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SCHMIDT® Technology

SCHMIDT® Flow Sensor
SS 20.420
Instructions for Use

SCHMIDT® Flow Sensor
SS 20.420

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Impressum:

Revision: 538888.02C

Errors and technical modifications subject to change

1 Important Information

These instructions for use contain all required information for a fast commissioning and a safe operation of **SCHMIDT® flow sensors of the SS20.420 type.**

- These instructions for use must be read completely and observed carefully, before putting the unit into operation.
- Any claims under the manufacturer's liability for damage resulting from non-observance or non-compliance with these instructions will become void.
- Tampering with the device in any way whatsoever - with the exception of the designated use and the operations described in these instructions for use - will forfeit any warranty and exclude any liability.
- The unit is designed exclusively for the use described below (see chapter 2). In particular, it is not designed for direct or indirect protection of personal and machinery.
- **SCHMIDT Technology** cannot give any warranty as to its suitability for certain purpose and cannot be held liable for errors contained in these instructions for use or for accidental or sequential damage in connection with the delivery, performance or use of this unit.

Symbols used in this manual

In the following section, all the symbols used in this manual are explained.

Danger warnings and safety instructions - please read them!

The non-observance of these instructions may lead to personal injury or malfunction of the device.

General information

All dimensions are indicated in mm.

2 Application Range

The **SCHMIDT® flow sensor SS 20.420** (538045) is designed for stationary use in clean rooms, air ducts or air shafts under atmospheric pressure conditions and clean environmental conditions. The sensor measures flow velocity of the measuring medium as standard velocity[1] (unit: m/s) relative to standard pressure of 1,013.25 hPa and standard temperature of 20 °C. The output signal is linear and independent of pressure and temperature of the medium. The decisive characteristics of the product are listed below:

- Measuring task
  - Measurement of flow velocity
  - Detection of flow direction (bidirectional version)
- Application examples
  - Laminar-flow monitoring in cleanrooms
  - Monitoring of room cross-flow
  - Cooling air monitoring
  - Flow measurement in test benches

Only suitable for the use in clean gases.
The medium to be measured must not contain oils, residue forming substances or abrasive particles.

When transporting the sensor or when carrying out not approved cleaning measures, always place the protective cap on the sensor.

The **SCHMIDT® flow sensor SS 20.420** is designed for the use inside closed rooms and is not suitable for outdoor use.

General information

All dimensions are indicated in mm.

[1] Corresponds to the actual velocity under standard conditions.

3 Mounting Instructions

For the installation of the following accessories are available:

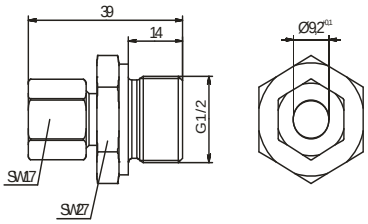
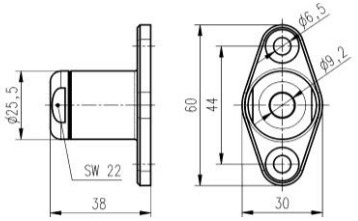
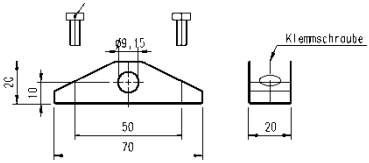
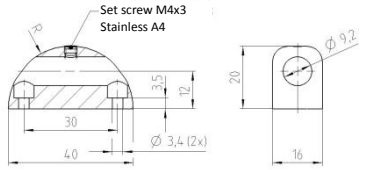
Type / art. no.	Drawing	Assembly
Through bolt joint 532160		- Immersion sensor - Pipe (typ.) - Wall - Incorporation in clamp[2] - Material: Stainless steel 1.4571 Clamp collar PTFE
Wall mounting flange 520181		- Immersion sensor - Wall - Plain surface - To be fixed with: 2 screws M5[3] - Material: Stainless steel 1.4571 PTFE O-ring Viton
Wall mounting bracket 503895		- Room cross-flow - Wall - Plain surface - To be fixed with: 2 screws M5 x 12 - Material: Anodised aluminium
Wall mounting bracket (stainless steel) 551740		- Room cross-flow - Wall - Plain surface - Attachment with: 2 screws M5 x 12 - Material: Stainless steel 1.4404

Table 1

All types fix the sensor via a frictional connection on the sensor tube. This facilitates a stepless positioning of the sensor on the holder in axial direction of the longitudinal sensor axis (immersion depth) and in rotational direction around the same axis (tilting).

