
- Change the sensor settings.

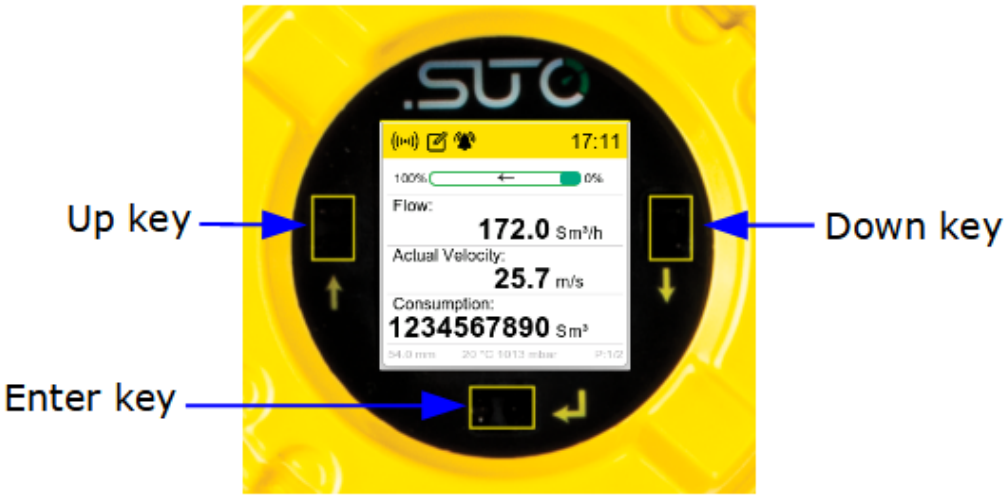
11.1 Information on the Display

11.1.1 Home Page

After powered up, the display starts an initialization procedure. After it is completed, it enters the standard mode, showing online values as below.



Three optical keys on the S453 are available for operation.



11.1.2 Icons Shown in the Status Bar

Icons in the status bar indicate status or warnings for the device.

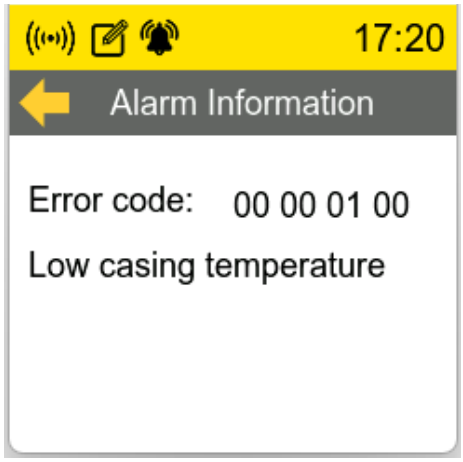
Icon	Explanation
	Wireless connection is established between the S453 and the mobile phone.
	The integrated logger is enabled.
	An alarm is raised.

11.1.3 Alarm and Error Code

When an alarm is raised, the alarm icon  comes up in the status bar.

To see the details of the raised alarm, do the following:

1. Press the **Enter** button on the S453, then **Menu** page shows on the display.
2. On the **Menu** page, click **Information** > **Alarm information**. The alarm's error code and description show on the screen, as in the picture below.



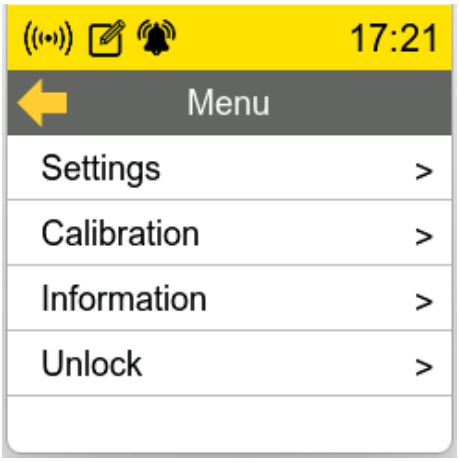
All alarm error codes and their meanings are as follows.

