Operating Instruction

VA 452

thermal mass flow sensor

Table of Contents

1. General information

Important information

The operating instructions must be read in full and carefully observed 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 cancelled and the manufacturer is exempt from liability.

CS Instruments is not liable for errors which may have slipped into this operating manual.

Area of application

The CS flow meter VA 452 works based on the thermal mass flow principle and is to be used for measuring the mass flow of gases. The device can be configured to measure pure gases (e.g. CO2, N2, O2, Ar etc.) or gas mixtures (e.g. air, natural gas). It is used to measure gas/air consumption, control and monitor flow rates.

Any use other than that described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

Installation and operation

The measuring device must only be installed, connected, commissioned and maintained by qualified and authorized specialists (e.g. electrical technicians) in full compliance with the instructions in this manual, the applicable norms, legal regulations and certificates (depending on the application).

The measuring device may only be modified or repaired if such work is permitted in this instruction manual.

In order to achieve and maintain the accuracy stipulated in the technical data, the sensor must be installed according to the instructions in this manual.

Unhindered flow characteristics are achieved if the sections in front of the sensor (inlet) and behind the sensor (outlet) are sufficiently long, absolutely straight and without obstructions such as edges, seams, bends etc.

Careful attention must be paid to the design of the outlet section as obstructions can cause counter-flow turbulence as well as turbulence in the direction of the flow.

Notes on safety

- VA 452 is designed to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. Relevant regulations and European standards have been observed.
- The wiring of the device has to be done correctly in accordance with the wiring diagrams.
- Observe the technical data on the nameplate!
- Do not exceed the pressure range of 4.0 MPa.
- Observe permissible storage, transport and operating temperatures.
- VA 452 for use in hazardous areas are labeled accordingly on the nameplate. Relevant national regulations must be observed when operating the device in hazardous areas. Observe the installation regulations, connection data and safety instructions provided in the Ex documentation must be observed.

2. Introduction

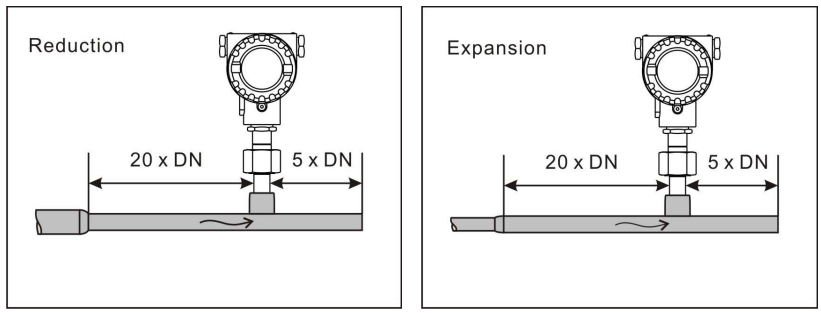
Product features

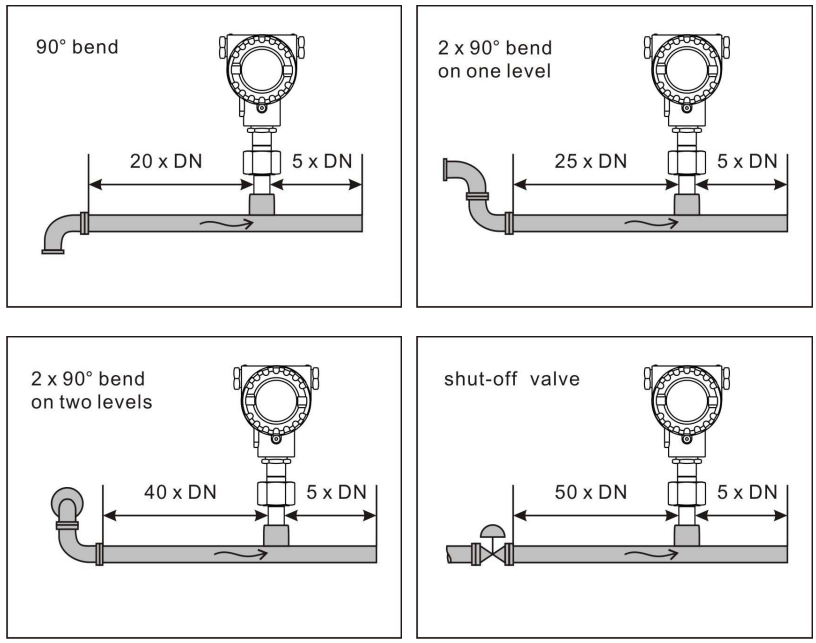
- Direct measurement of mass flow and standard flow without the need of pressure compensation
- Wide range of tube sizes are supported with insertion type for big tubes and inline types for small tubes
- No moving parts, non clogging
- All parts which come into contact with the measurement medium are made of stainless steel 316L.
- Robust metal enclosure suitable for out-door applications in harsh environment
- Wireless Bluetooth interface for commissioning on site
- Display showing flow rates, consumption, medium temperature and diagnostic results
- 2 analogue outputs (4-20 mA) and 1 pulse output
- Available options:
  - Fieldbus interface: HART, Modbus, MBus
  - Hazardous approval ATEX: II 2 G Ex IIC T4
  - 2-directional measurement
  - Flow conditioning