- The angle of tilt[4] to flow direction should not exceed ±3° in order to avoid significant measuring errors (> 1 %).

[2] Commercially available welding stud (not included in the delivery) must be welded.
[3] Countersunk head, not included in the delivery.
[4] Deviation between the measuring direction of the sensor head and the flow direction.

- In inhomogeneous, laminar flow fields (for example a quasi-parabolic speed profile in a tube), the sensor tip should be positioned at the place at which the highest speed occurs (adjustment of the immersion depth) since this point has normally the largest distance to interfering elements such as boundary surfaces.

If correctly mounted, both through bolt joint and wall mounting flange are tight up to a gauge pressure of 500 mbar[5].

The customer himself must ensure that the sensor is protected against an unintentional pressing out caused by the overpressure.

Tube-related flow

Installation in a flow guiding tube is carried out by means of a through bolt joint (532160, see Figure 3-1):

- Screw the threaded part of the through bolt joint into the pipe union (hexagon AF 27). Unscrew the spigot nut (AF17) to such an extent that the sensor can be inserted without jamming.
- Introduce sensor into the through bolt joint until its tip is located in the middle of the tube. Then tighten the spigot nut slightly using the fork wrench AF17 to fix the sensor.
- Align sensor to nominal flow direction (direction of arrow) considering that immersion depth must be maintained.

  The angular deviation should not be greater than ±3° referenced to the ideal position. Otherwise measurement accuracy may be affected.

- Tighten the spigot nut by turning the fork wrench (AF17) by a quarter while maintaining the sensor in position.

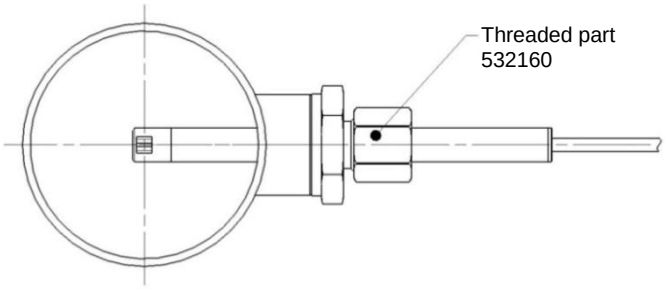


Figure 3-1

[5] The screw-in thread of the through bolt joint must be sealed, e.g. with a teflon tape.

To reach accuracy specified in data sheets, the **SS 20.420** has to be positioned in a straight conduit and at a place with undisturbed flow profile. An undisturbed flow profile can be achieved if a sufficiently long distance in front of the sensor (run-in distance) and behind the sensor (run-out distance) is held absolutely straight and without disturbances (such as edges, seams, bends, etc.).

Correct measurements require laminar[6] flow with as low turbulence as possible.

The design of the run-out distance is also important, since disturbances do not only act **in** the direction of the air flow but also lead to turbulences **opposite** to flow direction.

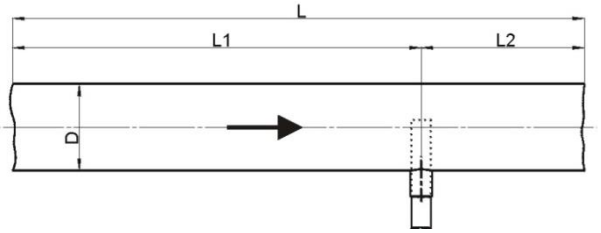


Figure 3-2

L	Length of whole measuring distance
L1	Length of run-in distance
L2	Length of run-out distance
D	Inner diameter of measuring distance

The following Table 2 shows the required straight conduit lengths depending on tube diameter and different disturbances.

This table lists the *minimum values* required in each case. If the listed straight conduit lengths cannot be achieved, measurement accuracy may be impaired or additional actions are required like the use of flow rectifiers[7].

[6] The term “laminar” means here an air flow low in turbulence (not according to its physical definition saying that the Reynolds number is < 2300).

