R i t t a l GmbH & Co. KG
Auf dem Stützelberg
D – 35745 Herborn

Service - Tel.: (++49) - (0)2772 / 505-1855
Service - Fax: (++49) - (0)2772 / 505-1850

Installation / Operating Instructions

Recooling unit

SK 3318.xxx

SK 3319.xxx

SK 3320.xxx

SK 3334.xxx

SK 3335.xxx

SK 3336.xxx

SK 3338.xxx

SK 3339.xxx

SK 330x.xxx

ENGLISH

For exact type designation see type plate

Important:
It is mandatory to read these operating instructions prior to commissioning and to keep these for future use. The manufacturer cannot accept any liability for damage or operating problems resulting from nonobservance of these operating instructions. The right to make technical changes for further development is reserved.

06/2006 V01

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1. General description

Intended use of the cooling system
The system is used for the cooling of water or of a water-glycol mixture.

When using other media (e.g. de-ionised water) please refer to the technical data contained in the appendix, or contact the manufacturer. The limit values given in the technical data must in no case be exceeded.

Warning:
The use of the system for cooling inflammable or explosive substances is prohibited: Explosion hazard.

2. Important safety measures

General notes
These operating instructions are containing basic notes which must be observed during commissioning, operation and maintenance. It is mandatory, therefore, for the fitter and the responsible operating staff/ operator to read these prior to commissioning. They must always be available at the location of the system. It is a must to observe not only the general safety notes given in this section, but also the special safety notes included in the other sections.

Qualification of personnel and training
The personnel for operation, maintenance, inspection, and installation must have the appropriate qualification for this work. The scope of responsibility, competence, and supervision of the personnel must be defined precisely by the operator.

Risks in case of nonobservance of safety notes
In case of nonobservance of the safety notes hazards may occur for personnel, as well as for the environment and the system proper. Nonobservance of safety notes will entail loss of any rights to claim damages.

Safety consciousness at work
The safety notes listed in these operating instructions, the existing national regulations for the prevention of accidents, and also any further internal work, operating, safety regulations must be observed.

Safety notes for the operating company / operator
Any existing contact hazard protection for moving parts must not be removed from plants being in operation. Hazards due to electrical energy must be excluded. (→ For details on this see, for instance, the VDE regulations and those of the local utilities).

Safety notes for maintenance, inspection, and installation work
On principle, cleaning and maintenance work must be carried out only with the plant in standstill condition. It is mandatory to follow the procedures described in the operating instructions for shut-down of the plant.
Warning! Prior to maintenance work the recooling unit must be switched voltage-free at the input end. Immediately after completion of this work the safety and protective system must be attached again or their function restored.

Unauthorised modification and production of spare parts
Any modification or change of the plant is allowed only as agreed with the manufacturer. Original spare parts and accessories approved by the manufacturer enhance safety. The use of other parts can make void the liability for the consequences arising from this.

Unallowable operating modes
The operational reliability of the system supplied is ensured only in case of intended use. The limit values given in the technical data must in no case be exceeded.

Health hazards originating from the refrigerant
There is only very little risk to the health originating from the refrigerant. Narcotic properties are met only in case of very high concentrations. Following direct effect of very high concentrations this is eliminated again very quickly via the lungs. The refrigerant can have a certain irritating effect on skin and mucous membranes. The effect of liquid refrigerant on the skin may cause frostbite. In the presence of open fire or hot surfaces refrigerants may decompose and form poisonous decomposition products (e.g. hydrogen chloride, phosgene). The refrigerant volatises when escaping in gaseous form into the open. An intentional discharge is not allowed. Refrigerating systems must be positioned in a way that they do not become damaged due to internal traffic and transport processes.

3. Transport and handling

ATTENTION:
Please note when using water refrigerant!

When the recooling unit is stored or transported at temperatures below freezing point the consumer circuit must be drained completely and if necessary flushed with a water-glycol mixture for preventing frost damage.
This also applies to the cooling circuit for water-cooled condensers.

Until first start-up the cooling system may be transported only in its original packaging material. In case of damage the manufacturer must be informed immediately. If the unit is being moved inside the works all connections must be disconnected from the unit. Moving of the unit must be done in a manner that no damage can occur. If damage should occur in spite of these notes, the unit must be inspected prior to renewed start-up by an expert and be repaired if necessary.
A possibly existing tank must be emptied prior to transportation.

When preventing the recooling system the weight specified on the type plate must be taken into consideration. A fork lift truck or transport device of the appropriate carrying capacity should be used.

For preventing damage on transport:

- **The unit may be transported in upright position only.**
- **Suspend the recooling unit for transport only at the lifting rings provided for this purpose or on the pallet supplied with it.**
- **Strong shocks during transport must be prevented.**

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4. Installation

Conditions for Installation

- The site of the recooling unit should be, if possible, directly next to the consumers for avoiding long distances and line losses connected with this. Line losses are mainly caused by:
  - Pressure loss in line system caused by piping resistance and separate resistance due to shut-off fittings and pipe bends.
  - Heat transfer at non-insulated pipelines due to prevailing temperature differential along the piping system.
- The site for the recooling unit chosen should be such that – in case of service intervals or repair work - easy access is possible at any time. This facilitates maintenance and repair.
- It must be assured that the fans are not working in "air short-circuit". Air short-circuits may cause loss of performance of the recooling unit. If ventilation of the room in which the recooling unit is placed is insufficient room temperature may increase due to accumulated waste heat. This may cause a decrease of performance of the cooling unit.

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IMPORTANT:

When installing the recooling unit attention should be paid to the following:

- **With air-cooled recooling units the following minimum distances to wall and ceiling must be maintained:**

  Wall:
  Minimum 1 x height of condenser
  Ceiling:
  Minimum 3 x height of condenser

- **The connection of a duct for fresh and exhaust air is allowed only following prior release by the manufacturer →loss of performance (air-cooled recooling unit).**
- **Do not place the recooling unit in the vicinity of a heating device →loss of performance.**
- **The recooling unit may be positioned only on level firm surfaces . The maximum deviation from the vertical is 2° ensuring a safe stand.**
- **The consumer to be cooled is to be connected to the recooling unit by means of insulated piping or hose connections.**
- **If the consumer is positioned on a higher level than the recooling unit a non-return valve is to be installed in the feed line and a solenoid valve in the return line →to prevent the tank from flowing over.**
- **With recooling units to be sited in the open under a roof the minimum outside temperature should be taken from the technical data.**
- **With recooling units (for water) with a tank at below-zero temperatures a water-glycol mixture of the specified ratio, → see technical data, is to be filled in.**
- **When it is possible to shut-off the consumer circuit an appropriate bypass must be provided to protect the pump.**
- **The circulation pump must never run dry → otherwise the pump will be damaged.**

5. Electrical connection

It is mandatory to observe the following notes:

- The electrical connection, in accordance with the type plate, may be made only by authorised specialist personnel.
- Recooling units must always be integrated into the potential equalisation.
- The conductor cross sections of the power cables must be selected according the rated current (see nameplate).
- The max. voltage drop must not exceed 10%.
- With three-phase current systems the connection must be made with a clockwise rotating field.
- The cooling system must be connected to the mains by means of a disconnecting device ensuring a minimum contact gap of 3 mm in switched-off condition.
- With a transformer installed (option) one must check whether it is connected to the correct terminal (on primary side).

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6. Start-up

- **When connecting the recooling unit to the fluid circuit to be cooled the latter should always be flushed. This procedure prevents any depositions existing in the fluid circuit to contaminate the recooling unit which may, under circumstances, cause damage to or failure of the internal pump.**
- Unpack unit, place it on a level surface and align it using a spirit-level.
- With air-cooled recooling units the siting selected must be such that no “air short-circuiting” (hot air exit ← → air intake condenser) can occur.
- Observe allowed ambient temperature and wall distance.
- Connect to mains.
- Make media connections.
- Make cooling water connections (water-cooled condenser).
- Nominal width of piping must correspond at least to the nominal width of media connections at unit.
- Fill medium into the unit.
- For closed systems: please prepare an admission pressure of 1.2-2 bar.
- Start up recooling unit.
- Check direction of rotation of motors.
- Vent piping, top up medium.
- Activate cooling water circuit (water-cooled condenser).
- Check connection lines and pipe connections during start-up phase for leak-tightness.

Prolonged standstill
If a prolonged standstill of the system is intended, drain the medium circuit completely. For renewed start-up of the system the same checks are be carried out as with initial start-up.

7. Hydrological data

In order to prevent problems in the water circuit (this also applies to water-cooled units) it is mandatory to comply with the VEB Cooling water guidelines (VGB-R 455 P).
Antifreeze component in cooling water: see technical data

Cooling water and/ or cold water must not cause sediments of water scale or lose precipitation. It should also be of low hardness, in particular of low carbonate hardness. Particularly with cooling by circulating operation carbonate hardness should not be too high. On the other hand, the water should not be soft to an extent that materials are attacked. When the cooling water is recooled the salt content should not increase due to evaporation to an extent that with increasing concentration of dissolved substances the electric conductivity increases, making the water more corrosive. Therefore, not only a corresponding amount of fresh water must always be added, but also a part of the enriched water must be taken out.

Note:
We have to point out again that without water treatment it is only seldom possibly to achieve satisfactory conditions. The water treatment by the client must ensure that even with extreme conditions depositions and corrosion are avoided.

IMPORTANT
Only fill in distilled or DI water in recooling units specified for this purpose (see data sheet).

Treatment and/ or maintenance of the water in recooling units

The cooling water must meet particular conditions, depending on the installation to be cooled. Depending on its contamination and size and design of the recooling unit a suitable process will then be employed for water treatment and/ or maintenance. The most frequent types of contamination and normal processes for dealing with these in industrial cooling are:

- **Mech. contamination:**
  Filtering of the water using screen filters, gravel filters, cartridge filters, precoated filters
- **Hardness too high:**
  Softening of the water by ion exchange
- **Moderate content of mechanical contamination and hardness constituents:**
  Softening of the water by ion exchange
- **Moderate content of chemical contamination:**
  Inoculation of the water with passivators and/ or inhibitors
- **Biological contamination, slime bacteria, and algae:**
  Inoculation of the water with biocides

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Check water quality regularly.
Evaporation processes at the system water surface have a thickening effect on the system water. Remove thickened water from the system by water exchange, in order to keep water values within the required limits.

The properties of the water used should not deviate from the hydrological data listed below.

pH value	7 - 8,5	
Carbonate hardness	3 - 8° dH	
Free carbon dioxide	8 - 15 mg/dm^3	
Associated carbon dioxide	8 - 15 mg/dm^3	
Aggressive carbon dioxide	0 mg/dm^3	
Sulphides	Zero	
Oxygen	< 10 mg/dm³	
Chloride ions	< 50 mg/dm³	
Sulphate ion	< 250 mg/dm³	
Nitrates and nitrites	< 10 mg/dm³	
CSB (chemical oxygen consumption)	<7 mg/dm³	
Ammonia	< 5 mg/dm³	
Iron	< 0.2 mg/dm³	
Manganese	< 0.2 mg/dm³	
Conductivity	200 – 2200 µS/cm	
Residue on evaporation	< 500 mg/dm³	
Potassium permanganate consumption	< 25 mg/dm³	
Suspended matter	< 3 mg/dm³	
	3 – 15 mg/dm³	Split stream cleaning recommended
	> 15 mg/dm³	Continuous cleaning recommended

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8. Maintenance

The cooling circuit which is a hermetically sealed system has been filled at works with the required volume of refrigerant, tested for leak tightness, and subjected to a functional trial run.

Attention!

Prior to maintenance work the recooling unit must be switched voltage-free at the input end.

Important!

- **For ensuring proper function of the recooling unit it is a must to take care that the laminae of the air-cooled condenser are kept clean.**
- **Oil-containing ambient air in combination with dust will cause increased dirt deposition on the condenser laminae. Here, the following should be observed:**

Simply sweeping the outside with the fan running will not afford thorough cleaning. It is absolutely necessary to use oil-solving agents, like cleaner's naphtha, or similar, for cleaning and we recommend using a spray gun for penetrating into the depth of the condenser. When doing this, functional components, mounted in the lower part, must be well covered in order to remove the flushed contamination and to prevent damage to surrounding components. Cleaning should be done at regular intervals with the frequency depending on the degree of contamination in the room where the system is put up.

With cooling of / with water or similar media please pay attention always to:

- **Solid matter residues (clean used filters regularly, if applicable)**
- **Algae and depositions**
- **Corrosion**

may cause irreversible damage to the recooling unit. Such residues will always have the effect that the performance of the recooling unit can suffer. The manufacturer's guarantee and liability become void in cases of incorrect use and treatment of the recooling unit. In such cases we do not accept any liability for damage.

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Summary of service activities recommended by us

Compressor

- No servicing is required with fully hermetic compressors.

Fan (air-cooled recooling unit)

- Check noise level
  → ½ year

Condenser (air-cooled recooling unit)

- Clean laminae by compressed air or by sweeping
  → 2 months
- Clean filter mat
  → 4 weeks

Condenser (water-cooled recooling system)

Please note the special data in the appendix

Inspection glass cooling circuit (unit-specific)

- Check moisture indicator,

  green for dry = OK, yellow for moist, possible moisture in cooling circuit or condenser defect

  → ½ year

Consumer medium

- Check medium circuit for contamination and possible solid matter (chips or similar)
  → 4 weeks

Tank, components, and all connections (piping, valves and fittings, hoses) of consumer circuit

- Check for leaks
  → 1 week

Filling level medium

- Check for sufficient filling level, top up if necessary
  → 1 week

Electrical connections

- Check terminals and connections
  → ½ year

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9. Shutting down / disposing the cooling system

Shutting down / disposing the recooling unit may be carried out only by authorised expert personnel. Because the refrigerant will volatise when escaping in gaseous form into the open intentional blowing off is not permitted. The refrigerant and the components of the cooling unit must be disposed of in accordance with the rules of the trade and local regulations. The same applies to the oil in the compressor and possibly present waste water.

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10. General fault analysis

Problem	Possible cause	Remarks
Insufficient cooling performance resp. low air outlet temperature from condenser at ambient temperature. **Refrigerant shortage**	- Refrigerant shortage is announced by a marked drop of cooling performance. The cooling circuit is leaking in this case.	- Eliminate leakage and top up cooling circuit again. The cooling circuit may be repaired by a specialist firm only. In case of cooling circuit problems please contact the manufacturer.
Increased condenser pressure When the allowed condenser pressure is exceeded the high-pressure limiter will trip and switch off the compressor. An indicator light or a fault indicator (option) gives a fault message.	- Too high ambient temperature (see technical data) - Nonobservance of required distances (see siting) - Contaminated condenser or filter (option) - Too high feed medium temperature (see technical data) - Water-flow controller defective (with water-cooled units only) - Contamination of cooling water inlet / outlet (with water-cooled units only) - Cooling water temperature outside limits (with water-cooled units only, see technical data) - Cooling water shortage (with water-cooled units only, see technical data)	- A specialist is needed for manual resetting of the high-pressure limiter
Evaporator pressure If the required evaporator pressure is not reached the low-pressure limiter (option) trips and switches off the compressor. An indicator light or a fault indicator (option) gives a fault message.	- Too low ambient temperature (see technical data) - Refrigerant shortage - Expansion valve or capillary tube defective - Operation solenoid valve defective (if existing, see wiring plan) - When using evaporating coils in tank: not enough medium in tank	- The evaporating coils must be covered completely by the medium.
Compressor is continuously being switched on and off	- Cooling performance of recooling system too high - Differential gap of controller too small - Medium temperature too high	- Check parameter setting - Check temperature of medium

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Problem	Possible cause	Remarks
Unit does not work	- Check voltage supply - Contactor defective	- Check function and rating of current supply.
Compressor, pump, and fan are working **Cooling performance low** **Current input high**	- Condenser or air inlet filter heavily contaminated - Air short-circuit: hot air is taken in again because of obstacles at place of siting	- Cleaning without using any aggressive agents - Remove obstacles or re-direct air flow
Insufficient cooling effect and condensate formation at condenser	- Volume flow through evaporator too low	- Check function of pump - Check heat loss of hydraulic circuit
Compressor without function An indicator light or a fault indicator (option) gives a fault message.	- Thermal stop of compressor (motor circuit-breaker)	- Condenser pressure too high (contaminated air filter or condenser) - Air short-circuit - Ambient temperature too high (>45° C)
Fan without function An indicator light or a fault indicator (option) gives a fault message	- Thermal stop of fans (motor circuit-breaker)	- High pressure loss (Obstacles in area of air outlet). - Fan blocked
Pump without function An indicator light or a fault indicator (option) gives a fault message	- Thermal stop of pumps (motor circuit-breaker)	- Compare pressure of pump with data on nameplate - Cooling insufficient (air inlet contaminated) - Pump blocked
No medium circulation An indicator light or a fault indicator (option) gives a fault message	- Pump blocked - Valve shut possibly	- Check pump - Open the valve in question

While in continuous operation, the recooling system is in stable operating condition. The recooling system keeps the medium feed temperature at the set desired value.
Possible causes for deviation from desired value could be:

- Cooling demand too high (see technical data) - Too high ambient temperature (see technical data) - Required distances are not held (see technical data) - Evaporator contaminated - Condenser contaminated	- Refrigerant shortage (bubble formation in inspection glass) - Medium level too low in tank (not with once-through cooler) - Medium temperature set too low (see technical data) - Parameters set incorrectly

11. Appendix

- **Technical data**
- **P+ID Schematics**
- **Wiring plan**
- **Description of components**

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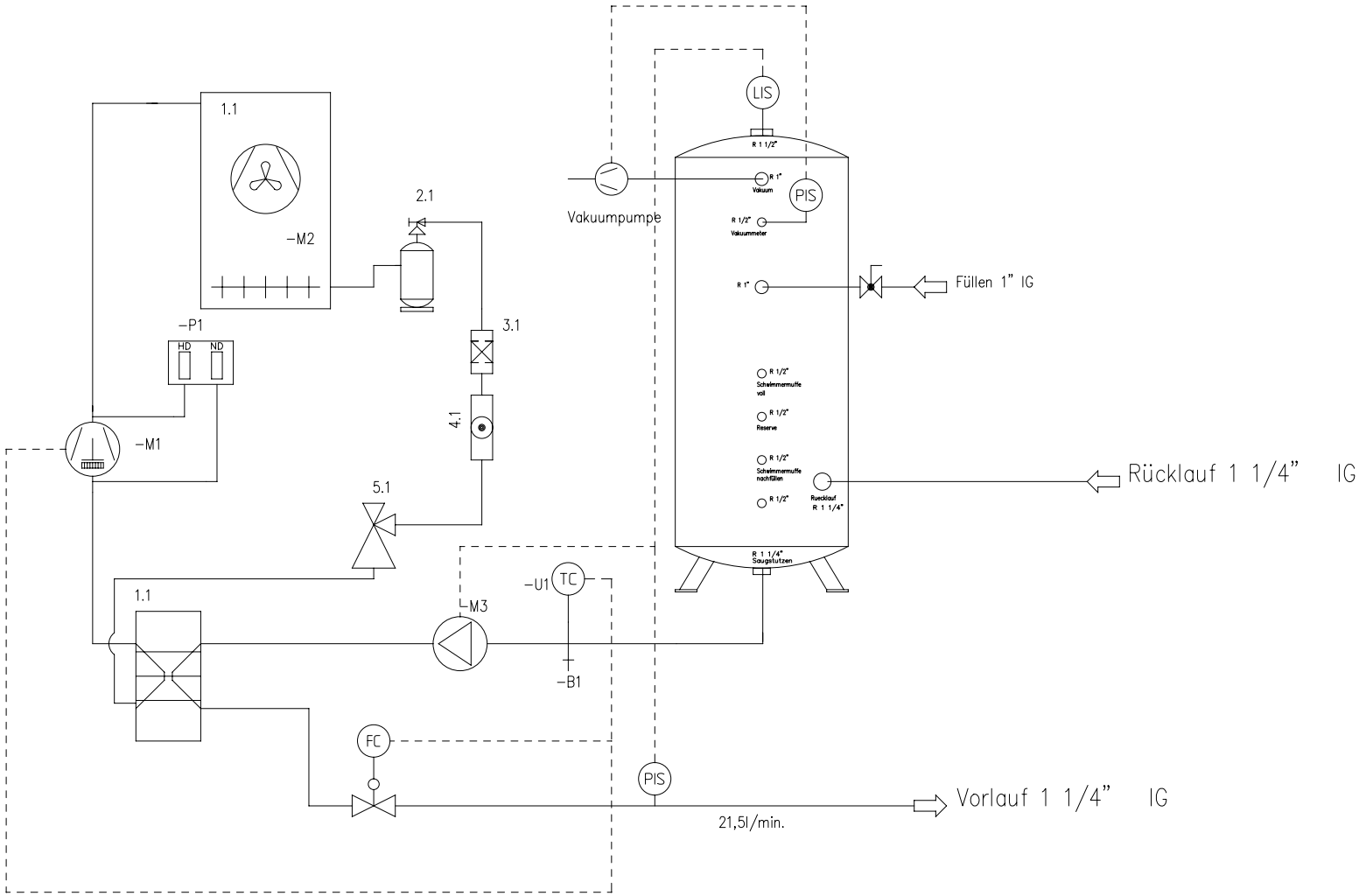
Technische Daten
Technical data
Caractéristiques techniques
Dati tecnici

SK3335.069, WA Nr.: 6952001/001, Masch.-Nr. 06 06 19

Deutsch	**English**	**Français**	**Italiano**	
Nennspannung	Rated voltage	Tension nominale	Tensione nominale	**400 V / 3~ / PE**
Netzfrequenz	Mains frequency	Fréquence du réseau	Frequenza di rete	**50 Hz**
Nennstrom	Rated current	Courant nominal	Corrente nominale	**12 A**
Steuerspannung	Control voltage	tension de contrôle	Controlli la tensione	**24VDC / 230 VAC**
Anlaufstrom	Start-up current	Courant de démarrage	Corrente di spunto	**3 x I_{Nenn}**
Anschluss-leistung	Connected load	Puissance connectée	Potenza allacciata	**4200 W**
Kühlleistung	**Cooling output**	**Puissance frigorifique**	**Potenza frigorifera**	**6000 W** T_{W1} **= +18°C /** T_U **= +32°C**
Kältemittel	Refrigerant	Agent réfrigérant	Refrigerante	**R407 C**
Kältemittelmenge	Refrigerant quantity	Quantité de réfrigérant	Quantità di refrigerante	**3,5kg**
Temperaturbe-reich Umgebung	Temperature range ambient air	Zone de température de l'air ambiant	Gamma di tem-peratura dell'aria ambiente	**+10°C bis +43C**
Tank	Tank capacity	Capacité de réservoir	Volume utile vasca	**150 ltr.**
Geräuschpegel	Noise level	Niveau sonore	Livello di rumorosità	**70 dB(A)**
Gewicht	Weight	Poids	Peso	**280 kg**
Abmessungen	Dimensions	Dimensions	Dimensioni	
Breite	Width	Largeur	Larghezza	**1200 mm**
Höhe	Height	Hauteur	Altezza	**2000 mm**
Tiefe	Depth	Profondeur	Profondità	**600 mm**
Temperatur Vorlauf	Temperature outlet	Température vidange	Temperatura scarico	**+18°C**
Hysterese	Hysteresis	Hystérésis	Isteresi	**+2 K**
Nennförder-leistung	Rated delivery power	Puissance nominale de débit	Potenza nominale di flusso	**21,5 ltr./min bei 0,5bar absolut**
Rohranschluss, Vorlauf	Pipe connection, outlet	Connexion de tuyau, vidange	Connessione tubo, scarico	**1 ¼“ IG**
Rohranschluss, Rücklauf	Pipe connection, inlet	Connexion de tuyau, admission	Connessione tubo, immissione	**1 ¼“ IG**
Frostschutzanteil	Anti-frost agent content	Part de l'antigel	Percentuale antigelo	**30 % max**
Wir empfehlen:	We recommend:	Fournisseur préconisé:	Nostra direttiva interna:	
Hersteller	Manufacturer	Fabricant	Fornitore	**Clariant**
Typ	Type	Type	Tipo	**Antifrogen N**



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RITTAL GmbH & Co. KG

Auf dem Stützelberg
D-35745 Herborn

http://www.rittal.de

Plant designation	SK 3335.169
Maschine number	06 06 19
Drawing number	06 06 19

Incoming supply	3 x 400V/PE
Control voltage	24VDC/ 230VAC
max. power supply	4,2kW
max. current supply	12A

Project leader :
Last change : 22.06.06
Last processor : TRA

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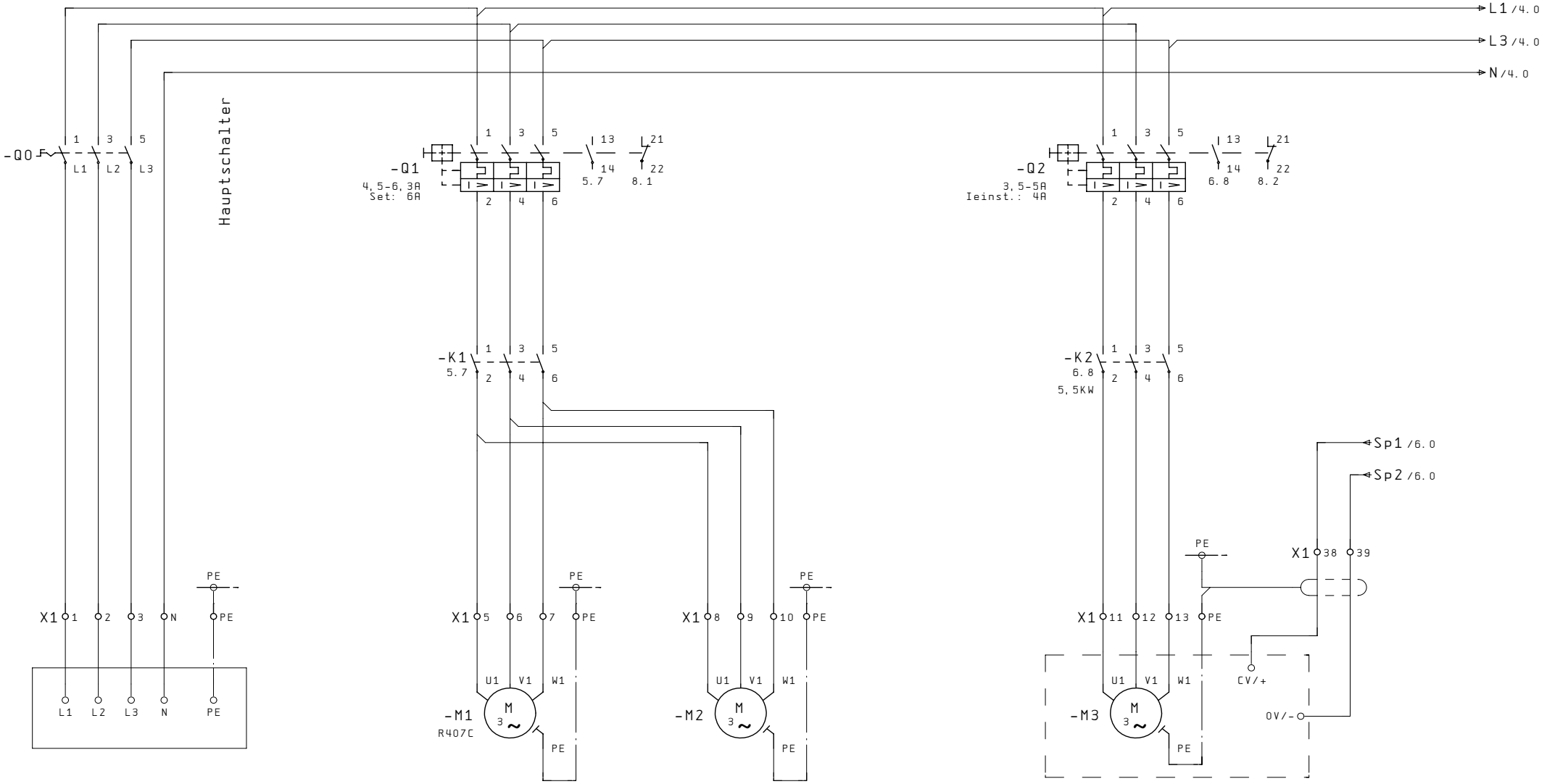

Input

3x400V / PE /50 Hz

Compressor

MTZ 28-4
U: 400V 50Hz
I: 5,5A
P: 3,2KW

Fan

S 4 D 350
U: 400V 50Hz
I: 0,34A
P: 0,16KW

Pump

MHIE 205-2G
U: 400V
I: 4A
P: 1,5KW

0...10V Signal Pump

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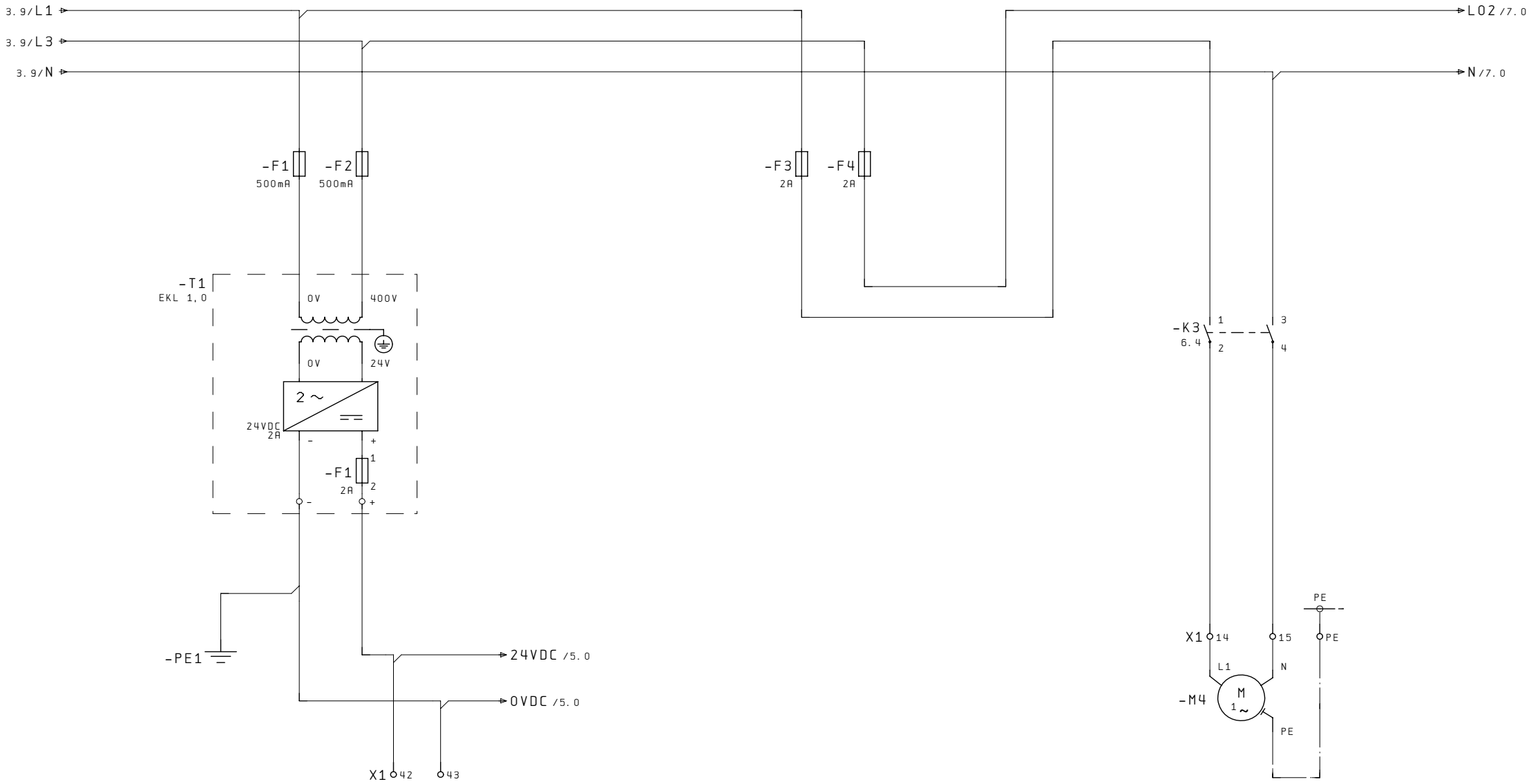

for extern signals

Vakuum pump

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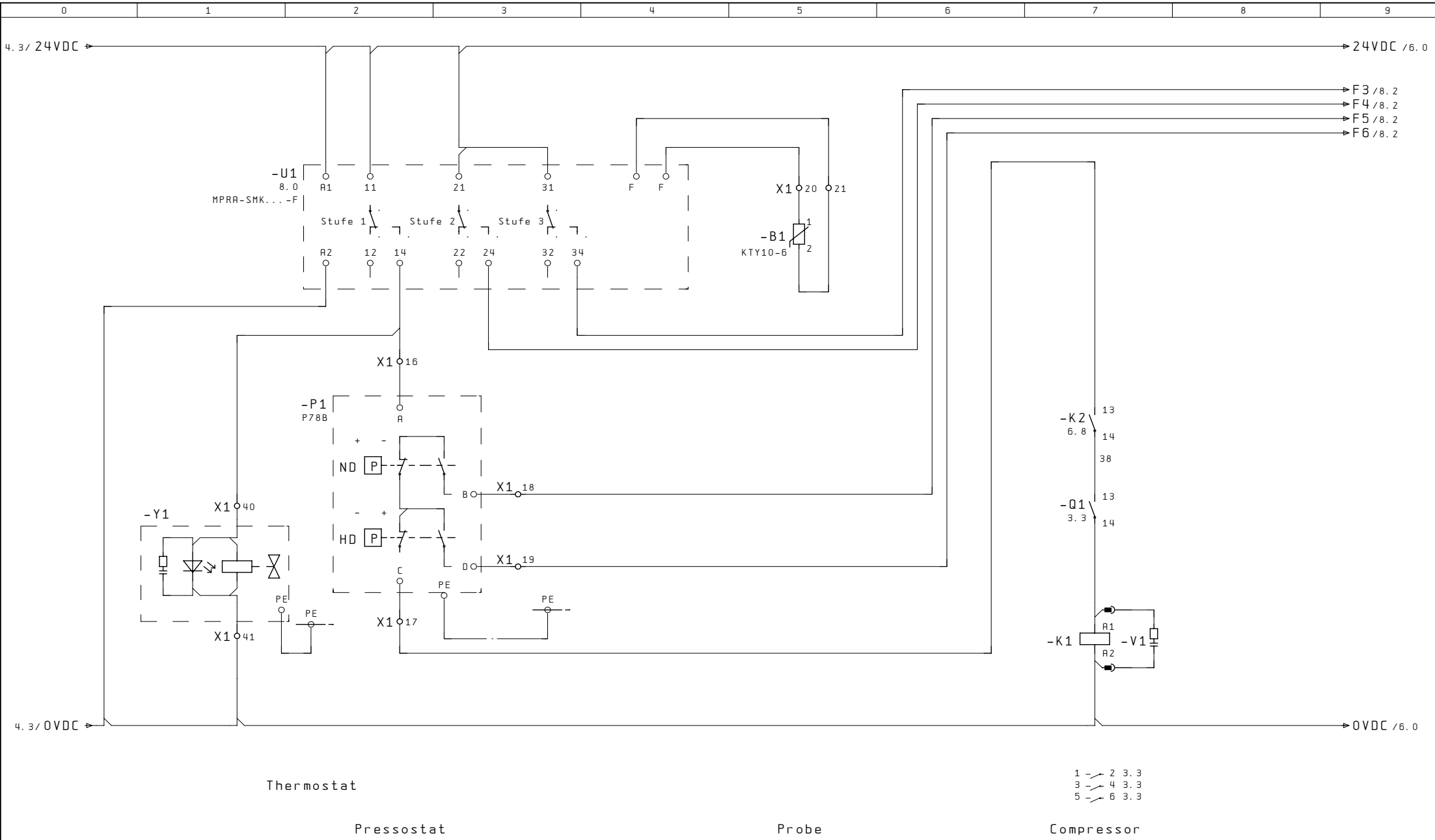

Thermostat

Pressostat

Probe

Compressor

4

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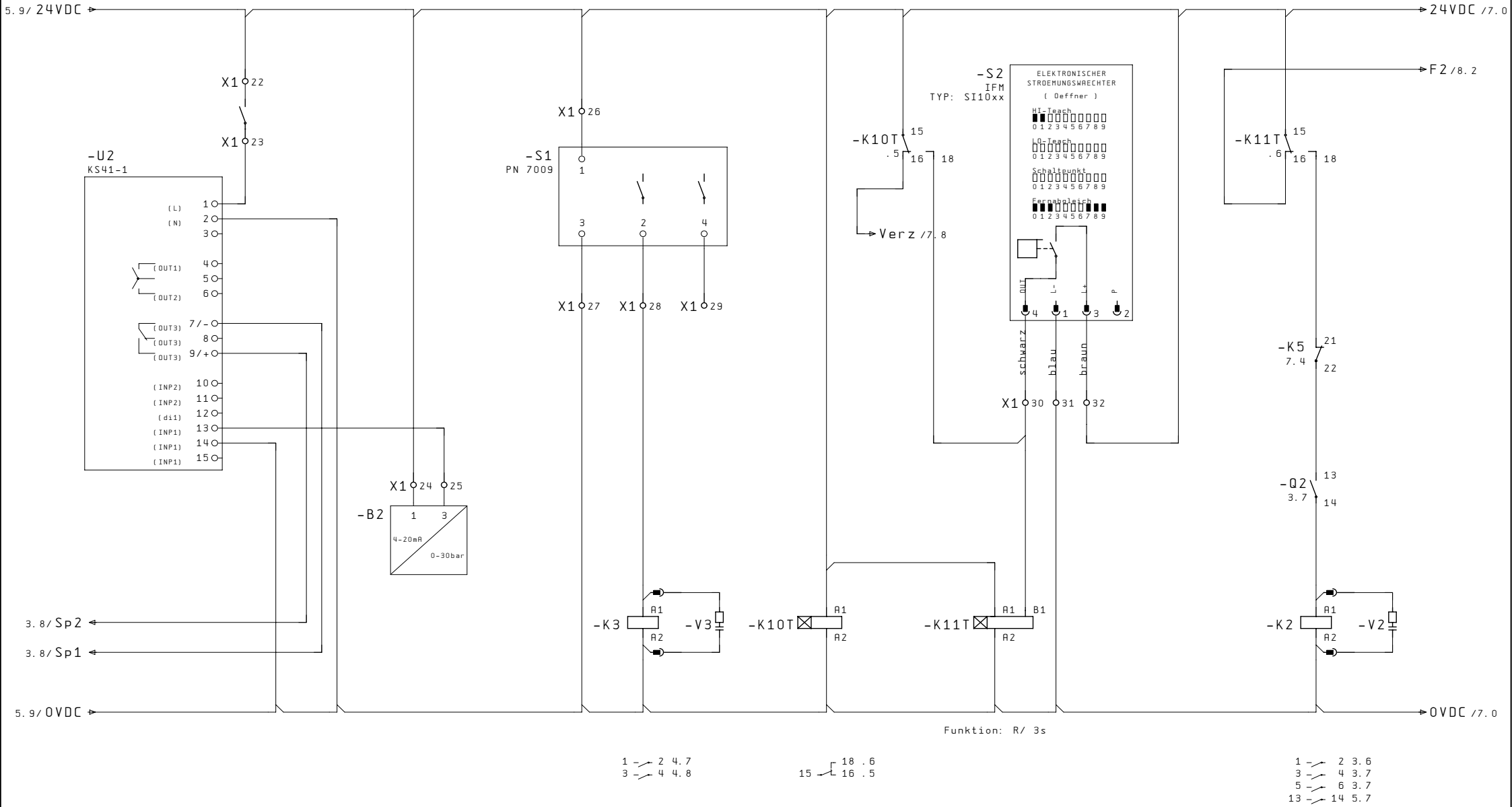

Remote

Pressure control -B2

Pressure control S1

Float switch -S2

Regulator for pump M3

Vakuum pump

Pump

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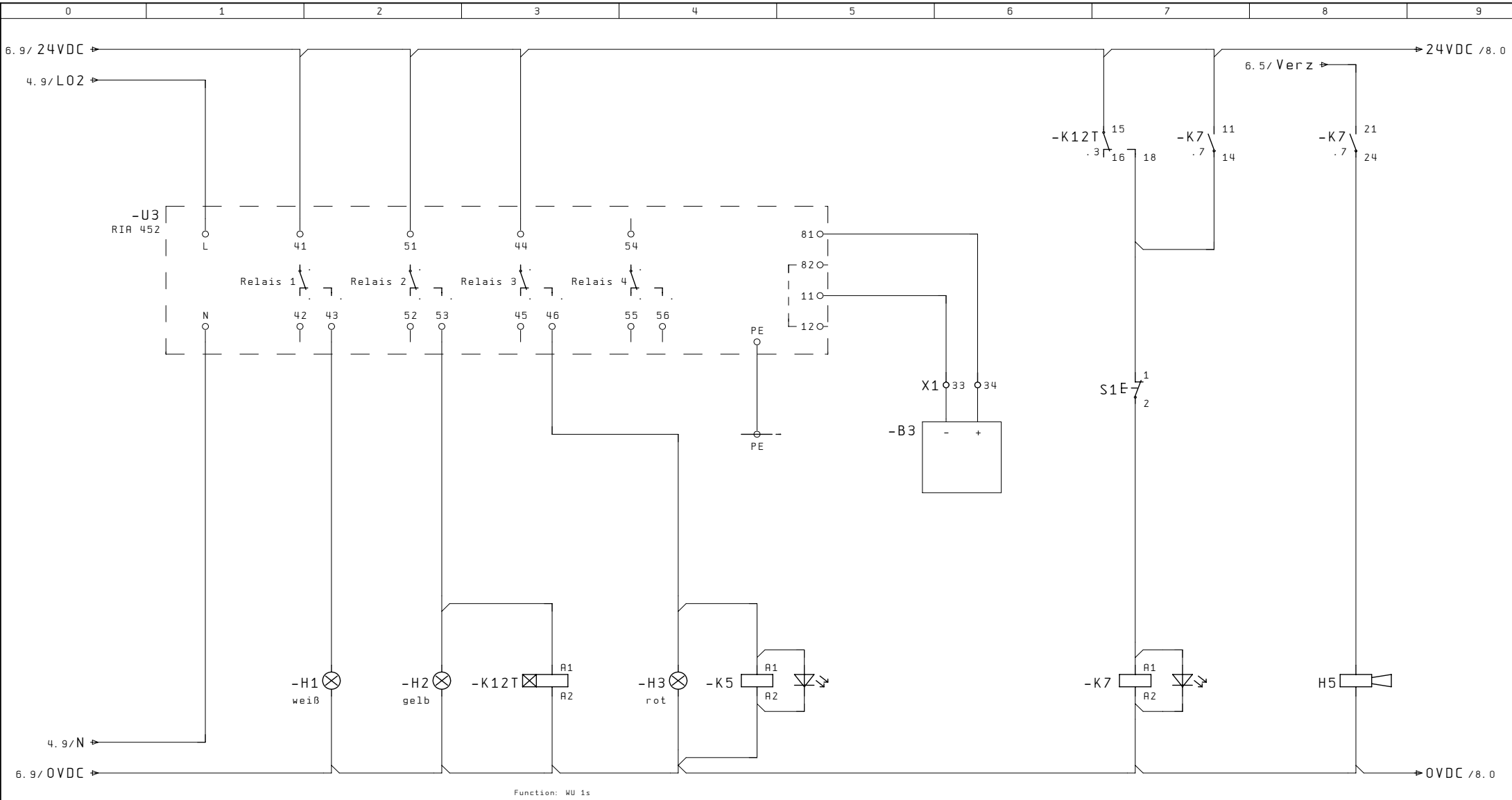
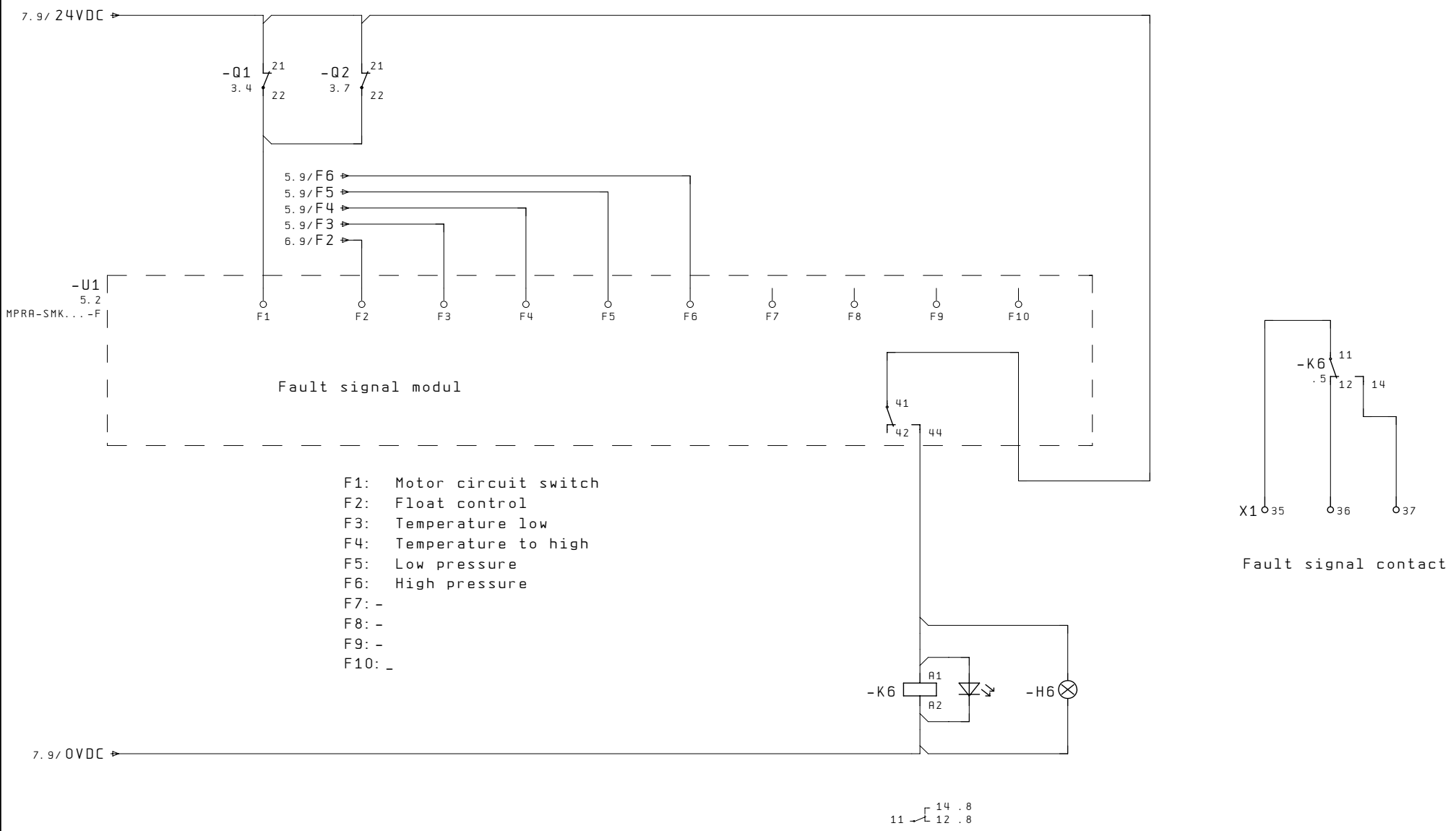
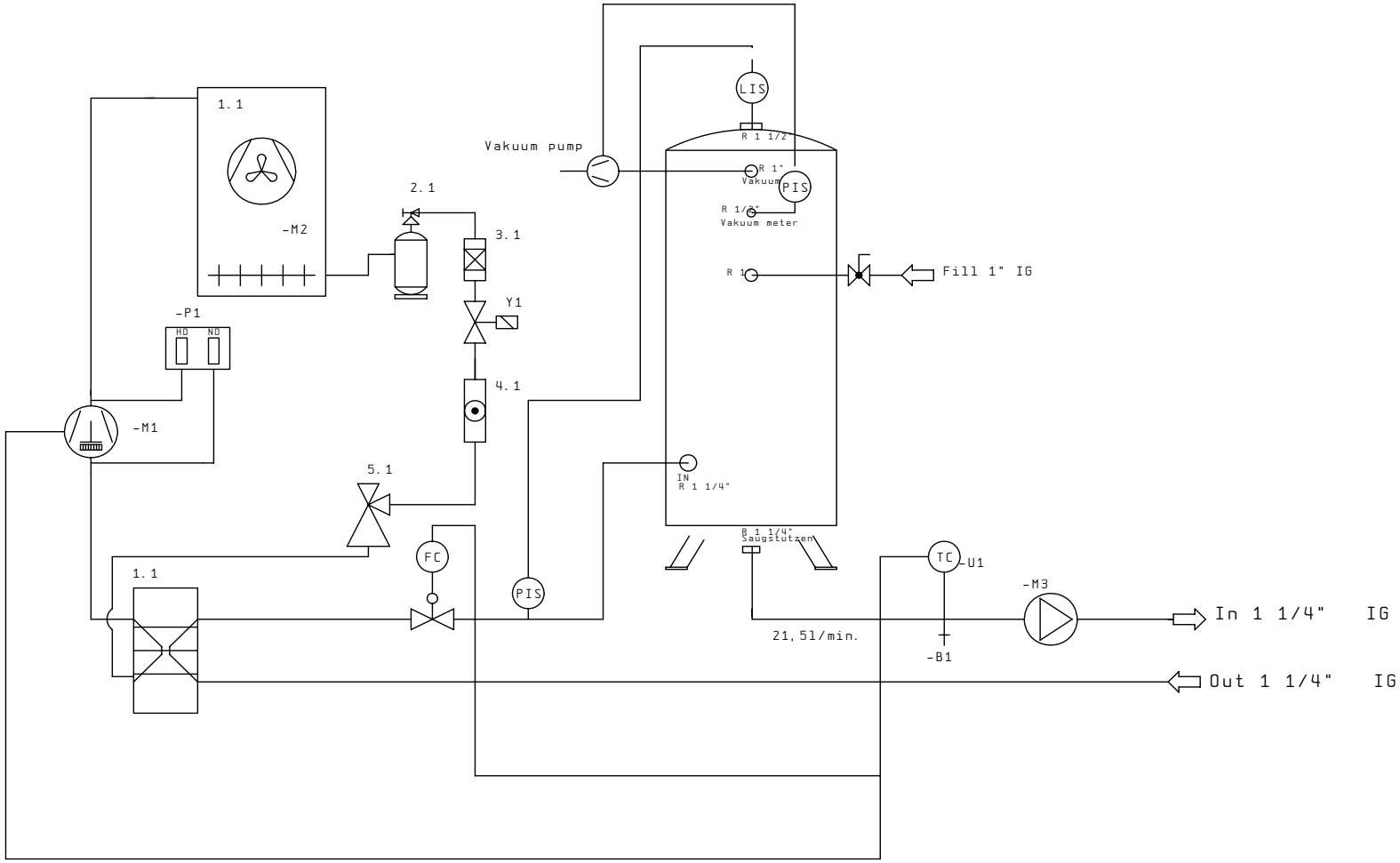
			Gepr.	22.06.06				Bl. 6
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.	12 Bl.



			Datum		WA 6952001/001	Rittal GmbH & Co. KG	Water level control	Zeichnungsnummer: 06 06 19	=
			Bearb.	TRA		Auf dem Stützelberg			+
			Gepr.	22.06.06	SK 3335.169	D - 35745 Herborn			Bl. 7
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.		12 Bl.



