



Caprolactam production

Contents

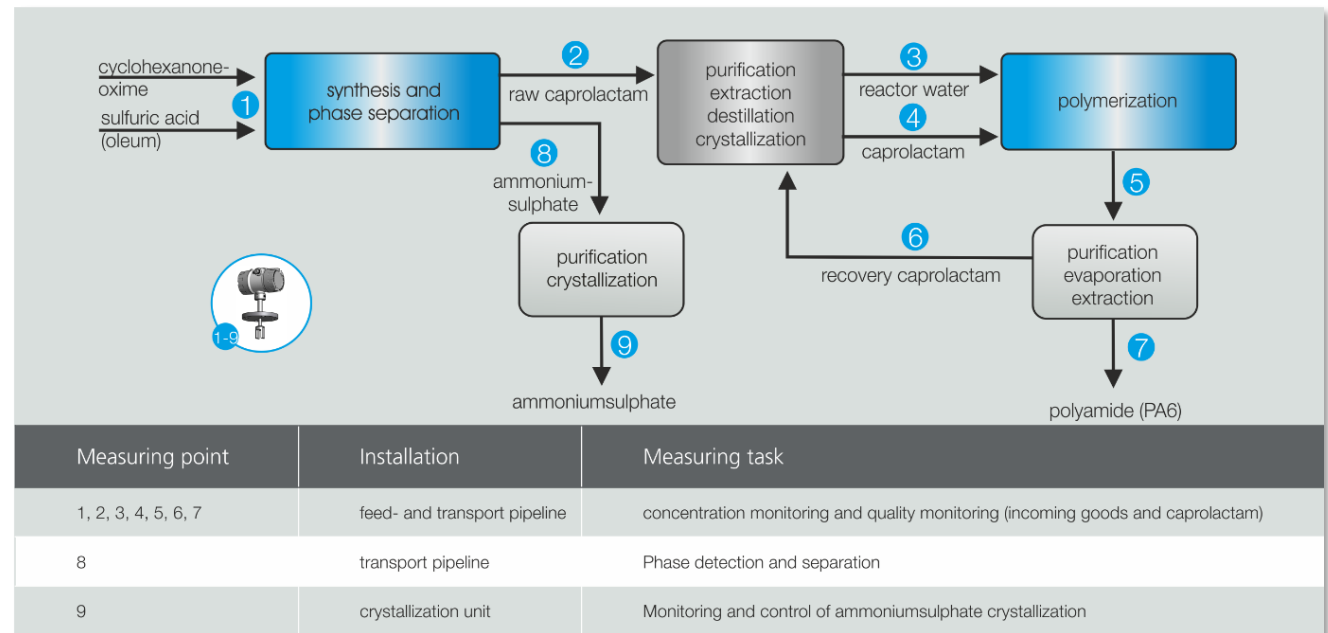
Caprolactam	3
LiquiSonic® system	4
Controller	7
Sensors	17
Bus wiring	22

Caprolactam

Production process

LiquiSonic® applications

- check of incoming goods
- synthesis (Beckmann process): H_2SO_4 and oleum
- phase separation: caprolactam and ammonium sulphate
- crystallization: ammonium sulphate
- extraction: caprolactam in solvent
- distillation: caprolactam in water
- reactor water: water in caprolactam



Caprolactam

LiquiSonic® system benefits

- control signal for the evaporation process
- reducing steam consumption in the recovery process
- concentration of residual CPL monomers can be reduced to a minimum
 - save resources
 - increase of plant productivity
- sensors approved by ATEX, IECEx and FM
- elimination of manual process steps:
 - typically time saving: 1 h per day (sampling, laboratory, documentation)
 - Reduced laboratory material costs
 - average amortization < 1 year