inlet / outlet runs

Thermal mass flow meters are sensitive disturbances in the flowing gas stream (e.g. vortex formation). As a general rule, the installed sensor should always be installed as far away as possible from any flow disturbances . Further information can be found in ISO Standard 14511.

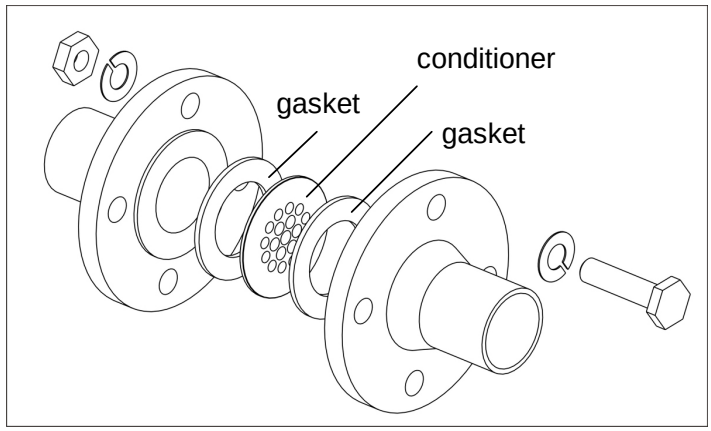
Please observe the following recommended minimum values with regard to the inlet and outlet runs.





Flow conditioner

In areas where the required inlet / outlet rungs can not be achieved it's recommended to use a flow conditioner upstream of the sensor. This will reduce the minimum inlet run to 5-8 x D.



Pressure loss calculation:

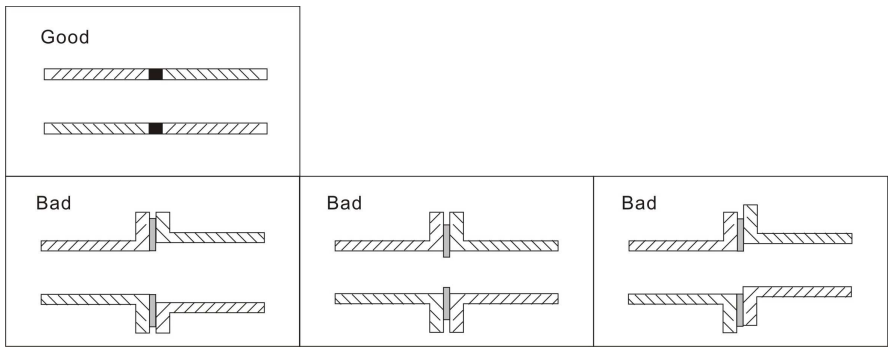
$$DP = K * v^2 * \rho$$

DP: Pressure loss [hPa or mbar]
K: Constant = 0.008
v: Actual velocity of gas at conditioner inlet [m/s]
ρ: Density of gas [kg/m3]

Pipe requirements

At all times good installation practice should be followed:

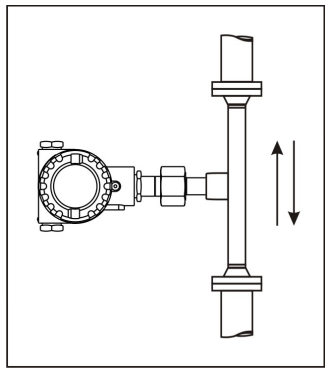
- Clean pipes and flange welded joints
- Correctly sized gaskets
- Correctly aligned flanges and gaskets
- Use seamless pipes immediately upstream of the flowmeter.
- Use of pipes that match in regards of the internal diameter next to the flowmeter. Avoid any disturbance or miss-alignment greater than 1 mm.
- Anything that disturbs the smoothness of the internal pipe wall (see figure below) should be eliminated; the goal should be a smooth uninterrupted internal surface. For further information please refer to ISO 14511.

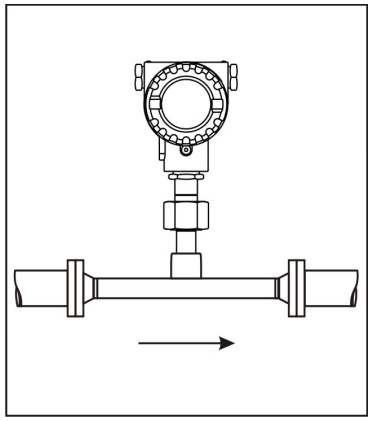


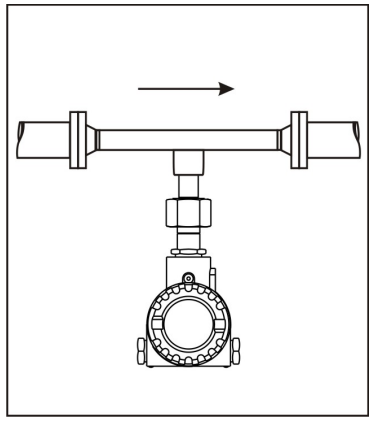
3. Installation

Installation

1. Orientation







The unit can be installed in any position in the piping. In the case of wet/dirty gases, upward flow is recommended in vertical pipes to minimize condensation/contamination on or around the sensing element. In particular, where free condensation can occur (e.g. Bio-gas) the sensor should be orientated to prevent water collecting on or around the sensing elements (e.g. do not install the sensor at a low point in the installation without adequate drainage).

Ensure that the direction arrow on the sensor matches the direction of flow .

2. Display orientation

The display version of VA 452 can be rotated in both directions 270°. For this purpose the the nut at the top of the shaft has to be opened fully. Then pull up the metal casing and rotate it in the desired direction. It can be rotated in 90° steps in both directions. A metal pin locks the position. When the desired position is achieved, press down the metal casing onto the shaft so that the metal pin can insert into the position hole. Tighten up the nut.

Sensor head can be rotated in 90° steps through the screw nut

3. Protect sensor tip

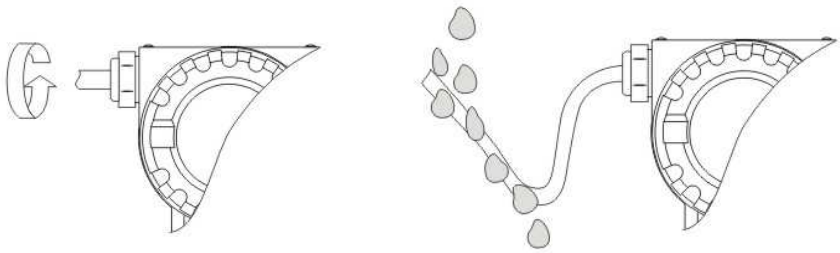
The sensor unit can be removed from the measuring section for example for cleaning or service / calibration. To protect the sensor during transportation we recommend to use a sensor protection cap as indicated in the picture below.

Please contact our local service for sensor protection cap.