[7] For example honeycombs made of plastics or ceramics; profile factor may change therefore.

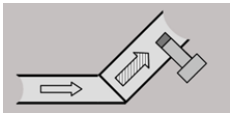
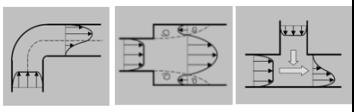
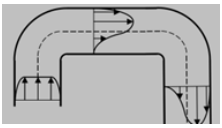
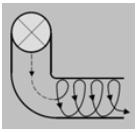
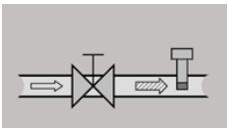
Flow obstacle upstream of measuring distance		Minimum length of run-in distance (L1)	Minimum length of run-out distance (L2)
Light bend (< 90°)		**10 x D**	**5 x D**
Reduction, expansion, 90° bend or T-junction		**15 x D**	**5 x D**
Two 90° bends in one plane (2-dimensional)		**20 x D**	**5 x D**
Two 90° bends with 3-dimensional change in direction		**35 x D**	**5 x D**
Shut-off valve		**45 x D**	**5 x D**

Table 2

When mounting the sensor in a tube with a known cross section area, the output signal of the flow velocity can be used to calculate the standard volumetric flow of the medium.

$$A = \frac{\pi}{4} \cdot D^2$$

$$\overline{w}_N = PF \cdot w_N$$

$$\dot{V}_N = \overline{w}_N \cdot A$$

D	Inner diameter of pipe [m]
A	Cross section area of tube [m^2]
w_N	Flow velocity in the middle of tube [m/s]
$\overline{w}_N$	Average flow velocity in tube [m/s]
PF	Profile factor (for tubes with a circular cross section A)
$\dot{V}_N$	Standard volumetric flow [m^3/s]

For calculating flow velocity or volume flow in pipes for different sensor types, **SCHMIDT Technology** offers a flow calculator that can be downloaded from its homepage.

http://www.schmidt-sensors.com/ or http://www.schmidttechnology.com/

Wall mounting

The wall mounting flange (520181) is designed for installation of the flow sensor **SS 22.400** as an immersion sensor through a wall (e.g. wall of a flow box). The threaded bush included in the delivery has a base provided with a plane contact surface and two holes which allow a fast and easy installation by means of two screws.

All advantages, requirements and installation instructions regarding the stepless sensor installation are applicable for the through bolt joint (see subchapter: Tube-related flow).

Mounting for measuring cross-flow

A cross-flow sensor is fixed by means of a wall mounting bracket (503895 in anodized aluminum or 551740 in stainless steel). The sensor should be placed in flow direction behind the wall opening, whereas the sensor tip must be located in the middle of the opening (see for example figure 3-3 with 503895).

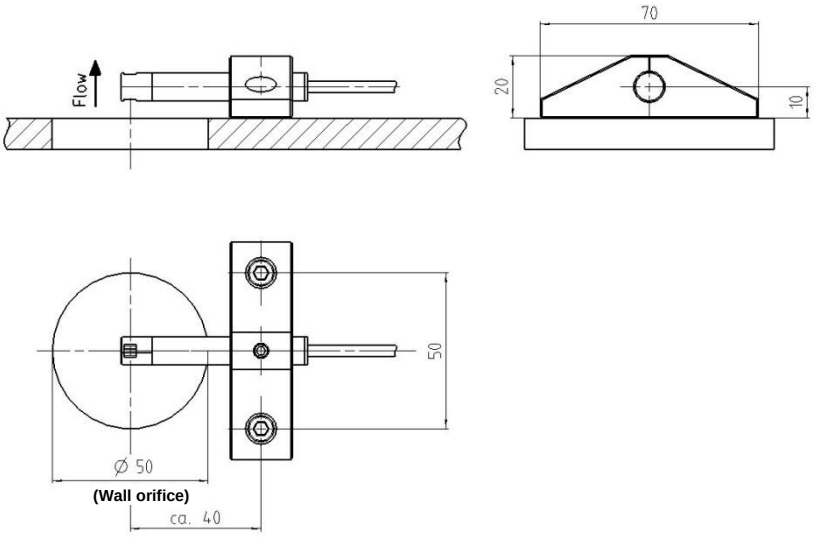


Figure 3-1

The application of a **SS 20.420** with bidirectional measurement capability allows the detection of backflow and is therefore able to signalize critical operating conditions.