Caprolactam

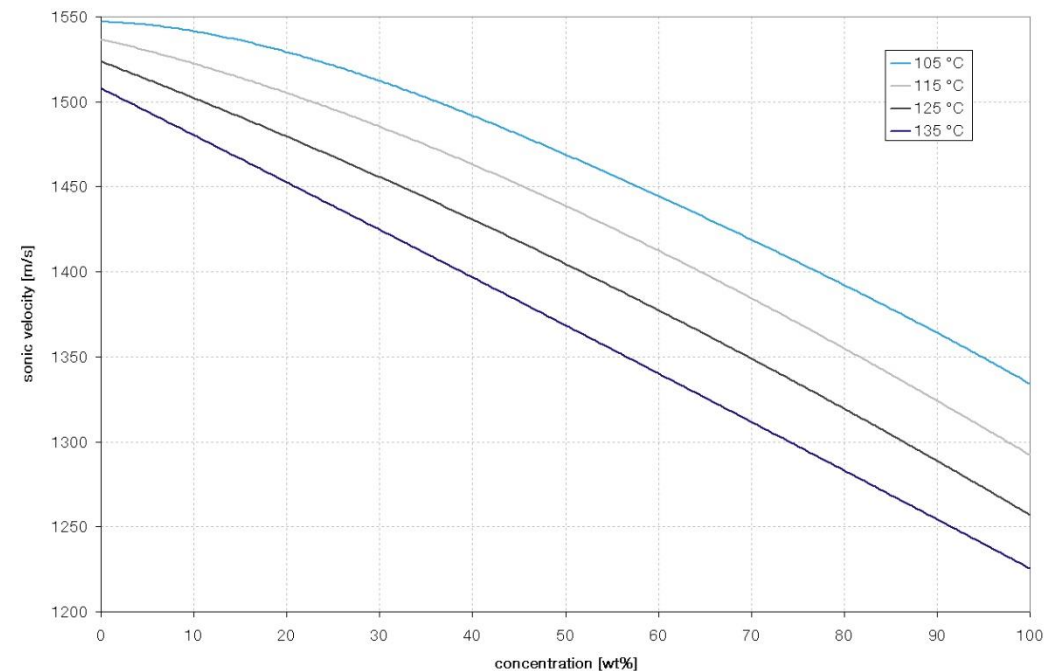
LiquiSonic® - powerful references



LiquiSonic® system

Water in recycled caprolactam

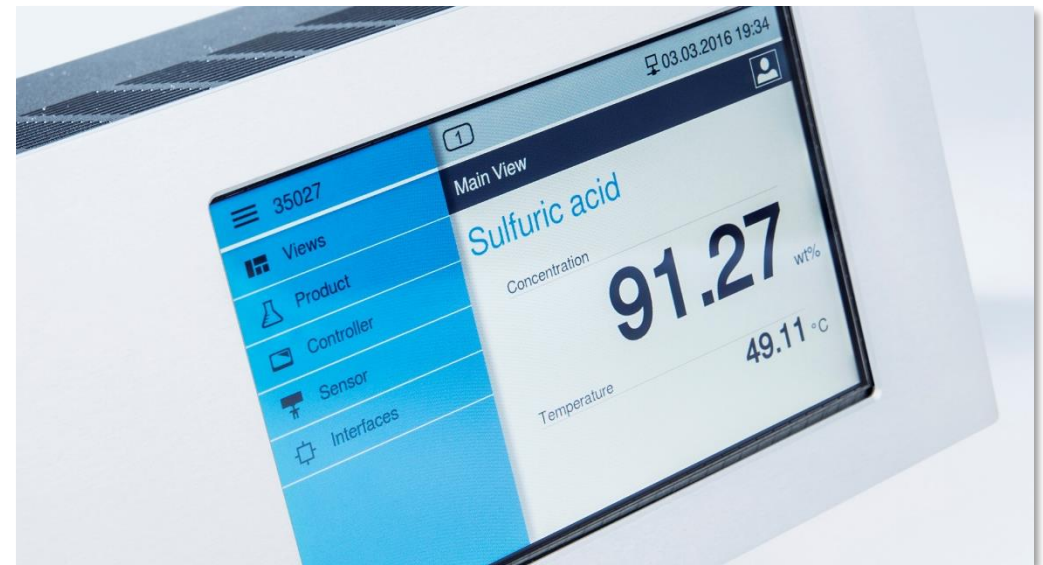
- caprolactam recovery with thin film evaporator
- several concentration ranges at temperatures up to 150 °C
 - residual water in caprolactam (98 - 100 wt%)
 - residual caprolactam in reactor water (2 - 10 wt%)
 - caprolactam process (60 to 70 wt%)



Controller

Measuring data to analyze and monitor

- panel mounting casing
- material: powder-coated steel
- front panel: anodized aluminum
- display protection: glass
- protection degree: IP30 (NEMA 2),
front: IP65 (NEMA 4)
- display: capacitive touch screen, 7“,
800 x 480 pixel (16 Mio. colors)
- front panel: 260 x 133 mm (10.2“ x 5.2“)
- panel cut-out: 242 x 122 mm (9.5“ x 4.8“)
- installation depth: 250 mm (9.8“)
- operation via touch display or browser