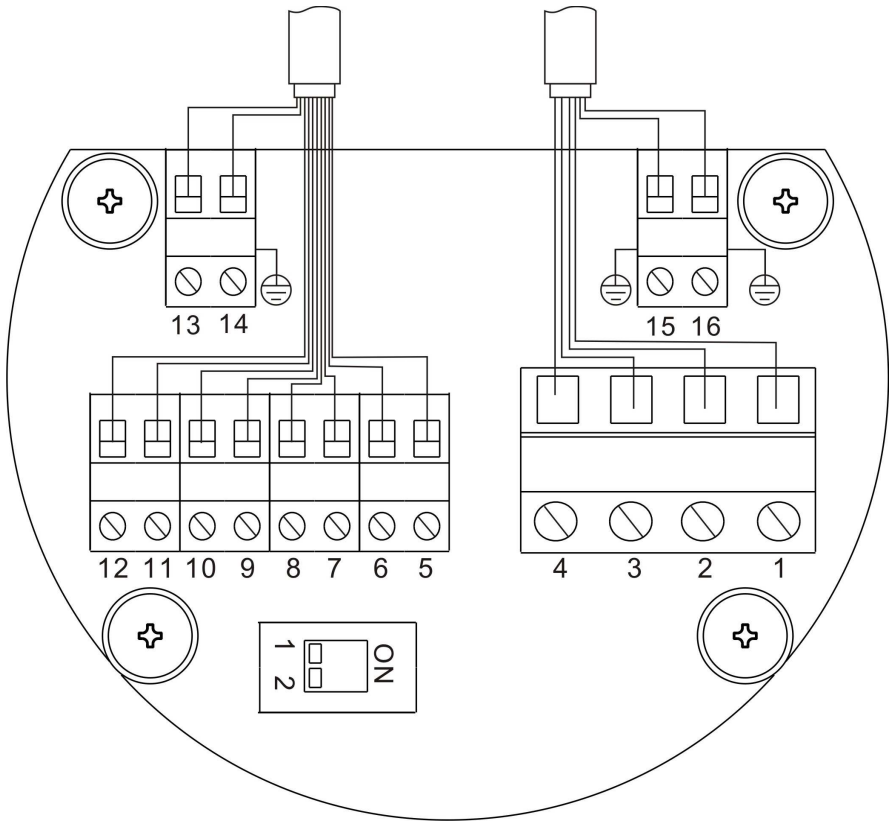
Wiring

When installing the cables please consider following points:

- Keep the stripped and twisted lengths of cable shield as short as possible.
- Screen and ground the signal lines
- Install the measuring device that the cable entries do not point upwards.
- Do not remove the seal from the cable entry.
- 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



Connection diagram



Pin	Signal description
1	Ground for SDI
2	V+
3	V-
4	SDI
5	Direction input D1 (flow switch)
6	Direction input D2 (flow switch)
7	Pulse output P1 / Alarm switch A1
8	Pulse output P2 / Alarm switch A2
9	Current output channel 1 - / HART bus
10	Current output channel 1 + / HART bus
11	Current output channel 2 - / MODBUS data + / MBUS M1
12	Current output channel 2 + / MODBUS data - / MBUS M2
13	Ground for MODBUS cable
14	Earth
15	Earth
16	Earth

Connecting DS 300

DS 300 is connected to VA 452 through a 3 pole cable.

VA 452		DS 300	
Pin	Signal	Pin	Pin
4	SDI	I-3	G-6
2	V+	I-1	G-8
3	V-	I-4	G-7

DS 300 has 2 inputs (I and G) for flow / dew point sensors.
If there are more than 1 VA 452 to be connected to DS 300 a separate power supply has to be used for at least one of the VA 452, since DS 300 can only supply one VA 452 flow sensor.

VA 452		DS 300		Ext. 24 VDC
Pin	Signal	Pin	Pin	
4	SDI	I-3	G-6	
2	V+	N.C.	N.C.	24V+
3	V-	I-4	G-7	24V-

Connecting analogue / pulse outputs

VA 452 in the standard configuration comes with 2 analogue outputs and 1 pulse output. All signals are electrically isolated. The analogue output can be used as an active output—current is sourced through the positive connection pin—or passive. In the passive configuration a current signal is modulated onto the external signal voltage.