			Datum		WA 6952001/001	Rittal GmbH & Co. KG Auf dem Stützelberg D - 35745 Herborn	Fault signal	Zeichnungsnummer: 06 06 19	=
			Bearb.	TRA					+
			Gepr.	22.06.06	SK 3335.169				Bl. 8
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.		12 Bl.



8 10

			Datum		WA 6952001/001	Rittal GmbH & Co. KG	Flowdiagram	Zeichnungsnummer: 06 06 19	=
			Bearb.	TRA		Auf dem Stützelberg			+
			Gepr.	22.06.06	SK 3335.169	D - 35745 Herborn			Bl. 9
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.		12 Bl.

Clamp plan

ESSK016D

Name of terminal blockX1

Cable name	wire	cable type	Target-name	Connect	Cl.-Nb.	Brigde		Target name	Connect	Cable name	wire	Cable type	Side/ Path	Function text
			L1		1		L1	-Q0	L1				3.0	Input
			L2		2		L2	-Q0	L2				3.0	=
			L3		3		L3	-Q0	L3				3.1	=
			N		N		N	-K3	3				3.1	=
					PE								3.1	=
			-M1	U1	5			-K1	2				3.3	Compressor
			-M1	V1	6			-K1	4				3.3	=
			-M1	W1	7			-K1	6				3.3	=
					PE								3.3	=
			-M2	U1	8			-K1	2				3.4	Fan
			-M2	V1	9			-K1	4				3.4	=
			-M2	W1	10			-K1	6				3.4	=
					PE								3.5	=
					11			-K2	2				3.6	Pump
					12			-K2	4				3.7	=
					13			-K2	6				3.7	=
					PE								3.7	=
			-M4	L1	14			-K3	2				4.7	Vakuum pump
			-M4	N	15			-K3	4				4.8	=
					PE								4.8	=
			-P1	A	16			-U1	14				5.2	Pressostat
			-K2	13	17			-P1	C				5.2	=
			-U1	F5	18			-P1	B				5.3	=
			-U1	F6	19			-P1	D				5.3	=
WX1/-B1	1		-B1	1	20			-U1	F				5.5	Probe
WX1/-B1	2		-B1	2	21			-U1	F				5.5	=
					22	●		-U1	31				6.1	Remote
			-U2	1	23	┃							6.1	=
			-B2	1	24	●							6.2	Pressure control -B2
			-B2	3	25	┃		-U2	13				6.2	=
			-S1	1	26	●		-K10T	A1				6.3	Pressure control S1
			-U2	2	27			-S1	3				6.3	=
			-K3	A1	28			-S1	2				6.4	=
					29			-S1	4				6.4	=
			-K11T	B1	30								6.6	Float switch -S2
			-K11T	A2	31			-S2	1				6.6	=
					32								6.7	=
			-B3	-	33			-U3	11				7.6	Water level sensor
			-B3	+	34			-U3	81				7.6	=
					35			-K6	11				8.7	Fault signal contact
					36			-K6	12				8.8	=
					37			-K6	14				8.8	=
					38			-U2	7/-				3.8	0...10V Signal Pump
					39			-U2	9/+				3.8	=
					40			-U1	14				5.1	
					41								5.1	
					42			-T1	+				4.2	for extern signals
					43			-T1	-				4.2	=

			Datum	22.06.06	WA 6952001/001	Rittal GmbH & Co. KG	Clamp plan X1	Zeichnungsnummer: 06 06 19
			Bearb.	TRA	SK 3335.169	Auf dem Stützelberg		
			Gepr.	22.06.06		D - 35745 Herborn		
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.	

= + Bl. 10 12 Bl.

List of parts

NIL_133E / 02.04.03

COMPONENT	AMOUNT	DESIGNATION	ORDER NUMBER	IDENTIFICATION	SUPPLIER	PAGE PATH
-B2	1	DRUCKTRANSMITTER 1/4"	DRUCKTRANSMITTER 1/4"	DRUCKTRANSMITTER 1/4"	Wilo	6.1
-B3	1	Messwertaufnehmer	942205-9000	MULTICAP T DC11TEN	Endress&Hauser	7.5
-F1	1	Feinsicherungshalter 5x20mm, 2,5qmm	ASK 1	ASK 1	Weidmueller	4.2
-F2	1	Feinsicherungshalter 5x20mm, 2,5qmm	ASK 1	ASK 1	Weidmueller	4.2
-F3	1	Feinsicherungshalter 5x20mm, 2,5qmm	ASK 1	ASK 1	Weidmueller	4.5
-F4	1	Feinsicherungshalter 5x20mm, 2,5qmm	ASK 1	ASK 1	Weidmueller	4.5
-H1	1	Leuchtmelder mit glatter Linse (ws)	3SB32 44-6AA60	3SB32 44-6AA60	Siemens	7.2
-H2	1	Leuchtmelder mit glatter Linse (ge)	3SB32 44-6AA30	3SB32 44-6AA30	Siemens	7.2
-H3	1	Leuchtmelder mit glatter Linse (rt)	3SB32 44-6AA20	3SB32 44-6AA20	Siemens	7.4
-H6	1	Leuchtmelder mit glatter Linse (rt)	3SB32 44-6AA20	3SB32 44-6AA20	Siemens	8.6
-K1	1	SCHÜTZ, 230 V,50/60 Hz, 5,5 KW,1S,	3RT10 17-1AP01	3RT1017-1AP01	Siemens	5.7
-K2	1	SCHÜTZ, 230 V,50/60 Hz, 5,5 KW,1S,	3RT10 17-1AP01	3RT1017-1AP01	Siemens	6.8
-K3	1	SCHÜTZ 24VDC, 5,5kW, 1S	3RT1017-1BB41	3RT1017-1BB41	Siemens	6.4
-K5	1	Relais RSS214-24VDC	RSS214-24VDC	RSS214-24VDC	Tele	7.4
-K6	1	Relais RSS214-24VDC	RSS214-24VDC	RSS214-24VDC	Tele	8.5
-K7	1	Relais RSS214-24VDC	RSS214-24VDC	RSS214-24VDC	Tele	7.7
-K10T	1	Zeitrelais MRF 24VAC/DC-110-240VAC	MRF	MRF	Conta-Clip	6.5
-K11T	1	Zeitrelais MRF 24VAC/DC-110-240VAC	MRF	MRF	Conta-Clip	6.6
-K12T	1	Zeitrelais MRF 24VAC/DC-110-240VAC	MRF	MRF	Conta-Clip	7.3
-M1	1	Kompressor MTZ28-4	MTZ28-4	MTZ28-4	Maneurop	3.3
-M2	1	Lüfter S4D-350-AP08-01	S4D-350-AP08-01	S4D-350-AP08-01	EBM	3.4
-M3	1	Pumpe MHIE 205/2G mit Frequenzumrichter	MHIE 205/2G	MHIE 205/2G	Wilo	3.6
-M4	1	VAKUUM-PUMPE N026ANE	VAKUUM-PUMPE N026ANE	VAKUUM-PUMPE N026ANE	KNF	4.7
-P1	1	Duo-Druckwächter P 78 B	P 78 B	P 78 B	PENN	5.2
-Q0	1	Hauptschalter 9,5kW, 25A, Schwarz	3LD2103-0TK51	3LD2103-0TK51	Siemens	3.0

			Datum	21.06.06	WA 6952001/001	Rittal GmbH & Co. KG Auf dem Stützelberg D - 35745 Herborn	Stückliste	Zeichnungsnummer: 06 06 19
			Bearb.	TRA	SK 3335.169			Bl. 11
			Gepr.	22.06.06				12 Bl.
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.	

List of parts

NIL_133E / 02.04.03

COMPONENT	AMOUNT	DESIGNATION	ORDER NUMBER	IDENTIFICATION	SUPPLIER	PAGE PATH
-Q1	1	Motorschutzschalter 3RV 1011-1GA10 /4,5-6,3	3RV 1011-1GA10 /4,5-6,3	3RV 1011-1GA10 /4,5-6,3	Siemens	3.3
-Q2	1	Motorschutzschalter 3RV 1011-1FA10 /3,5-5	3RV 1011-1FA10 /3,5-5	3RV 1011-1FA10 /3,5-5	Siemens	3.6
-S1	1	Drucksensor PN7009	PN7009	PN7009	ifm electronic	6.3
S1	1	Öffnerelement 3SB34 00 -0C	3SB34 00 -0C	3SB34 00 -0C	Siemens	7.7
S1	1	3SB30 00-0AA71	3SB30 00-0AA71	TASTER 3SB30 00-0AA71	Siemens	7.7
-S2	1	Stroemungswaechter SI 1000	SI 1000 STROEMUNGSWAECH.	SI 1000 STROEMUNGSWAECH.	ifm electronic	6.6
-T1	1	Netzteil EKL 1,0	EKL 1,0	EKL 1,0	MARX	4.1
-U1	1	Temperaturregler MPRA-SMK-A-3-KT-F / 24UCV	MPRA-SMK-A-3-KT-F	MPRA-SMK-A-3-KT-F	ers	5.2
-U2	1	Temp. regler KS 41	KS41-113-000D-000	KS41-113-000D-000	PMA	6.0
-U3	1	PROZESSANZEIGER	51008029	PROZESSANZEIGER RIA452	Endress&Hauser	7.1
-V1	1	RC Beschaltung 24VAC/DC, S00	3 RT 1916-1CB00	3 RT 1916-1CB00	Siemens	5.7
-V2	1	RC Beschaltung 127...240VAC, S00	3 RT 1916-1CD00	3 RT 1916-1CD00	Siemens	6.9
-V3	1	RC Beschaltung 24VAC/DC, S00	3 RT 1916-1CB00	3 RT 1916-1CB00	Siemens	6.4
-Y1	1	Magnetventilspule 24VDC	SPULE 24VDC	SPULE 24VDC	CASTEL	5.1
-Y1	1	RC-GLIED 24VUC	RC-GLIED 24VUC	RC-GLIED	Murrelektronik	5.1

			Datum	21.06.06	WA 6952001/001		Rittal GmbH & Co. KG Auf dem Stützelberg D - 35745 Herborn	Stückliste	Zeichnungsnummer: 06 06 19
			Bearb.	TRA	SK 3335.169				
			Gepr.	22.06.06					Bl. 12
Änderung	Datum	Name	Norm		Urspr.	Ers. f.	Ers. d.		12 Bl.

Parameter-List for temperature controller MPR-SMK-A-x-xx-x

Working level

Indication	Description
Present value	The present temperature of the medium as measured is permanently displayed.
Target value	Press the SET button to see the target temperature set for output port relay K1.

Press the "RESET" button to reset a failure message

C – Parameter level

Switching to C-Parameter level:
Press the "UP" and "Down" arrow key simultaneously for 5 seconds until "C1"
appears on the display.

Back to working level : Press "UP" and "DOWN" arrow key for 5 seconds.

Indication	Description		Zone
C1	Target temperature C1 Compressor		**+18°C**
C2	Target temperature C2 Temperature high		**+30°C**
C3	Target temperature C3 Temperature low		**+5°C**
C4	Target temperature C4 (depends on setting in parameter P5)		**-**
C20	Hysteresis for target-temperature C1		**1,5K**
C21	Hysteresis for target-temperature C2 (if present)		**1K**
C22	Hysteresis for target-temperature C3 (if present)		**1K**
C23	Hysteresis for target-temperature C4 (depends on setting in parameter P5)		**-**
C91	Actual value correction for sensor (offset value)		**0K**
C99	Button lock	0 = not locked 1 = locked	**0**

P – Parameter level

Switching to P-Parameter level: Jump first into C-Parameter level than press the “UP” arrow key simultaneously till “C99” appears. Hold down the “UP” arrow key and press additionally the “Down” arrow key till “P1” is seen on the display.

Back to working level: Press “UP” and “DOWN” arrow key for 5 seconds.

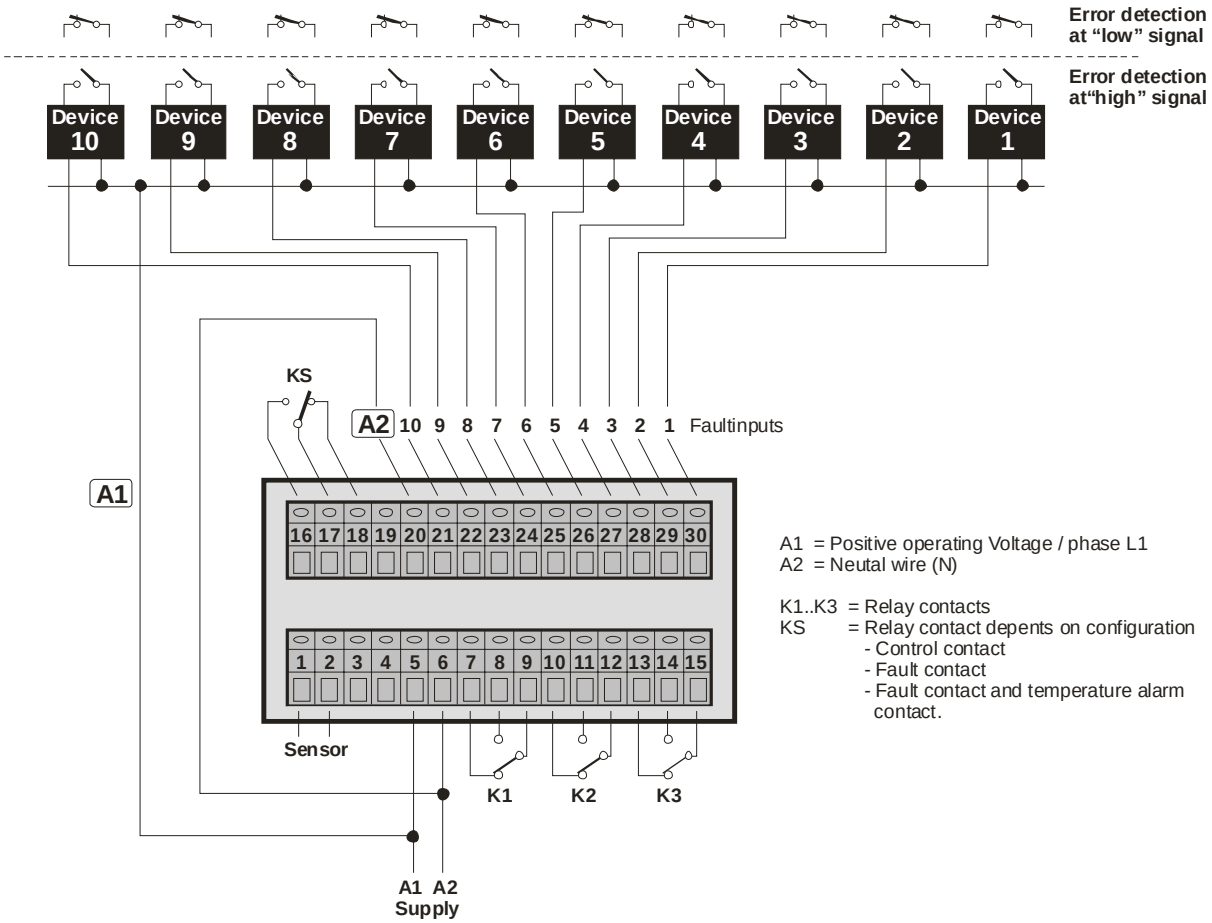
Parameter	Description		Zone
P1	Switching direction Relay K1	**0** = Heating contact **1** = Cooling contract	**1**
P2	Switching direction Relay K2 (if present)	**0** = Heating contact **1** = Cooling contract	**0**
P3	Switching direction Relay K3 (if present)	**0** = Heating contact **1** = Cooling contract	**1**
P4	Switching direction Relay K4 (depends on setting in parameter P5)	**0** = Heating contact **1** = Cooling contract	**-**
P5	General function for relay K4	0 = control contact 1 = alarm contact 2 = alarm contact for upper- or – lower target value C4	**1**
P6	Wire protection function for all fault inputs	0 = Fault recognition by “low” input signal 1 = Fault recognition by “high” input signal	**1**
P7	Alarmfunction relay K4 (only active if P5 = 1 or 2)	0 = Relay K4 is off at alarm or fault signal 1 = Relay K4 is on at alarm or fault singal	**0**
P10	Function K1 in event of sensor failure	**0** = inactive in event of failure **1** = active in event of failure	**0**
P11	Function K2 in event of sensor failure (if present)	**0** = inactive in event of failure **1** = active in event of failure	**0**
P12	Function K3 in event of sensor failure (if present)	**0** = inactive in event of failure **1** = active in event of failure	**0**
P13	Function K4 in event of sensor failure	**0** = inactive in event of failure **1** = active in event of failure	**0**
P15	Hysteresis mode target temperature C1	0 = symmetrical 1 = only on one side	**1**
P16	Hysteresis mode target temperature C2 (if present)	0 = symmetrical 1 = only on one side	**1**
P17	Hysteresis mode target temperature C3 (if present)	0 = symmetrical 1 = only on one side	**1**
P18	Hysteresis mode target temperature C4 (depends on settingin parameter P5)	0 = symmetrical 1 = only on one side	**1**
P20	Limit for target temperature C1 downwards	-50°C .. +150°C	**+10°C**
P21	Limit for target temperature C1 upwards	-50°C .. +150°C	**+25°C**
P22	Limit for target temperature C2 downwards (if present)	-50°C .. +150°C	**+30°C**
P23	Limit for target temperature C2 upwards (if present)	-50°C .. +150°C	**+40°C**
P24	Limit for target temperature C3 downwards (if present)	-50°C .. +150°C	**+0°C**
P25	Limit for target temperature C3 upwards (if present)	-50°C .. +150°C	**+5°C**
P26	Limit for target temperature C4 downwards	-50°C .. +150°C	
P27	Limit for target temperature C4 upwards	-50°C .. +150°C	

Parameter	Description		Zone
P30	Limit for hysteresis 1 downwards (parameter C20)	0,1K .. 99,9 K	**1K**
P31	Limit for hysteresis 1 upwards (parameter C20)	0,1K .. 99,9 K	**3K**
P32	Limit for hysteresis 2 downwards (parameter C21)	0,1K .. 99,9 K	**1K**
P33	Limit for hysteresis 2 upwards (parameter C21)	0,1K .. 99,9 K	**3K**
P34	Limit for hysteresis 3 downwards (parameter C22)	0,1K .. 99,9 K	**1K**
P35	Limit for hysteresis 3 upwards (parameter C22)	0,1K .. 99,9 K	**3K**
P36	Limit for hysteresis 4 downwards (parameter C23)	0,1K .. 99,9 K	**-**
P37	Limit for hysteresis 4 upwards (parameter C23)	0,1K .. 99,9 K	**-**
P50	Minimum action time for relay K1	0...999 Sec.	**0 sec.**
P51	Minimum pause time for relay K1	0...999 Sec.	**0 sec.**
P52	Minimum action time for relay K2 (if present)	0...999 Sec.	**0 sec.**
P53	Minimum pause time for relay K2 (if present)	0...999 Sec.	**0 sec.**
P54	Minimum action time for relay K3 (if present)	0...999 Sec.	**0 sec.**
P55	Minimum pause time for relay K3 (if present)	0...999 Sec.	**0 sec.**
P56	Minimum action time for relay K4 (depends on setting in parameter P5)	0...999 Sec.	**0 sec.**
P57	Minimum pause time for relay K4 (depends on setting in parameter P5)	0...999 Sec.	**0 sec.**
P99	Temperature unit °C / °F	0 = °C 1 = °F	**0**

Fault And Error Codes

The display shows the relevant fault code in case of a fault. (display flashes)

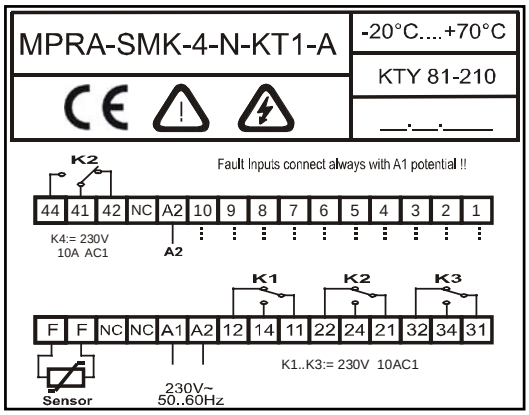
Code	Description	
F1	Failure on input 1	Motor circuit breaker
F2	Failure on input 2	Float control
F3	Failure on input 3	Temperature low
F4	Failure on input 4	Temperature high
F5	Failure on input 5	Low pressure
F6	Failure on input 6	High pressure
F7	Failure on input 7	-
F8	Failure on input 8	-
F9	Failure on input 9	-
F10	Failure on input 10	-
E1	Short circuit sensor Damaged sensor	
E2		
FFF	Exceeded maximum measurement field of sensors	
F13	Memory error	



Connecting diagram (the right number of replays are shown of the device label)

Specification of the temperature controller MPR-SMK-x-xx-x

Connecting Diagram



Sample – please refer the label of your device

Technical Data

Number of Sensors:	1
Type of Sensor:	KTY 81-210 (PT100)
Effective range :	-50°C bis +150°C

The effective range is only good if you use a right type of sensor and wiring.

Output

Number of outputs:	Max. 3 + 1
Output 1 … 4 (**K1 .. KS**):	Two way contact (voltage free) Max. switching current 10A (1,5)A Max. switching voltage 250V~

Number of inputs:	10

Note: Connect the inputs always with A1!!

Features

- Two-step regulator
- Free adjustable Hysteresis
- Heating/cooling interchangeable
- Temperature alarm
- Fault indicator with 10 digital inputs

Operation voltage

24V AC with (50 ... 60) Hz or 230V AC (50 … 60) Hz
(Use only the operation voltage as shown on the device label)

Connectors

- Screw terminals and plug connectors
- 2 x 15 polar, grid 5,00 mm for 2,5 mm² wire

Display

- 3 digits LED-Display red, 13,0 mm
- 4 LEDs for output status control
- Range of display from –99 to 999

Housing

The regulator is fit for board montage

Front-panel	(48 x 96) mm
Front-panel cut-out	(42 x 90) mm
Installation depth	ca. 88 mm

Protection code IP64 (Front panel side)

Ambient temperature

Operating temperature:	0°C … +50°C
Storage temperature:	-20°C … +70°C
Max. humidity:	75 % (no condensation)

PMA Prozeß- und Maschinen-Automation GmbH

Industrial controller KS 40-1, KS41-1 and KS42-1

KS40-1

KS41-1

KS42-1

universal line

Operating manual

English

9499-040-62711

Valid from: 8415

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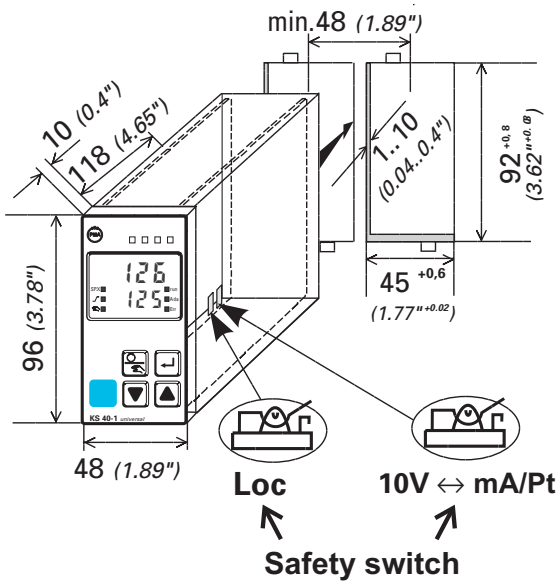
Description of symbols:

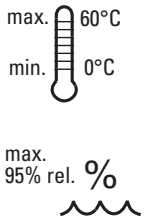
- General information
- General warning
- Attention: ESD sensitive devices

A publication of PMA Prozeß- und Maschinen Automation
P.O.Box 310229
D-34058 Kassel
Germany

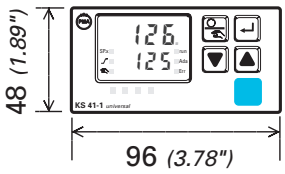
Contents

1 Mounting

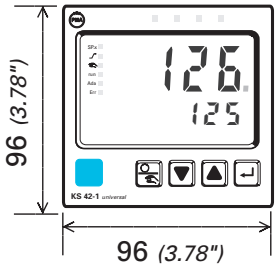


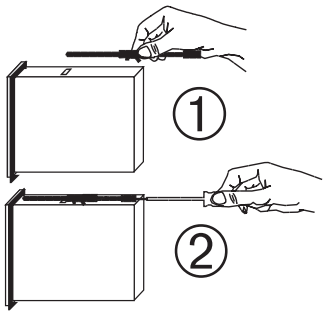


Front view KS41-1

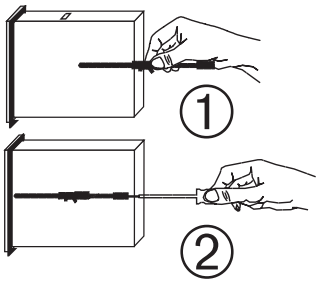


Front view KS42-1





or:



Safety switch:
For access to the safety switches, the controller must be withdrawn from the housing. Squeeze the top and bottom of the front bezel between thumb and forefinger and pull the controller firmly from the housing..

10V ↔ mA/Pt	right ❶	Current signal / Pt100 / thermocouple at inP.1
	left	Voltage signal at inP.1
Loc	open	Access to the levels is as adjusted by means of BlueControl (engineering tool) ❷
	closed ❶	all levels accessible wihout restriction

❶ Factory setting

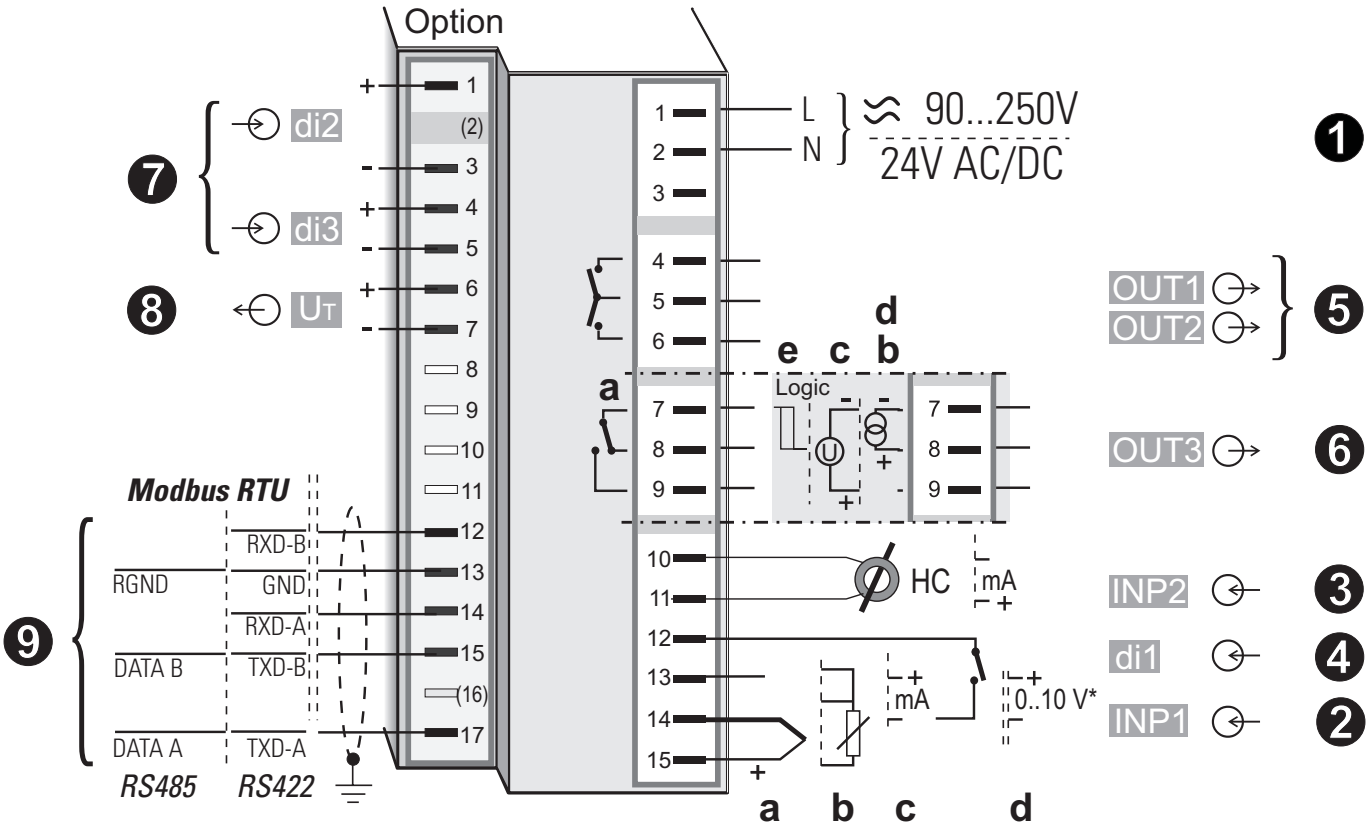
❷ Default setting: display of all levels suppressed, password PASS = OFF

Safety switch 10V ↔ mA/Pt always in position left or right. Leaving the safety switch open may lead to faulty functions!

Caution! The unit contains ESD-sensitive components.

2 Electrical connections

2.1 *Connecting diagram*



* Safety switch mA ↔ V in position left

Dependent of order, the controller is fitted with :
- flat-pin terminals 1 x 6,3mm or 2 x 2,8mm to DIN 46 244 or screw terminals for 0,5 to 2,5mm²

2.2 *Terminal connection*

Power supply connection ❶

See chapter 11 "Technical data"

Connection of input INP1 ❷

Input for variable x1 (process value)

a thermocouple
b resistance thermometer (Pt100/ Pt1000/ KTY/ ...)
c current (0/4...20mA)
d voltage (0/2...10V)

Connection of input INP2 ❸

Heating current input (0...50mA AC) or input for ext. set-point (0/4...20mA)

Connection of input di1 ❹

Digital input, configurable as switch or push-button

Connection of outputs OUT1/2 ❺

Relay outputs 250V/2A normally open with common contact connection

Connection of output OUT3 ❻

a relay (250V/2A), potential-free changeover contact

universal output

b current (0/4...20mA)
c voltage (0/2...10V)
d transmitter supply
e logic (0..20mA / 0..12V)

Connection of inputs di2/3 ❼ *(option)*

Digital inputs (24VDC external), galvanically isolated, configurable as switch or push-button

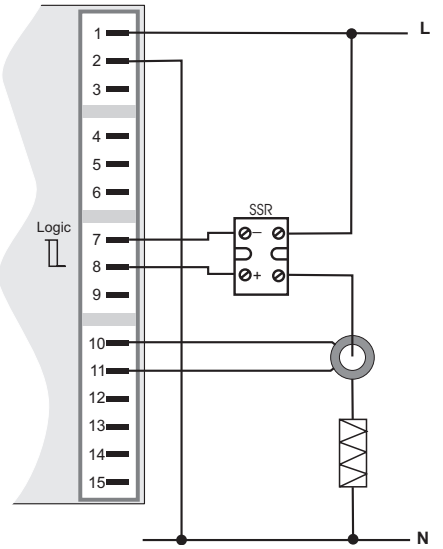
Connection of output U_T ❽ *(option)*

Supply voltage connection for external energization

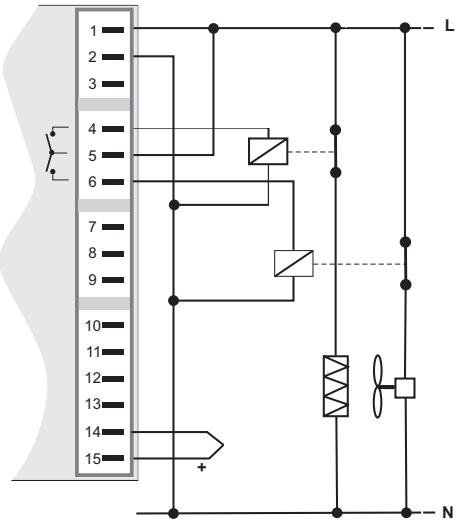
Connection of bus interface ❾ *(option)*

RS422/485 interface with Modbus RTU protocol

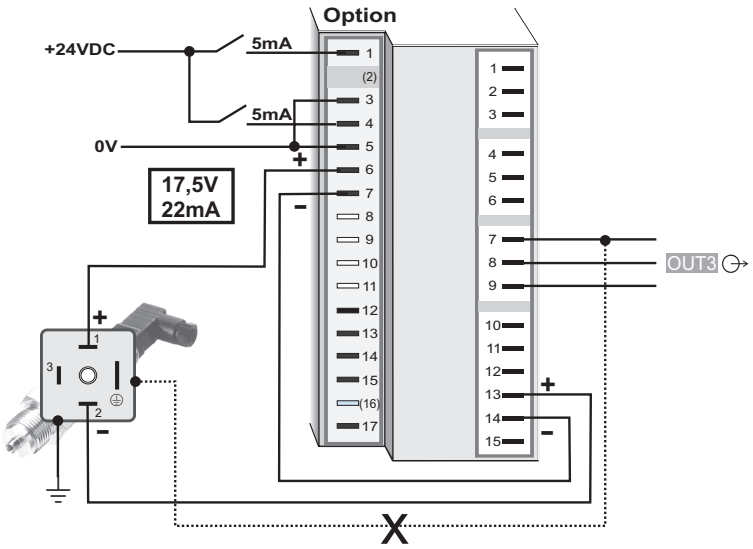
❸ *INP2 current tansformer*



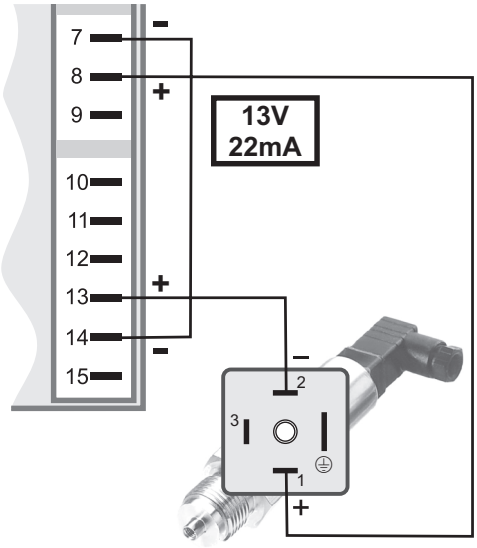
❺ *OUT1/2 heating/cooling*



❼ ❽ *di2/3, U_T 2-wire transmitter supply*

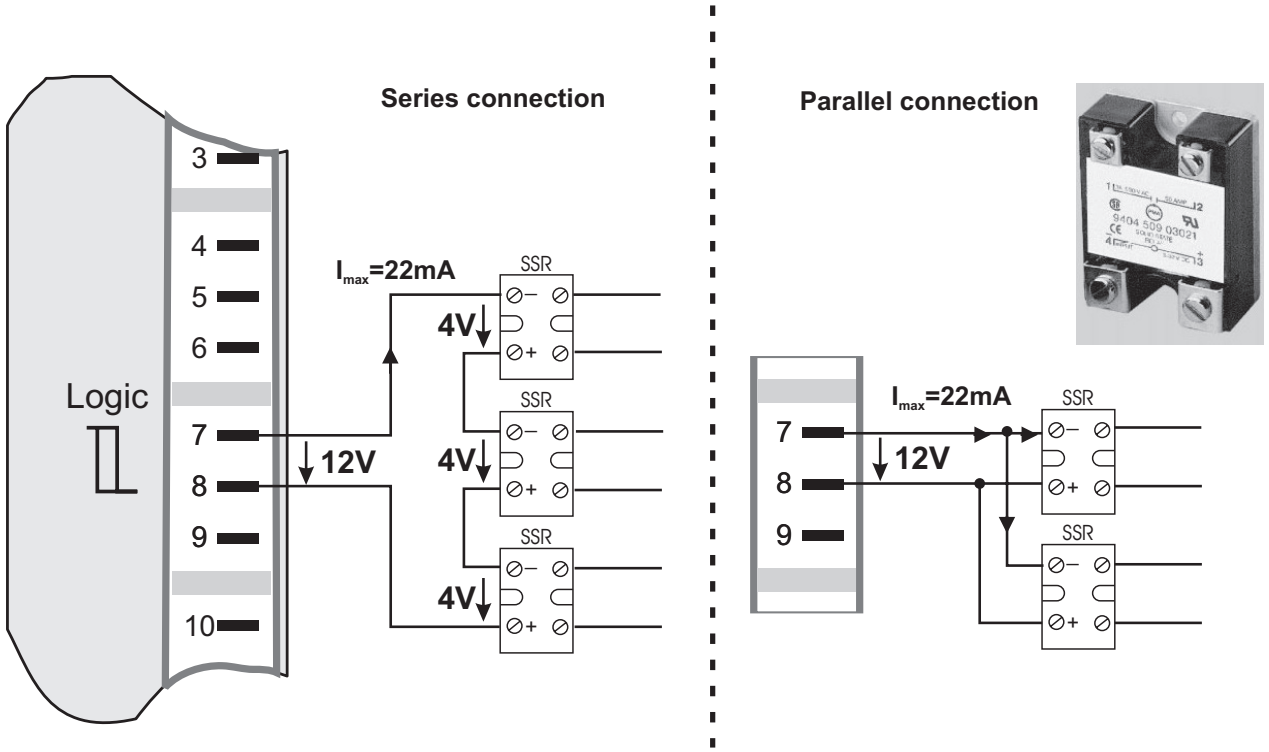


❻ *OUT3 transmitter supply*

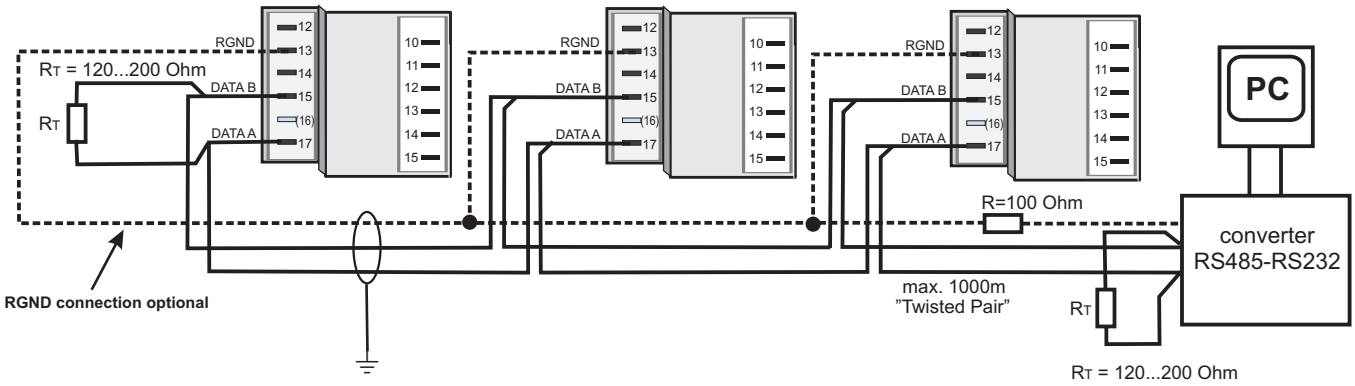


⚠ If U_T and the universal output OUT3 is used there may be no external galvanic connection between measuring and output circuits!

❻ *OUT3 as logic output with solid-state relay (series and parallel connection)*

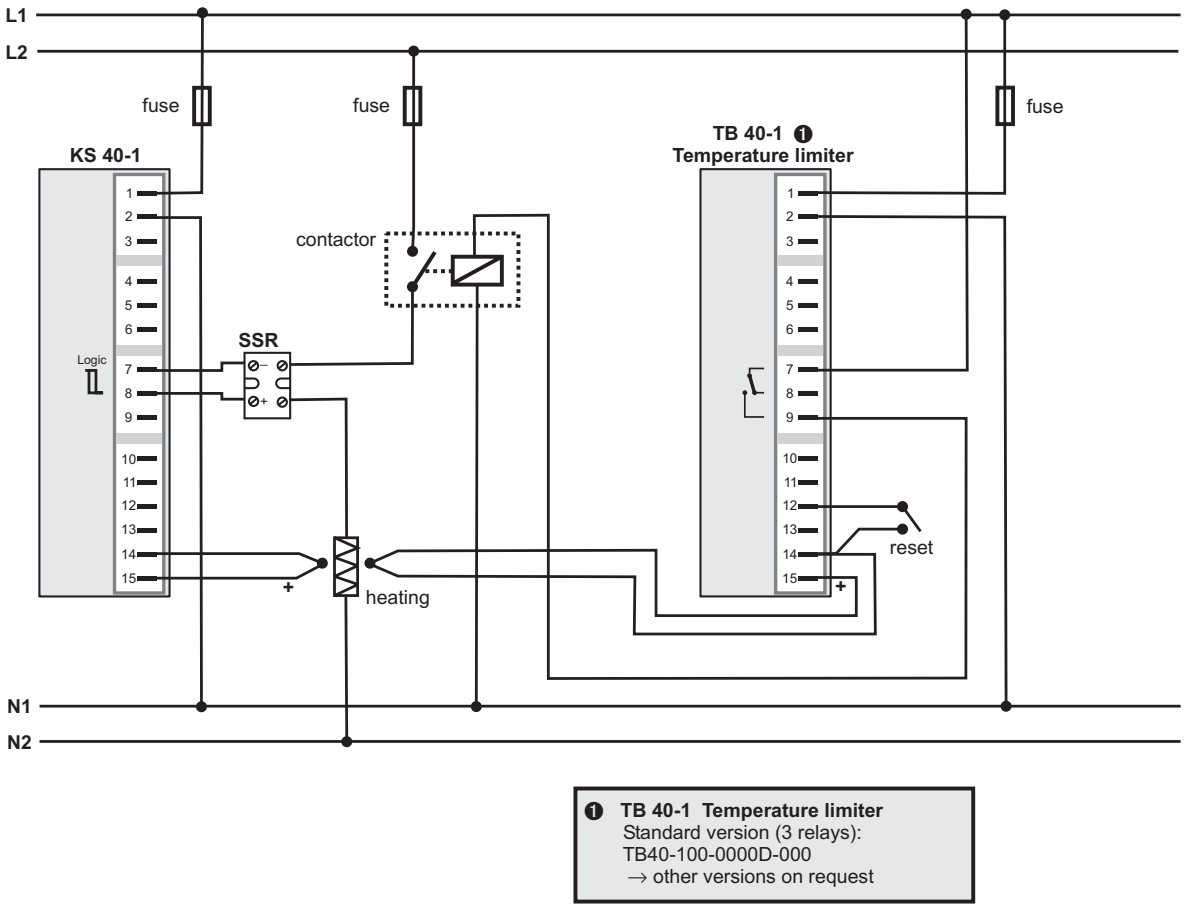


❾ *RS485 interface (with RS232-RS485 interface converter)* *



* Interface description Modbus RTU in seperate manual: see page 50.

KS4x-1 connecting example:

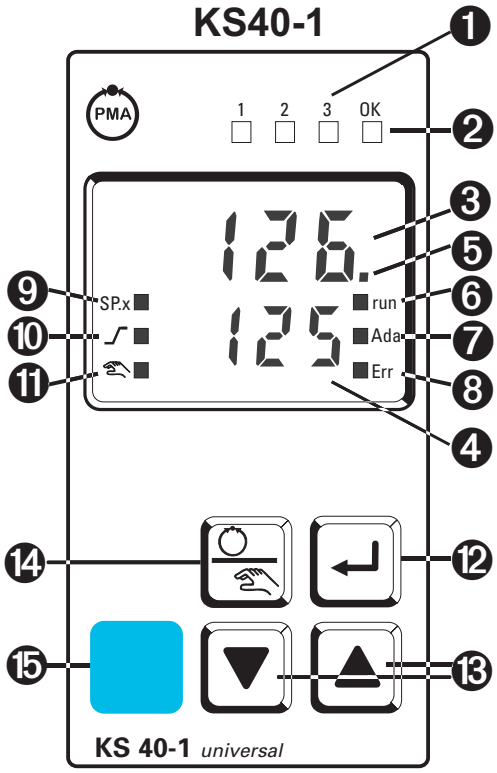


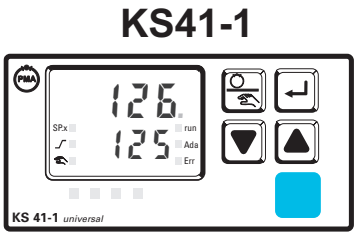
❶ **TB 40-1 Temperature limiter**
Standard version (3 relays):
TB40-100-0000D-000
→ other versions on request

CAUTION: Using a temperature limiter is recommendable in systems where overtemperature implies a fire hazard or other risks.

3 Operation

3.1 *Front view*





❶ Status of switching outputs Out.1 ... 3
❷ Lit with limit value 1 (PArA / Lim) not exceeded
❸ Process value display
❹ Set-point, controller output
❺ Signals Conf and PArA level
❻ Programmer or timer running
❼ Self-tuning active
❽ Entry in error list
❾ Set-point SP.2 or SP.E is effective
❿ Set-point gradient effective
⓫ Manual/automatic switch-over:
Off: Automatic
On: Manual
(changing possible)
Blinks: Manual
(changing not possible
(→ Conf / Cntr / nAn)
⓬ Enter key:
calls up extended operating level / error list
⓭ Up/down keys:
changing the set-point or the controller output value
⓮ Manual mode /spec. function
(Conf / LOGI)
⓯ PC connection for BlueControl (engineering tool)

LED colours:

LED 1, 2, 3:	yellow
LED OK:	green
other LEDs:	red

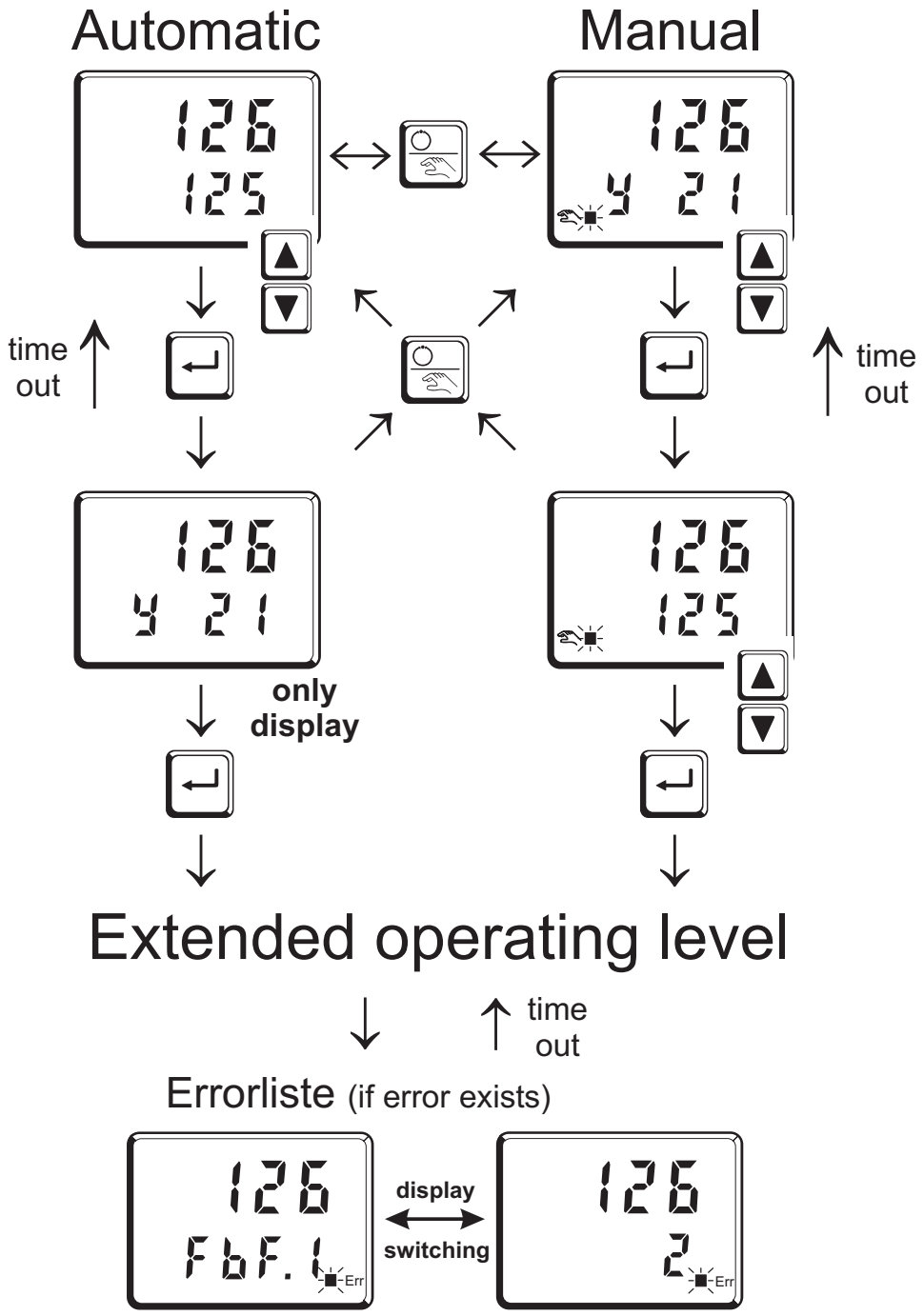
In the upper display line, the process value is always displayed. At parameter, configuration, calibration as well as extended operating level, the bottom display line changes cyclically between parameter name and parameter value.

3.2 *Behaviour after power-on*

After supply voltage switch-on, the unit starts with the **operating level**.
The unit is in the condition which was active before power-off.
If KS4x-1 was in manual mode before power-off, the controller starts with correcting value Y2 after switching on again.

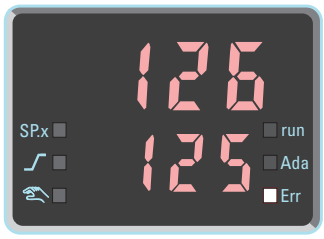
3.3 *Operating level*

The content of the extended operating level is determined by means of BlueControl (engineering tool). Parameters which are used frequently or the display of which is important can be copied to the extended operating level.



3.4 *Maintenance manager / Error list*

With one or several errors, the extended operating level always starts with the error list. Signalling an actual entry in the error list (alarm, error) is done by the Err LED in the display. To reach the error list press ↵ twice.