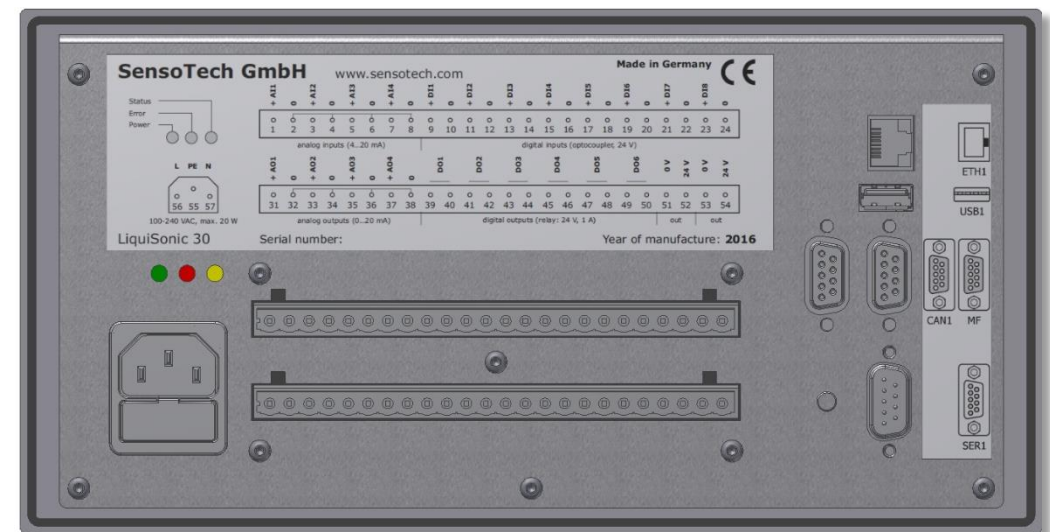
Controller

Connection side

- simple assembling
- plug in clamping contacts

Inputs and outputs

- analog outputs: up to 4 x 4..20 mA
- digital outputs: up to 6 x electronic relays
- analog inputs: up to 4 x 4..20 mA
- digital inputs: 8 x binary inputs
- USB interface
- serial interface RS-232
- inputs and outputs isolated
- supply 100 V AC to 240 V AC or 24 V DC
- optional:
 - network (Ethernet)
 - fieldbus interface (Profibus DP, DeviceNet, Modbus RTU, Modbus TCP, CAN)