Pin		Signal	Description
12	Analog 2	I+	Positive signal output
11		I-	Negative signal output
10	Analog 1	I+	Positive signal output
9		I-	Negative signal output
7	Pulse	P1	No polarity required
8		P2	No polarity required

Connecting HART

The HART signal is modulated on analogue output 1. In case VA 452 is used in a multi drop configuration (more than 1 slave on the 4-20 mA line) the analogue output can not be used anymore.

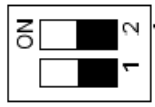
Pin		Signal	Description
10	Analog 1	I+ / HART+	Positive signal output
9		I- / HART-	Negative signal output

Connecting Modbus

The version with Modbus comes with one analogue output and one pulse output.

Pin		Signal	Description
11	Modbus	Data+	RS-485
12		Data-	RS-485
10	Analog 1	I+	Positive signal output
9		I-	Negative signal output
7	Pulse	P1	No polarity required
8		P2	No polarity required

Modbus requires to activate terminal resistors at the last device on the bus system. For this purpose the DIP switches on the connector board should be set to “ON” position.



Termination resistor network switch

Connecting MBus

The version with MBus comes with one analogue output and one pulse output.

Pin		Signal	Description
11	MBus	M1	MBus
12		M2	MBus
10	Analog 1	I+	Positive signal output
9		I-	Negative signal output
7	Pulse	P1	No polarity required
8		P2	No polarity required

Pulse output

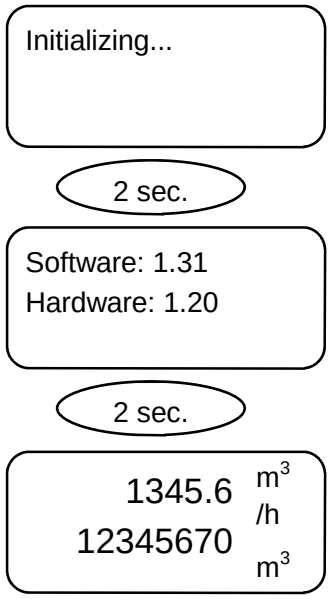
The maximum number of pulses per second is limited to 45 pulse per second. As a result depending on the flow rate and the selected consumption unit the maximum flow rate is limited to the values in the table below..

Unit	Max flow		
Pulses per consumption unit	1	1/10	1/100
m3/h	162,000	1,620,000	16,200,000
m3/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	27,0000
Kg/s	45	450	4,500
	Default	To be configured by service software	

4. Operation

Startup

The version with display will startup in the sequence as described below.

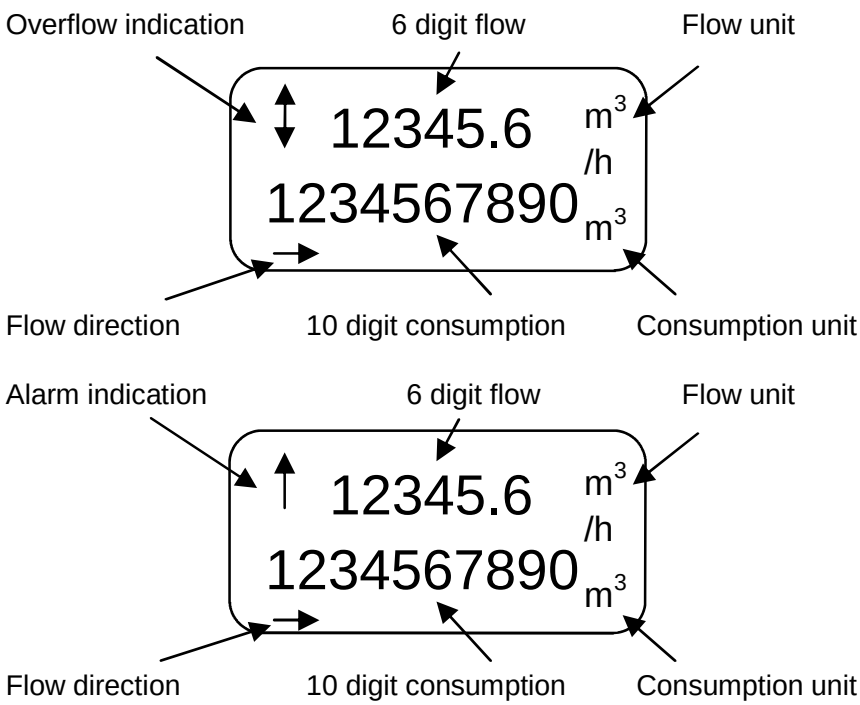


Software and hardware version

VA 452 will then show the actual online values of flow and total consumption. After reset the sensor has a warm-up time of about 20 seconds., during this time the flow rate is zero.