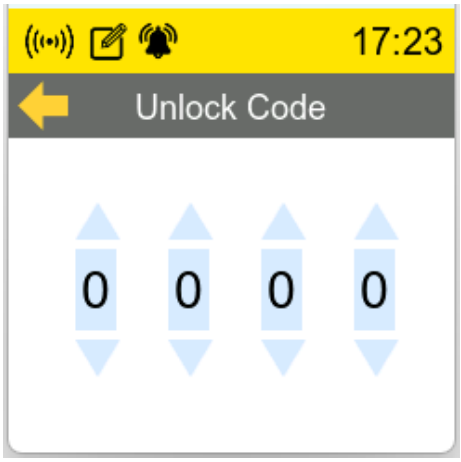
Error code	Description
00 00 00 01	EEPROM communication error
00 00 00 02	ADC communication error
00 00 00 04	Option board communication error
00 00 00 08	Wireless communication error
00 00 00 10	Temperature sensor communication error

00 00 01 00	Low casing temperature
00 00 02 00	High casing temperature
00 00 04 00	Low media temperature
00 00 08 00	High media temperature
00 01 00 00	PT20 sensor broken
00 02 00 00	PT1000 sensor broken
00 04 00 00	PT20 sensor shorten
00 08 00 00	PT1000 sensor shorten
01 00 00 00	Consumption checksum error

11.2 Operation

By pressing the **Enter** key on the S453, the **Menu** page comes up.





In order to perform any settings or calibration, the user has to enter a 4-digit password number under the **Unlock** menu.

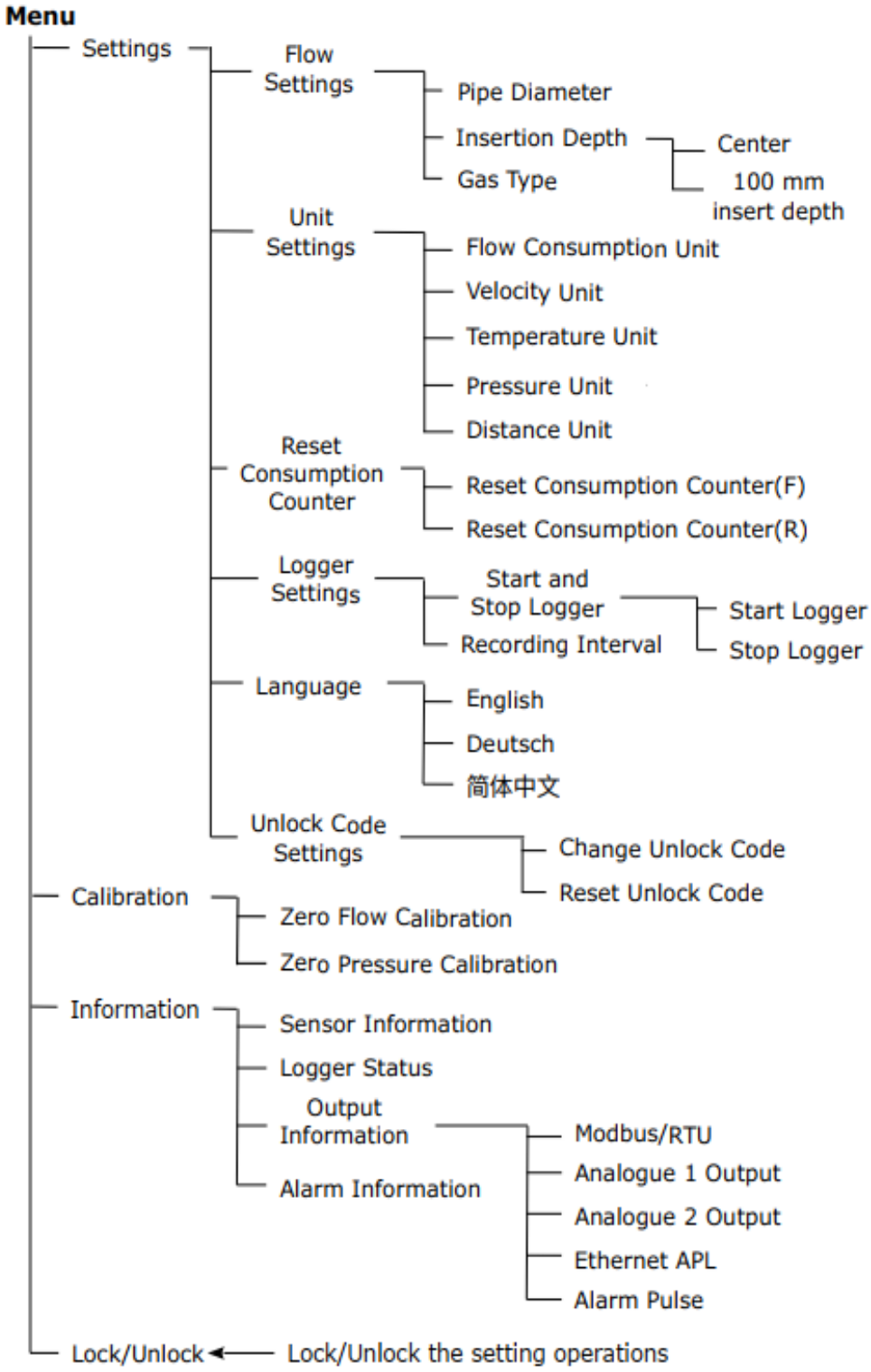
If the operation has stopped for more than 3 minutes, the password is reset and it has to be entered again. In general: if there is no operation happening for more than 3 minutes, the display will jump back to main screen.