Controller

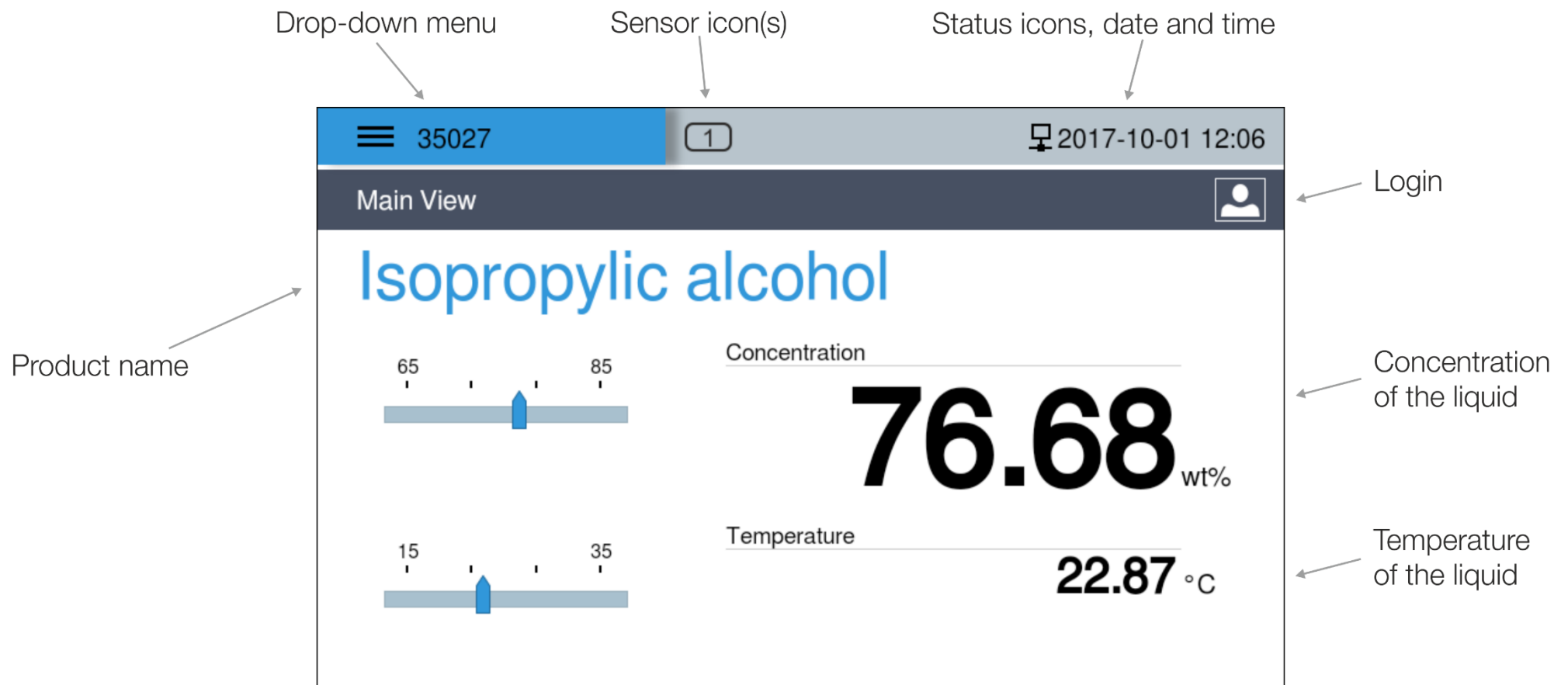
19" rack mounting version

- dimension: 19", 4 RU
- installation in a 19" standard frame



Controller

Main view



Controller

Main view

standard

Sensor is connected and operates properly.

connection fault

Sensor is not connected.

stop

There is no liquid flow around the sensor.

no liquid, gas bubbles

The sensor is not in the liquid, or too much gas bubbles, foam or solids are present on the sensor.

USB

USB flash drive is connected.

network

Network is on.

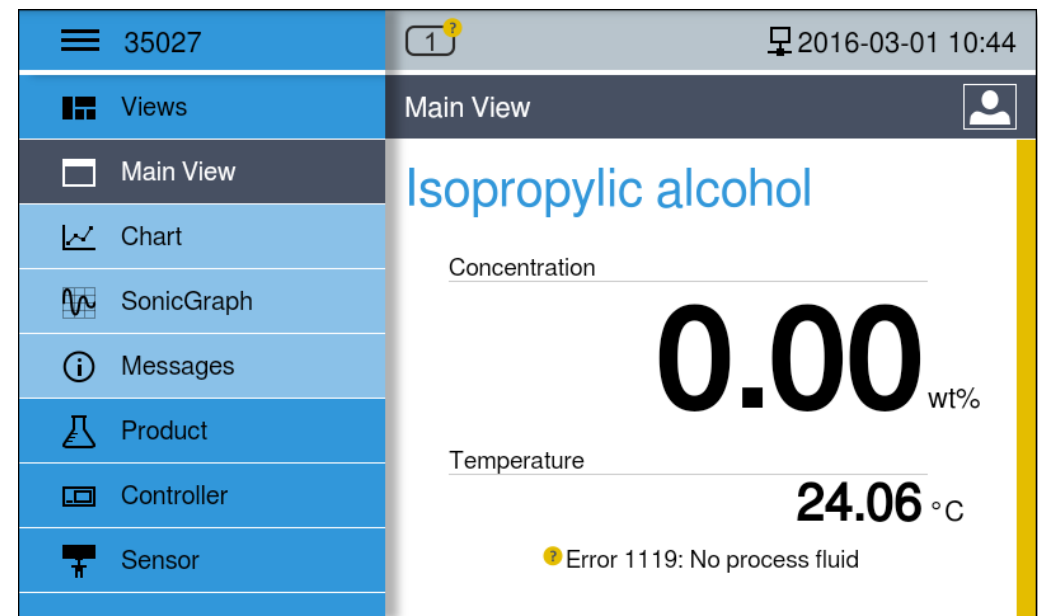
network error

Network connection is interfered.