Every 5 seconds the display will show the medium and the ambient temperature together with an error code. The error code information is helpful for service engineers .

Display



Configuration

In order to fully utilize ethe functionality of VA 452 a configuration is required. There are various paramters which need to be set in the flow meter. The table below gives an overview about the available settings.

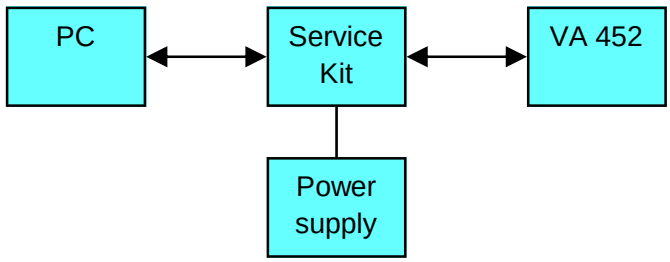
Area	Available settings	Default
Measurement	Tube diameter Flow unit Consumption unit Reference conditions Gas type selection Consumption counter Operation pressure Flow direction	54.0 m^3/h m^3 P_S = 1000 hPA T_S = 20 ℃ Air 0 m^3 0.6 MPa Standard
Analogue output 1	Measurement channel Scaling Active / passive	Flow 4 mA: 0 m^3/h 20 mA: max flow Active
Analogue output 2	Measurement channel Scaling Active / passive	Medium Temp. 4 mA: -50 ℃ 20 mA: 200 ℃ Active
Pulse output	Pulse / Alarm Pulses per consumption unit	Pulse 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, E, 1 RTU
MBus	Address Manufacturer code Baudrate Access Number	0 END 300 0

Configuration settings have to be done through the service software which is included in the scope of delivery. The service software can be isntalled on any PC with windows operating system. To communicate with the sensor the PC needs to have a Bluetooth interface. Alternativly a service kit can be used which cis as option

Bluetooth

Bluetooth provides a convenient way of configuring the sensor without the hazel of cable connections. VA 452 needs to be powered up. Ensure that the distance between VA 452 and PC is no more that 5 meter and the PC Bluetooth antenna should point roughly in the direction of the display (front part). Please follow the instruction in the service software and the help file.

Service Kit



The diagram above shows the connection when using the optional service kit (0554 2005). Please ensure that also in this case the power supply of either VA 452 or of the service kit is connected (USB port is not supplying enough power).

Technical data

Measuring range

Standard range calibration:

Pipe			sm^3/h		kg/h	
Inch	DN	mm	Min	Max	Min	Max
1/2”	DN15	16.1	0.2	45.6	0.2	54.2
3/4”	DN20	21.7	0.4	89.1	0.4	105.9
1"	DN25	27.3	0.6	147.7	0.7	175.5
1 1/4"	DN32	36.0	1.1	266.3	1.3	316.5
1 1/2"	DN40	41.9	1.5	366.7	1.7	435.9
2”	DN50	53.1	2.4	600	2.9	713
2 1/2"	DN65	68.9	4.1	1027	4.9	1220
3”	DN80	80.9	5.7	1424	6.8	1693

Max range calibration:

Pipe			sm^3/h		kg/h	
Inch	DN	mm	Min	Max	Min	Max
1/2”	DN15	16.1	0.4	100.0	0.4	108.1
3/4”	DN20	21.7	0.7	177.8	0.8	211.4
1"	DN25	27.3	1.2	294.7	1.4	350.3
1 1/4"	DN32	36.0	2.1	531.5	2.5	631.7
1 1/2"	DN40	41.9	2.9	731.9	3.5	869.9
2”	DN50	53.1	4.8	1198	5.7	1423
2 1/2"	DN65	68.9	8.2	2049	9.7	2435
3”	DN80	80.9	11.4	2841	13.5	3377

Volumetric flow is stated at 1000 hPa and 20 ℃

VA 452 can measure from zero flow onwards, the stated minimum flow is only required for achieving the specification. Flow rates above the maximum flow can not be measured.