Note: Following settings are at the moment not available on the display, but only on the mobile App:

- Alarm settings
- Measurement: Reference conditions, Flow direction, Consumption counter
- Output settings for analogue, pulse, Modbus and Ethernet/APL
- Default values of all above settings

For details, see chapter 12 Configuration Using S4C-FS App.

11.3 Menu Map


Menu
Settings
Flow Settings
Pipe Diameter
Insertion Depth
Center
100 mm insert depth
Gas Type
Unit Settings
Flow Consumption Unit
Velocity Unit
Temperature Unit
Pressure Unit
Distance Unit
Reset Consumption Counter
Reset Consumption Counter(F)
Reset Consumption Counter(R)
Logger Settings
Start and Stop Logger
Start Logger
Stop Logger
Recording Interval
Language
English
Deutsch
简体中文
Unlock Code Settings
Change Unlock Code
Reset Unlock Code
Calibration
Zero Flow Calibration
Zero Pressure Calibration
Information
Sensor Information
Logger Status
Output Information
Modbus/RTU
Analogue 1 Output
Analogue 2 Output
Ethernet APL
Alarm Pulse
Alarm Information
Lock/Unlock
Lock/Unlock the setting operations

12 Configuration Using S4C-FS App

12.1 Configurable Parameters

The S453 enables you to configure parameter settings according to the on-site requirements. The following table gives an overview about the available settings.

Parameters	Available settings	Default
Measurement	Tube diameter	54.0
	Flow unit	Sm^3/h
	Consumption unit	Sm^3
	Reference conditions	P_s= 1000 hPA, T_s= 20°C
	Gas type selection	Air
	Consumption counter	0 Sm^3
	Flow direction	Standard
Analog output 1	Measurement channel	Flow
	Scaling	4 mA: zero flow 20 mA: max flow
Analog output 2	Measurement channel Scaling	Medium pressure 4 mA: 0.00 MPa 20 mA: 1.6 MPa or 5.0 MPa Or Medium temperature 4 mA: -40°C 20 mA: +140°C
Pulse output	Pulse / Alarm	Pulse
	Pulses/consumption unit	1
Modbus	Device address	1
	Baudrate	19200
	Framing/parity/Stop bit	8, N, 1
	Transmission mode	RTU
Modbus/TCP over Ethernet/APL and Modbus/TCP	DHCP	Enable
	MAC	Set ex-factory
	IP address	Static (when DHCP=disable) Dynamic (when DHCP=enable)
	Subnet mask	
	Gateway	

Parameters	Available settings		Default
over single pair Ethernet	TCP	Port	504
		Timeout	⩾200 ms

To configure S453 settings, use the mobile app **S4C-FS** for the full settings or the local display for the most common settings.