Err LED status	Signification	Proceed as follows
blinks (Status 2)	Alarm due to existing error	- Determine the error type in the error list via the error number - -Change to status 1 after error removal.
lit (Status 1)	Error removed, Alarm not acknowledged	- Acknowledge the alarm in the error list pressing key ▲ or ▼ - The alarm entry was deleted (Status 0) .
off (Status 0)	No error, all alarm entries deleted	-Not visible except when acknowledging

Error list:

Name	Description	Cause	Possible remedial action
E.1	Internal error, cannot be removed	- E.g. defective EEPROM	- Contact PMA service - Return unit to our factory
E.2	Internal error, can be reset	- e.g. EMC trouble	- Keep measurement and power supply cables in separate runs - Ensure that interference suppression of contactors is provided
E.4	Hardware error	- Codenumber and hardware are not identical	- Contact PMA service - Elektronic-/Optioncard must be exchanged
FbF.1	Sensor break INP1	- Sensor defective - Faulty cabling	- Replace INP1 sensor - Check INP1 connection
ShE.1	Short circuit INP1	- Sensor defective - Faulty cabling	- Replace INP1 sensor - Check INP1 connection
POL.1	INP1polarity error	- Faulty cabling	- Reverse INP1 polarity
FbF.2	Sensor break INP2	- Sensor defective - Faulty cabling	- Replace INP2 sensor - Check INP2 connection
ShE.2	Short circuit INP2	- Sensor defective - Faulty cabling	- Replace sensor INP2 - Check INP2 connection
POL.2	INP2 polarity	- Faulty cabling	- Reverse INP2 polarity
HCA	Heating current alarm (HCA)	- Heating current circuit interrupted, I< HC.A or I> HC.A (dependent of configuration) - Heater band defective	- Check heating current circuit - If necessary, replace heater band
SSr	Heating current short circuit (SSR)	- Current flow in heating circuit with controller off - SSR defective	- Check heating current circuit - If necessary, replace solid-state relay

Name	Description	Cause	Possible remedial action
LooP	Control loop alarm (LOOP)	- Input signal defective or not connected correctly - Output not connected correctly	- Check heating or cooling circuit - Check sensor and replace it, if necessary - Check controller and switching device
AdA.H	Self-tuning heating alarm (ADAH)	- See Self-tuning heating error status	- see Self-tuning heating error status
AdA.C	Self-tuning heating alarm cooling (ADAC)	- See Self-tuning cooling error status	- see Self-tuning cooling error status
Lim.1	stored limit alarm 1	- adjusted limit value 1 exceeded	- check process
Lim.2	stored limit alarm 2	- adjusted limit value 2 exceeded	- check process
Lim.3	stored limit alarm 3	- adjusted limit value 3 exceeded	- check process
InF.1	time limit value message	- adjusted number of operating hours reached	- application-specific
InF.2	duty cycle message (digital ouputs)	- adjusted number of duty cycles reached	- application-specific

Saved alarms (Err-LED is lit) can be acknowledged and deleted with the digital input di1/2/3 or the -key.
Configuration, see page 27: ConF / LOGI / Err.r

If an alarm is still valid that means the cause of the alarm is not removed so far (Err-LED blinks), then other saved alarms can not be acknowledged and deleted.

Self-tuning heating (AdA.H) and cooling (AdA.C) error status:

Error status	Description	Behaviour
0	No error	
3	Faulty control action	Re-configure controller (inverse ↔ direct)
4	No response of process variable	The control loop is perhaps not closed: check sensor, connections and process
5	Low reversal point	Increase (AdA.H) max. output limiting Y.H i or decrease (AdA.C) min. output limiting Y.L o
6	Danger of exceeded set-point (parameter determined)	If necessary, increase (inverse) or reduce (direct) set-point
7	Output step change too small (dy > 5%)	Increase (AdA.H) max. output limiting Y.H i or reduce (AdA.C) min. output limiting Y.L o
8	Set-point reserve too small	Increase set-point (invers), reduce set-point (direct) or increase set-point range (→ PArA / SEtP / SP.LO and SP.Hi)

3.5 *Self-tuning*

For determination of optimum process parameters, self-tuning is possible.
After starting by the operator, the controller makes an adaptation attempt, whereby the process characteristics are used to calculate the parameters for fast line-out to the set-point without overshoot.

The following parameters are optimized when self-tuning:
Parameter set 1:

- Pb1 - Proportional band 1 (heating) in engineering units [e.g. °C]
- t.1 - Integral time 1 (heating) in [s] → only, unless set to OFF
- td1 - Derivative time 1 (heating) in [s] → only, unless set to OFF
- t1 - Minimum cycle time 1 (heating) in [s] → only, unless Adt0 was set to "no self-tuning" during configuration by means of BlueControl®.

- Pb2 - Proportional band 2 (cooling) in engineering units [e.g. °C]
- t.2 - Integral time 2 (cooling) in [s] → only, unless set to OFF
- td2 - Derivative time 2 (cooling) in [s] → only, unless set to OFF
- t2 - Minimum cycle time 2 (cooling) in [s] → only, unless Adt0 was set to "no self-tuning" during configuration by means of BlueControl®

3.5.1 Preparation for self-tuning

- Adjust the controller measuring range as control range limits. Set values rnG.L and rnG.H to the limits of subsequent control. (Configuration →Controller→lower and upper control range limits)
  ConF →Cntr → rnG.L and rnG.H
- Determine which parameter set shall be optimized (see tables above).

3.5.2 Self-tuning sequence

The controller outputs 0% correcting variable or Y.Lo and waits, until the process is at rest (see start-conditions on page 8).

Subsequently, a correcting variable step change to 100% is output.

The controller attempts to calculate the optimum control parameters from the process response. If this is done successfully, the optimized parameters are taken over and used for line-out to the set-point.

With a *3-point controller,* this is followed by *"cooling"*.

After completing the 1st step as described, a correcting variable of -100% (100% cooling energy) is output from the set-point.
After successfull determination of the "cooling parameters", line-out to the set-point is using the optimized parameters.

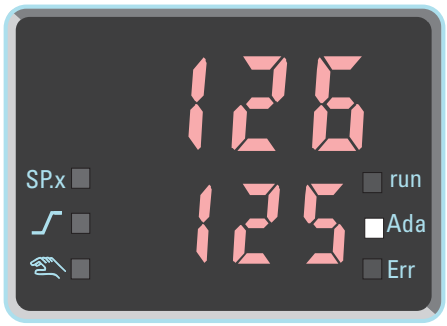
Start condition:

- Rest condition

For process evaluation, a stable condition is required. Therefore, the controller waits until the process has reached a stable condition after self-tuning start.
The rest condition is considered being reached, when the process value oscillation is smaller than 0,5% of (rnG.H - rnG.L).

Set-point reserve
After having come to rest with 0% correcting variable or with Y.Lo , the controller requires a sufficient set-point reserve for its self-tuning attempt, in order to avoid overshoot.
Sufficient set-point reserve:
inverse controller:(with process value<set-point-(10% of SP.Hi - SP.LO)
direct controller:(with process value>set-point+ (10% of SP.Hi - SP.LO)

3.5.3 Self-tuning start



Self-tuning start can be locked via BlueControl (engineering tool) (P.Loc).

The operator can start self-tuning at any time. For this, keys ↵ and ▲ must be pressed simultaneously. The AdA LED starts blinking. The controller outputs 0% or Y.Lo , waits until the process is at rest and starts self-tuning (AdA LED lit permanently).

After successful self-tuning, the AdA-LED is off and the controller continues operating with the new control parameters.

3.5.4 Self-tuning cancellation

By the operator:
Self-tuning can always be cancelled by the operator. For this, press ↵ and ▲ key simultaneously. With manual-automatic switch-over configured via key, self-tuning can also be canceled by actuating key. The controller continues operating with the old parameters in automatic mode in the first case and in manual mode in the second case.

By the controller:
If the Err LED starts blinking whilst self-tuning is running, successful self-tuning is prevented due to the control conditions. In this case, self-tuning was cancelled by the controller.
Dependent of control type, the output status is:

- 3-pnt. stepping controller:
  actuator is closed (0% output)
- 2-pnt./ 3-pnt./ continuous controller:
  If self-tuning was started from the automatic mode, the controller output is 0%. With self-tuning started from manual mode, the controller output is Y2.

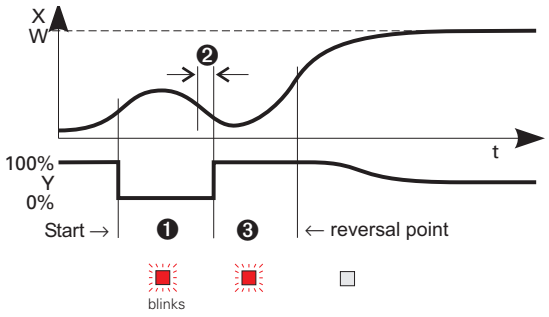
3.5.5 Acknowledgement procedures in case of unsuccessful self-tuning

1. Press keys ↵ *and* ▲ simultaneously:
   The controller continues controlling using the old parameters in automatic mode. The Err LED continues blinking, until the self-tuning error was acknowledged in the error list.
2. *Press key* ⎚ *(if configured):*
   The controller goes to manual mode. The Err LED continues blinking, until the self-tuning error was acknowleged in the error list.
3. *Press key* ↵ *:*
   Display of error list at extended operating level. After acknowledgement of the error message, the controller continues control in automatic mode using the old parameters.

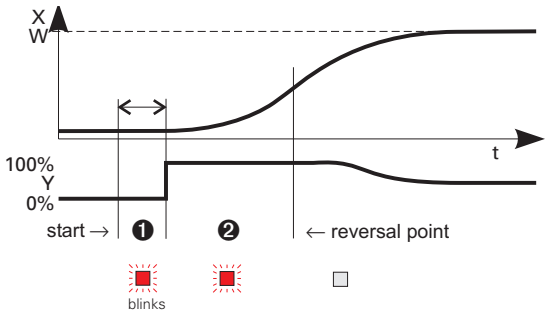
Cancellation causes:
→ page 13: "Error status self-tuning heating (AdA.H) and cooling (AdA.C)"

3.5.6 Examples for self-tuning attempts (controller inverse, heating or heating/cooling)

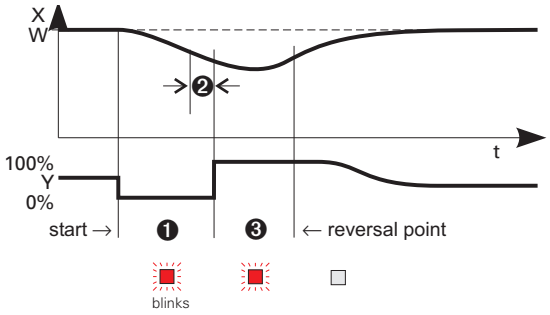
Start: heating power switched on
Heating power Y is switched off (❶). When the change of process value X was constant during one minute (❷), the power is switched on (❸). At the reversal point, the self-tuning attempt is finished and the new parameter are used for controlling to set-point W.



Start: heating power switched off
The controller waits 1,5 minutes (❶). Heating power Y is switched on (❷). At the reversal point, the self-tuning attempt is finished and control to the set-point is using the new parameters.

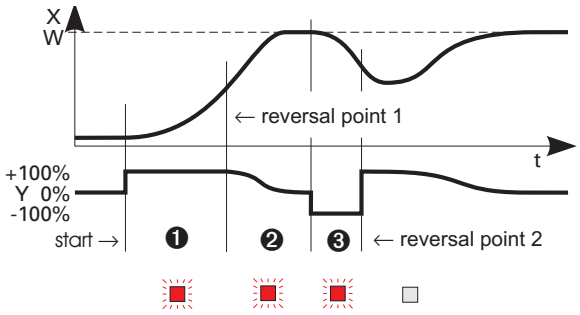


Start: at set-point



Heating power Y is switched off (❶). If the change of process value X was constant during one minute and the control deviation is > 10% of SP.Hi - SP.LO (❷), the power is switched on (❸). At the reversal point, the self-tuning attempt is finished, and control to set-point W is using the new parameters.

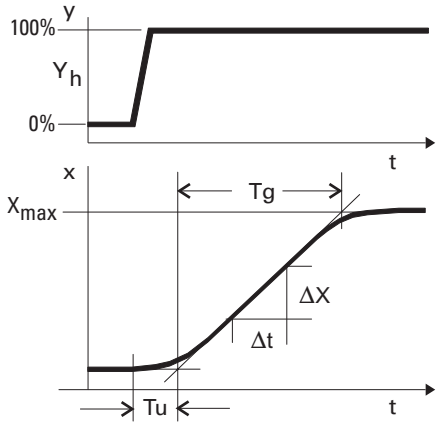
Three-point controller



The parameters for heating and cooling are determined in two attempts. The heating power is switched on (❶). At reversal point 1, heating parameters Pb1, tn1, td1 and t1 are determined. The process value is lined out to the set-point (❷). The cooling power is switched on (❸). At reversal point 2, parameters Pb2, tn2, td2 and t2 are determined and the self-tuning attempt is finished. Control to set-point W is using the new parameters.

3.6 *Manual tuning*

The optimization aid should be used with units on which the control parameters shall be set without self-tuning.
For this, the response of process variable x after a step change of correcting variable y can be used. Frequently, plotting the complete response curve (0 to 100%) is not possible, because the process must be kept within defined limits. Values T_g and x_{max} (step change from 0 to 100 %) or t and x (partial step response) can be used to determine the maximum rate of increase v_{max}.



y = correcting variable
Y_h = control range
Tu = delay time (s)
Tg = recovery time (s)
X_{max} = maximum process value

$$V_{max} = \frac{Xmax}{Tg} = \frac{\Delta x}{\Delta t} \triangleq \text{max. rate of increase of process value}$$

The control parameters can be determined from the values calculated for delay time T_u , maximum rate of increase v_{max}, control range X_h and characteristic K according to the **formulas** given below. Increase Xp, if line-out to the set-point oscillates.

Parameter adjustment effects

Parameter		Control	Line-out of disturbances	Start-up behaviour
Pb 1	higher	increased damping	slower line-out	slower reduction of duty cycle
	lower	reduced damping	faster line-out	faster reduction of duty cycle
td 1	higher	reduced damping	faster response to disturbances	faster reduction of duty cycle
	lower	increased damping	slower response to disturbances	slower reduction of duty cycle
t.1	higher	increased damping	slower line-out	slower reduction of duty cycle
	lower	reduced damping	faster line-out	faster reduction of duty cycle

Formulas

K = Vmax * Tu

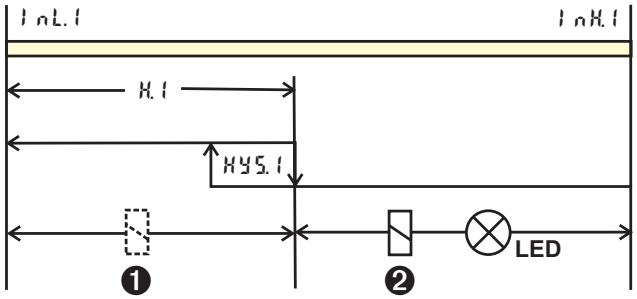
With 2-point and 3-point controllers, the cycle time must be adjusted to
t1 /t2 ≤ 0,25 * Tu

controller behavior	Pb 1 [phy. units]	td 1 [s]	t.1 [s]
PID	1,7 * K	2 * Tu	2 * Tu
PD	0,5 * K	Tu	OFF
PI	2,6 * K	OFF	6 * Tu
P	K	OFF	OFF
3-point-stepping	1,7 * K	Tu	2 * Tu

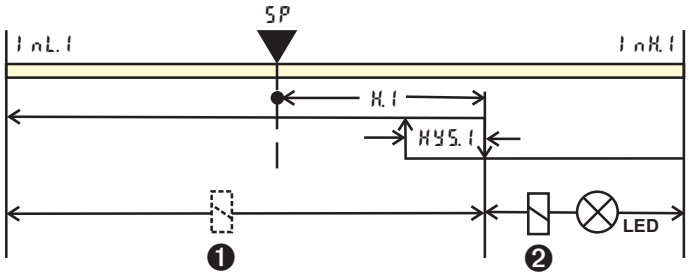
3.7 *Alarm handling*

Max. three alarms can be configured and assigned to the individual outputs. Generally, outputs Out.1... Out.3 can be used each for alarm signalling. If more than one signal is linked to one output the signals are OR linked. Each of the 3 limit values Lim.1 ... Lim.3 has 2 trigger points H.x (Max) and L.x (Min), which can be switched off individually (parameter = "OFF"). Switching difference HYS.x of each limit value is adjustable.

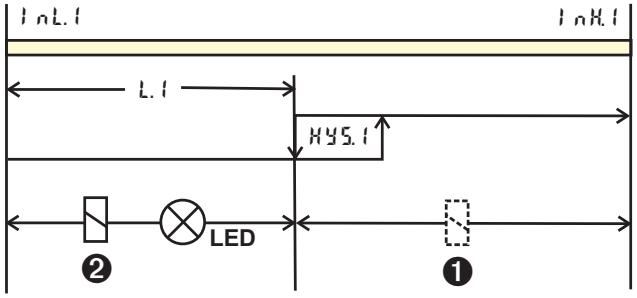
① *Operaing principle absolut alarm*
L.1 = OFF



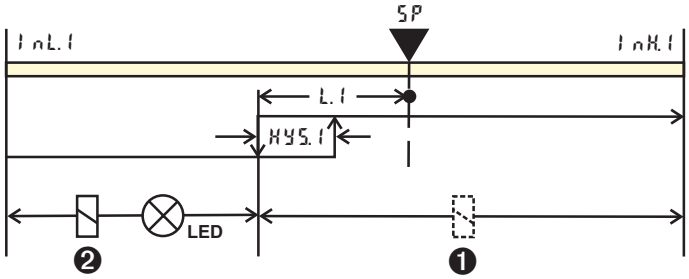
② *Operating principle relative alarm*
L.1 = OFF

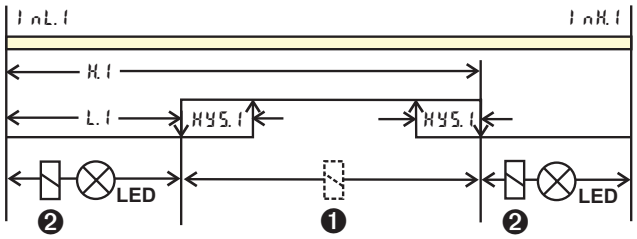


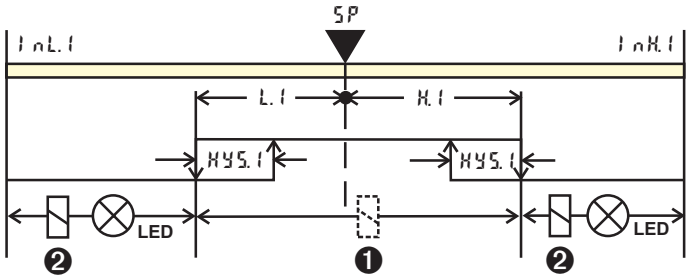
H.1 = OFF



H.1 = OFF







❶: normally closed (ConF / Out.x / O.Act = 1)
❷: normally open (ConF / Out.x / O.Act = 0)

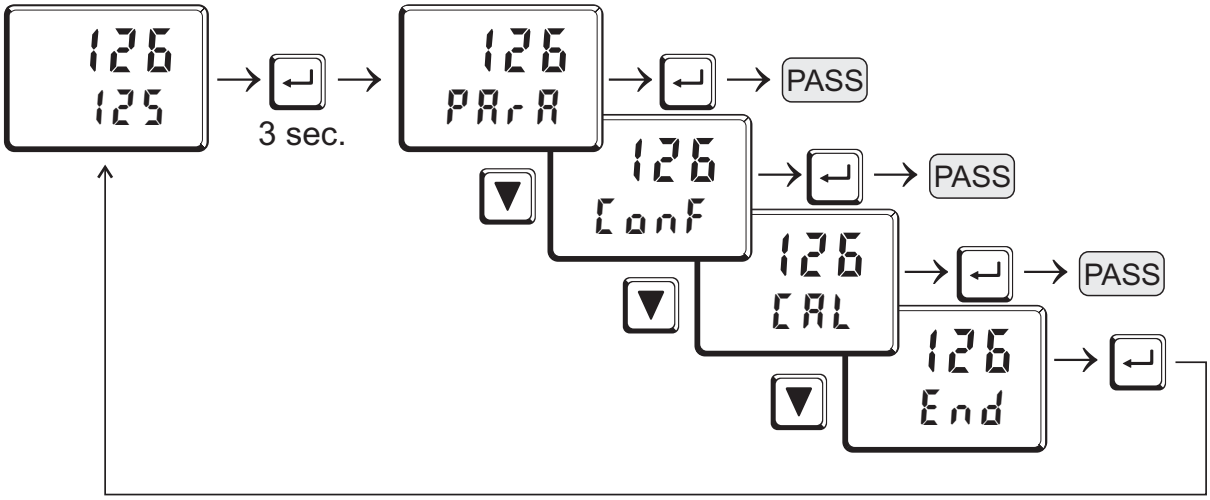
The variable to be monitored can be selected seperately for each alarm via configuration
The following variables can be monitored:

- process value
- control deviation xw (process value - set-point)
- control deviation xw + suppression after start-up or set-point change
- effective set-point Weff
- correcting variable y (controller output)

If measured value monitoring + alarm status storage is chosen (ConF / L in / Fnc.x = 2), the alarm relay remains switched on until the alarm is resetted in the error list (L in 1..3 = 1).

3.8 *Operating structure*

After supply voltage switch-on, the controller starts with the **operating levels**. The controller status is as before power off.



PArA - level: At PArA - level, the right decimal point of the upper display line is *lit continuously*.

ConF - level: At ConF - level, the right decimal point of the upper display line *blinks*

.

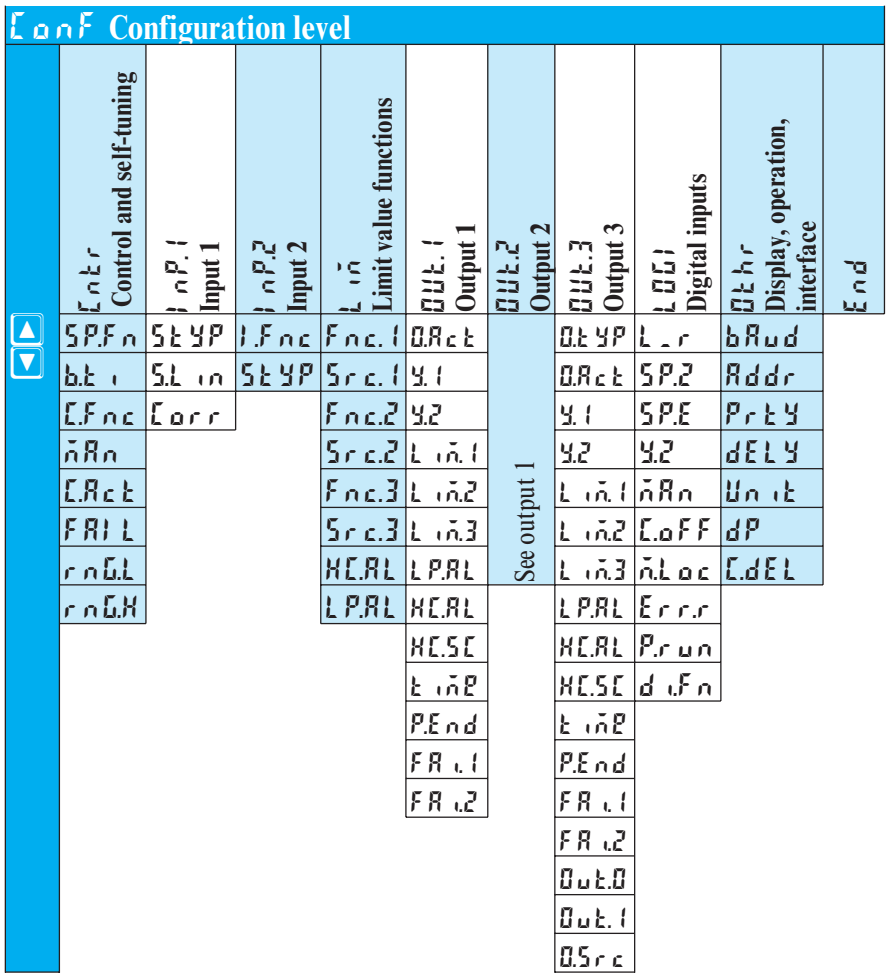
PASS When safety switch **Loc** is open, only the levels enabled by means of BlueControl (engineering tool) are visible and accessible by entry of the password adjusted by means of BlueControl (engineering tool). Individual parameters accessible without password must be copied to the extended operating level.

Factory setting: Safety switch **Loc** closed: all levels accessible without restriction, password PASS = OFF .

Safety switch Loc	Password entered with BluePort®	Function disabled or enabled with BluePort®	Access via the instrument front panel:
closed	OFF / password	disabled / enabled	**enabled**
open	OFF / password	disabled	**disabled**
open	OFF	enabled	**enabled**
open	Password	enabled	**enabled after password entry**

4 Configuration level

4.1 *Configuration survey*



Adjustment:

- The configuratiuons can be adjusted by means of keys ▲▼ .
- Transition to the next configuration is by pressing key ↵ .
- After the last configuration of a group, donE is displayed and followed by automatic change to the next group

Return to the beginning of a group is by pressing the ↵ key for 3 sec.

4.2 *Configuration*

CntR

Name	Value range	Description	Default
SP.Fn		**Basic configuration of setpoint processing**	0
	0	set-point controller can be switched over to external set-point (LOGI /SP.E)	
	1	program controller	
	2	timer, mode 1(bandwidth-controlled, switched off at the end)	
	3	timer, mode 2 (bandwidth-controlled, set-point remains active at the end)	
	4	timer, mode 3 (switched off at the end)	
	5	timer, mode 4 (set-point remains active at the end)	
	6	timer, mode 5 (switch-on delay)	
	7	timer, mode 6 (set-point switch-over)	
b.t i	0...9999	**Timer tolerance band for timer mode 1, 2 and 6. The timer starts when process value = setpoint b.ti**	5
C.Fnc		**Control behaviour (algorithm)**	1
	0	on/off controller or signaller with one output	
	1	PID controller (2-point and continuous)	
	2	/ Y / Off, or 2-point controller with partial/full load switch-over	
	3	2 x PID (3-point and continuous)	
	4	3-point stepping controller	
mAn		**Manual operation permitted**	0
	0	no	
	1	yes (see also LOGI /mAn)	
C.Act		**Method of controller operation**	0
	0	inverse, e.g. heating	
	1	direct, e.g. cooling	
FAIL		**Behaviour at sensor break**	1
	0	controller outputs switched off	
	1	y = Y2	
	2	y = mean output. The maximum permissible output can be adjusted with parameter Yn.H . To prevent determination of inadmissible values, mean value formation is only if the control deviation is lower than parameter L.Yn .	
rnG.L	-1999...9999	**X0 (low limit range of control)** ❶	0
rnG.H	-1999...9999	**X100 (high limit range of control)** ❶	900
Adt0		**Optimization of T1, T2** (only visible with BlueControl!)	0
	0	Automatic optimization	
	1	No optimization	

❶ rnG.L and rnG.H are indicating the range of control on which e.g. the self-tuning is refering

InP.1

Name	Value range	Description	Default
S.tYP		**Sensor type selection**	1
	0	thermocouple type L (-100...900°C) , Fe-CuNi DIN	
	1	thermocouple type J (-100...1200°C) , Fe-CuNi	
	2	thermocouple type K (-100...1350°C), NiCr-Ni	
	3	thermocouple type N (-100...1300°C), Nicrosil-Nisil	
	4	thermocouple type S (0...1760°C), PtRh-Pt10%	
	5	thermocouple type R (0...1760°C), PtRh-Pt13%	
	20	Pt100 (-200.0 ... 100,0 °C)	
	21	Pt100 (-200.0 ... 850,0 °C)	
	22	Pt1000 (-200.0 ... 200.0 °C)	
	23	special 0...4500 Ohm (pre-defined as KTY11-6)	
	30	0...20mA / 4...20mA ❶	
	40	0...10V / 2...10V ❶	
S.Lin		**Linearization (only at S.tYP = 23 (KTY 11-6), 30 (0..20mA) and 40 (0..10V) adjustable)**	0
	0	none	
	1	Linearization to specification. Creation of linearization table withBlueControl (engineering tool) possible. The characteristic for KTY 11-6 temperature sensors is preset.	
Corr		**Measured value correction / scaling**	0
	0	Without scaling	
	1	Offset correction (at CAL level)	
	2	2-point correction (at CAL level)	
	3	Scaling (at PArA level)	
fAI1		**Forcing INP1** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

InP.2

Name	Value range	Description	Default
I.Fnc		**Function selection of INP2**	1
	0	no function (subsequent input data are skipped)	
	1	heating current input	
	2	external set-point (SP.E)	
S.tYP		**Sensor type selection**	31
	30	0...20mA / 4...20mA ❶	
	31	0...50mA AC ❶	
fAI2		**Forcing INP2** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

Lim

Name	Value range	Description	Default
Fnc.1 Fnc.2 Fnc.3		**Function of limit 1/2/3**	1
	0	switched off	
	1	measured value monitoring	
	2	Measured value monitoring + alarm status storage. A stored limit value can be reset via error list, -key or a digital input (LOGI /Errr).	
Src.1 Src.2 Src.3		**Source of limit 1/2/3**	1
	0	process value	
	1	control deviation xw (process value - set-point)	
	2	control deviation xw (with suppression after start-up and set-point change)	
	6	effective set-point Weff	
	7	correcting variable y (controller output)	
HCAL		**Alarm heat current function (INP2)**	0
	0	switched off	
	1	Overload short circuit monitoring	
	2	Break and short circuit monitoring	
LPAL		**Monitoring of control loop interruption for heating**	0
	0	switched off / inactive	
	1	active If tdi1=0 LOOP alarm is inactive!	
Hour	OFF..999999	**Operating hours** (only visible with BlueControl!)	OFF
Swit	OFF..999999	**Output switching cycles** (only visible with BlueControl!)	OFF

Out.1

Name	Value range	Description	Default
OAct		**Method of operation of output OUT1**	0
	0	direct / normally open	
	1	inverse / normally closed	
Y.1 Y.2		**Controller output Y1/Y2**	1
	0	not active	
	1	active	
Lim.1 Lim.2 Lim.3		**Limit 1/2/3 signal**	0
	0	not active	
	1	active	
LPAL		**Interruption alarm signal (LOOP)**	0
	0	not active	
	1	active	
HCAL		**Heat current alarm signal**	0
	0	not active	
	1	active	

❶ with current and voltage input signals, scaling is required (see chapter 5.3)

Resetting the controller configuration to factory setting (Default)
→ chapter 12.1 (page 56)

Name	Value range	Description	Default
HC.SC		**Solid state relay (SSR) short circuit signal**	0
	0	not active	
	1	active	
t inE		**Timer end signal**	0
	0	not active	
	1	active	
P.End		**Programmer end signal**	0
	0	not active	
	1	active	
FA i.1 FA i.2		**INP1/ INP2 error signal**	0
	0	not active	
	1	active	
fOut		**Forcing OUT1** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

Out.2

Configuration parameters Out.2 as Out.1 except for: Default Y.1 = 0 Y.2 = 1

Out.3

Name	Value range	Description	Default
O.tYP		**Signal type selection OUT3**	0
	0	relay / logic (only visible with current/logic voltage)	
	1	0 ... 20 mA continuous (only visible with current/logic/volt.)	
	2	4 ... 20 mA continuous (only visible with current/logic/volt.)	
	3	0...10 V continuous (only visible with current/logic/voltage)	
	4	2...10 V continuous (only visible with current/logic/voltage)	
	5	transmitter supply (only visible without OPTION)	
O.Act		**Method of operation of output OUT3 (only visible when O.TYP=0)**	1
	0	direct / normally open	
	1	inverse / normally closed	
Y.1 Y.2		**Controller output Y1/Y2 (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
L in.1 L in.2 L in.3		**Limit 1/2/3 signal (only visible when O.TYP=0)**	1
	0	not active	
	1	active	
LP.AL		**Interruption alarm signal (LOOP) (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
HC.AL		**Heat current alarm signal (only visible when O.TYP=0)**	0
	0	not active	
	1	active	

Name	Value range	Description	Default
HE.SE		**Solid state relay (SSR) short circuit signal (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
t inE		**Timer end signal (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
P.End		**Programmer end signal (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
FA.1 FA.2		**INP1/ INP2 error (only visible when O.TYP=0)**	1
	0	not active	
	1	active	
Out.0	-1999...9999	**Scaling of the analog output for 0% (0/4mA or 0/2V, only visible when O.TYP=1..5)**	0
Out.1	-1999...9999	**Scaling of the analog output for 100% (20mA or 10V, only visible when O.TYP=1..5)**	100
O.Src		**Signal source of the analog output OUT3 (only visible when O.TYP=1..5)**	1
	0	not used	
	1	controller output y1 (continuous)	
	2	controller output y2 (continuous)	
	3	process value	
	4	effective set-point Weff	
	5	control deviation xw (process value - set-point)	
fOut		**Forcing OUT3** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

Method of operation and usage of output Out.1 to Out.3:
Is more than one signal chosen active as source, those signals are OR-linked.

LOGI

Name	Value range	Description	Default
L.r		**Local / Remote switching (Remote: adjusting of all values by front keys is blocked)**	0
	0	no function (switch-over via interface is possible)	
	1	active	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
SP.2		**Switching to second setpoint SP.2**	0
	0	no function (switch-over via interface is possible)	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	

Name	Value range	Description	Default
SP.E		**Switching to external setpoint SP.E**	0
	0	no function (switch-over via interface is possible)	
	1	active	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
Y2		**Y/Y2 switching**	0
	0	no function (switch-over via interface is possible)	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
	6	key	
HAn		**Automatic/manual switching**	0
	0	no function (switch-over via interface is possible)	
	1	always activated (manual station)	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
	6	key	
C.oFF		**Switching off the controller**	0
	0	no function (switch-over via interface is possible)	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
	6	key	
H.Loc		**Blockage of hand function**	0
	0	no function (switch-over via interface is possible)	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
Err.r		**Reset of all error list entries**	0
	0	no function (switch-over via interface is possible)	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
	6	key	
P.run		**Programmer Run/Stop (see page 44)**	0
	0	no function (switch-over via interface is possible)	
	2	DI1	
	3	DI2 (only visible with OPTION)	
	4	DI3 (only visible with OPTION)	
d.Fn		**Function of digital inputs (valid for all inputs)**	0
	0	direct	
	1	inverse	
	2	toggle key function	
fDI1		**Forcing di1** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

Name	Value range	Description	Default
fDI2		**Forcing di2** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	
fDI3		**Forcing di3** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

othr

Name	Value range	Description	Default
bAud		**Baudrate of the interface (only visible with OPTION)**	2
	0	2400 Baud	
	1	4800 Baud	
	2	9600 Baud	
	3	19200 Baud	
Addr	1...247	**Address on the interace (only visible with OPTION)**	1
PrtY		**Parity (only visible with OPTION)**	1
	0	no parity (2 stop bits)	
	1	even parity	
	2	odd parity	
dELY	0...200	**Delay of response signal [ms] (only visible with OPTION)**	0
Unit		**Unit**	1
	0	without unit	
	1	°C	
	2	°F	
dP		**Decimal point (max. number of digits behind the decimal point)**	0
	0	no digit behind the decimal point	
	1	1 digit behind the decimal point	
	2	2 digits behind the decimal point	
	3	3 digits behind the decimal point	
C.dEL	0..200	**Modem delay [ms]**	0
FrEq		**Switching 50 Hz / 60 Hz** (only visible with BlueControl!)	0
	0	50 Hz	
	1	60 Hz	
ICof		**Block controller off** (only visible with BlueControl!)	0
	0	Released	
	1	Blocked	
IAda		**Block auto tuning** (only visible with BlueControl!)	0
	0	Released	
	1	Blocked	
IExo		**Block extended operating level** (only visible with BlueControl!)	0
	0	Released	
	1	Blocked	
Pass	OFF...9999	**Password** (only visible with BlueControl!)	OFF

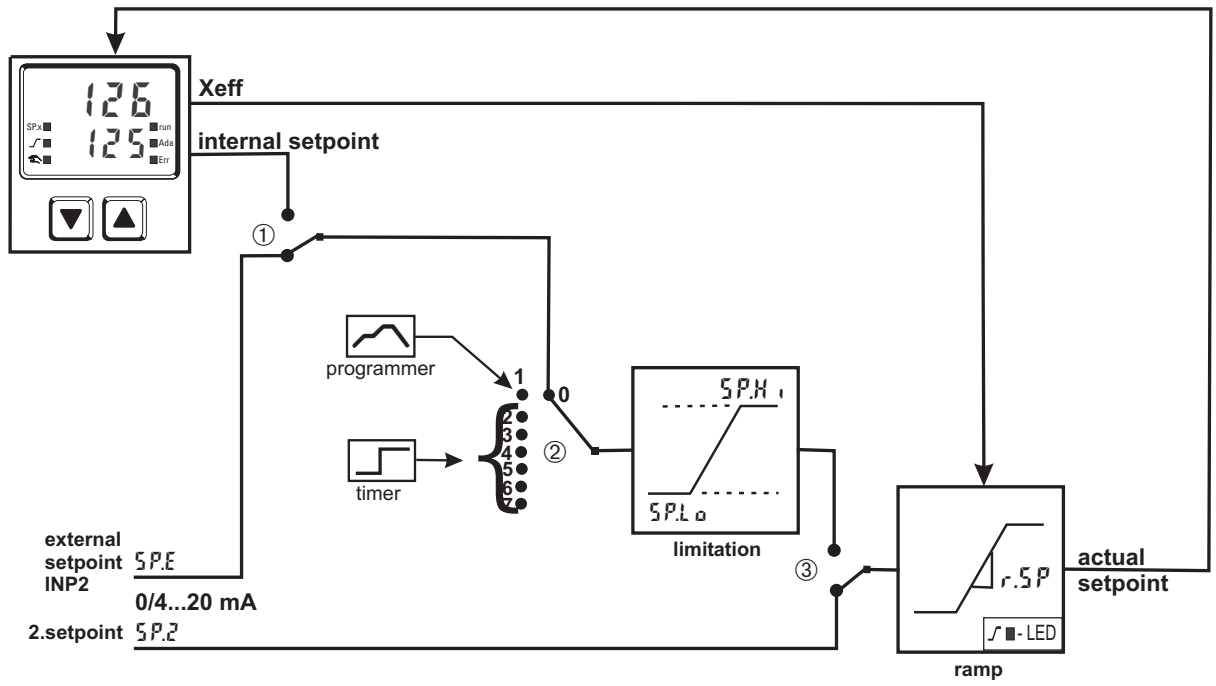
Name	Value range	Description	Default
IPar		**Block parameter level** (only visible with BlueControl!)	1
	0	Released	
	1	Blocked	
ICnf		**Block configuration level** (only visible with BlueControl!)	1
	0	Released	
	1	Block	
ICal		**Block calibration level** (only visible with BlueControl!)	1
	0	Released	
	1	Blocked	

BlueControl - the engineering tool for the BluePort controller series

3 engineering tools with different functionality facilitating KS4x-1 configuration and parameter setting are available (see chapter 10: *Accessory equipment with ordering information*).
In addition to configuration and parameter setting, the engineering tools are used for data acquisition and offer long-term storage and print functions. The engineering tools are connected to KS4x-1 via the front-panel interface "BluePort " by means of PC (Windows 95 / 98 / NT) and a PC adaptor.
Description BlueControl: see chapter 9: *BlueControl* (page 49)

4.3 *Set-point processing*

The set-point processing structure is shown in the following picture:



Index:

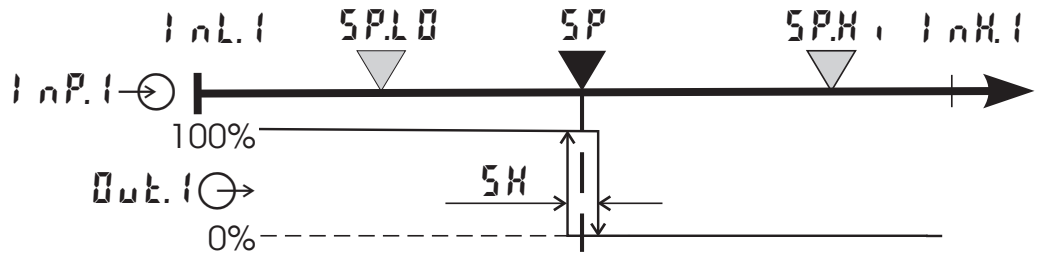
① : int/ext-setpoint switching
② : configuration SP.Fn
③ : SP / SP.2 switching

The ramp starts at process value with the following switchings:

- int / ext-setpoint switching
- SP / SP.2 switching
- Manual-/ Automatic switching
- at power on

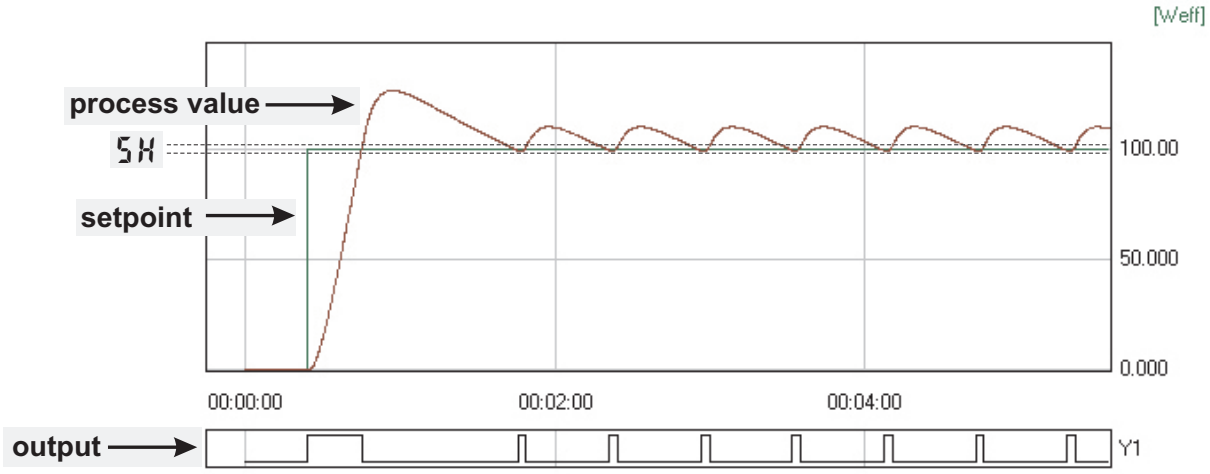
4.4 *Configuration examples*

4.4.1 On-Off controller / Signaller (inverse)

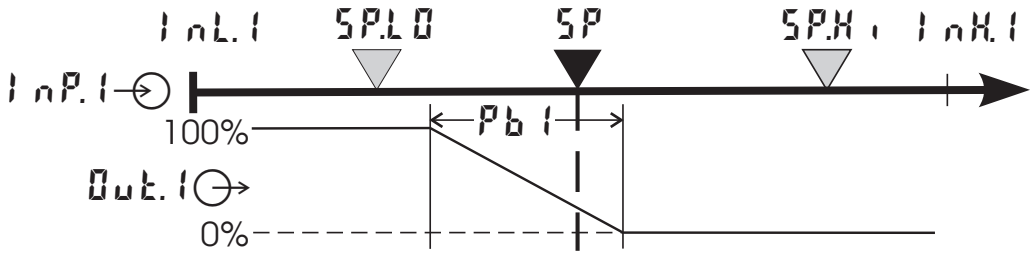


ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	0	signaller with one output
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
PArA / Cntr:	SH	=	0...9999	switching difference (symmetrical to the trigger point)
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.H,	=	-1999...9999	set-point limit high for Weff

For direct signaller action, the controller action must be changed (ConF / Cntr / C.Act = 1)

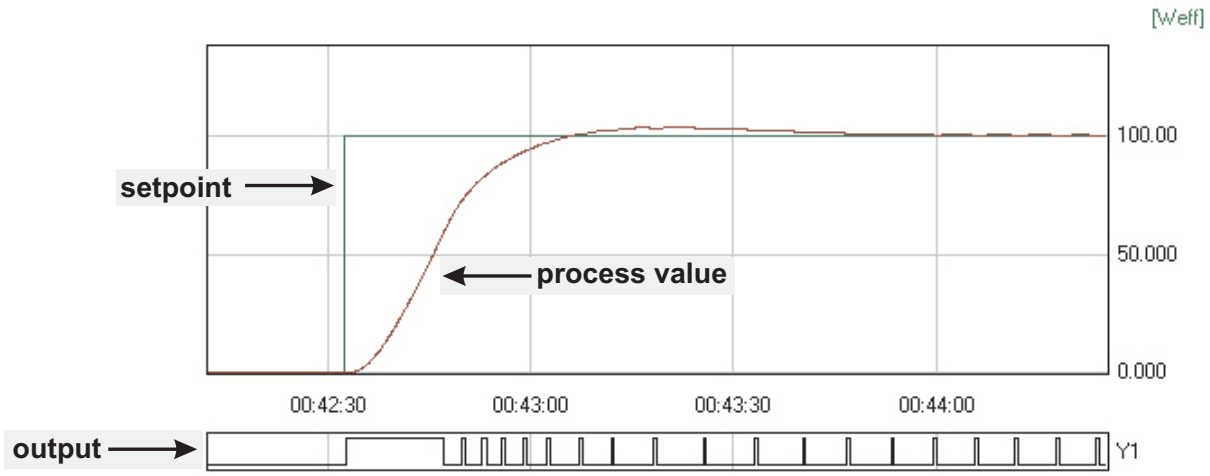


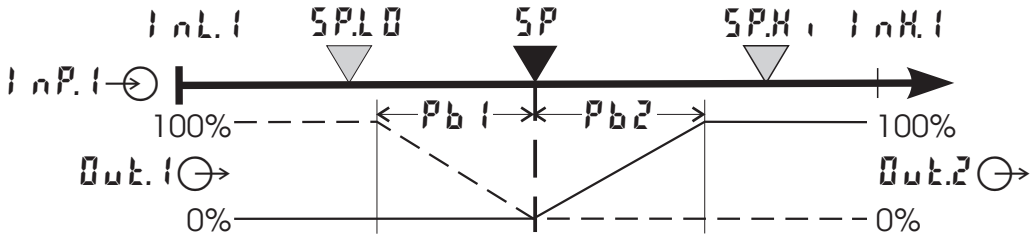
4.4.2 2-point controller (inverse)



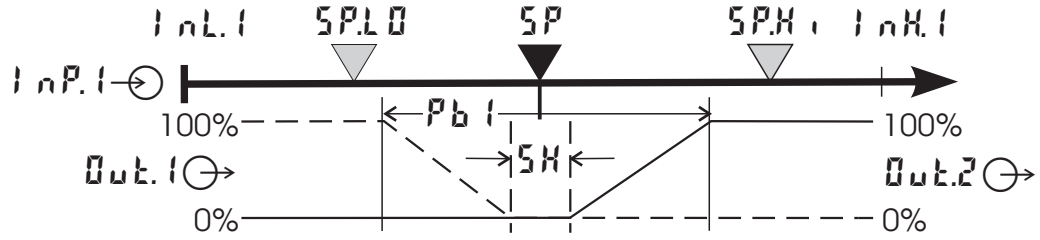
ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	1	2-point controller (PID)
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
PArA / Cntr:	Pb1	=	0,1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	t.1	=	1...9999	integral time 1 (heating) in sec.
	td1	=	1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hi	=	-1999...9999	set-point limit high for Weff

For direct action, the controller action must be changed (ConF / Cntr / C.Act = 1).



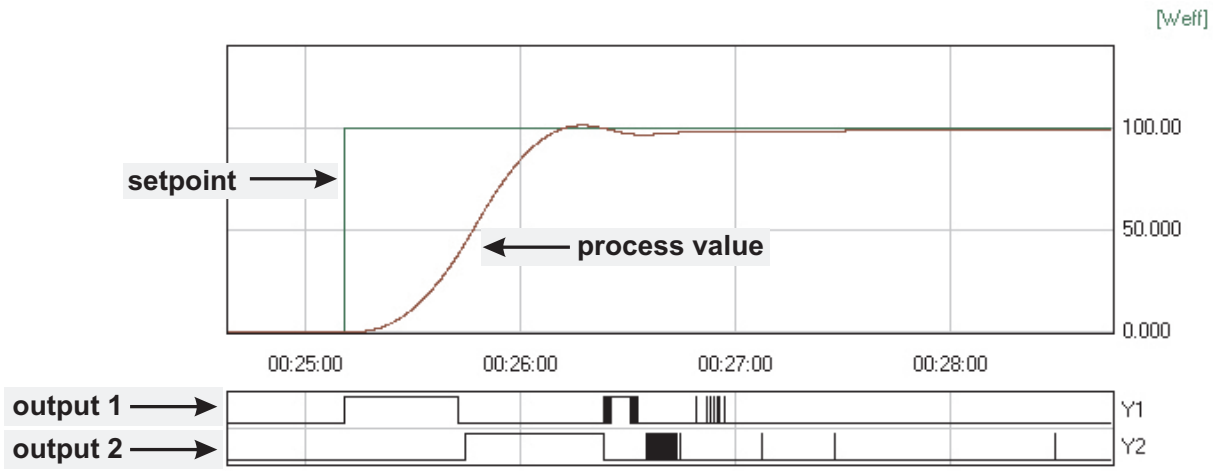

InL.1
SP.LO
SP
SP.HI
InH.1
InP.1
100%
Pb1
Pb2
100%
Out.1
Out.2
0%
0%

4.4.4 3-point stepping controller (relay & relay)

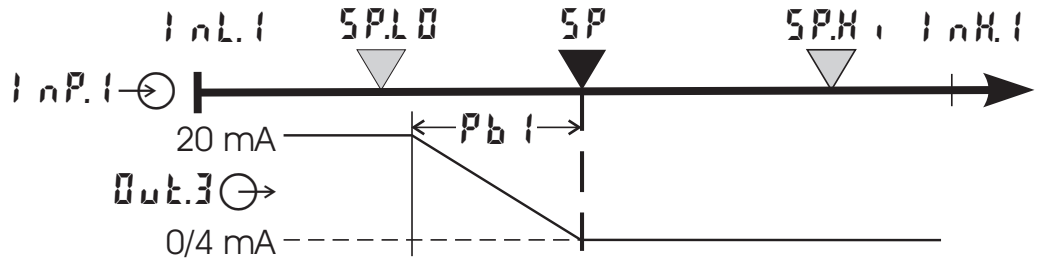


ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	4	3-point stepping controller
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
	Y.2	=	0	control output Y2 not active
ConF / Out.2:	O.Act	=	0	action Out.2 direct
	Y.1	=	0	control output Y1 not active
	Y.2	=	1	control output Y2 active
PArA / Cntr:	Pb1	=	0,1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	tn1	=	1...9999	integral time 1 (heating) in sec.
	td1	=	1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
	5H	=	0...9999	neutral zone in units of phy. quantity
	tP	=	0,1...9999	min. pulse length in sec.
	tt	=	3...9999	actuator travel time in sec.
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hı	=	-1999...9999	set-point limit high for Weff

For direct action of the 3-point stepping controller, the controller output action must be changed (ConF / Cntr / C.Act = 1).



4.4.5 Continuous controller (inverse)

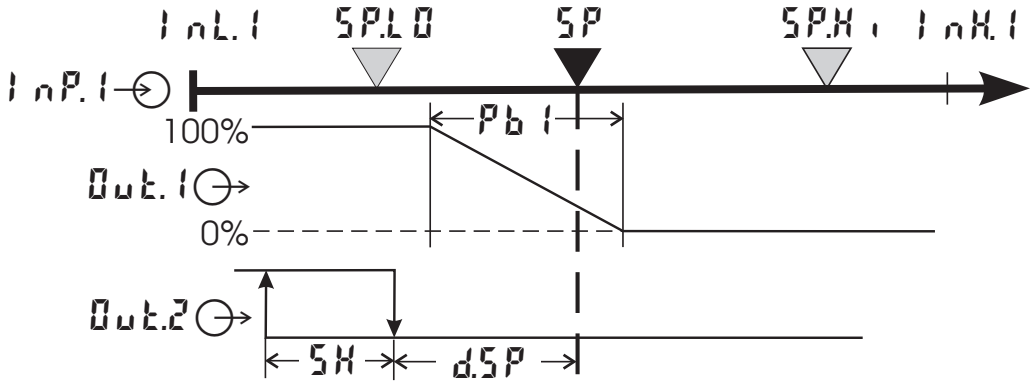


ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	1	continuous controller (PID)
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.3:	O.tYP	=	1 / 2	Out.3 type (0/4 … 20mA)
	Out.0	=	-1999...9999	scaling analog output 0/4mA
	Out.1	=	-1999...9999	scaling analog output 20mA
PArA / Cntr:	Pb1	=	0,1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	t.1	=	1...9999	integral time 1 (heating) in sec.
	td1	=	1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hi	=	-1999...9999	set-point limit high for Weff

For direct action of the continuous controller, the controller action must be changed (ConF / Cntr / C.Act = 1).