Accuracy

Uncertainty:	1.5% of reading + 0.3% of full scale
Repeatability:	0.25 % of reading
Stated uncertainty at:	
Ambient / process temperature:	23 ℃ ± 3 ℃
Ambient / process humidity:	<90%, no condensation
Process pressure:	0.6 MPa

Tube size

DN 15 (1/2”), DN 20 (3/4”), DN 25 (1”), DN 32 (1 ¼”),
DN 40 (1 ½”), DN 50 (2”), DN 65 (2 ½”), DN 80 (3”)

Response / Sampling

Response time:	T_{95} < 5 seconds
Sampling rate:	5 samples per second
	Display is refreshed every 0.5 seconds
	Outputs are refreshed every 0.2 seconds

Power supply

16 - 30 VDC, 7 W

Process connection

R thread (ISO 7-1), Flange EN 1092-1
All parts in contact with the medium are of stainless steel 316L

Environment conditions

Ambient temp.:	-30 … +65 ℃ (non display version)
	-25 … +65 ℃ (display version)
Storage temp.:	-40 … +65 ℃
Protection:	IP 67
Shock resistance:	IEC 60068-2-31
Vibration resist.:	IEC 60068-2-6
EMC:	IEC / EN 61326

Operating conditions

Medium temp.:	-40 … +100 ℃
Pressure loss:	< 3 hPa (4” pipe)
Medium pressure:	-0.1 … 4.0 MPa

Analogue output

Active / passive selectable, galvanic isolated

Active:	4 to 20 mA, RL < 400 Ω
Passive:	4 to 20 mA; supply voltage 18 … 30 V DC, RL < 500 Ω
for HART:	RL ≥ 250 Ω
Uncertainty:	< 0.3% of reading
Resolution:	0.005 mA

Pulse/Alarm output

	NO switch, no polarity required, galv. isolated
Max rating:	30 VDC, 200 mA
Pulse width:	10 … 100 msec (depending on flow rate)

Bluetooth

Communication Distance:	< 3m (depend on environment)
Device name:	VA 452 + s/n (Can be edited)

HART

Device type:	Slave
Polling address:	1 to 15 Bus address can be set through software
Physical interface:	BELL 202
Protocol version:	V5.2
Tag:	VA 452
Tag description:	FLOW METER
Frame/parity/Stop:	8, O, 1

Modbus

Device type:	Slave
Address range:	1 to 247 Bus address can be set through software
Physical interface:	RS485 in accordance with EIA/TIA-485 standard
Baudrates:	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
Transm. mode:	ASCII, RTU
Response times:	Direct data access = 0 to 255 ms (can be con figured)

MBus

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

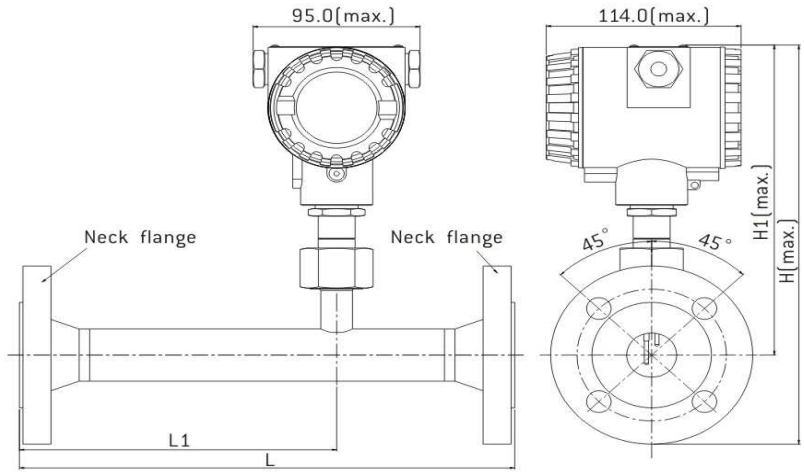
Approvals Certificates

CE mark:	The measuring system is conform with the statutory requirements of the EC Directives. CS Instruments has successful tested the device and affixed the CE mark.
Ex approval:	CS Instruments provides a separate documentation.