4 Electrical Connection

During electrical installation ensure that no voltage is applied and inadvertent activation is not possible.

The sensor is equipped with a firmly attached connection cable (pin assignment see Table 3).

No.	Designation	Function	Wire colour
1	Power	Operating voltage: $+U_B$	brown
2	Flow	Velocity signal w_N	green
3	GND	Operating voltage: mass	white

Table 3

The metallic housing is coupled to GND (VDR[8], in parallel with 100 nF) and should be connected to an anti-interference potential, e.g. GND (depending on the shielding concept).

The appropriate protection class III (SELV) respective PELV (EN 50178) has to be considered.

Operating voltage

The **SS 20.420** is protected against a polarity reversal of the operating voltage.

It has a nominal operating voltage range of U_B = 12 ... 26.4 V_{DC}.

Only operate sensor in the defined operating voltage range (12 ... 26.4 V_{DC}).

Undervoltage may result in malfunction. Overvoltage may lead to irreversible damage to the sensor.

The specifications for the operating voltage are valid for the connection at the sensor. Voltage drops generated due to line resistances must be considered by the customer.

Current consumption of the sensor is typical 6 mA, at maximum less than 10 mA (including signal output current).

[8] Voltage dependent resistor; breakdown voltage 27 V @ 1 mA

Analog signal output

The analog output utilizes a voltage interface and is protected against a short circuit towards both rails.

Signal range:	0 ... 10 V
Type:	high side driver, load resistance against GND
Minimum load resistance R_L:	10 kΩ
Maximum load capacity C_L:	1 nF
Maximum short-circuit current:	10 mA
Maximum cable length:	10 m
Wiring:	

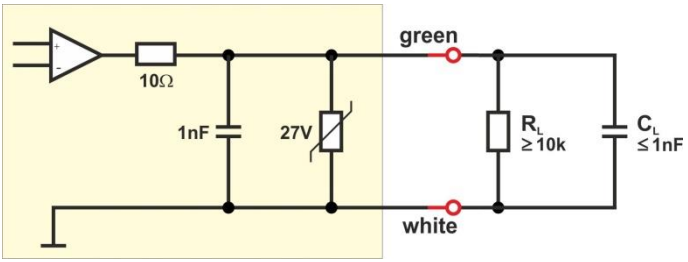


Figure 4-1

The voltage drop[9] in the GND wire of the connecting cable (mass offset) can significantly affect the analog signal of the voltage output.

[9] The specific resistance of the lead of the nominal cable (0.14 mm^2) is 0.138 Ω/m (20 °C); at L = 10 m a current of $I_{B,max}$ = 10 mA can cause a voltage drop up to 14 mV.

5 Signalizing

Analog output

The **SS 20.420** measures flow speed either in one (unidirectional) or optionally in both directions (bidirectional).

- Representation of measuring range and flow direction[10]:

  The measuring range (0 … $w_{N,max}$) of the unidirectional version is mapped proportionally to the whole signaling range (0 … 10 V) of the voltage interface (see Table 4, left column). This direction is defined as the nominal measuring direction (also for the bidirectional version) and marked with two engraved arrows on the sensor tube.

  In case of a bidirectional version (measuring range: $-w_{N,max}$ … + $w_{N,max}$) the representation area of the analog signal output is spread symmetrically, that means a flow of zero complies with 50 % of the signal range (5 V, see Table 4, right column).

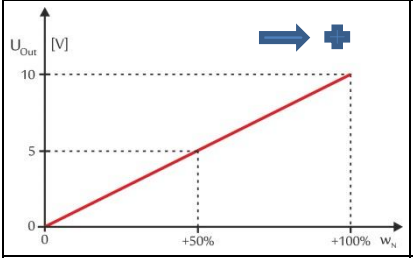
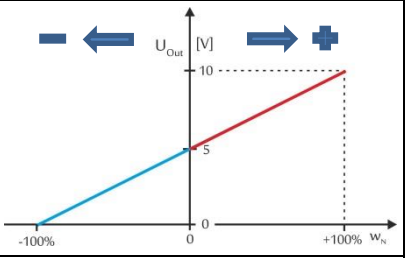
Unidirectional version	Bidirectional version
	
$w_N = \frac{w_{N,\max}}{10V} \cdot U_{Out}$	$w_N = (\frac{U_{Out}}{5V} - 1) \cdot w_{N,\max}$

Table 4

- Overflow:

  Flow speeds which exceed the positive measuring range are furthermore output in a linear way up to 110 % of the measuring range (end value + 10 %), to signalize clearly that there is an overflow. For higher values of flow the output signal remains constant.