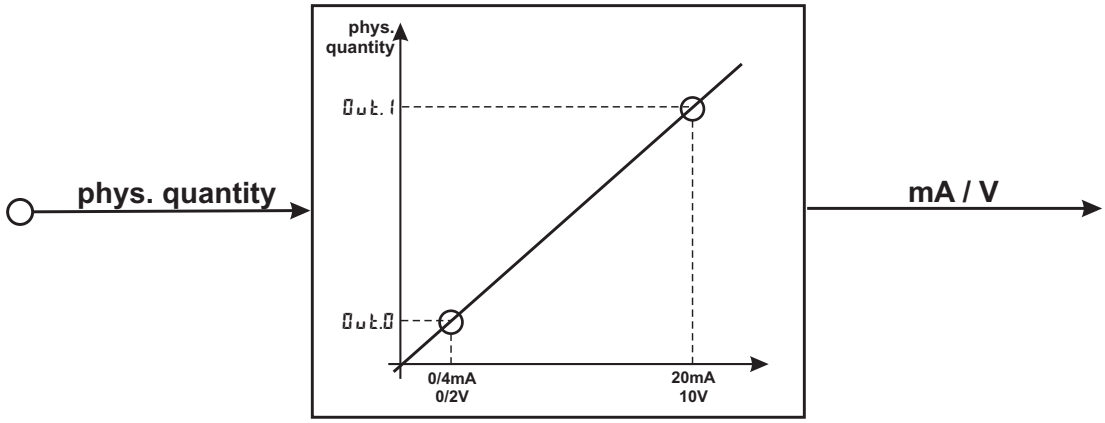
To prevent control outputs Out.1 and Out.2 of the continuous controller from switching simultaneously, the control function of outputs Out.1 and Out.2 must be switched off (ConF / Out.1 and Out.2 / Y.1 and Y.2 = 0).

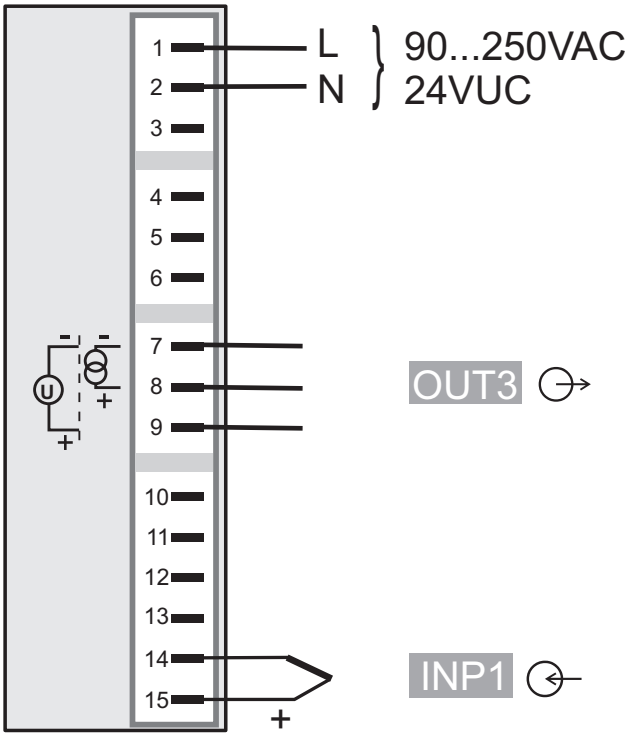
4.4.6 - Y - Off controller / 2-point controller with pre-contact



ConF / Entr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	2	-Y-Off controller
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
	Y.2	=	0	control output Y2 not active
ConF / Out.2:	O.Act	=	0	action Out.2 direct
	Y.1	=	0	control output Y1 not active
	Y.2	=	1	control output Y2 active
PArA / Entr:	Pb 1	=	0,1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	t ı 1	=	1...9999	integral time 1 (heating) in sec.
	td 1	=	1...9999	derivative time 1 (heating) in sec.
	t 1	=	0,4...9999	min. cycle time 1 (heating)
	SH	=	0...9999	switching difference
	d.SP	=	-1999...9999	trigg. point separation suppl. cont. / Y / Off in units of phys. quantity
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.H ı	=	-1999...9999	set-point limit high for Weff

4.4.7 KS4x-1 with measured value output

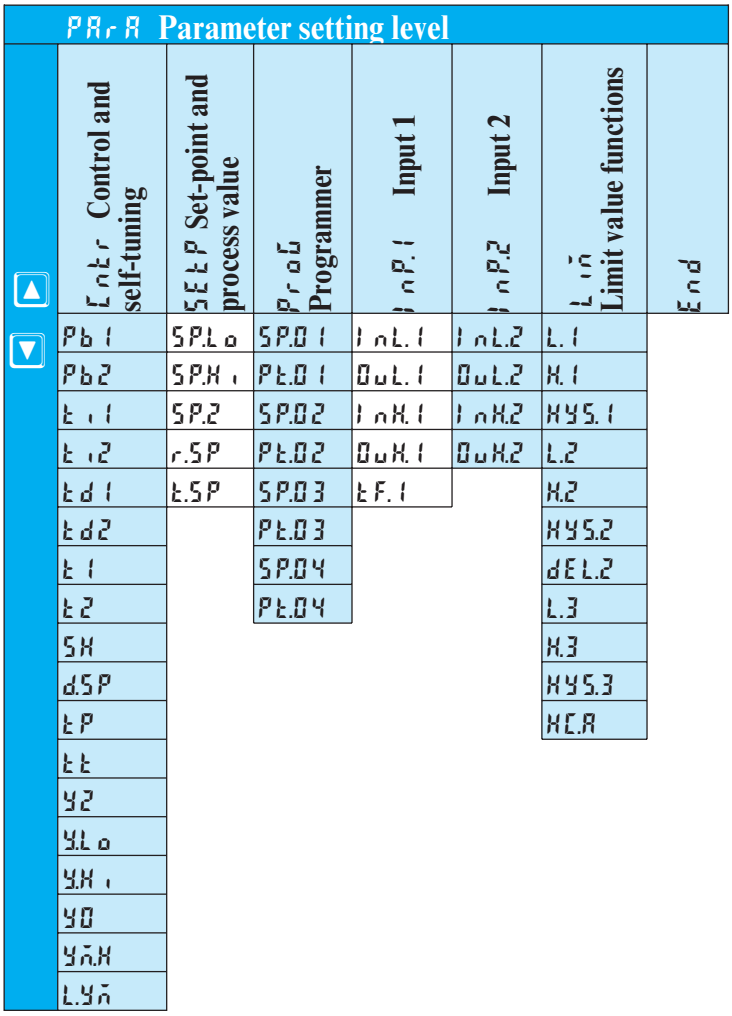




ConF / Out.3:	Otyp	= 1	Out.3 0...20mA continuous
		= 2	Out.3 4...20mA continuous
		= 3	Out.3 0...10V continuous
		= 4	Out.3 2...10V continuous
	Out.0	= -1999...9999	scaling Out.3 for 0/4mA or 0/2V
	Out.1	= -1999...9999	scaling Out.3 for 20mA or 10V
	Osrc	= 3	signal source for Out.3 is the process value

5 Parameter setting level

5.1 *Parameter survey*



Adjustment:

- The parameters can be adjusted by means of keys ▲▼
- Transition to the next parameter is by pressing key ↵
- After the last parameter of a group, donE is displayed, followed by automatic change to the next group.

Return to the beginning of a group is by pressing the ↵ key for 3 sec.

If for 30 sec. no keypress is excecuted the controler returns to the process value and setpoint display (Time Out = 30 sec.)

5.2 *Parameters*

CntR

Name	Value range	Description	Default
Pb1	1...9999 ❶	Proportional band 1/2 (heating) in phys. dimensions (e.g. °C)	100
Pb2	1...9999 ❶	Proportional band 2 (cooling) in phys. dimensions (e.g. °C)	100
t.i1	1...9999	Integral action time 1 (heating) [s]	180
t.i2	1...9999	Integral action time 2 (cooling) [s]	180
td1	1...9999	Derivative action time 1 (heating) [s]	180
td2	1...9999	Derivative action time 2 (cooling) [s]	180
t1 t2	0,4...9999	Minimal cycle duration 1/2 (heating/cooling) [s]. The minimum impulse is 1/4 x t1/t2	10
SH	0...9999	Dead zone or switching differential for on-off control [phys. dimensions)	2
d.SP	-1999...9999	Trigger point speration for series contact / Y / Off [phys. dimensions]	100
tP	0,1...9999	Minimum impulse [s]	OFF
tt	3...9999	Actuator response time for servo-motor [s]	60
Y2	-120...120	2. correcting variable	0
Y.Lo	-120...120	Lower output limit [%]	0
Y.Hi	-120...120	Upper output limit [%]	100
Y.0	-120...120	Working point for the correcting variable [%]	0
Ym.H	-120...120	Limitation of the mean value Ym [%]	5
L.Ym	0...9999	Max. deviation xw at the start of mean value calculation [phys. dimensions]	8

❶ Valid for ConF / otHr / dP = 0. At dP = 1 / 2 / 3 also 0,1 / 0,01 / 0,001.

SEtP

Name	Value range	Description	Default
SP.LO	-1999...9999	Set-point limit low for Weff	0
SP.Hi	-1999...9999	Set-point limit high for Weff	900
SP.2	-1999...9999	Set-point 2.	0
r.SP	0...9999	Set-point gradient [/min]	OFF
t.SP	0...9999	Timer time [min]	5
SP	-1999...9999	Set-point (only visible with BlueControl!)	0

ProG

Name	Value range	Description	Default
SP.01	-1999...9999	Segment end set-point 1	100 ❶
Pt.01	0...9999	Segment time 1 [min]	10 ❷
SP.02	-1999...9999	Segment end set-point 2	100 ❶
Pt.02	0...9999	Segment time 2 [min]	10 ❷
SP.03	-1999...9999	Segment end set-point 3	200 ❶
Pt.03	0...9999	Segment time 3 [min]	10 ❷

Name	Value range	Description	Default
SP.04	-1999...9999	Segment end set-point 4	200 ❶
Pt.04	0...9999	Segment time 4 [min]	10 ❷

❶ If SP.01 ... SP.04 = OFF then following parameters are not shown

❷ If segment end set-point = OFF then the segment time is not visible

InP.1

Name	Value range	Description	Default
InL.1	-1999...9999	Input value for the lower scaling point	0
OuL.1	-1999...9999	Displayed value for the lower scaling point	0
InH.1	-1999...9999	Input value for the upper scaling point	20
OuH.1	-1999...9999	Displayed value for the lower scaling point	20
t.F 1	-1999...9999	Filter time constant [s]	0,5

InP.2

Name	Value range	Description	Default
InL.2	-1999...9999	Input value for the lower scaling point	0
OuL.2	-1999...9999	Displayed value for the lower scaling point	0
InH.2	-1999...9999	Input value for the upper scaling point	50
OuH.2	-1999...9999	Displayed value for the upper scaling point	50

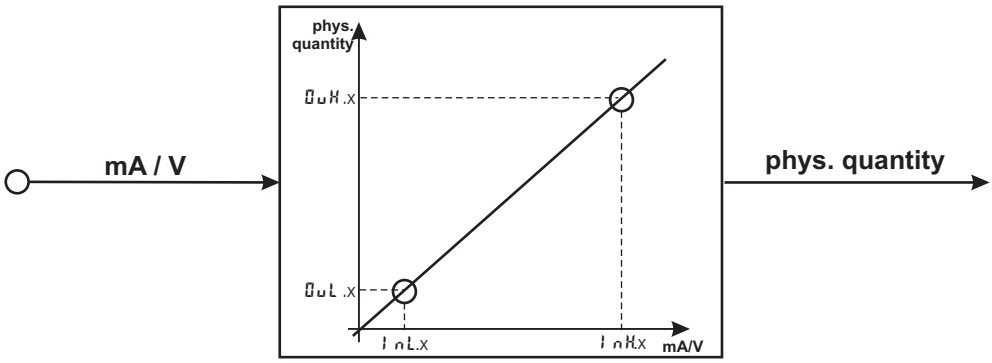
Lim

Name	Value range	Description	Default
L.1	-1999...9999	Lower limit 1	-10
H.1	-1999...9999	Upper limit 1	10
HYS.1	0...9999	Hysteresis limit 1	1
L.2	-1999...9999	Lower limit 2	OFF
H.2	-1999...9999	Upper limit 2	OFF
HYS.2	0...9999	Hysteresis limit 2	1
L.3	-1999...9999	Lower limit 3	OFF
H.3	-1999...9999	Upper limit 3	OFF
HYS.3	0...9999	Hysteresis limit 3	1
HC.A	-1999...9999	Heat current control limit [A]	50

Resetting the controller configuration to factory setting (Default)
→ chapter 12.1 (page 56)

5.3 *Input scaling*

When using current or voltage signals as input variables for InP.1 or InP.2, scaling of input and display values at parameter setting level is required. Specification of the input value for lower and higher scaling point is in the relevant electrical unit (mA / V).



5.3.1 Input InP.1

Parameters InL.1 , OuL.1, InH.1 and OuH.1 are only visible if ConF /InP.1 /Corr = 3 is chosen.

SEnS	Input signal	InL.1	OuL.1	InH.1	OuH.1
30 (0...20mA)	**0 … 20 mA**	0	any	20	any
	4 … 20 mA	4	any	20	any
40 (0...10V)	**0 … 10 V**	0	any	10	any
	2 … 10 V	2	any	10	any

In addition to these settings, InL.1 and InH.1 can be adjusted in the range (0...20mA / 0...10V) determined by selection of SEnS .

For using the predetermined scaling with thermocouple and resistance thermometer (Pt100), the settings for InL.1 and OuL.1 and for InH.1 and OuH.1 must have the same value.

Input scaling changes at calibration level (→ page 41) are displayed by input scaling at parameter setting level. After calibration reset (OFF), the scaling parameters are reset to default.

5.3.2 Input InP.2

SEnS	Input signal	InL.2	OuL.2	InH.2	OuH.2
30	**0 … 20 mA**	0	any	20	any
31	**0 … 50 mA**	0	any	50	any

In addition to these settings, InL.2 and InH.2 can be adjusted in the range (0...20/ 50mA) determined by selection of SEnS.

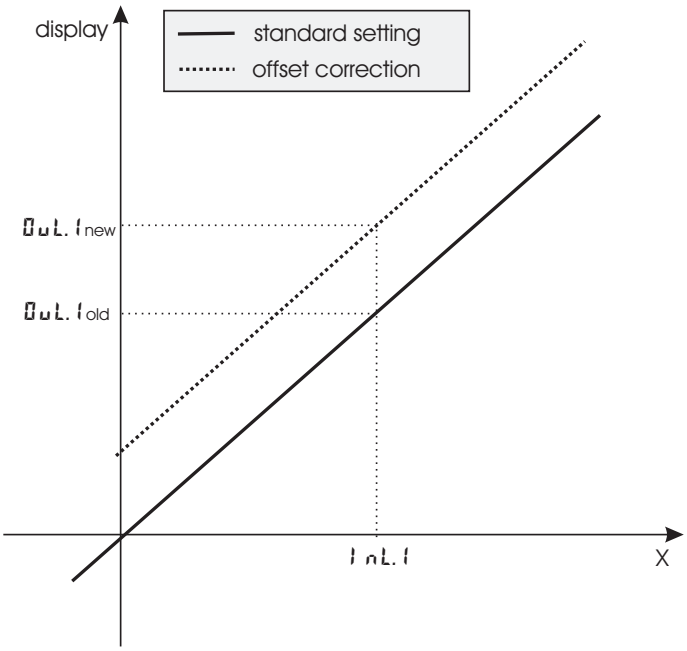
6 Calibration level

Measured value correction (CAL) is only visible if ConF / InP.1 / Corr = 1 or 2 is chosen.

The measured value can be matched in the calibration menu (CAL). Two methods are available:

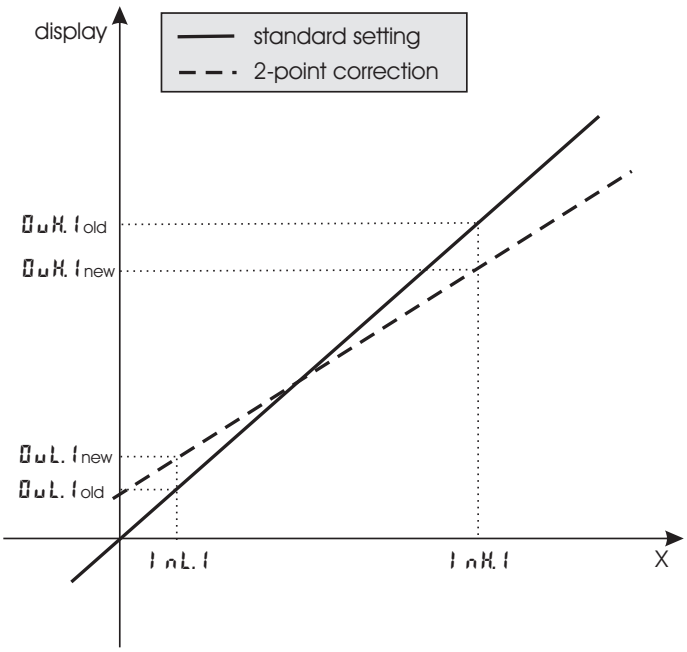
Offset correction
(ConF / InP.1 / Corr = 1):

- possible on-line at the process

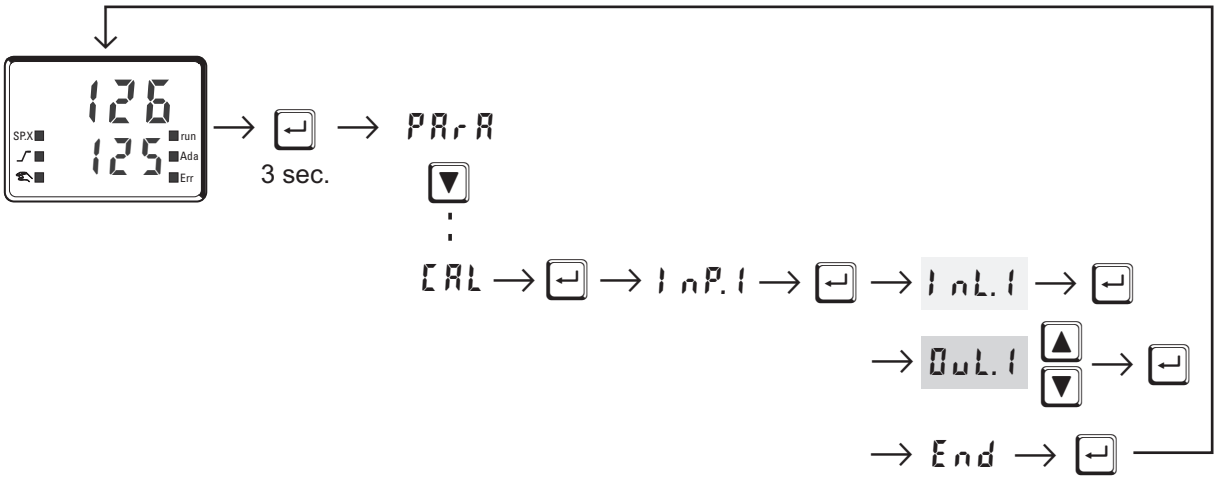


2-point correction
(ConF / InP.1 / Corr = 2):

- is possible off-line with process value simulator



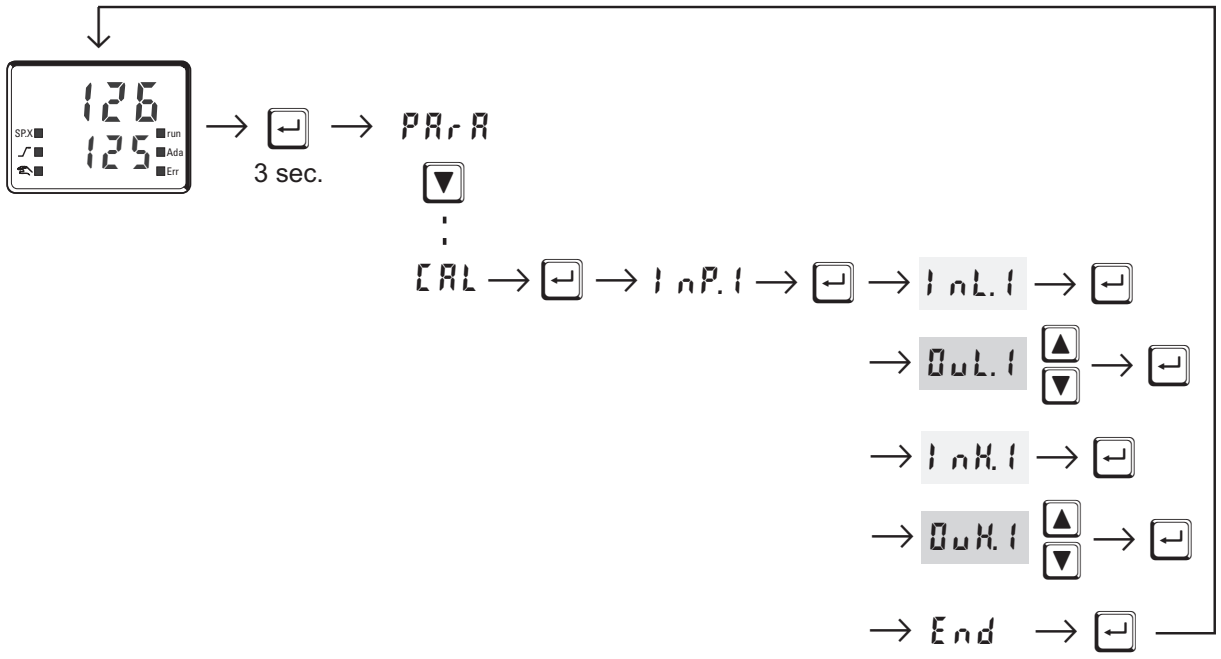
Offset correction **(ConF / InP.1 / Corr = 1):**



InL.1: The input value of the scaling point is displayed.
The operator must wait, until the process is at rest.
Subsequently, the operator acknowledges the input value by pressing key ↵.

OuL.1: The display value of the scaling point is displayed.
Before calibration, OuL.1 is equal to InL.1.
The operator can correct the display value by pressing keys ▲▼ .
Subsequently, he confirms the display value by pressing key ↵.

2-point correction **(ConF / InP.1 / Corr = 1):**



InL.1: The input value of the lower scaling point is displayed.
The operator must adjust the lower input value by means of a process value simulator and confirm the input value by pressing key ↵.

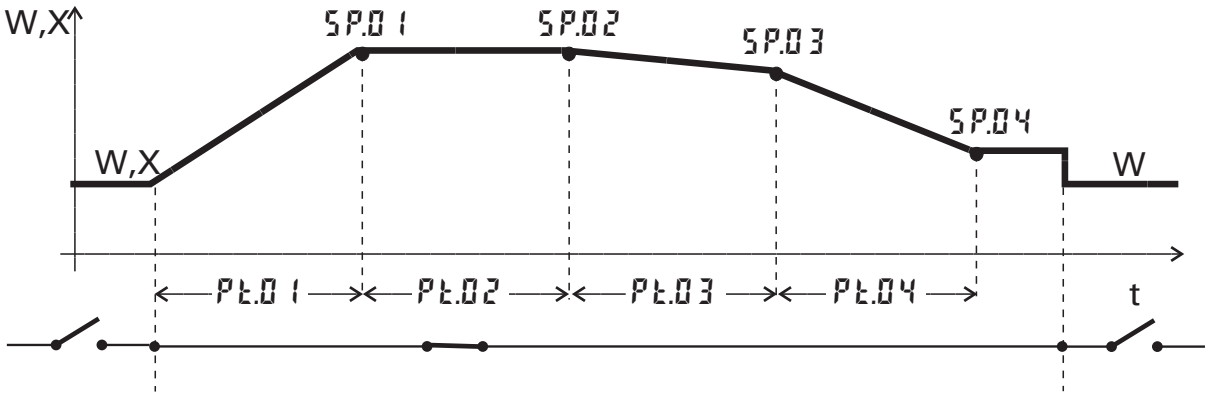
OuL.1: The display value of the lower scaling point is displayed.
Before calibration, OuL.1 equals InL.1.
The operator can correct the lower display value by pressing the ▲▼ keys. Subsequently, he confirms the display value by pressing key ↵.

InH.1: The input value of the upper scaling point is displayed. .
The operator must adjust the upper input value by means of the process value simulator and confirm the input value by pressing key ↵.

OuH.1: The display value of the upper scaling point is displayed.
Before calibration OuH.1 equals InH.1.
The operator can correct the upper display value by pressing keys ▲▼
Subsequently, he confirms the display value by pressing key ↵.

The parameters (OuL.1, OuH.1) changed at CAL level can be reset by adjusting the parameters below the lowest adjustment value (OFF) by means of decrement key ▼ .

7 Programmer



Programmer set-up:
For using the controller as a programmer, select parameter SP.Fn = 1 in the ConF menu (→ page 21). The programmer is started via one of digital inputs di1..3. Which input shall be used for starting the programmer is determined by selecting parameter P.run = 2 / 3 / 4 in the ConF menu accordingly. (→ page 23).
For assigning the program end as a digital signal to one of the relay outputs, parameter P.End = 1 must be selected for the relevant output OUt.1...OUt.3 in the ConF menu (→ page 26, 27).

Programmer parameter setting:
A programmer with 4 segments is available to the user. Determine a segment duration Pt.01 .. Pt.04 (in minutes) and a segment target set-point SP.01 .. SP.04 for each segment in the PArA menu (→ page 38).

Starting/stopping the programmer:
Starting the programmer is done by a digital signal at input di1..3 selected by parameter P.run (→ page 23).
The programmer calculates a gradient from segment end setpoint and segment time. This gradient is always valid. Normaly, the programmer starts the first segment at process value. Because of this the effective run-time of the first segment may differ from the at PArA level setted segment time (process value set-point).
After program end, the controller continues controlling with the target set-point set last.
If the program is stopped during execution (signal at digital input di1..3 is taken away), the programmer returns to program start and waits for a new start signal.

Program parameter changing while the program is running is possible.

Changing the segment time:
Changing the segment time leads to re-calculation of the required gradient. When the segment time has already elapsed, starting with the new segment is done directly, where the set-point changes with a step.

Changing the segment end setpoint:
Changing the set-point leads to re-calculation of the required gradient, in order to reach the new set-point during the segment rest time, whereby the required gradient polarity sign can change.

8 Timer

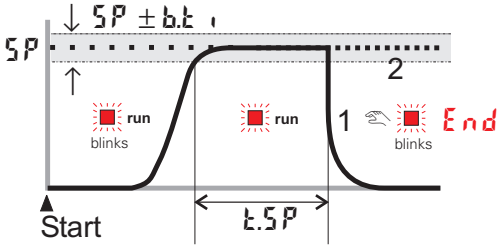
8.1 *Setting up the timer*

8.1.1 Operating modes

6 different timer modes are available to the user. The relevant timer mode can be set via parameter SP.Fn in the ConF menu (→ page 21).

Mode 1 (—)

After timer start, control is to the adjusted set-point . The timer (t.SP) runs as soon as the process value enters or leaves the band around the set-point (x = SP ± b.t 1). After timer elapse, the controller returns to Y2. End and the set-point are displayed alternately in the lower display line.

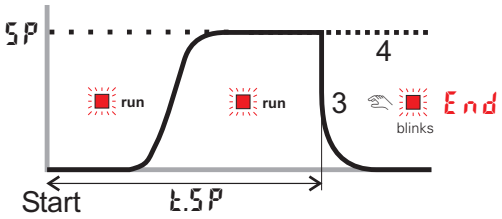


Mode 2 (····)

Mode 2 corresponds to mode 1, except that control is continued with the relevant set-point after timer (t.SP) elapse.

Mode 3 (—)

After timer start, control is to the adjusted set-point. The timer (t.SP) starts immediately after switch-over. After timer elapsing the controller switches off. End and the set-point are displayed alternately in the bottom display line.

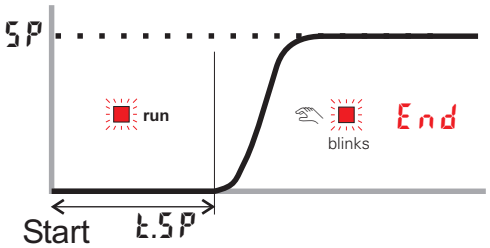


Mode 4 (····)

Mode 4 corresponds to mode 3, except that control is continued with the relevant set-point after timer (t.SP) elapse.

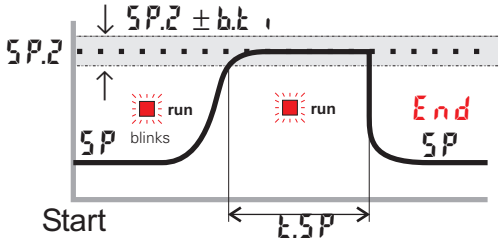
Mode 5 (delay)

The timer starts immediately. The controller output remains on Y2. After timer (t.SP) elapse, control starts with the adjusted set-point.



Mode 6

After set-point switch-over (SP → SP.2), control is to SP.2. The timer (t.SP) starts when the process value enters the adjusted band around the set-point (x = SP.2 ± b.t.1). After time elapse the controller returns to SP. End and the set-point are displayed alternately in the lower display line.



8.1.2 Tolerance band

Timer modes 1,2 and 6 are provided with a freely adjustable tolerance band. The tolerance band around the set-point can be adjusted via parameter b.t.1 in the Conf menu (x = SP.2 ± b.t.1)
(→ page 21).

8.1.3 Timer start

Various procedures for starting the timer are possible:

Start via		LOGI		Mode					
		Y2 =	SP.2 =	1	2	3	4	5	6
Y / Y2 ❶ switch-over via digital input	di1	2	x	✔	✔	✔	✔	✔	-
	di2	3	x	✔	✔	✔	✔	✔	-
	di3	4	x	✔	✔	✔	✔	✔	-
SP / SP.2 switch-over via digital input ❶	di1	x	2	-	-	-	-	-	✔
	di2	x	3	-	-	-	-	-	✔
	di3	x	4	-	-	-	-	-	✔
Pressing key		6	x	✔	✔	✔	✔	✔	-
Power On		0	x	✔	✔	✔	✔	✔	-
		x	0	-	-	-	-	-	✔
Changing t.t.1 (extended operating level)		x	x	✔	✔	✔	✔	✔	✔
Serial interface (if provided)		x	x	✔	✔	✔	✔	✔	✔

❶ when using a digital input, adjust parameter d.Fn = 2 (Conf / LOGI) (key function)
x no effect

8.1.4 Signal end

If one of the relays shall switch after timer elapse, parameter t.End = 1 and inverse action OAct = 1 must be selected for the relevant output Out.1 … Out.3 in the Conf menu (→ page 25, 26). If direct action is selected, the relevant output signals the active timer.

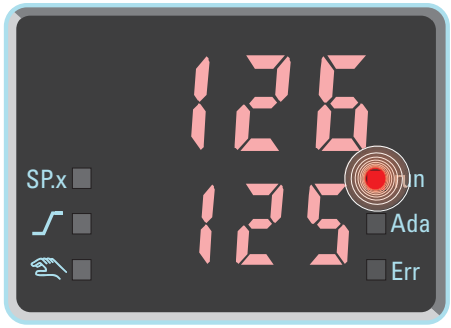
8.2 *Determining the timer run-time*

The timer run-time can be determined via parameter t.SP in the PArA menu. The timer run-time must be specified in minutes with one digit behind the decimal point (0,1 minutes = 6 seconds).
Alternatively, the timer run-time can be determined directly at extended operating level (→ chapter 8.3).

8.3 *Starting the timer*

Dependent of configuration, the timer start is as follows:

- by a positive flank at one of digital inputs di1..3
- by pressing key
- by switching on the controller (power On)
- by changing the timer run-time t.t1 > 0 (extended operating level)
- via the serial interface



Display:

Run LED	Signification
blinks	- timer was started - timer is not running yet
lit	- timer was started - timer is running
off (End and setpoint are displayed alternately)	- timer is off - timer has elapsed - deletion of End display by pressing any key

With active timer, the time can be adjusted by changing parameter t.t1 at extended operating level.

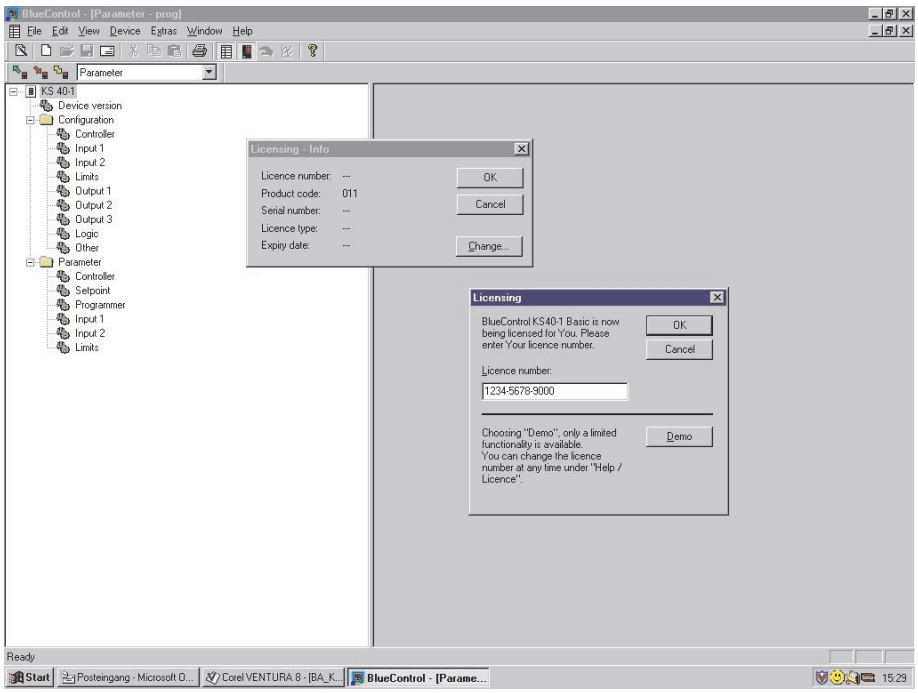
9 BlueControl

BlueControl is the projection environment for the BluePort controller series of PMA. The following 3 versions with graded functionality are available:

FUNCTIONALITY	MINI	BASIC	EXPERT
parameter and configuration setting	yes	yes	yes
controller and loop simulation	yes	yes	yes
download: trnsfer of an engineering to the controller	yes	yes	yes
online mode/ visualization	SIM only	yes	yes
defining an application specific linearization	yes	yes	yes
configuration in the extended operating level	yes	yes	yes
upload: reading an engineering from the controller	SIM only	yes	yes
basic diagnostic functions	no	no	yes
saving data file and engineering	no	yes	yes
printer function	no	yes	yes
online documentation, help	yes	yes	yes
implementation of measurement value correction	yes	yes	yes
data acquisition and trend display	SIM only	yes	yes
wizard function	yes	yes	yes
extended simulation	no	no	yes
programmeditor (KS 90-1prog only)	no	no	yes

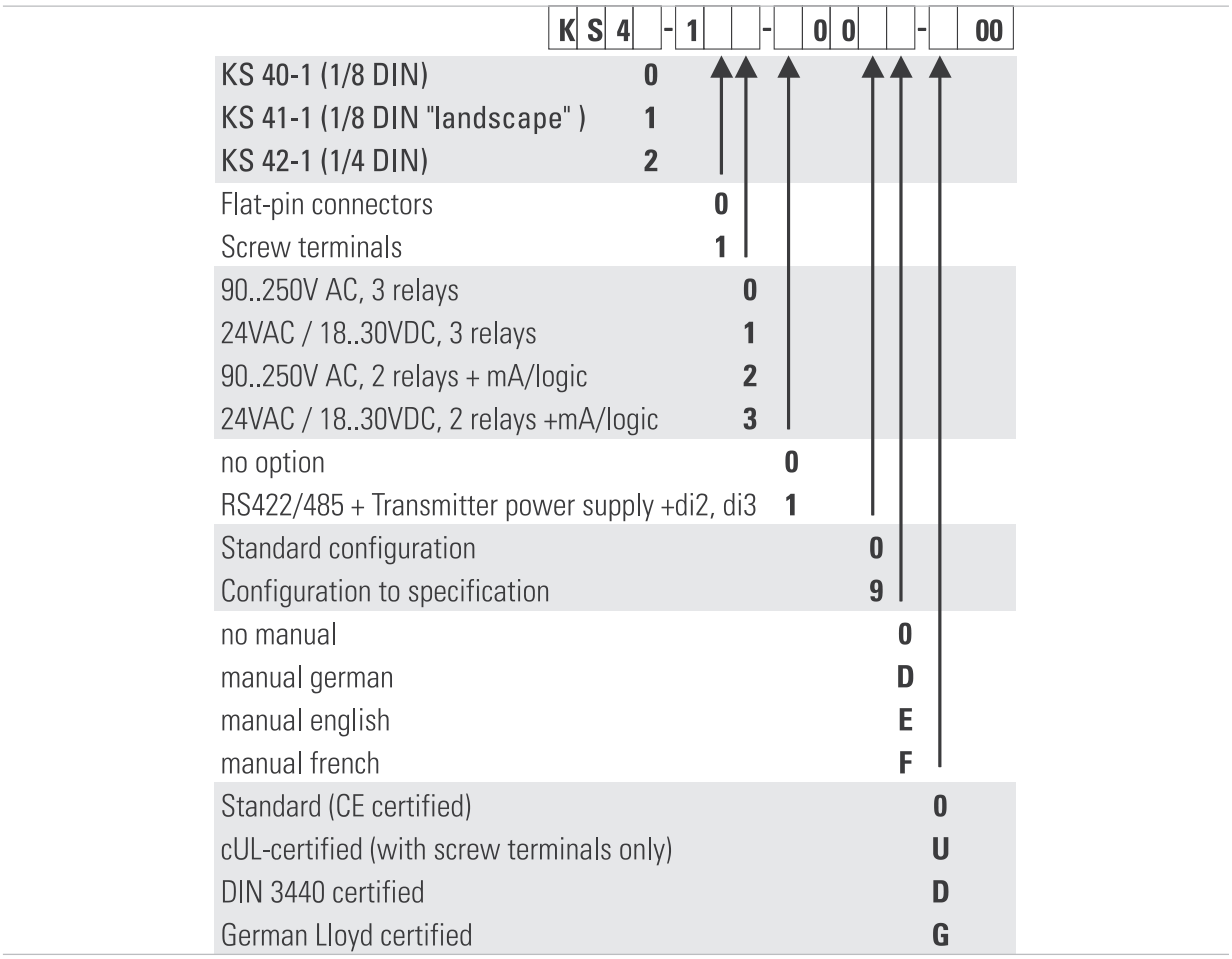
The mini version is - free of charge - at your disposal as download at PMA homepage ***www.pma-online.de*** or on the PMA-CD (please ask for).

At the end of the installation on the licence number has to be stated or DEMO mode must be chosen.



At DEMO mode the licence number can be stated subsequently under ***Help*** → ***Licence*** → ***Change***.

10 Versions



Accessories delivered with the unit

Operating manual (if selected by the ordering code)

- 2 fixing clamps
- operating note in 15 languages

Accessory equipment with ordering information

Description			Order no.
Heating current transformer 50A AC			9404-407-50001
PC-adaptor for the front-panel interface			9407-998-00001
Standard rail adaptor			9407-998-00061
Operating manual	German		9499-040-62718
Operating manual	English		9499-040-62711
Operating manual	French		9499-040-62732
Interface description Modbus RTU	German		9499-040-63518
Interface description Modbus RTU	English		9499-040-63511
BlueControl (engineering tool)	Mini	Download	www.pma-online.de
BlueControl (engineering tool)	Basic		9407-999-11001
BlueControl (engineering tool)	Expert		9407-999-11011

11 Technical data

INPUTS

PROCESS VALUE INPUT INP1

Resolution:	> 14 bits
Decimal point:	0 to 3 digits behind the decimal point
Dig. input filter:	adjustable 0,000...9999 s
Scanning cycle:	100 ms
Measured value correction:	2-point or offset correction

Thermocouples

→ Table 1 (page 53)

Input resistance:	≥ 1 MΩ
Effect of source resistance:	1 μV/Ω

Cold-junction compensation

Maximal additional error:	0,5 K

Sensor break monitoring

Sensor current:	≤ 1 μA

Configurable output action

Resistance thermometer

→ Table 2 (page 53)

Connection:	2 or 3-wire
Lead resistance:	max. 30 Ohm
Input circuit monitor:	break and short circuit

Special measuring range

BlueControl (engineering tool) can be used to match the input to sensor KTY 11-6 (characteristic is stored in the controller).

Physical measuring range:	0...4500 Ohm
Linearization segments	16

Current and voltage signals

→ Table 3 (page 53)

Span start, end of span:	anywhere within measuring range
Scaling:	selectable -1999...9999
Linearization:	16 segments, adaptable with BlueControl
Decimal point:	adjustable
Input circuit monitor:	12,5% below span start (2mA, 1V)

SUPPLEMENTARY INPUT INP2

Resolution:	> 14 bits
Scanning cycle:	100 ms
Accuracy:	< 0,5 %

Heating current measurement

via current transformer (Accessory equipment)

Measuring range:	0...50mA AC
Scaling:	adjustable -1999...0,000...9999 A

Current measuring range

Technical data as for INP1

CONTROL INPUT DI1

Configurable as switch or push-button!
Connection of a potential-free contact suitable for switching "dry" circuits.

Switched voltage:	2,5 V
Current:	50 μA

CONTROL INPUTS DI2, DI3 (0PTI0N)

Configurable as switch or push-button!
Optocoupler input for active triggering

Nominal voltage	24 V DC external
Current sink (IEC 1131 type 1)	
Logic "0"	-3...5 V
Logic "1"	15...30 V
Current requirement	approx.. 5 mA

TRANSMITTER SUPPLY U_T (0PTI0N)

Power:	22 mA / ≥ 18 V

If the universal output OUT3 is used there may be no external galvanic connection between measuring and output circuits!

GALVANIC ISOLATION

—— Safety isolation
═══ Function isolation

Power supply connections	Process value input INP1 Supplementary input INP2 Digital input di1
Relay outputs OUT 1,2	RS422/485 interface
Relay output OUT3	Digital inputs di2, 3
	Universal output OUT3
	Transmitter supply U_T

OUTPUTS

RELAY OUTPUTS OUT1, OUT2

Contact type:	2 NO contacts with common connection
Max. contact rating:	500 VA, 250 V, 2A at 48...62Hz, resistive load
Min. contact rating:	6V, 1 mA DC

Operating life (electr.):	800.000 duty cycles with max. rating

OUT3 USED AS RELAY OUTPUT

Contact type:	potential-free changeover contact
Max.contact rating:	500 VA, 250 V, 2A at 48...62Hz, resistive load
Min. contact rating:	5V, 10 mA AC/DC
Operating life (electr.):	600.000 duty cycles with max. contact rating

Note:
If the relays OUT1...OUT3 operate external contactors, these must be fitted with RC snubber circuits to manufacturer specifications to prevent excessive switch-off voltage peaks.

OUT3 AS UNIVERSAL OUTPUT

Galvanically isolated from the inputs.

Freely scalable
Resolution: 11 bits

Current output

0/4...20 mA configurable.

Signal range:	0...approx.22mA
Max. load:	≤ 500 Ω
Load effect:	no effect
Resolution:	≤ 22 µA (0,1%)
Accuracy	≤ 40 µA (0,2%)

Voltage output

0/2...10V configurable

Signal range:	0...11 V
Min. load:	≥ 2 kΩ
Load effect:	no effect
Resolution:	≤ 11 mV (0,1%)
Accuracy	≤ 20 mV (0,2%)

OUT3 used as transmitter supply

Output power:	22 mA / ≥ 13 V

OUT3 used as logic output

Load ≤ 500 Ω	0/≤ 20 mA
Load > 500 Ω	0/> 13 V

POWER SUPPLY

Dependent of order:

AC SUPPLY

Voltage:	90...260 V AC
Frequency:	48...62 Hz
Power consumption	approx. 7,0 VA

UNIVERSAL SUPPLY 24 V UC

AC voltage:	20,4...26,4 V AC
Frequency:	48...62 Hz
DC voltage:	18...31 V DC
Power consumption:	approx.. 7,0 VA

BEHAVIOUR WITH POWER FAILURE

Configuration, parameters and adjusted set-points, control mode:
Non-volatile storage in EEPROM

BLUEPORT FRONT INTERFACE

Connection of PC via PC adapter (see "Accessory equipment"). The BlueControl software is used to configure, set parameters and operate the KS4x-1.

BUS INTERFACE (OPTION)

Galvanically isolated

Physical:	RS 422/485
Protocol:	Modbus RTU
Transmission speed:	2400, 4800, 9600, 19.200 bits/sec
Address range:	1...247
Number of controllers per bus:	32

Repeaters must be used to connect a higher number of controllers.

ENVIRONMENTAL CONDITIONS

Protection modes

Front panel:	IP 65 (NEMA 4X)
Housing:	IP 20
Terminals:	IP 00

Permissible temperatures

For specified accuracy:	0...60°C
Warm-up time:	≥ 15 minutes
For operation:	-20...65°C
For storage:	-40...70°C

Humidity

75% yearly average, no condensation

Shock and vibration

Vibration test Fc (DIN 68-2-6)

Frequency:	10...150 Hz
Unit in operation:	1g or 0,075 mm
Unit not in operation:	2g or 0,15 mm

Shock test Ea (DIN IEC 68-2-27)

Shock:	15g
Duration:	11ms

Electromagnetic compatibility
Complies with EN 61 326-1
(for continuous, non-attended operation)

GENERAL

Housing
Material: Makrolon 9415 flame-retardant
Flammability class: UL 94 V0, self-extinguishing

Plug-in module, inserted from the front

Safety test
Complies with EN 61010-1 (VDE 0411-1):
Overvoltage category II
Contamination class 2
Working voltage range 300 V
Protection class II

Certifications
Type-tested to DIN 3440
For use in:
- Heat generating plants with outflow temperatures up to 120°C to DIN 4751
- Hot water plants with outflow temperatures above 110°C to DIN 4752
- Thermal transfer plants with organic transfer media to DIN 4754
- Oil-heated plants to DIN 4755

cUL certification
(Type 4x, indoor use)
File: E 208286

For compliance with cUL certificate,the following information must be taken into account:
- Use only 60 / 75 or 75°C copper (Cu) wire.
- Tighten the terminal- screws with a torque of 0,5 - 0,6 Nm

Mounting
Panel mounting with two fixing clamps at top/bottom or right/left,
High-density mounting possible

Mounting position: uncritical
Weight: 0,27kg

Accessories delivered with the unit
Operating manual
Fixing clamps

Table 1 Thermocouple measuring ranges

Thermocouple type		Range		Accuracy	Resolution (∅)
L	Fe-CuNi (DIN)	-100...900°C	-148...1652°F	≤ 2K	0,1 K
J	Fe-CuNi	-100...1200°C	-148...2192°F	≤ 2K	0,1 K
K	NiCr-Ni	-100...1350°C	-148...2462°F	≤ 2K	0,2 K
N	Nicrosil/Nisil	-100...1300°C	-148...2372°F	≤ 2K	0,2 K
S	PtRh-Pt 10%	0...1760°C	32...3200°F	≤ 2K	0,2 K
R	PtRh-Pt 13%	0...1760°C	32...3200°F	≤ 2K	0,2 K

Table 2 Resistance transducer measuring ranges

Type	Sens. current	Range		Accuracy	Resolution (∅)
Pt100	0,2mA	-200...100°C	-140...212°F	≤ 1K	0,1K
Pt100		-200...850°C	-140...1562°F	≤ 1K	0,1K
Pt1000		-200...850°C	-140...1562°F	≤ 2K	0,1K
KTY 11-6		-50...150°C	-58...302°F	≤ 2K	0,05K

Table 3 Current and voltage measuring ranges

Range	Input resistance	Accuracy	Resolution (∅)
0-10 Volt	≈ 110 kΩ	≤ 0,1 %	≤ 0,6 mV
0-20 mA	49 Ω (voltage requirement ≤ 2,5 V)	≤ 0,1 %	≤ 1,5 µA

12 Safety hints

This unit was built and tested in compliance with VDE 0411-1 / EN 61010-1 and was delivered in safe condition.
The unit complies with European guideline 89/336/EWG (EMC) and is provided with CE marking.
The unit was tested before delivery and has passed the tests required by the test schedule. To maintain this condition and to ensure safe operation, the user must follow the hints and warnings given in this operating manual.
The unit is intended exclusively for use as a measurement and control instrument in technical installations.

Warning
If the unit is damaged to an extent that safe operation seems impossible, the unit must not be taken into operation.

ELECTRICAL CONNECTIONS
The electrical wiring must conform to local standards (e.g. VDE 0100). The input measurement and control leads must be kept separate from signal and power supply leads.
In the installation of the controller a switch or a circuit-breaker must be used and signified. The switch or circuit-breaker must be installed near by the controller and the user must have easy access to the controller.

COMMISSIONING
Before instrument switch-on, check that the following information is taken into account:

- Ensure that the supply voltage corresponds to the specifications on the type label.
- All covers required for contact protection must be fitted.
- If the controller is connected with other units in the same signal loop, check that the equipment in the output circuit is not affected before switch-on. If necessary, suitable protective measures must be taken.
- The unit may be operated only in installed condition.
- Before and during operation, the temperature restrictions specified for controller operation must be met.

SHUT-DOWN
For taking the unit out of operation, disconnect it from all voltage sources and protect it against accidental operation.
If the controller is connected with other equipment in the same signal loop, check that other equipment in the output circuit is not affected before switch-off. If necessary, suitable protective measures must be taken.

MAINTENANCE, REPAIR AND MODIFICATION
The units do not need particular maintenance.

Warning
When opening the units, or when removing covers or components, live parts and terminals may be exposed.

Before starting this work, the unit must be disconnected completely.

After completing this work, re-shut the unit and re-fit all covers and components. Check if specifications on the type label must be changed and correct them, if necessary.

Caution
When opening the units, components which are sensitive to electrostatic discharge (ESD) can be exposed. The following work may be done only at workstations with suitable ESD protection.
Modification, maintenance and repair work may be done only by trained and authorized personnel. For this purpose, the PMA service should be contacted.

The cleaning of the front of the controller should be done with a dry or a wetted (spirit, water) kerchief.

12.1 *Resetting to factory setting*

In case of faultyconfiguration, KS4x-1 can be reset to the default condition.

❶ For this, the operator must keep the keys increment and decrement pressed during power-on.
❷ Then, press key increment to select YES.
❸ Confirm factory resetting with Enter and the copy procedure is started (display COPY).
❹ Afterwards the device restarts.
In all other cases, no reset will occur (timeout abortion).

If one of the operating levels was blocked and the safety lock is open, reset to factory setting is not possible.

If a pass number was defined (via BlueControl®) and the safety lock is open, but no operating level was blocked, enter the correct pass number when prompted in ❸. A wrong pass number aborts the reset action.

The copy procedure (COPY) can take some seconds.
Now, the transmitter is in normal operation.