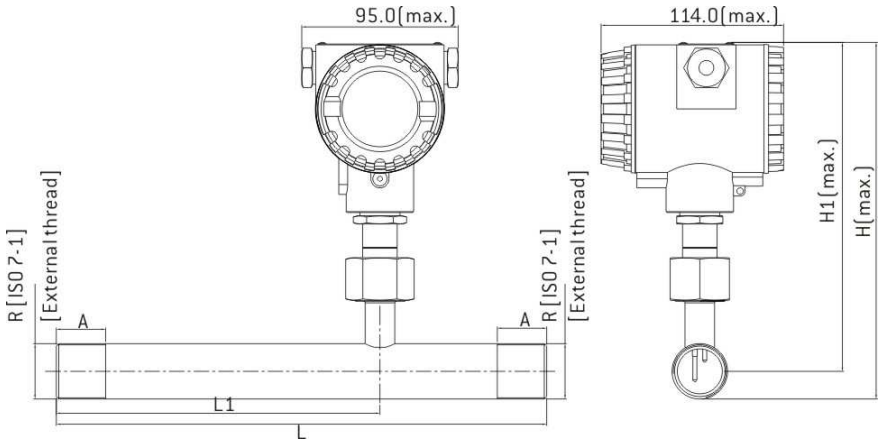
Other Standards

EN 60529	Protection by housing (IP code)
IEC/EN 61326	EMC- requirements
ISO 14511	Thermal mass flowmeters.
NAMUR NE 43	Standardization analogue outputs

Dimensions



Pipe nominal size [inch]	DN	Outer diameter x thickness/[inner dia] [mm]	L total length [mm]	L1 inlet length [mm]	H total height [mm]	H1 from pipe center to casing top [mm]
1/2"	DN15	Ø21.3 x 2.6/[Ø16.1]	300	210	247.65	200.15
3/4"	DN20	Ø26.9 x 2.6/[Ø21.7]	475	275	252.65	200.15
1"	DN25	Ø33.7 x 3.2/[Ø27.3]	475	275	257.65	200.15
1 ¼"	DN32	Ø42.4 x 3.2/[Ø36.0]	475	275	270.15	200.15
1 ½"	DN40	Ø48.3 x 3.2/[Ø41.9]	475	275	275.15	200.15
2"	DN50	Ø60.3 x 3.6/[Ø53.1]	475	275	282.65	200.15
2 ½"	DN65	Ø76.1 x 3.6/[Ø68.9]	475	275	300.55	208.05
3"	DN80	Ø88.9 x 4.0/[Ø80.9]	475	275	314.45	214.45



5. Trademarks

Trademarks

HART®
Registered trademark of HART Communication Foundation, Austin, USA

MODBUS®
Registered trademark of the MODBUS Organization

MBUS®
Registered trademark of the MBUS Organization

Bluetooth®
Registered trademark of the Bluetooth Organization

6. Warranty

Warranty

CS provides a warranty for this product of 24 months covering the material and workmanship under the stated operating conditions from the date of delivery.

Please report any findings immediately and within the warranty time guaranteed by us.

Excluded from this warranty is damage caused by improper use and non-adherence to the instruction manual.

The warranty is also cancelled once the measuring instrument has been opened provided this is not described in the instruction manual for maintenance purposes. This is also the case if the serial number has been changed, damaged or removed.

If in addition to the warranty service necessary repairs, adjustments or similar are carried out, the warranty services are free of charge but there is a charge for other services such as transport and packing costs. Other claims, especially those for damage occurring outside the instrument are not included unless responsibility is legally binding.

По вопросам продаж и поддержки обращайтесь:

Архангельск (8182)63-90-72
Астана +7(7172)727-132
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
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Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Тверь (4822)63-31-35
Томск (3822)98-41-53
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