Controller

Self diagnostics, alarm messages

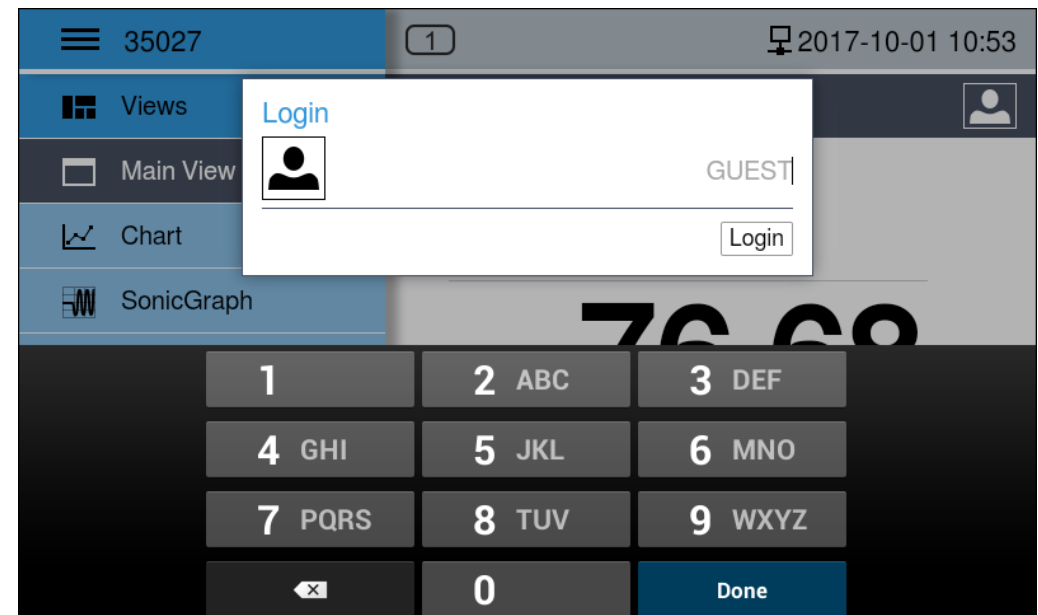
- the controller has an internal service “task” to watch the device functionality
- it is possible to detect process disturbances and/or device failures
- clear messages instead of cryptic numbers are presented on the display of the controller



Controller

Operator management

- user access with ID
- own access code for each user
- different access levels depending on user for
 - service
 - calibration
 - standard operation
- each interaction will be traced within the event memory