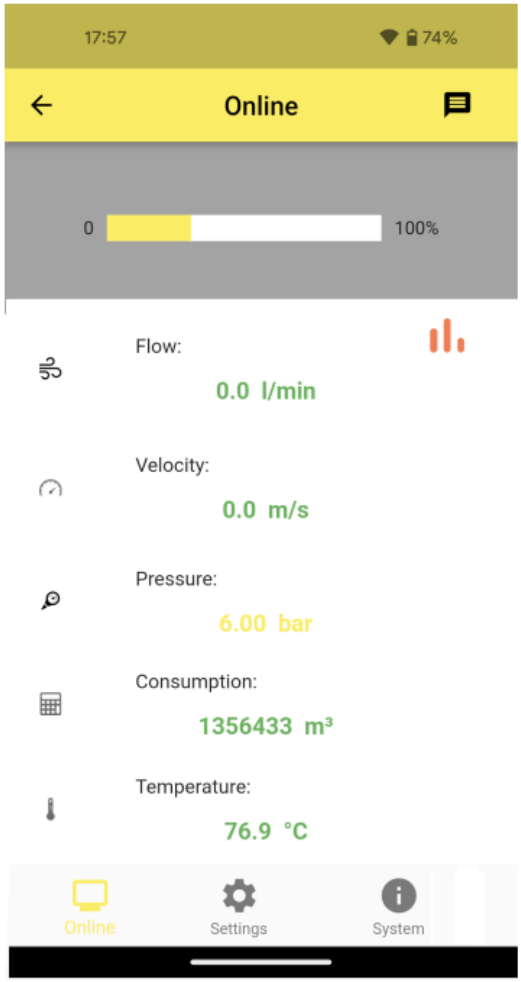
12.2 Alarm Settings

Parameter	Description	Settings
Alarm setting	Indicate if the alarm is enabled or disabled.	: **disabled** : enabled
Select channel	Select a channel for alarm setting.	- **Flow(F)** - Actual Velocity(F) - Flow(R) - Actual Velocity(R) - Temperature - Pressure
Select Alarm	Low Alarm: indicates an alarm with a lower threshold. High Alarm: indicates an alarm with a higher threshold.	- **Low Alarm** - High Alarm
Threshold	The threshold and hysteresis are used to activate or deactivate an alarm. For Low Alarm, when the channel value ≤ threshold, the low alarm is activated. When the channel value ＞ (threshold + hysteresis), the low alarm is deactivated. For High Alarm, when the channel value ≥ threshold, the high alarm is activated. When the channel value ＜ (threshold - hysteresis), the high alarm is deactivated.	Default threshold=0
Hysteresis		Default hysteresis=0

12.3 Use the Service App S4C-FS

The S4C-FS is an Android or iOS-based App that enables you to view online measurements and change settings for SUTO flow meters wirelessly.

Download S4C-FS from Google Play Store, the Apple Shop or SUTO website, and install it as you do for any apps on your mobile phone.



For more information about introduces of the sensor settings, see the

S4C-FS Instruction and Operation Manual, which you can download from SUTO website www.suto-itec.com (Download > Search: S4C-FS).

13 Optional Accessories

13.1 Sensor Display

The S453 display shows the values of velocity, flow rate, consumption and error messages.

14 Calibration

The flow meter is calibrated ex work. The exact calibration date is printed on the certificate which is supplied together with the flow meter. The accuracy of the flow meter 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, it is recommended 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.

15 Maintenance

To clean the instrument it is recommended to use distilled water or isopropyl alcohol only. If the contamination can not be removed the instrument must be inspected and maintained by the manufacturer.

16 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.

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