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9499- 040- 62711

A5 auf A6 gefaltet, 2-fach geheftet, SW-Druck Normalpapier weiß 80g/m^2

Subject to alterations without notice
Änderungen vorbehalten
Sours réserve de toutes modifications

P.O.B. 310 229, D-34058 Kassel, Germany
Printed in Germany 9499-040-62711 (07/2004)

A6

Project information	
File name	SK3335.069_060619
Program version	2.4 SR1
device	KS 41-1 universal
operating version	2
Order number	KS41-103-0000D-000
Terminals	Flat pin connection
Power supply	24 V AC / 18...30 V DC
output type	2 relays + mA / V / logic
input variant	INP1 and INP2
Bus interface	no interface
option module	no option
Software option	no option
Project name	Gerät1
Operator	
Version number	1.0
Creation date	20-JUN-2006 08:59:25
Change date	22-JUN-2006 14:22:13
Description	

Configuration | Controller				
Name	**Description**	**Value**	**Range**	**Visible**
Cntr	**Controller**			**x**
SP.Fn	setpoint processing	0: Setpoint/ ext. Setpoint		x
C.Fnc	control behaviour	1: PID controller (2-point and continuous)		x
mAn	manual operation admitted	0: Manual operation not permitted		x
C.Act	direction of operation	0: inverse, e.g. heating		x
FAIL	behaviour at sensor break	1: switch to Y2		x
rnG.L	lower control range [phys]	0	-1999...99	x
rnG.H	upper control range [phys]	100	1...9999	x
Adt0	tuning of cycle time t1, t2	0: automatic tuning		

Configuration | Input 1				
Name	**Description**	**Value**	**Range**	**Visible**
InP.1	**Input 1**			**x**
S.tYP	sensor type	30: current : 0/4...20 mA		x
S.Lin	linearization	0: no linearization		x
Corr	measured value correction	3: scaling		x
fAI1	forcing INP1	0: -		

Configuration | Input 2				
Name	**Description**	**Value**	**Range**	**Visible**
InP.2	**Input 2**			**x**
I.Fnc	function INP2	1: heating current input		x
S.tYP	sensor type	31: AC (0...50 mA)		x
fAI2	forcing INP2	0: -		

Configuration | Limit				
Name	**Description**	**Value**	**Range**	**Visible**
Lim	**Limit**			**x**
Fnc.1	function of limit 1	1: measurement value		x
Src.1	source of limit 1	1: control deviation		x
Fnc.2	function of limit 2	0: switched off		x
Fnc.3	function of limit 3	0: switched off		x
HC.AL	heating current alarm	0: switched off		x
LP.AL	loop alarm	0: no LOOP alarm		x
Hour	operating hours, limit	off	0...999999	
Swit	output switching, limit	off	0...999999	

Configuration | Output 1				
Name	**Description**	**Value**	**Range**	**Visible**
Out.1	**Output 1**			**x**
O.Act	direction of operation	0: direct		x
Y.1	controller output Y1	0: -		x
Lim.1	signal limit 1	0: -		x
FAi.1	signal INP1 fail	0: -		x
FAi.2	signal INP2 fail	0: -		x
fOut	forcing OUT1	0: -		

Configuration | Output 2				
Name	**Description**	**Value**	**Range**	**Visible**
Out.2	**Output 2**			**x**
O.Act	direction of operation	0: direct		x
Y.1	controller output Y1	0: -		x
Lim.1	signal limit 1	0: -		x
FAi.1	signal INP1 fail	0: -		x
FAi.2	signal INP2 fail	0: -		x
fOut	forcing OUT2	0: -		

Configuration | Output 3				
Name	**Description**	**Value**	**Range**	**Visible**
Out.3	**Output 3**			**x**
O.tYP	type of OUT	3: 0 ... 10 V continuous		x
Out.0	scaling 0%	0.00	-1999...9999	x
Out.1	scaling 100%	100.0	-1999...9999	x
O.Src	signal source	1: controller output y1 (cont.)		x
fOut	forcing OUT3	0: -		

Configuration | Logic				
Name	**Description**	**Value**	**Range**	**Visible**
LOGI	**Logic**			**x**
L_r	block front	0: interface only		x
SP.2	2nd setpoint	0: interface only		x
SP.E	external setpoint	0: interface only		x
Y2	2nd actuator value	0: interface only		x
mAn	automatic/manual switching	0: interface only		x
C.oFF	controller off	0: interface only		x
m.Loc	A/M-key blockage	0: interface only		x
Err.r	reset error list	0: interface only		x
di.Fn	function of inputs	0: direct		x
fDI1	forcing di1	0: -		

Configuration | Other				
Name	**Description**	**Value**	**Range**	**Visible**
othr	**Other**			**x**
Unit	unit	1: in Celsius		x
dP	decimal points	2: 2 digits behind the decimal point		x
C.dEL	modem delay [ms]	0	0...200	x
FrEq	switching 50/60 Hz	0: mains frequency 50 Hz		
ICof	access controller off	0: enabled		
IAda	access auto tuning	0: enabled		
IExo	access extended operation level	0: enabled		
ILat	suppress error latch	0: no		
Pass	password	off	0...9999	
IPar	access parameter level	1: blocked		
ICnf	access configuration level	1: blocked		
ICal	access calibration level	1: blocked		

Parameter | Controller				
Name	**Description**	**Value**	**Range**	**Visible**
Cntr	**Controller**			**x**
Pb1	proportional band 1 [phys]	20.00	0.01...9999	x
ti1	integral action 1 [s]	2	1...9999	x
td1	derivative action 1 [s]	2	1...9999	x
t1	min. cycle time 1 [s]	5.00	0.08...9999	x
Y2	correcting variable 2	0	-100...100	x
Y.Lo	lower output range [%]	10	0...99	x
Y.Hi	upper output range [%]	100	11...105	x
Y.0	working point [%]	0	-100...100	x

Parameter | Setpoint				
Name	**Description**	**Value**	**Range**	**Visible**
Setp	**Setpoint**			**x**
SP.LO	lower setpoint range [phys]	0.10	-1999...9999	x
SP.Hi	upper setpoint range [phys]	3.25	-1999...9999	x
SP.2	2nd setpoint [phys]	0.00	-1999...9999	x
r.SP	setpoint ramp [/min]	off	0.01...9999	x
SP	setpoint	0.10	0.10...3.25	

Parameter | Programmer				
Name	**Description**	**Value**	**Range**	**Visible**
ProG	**Programmer**			**x**

Parameter | Input 1				
Name	**Description**	**Value**	**Range**	**Visible**
InP.1	**Input 1**			**x**
InL.1	lower input value 1 [phys]	4.0	0.0...20.0	x
OuL.1	lower output value 1 [phys]	-1.00	-1999...9999	x
InH.1	upper input value 1 [phys]	20.0	0.0...20.0	x
OuH.1	upper output value 1 [phys]	4.00	-1999...9999	x
t.F1	filter time 1 [s]	3.0	0.0...100.0	x

Parameter | Input 2				
Name	**Description**	**Value**	**Range**	**Visible**
InP.2	**Input 2**			**x**
InL.2	lower input value 2 [phys]	0.0	0.0...50.0	x
OuL.2	lower output value 2 [phys]	0.00	-1999...9999	x
InH.2	upper input value 2 [phys]	50.0	0.0...50.0	x
OuH.2	upper output value 2 [phys]	50.00	-1999...9999	x

Parameter | Limit				
Name	**Description**	**Value**	**Range**	**Visible**
Lim	**Limit**			**x**
L.1	lower limit 1 [phys]	-10.00	-1999...9999	x
H.1	upper limit 1 [phys]	10.00	-1999...9999	x
HYS.1	hysteresis 1 [phys]	1.00	0.00...9999	x

Display 2		
	Name	Description

Extended operation level		
	Name	Description

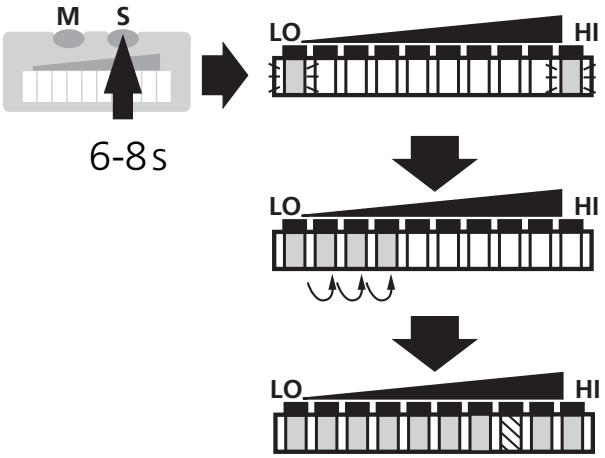
Connection diagram		
terminal row 2		
pin	**description**	**Description**
A1	PWR L 24V AC/DC	
A2	PWR N 24V AC/DC	
A3	---	
A4	OUT1 NO	
A5	OUT1 C / OUT2 C	
A6	OUT2 NO	
A7	OUT3 -C	
A8	---	
A9	OUT3 +V	
A10	INP2 HC	heating current input
A11	INP2 HC	
A12	+di1	
A13	INP1 +mA	actual value X1
A14	-di1, INP1 -mA	
A15	---	

Brief adjustment instructions

1

- After installation (→ page 24) and electrical connection (→ page 26),
- apply the operating voltage.
  After approx. 15 s the unit is ready.
- Allow the medium to flow through the system at the required maximmum flow rate.

2



Press the **Learn/Set** button and keep it pressed.
The green LEDs on the right and on the left flash,
after 5 s the LED bar (green) fills from left to right
(**release the button** now).

The indication goes off briefly.
The unit stores the current flow as maximum flow and passes into the operating mode.

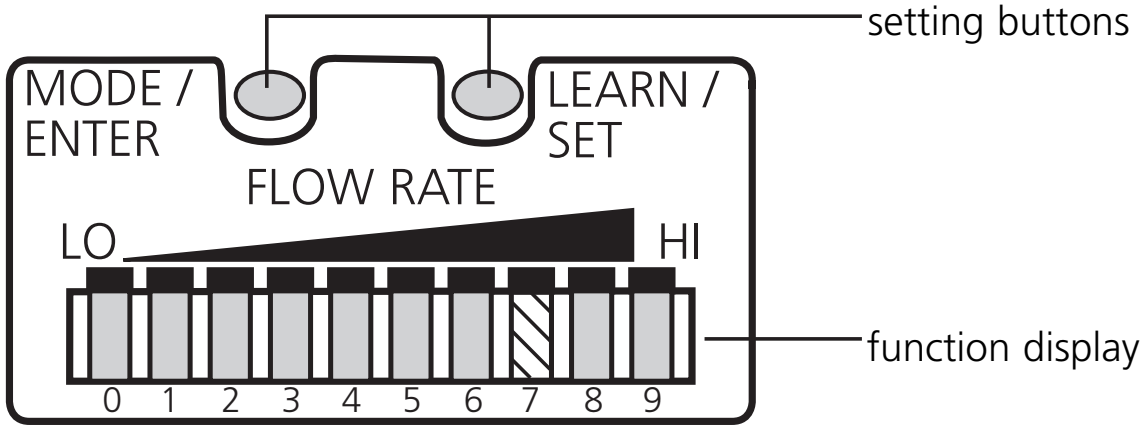
After this procedure the unit is ready for normal operation.

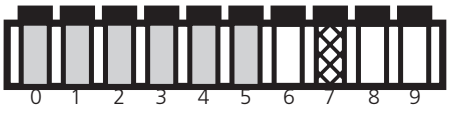
- This setting is sufficient for the majority of waterbased applications. Optional: adjustment to minimum flow (→ page 27)
- If needed, set the switch point (for changing the reaction time and excess gain, → page 27).

Manual setting options

- Manual adjustment to maximum flow (→ page 27).
- Manual adjustment to maximum flow / monitoring and optical indication of excess flow (→ page 27).
- Manual adjustment to minimum flow / flow standstill (→ page 28).
- Activate / deactivate the function for remote adjustment (→ page 28).

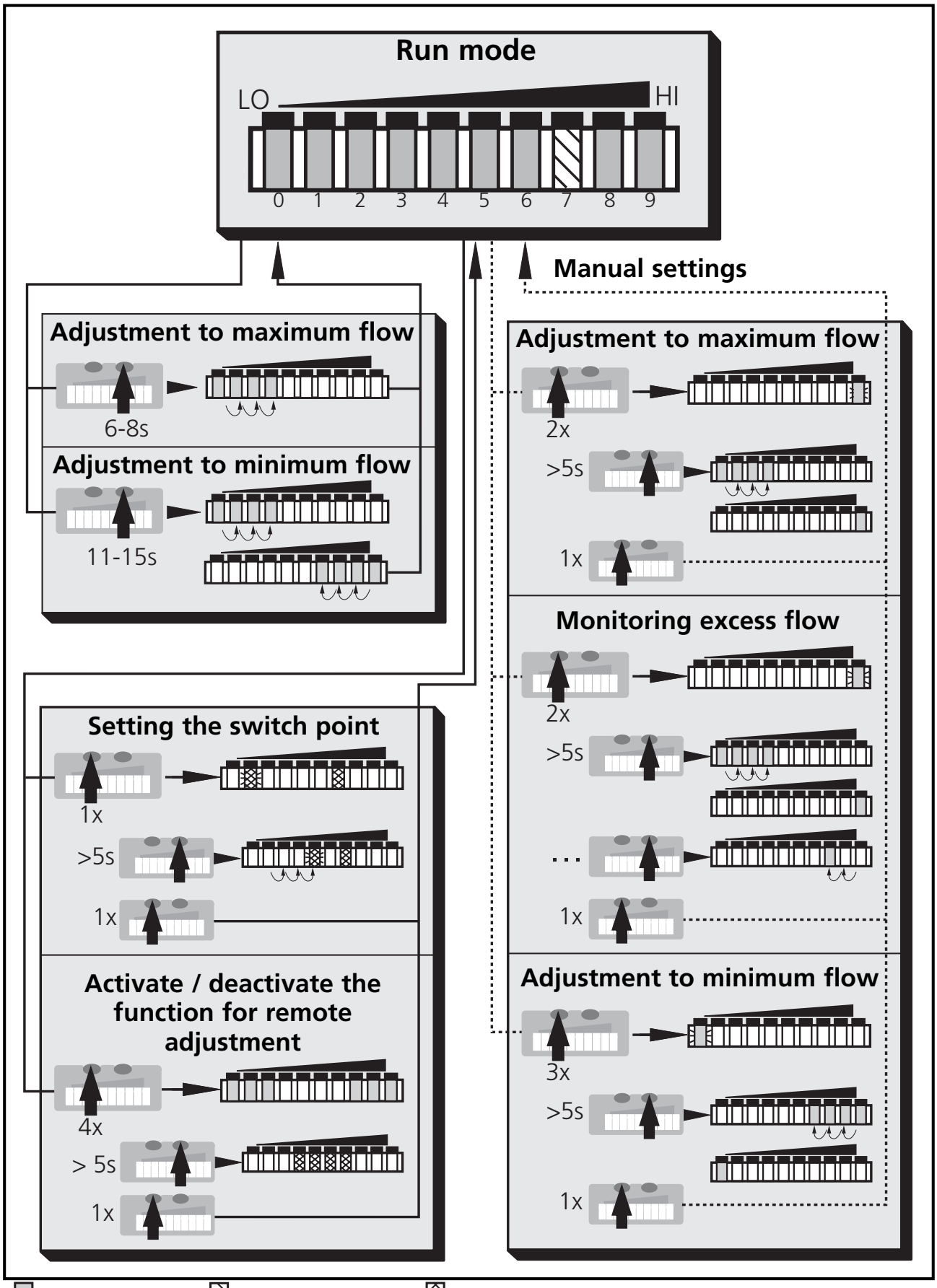
Controls and visual indication



Function display (Run mode)	
	current flow within the display range (LED bar green)
	excess flow (LED 9 flashes)
	underflow (LED 0 flashes)
Indication of the switch point (SP): LED orange: flow ≥ SP; LED red: flow < SP	

Setting buttons
Mode / Enter: selection of the menu items and acknowledgement
Learn/Set: adjustment to maximum / minimum flow; setting of values (scrolling by holding pressed;incremental by pressing briefly)

Menu structure



LED = green LED = orange LED = red

Contents

Function and features

The flow monitor

- detects the **flow velocity** in liquid and gaseous media
- switches the **output** according to the programming (N.O./ or N.C./, programmmable by wiring; → page 26)
- and indicates the relative flow value within the adjustable detection range by means of **LEDs**:
  - LED 0 = lower limit of the detection range (maximum value / **LO**)
  - LED 9 = upper limit of the detection range (minimum value / **HI**)

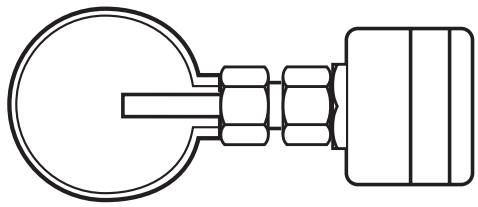
- It is also possible to indicate:
  - Switching status (LED red: flow below the switch point, LED orange: flow has reached the switch point).
  - Excess flow: LED 9 flashes if the flow is considerably higher (2 LEDs) than the display range.
  - Underflow / flow standstill: LED 0 flashes if the flow is lower than the display range.

Installation

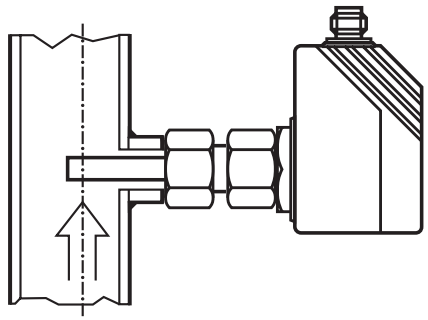
The unit is adaptable for various process fittings (adapters to be ordered separately as accessories).

- In the case of horizontal pipes mount the unit from the side, if possible (fig. 1).
  When the unit is to be mounted at the bottom of the pipe, it should be free from deposits.
  When the unit is to be mounted at the top of the pipe, it should be completely filled with the medium to be monitored.
- In the case of vertical pipes mount the unit in a place where the medium flows upwards (fig. 2).

1



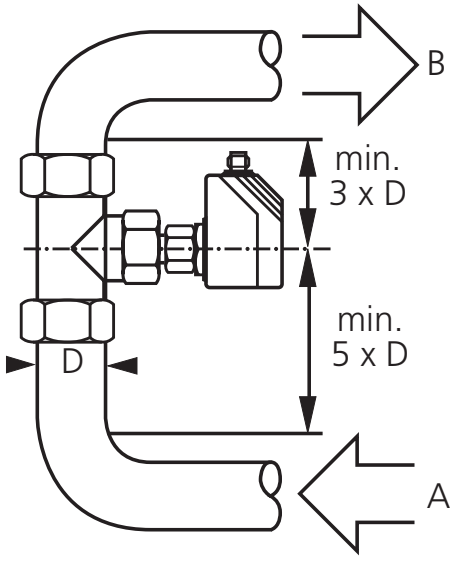
2

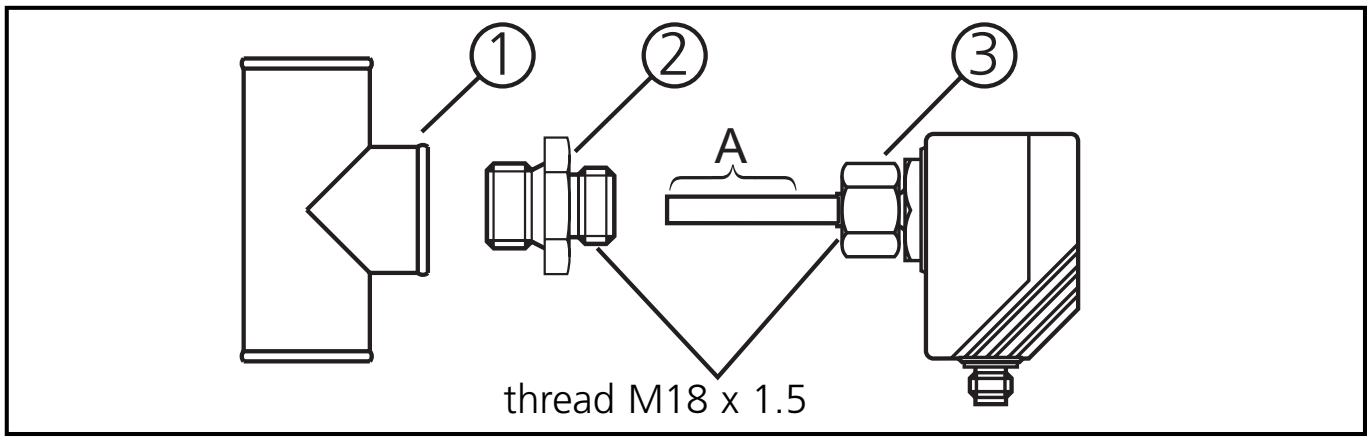


To avoid malfunction a minimum distance between the flow monitor and bends, valves, changes in cross-section or such like must be observed:

- Min. 5 x pipe diameter upstream (A),
- min. 3 x pipe diameter downstream (B).

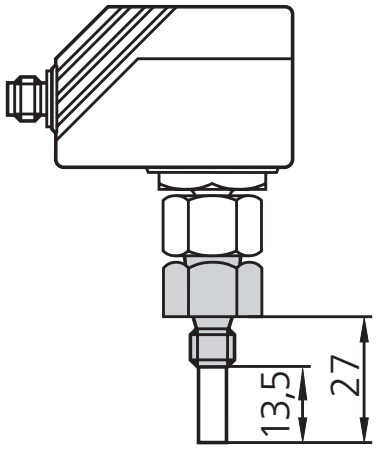
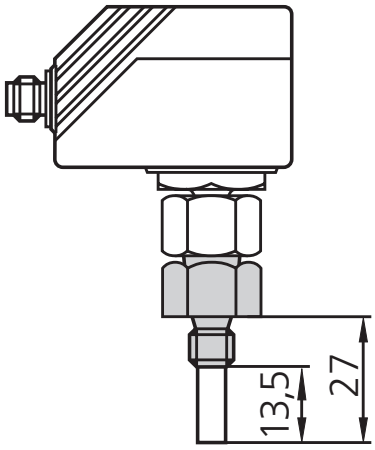
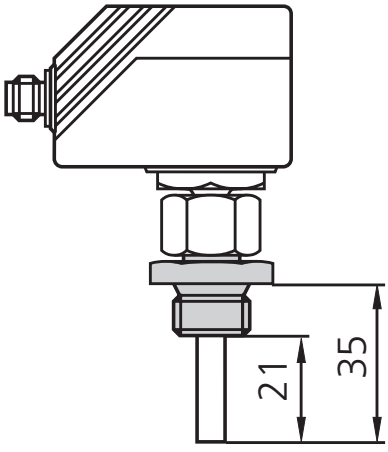
3





1. Lubricate the nut (3) and all threads with grease to ensure the nut can be loosened and tightened several times.
   Note: No grease must be applied to the sensor tip (A).
2. Screw the suitable adapter (2) onto the process fitting (1).
3. Insert the flow monitor into the adapter. While keeping the unit aligned tighten the nut (3); (max. tightening torque 50 Nm).

Insertion depth of the sensor: min. 12 mm in the pipe. When the adapters are used which are available as accessories, the correct depth is ensured.
Note: The sensor tip must not touch the pipe wall.

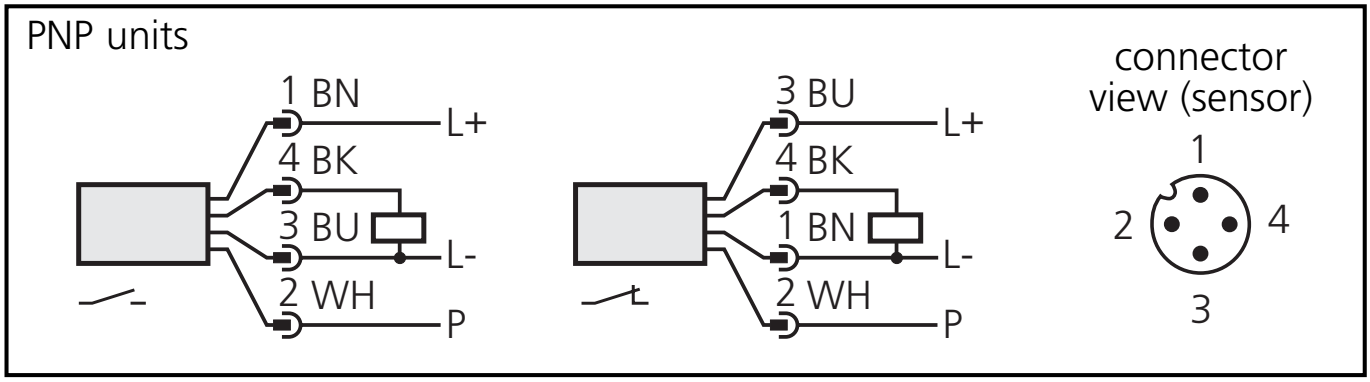
mounting dimension with M12 adapter	mounting dimension with G¼ adapter	mounting dimension with G½ adapter
		

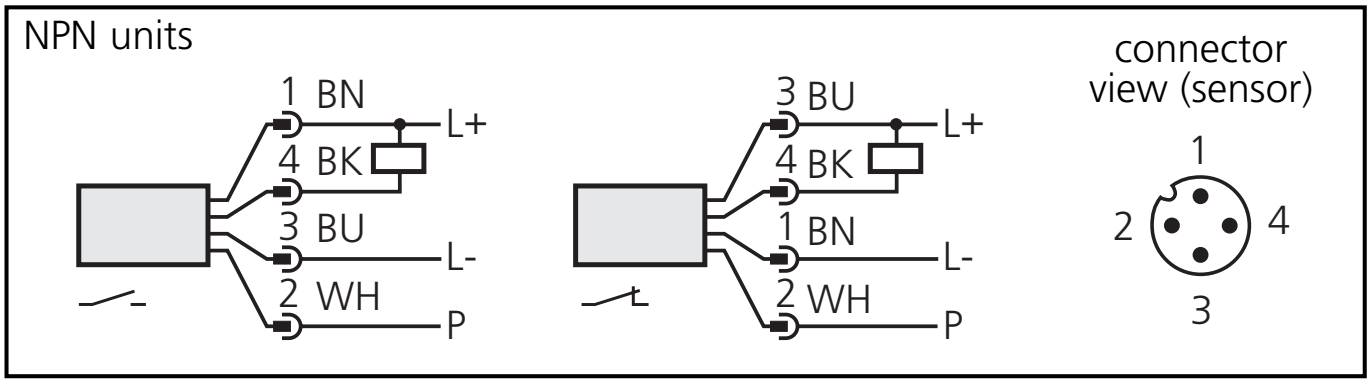
ENGLISH

Electrical connection

The unit must only be connected by an electrician.
The national and international regulations for the installation of electrical equipment must be observed.
Voltage supply to EN50178, SELV, PELV.
The device shall be supplied from an isolating source and protected by an overcurrent device such that the limited voltage circuit requirements in accordance with UL 508 are met.

Disconnect power before connecting the unit.
Wiring (⊣ = N.O. / ⊢ = N.C.):





P = programming wire (for remote adjustment)
Core colours of ifm sockets:
1 = BN (brown), 2 = WH (white), 3 = BU (blue), 4 = BK (black)

If the function for **remote adjustment** is **active**:
Use 4-wire connection cables without a link between pins 2 and 4.
With 3-wire sockets with a link between pin 2 and pin 4 switching of the output stage triggers the remote adjustment!

Failure indication: In the case of a short circuit the function indication and the red LED row are lit alternately.

Programming

■ **Setting of the detection range** (→ page 30)

- Allow the medium to flow through the system at the required maximum flow rate.
- Press the **Learn/Set** button for 6-8 s (= adjustment to maximum flow / upper limit of the detection range).
  This setting is sufficient for the majority of waterbased applications.
  Optional: adjustment to minimum flow.
- Allow the medium to flow through the system at the required minimum flow rate or bring flow to a standstill.
- Press the **Learn/Set** button for 11-15 s (= adjustment to minimum flow or flow standstill / lower limit of the detection range).

■ **Remote adjustment via programming wire**

Apply the operating voltage (+U_B) to pin 2 for the respective time.

■ **Setting of the switch point** (→ page 32)

- Press the **Mode/Enter** button briefly.
- Press the **Learn/Set** button for 5 s,
- keep the Learn/Set button pressed or press the button several times until the requested switch point is set.
- Press the **Mode/Enter** button briefly.

■ **Manual adjustment to maximum flow (HI-Teach)** (→ page 33)

- Allow the medium to flow through the system at the required maximum flow rate.
- Press the **Mode/Enter** button twice.
- Press the **Learn/Set** button for 5 s, release the button when LED bar fills from left to right.
- Press the **Mode/Enter** button briefly, when LED 9 is lit.

■ **Manual adjustment to maximum flow (HI-Teach) / monitoring excess flow** (→ page 34)

- Allow the medium to flow through the system at the required maximum flow rate.
- Press the **Mode/Enter** button twice.
- Press the **Learn/Set** button for 5 s, release the button when LED bar fills from left to right.
- When LED 9 (= LED for the maximum display value) is lit: Press the **Learn/Set** button several times to shift the LED.
- Press the **Mode/Enter** button briefly.

■ Manual adjustment to minimum flow (LO-Teach) (→ page 35)

- Allow the medium to flow through the system at the required minimum flow rate or bring flow to a standstill.
- Press the **Mode/Enter** button three times.
- Press the **Learn/Set** button for 5 s, release the button when LED bar fills from right to left.
- Press the **Mode/Enter** button briefly, when LED 0 is lit.

■ Activate / deactivate the function for remote adjustment (→ page 36)

- Press the **Mode/Enter** button four times.
- Press the **Learn/Set** button for 5 s,
- keep the Learn/Set button pressed or press the button several times until the requested function is set (function **active**, when **3 LEDs on the right and 3 LEDs left are lit green**; function not active, when the 4 LEDs in the middle are lit in red).
- Press the **Mode/Enter** button briefly.

■ The following applies to all setting procedures:

- If no button is pressed for 20 s during the setting procedure, the unit returns to the operating mode with the parameter values unchanged.
- If adjustment has not been possible, all the red LEDs flash. The unit returns to the operating mode with the parameter values unchanged.

■ Locking / Unlocking

The unit can be electronically locked to prevent unwanted adjustment of the set parameters: Press both setting buttons for 10 s (the unit must be in Run mode). Indication goes out briefly (acknowledgement of locking / unlocking).
Units are delivered from the factory in the unlocked state.
If the unit is locked, it is possible to indicate

- the current switch point (press the Mode/Enter button once) and
- the setting of the function for remote adjustment (press the Mode/Enter button two times).

Installation and set-up / Operation / Maintenance

After mounting, wiring and setting check whether the unit operates correctly.
At power on, all LEDs light and go off one after the other.* The unit is then ready for operation.
*During this time the output is switched according to the programming: ON with the NO function and OFF with the NC function.
Failure indication: In the case of a short circuit the function indication and the red LED row are lit alternately.

Recommended maintenance

Check the sensor tip for build-up from time to time. Clean it with a soft cloth. If necessary, build-up which adheres firmly (e.g. lime) can be removed with a common vinegar cleansing agent.

Technical data

Operating voltage [V]	20 ... 36 DC [1]
Current rating [mA]	400; short-circuit protection; reverse polarity protection / overload protection
Voltage drop [V]	< 2.5
Current consumption [mA]	< 80
Liquids	
Medium temperature [°C]	-25 ... +80
Setting range [cm/s]	3 ... 300
Greatest sensitivity [cm/s]	3 ... 60
Max. temperature gradient of medium [K/min]	300
Gases	
Medium temperature [°C]	-25 ... +80
Setting range [cm/s]	200 ... 3000
Greatest sensitivity [cm/s]	200 ... 800
Response time [s]	1 ... 10
Power-on delay time [s]	15, optically indicated
Pressure rating [bar]	300
Operating temperature [°C]	-25 ... +80
Protection	IP 67 (IEC 60529) / UL50)
Housing material	PBT-GF 20
Material sensor surface (SI10xx)	stainless steel (316S12); O-ring: FPM 8x1.5 gr 80° Shore A
Material sensor surface (SI11xx)	titanium; O-ring: FPM 8x1.5 gr 80° Shore A

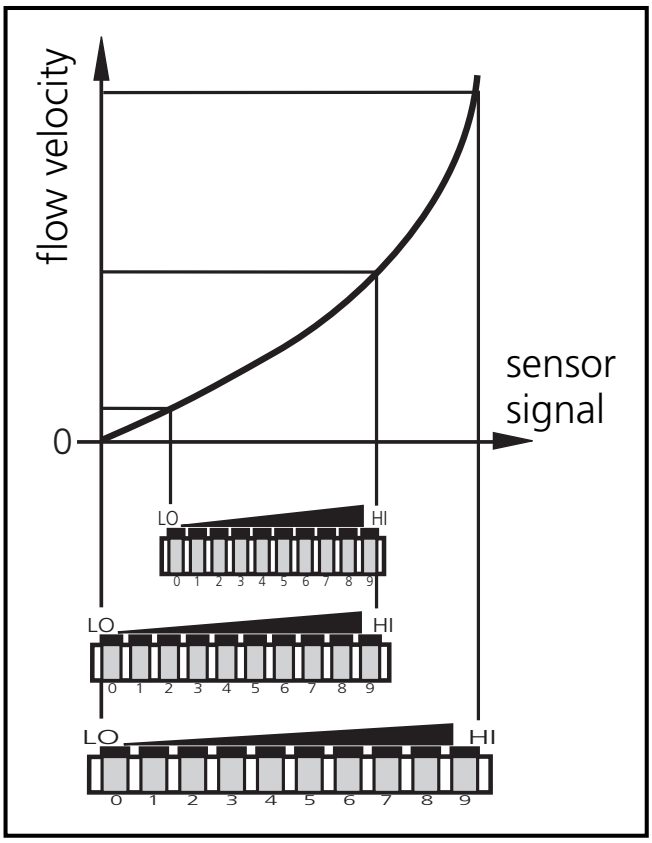
[1] to EN50178, SELV, PELV;
referring to UL: see page 26 (Electrical connection).

Programming diagrams / Technical information

■ Setting of the detection range

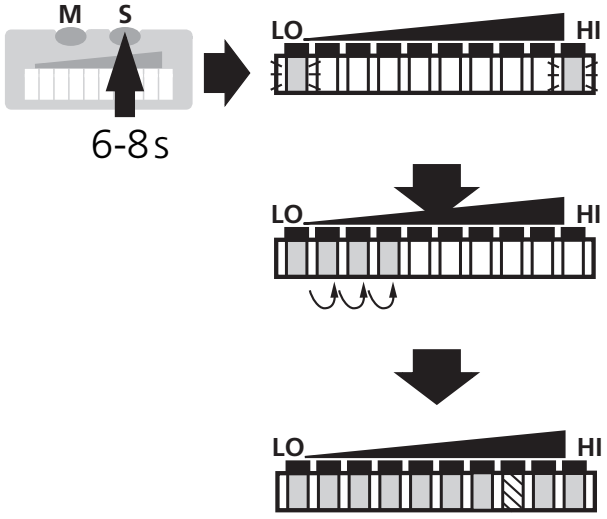
The **detection range** (window) is determined by:

- Adjustment to the required maximum flow (HI-Teach) = upper limit of the window. This setting is sufficient for the majority of waterbased applications.
- Adjustment to the required minimum flow / flow standstill (LO-Teach) = lower limit of the window.



- **Adjustment to maximum flow (HI-Teach)**

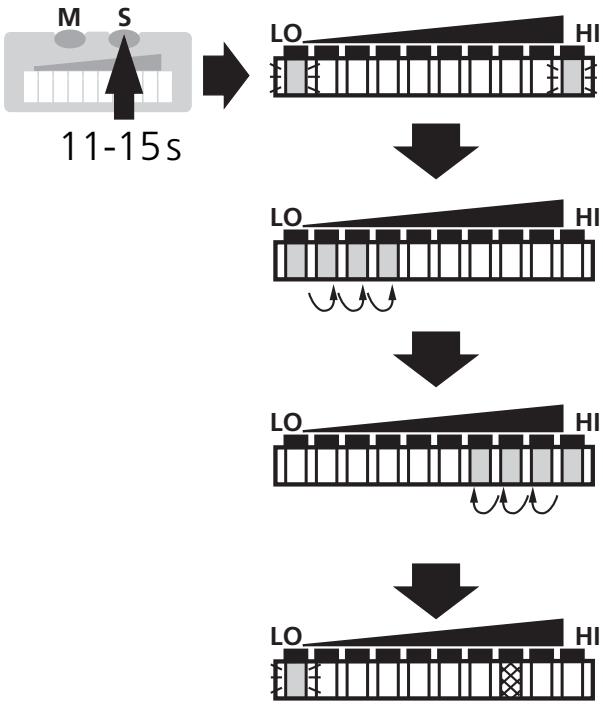
The unit detects the current flow and sets this value as the maximum value for the LED display (LED 9).

1	Apply the operating voltage. After approx. 15 s the unit is ready. Allow the medium to flow through the system at the required **maximum flow rate**.
2	 Press the **Learn/Set** button and keep it pressed. The green LEDs on the right and on the left flash, after 5 s the LED bar (green) fills from left to right (**release the button** now). The indication goes off briefly. The unit stores the current flow as maximum flow and passes into the operating mode.

- **Adjustment to minimum flow / flow standstill (LO-Teach), optional**

The unit detects the current flow and sets this value as the minimum display value for the LED display. In normal operation the first green LED (LED 0) flashes when the flow falls below this value (or when it comes to a standstill).

NOTE: The LO-Teach operation may only be carried out after the HI-Teach operation.

1	Allow the medium to flow through the system at the required minimum flow rate or bring to a standstill.
2	 Press the **Learn/Set** button and keep it pressed. The green LEDs on the right and on the left flash, after 5 s the LED bar (green) fills from left to right after a further 5 s the LED bar (gren) fills from right to left (**release the button** now). The indication goes off briefly. The unit stores the current flow as minimum flow and passes into the operating mode.

- **Remote adjustment**

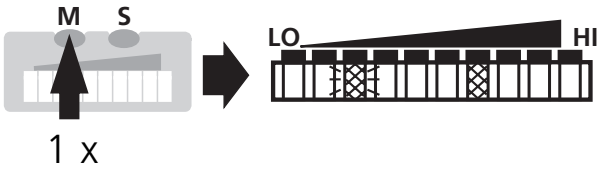
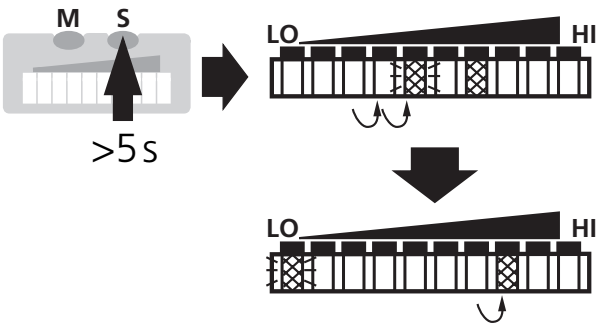
You can also adjust the unit via the programming wire, if the function for remote adjustment is active. Apply the operating voltage (+U_B) to pin 2 (P) for the respective time: min. 6 s / max. 8 s for HI-Teach; min. 11 s / max. 15 s for HI-Teach.

If the operating voltage is applied to pin 2 for more than 15 s,
- the adjustment does not become effective; the unit passes into the operating mode with unchanged values,
- the unit is locked (the buttons are inactive as long as the operating voltage is applied).

■ Setting of the switch point

The switch point is preset at the factory (LED 7). The setting influences the reaction time of the unit.

- High switch point = fast reaction in the case of flow decrease.
- Low switch point = fast reaction in the case of flow increase.

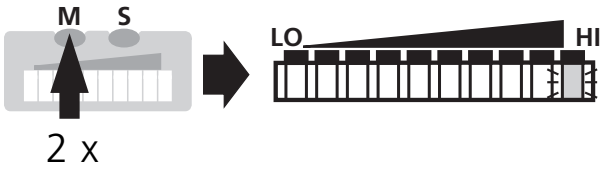
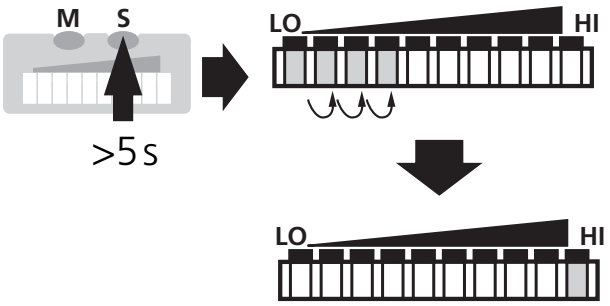
1		Press the **Mode/Enter** button briefly. The current switch point is indicated: LED lit: coarse setting, LED flashes: fine setting.
2		Press the **Learn/Set** button and keep it pressed. After 5 s the switch point is increased* (incremental by pressing briefly or scrolling by holding pressed). **Indication:** The flashing LED moves from left to right. After LED 9 has been reached the cycle starts again at LED 0. The LED which is constantly lit moves on by one position.**
3		Press the **Mode/Enter** button briefly (acknowledgement). The indication goes off briefly. The set switch point becomes effective; the unit passes into the operating mode.

*Decrease the switch point: Let the flashing and lit LEDs move to the maximum setting value. Then the cycle starts again at the minimum setting value.

**Overflow: If the flashing LED and the lit LED exceed the maximum setting value, the cycle starts again at the minimum setting value.

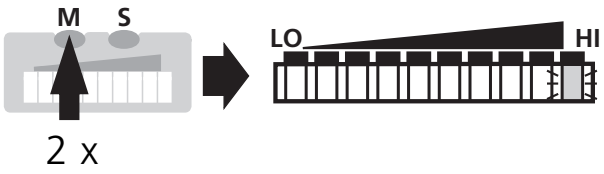
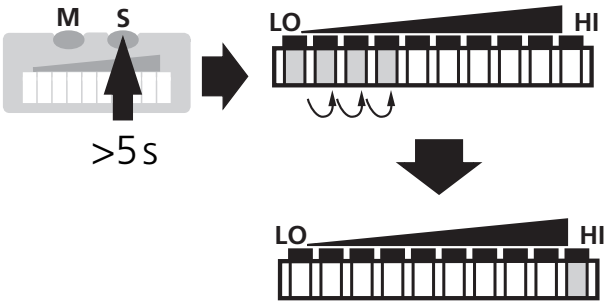
■ Manual adjustment to maximum flow (HI-Teach)

The unit detects the current flow and sets this value as the maximum value for the LED display (LED 9).
In normal operation all LEDs are lit in green when the max. flow is reached. They go out step by step as the flow decreases.

1	Apply the operating voltage. After approx. 15 s the unit is ready. Allow the medium to flow through the system at the required **maximum flow rate**.	
2		Press the **Mode/Enter** button twice. LED 9 flashes.
3		Press the **Learn/Set** button and keep it pressed. after 5 s the LED bar (green) fills from left to right (**release the button** now), after this LED 9 is lit.
4		Press the **Mode/Enter** button briefly (acknowledgement). The indication goes off briefly. The unit stores the current flow as maximum flow and passes into the operating mode.

■ Manual adjustment to maximum flow (HI-Teach) / monitoring excess flow

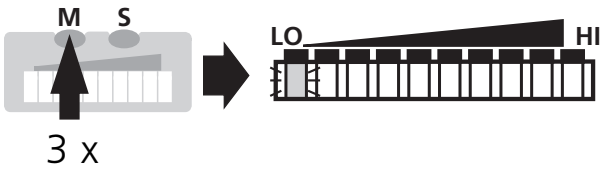
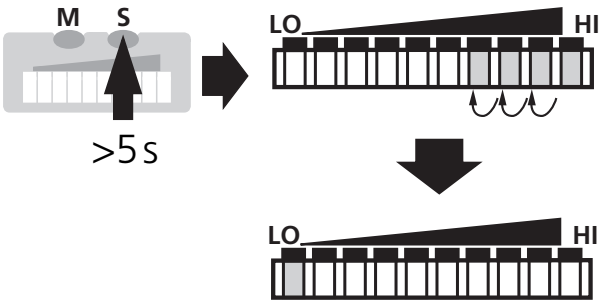
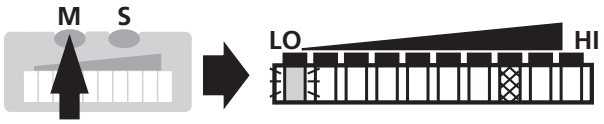
The unit detects the current flow and sets this value as the maximum value for the LED display (LED 9).
In addition the **position of the display window** within the detection range can be defined: Shift the LED for the maximum display value to position 8, 7, 6 or 5. In the case of maximum flow all LEDs from 0 up to this LED are lit. The LEDs above the range signal excess flow. If the switch point is above this range, the unit switches in the case of excess flow.

1	Apply the operating voltage. After approx. 15 s the unit is ready. Allow the medium to flow through the system at the required **maximum flow rate**.	
2		Press the **Mode/Enter** button twice. LED 9 flashes.
3		Press the **Learn/Set** button and keep it pressed, after 5 s the LED bar (green) fills from left to right (**release the button** now), after this LED 9 is lit.
4		Press the **Learn/Set** button several times until the requested LED lights (LED 8, 7, 6 or 5). Each time the button is pressed the LED moves back by one position. When it is lower than LED 5 the cycle starts again at LED 9.
5		Press the **Mode/Enter** button briefly (acknowledgement). The indication goes off briefly. The unit stores the current flow as maximum flow and passes into the operating mode.

■ Manual adjustment to minimum flow (LO-Teach)

The unit detects the current flow and sets this value as the minimum display value for the LED display. In normal operation the first green LED (LED 0) flashes when the flow falls below this value (or when it comes to a standstill).

NOTE: The LO-Teach operation may only be carried out after the HI-Teach operation.

1	Allow the medium to flow through the system at the required **minimum flow rate** or bring to a **standstill**.	
2		Press the **Mode/Enter** button three times. LED 0 flashes.
3		Press the **Learn/Set** button and keep it pressed. after 5 s the LED bar (green) fills from right to left (**release the button** now), after this LED 0 is lit.
4		Press the **Mode/Enter** button briefly (acknowledgement). The indication goes off briefly. The unit stores the current flow as minimum flow and passes into the operating mode.

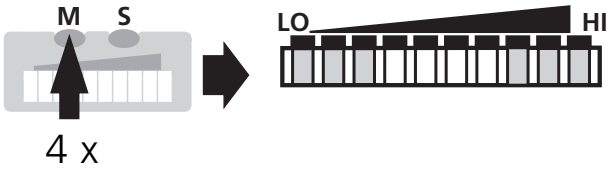
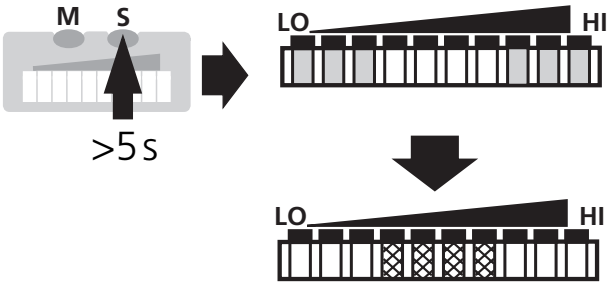
■ Activate / deactivate the function for remote adjustment

If the function is active, the unit can be adjusted by applying voltage to pin 2.

Unit supplied: function active.

Function active		The 3 LEDs on the right and left are lit in green.*
Function not active		The 4 LEDs in the middle are lit in red.*

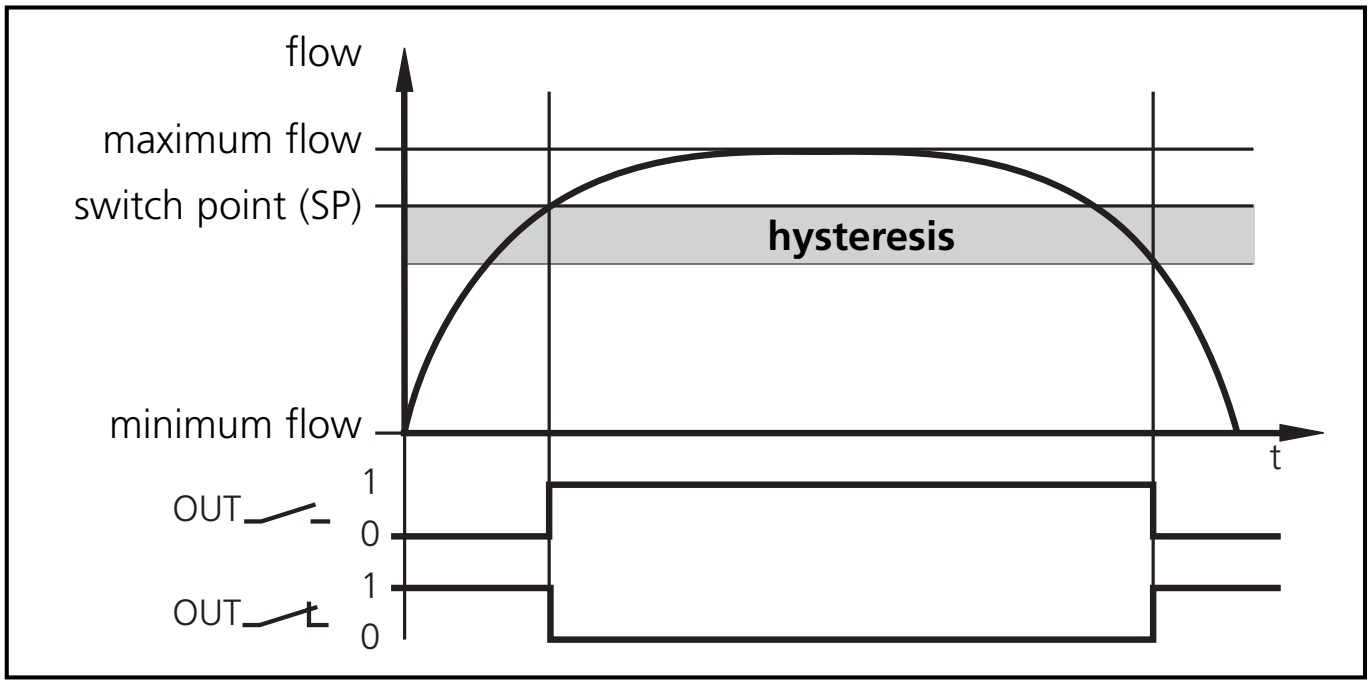
*The LEDs flash if voltage is applied to pin 2.

1		Press the Mode/Enter button four times. The current setting is indicated.
2		Press the **Learn/Set** button and keep it pressed, after 5 s the function changes. (Each time the **Learn/Set** button is pressed the function changes again).
3		Press the Mode/Enter button briefly (= acknowledgement). The indication goes off briefly, the unit then passes into the operating mode.

If the function for **remote adjustment** is **active** and the operating voltage is applied to pin 2 for more than 15 s, the unit is locked (the buttons are inactive as long as the operating voltage is applied).

Use 4-wire connection cables without a link between pins 2 and 4.
With 3-wire sockets with a link between pin 2 and pin 4 switching of the output stage triggers the remote adjustment!

Hysteresis function



When the flow rises, the output switches when the switch point (SP) has been reached.
When the flow falls again, the output switches back when the value "SP minus hysteresis" has been reached.

The hysteresis is considerably influenced by the choice of the operating range on the sensitivity curve of the sensor:

- In the case of adjustment to HI-Flow values in the range 0 ... 60 cm/s the hysteresis is 2 - 4 cm/s (values apply to water).
- In the case of adjustment to HI-Flow values above 100 cm/s the hysteresis increases as the flow rises.