Controller

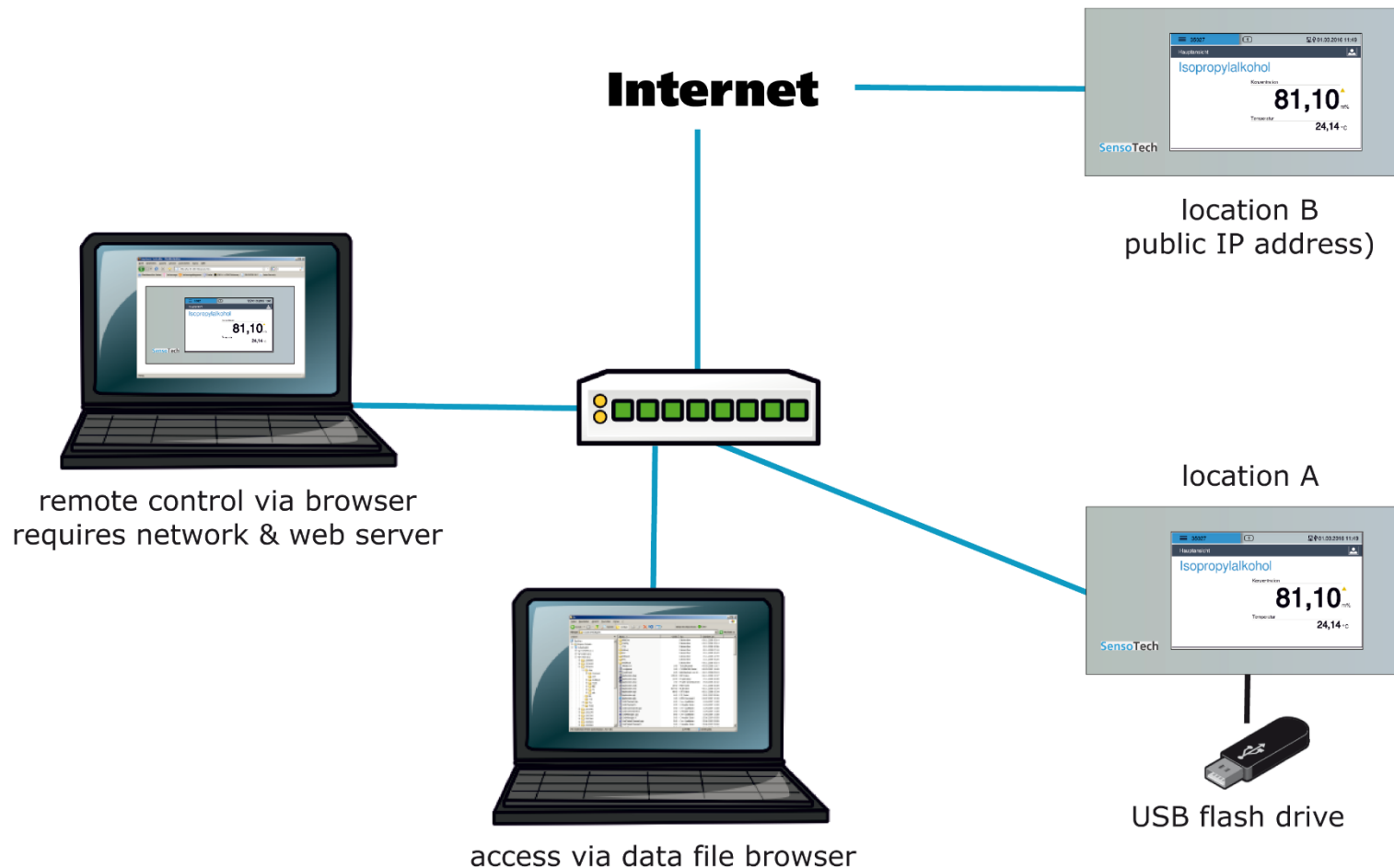
Event memory

- important events and operations are automatically traced within the event memory:
 - errors
 - warnings
 - login and logout of users
 - product change
 - calibration
- the events are presented on the display and can be read out

≡ 35027	1	2017-10-01 10:33
Views	Messages	All Information
Main View	09:55:42 Sensor 1	Switched to product 8 (108.01).
Chart	08:55:42 Controller	Login is reset due to auto logoff.
SonicGraph	08:44:42 Sensor 1	Switched to product 1 (105.01).
Messages	08:44:27 Sensor 1	Product 1 (105.01, C1) has been calibrated: +0.01.
Product	08:43:22 Controller	A backup of the configuration data was saved internally.
Controller	08:43:17 Controller	The product dataset 105.01 has been copied from product 1 to product 23.
Sensor	08:40:04 Controller	Data log channel 1 has been reassigned.
	08:39:44 Controller	Successful login (ADVANCED).
	08:34:44 Sensor 1	The connection to the sensor was established.
	08:34:19 Controller	The system was restarted (0).
	08:33:54 Controller	Reset command was received (0).
	08:33:00 Sensor 1	The sensor needs to be assigned.

Controller

Overview of network integration



Controller

Fieldbus

Supported fieldbus standards (layer 2)

- Profibus DP
- Modbus RTU
- Modbus TCP
- DeviceNet
- CAN

Supported parameters

- concentration sensor 1 to 4
- temperature sensor 1 to 4
- sonic velocity sensor 1 to 4
- standard deviation sensor 1 to 4
- derivation of sonic velocity and temperature
- second physical value sensor 1 to 2
- error state sensor 1 to 4
- product switch
- serial number and firmware version
- and many more

Sensors

Measuring can be so simple

- absolute sonic velocity as a well-defined and retraceable physical value
- installation directly in main pipes or vessels
- contact less measuring method independent of color, conductivity and transparency of the process liquid
- rugged construction in completely metallic sensor design without gaskets or moving parts
- drift- and maintenance-free
- corrosion resistance by using special materials
- connection of up to 4 sensors per controller
- forwarding of measuring results via fieldbus, (e. g. Profibus DP, Modbus), analog outputs, serially or Ethernet



Sensors

Measuring method

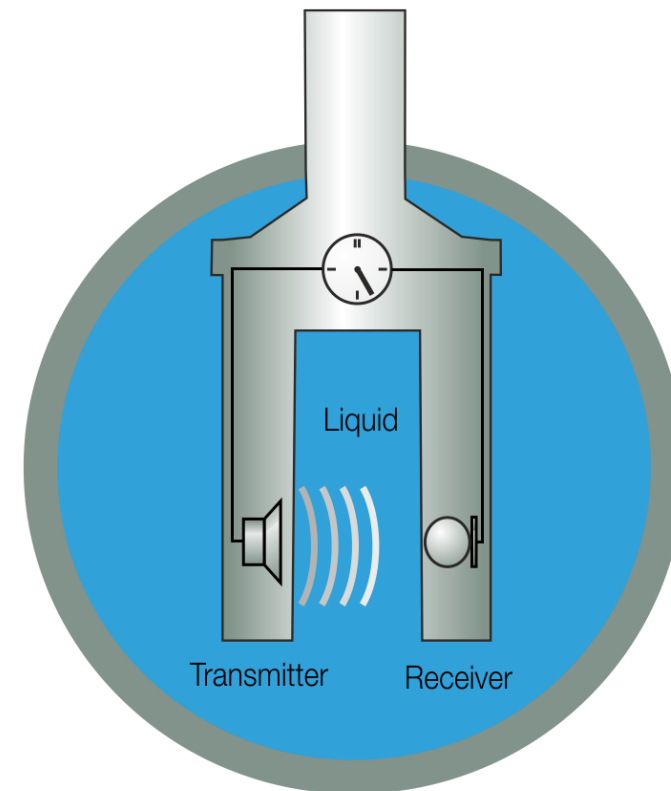
- measurement of the propagation velocity of ultrasonic waves in a liquid:

$$v = \frac{s}{t}$$

v: sonic velocity

s: distance

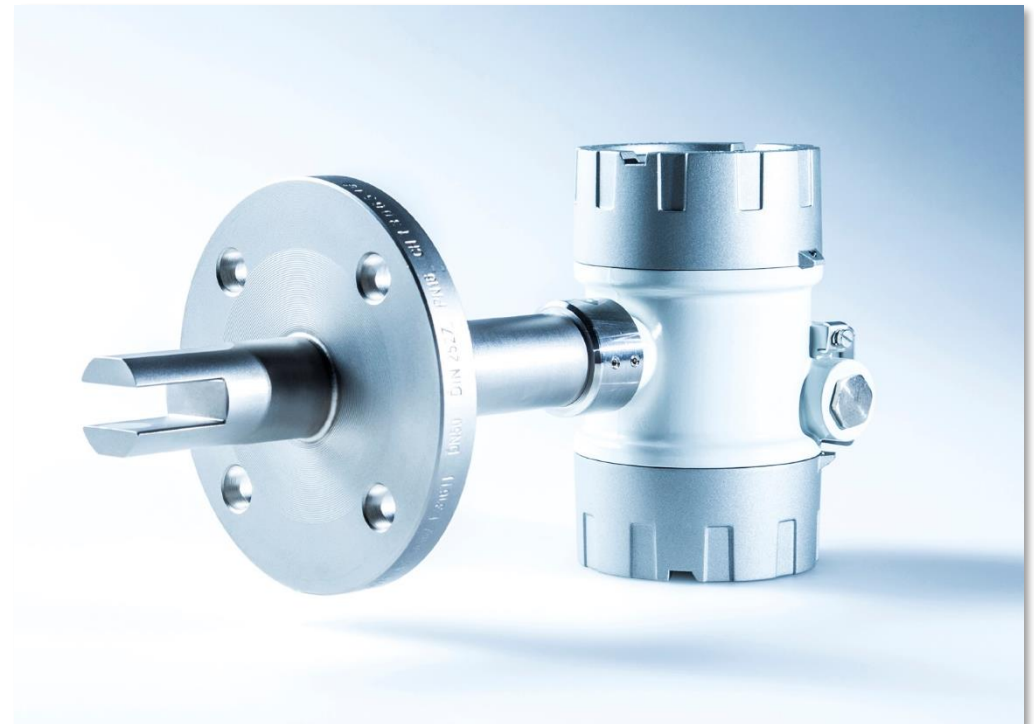
t: travel time



Sensors

Immersion sensor 40-40 Ex

- process connection as DIN, ANSI or other flanges possible
- immersion lengths up to 3 m
- temperature withstand up to 180 °C
- high power option for high damping liquid
- sensor material:
 - stainless steel 1.4571
 - Hastelloy HC2000
 - Hastelloy BC1-Hybrid
 - Zirconium
 - Tantalum
 - and more