- Error signaling:

  The voltage interface (0 … 10 V) is set to 0 V.

[10] Related to nominal measuring direction (defined as positive) of the sensor head.

6 Startup

Prior to turn on the device, the following checks have to be carried out:

- Correct connection of connecting cable in the field.
- Tightness between sensor connector and connecting cable (flat seal must be correctly inserted in the female cable connector).
- Tight fit of the spigot nut on connecting cable connector.

5 seconds after switch-on, the sensor is ready for operation. If the sensor has another temperature than its ambient, this time is prolonged until the sensor has reached ambient temperature.

In case of faults or other problems during installation, the fault table (Table 5) can help to resolve the problem.

If the problems persist, please contact **SCHMIDT Technology**.

7 Information on Continuous Operation

Sterilization

The **SS 20.420** can be sterilized during operation.

Approved disinfectants are alcohol (drying without leaving residues). If too much cleaning agent is applied to the sensor, the "soiling detection" can be activated and the analog signal is set to error state (0 V). As soon as the sensor element is dried, the sensor is automatically reset to its normal function.

Due to its capillarity, the chamber head gap in the sensor tip can be filled completely with cleaning agent. In this case, it is possible that it will take **more than one hour** until the liquid is evaporated and the sensor works again without problems. To accelerate the drying process, the measuring gap can be cleaned by means of a short compressed air blast or similar methods.

Cleaning of the system

If it is necessary at any time to clean the system in which the sensor is included using another cleaning agent than mentioned above, the sensor tip must be protected against the penetration of inappropriate cleaning agents by means of the protective cap included in the delivery. This is especially important for cleaning agents which do not dry without leaving residues or cleaning processes during which dirt may come into the sensor tip.

Prior to carry out problematic cleaning measures (e.g. using inadmissible cleaning agents), the (yellow) protective cap included in the delivery must be placed on the sensor head to protect its sensor element.

See also chapter 8 Service information, subchapter "Cleaning of the sensor head".

8 Service Information

Maintenance

A soiled sensor tip may distort the measured value. Therefore the sensor tip must be checked for soiling at regular intervals. If it is soiled or wetted by a liquid, the sensor sends an error signal via the analog output (0 V). In this case, clean sensor as described below. If the error signal does not disappear after cleaning and drying, the sensor must be sent in to the manufacturer for repair.

Cleaning sensor tip

If the sensor tip is soiled or dusty, it must be carefully cleaned by means of compressed air (avoid strong pressure impulses!). If this procedure is not successful, the sensor tip can be cleaned by immersing and washing it in alcohol which dries without leaving residues (e.g. isopropyl alcohol). As soon as the alcohol has been evaporated, the sensor is again ready for operation.

- Do not shake or tap the wet sensor!
- Do not try to clean the sensor tip by any type of mechanical methods. Do not touch the sensor element located in the chamber head. This may irreversibly damage the sensor.
- Do not use strong cleaners, brush or other objects, fluffy cloths etc. to clean the sensor tip!
- Inappropriate cleaning agents may leave residues on the sensor element and therefore lead to faulty measurements or result in permanent damage to the sensor element.
- If the chamber head gap of the sensor tip is completely filled with cleaning agent, accelerate the drying process by blowing it out, if necessary.

Removing malfunctions

The following Table 5 lists possible errors with a description how to detect them. Furthermore, possible causes and measures to be taken to remove them are listed.