The typical **response time** of the unit is 3 ... 8s. It can be influenced by setting the LO-Teach and the switch point:

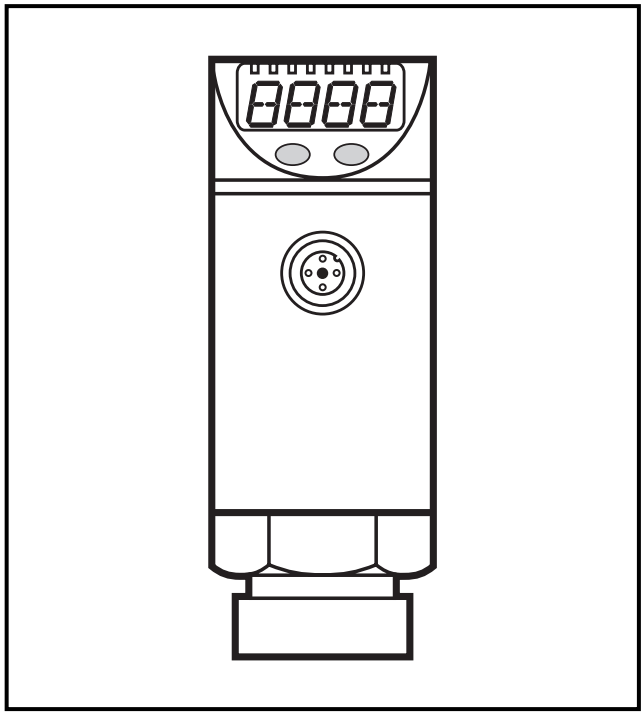
- The lower the LO-Teach or the switch point is set, the faster the unit switches **on**.
- The higher the LO-Teach or switch point is set, the faster the unit switches **off**.

Bedienungsanleitung
Operating instructions
Notice utilisateurs

efector500®

Elektronischer Drucksensor
Electronic pressure sensor
Capteur de pression électronique

PN70XX



DEUTSCH

ENGLISH

FRANÇAIS

Sachnr. 701844/00 10/04

Safety instructions

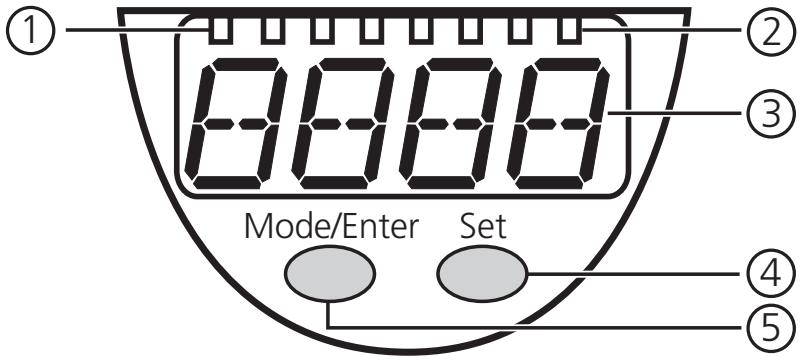
Read the product description before installing the unit. Ensure that the product is suitable for your application without any restrictions.

Non-adherence to the operating instructions or technical data can lead to personal injury and/or damage to property.

In all applications check compliance of the product materials (see Technical data) with the media to be measured.

For gaseous media the application is limited to max. 25 bar.

Controls and indicating elements



①	3 (4) x LED green	Lighting LED = set display unit.
②	2 x LED yellow	Switching status; lights if the respective output has switched.
③	4-digit alphanumerical display	Display of the system pressure, display of parameters and parameter values.
④	Set button	Setting of the parameter values (scrolling by holding pressed; incremental by pressing briefly).
⑤	Mode / Enter button	Selection of the parameters and acknowledgement of the parameter values.

Function and features

- The pressure sensor **detects the system pressure,**
- shows the current system pressure on its **display,**
- and generates **2 output signals** according to the set output configuration.

Switching function (output 1 and output 2; function can be selected for each output separately)	hysteresis function / N.O. (**Hno**)
	hysteresis function / N.C. (**Hnc**)
	window function / N.O. (**Fno**)
	window function / N.C. (**Fnc**)
Diagnostic function (only output 2)	OU2 = dESI; in case of a fault output 2 becomes inactive.

Applications (Type of pressure: relative pressure)

Order no.	Measuring range		Permissible overl. pressure		Bursting pressure	
	bar	PSI	bar	PSI	bar	PSI
PN7000	0...400	0...5800	600	8700	1000	14500
PN7001	0...250	0...3625	400	5800	850	12300
PN7002	0...100	0...1450	300	4350	650	9400
PN7003	0...25	0...363	150	2175	350	5075
PN7004	-1...+10	-14.5...145	75	1087	150	2175
PN7006	0...2.5	0...36.3	20	290	50	725
PN7007	0...1	0...14.5	10	145	30	450
PN7009	-1...+1	-14.5...+14.5	20	290	50	725
PN7060	0...600	0...8700	800	11600	1200	17400

MPa = bar ÷ 10 / kPa = bar × 100

Avoid static and dynamic overpressure exceeding the given overload pressure.
For gaseous media the application is limited to max. 25bar.
Even if the bursting pressure is exceeded only for a short time the unit can be destroyed (danger of injuries)!

High-pressure units (400 bar, 600 bar) are supplied with an integrated damping device to comply with the regulations for UL approval and to avoid any risk of injury in case of bursting when bursting pressure is exceeded.

When the damping device is removed
- the unit can no longer be used under UL conditions,
- the damping device can become unusable.

If you have any questions, please contact ifm electronic's sales specialists.

Operating modes

Run mode

Normal operating mode

At power on the unit is in the Run mode. It carries out its measurement and evaluation functions and provides output signals according to the set parameters.

The display shows the current system pressure. The yellow LEDs indicate the switching state of the outputs.

Display mode

Indication of parameters and the set parameter values

When the "Mode/Enter" button is pressed briefly, the unit passes to the Display mode which allows parameter values to be read. The internal sensing, processing and output functions of the unit continue as if in Run mode.

- The parameter names are scrolled with each pressing of the "Mode/Enter" button.
- When the "Set" button is pressed briefly, the corresponding parameter value is displayed for 15 s. After another 15 s the unit returns to the Run mode.

Programming mode

Setting of the parameter values

While viewing a parameter value pressing the "Set" button for more than 5 s causes the unit to enter the programming mode. You can alter the parameter value by pressing the "Set" button and confirm the new value by pressing the "Mode/Enter" button. The internal sensing, processing and output functions of the unit continue as if in Run mode with the original parameter values unless a new value is confirmed.

The unit returns to the Run mode when no button has been pressed for 15 s.

Installation

Before mounting and removing the sensor, make sure that no pressure is applied to the system.

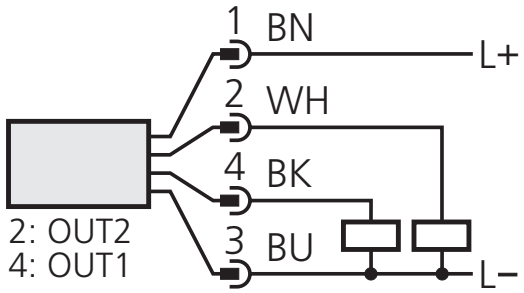
Mount the pressure sensor on a G¼ process connection.

Electrical connection

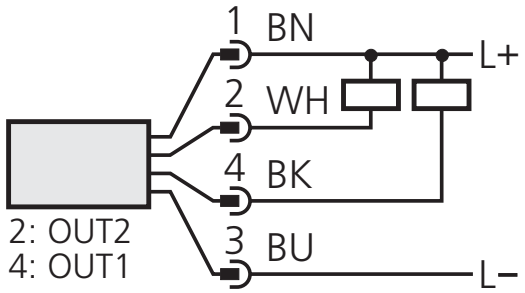
The unit must be connected by a suitably qualified electrician.
The national and international regulations for the installation of electrical equipment must be observed.
Voltage supply to EN50178, SELV, PELV.
The device shall be supplied from an isolating source and protected by an overcurrent device such that the limited voltage circuit requirements in accordance with UL 508 are met.

Disconnect power before connecting the unit as follows:

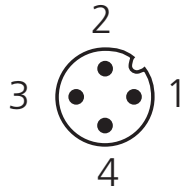
2 x p-switching



2 x n-switching



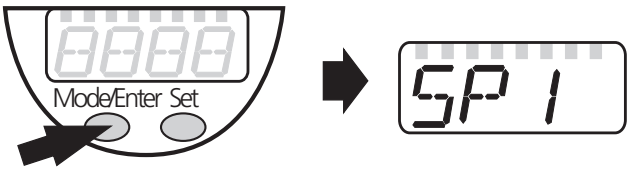
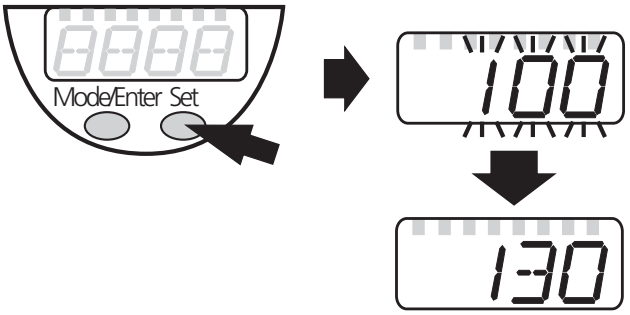
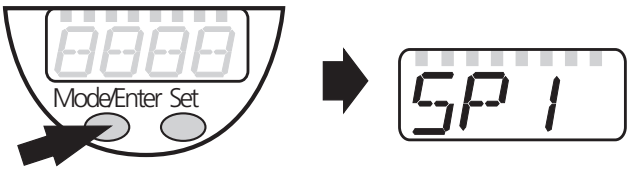
Connector view (sensor)



Core colours of ifm sockets:
1 = BN (brown), 2 = WH (white),
3 = BU (blue), 4 = BK (black).

Pin 4 (OUT1) = switching output
Pin 2 (OUT2) = switching output if OU2 = **Hno**, **Hnc**, **Fno**, **Fnc**
Pin 2 (OUT2) = diagnostic output if OU2 = **dESI**

Programming

1		Press the **Mode/Enter** button several times until the **respective parameter** is displayed.
2		Press the **Set** button and keep it pressed. The current **parameter value flashes** for 5 s, **then** the value **is increased*** (incremental by pressing briefly or scrolling by holding pressed).
3		Press the **Mode/Enter** button **briefly** (= acknowledgement). The parameter is displayed again, the set **parameter value becomes effective**.
4	**Change more parameters:** Start again with step 1.	**Finish programming:** Wait for 15 s or press the Mode/Enter button until the current measured value is indicated again.

*Decrease the value: Let the display of the parameter value move to the maximum setting value. Then the cycle starts again at the minimum setting value.

Select the display unit (**Uni**) **before** setting values for the parameters **SPx** and **rPx**. This avoids rounding errors generated internally during the conversion of the units and enables exact setting of the values.
Setting at the factory: **bAr**.

If no button is pressed for 15 s during the setting procedure, the unit returns to the Run mode with unchanged values.

The unit can be electronically locked to prevent unwanted adjustment of the set parameters: Press both pushbuttons until Loc is displayed. To unlock: Press both pushbuttons until uLo is displayed. Units are delivered from the factory in the unlocked state.
With the unit in the locked state Loc is indicated briefly when you try to change parameter values.

Installation and set-up / operation

After mounting, wiring and setting check whether the unit operates correctly.

Fault indication

OL	Overload (above measuring range of the sensor).
UL	Underload (below measuring range of the sensor).
SC 1	Flashing: short circuit in the switching output 1*.
SC2	Flashing: short circuit in the switching output 2*.
SC	Flashing: short circuit in both switching outputs*.
Err	Flashing: internal fault

*The output concerned is switched off as long as the short circuit continues. The faults SC1, SC2, SC, Err are indicated even if the display is deactivated.

Diagnostic function

(according to DESINA specification)

Output 2 is used as a diagnostic output if OU2 = dESI.

- If there is no fault, the output is switched and carries UB+ (if **P-n** = **PnP**) or UB- (if **P-n** = **nPn**).
- In case of malfunctions the output becomes inactive. The following malfunctions are detected:
  Measuring cell defect; short circuit in output 1; exceeding / not reaching the limits of the measuring range, EEPROM fault, RAM fault, processor fault.

ENGLISH

Technical informations / Functioning / Parameters

Adjustable parameters

SP 1 SP2	**Switch-on point 1 / 2:** Upper limit value at which the output changes its switching status. Setting range → page 38 / 39. SP2 is active only if **OU2** = **Hno**, **Hnc**, **Fno** or **Fnc.**
rP 1 rP2	**Switch-off point 1 / 2** Lower limit value at which the output changes its switching status. rPx is always lower than SPx. The unit only accepts values which are lower than SPx. Changing the switch-on point also changes the switch-off point (the distance between SPx and rPx remains constant). If the distance is higher than the new switch point, it is automatically reduced (rPx is set to the minimum setting value). Setting range → page 38 / 39. rP2 is active only if **OU2** = **Hno**, **Hnc**, **Fno** or **Fnc.**
OU 1	**Configuration of output 1** 4 switching functions can be set: - **Hno** = hysteresis / normally open - **Hnc** = hysteresis / normally closed - **Fno** = window function / normally open - **Fnc** = window function / normally closed
OU2	**Configuration of output 2** 4 switching functions and the diagnostic function can be set: - **Hno** = hysteresis / normally open - **Hnc** = hysteresis / normally closed - **Fno** = window function / normally open - **Fnc** = window function / normally closed - **dESI** = Output 2 is used as a diagnostic output
EF	**Enhanced functions** This menu item contains a submenu with additional parameters. You can access these parameters by pressing the SET button briefly. If the submenu is protected with an access code,"Cod1" flashes in the display. - Press the "Set" button and hold it pressed until the valid code no. is shown. - Then briefly press the "Mode/Enter" button. Delivery by ifm electronic: no access restriction.

Uni	**Display unit** The measured value and the values for SPx, rPx can be displayed in the following units: bar/mbar, PSI, MPa/kPa, for PN7007 and PN7009 in addition inHg. Select the display unit **before** setting the values for the parameters SPx, rPx. This avoids rounding errors generated internally during the conversion of the units and enables exact setting of the values. Setting at the factory: **Uni** = **bAr**.
HI LO	**Min-Max memory for system pressure** • HI: displays the highest measured pressure • LO: displays the lowest measured pressure (only PN7004 and PN7009). Erase the memory: - Press the "Mode/Enter" button until **HI** or **LO** is displayed. - Press the "Set" button and keep it pressed until "**- - - -**" is displayed. - Then press the "Mode/Enter" button briefly.
dS 1 dS2 dr- 1 dr-2	**Delay time for the switching outputs** **dSx** = switch-on delay; **drx** = switch-off delay. The output does not immediately change its switching status when the switching condition is met but when the delay time has elapsed. If the switching condition is no longer met when the delay time has elapsed, the switching state of the output does not change. • Setting range: 0 (= delay time not active) - 0.2 ... 50 s, • in steps of 0.2 s. dS2 / dr2 are **not** active if **OU2** = **dESI.**
P--n	**Output polarity** 2 options can be selected: - **PnP** = positive switching / - **nPn** = negative switching This setting applies to both switching outputs.
dAP	**Damping for the switching outputs** Pressure peaks of short duration or high frequency can be filtered out. dAP-value = response time between pressure change and change of the switching status in ms. • The value for **dAP** defines the switching frequency (f) of the output:

dAP	3	6	10	17	30	60	125	250	500
f [Hz]	170	80	50	30	16	8	4	2	1

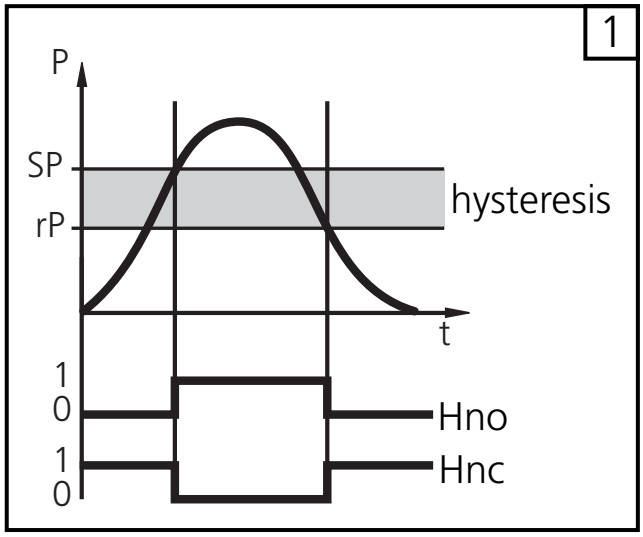
d1 S	**Setting of the display** 7 options can be selected: **d1** = update of the measured value every 50 ms. **d2** = update of the measured value every 200 ms. **d3** = update of the measured value every 600 ms. The update interval only refers to the display. It has no effect on the output. **rd1**, **rd2, rd3,** = display as d1, d2, d3; but rotated 180°. **OFF** = In the Run mode the display of the measured value is deactivated. If one of the buttons is pressed, the current measured value is displayed for 15 s. Another press of the Mode/Enter button opens the Display mode. The LEDs remain active even if the display is deactivated.

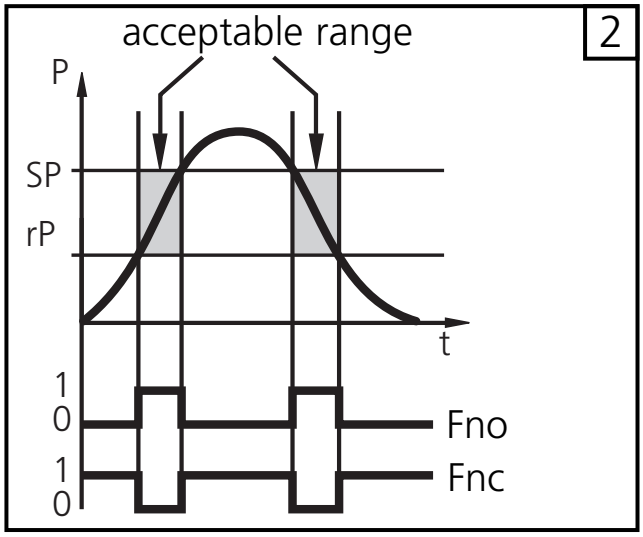
Hysteresis function (fig. 1):

The hysteresis keeps the switching state of the output stable if the system pressure varies about the preset value. With the system pressure rising, the output switches when the switch-on point has been reached (SPx). With the system pressure falling the output does not switch back until the switch-off point (rPx) has been reached.
The hysteresis can be adjusted: First the switch-on point is set, then the switch-off point with the requested distance.

Window function (fig. 2):

The window function enables the monitoring of a defined acceptable range. When the system pressure varies between the switch-on point (SPx) and the switch-off point (rPx), the output is switched (window function / NO) or not switched (window function / NC).
The width of the window can be set by means of the difference between SPx and rPx. SPx = upper value, rPx = lower value.





Technical data

Operating voltage [V]	18 ... 36 DC[1)]
Current consumption [mA]	< 50
Current rating [mA]	250
Reverse polarity and overload protected	up to 40 V
	Short-circuit protected; Watchdog
Voltage drop [V]	< 2
Power-on delay time [s]	0.3
Switching frequency [Hz]	170 ... 1
Accuracy / deviations (in% of the span)	
- Accuracy of switch point	< ± 0.5
- Characteristics deviation	< ± 0.5
- Hysteresis	< ± 0.25 (0.5 for PN7060)
- Repeatability	< ± 0.1
- Long-time stability (in% of value of measuring range / 6 months)	< ± 0.05
- Temperature coefficients (TEMPCO) in the compensated temperature range 0 ... +80°C (in% of the span/10K) greatest TEMPCO of the zero point / of the span	0.2 / 0.2
Materials (wetted parts)	stainless steel (303S22); ceramics; FPM (Viton)
Housing material	stainless steel (304S15); stainless steel (316S12); PC(Macrolon); Pocan; PEI; EPDM/X (Santoprene); FPM (Viton) in addition PTFE (PN7003 ... PN7009)
Protection / Housing[2)]	IP 67 (IEC 60529) / (UL50)
Protection / Housing[3)]	IP 65 (IEC 60529) / (UL50)
Protective class	III (EN 50178)
Insulation resistance [MΩ]	> 100 (500 V DC)
Shock resistance [g]	50 (DIN / IEC 68-2-27, 11ms)
Vibration resistance [g]	20 (DIN / IEC 68-2-6, 10 - 2000 Hz)
Switching cycles min.	100 million (50 million for PN7060)
Operating temperature [°C]	-20 ... +80 (at UB < 32 V)
	-20 ... +60 (at UB > 32 V)
Medium temperature [°C]	-25 ... +80
Storage temperature [°C]	-40 ... +100
EMC EN 61000-4-2 ESD:	4 / 8 KV
EN 61000-4-3 HF radiated:	10 V/m
EN 61000-4-4 Burst:	2 KV
EN 61000-4-5 Surge:	0.5 / 1 KV
EN 61000-4-6 HF conducted:	10 V

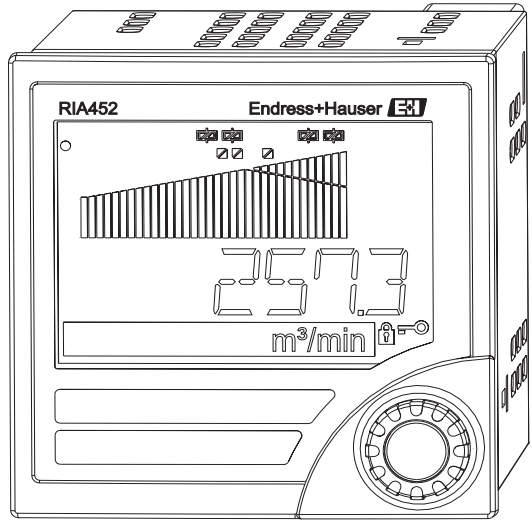
[1)] to EN50178, SELV, PELV
referring to UL; see also page 19 (Electrical connection)
[2)] for PN7060, PN7000 ... PN7002
[3)] for PN7003 ... PN7009

Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

RIA452

Process display



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Endress+Hauser

People for Process Automation

Table of contents

1 Safety instructions

Safe operation of the process display unit is only guaranteed if these Operating Instructions have been read and the safety instructions have been observed.

1.1 Designated use

The RIA452 process display unit analyses analog process variables and depicts them on its multi-coloured display. Processes can be monitored and controlled using analog and digital outputs and limit relays. RIA452 provides the user with a wide range of software functions for this purpose. Power can be supplied to 2-wire sensors with the integrated transmitter power supply.

– The device is seen as accessory equipment and may not be installed in hazardous areas.
– The manufacturer does not accept liability for damage caused by improper or non-designated use. The device may not be converted or modified in any way.
– The device is designed for installation in a panel and may only be operated in an installed state.

1.2 Installation, commissioning and operation

This device has been constructed to state-of-the-art technology and meets all applicable standards and EU directives. The device, however, can be a source of application-related danger if used improperly or other than intended.
Installation, wiring, commissioning and maintenance of the device must only be carried out by trained technical personnel. They must have read and understood these Operating Instructions and must follow the instructions they contain. The information in the electrical wiring diagrams (see Section 4 'Wiring') must be observed closely.

1.3 Operational safety

Technical improvement
The manufacturer reserves the right to adapt technical details to the most up-to-date technical developments without any special announcement. Contact your local sales centre for information about the current state of and possible extensions to the Operating Instructions.

1.4 Return

For a return, e.g. in case of repair, the device must be sent in protective packaging. The original packaging offers the best protection. Repairs must only be carried out by your supplier's service organisation.

Note!
Please enclose a note describing the fault and the application when sending the unit in for repair.

1.5 Notes on safety conventions and icons

The safety instructions in these Operating Instructions are labelled with the following safety icons and symbols:

Caution!
This symbol indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the device.

Warning!
This symbol indicates an action or procedure which, if not performed correctly, can result in injury, a safety hazard or the destruction of the device.

Note!
This symbol indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

2 Identification

2.1 Device designation

2.1.1 Nameplate

Compare the nameplate on the device with the following diagram:

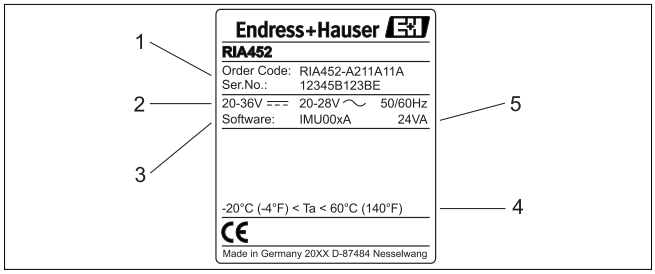


Fig. 2: Nameplate of the process display unit (example)

1 Order code and serial number of the device
2 Power supply
3 Software version number
4 Ambient temperature
5 Performance

2.2 Scope of delivery

The scope of delivery of the process display unit comprises:

- Process display unit for panel mounting
- Operating Instructions
- CD-ROM with PC configuration software and interface cable RS232 (optional)
- Fixing clips
- Sealing ring

Note!
Please note the device accessories in Section 8 'Accessories'.

2.3 Certificates and approvals

CE mark, declaration of conformity
The process display unit 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. The device meets the relevant standards and directives as per IEC 61 010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use".
The device described in these Operating Instructions thus meets the legal requirements of the EU directives. The manufacturer confirms that the device has been tested successfully by affixing the CE mark.

3 Installation

3.1 Installation conditions

The permitted ambient conditions (see Section 10 "Technical data") must be observed when installing and operating. The device must be protected against the effects of heat.

3.1.1 Dimensions

Observe the device face-to-face length of 150 mm (5.91"). Further dimensions are provided in Section 10 "Technical data".

3.1.2 Mounting location

Installation in panel with 92x92 mm (3.62"x3.62") cutout (as per EN 60529). The mounting location must be free from vibrations.

3.1.3 Orientation

Horizontal +/- 45 in every direction.

3.2 Installation instructions

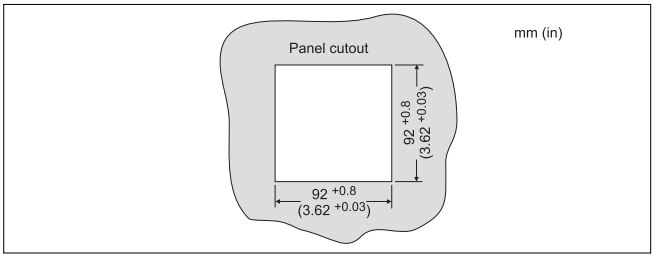


Fig. 3: Panel cutout (data in mm, data in inches in brackets)

Provide a panel cutout of 92x92mm (3.62"x3.62"). The installation depth is 150mm (5.91").

1. Push the device with the sealing ring through the panel cutout from the front.
2. Keep the device horizontal and suspend the two fixing clips in the recesses provided.
3. Tighten the screws of the fixing clips evenly with a screwdriver.

The dimensions of the process display unit are provided in Section 10 "Technical data".

4 Wiring

4.1 Quick wiring guide

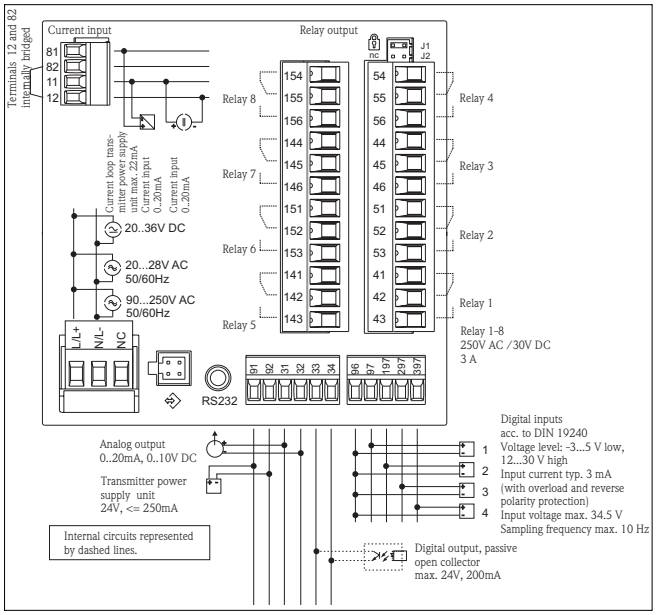


Fig. 4: Terminal assignment of process display unit (Universal input see Page 58)

Terminal assignment

Terminal	Terminal assignment	Type
L/L+	L for AC L+ for DC	Power supply
N/L-	N for AC L- for DC	
NC	Not connected	
J1	Jumper for locking device operation via hardware. If the jumper is set to J1, the configuration cannot be modified.	Note! The device can always be configured with Readwin® 2000 via RS232, even if the jumper is attached to J1.
J2	Not connected	
11	+ 0/4 to 20mA signal	

Terminal	Terminal assignment	Type
12	Signal ground (current)	
81	24 V, sensor power supply 1	Transmitter power supply (optionally intrinsically safe)
82	Ground, sensor power supply 1	
41	Normally closed (NC)	Relay 1
42	Common (COM)	
43	Normally open (NO)	
51	Normally closed (NC)	Relay 2
52	Common (COM)	
53	Normally open (NO)	
44	Normally closed (NC)	Relay 3
45	Common (COM)	
46	Normally open (NO)	
54	Normally closed (NC)	Relay 4
55	Common (COM)	
56	Normally open (NO)	
141	Normally closed (NC)	Relay 5 (optional)
142	Common (COM)	
143	Normally open (NO)	
151	Normally closed (NC)	Relay 6 (optional)
152	Common (COM)	
153	Normally open (NO)	
144	Normally closed (NC)	Relay 7 (optional)
145	Common (COM)	
146	Normally open (NO)	
154	Normally closed (NC)	Relay 8 (optional)
155	Common (COM)	
156	Normally open (NO)	

Terminal	Terminal assignment	Type
96	Ground for digital status inputs	Digital inputs
97	+ digital status input 1	
197	+ digital status input 2	
297	+ digital status input 3	
397	+ digital status input 4	
31	+ analog output	Analog output (optional)
32	Ground, analog output	
33	+ digital output	Digital output (optional)
34	Ground, digital output	
91	24 V, sensor power supply 2	Transmitter power supply
92	Ground, sensor power supply 2	

Universal input option
The device can be optionally equipped with a universal input instead of a current input.

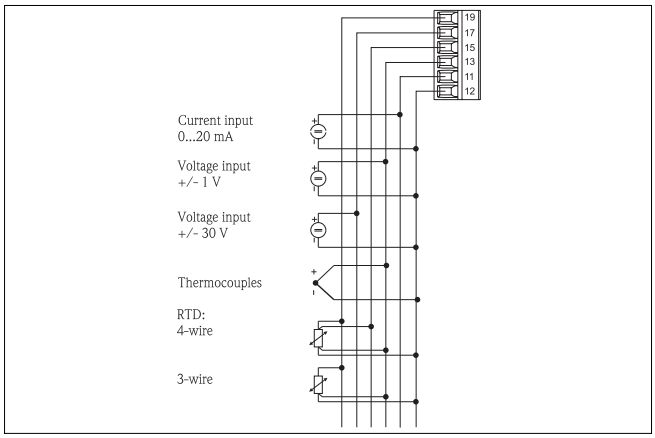


Fig. 5: Universal input terminal assignment

Terminal assignment

Terminal	Terminal assignment
11	+ 0/4 to 20 mA signal
12	Signal ground (current, voltage, temperature)
13	± 1 V, + thermocouples, - resistance thermometer signal (3-wire/4-wire)
15	+ resistance thermometer signal (4-wire)
17	± 30 V
19	+ resistance thermometer power supply (3-wire/4-wire)

4.2 Connecting the device

Caution!
Do not install or wire the device when it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.

4.2.1 Connecting the power supply

Caution!
- Before wiring the device, ensure that the supply voltage corresponds to the specification on the nameplate.
- For the 90 to 250 V AC version (mains connection), a switch marked as a separator, as well as an overvoltage organ (rated current ≤ 10 A), must be fitted in the supply line near the device (easy to reach).

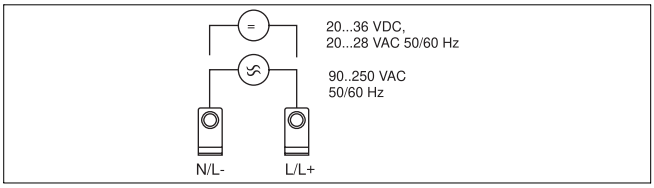


Fig. 6: Connecting the power supply

4.2.2 Connecting external sensors

Note!
Active and passive sensors with analog, TC, resistance and RTD sensors can be attached to the device.
Depending on the type of signal of the sensor in question, the terminals can be freely selected which means the process display unit can be used with great flexibility.

Current input 0/4...20 mA

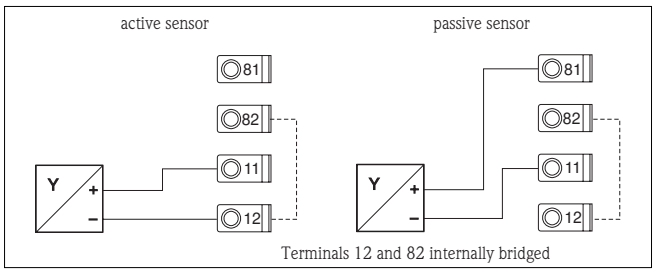


Fig. 7: Connecting a 2-wire sensor to current input 0/4...20 mA

Universal input

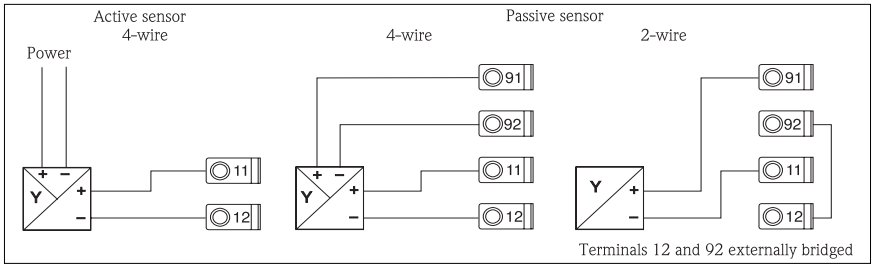


Fig. 8: Connecting a sensor to universal input

4.3 Post-connection check

Device condition and specifications	Notes
Is the device or cable damaged (visual inspection)?	–
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	90 to 250 V AC (50/60 Hz) 20 to 36 V DC 20 to 28 V AC (50/60 Hz)
Are all of the terminals firmly engaged in their correct slots? Is the coding on the individual terminals correct?	–
Are the mounted cables strain relieved?	–
Are the power supply and signal cables correctly connected?	See wiring diagram on the housing
Are all screw terminals firmly tightened?	–

5 Operation

5.1 Quick operation guide

M1	*Analog input* INPUT	*Signal type* Signal type	*Connection type** Connection	*Curve* Curve	*Signal damping 1st order low pass* Damp	*Dimension* Dimension	*Decimal point* *Dec. point*	* = Only available if the associated option is installed in the device
		0% value 0% value	*00% value* 100% value	*Offset* Offset	*Comparative temperature** Comp. temp	*Fixed comparative temperature** Const. temp	*Cable open circuit detection* Open circ.	
M2	*Display* DISPLAY	*Assign numerical display* Ref. num.	*Assign bargraph* Ref. bargraph	*Decimal point bargraph* Dec. point	*0% value* Bar 0%	*100% value* Bar 100%	*Orientation* Bar rise	
M3	*Analog output* ANALOG OUT	*Assignment* Ref. num.	*Damping* Out damp	*Output range* Out range	*Decimal point* Dec. point	*0% value* Out 0%	*100% value* Out 100%	
		Offset Offset	*Output in the event of a fault* Fail mode	*Value in the event of a fault* Fail value	*Simulation mA* Simu mA	*Simulation Volt* Simu V		
M5	*Digital input 1-4* DIGITAL INP.	*Function, digital input 1-4* Function	*Active level 1-4* Level	*Pump monitoring sampling time* Sampl. time				
M10 – M17	*Limit 1-4 (8)* LIMIT	*Assignment* Ref. num	*Function 1-4 (8)* Function	*Decimal point* Dec. point	*Switch point A* Setpoint A	*Switch point B* Setpoint B	*Hysteresis or switchback gradient* Hysteresis	*Switching delay 1-4 (8) in seconds* Delay
		Alternate function 1-4 (8) Alternate	*Recurrent operation* 24 h	*Runtime display 1-8* Runtime	*Switching freq. display 1-8* Count	*Reset switching freq. and runtime* Reset	*Relay simulation* Simu Relay	
M18	*Integration* INTEGRATION	*Signal source for integration* Ref. Integr.	*Integration base* Integr. base	*Decimal point factor* Dec. factor	*Factor* Factor	*Dimension totalizer* Dimension	*Decimal point totalizer* Dec. total	*Reset totalizer* Totalizer
M19	*Pulse output* PULSE OUT	*Decimal point pulse value* Dec value	*Pulse value* Unit Value	*Pulse width* Pulse width	*Pulse output simulation* Sim pulseout			
M20	*Min/Max memory* MIN/MAX	*Signal source for Min/Max* Ref. Min/Max	*Decimal point* Dec. point	*Display minimum value* Min. value	*Display maximum value* Max. value	*Reset minimum value* Reset min	*Reset maximum value* Reset max	
M21	*Linearisation table* LIN-TABLE	*Number of support points* Counts	*Dimension linearised value* Dimension	*Decimal point Y-axis* Dec. Y value	*Delete all support points* Del points	*Show all support points* Show points		
M23 – Mxx	*Lin. support points* NO 01 NO 32	*X-axis* X value	*Y-axis* Y value					
M55	*Operating parameters* PARAMETERS	*User code* User code	*Program name* Progname	*Program version* Version	*Pump rotation function* Func. alt.	*Relay lock time* Lock time	*Relay failsafe mode* Rel. Mode	*Time for gradient evaluation* Grad. Time
		Failsafe mode at 4-20 mA input Namur	*Error limit 1* Range 1	*Error limit 2* Range 2	*Error limit 3* Range 3	*Error limit 4* Range 4	*Display contrast* Contrast	
M56	SERVICE	- For service personnel only. The service code must be entered.						
M57	EXIT	- Exit the menu. If parameters have been changed, a query is issued whether the changes are to be saved.						
M58	SAVE	- Changes are saved and the menu is exited.						

Fig. 9: Operating matrix

5.2 Display and operating elements

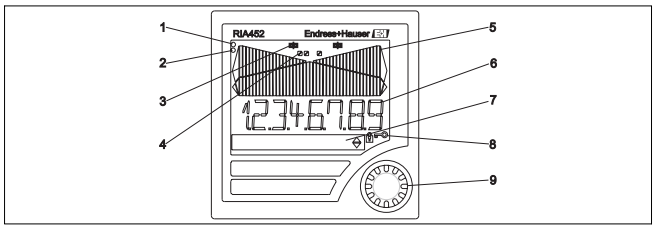


Fig. 10: Display and operating elements

1) Green operating indicator, lights up when supply voltage is applied
2) Red fault indicator, flashes in event of sensor or device error
3) Limit value display: If power is supplied to a relay, the symbol is displayed.
4) Digital input status: green indicates ready for operation, yellow indicates a signal is present
5) Bargraph yellow, 42-section with orange/red range overshoot and undershoot
6) 7-digit 14-segment display in white for measured values
7) 9x77 DOT matrix in white for text or units
8) Key or lock symbol indicates whether device operation is locked (see Section 5.3.3)
9) Jog/shuttle dial for local device operation

5.2.1 Display

Range	Display	Relay	Analog output	Integration
Input current is < lower error limit	Display "⌐⌐⌐⌐⌐"	Fault condition	Set failsafe mode	No integration
Input current above lower error limit and below lower limitations of validity	Display "-----"	Normal limit value behaviour	Normal behaviour with max. 10% overrange. No output < 0 mA/0 V possible	Normal behaviour (negative integration not possible)
Input current in valid range	Display scaled measured value	Normal limit value behaviour	Normal behaviour with max. 10% overrange. No output < 0 mA/0 V possible	Normal behaviour (negative integration not possible)
Input current below upper error limit and above upper limitations of validity	Display "-----"	Normal limit value behaviour	Normal behaviour with max. 10% overrange. No output < 0 mA possible.	Normal behaviour (negative integration not possible)
Input current above upper error limit	Display "⌐⌐⌐⌐⌐"	Fault condition	Set failsafe mode	No integration

Relay display

No power to relay: no display

Power to relay: (symbol displayed (yellow))

Digital input status display

Digital input configured: (green)

Signal at digital input: (yellow)

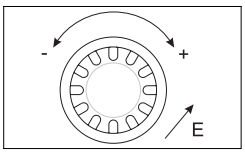
Note!
Information on trouble-shooting can be found in Sections 9.1 and 9.2 of these Operating Instructions.

5.3 Local operation

You can enter the menu by pressing the jog/shuttle dial for > 3 s.

5.3.1 Operation using the jog/shuttle dial

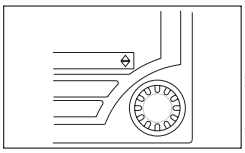
A) E+H 3-key functions



- Press = "Enter"
- Turning clockwise = "+"
- Turning counterclockwise = "-"

Fig. 11: Operation using jog/shuttle dial

B) List selection



▼ Downward arrow:
Selection is at top of the list. Further entries are displayed when the jog/shuttle dial is turned to the right.

▲ Both arrows visible:
▼ User is in the middle of the selection list.

▲ Upward arrow:
End of selection list is reached. User moves towards top of the list by turning jog/shuttle dial to the left.

Fig. 12: List selection with jog/shuttle dial

5.3.2 Entering text

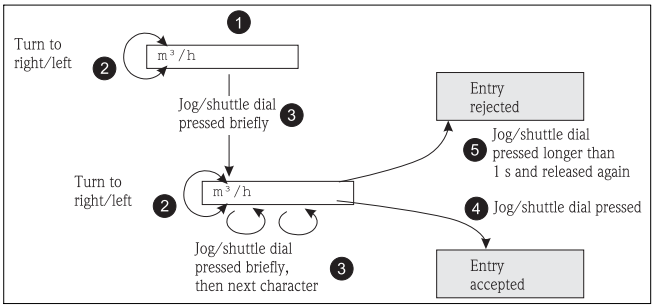


Fig. 13: Entering text with RIA452

Item No.	Description
1	Start entering text by pushing the jog/shuttle dial for > 3 s. The first character starts flashing.
2	Turn the jog/shuttle dial to change the flashing (selected) character (see "Possible characters").
3	Press the jog/shuttle dial to select the next character (in our example, the second character is now flashing).
4	If the jog/shuttle dial is pressed briefly for the last character, the information entered is accepted.
5	If the jog/shuttle dial is pressed longer than 1 second (max. 2 seconds), the data input is rejected.

Possible characters

The following characters can be entered:
space +ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789/\%#+-.,:*()

5.3.3 Disabling the programming mode

The entire configuration can be protected against unintentional access by means of a four-digit code. This code is assigned in the submenu "Parameter/User Code". All the parameters remain visible. If the value of a parameter should be changed, you are first asked for the user code.
In addition, configuration can also be locked using a switch on the rear of RIA452 (see Section 4.1). This is indicated with a corresponding symbol on the display.
The "key" symbol is displayed if configuration is locked using the user code.
The "lock" symbol is displayed if hardware locking is activated.

6 Commissioning

6.1 Function check

Make sure that all post-connection checks have been carried out before you commission your device:
- See Section 3.3 'Post-installation check'
- Checklist Section 4.3 'Post-connection check'

6.2 Switching on the measuring device

Once the operating voltage is applied, the green LED (= device operating) lights up if no fault is present.
- When the device is first commissioned, it is in the status when delivered and uses the default settings for all parameters.
- When commissioning a device already configured or preset, measuring is immediately started as per the settings. The limit values only switch once the first measured value has been determined.

6.3 Device configuration

This section describes all the configurable device parameters with the associated value ranges and factory settings (default values).

6.3.1 Analog input - INPUT/M1

All the parameters available for the input can be found under the analog input menu item which is marked as INPUT in the device.

Function (menu item)	Parameter setting	Description
Signal type	Off 4 - 20 mA 0 - 20 mA 0 - 5 mA* 0 - 100 mV* 0 - 200 mV* 0 - 1 V* 0 - 10 V* ± 150 mV* ± 1 V* ± 10 V* ± 30 V* Type B (IEC584)* Type J (IEC584)* Type K (IEC584)* Type L (DIN43710)* Type L (GOST)* Type N (IEC584)* Type R (IEC584)* Type S (IEC584)* Type T (IEC584)* Type U (DIN43710)* Type D (ASTME998)* Type C (ASTME998)*	Selects the signal type of the connected sensor. Parameters marked * can only be selected with the universal input option.

Function (menu item)	Parameter setting	Description
	PT50 (GOST)* PT100 (IEC751)* PT100 (JIS1604)* PT100 (GOST)* PT500 (IEC751)* PT500 (JIS1604)* PT500 (GOST)* PT1000 (IEC751)* PT1000 (JIS1604)* PT1000 (GOST)* Cu50 (GOST)* Cu100 (GOST)* 30 – 3000 Ohm*	Selects the signal type of the connected sensor. Parameters marked * can only be selected with the universal input option.
Connection	3 Wire 4 Wire	Configures the sensor connection in 3-wire or 4-wire technology. Can only be selected for "Signal type" 3000 Ω, PT50/100/1000, Cu50/100
Curve	Linear Quad. °C °F Kelvin	Linear or square (quad.) curve of the sensor used; can be selected for analog signals. °C, °F, Kelvin physical measured variable, can be selected for temperature sensors.
Damp	0..99.9	Signal damping of measuring input with 1st order low pass. Time constant can be selected from 0 to 99.9 sec.
Dimension	XXXXXXXXX	The technical unit or an arbitrary text for the measured value of the sensor can be configured here. Max. length 9 characters.
Dec. point	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Number of places after the decimal point for displaying the measured value.
0% value	-99999..99999	Start value of measured value, can be selected for analog signal types
100% value	-99999..99999	End value of measured value, can be selected for analog signal types
Offset	-99999..99999	Shifts the zero point of the response curve. This function is used to adjust the sensor.
Comp. temp	Intern const	Comparative temperature for thermocouple measurement. An internal cold junction (= Intern) or a constant value (= const) can be selected.
Const. temp	9999.9	Fixed comparative temperature. This can only be selected if const is set for "Cmp. Temp".
Open circ.	No Yes	Cable open circuit detection

Adjusting the analog input

The input can be adjusted to the sensor with the aid of the following parameters.
For non-temperature sensors, a scaled value is calculated from the sensor signal:

$$Scaled\ value = \frac{Input\ value\ [\text{in } \%]}{100} * (scaling_{[100\%]} - scaling_{[0\%]}) + offset$$

For temperature outputs, the scaled value is calculated from linearisation tables. The temperature value can be converted to degrees Celsius, degrees Fahrenheit or Kelvin. In addition, the temperature value can be corrected by means of an offset.

6.3.2 Display - DISPLAY/M2

All the settings for the device display are grouped under this menu item.

Function (menu item)	Parameter setting	Description
Ref. num.	Input Lintab Total	Selects which value is shown on the display. ■ Input = measured value ■ Lintab = linearised measured value ■ Total = integrated value (can only be selected if the pulse output option is available)
Ref. bargraf	Input Lintab	Selects the signal source for the bargraph
Dec. point	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Number of places after the decimal point for bargraph scaling.
Bar 0%	-99999..99999	Start value for the bargraph
Bar 100%	-99999..99999	End value for the bargraph
Bar rise	Right Left	Bargraph orientation. ■ Right = 100% value (rising from left to right) ■ Left = 100% value left (falling from left to right)

6.3.3 Analog output - ANALOG OUT/M3

All the parameters available for the output can be found under the analog output menu item which is marked as ANALOG OUT in the device.

Function (menu item)	Parameter setting	Description
Ref. num.	Input Lintab	Selects which value is output at the analog output. ■ Input = measured value ■ Lintab = linearised measured value
Out damp	0..99.9	Signal damping of measuring input with 1st order low pass. Time constant can be selected from 0 to 99.9 sec.
Out range	Off 0 - 20 mA 4 - 20 mA 0 - 10 V 2 - 10 V 0-1 V	Signal type of output ✎ Note! "Off" switches the output signal off completely.
Dec. point	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Number of places after the decimal point for outputting the measured value. Can be selected for analog signal types
Out 0%	-99999..99999	Start value of the output signal
Out 100%	-99999..99999	End value of the output signal
Offset	-999.99..999.99	Shifts the zero point of the output curve in mA or V.

Function (menu item)	Parameter setting	Description
Fail mode	Hold const Min Max	Output value if a sensor or device error occurs. ■ Hold = last valid value ■ Const = freely selectable value ■ Min = output value is 3.5 mA for 4-20 mA, and 0 V or 0 mA otherwise ■ Max = output value is 22.0 mA for 0/4-20 mA, and 1.1 V or 11 V otherwise
Fail value	0..999.99	The freely selectable value for "Fail mode = Const" can be set here. Current output: 0...22 mA Voltage output: 0...11 V
Simu mA	OFF 0.0 mA 3.6 mA 4 mA 10 mA 12 mA 20 mA 21 mA	Outputs the selected current at the output regardless of the input value. Is automatically set to OFF when exited.
Simu V	OFF 0.0 V 5.0 V 10.0 V	Outputs the selected voltage at the output, regardless of the input value. Is automatically set to OFF when exited.

6.3.4 Digital input - DIGITAL INP./M5

The settings for the digital status inputs, e.g. for monitoring pumps, starting/stopping the counter or resetting the min/max-value memory are grouped in this section.
Note: The digital status inputs are permanently assigned to the relays in the PUMP function. Relay 1 is monitored by digital input 1, relay 2 by digital input 2 etc.

Function (menu item)	Parameter setting	Description
Function	OFF Pump Res. Tot. Start/Stop Min/Max	Function of the selected digital input. ■ OFF ■ Pump = pump monitoring (see Pump monitoring function) ■ Res. Tot. = reset the totalizer* ■ Start/Stop = start or stop the totalizer* ■ Min/Max = reset the min/max memory values ✎ Note! Parameters marked * are only available with the pulse output option.
Level	Low High	Selects the side for evaluation. ■ Low = descending side ■ High = increasing side
Sampl. time	0..99	Defines the time within which pump feedback at the digital input is to be expected. If there is no feedback within the defined time, an error message is generated and a second pump is activated if more than one pump is available.

Pump monitoring function

The digital inputs 1–4 are permanently assigned to each relay 1–4. If the function of the digital input is set to pump monitoring, the sampling time starts when the relay is switched on. When the sampling time expires, the digital input is sampled continuously. If the signal is not active, the relay is switched off immediately and a fault message is generated (see). If the alternate function for this relay is activated, a relay with an alternate function is also searched for and switched on.