Sensors

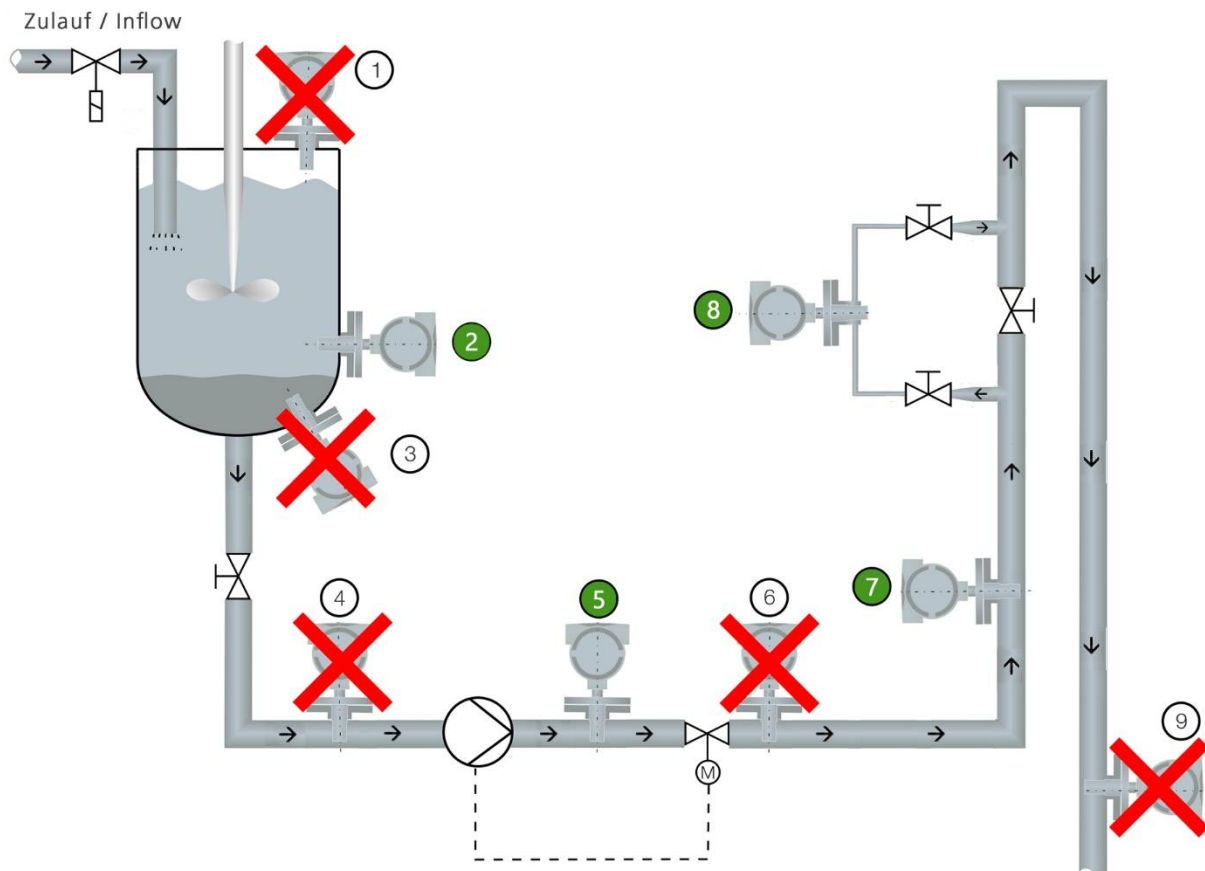
Flange sensor DN 80 PFA (coating)

- for hot acids and adhesive liquids
- maximum liquid temperature: 130 °C
- coating material: PFA (Perfluoroalkoxy)
- high power option for high damping liquid



Sensors

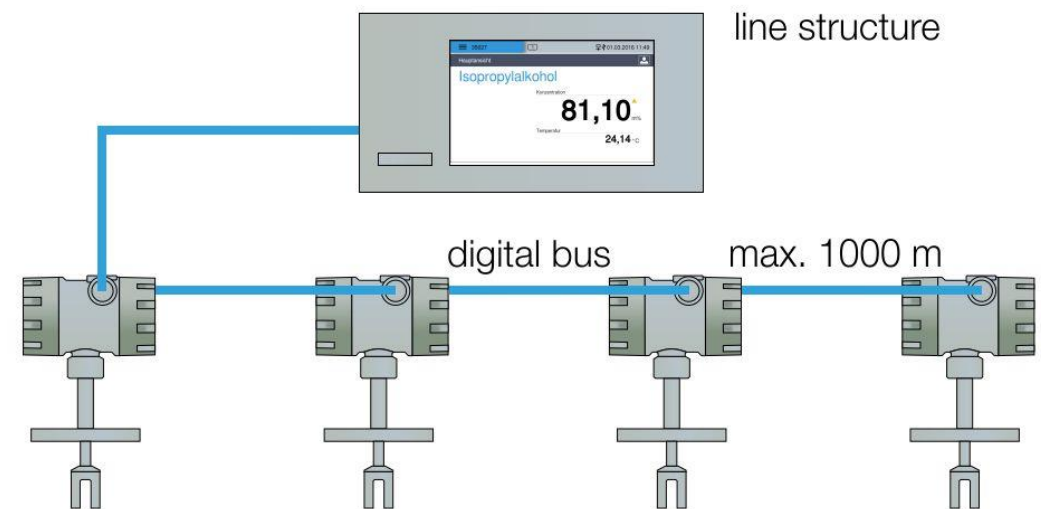
Recommendations for installation



Bus wiring

Line connection

- digital bus connection between controller and sensors
- standard up to 1000 m cable length (optional longer than 1000 m)



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In liquids, we set the measure.

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