Error image	Possible cause	Remedy
No output signals (A_{Out} = 0 V)	Operating voltage (not / incorrectly connected)	Check operating voltage and wiring
	Sensor defective	Send in for repair
Error message of the sensor A_{Out} = 0 V, although there is a flow	Sensor element wetted	Wait until the element is dry
		Blow out sensor tip (if possible)
	Sensor element soiled	Clean sensor tip
	Sensor element defective	Send in for repair
Unexpected values of analog output Measured A_{Out} too high / low Strong noise or drift	Sensor configuration (measuring range / indication of direction / type of output)	Check order configuration and measurement settings
	Medium to be measured does not correspond to the calibration medium (Standard medium: Air at 1013.25 hPa and 20 °C)	Check medium parameters
	Mounting conditions (tilting / immersion depth / distorsion)	Check mounting conditions
	Irregular flow behaviour (turbulences / other disturbances)	Check run-in distance Increase damping of the measured values
	Sensor element soiled	Clean sensor top etc.
	Operating voltage not OK (stability / value)	Check operating voltage
	Large variations in pressure and temperature	Check medium parameters
	Faulty wiring	Check wiring
	Digital short-circuit protection active	Increase load resistance ($R_L > R_{L,min}$) Reduce load capacity C_L Insert resistor in series to C_L

Table 5

Transport / dispatch of the sensor

Before transport or dispatch of the **SS 20.420**, the delivered protective cap must be put over the sensor head. Avoid soiling or mechanical stress.

Calibration

If the customer has made no other provisions, we recommend repeating the calibration at a 12-month interval. To do so, the sensor must be sent in to the manufacturer.

Spare parts or repair

No spare parts are available, since a repair is only possible at the manufacturers. In case of defects, the sensors must be sent in to the supplier for repair.

When the sensor is used in systems important for operation, we recommend keeping a replacement sensor in stock.

Test certificates and material certificates

Every newly produced sensor is accompanied by a certificate of compliance according to EN 10204-2.1. Material certificates are not available.

Upon request, we shall prepare, at a charge, a factory calibration certificate, traceable to national standards.

9 Technical Data

Measuring quantity	Normal velocity w_N of air based on normal conditions of 20 °C and 1013.25 hPa
Medium to be measured	Clean air or nitrogen; more gases on request
Measuring range	(±) 0 ... 1 / 2.5 / 5 / 10 m/s unidirectional or bidirectional
Lower detection limit	(±) 0.05 m/s
Measuring accuracy[11] - Standard - High precision	 ±(5 % of meas. value +[1 % of end value; min. ± 0.05 m/s]) ±(3 % of meas. value +[1 % of end value; min. ± 0.05 m/s])
Repeatability	±1.5 % of measured value
Response time t_{90}	1 s (configurable: 0.2 ... 10 s)
Analogue output - Voltage	Short circuit protected 0 ... 10 V (R_L ≥ 10 kΩ, C_L ≤ 1 nF)
Operating voltage	12 ... 26.4 V DC
Current consumption	Typical 6 mA (max. 10 mA[12])
Humidity range	Not condensing (≤ 95 % RH)
Operating pressure	Atmospheric (700 ... 1,300 hPa)
Mounting tolerance	±3° relative to nominal flow direction
Operating temperature	0 ... +50 °C
Storage temperature	-20 ... +70 °C
Connection cable	Fixed at housing, 5 m, 3 x 0.14 mm², pigtail, PVC
Protection class	III (SELV) or PELV (EN 50178)
Protection type	Sensor head: IP 67 Cable entry: IP 65
Dimensions / material - Sensor head - Sensor tube - Total length of sensor	 Ø 9 mm x 10 mm Anodised aluminium Ø 9 mm x 50 / 100 mm Stainless steel 1.4404 Ø 9 mm x 60 / 110 mm
Weight	About 40 g

[11] Under reference condition
[12] Including signal output current

10 Declaration of Conformity

EU-Declaration of conformity

SCHMIDT Technology GmbH herewith declares that the product

SCHMIDT® Flow Sensor SS 20.420

Part-No. **538 045**

is in compliance with the following European guideline:

No.: **2014/30/EU**

Text: Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to **electromagnetic compatibility (EMC)**

The following European standards were used for assessment of the product therefore:

- Emission (residence): **EN 61000-6-3: 2007/A1:2011/AC:2012**
- Imission (industrial): **EN 61000-6-2: 2006+A1:2011**

This declaration certificates the compliance with the mentioned directive but comprises no confirmation of attributes. The security advices of the included product documentation have to be observed. The above mentioned product was tested in a typical configuration.

St. Georgen, 28.06.2016

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