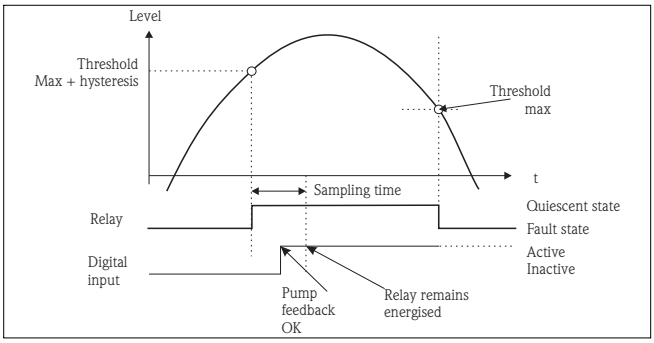


Fig. 14: Pump monitoring, pump OK

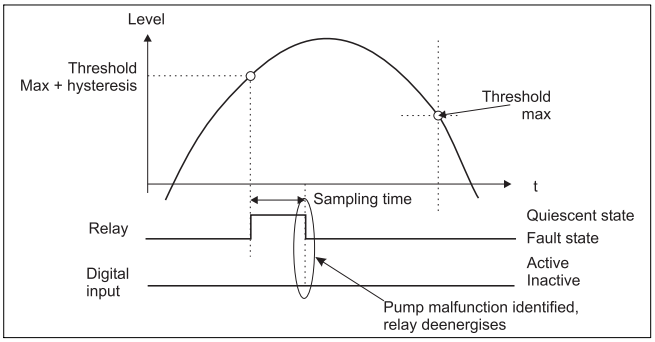


Fig. 15: Pump monitoring, pump fault

The following parameters must be configured:

Menu	Function (menu item)	Setting value
DIGITAL INP./M5	Function Level Sampl. time	Pump Low or High Sampling time in seconds

6.3.5 Limit values - LIMIT 1...8/M10...17

Function (menu item)	Parameter setting	Description
Ref. num.	Input Lintab	Selects which value is used: ■ Input: scaled value from analog input ■ Lintab: value from linearisation table
Function	Min Max Grad In band Out band Alarm	Selects limit value and fault monitoring. The relays are currentless in the event of device errors or incorrect input values (see error limits range 1...4 in Section 1.3.11). ■ Min: minimum with hysteresis (see Fig. 16) ■ Max: maximum with hysteresis (see Fig. 17) ■ Grad: gradient (see Fig. 18) ■ In band: validity range within two values ■ Out band: validity range outside of two values ■ Alarm: relay is used as an alarm relay
Dec. point	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Number of digits after the decimal point for the limit value.
Setpoint A	-99999...99999	Measured value at which a change in the switch status occurs (slope for gradient). Default: 0.0
Setpoint B	-99999...99999	The second setpoint can be configured for the "In band" and "Out band" operating modes.
Hysteresis	-99999...99999	For entering the hysteresis for the threshold at minimum/maximum.
Delay	0...99	Sets the limit value event delay once the threshold is reached (in seconds) (see Fig. 19).
Alternate	No Yes	Determines the switching function for this relay: ■ No: none; switch point permanently assigned to relay ■ Yes: alternate function (see Fig. 20)
24h	0...60	Limit value is activated cyclically every 24 hours for 0...60 min.
Runtime		Displays the run time of the connected device, e.g. pump, in hours [h].
Count		Records the switching frequency of the limit value.
Reset	No Yes	Resets the run time and switching frequency for this limit value.
Simu relay	Off Low High	Simulation of the selected limit value. Is automatically set to OFF when exited.

Min operating mode

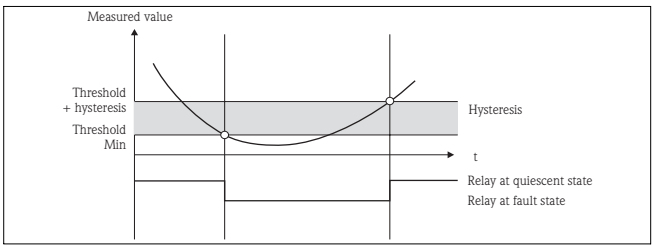


Fig. 16: Min operating mode

The following parameters must be configured:

Menu	Function (menu item)	Setting value
LIMIT 1...8/M10...17	Function Setpoint A Hysteresis	Min Value for threshold Value for hysteresis

Max operating mode

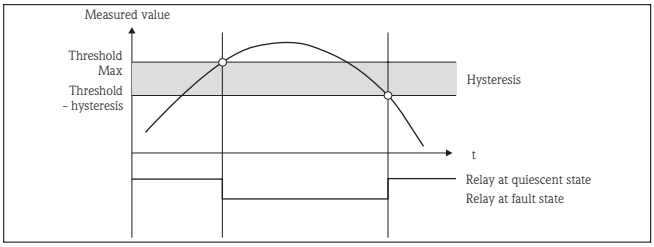


Fig. 17: Max operating mode

The following parameters must be configured:

Menu	Function (menu item)	Setting value
LIMIT 1...8/M10...17	Function Setpoint A Hysteresis	Max Value for threshold Value for hysteresis

Grad operating mode

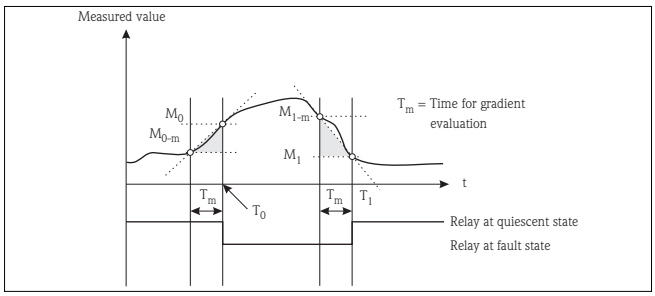


Fig. 18: Grad operating mode

The "Grad" operating mode is used for monitoring the changes in the input signal over time. The time basis t_m of the monitoring system is configured in the "PARAMETER/M55 -> Grad. time" menu.
The difference between the lower range value M_{0-m} and the upper range value M_0 of the interval is calculated. If the calculated value is greater that the value set under "Setpoint A", the relay is switched currentless.
The relay is switched on again once the difference between M_{1-m} and M_1 drops below the value set in "Hysteresis". The sign determines the direction of signal change. A new value is calculated every 1.0 s (floating interval).

The following parameters must be configured:

Menu	Function (menu item)	Setting value
LIMIT 1...8/M10...17	Function Setpoint A Hysteresis	Grad Gradient value for threshold Value for hysteresis

Delay

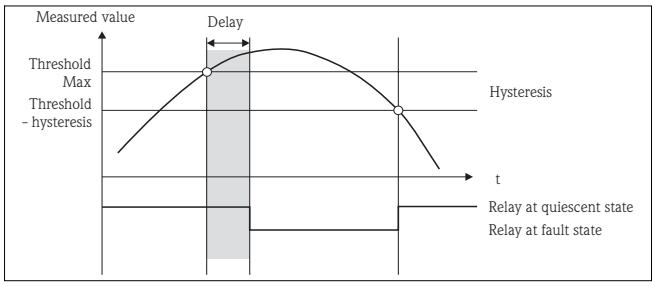


Fig. 19: Delay

The following parameters must be configured:

Menu	Function (menu item)	Setting value
LIMIT 1...8/M10...17	Setpoint A Hysteresis Delay	Value for threshold Value for hysteresis Delay time in [s]

Alternate

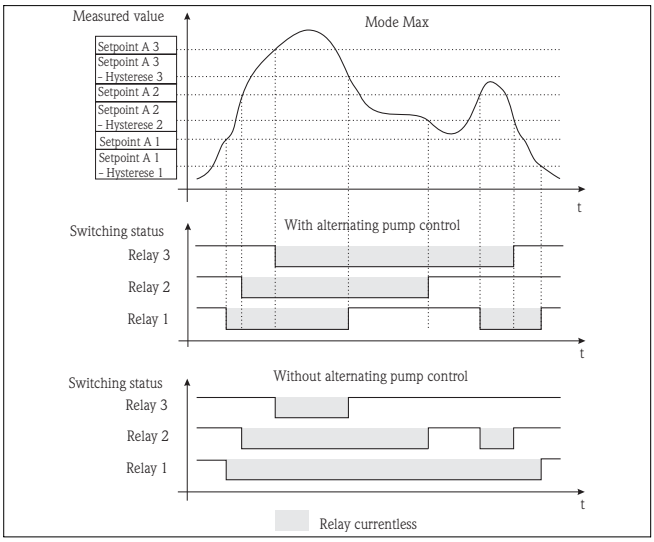


Fig. 20: Alternating pump control

Alternate switching is used to ensure that several pumps are utilised evenly in level control systems. The main factor for switching on a certain pump is not a fixed assigned switch-on value but rather the question as to which pump was out of operation the longest.

Note!
Relays not included in alternating pump control are available.
This function cannot be applied to individual relays. Relays not included are not assessed based on the switch-on and switch-off duration.

The following parameters must be configured for the example above:

Menu	Function (menu item)	Setting value
LIMIT 1...3/M10...12	Each: Setpoint A Each: hysteresis Each: alternate	Value for threshold Value for hysteresis Yes

6.3.6 INTEGRATION/M18

This function can only be selected if the pulse output option is available in the device.

Function (menu item)	Parameter setting	Description
Ref. integr.	Input Lintab	Selects which value should be integrated. ■ Input = measured value ■ Lintab = linearised measured value
Integr. base	OFF sec Min hour day	Time basis for integration
Dec. factor	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Decimal point position of the conversion factor
Factor	0 ..99999	Conversion factor
Dimension	XXXXXXXXX	The technical unit or an arbitrary text for the measured value of the sensor can be configured here. Max. length 9 characters.
Dec. total	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Decimal point of totalizer
Totalizer	9999999	Assign totalizer a default value.
Reset Total	No Yes	Reset totalizer ✎ Note! Cannot be configured with ReadWin® 2000.

Integration function

With this function, the computed value from the linearisation table or that of the analog input can be numerically integrated to create a totalizer for example.
The totalizer is calculated as follows:

$$Totalizer_{new} = Totalizer_{old} + value * \frac{Measuring\ interval}{Integration\ base} * Conversion\ factor$$

The measuring interval is 0.1 s.

6.3.7 Pulse output - PULSE OUT/M19

All the possible settings for the pulse output can be found in this menu item. This menu item can only be selected if your device is fitted with this option.

Function (menu item)	Parameter setting	Description
Dec. value	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Decimal point position of the pulse value.

Function (menu item)	Parameter setting	Description
Unit value	0 ..99999	Pulse value with which the pulses at the output should be output.
Pulse width	0.04 .. 2000ms	Sets the pulse width at the pulse output. ✎ Note! The maximum output frequency depends on the pulse width: f(max) = 1 / (2*pulse width)
Sim pulseout	OFF 1 Hz 10 Hz 100 Hz 1000 Hz 10000 Hz	Outputs the selected pulses at the pulse output regardless of the input value. Is automatically set to OFF when exited.

6.3.8 Min/Max memory - MIN MAX/M20

The RIA452 can save a minimum and a maximum measured value. The input signal or the signal processed using the linearisation table are available as the signal source. The memory is reset manually or using the digital input (see Section 6.3.4).

Function (menu item)	Parameter setting	Description
Ref. min/max	Input Lintab	Signal source for the min/max value memory. ■ Input = input signal ■ Lintab = linearised input signal
Dec. point	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX	Number of digits after the decimal point for the min/max value memory.
Min. value	0..99999	Displays the current minimum value in the memory.
Max. value	0..99999	Displays the current maximum value in the memory.
Reset min	No Yes	Resets the minimum value memory.
Reset max	No Yes	Resets the maximum value memory.

6.3.9 Linearisation table - LIN. TABLE/M21

The RIA452 can store a table which can be used to linearise the input signal. This table can convert a level signal to the associated volume for example.

Function (menu item)	Parameter setting	Description
Counts	2..32	Number of support points needed. At least two points have to be entered.
Dimension	XXXXXXXXX	The technical unit or an arbitrary text for the measured value of the sensor can be configured here. Max. length 9 characters.
Dec. Y value	XXXXXXX XXXXXX.X XXXXX.XX XXXX.XXX XXX.XXXX	Decimal point position for the Y-values in the linearisation table.
Del. points	No Yes	Delete all programmed support points.
Show points	No Yes	Show all programmed support cells.

6.3.10 Support points of linearisation table - LINPOINTS 1..X/ M23..MXX

Displays the set value pairs of the linearisation table. This menu item is only visible if a linearisation table was configured under Section 6.3.9 and "Yes" was selected in the "Show points" parameter in the "LIN. TABLE/M21" menu.

Function (menu item)	Parameter setting	Description
X value	-99999..99999	X-value of the linearisation table. Corresponds to the input value.
Y value	-99999..99999	Y-value that belongs to the previous X-value. Corresponds to the converted measured value.

6.3.11 Operating parameter - PARAMETER/M55

This menu item contains configuration options such as the user code, failsafe mode of RIA452 to NAMUR etc.

Function (menu item)	Parameter setting	Description
User code	0..99999	Freely selectable user code. Once this code has been entered, configuration can only be enabled again by reentering this code. This is indicated on the display with the "key" figure once the code has been saved.
Progname	ILU00xA	Displays the name of the device software currently installed in the display unit.
Version	V X.XX.XX	Version of the software currently installed in the device.
Func. alt.	Time Count	Setting for controlling pump rotation in alternating pump control. ■ Time = switching time of the relay ■ Count = switching frequency of the relay
Lock time	99.9	Locking time of the relay, 0...99.9 s
Rel. Mode	OFF ON	Failsafe mode of the relays. ■ OFF = relays de-energise in the event of an error or device malfunction ■ ON = relays energise in the event of an error or device malfunction
Grad. Time	1..100	Time setting for gradient evaluation, 1...100 s
Namur	No Yes	Sensor evaluation to NAMUR (e.g. cable open circuit). Only for 4...20 mA current signal.
Range 1	3.6 (0.0...22.0)	Error limits for the input signal. In the "NAMUR=Yes" operating mode, ranges 1...4 are assigned the limits specified by Namur NE 43 and cannot be changed. In the "NAMUR=No" operating mode, the error limits can be freely selected. Here, please note that the following applies: Range 1 < Range 2 < Range 3 < Range 4. Violation of these limits can be evaluated with a relay for example ("Alarm" operating mode).
Range 2	3.8 (0.0...22.0)	
Range 3	20.5 (0.0...22.0)	
Range 4	21.0 (0.0...22.0)	
Contrast	0...99	Setting for the display contrast. ■ 0 = low contrast ■ 99 = high contrast

7 Maintenance

No special maintenance work is required on the device.

8 Accessories

Name	Order No.
ReadWin® 2000 PC configuration software and serial cable with jack connector 3.5 mm for RS232 port.	RIA452A-VK
ReadWin® 2000 PC configuration software and serial cable for USB port with TDL connecter.	TXU10A-xx
IP65 Field housing.	51009957

9 Trouble-shooting

The following section provides you with an overview of possible causes of errors to provide you with an initial trouble-shooting aid.

9.1 Trouble-shooting instructions

Warning!
In the case of Ex devices, fault diagnosis **cannot** be carried out on the open device as this annuls the explosion protection.

Display	Cause	Remedy
No measured value display	No power supply connected	Check the power supply of the device.
	Power supply applied, device defective	The device must be replaced.
The red marking for overrange/underrange is flashing on the bargraph.	Analog output is > 10% above or below the scaled range.	Check the scaling of the analog output (Out 100% or Out 0%).

Note!
Errors for which an error code is shown on the display are described in Section 9.2.
Further information on the display is also provided in Section 5.2.1.

9.2 Process error messages

Note!
Faults have the highest priority. The associated error code is displayed. A fault is present if the memory module for writing and reading data is defective or if data could not be read correctly.

9.2.1 Device malfunction

Error code	Cause	Effect	Remedy
E 101	Bus error reading the config/ calibration data after power-up	Faulty device functioning	Instrument error, notify Service
E 102	Implausible operating data (checksum)	Configuration lost	Perform preset
E 103	Implausible calibration data	Faulty device functioning	Instrument error, notify Service
E 104	Bus error reading the min/max data after power-up	Incorrect min/max values	Reset min/max values
E 105	Bus error reading the relay data after power-up	Incorrect relay data	Reset relay data
E 106	Universal card bus error	Faulty universal input functioning	Replace universal card, notify Service
E 210	Pulse output, pulse buffer overflow	A maximum of 10 pulses are buffered	Set the parameters of the pulse output in such a way that the maximum frequency is not exceeded
E 221	Pump error, digital input 1	Relay goes to failsafe mode	Acknowledge error via operation or switching power on/off
E 222	Pump error, digital input 2		
	Pump error, digital input 3		
	Pump error, digital input 4		
E 290	Number overshoot due to decimal point shift	Decimal point position cannot be altered	Check decimal point position and number range

9.2.2 Incorrect entries

Error code	Description	Reaction at device
E 290	The number of digits after the decimal point cannot be increased due to number overflow of the dependent parameters.	Error code is shown on the display until a key is pressed.

9.3 Spare parts

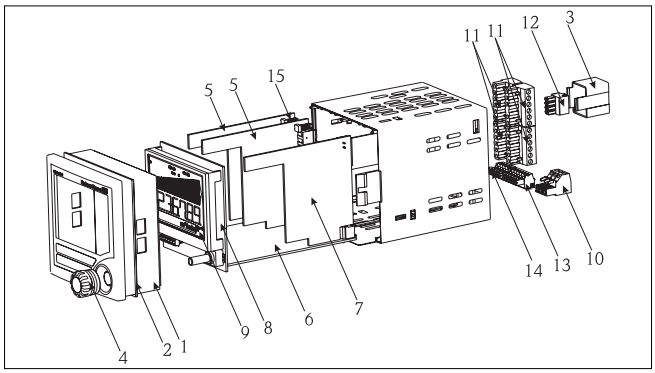


Fig. 21: RIA452 spare parts

Item No.	Name	Order No.
1	Housing front	RIA452X-HA
2	Housing seal	50070730
3	Ex-cover (rear panel)	51008272
4	Rotary button with seal	RIA452X-HB
5	Relay board	RIA452X-RA
6	Mainboard 90...250 V, 50/60 Hz	RIA452X-MA
	Mainboard 20...36 V DC; 20...28 V AC, 50/60 Hz	RIA452X-MB
7	Standard input card	RIA452X-IA
	Standard input card ATEX, FM, CSA approval	RIA452X-IB
	Multi-function input card	RIA452X-IC
8	Complete display board	RIA452X-DA
9	LC display (glass with background illumination)	RIA452X-DB
10	Terminal (mains) 3-pin	50078843
11	Terminal (relay 1-8) 6-pin	51005104
12	Terminal (analog input) 4-pin	51009302
13	Terminal (analog output, Open Collector, transmitter power supply) 6-pin	51008588
14	Terminal (digital inputs) 5-pin	51008587
15	Jumper operating lock	50033350
No Item No.	Casing fixing clip RIA452 (1 piece)	50084623

9.4 Return

To reuse later or in case of repair, the device must be sent in protective packaging, preferably the original packaging. Repairs must only be carried out by your supplier's service organisation or specially trained personnel. Enclose a note describing the fault when sending the unit in for repair.

9.5 Disposal

The device contains electronic components and must, therefore, be disposed of as electronic waste in the event of disposal. Please observe in particular the local waste disposal regulations of your country.

10 Technical data

10.0.1 Input

Measured variable	Current (standard) Digital inputs (standard) Current/voltage, resistance, resistance thermometer, thermocouples (universal input option)
Measuring ranges	**Current input:** ■ 0/4...20 mA +10% overrange, 0...5 mA ■ Short-circuit current: max. 150 mA ■ Input impedance: ≤ 5 Ω ■ Reaction time: ≤ 100 ms **Universal input:** Current: ■ 0/4...20 mA +10% overrange, 0...5 mA ■ Short-circuit current: max. 100 mA ■ Input impedance: ≤ 50 Ω Voltage: ■ ±150 mV, ±1 V, ±10 V, ±30 V, 0...100 mV, 0...200 mV, 0...1 V, 0...10 V ■ Input impedance: ≥ 100 kΩ Resistance: ■ 30...3,000 Ω in 3-wire/4-wire technology Resistance thermometer: ■ Pt100/Pt100/500/1000, Cu50/100, Pt50 in 3-wire/4-wire technology ■ Measuring current for Pt100/500/1000 = 250 μA Thermocouple types: ■ J, K, T, N, B, S, R as per IEC584 ■ D, C as per ASTME998 ■ U, L as per DIN43710/GOST ■ Reaction time: ≤ 100 ms **Digital input:** ■ Voltage level -3...5 V low, 12...30 V high (as per DIN19240) ■ Input voltage max. 34.5 V ■ Input current typ. 3 mA with overload and reverse polarity protection ■ Sampling frequency max. 10 Hz
Galvanic isolation	Towards all other circuits

10.0.2 Output

Output signal	Relay, transmitter power supply (standard) Current, voltage, pulse, intrinsically safe transmitter power supply (option)
Signal on alarm	No measured value visible on the LC display, no background illumination, no sensor power supply, no output signals, relays behave in fail safe manner.
Current/voltage output	Span: ■ 0/4...20 mA (active), 0...10 V (active) Load: ■ ≤ 600 Ω (current output) ■ Max. loop current 22 mA (voltage output)

Signal characterisation:
- Signal freely scalable

Galvanic isolation towards all other circuits

Pulse output

- Frequency range up to 12.5 kHz
- I_{max} = 200 mA
- U_{max} = 28 V
- $U_{low/max}$ = 2 V at 200 mA
- Pulse width = 0.04 up to 2000 ms
- Load min. 1 kΩ

Relay

Signal characterisation:
- Binary, switches when the limit value is reached

Switch function: limit relay switches for the operating modes:
- Minimum/maximum safety
- Alternating pump control function
- Batch function
- Time control
- Window function
- Gradient
- Device malfunction
- Sensor malfunction

Switching threshold:
- Freely programmable

Hysteresis:
- 0 to 99%

Signal source:
- Analog input signal
- Integrated value
- Digital input

Number:
- 4 in basic unit (can be extended to 8 relays, option)

Electrical specifications:
- Relay type: changeover
- Relay switching capacity: 250 V AC / 30 V DC, 3 A
- Switch cycles: typically 10^5
- Switching frequency: max. 5 Hz

Galvanic isolation towards all other circuits

Note! Assignment
Mixed assignment of low and extra-low voltage circuits is not permitted for neighbouring relays.

Transmitter power supply

Transmitter power supply 1, terminal 81/82 (optionally intrinsically safe):
Electrical specifications:
- Output voltage: 24 V ± 15%
- Output current: max. 22 mA (at $U_{out} \geq$ 16 V, sustained short-circuit proof)
- Impedance: ≤ 345 Ω

Approvals:
- ATEX
- FM
- CSA

Transmitter power supply 2, terminal 91/92:
Electrical specifications:
- Output voltage: 24 V ± 15%
- Output current: max. 250 mA (sustained short-circuit proof)

Transmitter power supply 1 and 2
Galvanic isolation:
- Towards all other circuits

HART®:
- No HART® signal influence

10.0.3 Power supply

Electrical connection

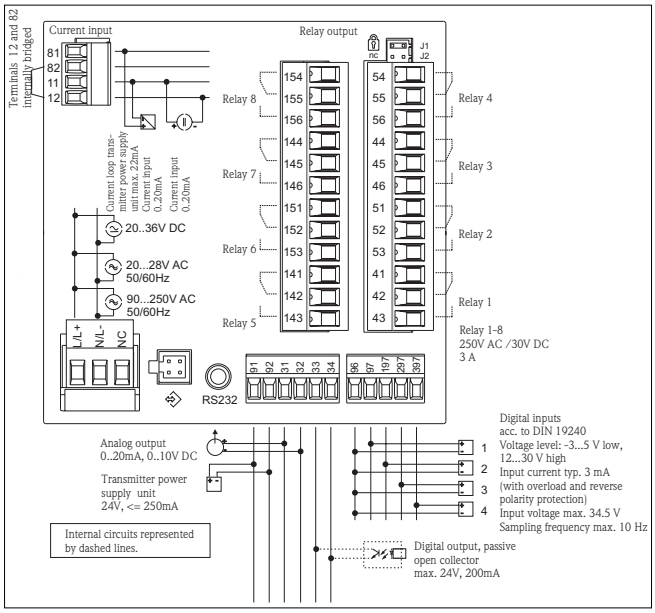


Fig. 22: Terminal assignment of process display unit

Universal input option

The device can be optionally equipped with a universal input instead of a current input.

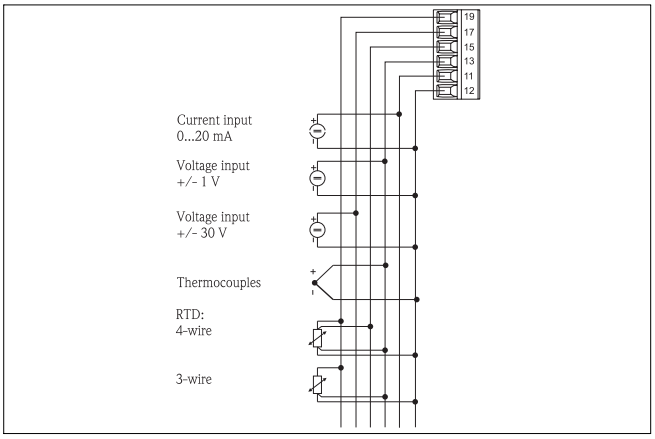


Fig. 23: Universal input terminal assignment (option)

Supply voltage	Power supply 90...250 V AC 50/60 Hz Low voltage power supply 20...36 V DC, 20...28 V AC 50/60 Hz
Power consumption	max. 24 VA
Connection data interface	**RS232** ■ Connection: jack socket 3.5 mm, rear of device ■ Transmission protocol: ReadWin® 2000 ■ Transmission rate: 38,400 Baud

10.0.4 Performance characteristics

Reference operating conditions	Power supply: 230 V AC ±10%, 50 Hz ±0.5 Hz Warm-up period: 90 min Ambient temperature range: 25 °C (77 °F)
Maximum measured error	*Current input:*

Accuracy	0.1% of full scale
Resolution	13 bit
Temperature drift	≤ 0.4%/10K (≤ 0.22%/10 °F)

Universal input:

Accuracy		
Input:	Range:	Maximum measured error of measuring range (oMR):
Current	0...20 mA, 0...5 mA, 4...20 mA Overrange: up to 22 mA	± 0.10%

Voltage > 1 V	0...10 V, ± 10 V, ± 30 V	± 0.10%
Voltage ≤ 1 V	± 1 V, 0...1 V, 0...200 mV, 0...100 mV, ± 150 mV	± 0.10%
Resistance thermometer	Pt100, -200...600 °C (-328 °F...1112 °F) (IEC751, JIS1604, GOST) Pt500, -200...600 °C (-328 °F...1112 °F) (IEC751, JIS1604) Pt1000, -200...600 °C (-328 °F...1112 °F) (IEC751, JIS1604)	4-wire: ± (0.10% oMR + 0.3K (0.54 °F)) 3-wire: ± (0.15% oMR + 0.8K (1.44 °F))
	Cu100, -200...200 °C (-328...392 °F) (GOST) Cu50, -200...200 °C (-328...392 °F) (GOST) Pt50, -200...600 °C (-328...1112 °F) (GOST)	4-wire: ± (0.20% oMR + 0.3K (0.54 °F)) 3-wire: ± (0.20% oMR + 0.8K (1.44 °F))
Resistance measurement	30...3000 Ω	4-wire: ± (0.20% oMR + 0.3K (0.54 °F)) 3-wire: ± (0.20% oMR + 0.8K (1.44 °F))
Thermocouples	Type J (Fe-CuNi), -210...999.9 °C (-346...1831 °F) (IEC584)	± (0.15% oMR +0.5K) from -100 °C (± (0.15% oMR +0.9 °F) from -148 °F)
	Type K (NiCr-Ni), -200...1372 °C (-328...2501 °F) (IEC584)	± (0.15% oMR +0.5K) from -130 °C (± (0.15% oMR +0.9 °F) from -202 °F)
	Type T (Cu-CuNi), -270...400 °C (-454...752 °F) (IEC584)	± (0.15% oMR +0.5K) from -200 °C (± (0.15% oMR +0.9 °F) from -328 °F)
	Type N (NiCrSi-NiSi), -270...1300 °C (-454...2372 °F) (IEC584)	± (0.15% oMR +0.5K) from -100 °C (± (0.15% oMR +0.9 °F) from -148 °F)
	Type B (Pt30Rh-Pt6Rh), 0...1820 °C (32...3308 °F) (IEC584)	± (0.15% oMR +1.5K) from 600 °C (± (0.15% oMR +2.7 °F) from 1112 °F)
	Type D (W3Re/W25Re), 0...2315 °C (32...4199 °F) (ASTME998)	± (0.15% oMR +1.5K) from 500 °C (± (0.15% oMR +2.7 °F) from 932 °F)
	Type C (W5Re/W26Re), 0...2315 °C (32...4199 °F) (ASTME998)	± (0.15% oMR +1.5K) from 500 °C (± (0.15% oMR +2.7 °F) from 932 °F)
	Type L (Fe-CuNi), -200...900 °C (-328...1652 °F) (DIN43710, GOST)	± (0.15% oMR +0.5K) from -100 °C (± (0.15% oMR +0.9 °F) from -148 °F)
	Type U (Cu-CuNi), -200...600 °C (-328...1112 °F) (DIN43710)	± (0.15% oMR +0.5K) from -100 °C (± (0.15% oMR +0.9 °F) from -148 °F)
	Type S (Pt10Rh-Pt), 0...1768 °C (32...3214.4 °F) (IEC584)	± (0.15% oMR +3.5K) for 0...100 °C (± (0.15% oMR +6.3 °F) for 32...212 °F) ± (0.15% oMR +1.5K) for 100...1768 °C (± (0.15% oMR +2.7 °F) for 212...3214.4 °F)
	Type R (Pt13Rh-Pt), -50...1768 °C (-58...3214.4 °F) (IEC584)	± (0.15% oMR +3.5K) for 0...100 °C (± (0.15% oMR +6.3 °F) for 32...212 °F) ± (0.15% oMR +1.5K) for 100...1768 °C (± (0.15% oMR +2.7 °F) for 212...3214.4 °F)
Resolution	16 bit	
Temperature drift	Temperature drift: ≤ 0.1%/10K (0.056%/10 °F)	

Current output:

Linearity	0.1% of full scale
Resolution	13 bit
Temperature drift	≤ 0.1%/10K (0.056%/10 °F)
Output ripple	10 mV to 500 Ω for ≤ 50 kHz

Voltage output

Linearity	0.1% of full scale

Resolution	13 bit
Temperature drift	≤ 0.1%/10K (0.056%/10 °F)

10.0.5 Installation

Installation instructions

Mounting location
Panel, cutout 92x92 mm (3.62x3.62") (see 'Mechanical construction').
Orientation
Horizontal +/– 45 in every direction

Environment

Ambient temperature range

–20 to +60 °C (–4 to 140 °F)

Storage temperature

–30 to +70 °C (-22 to 158 °F)

Operating height

< 3000 m (9842 ft) above MSL

Climate class

As per IEC 60654-1, Class B2

Condensation

Front: permitted
Casing: not permitted

Degree of protection

Front IP 65 / NEMA 4
Casing IP 20

Shock and vibration resistance

2(+3/-0) Hz - 13.2 Hz: ±1.0 mm
13.2 Hz - 100 Hz: 0.7 g

Electromagnetic compatibility (EMC)

- Interference immunity:
  To IEC 61326 industrial environments / NAMUR NE 21
- Interference emissions:
  To IEC 61326 Class A

10.0.6 Mechanical construction

Design, dimensions

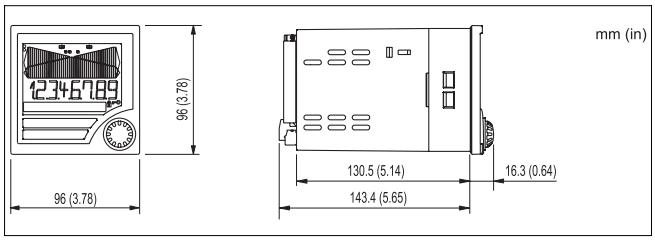


Fig. 24: Data in mm (data in inches in brackets)

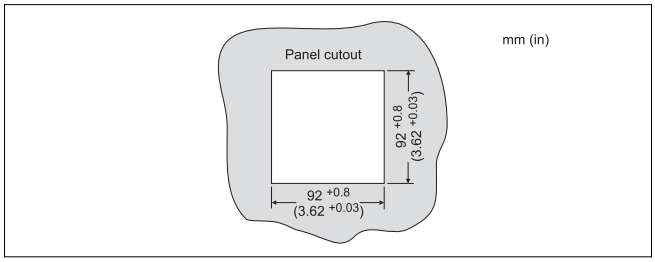


Fig. 25: Panel cutout (data in mm, data in inches in brackets)

Weight	approx. 500 g (1.1 lb)
Material	■ Housing front: ABS plastic, galvanised ■ Housing casing: plastic PC10GF
Terminals	Pluggable screw terminals, range 1.5 mm^2 (≙ 14 AWG) solid, 1.0 mm^2 (≙ 18 AWG) stranded with ferrule

10.0.7 Human interface

Display elements

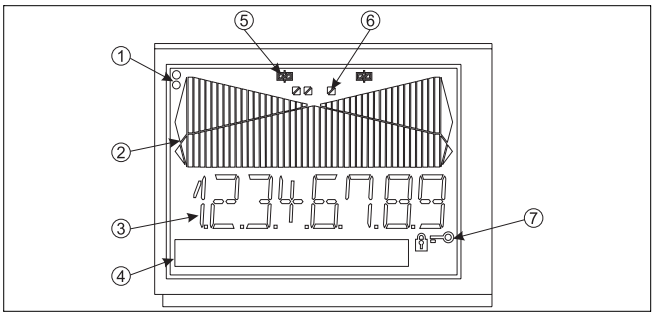


Fig. 26: LC display of process display unit

Pos 1: Device status LEDs: green - device ready for operation; red - device or sensor malfunction
Pos. 2: Bargraph with overreach and underreach
Pos. 3: 7-digit 14-segment display
Pos. 4: Unit and text field 9x77 dot matrix
Pos. 5: Limit value flags 1...8
Pos. 6: Status display, digital inputs
Pos. 7: Symbol for 'device operation blocked'

- Display range
  -99999 to +99999
- Signalling
  – Relay activation
  – Measuring range overrange/underrange

Operating elements

Jog/shuttle dial

Remote operation

Configuration
The device can be configured with the PC software ReadWin® 2000.

Interface
TDL interface at device; connection to PC via USB box (see 'Accessories')
RS232 interface at device; connection with serial interface cable (see 'Accessories')

10.0.8 Certificates and approvals

CE mark	The device meets the legal requirements of the EU directives. Endress+Hauser confirms that the device has been tested successfully by affixing the CE mark.
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Centre on request. All explosion protection data are given in a separate documentation which is available upon request.
Other standards and guidelines	■ IEC 60529: Degrees of protection by housing (IP code) ■ IEC 61010-1: Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures ■ CSA 1010.1 Safety requirements for electrical equipment for measurement, control, and laboratory use – General requirements ■ FM 3610 Intrinsically safe apparatus and associated apparatus for use in class 1, 2 and 3, division 1 hazardous (classified) locations ■ CSA C22.2.157 Intrinsically safe & non-incendive equipment for use in hazardous locations ■ CSA E79-11 Electrical apparatus for explosive gas atmospheres – intrinsic safety "i" ■ EN 50020 Electrical apparatus for hazardous areas – intrinsic safety "I"

10.0.9 Documentation

❑System components – display unit, top-hat rail devices, overvoltage protection and energy computer (FA016K/09/en)
❑Supplementary Ex documentation:
ATEX II(1)GD: XA 053R/09/a3

Index

Brief overview

For rapid and easy commissioning:

Safety instructions	Page 52
▼	
Installation	Page 55
▼	
Wiring	Page 56
▼	
Display and operating elements	Page 62
▼	
Commissioning	Page 65
Device configuration – explanation and use of all the configurable device functions with the associated value ranges and settings.	

Block diagram

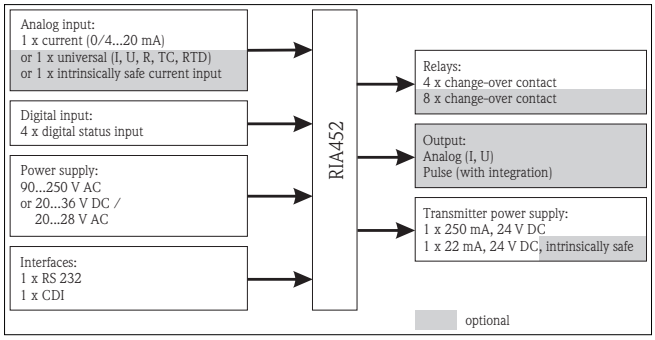
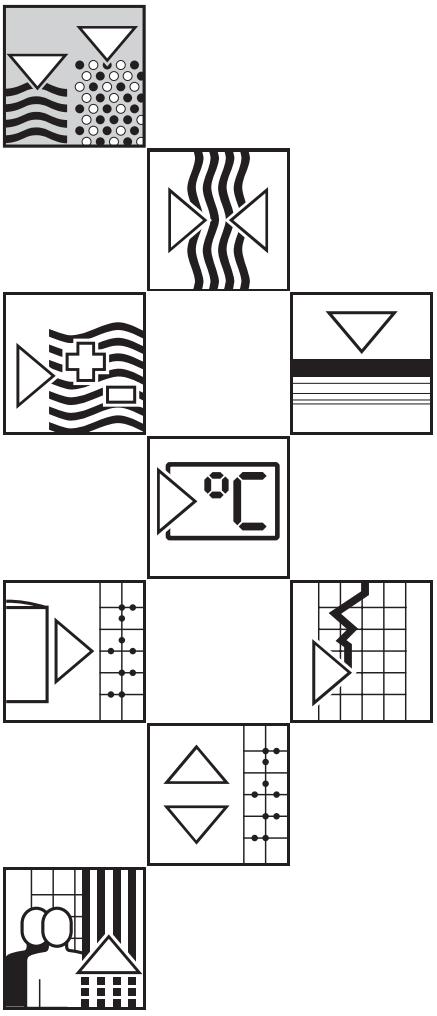


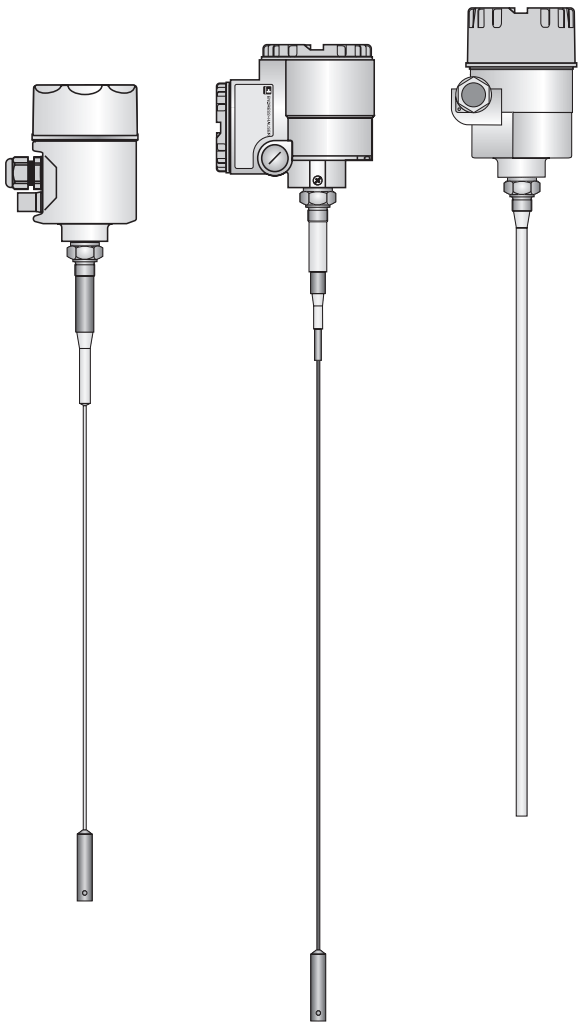
Fig. 1: Block diagram RIA452

BA 158F/00/en/06.03
016705-1000

multicap T
DC 12 TE
DC 11/16/21/26 TEN
DC 11/16/21/26 TES
Level Probes

Operating Instructions





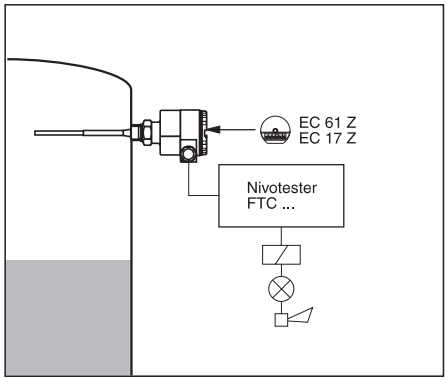
Endress+Hauser

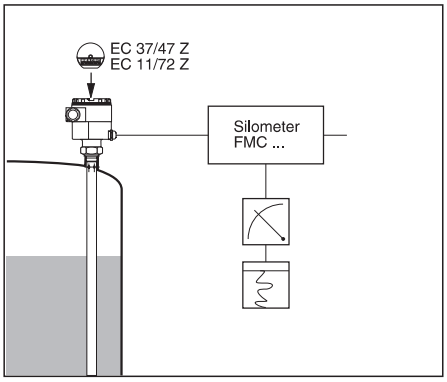
The Power of Know How

Measuring System

Left:
Limit detection with separate Nivotester switching unit

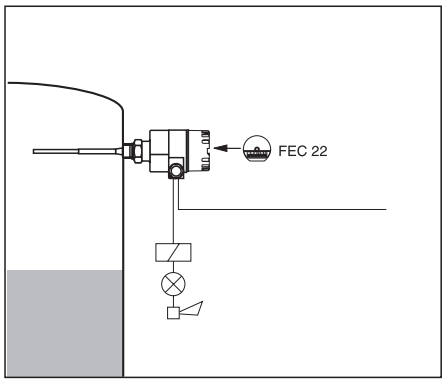
Right:
Level measurement with separate Silometer transmitter

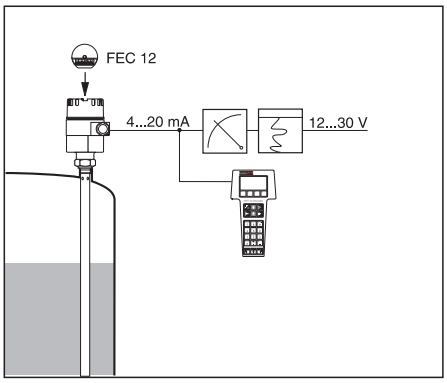




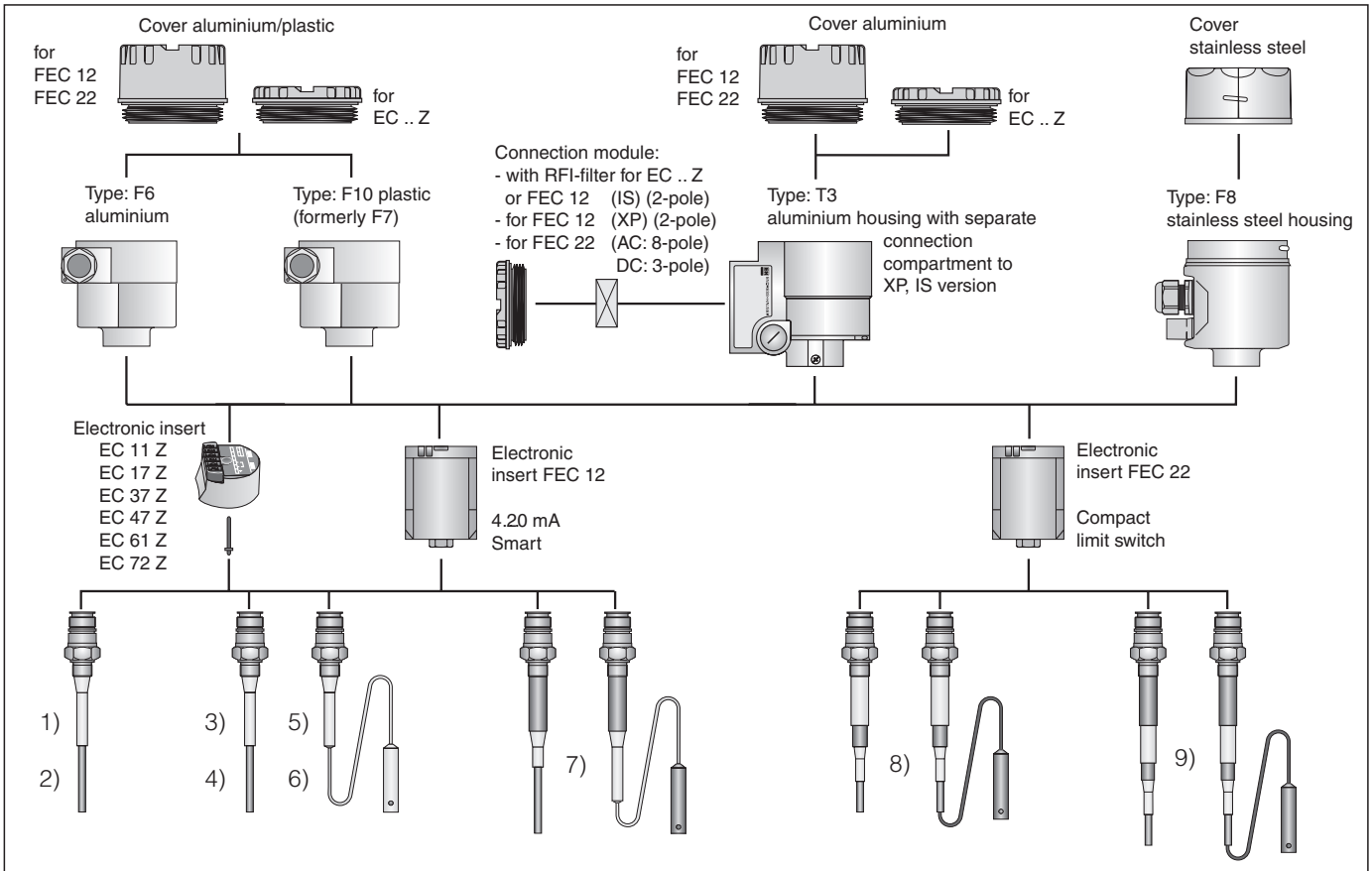
Left:
Compact level switch with relay or transistor output

Right:
Compact loop-powered level measurement system with standard 4.20 mA current output.
The FEC 12 is a smart electronic insert which allows remote calibration over the 4.20 mA output (HART protocol)





Probe Selection



1) DC 12 TE with reinforced rod, fully insulated
2) DC 12 TE with reinforced rod, partially insulated
3) DC 11 TEN with fully insulated rod
4) DC 16 TEN with partially insulated rod
5) DC 21 TEN with fully insulated rope
6) DC 26 TEN with partially insulated rope
7) DC 11, 16, 21, 26 TES with screening against condensation and material build-up at the process connection
8) DC 11, 16, 21, 26 TES with active compensation of conductive material build-up at the probe
9) DC 11, 16, 21, 26 TES with screening and active build-up compensation

Not shown: rod probes DC 11, 16 TEN and TES with ground tube; not for probes with active build-up compensation

Notes on Installation

Approved Usage
Multicap T capacitance probes are designed for level measurement or limit detection in tanks containing liquids or small silos containing light bulk solids. They have been designed to operate safely in accordance with current technical and safety standards, and must be installed by qualified personnel in accordance with the instructions which follow.

The manufacturer accepts no responsibility for any damage arising from incorrect use, installation or operation of the equipment. Changes or modifications not expressly approved in the following instructions or by the bodies responsible for compliance may make the user's authority to operate the equipment null and void.

Personnel
The equipment may be installed, commissioned and maintained by authorised personnel only.
The instructions which follow must have been read and understood before the equipment is installed.

Explosion Hazardous Areas
When installing equipment in explosion hazardous areas the instructions included in the accompanying certification as well as any local standards must be observed.
Please note that where the quoted technical data differs from that in the certificate, the certificate applies.

Operating Conditions
Before installing the probe, check that it is suitable for the operating conditions to be encountered, in particular:
- the chemical resistance of all probe materials
- the permitted operating temperature and pressure
- the approvals for use in explosion hazardous areas.

Unpacking
To avoid damage to the probe, remove the packaging on-site just before mounting.
Compare the code on the nameplate of the probe with the product designation on Page 14...18 to ensure that the correct probe is mounted.
Check the probe length (for shortening see page 5).

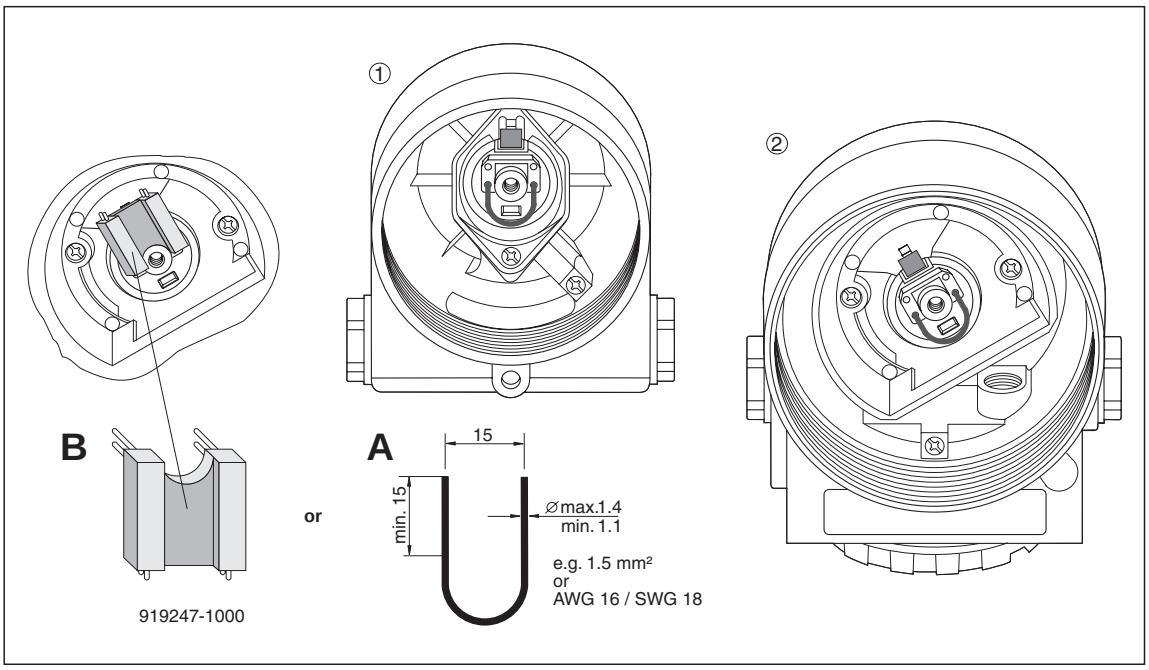
Preparations for Installation

When installing in explosion hazardous areas observe all national and local regulations as well as the specifications in the certificate.

When the electronic insert is not installed, connect the probe terminal in the housing to the ground terminal.

Possibilities for connection:
Insert plug or wire jumper in both sockets - to be found adjacent to the central thread.

Before the electronic insert is installed, remove the plug or jumper.



Grounding the probe rod or rope in the housing:
1) type F6 / F8 / F10
2) type T3

A Jumper, e.g. made from bare wire, 1.5 mm^2

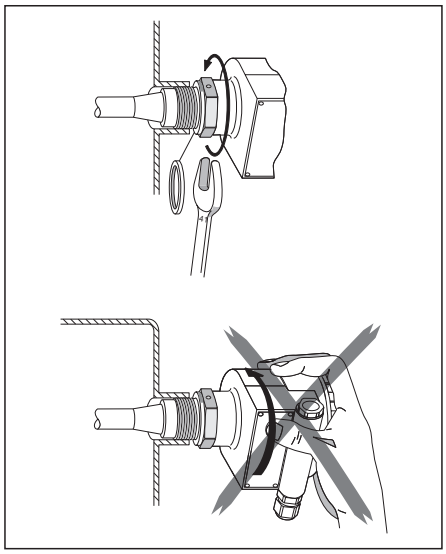
B Plug: supplied with probes without electronic insert

Mounting

Mounting the probe

Protect the insulation

Ensure that the insulation of the probe is not damaged when inserting the probe through the process connection of the vessel.



Probe with parallel thread G ¾ A and with sealing ring: Tighten at the hexagonal nut to max. 100 Nm (G 1 A to max. 180 Nm)

Do not tighten by rotating the housing!

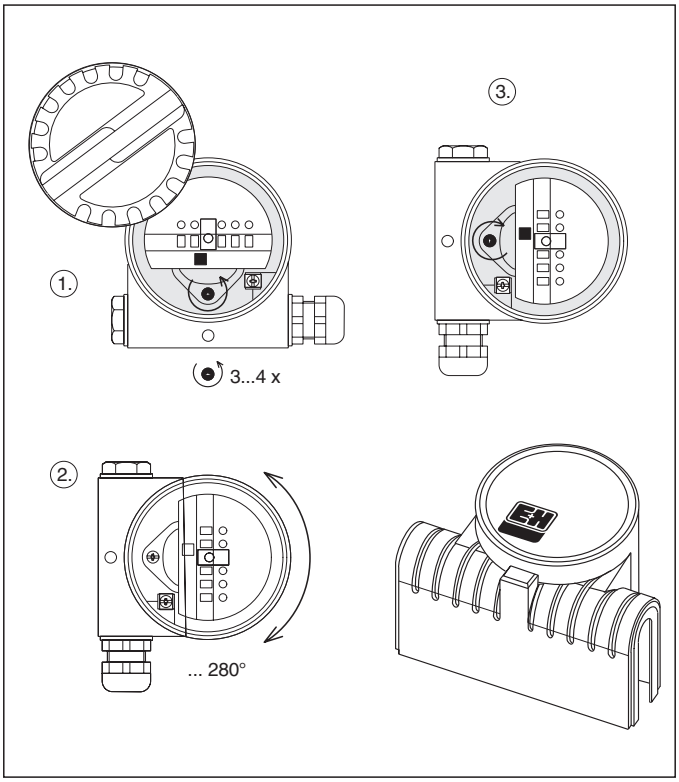
Probe with Triclamp, sanitary thread or flange:

Use a sealing material suitable for the application.

If the flange is PTFE-cladded, then this is generally a suitable seal up to the permitted operating pressure.

Probe with thread

- G ¾ A or G 1 A (parallel): Use the elastomer/fibre seal provided or any other chemically resistant seal which can withstand temperatures up to 300 °C.
- ¾ - 14 NPT or 1 - 11½ NPT (tapered): Wrap suitable sealing material around the thread.
- When tightening, rotate the probe at the hexagonal nut only, not at the housing!
- For probes with a G ¾ A parallel thread and seal: a torque of 30 Nm is sufficient for a tight seal against pressures in the vessel up to 25 bar. (G 1 A: sufficient torque = 50 Nm).



Rotating the small housing (type F6, F8, F10) 1. - 2. - 3.

Below right:

Protective cover for the small housing (type F6, F10).

Always to be used when the probe is mounted outdoors

Rotating the Housing

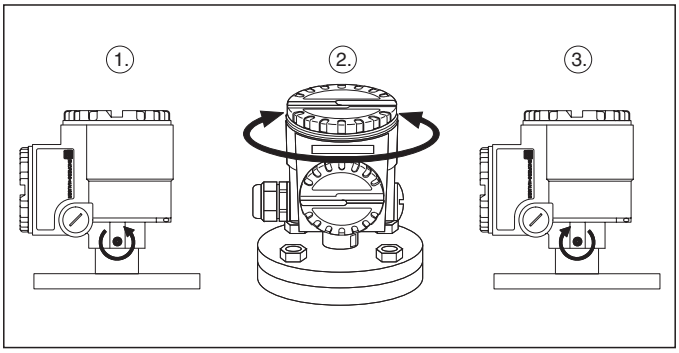
The housing can be rotated to reposition the cable entry.

In order to provide optimal protection from the entry of moisture, particular when the probe is mounted outdoors, we strongly recommend:

- A probe mounted laterally in the tank with *one* cable entry, should have the cable entry pointing downwards
- A probe mounted laterally in the tank with *two* cable entries, should have both cable entries positioned horizontally
- When mounted with protective cover the cable entries should always be positioned horizontally

Small housing (type F6, F8, F10)

- Unscrew cover
- Loosen the Phillips screw in the base of the housing by 3 or 4 turns
- The housing can now be rotated through 280° from one stop to the other
- Retighten the Phillips screw in the base of the housing.



Rotating the large housing (type T3) 1. - 2. - 3.

Large housing (type T3)

- Loosen the Phillips screw on the housing collar
- The housing can now be rotated through 280° from one stop to the other
- Retighten the Phillips screw at the housing collar.

Sealing the Probe Housing
It is important that no moisture enters the probe housing when mounting the probe, connecting the electronic insert or when operating the probe.
The housing cover and the cable entries must, therefore, always be screwed tight.
The O-ring seal at the housing cover and the thread of the aluminium cover are both smeared with a lubricant when delivered.

If the lubricant has been removed, it must be replaced e.g. with silicone or graphite, so that the cover is an air-tight seal and the aluminium thread does not seize when screwed down.
Under no circumstances should an oil-based lubricant be used as this would destroy the O-ring.

Altering the Probe Length

A *fully insulated* rod probe cannot be shortened or lengthened.

Shortening a rope probe
See instructions supplied with the rope shortening kit.

Shortening a partly insulated rod probe
- Clamp the probe by the bare rod, *not by the insulation and not* by the process connection so that the rod connection is not under strain and cannot be damaged.
  Saw off the rod and deburr.
  If the uninsulated rod is less than 100 mm, shorten the insulation accordingly.
- Change the length specification stated on the nameplate.

Lengthening a partially insulated rod probe
- Remove the electronic insert from the probe housing
- Weld on a section of rod or tube (use 1.4435 stainless steel)
  Note:
  - Do not damage or overheat the insulation
  - The weld must be as rugged and corrosion-resistant as the probe rod itself
  - A longer or thicker probe rod is subjected to higher loads by the movement of material, the maximum lateral load will be reduced.
  - Do not exceed the permitted probe length. See appropriate certificate
- Change the length specification stated on the nameplate
- Replace the electronic insert.

Connection

Refer to the appropriate Technical Information for connecting the electronic insert EC or FEC in the probe housing.

For T3 housing, the connection designations in the separate connection compartment are the same as those on the built-in electronic insert.

Insulated mounting of the probe in a metal container: Connect the ground terminal of the probe to the container with the aid of a short cable.
Mounting in a plastic container: Connect the ground terminal of the probe to the counterelectrode with the aid of a short cable.

Ensure that the probe housing is tightly sealed.

Calibration

Refer to the operating manual for the transmitter connected or the electronic insert FEC 12 or FEC 22 which is installed.

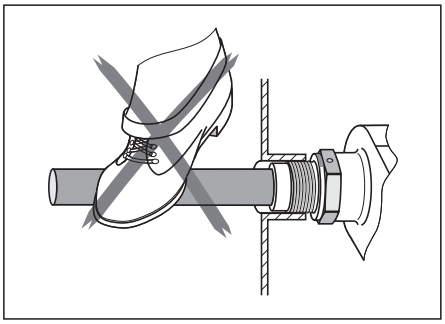
Replacing components

Mounting without electronic insert
Exchange of electronic inserts
- After the defective electronic insert has been removed and the replacement properly installed, the instrument must be recalibrated and checked for correct function.
- If fully insulated multicap probes are mounted in explosion hazardous areas without the electronic insert, and there is a risk of dangerous electronic discharges, then the probe terminal in the housing must be short-circuited with the ground terminal.

Maintenance

Cleaning and inspecting the vessel:
- Check the probe insulation for damage
- Remove material build-up especially at the process connection
- Check the housing cover and the cable entry for tightness.

Caution!
The probe can be damaged if used as a grip or support when inspecting the container.



Return of Goods

If a probe is to be returned to Endress+Hauser for repair or disposal, then all residue must be removed from it. This is especially important if the product measured can impair health.

Please do not return goods if the last traces of dangerous products cannot be removed, e.g. product has penetrated into fissures or diffused into plastic parts.

Disposal

Packaging
All sales and transportation packaging from Endress+Hauser is produced in conformance to the regulations governing packaging for reuse and recycling.

Instruments
For a small charge, Endress+Hauser will accept and recycle any instruments manufactured in its own E+H production program. These will then be disposed of according to the German regulations covering the disposal of electronics. Delivery to Endress+Hauser, Hauptstraße 1, 79689 Maulburg, Germany.

Accessories

- ❑ Protective cover for the small probe housing (type F6, F10)
  see Technical Information "Probe accessories"
  The protective cover shields the probe from excessive heat and prevents condensation from forming in the housing when temperatures vary over a wide range.
- ❑ Slip-on plate for partially insulated probe DC 12 TE for increasing the switching safety for limit detection
- ❑ Rope shortening kit for fully insulated probes
- ❑ Rope shortening kit for partially insulated probes

Supplementary Documentation

Technical Information
- ❑ Probe accessories
  Technical Information TI 229F/00/en
- ❑ Electronic insert FEC 12
  Technical Information TI 250F/00/en
- ❑ Electronic insert FEC 22
  Technical Information TI 251F/00/en
- ❑ Electronic insert EC 17 Z
  Technical Information TI 268F/00/en
- ❑ Electronic insert EC 61
  Technical Information TI 267F/00/en
- ❑ Electronic insert EC 37 Z, EC 47 Z
  Technical Information TI 271F/00/en
- ❑ Electronic insert EC 11, EC 72
  Technical Information TI 270F/00/en
- ❑ Transmitters for limit detection and continuous level measurement on request

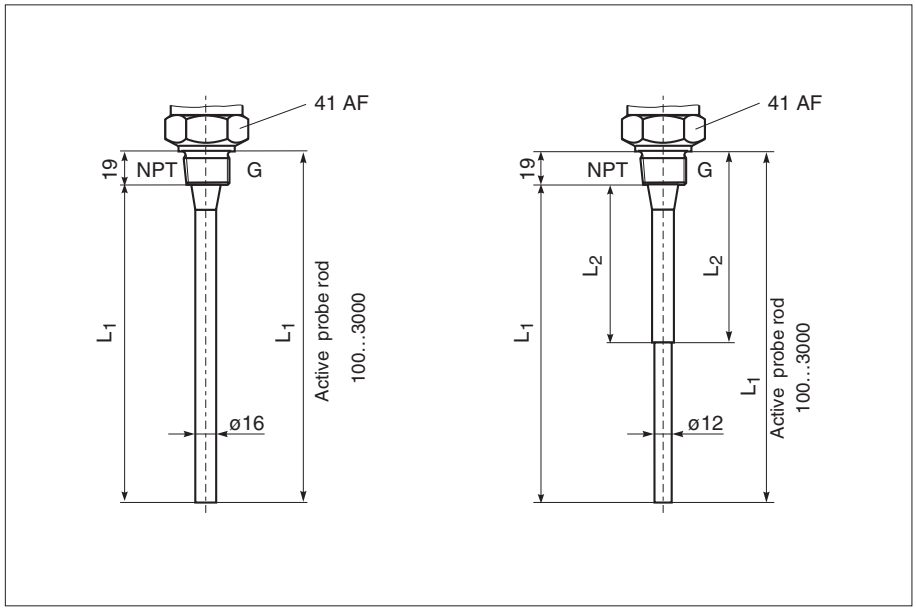
Certificates
See product structure on page 14/16.

Dimensions (Dimensions in mm)

DC 12 TE

L1 = Length of active probe rod
L2 = Length of partial insulation
minimum: 75 mm
maximum: length L1 minus 50 mm

Thread options: G ¾ A, G 1 A
¾ - 14 NPT, 1 - 11½ NPT



DC 12 TE
Rod probe with reinforced rod for high lateral load

Left:
fully insulated

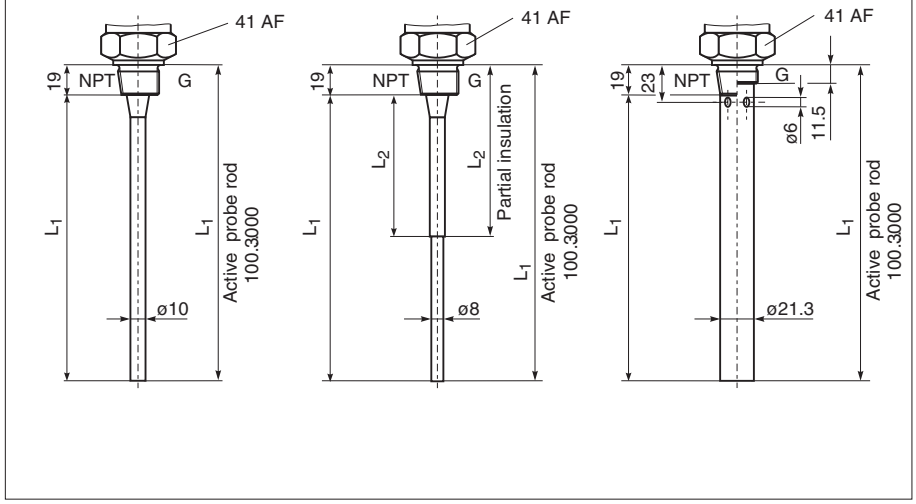
Right:
partially insulated

Dimensions (Dimensions in mm)

DC 11/16/21/26 TEN

L1 = Length of active probe rod or probe rope
L2 = Length of partial insulation
minimum: 75 mm
maximum: length L1 minus 50 mm

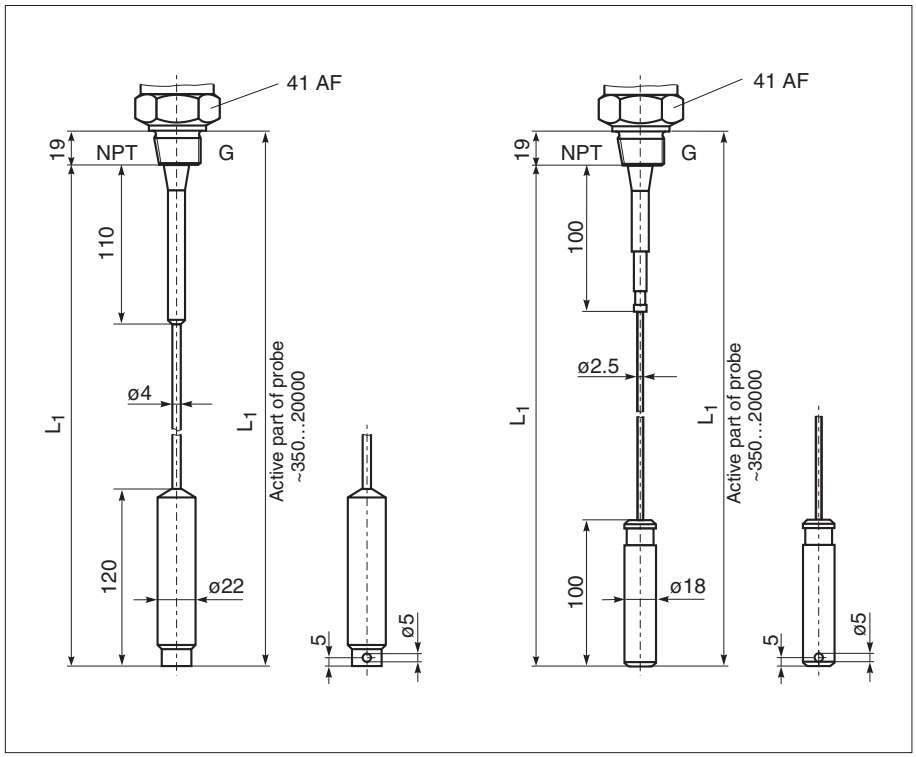
Thread options: G ¾ A, G 1 A
¾ - 14 NPT, 1 -11½ NPT



Left:
DC 11 TEN
Fully insulated rod probe

Centre:
DC 16 TEN
Partially insulated rod probe

Right:
DC 11, 16 TEN
with ground tube
(fully or partially insulated probe rod)



Left:
DC 21 TEN
Fully insulated rope probe

Right:
DC 26 TEN
Partially insulated rope probe

Tensioning weight
with anchor hole

Dimensions (Dimensions in mm)

DC 11/16/21/26 TES

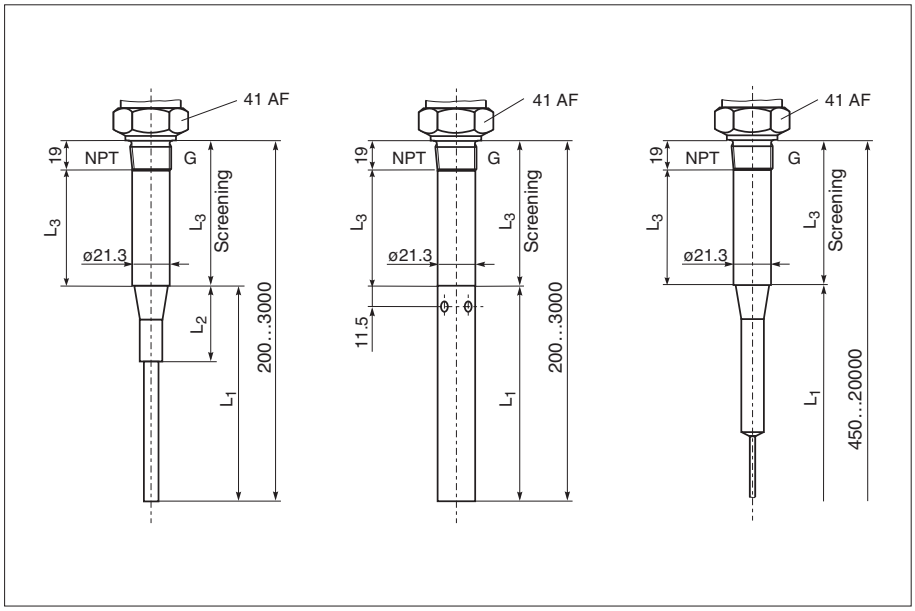
All probes on this page are shown with partial insulation. All versions are available with full insulation

L1 = Length of active probe rod or probe rope
L2 = Length of partial insulation see page 7

Thread options: G ¾ A, G 1 A
¾ - 14 NPT, 1 - 11½ NPT

Probes with **screening L3** against condensation and material build-up on the process connection

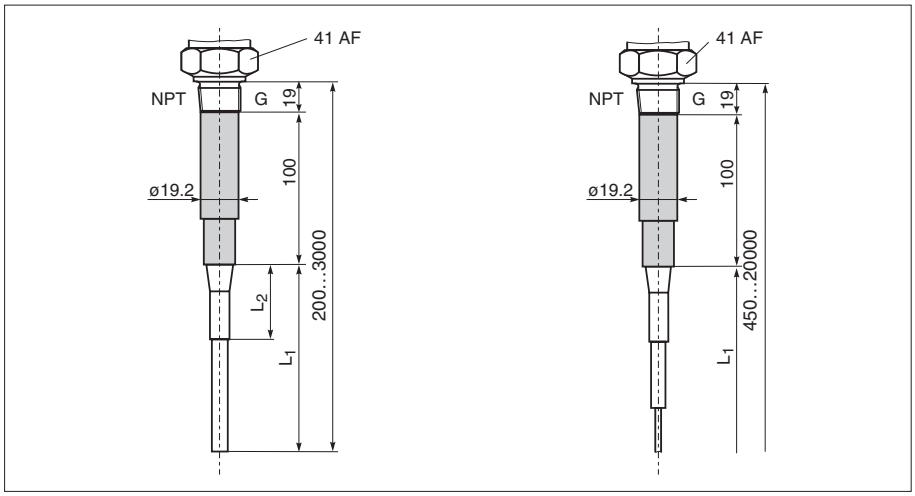
Left:
Rod probe DC 11 TES or DC 16 TES
Centre:
Rod probe DC 11 TES or DC 16 TES with ground tube
Right:
Rope probe DC 21 TES or DC 26 TES



Probes with **active build-up compensation** (always 100 mm)

Left:
Rod probe DC 11 TES or DC 16 TES

Right:
Rope probe DC 21 TES or DC 26 TES



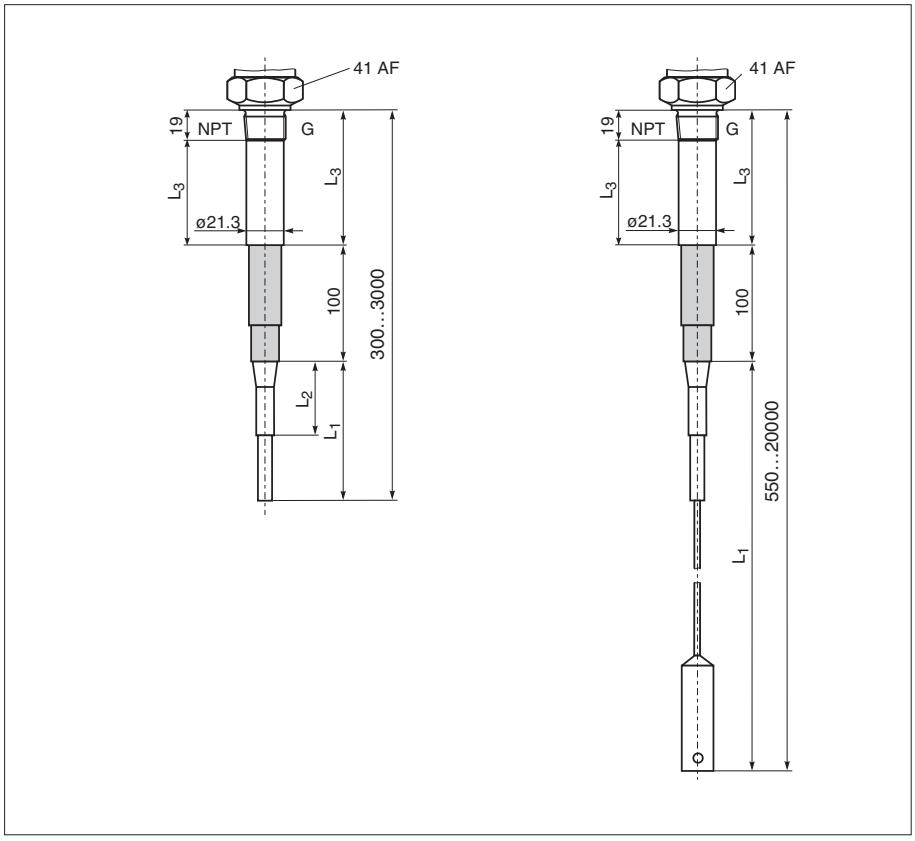
Probes with **screening L3** and with **active build-up compensation**

Left:
Rod probe DC 11 TES or DC 16 TES

Right:
Rope probe DC 21 TES or DC 26 TES

L3
The screening is available in three standard lengths:
L3 = 150 mm,
L3 = 250 mm,
L3 = 500 mm

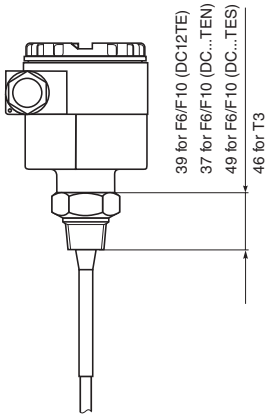
Special lengths on demand
L3 min. 100 mm
L3 max. 1500 mm



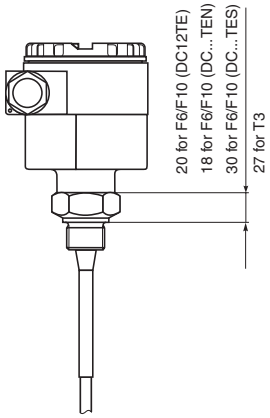
Dimensions Continued / Additional Process Connections

All probes shown with type F6/F10 housing
Dimensions for type T3 housing are also shown

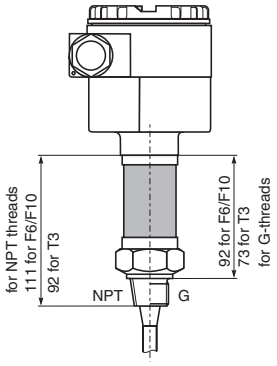
Tapered threads
$^3/_4$ - 14 NPT and 1 - 11$^1/_2$ NPT



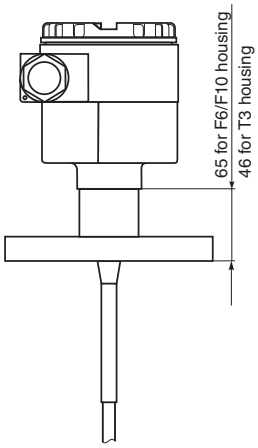
Parallel threads
G $^3/_4$ A and G 1 A



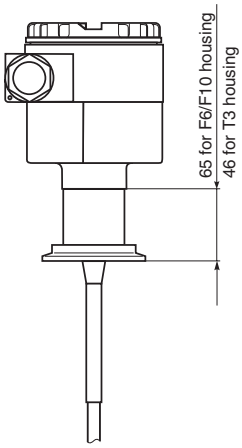
Dimensions of temperature spacer



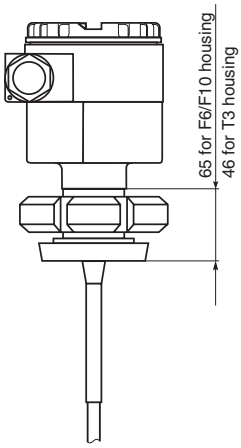
Flange



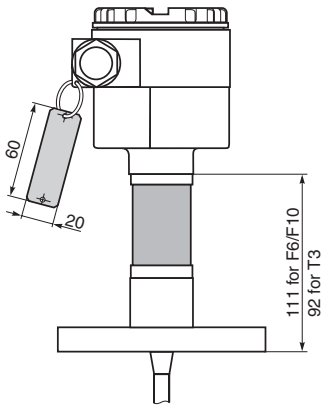
Triclamp Coupling 2"
Triclamp Coupling 1$^1/_2$"
Triclamp Coupling 1"



Sanitary thread DN 50



Options:
- Corrosion-resistant steel tag
- Temperature spacer



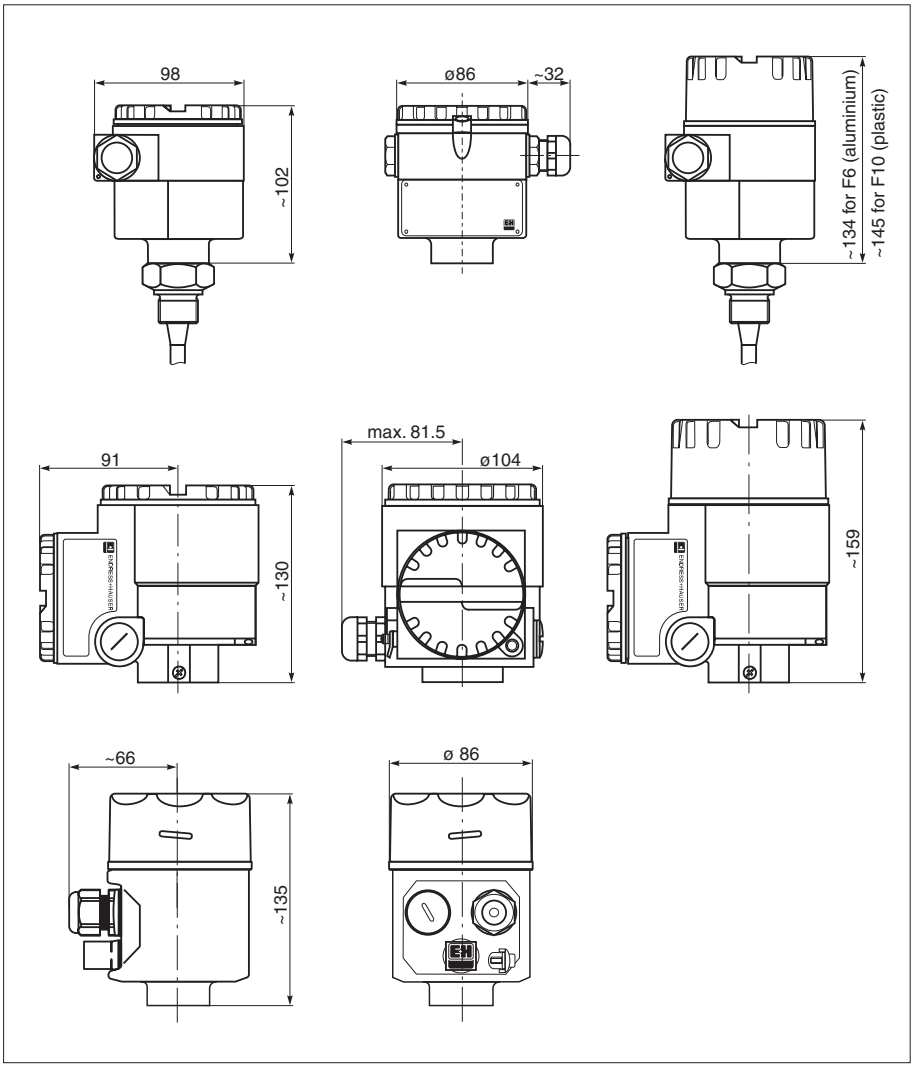
Housing Dimensions

Top row:
Housings in aluminium (type F6) or plastic (type F10, formerly F7)

Bottom row:
Housings in aluminium (type T3) with separate connection compartment;
- with RFI filter for small electronic inserts EC 17 Z, EC 61 Z EC 37 Z, EC 47 Z, EC 11 Z, EC 72 Z
- with RFI filter and terminal connection module for FEC 12 (EEx ia)
- with RFI filter and safety barriers for FEC 12 (EEx d)
- terminal connection module for FEC 22

Both housings:
- with low cover for small electronic inserts EC .. Z,
- with raised cover for electronic inserts FEC 12, FEC 22; with two cable entries, one sealed with a blind plug

Stainless steel housing (type F8) for electronic inserts EC .. Z/FEC .. , with two cable entries, one sealed with a blind plug.



Technical Data

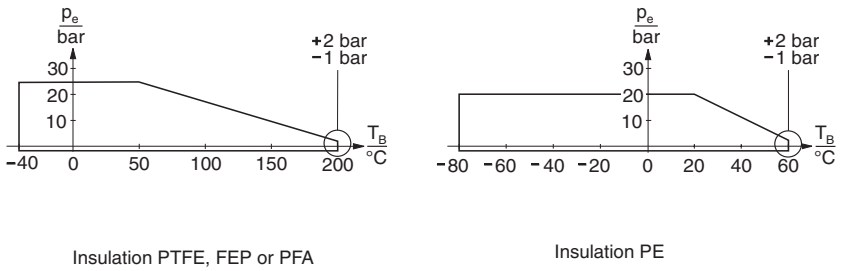
General Information

Manufacturer	Endress+Hauser GmbH+Co. D-79689 Maulburg, Germany
Instrument family	Multicap T
Instrument types	DC 12 TE, DC 11, 16, 21, 26 TEN / TES
Function	Probes for capacitive level measurement and limit detection

Operating data

Operating pressure	max. 25 bar depending on material - see below
Operating temperature	max. 200 °C depending on material - see below
Lateral load on probe rod	DC 12 TE: 30 Nm at 20 °C, static DC 11, 16: 15 Nm at 20 °C, static
Max. tension on probe rope	200 N at 20 °C, static

Permitted operating pressures p_e and operating temperatures T_B



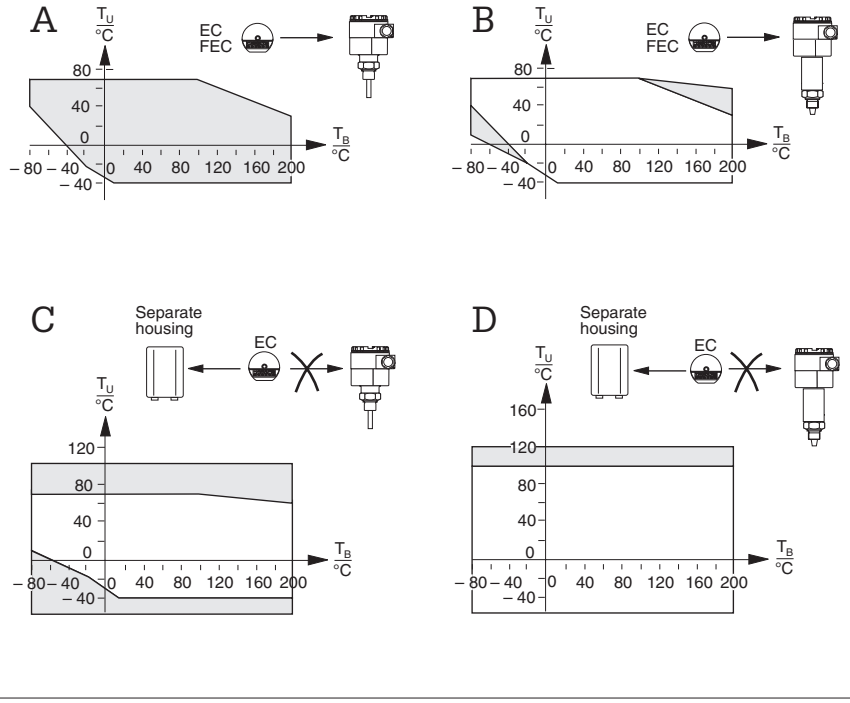
Insulation PTFE, FEP or PFA

Insulation PE

Mounting of the electronic insert as a function of operating temperature T_B and ambient temperature T_U:
A Basic probe
B Probe with temperature spacer
C Electronic insert in separate housing
D Probe with temperature spacer and electronic insert in separate housing

The graphs A and B apply to **all** electronic inserts

The graphs C and D apply to the small electronic inserts
EC 17 Z, EC 61 Z,
EC 37 Z, EC 47 Z
EC 11 Z, EC 72 Z



Probe Lengths

Total length of rod probe	min. 100 mm, max. 3000 mm, see dimensions
Total length of rope probe	min. 350 mm, max. 20000 mm, see dimensions

Capacitance values of the probe

Basic capacitance:	approx. 30 pF
Temperature spacer:	approx. 5 pF
Active build-up compensation:	< 10 pF

Operating data (continued)

Additional capacitances

Probe 250 mm from a conductive vessel wall	Probe rod: approx. 1.3 pF/100 mm in air Probe rope: approx. 1.0 pF/100 mm in air	
Insulated probe rod in water:	approx. 38 pF/100 mm DC TE approx. 50 pF/100 mm DC 11 TEN/TES	
Insulated probe rope in water:	approx. 20 pF/100 mm	
Rod probe with ground tube	insulated probe rod	in air approx. 6,4 pF/100 mm in water approx. 50 pF/100 mm
	uninsulated probe rod	in air approx. 5,6 pF/100 mm

Probe Lengths for continuous measurement in conducting liquids

EC with ΔC_{max} = 2000 pF (EC 47 Z, EC 72 Z, FEC 12)	Rope probe up to 8000 mm (up to 20000 mm in non conducting liquids) Rod probe up to 3000 mm
EC with ΔC_{max} = 4000 pF (EC 37 Z, EC 11 Z)	Rope probe up to 20000 mm Rod probe up to 3000 mm

Accuracy:

Length tolerances	up to 1 m: +0 mm, - 5 mm rod probe/ -10 mm rope probe up to 3 m: +0 mm, - 10 mm rod probe/ -20 mm rope probe up to 6 m: +0 mm, - 30 mm up to 20 m: +0 mm, - 40 mm
The following specifications apply to **fully insulated** probes operating in **conducting** liquids	
Linearity error	< 1 % for 1 m **
Temperature dependence of the probe rod	< 0,1 % per K DC 12 TE ** < 0,12 % per K DC 11 TE **
Pressure dependence of the probe rod	0,12…0,34 % per bar **
Temperature dependence of the probe rope	< 0,1 % per K **
Pressure dependence of the probe rope	< 0,1 % per bar **
**** Error in non-conducting materials insignificant**	

Process Connections

Parallel thread G ¾ A or G 1 A	DIN ISO 228/I, with sealing ring 27x32 or 33x39 to DIN 7603
Tapered thread ¾ - 14 NPT or 1 - 11 ½ NPT	ANSI B 1.20.1
DIN flanges without raised face	DIN 2527, Form B
DIN flanges with tongue	DIN 2512, Form F
DIN flanges with groove	DIN 2512, Form N
ANSI flanges	ANSI B 16.5
Sanitary thread	DIN 11851
Triclamp coupling	ISO 2852

Operating data (Continued)

Materials

Aluminium housing (F6, T3)	GD-Al Si 10 Mg, DIN 1725, plastic coated (blue/grey)
Plastic housing (F10)	fibre-glass reinforced polyester (blue/grey)
Sainless steel housing (F8)	stainless steel 1.4301 (AISI 304), unvarnished
Seal for housing cover	type F6, T3 housings: O-ring in EPDM (elastomer) type F10 housing: O-ring in silicone rubber type F8 housing: profiled O-ring in silicone
Cable gland IP 66 for cable entry Pg 16	Polyamide with neoprene CR seal for cable diameter 7...12 mm; ambient temperature up to 80°C
Sealing ring for process connection G $^3/_4$ A or G 1 A	Elastomer-fibre, asbestos-free, resistant to oils, solvents, steam, weak acids and alkalis; up to 300°C and 100 bar
Temperature spacer	Stainless steel SS 304 (1.4301) or similar
Probe rod, ground tube process connection, screening, build-up compensation, tensioning weight for rope probe	AISI 316L (1.4435)
Probe rope	AISI 316 (1.4401)
Further material specifications	see Product Structure on Page 14...18

Product Structure

DC 12 TE **Multicap T DC 12 TE**
Rod probe for standard applications

Basic weight 1,2 kg including ¾“ process connection and F10 housing

Certificate

A	For non-hazardous areas		
B	ATEX II 1/2 G	EEx ia IIC T6	
D	For non-hazardous areas		Overspill protection to WHG
E	ATEX II 2 G	EEx d [ia] IIC T6	
F	ATEX II 1/2 G	EEx ia IIC T6	Overspill protection to WHG
K	FM XP	Class I, Div. 1, Groups A-D	
R	CSA XP	Class I, Div. 1, Groups B-D	
Y	Special version		
1	ATEX II 2 G	EEx d (ia) IIB T6	
2	ATEX II 1/2 G	EEx ia IIB T6	Overspill protection to WHG
3	ATEX II 1/2 G	EEx ia IIB T6	
4	ATEX II 2 G	EEx d (ia) IIC T6*	
5	ATEX II 1/2 G	EEx ia IIC T6*	Overspill protection to WHG
6	ATEX II 1/2 G	EEx ia IIC T6*	

*) With note: “Avoid electrostatic charge”

Type of insulation Additional weight

1	Fully insulated probe	
6	Partiall insulated probe	

Length of insulation L2

A	.....mm (75 mm...3000 mm)	partially insulated PTFE	0,1 kg/m
B	.....mm (75 mm...3000 mm)	partially insulated PFA	0,1 kg/m
C	.....mm (75 mm...3000 mm)	partially insulated PE	0,1 kg/m
Y	Special version		
1	Fully insulated probe		

Active length L1, Material

A	.....mm (100 mm...3000 mm)	fully insulated PTFE	1 kg/m
B	.....mm (100 mm...3000 mm)	fully insulated PFA	1 kg/m
C	.....mm (100 mm...3000 mm)	fully insulated PE	1 kg/m
Y	Special version		
1	.....mm (100 mm...3000 mm)	partially insulated	0,9 kg/m

Process connection, Material

A	G ¾ A,	Thread	ISO 228	316L	
B	G 1 A,	Thread	ISO 228	316L	0,1 kg
C	¾” NPT	Thread	ANSI	316L	
D	1” NPT	Thread	ANSI	316L	0,1 kg
E	DN 50 PN 40		DIN 11851	316L	
	Hygienic connection				0,5 kg
F	DN 40-51 (2”)		ISO 2852	316L	
	Tri-Clamp connection				0,5 kg
G	DN 38 (1½“)		ISO 2852	316L	
	Tri-Clamp connection				
H	DN 25 (1”)		ISO 2852	316L	
	Tri-Clamp connection				
L	DN 38 (1½”) removable,		ISO 2852	316L, A3	
	Tri-Clamp connection				
Y	Special version				
5	Flanged process connection			316L	

Flange type, Material

1B	without process flange connection			
1C	DN 25 PN 6 B	DIN 2527	316L	0,6 kg
1D	DN 25 PN 25/40 B	DIN 2527	316L	1,2 kg
1E	DN 32 PN 6 B	DIN 2527	316L	1,0 kg
1F	DN 32 PN 25/40 B	DIN 2527	316L	1,8 kg
1G	DN 40 PN 6 B	DIN 2527	316L	1,2 kg
1H	DN 40 PN 25/40 B	DIN 2527	316L	2,2 kg
1K	DN 50 PN 6 B	DIN 2527	316L	1,4 kg
1L	DN 50 PN 25/40 B	DIN 2527	316L	3,0 kg
2D	DN 25 PN 25/40	DIN 2527	PTFE >316L	1,2 kg
2F	DN 32 PN 25/40	DIN 2527	PTFE >316L	1,8 kg
2H	DN 40 PN 25/40	DIN 2527	PTFE >316L	2,2 kg
2K	DN 50 PN 6	DIN 2527	PTFE >316L	1,4 kg
2L	DN 50 PN 25/40	DIN 2527	PTFE >316L	3,0 kg
3F	DN 32 PN 40 F	DIN 2512	316L	1,8 kg
3H	DN 40 PN 40 F	DIN 2512	316L	2,2 kg
3L	DN 50 PN 40 F	DIN 2512	316L	3,0 kg
4F	DN 32 PN 40 N	DIN 2512	316L	1,8 kg
4H	DN 40 PN 40 N	DIN 2512	316L	2,2 kg
4L	DN 50 PN 40 N	DIN 2512	316L	3,0 kg

Continued Page 15

DC 12 TE - Product designation (first part)

Product Structure (Continued)

Flange type, Material (Continued) — Additional weight

5A	1"	150 lbs,	RF,	ANSI B16.5	316L	0,7 kg
5B	1"	300 lbs,	RF,	ANSI B16.5	316L	1,2 kg
5E	1½"	150 lbs,	RF,	ANSI B16.5	316L	1,3 kg
5F	1½"	300 lbs,	RF,	ANSI B16.5	316L	2,5 kg
5G	2"	150 lbs,	RF,	ANSI B16.5	316L	2,2 kg
5H	2"	300 lbs,	RF,	ANSI B16.5	316L	3,0 kg
6A	1"	150 lbs,	RF,	ANSI B16.5	PTFE >316L	0,7 kg
6B	1"	300 lbs,	RF,	ANSI B16.5	PTFE >316L	1,2 kg
6E	1½"	150 lbs,	RF,	ANSI B16.5	PTFE >316L	1,3 kg
6F	1½"	300 lbs,	RF,	ANSI B16.5	PTFE >316L	2,5 kg
6G	2"	150 lbs,	RF,	ANSI B16.5	PTFE >316Ti	2,2 kg
6H	2"	300 lbs,	RF,	ANSI B16.5	PTFE >316L	3,0 kg
9Y	Special version					

Electronic insert

A	prepared for ECxx electronic insert with low housing cover	
B	with EC 61 Z, 3-wire insert	0,2 kg
C	with EC 11 Z, 3-wire Tx, 33 kHz	0,2 kg
D	with EC 72 Z, 3-wire Tx, 1 Mhz	0,2 kg
E	with EC 17 Z, 2-wire PFM	0,2 kg
G	with EC 37 Z, 2-wire PFM, 33 kHz	0,2 kg
H	with EC 47 Z, 2-wire PFM, 1 MHz	0,2 kg
K	with FEC 12, 2-wire 4-20 mA HART	0,3 kg**+ 0,3 kg
M	with FEC 22, 90…253 V AC, DPDT relay	0,3 kg**+ 0,3 kg
N	with FEC 22, 10…55 V DC, 3-wire PNP	0,3 kg**+ 0,3 kg
P	with FEC 14, PROFIBUS PA	
V	with FEC 14, Local operation FHB 20 and PROFIBUS PA	
Y	Special version	
2	prepared for FECxx electronic insert with raised housing cover	0,3 kg**

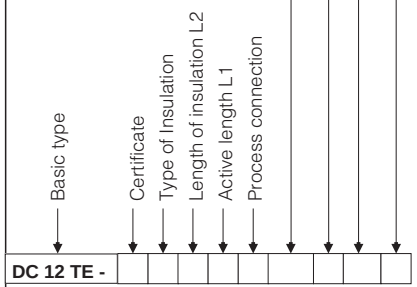
**) Additional weight for raised cover

Housing

A	Polyester	F10 Housing	gland Pg16	IP66	
E	Polyester	F10 Housing	HNA24x1,5	IP66	
F	Aluminium	F6 Housing	HNA24x1,5	IP66	
G	Aluminium	T3 Housing	HNA24x1,5	IP66	
K	Polyester	F10 Housing	gland M20x1,5	IP66	
L	Aluminium	F6 Housing	gland M20x1,5	IP66	
M	Aluminium	T3 Housing	gland M20x1,5	IP66	1,0 kg
N	Aluminium	T3 Housing	PA-plug M12	IP66	1,0 kg
O	316L	F8 Housing	PA-plug M12	IP66	1,0 kg
P	Polyester	F10 Housing	Nema4X, NPT ½"		
R	Aluminium	F6 Housing	Nema4X, NPT ½"		
S	Aluminium	T3 Housing	Nema4X, NPT ¾"		
T	Aluminium	T3 Housing	entry G ½ A	IP66	
Y	Special version				
1	316L	F8 Housing	gland Pg13,5	IP66	
2	316L	F8 Housing	entry G ½"	IP66	
3	316L	F8 Housing	gland M20x1,5	IP66	
4	316L	F8 Housing	entry NPT ½"	IP66	
5	Polyester	F10 Housing	PA-plug M12	IP66	
6	Aluminium	F6 Housing	PA-plug M12	IP66	

Option

1	Basic version	
2	TAG number	
3	Temperature spacer	0,2 kg
4	Temperature spacer and TAG number	0,2 kg
9	Special version	



Complete product designation for DC 12 TE

Please don't forget:

Length of

Partial insulation L2 ☐☐☐☐ mm

Active probe length L1 ☐☐☐☐ mm

Product Structure

DC 11 TEN- MULTICAP T DC 11 TEN
Fully insulated rod probe for standard applications — Basic weight including ¾" process connection and F10 housing, for rope probes with tensioning weight: 1,2 kg

DC 16 TEN- MULTICAP T DC 16 TEN
Partially insulated rod probe for standard applications — 1,2 kg

DC 21 TEN- MULTICAP T DC 21 TEN
Fully insulated rope probe for standard applications — 1,4 kg

DC 26 TEN- MULTICAP T DC 26 TEN
Partially insulated rope probe for standard applications — 1,4 kg

DC 11 TES- MULTICAP T DC 11 TES
Fully insulated rod probe with protection features — 1,2 kg

DC 16 TES- MULTICAP T DC 16 TES
Partially insulated rod probe with protection features — 1,2 kg

DC 21 TES- MULTICAP T DC 21 TES
Fully insulated rope probe with protection feature — 1,4 kg

DC 26 TES- MULTICAP T DC 26 TES
Partially insulated rope probe with protection features — 1,4 kg

Certificate

A	For non-hazardous areas		
B	ATEX II 1/2 G	EEx ia IIC T6	
D	For non-hazardous areas	Overspill protection to WHG	
E	ATEX II 2 G	EEx d (ia) IIC T6	
Y	Special version		
1	ATEX II 2 G	EEx d (ia) IIB T6	
3	ATEX II 1/2 G	EEx ia IIB T6	
4	ATEX II 2 G	EEx d (ia) IIC T6*	
6	ATEX II 1/2 G	EEx ia IIC T6*	

*) With note: "Avoid electrostatic charge"

Build-up protection — Additional weight

DC 11, 16, 21, 26 TEN

A	Protection feature not selected	

DC 11, 16, 21, 26 TES

B	100 mm active guard	0,2 kg
C	150 mm L3 screening	0,2 kg
D	250 mm L3 screening	0,3 kg
E	500 mm L3 screening	0,6 kg
F	.....mm (100 mm...1500 mm) L3 screening	1,2 kg/m
G	150 mm L3 screening and 100 mm active guard	0,4 kg
H	250 mm L3 screening and 100 mm active guard	0,5 kg
K	500 mm L3 screening and 100 mm active guard	0,9 kg
L	.....mm (100 mm...1500 mm) L3 screening and 100 mm active guard	1,7 kg/m + 0,2 kg
Y	Special version	

Probe insulation

DC 11 TEN/TES, DC 21 TEN/TES

1	Fully insulated probe	

DC 16 TEN/TES

A	.....mm (75 mm...3000 mm)	partially insulated PTFE	0,06 kg/m

DC 26 TEN/TES

D	rope type; 2,5 mm	

9	Special version	

Active length L1, Material

DC 11 TEN/TES

1	.....mm (100 mm...3000 mm)	316L+PTFE	0,5 kg/m
2	.....mm (100 mm...3000 mm) with ground tube	316L+PTFE	1,2 kg/m

DC 16 TEN/TES

1	.....mm (100 mm...3000 mm)	Rod 316L	0,4 kg/m
2	.....mm (100 mm...3000 mm) with ground tube	Rod 316L	1,1 kg/m

DC 21 TEN/TES

1	.....mm (100 mm...20000 mm) tensioning weight with anchor hole	316+FEP	0,04 kg/m

DC 26 TEN/TES

1	.....mm (100 mm...20000 mm)	316+FEP	0,03 kg/m

9	Special version

Continued Page 17

DC . . TE . - Product designation (first part)

Product Structure (Continued)

Process connection, Material — Additional weight

A	G ¾ A	Thread	ISO 228	316L	
B	G 1 A	Thread	ISO 228	316L	0,1 kg
C	¾" NPT	Thread	ANSI	316L	
D	1" NPT	Thread	ANSI	316L	0,1 kg
E	DN 50 PN 40		DIN 11851	316L	
	Hygienic connection				0,5 kg
F	DN 40-51 (2")		ISO 2852	316L	
	Tri-Clamp connection				0,5 kg
Y	Special version				
5	Flanged process connection			316L	

Flange type, Material

1B	without process flange connection				
1C	DN 25 PN 6 B		DIN 2527	316L	0,6 kg
1D	DN 25 PN 25/40 B		DIN 2527	316L	1,2 kg
1E	DN 32 PN 6 B		DIN 2527	316L	1,0 kg
1F	DN 32 PN 25/40 B		DIN 2527	316L	1,8 kg
1G	DN 40 PN 6 B		DIN 2527	316L	1,2 kg
1H	DN 40 PN 25/40 B		DIN 2527	316L	2,2 kg
1K	DN 50 PN 6 B		DIN 2527	316L	1,4 kg
1L	DN 50 PN 25/40 B		DIN 2527	316L	3,0 kg
2D	DN 25 PN 25/40		DIN 2527	PTFE >316L	1,2 kg
2F	DN 32 PN 25/40		DIN 2527	PTFE >316L	1,8 kg
2H	DN 40 PN 25/40		DIN 2527	PTFE >316L	2,2 kg
2K	DN 50 PN 6		DIN 2527	PTFE >316L	1,4 kg
2L	DN 50 PN 25/40		DIN 2527	PTFE >316L	3,0 kg
3F	DN 32 PN 40 F		DIN 2512	316L	1,8 kg
3H	DN 40 PN 40 F		DIN 2512	316L	2,2 kg
3L	DN 50 PN 40 F		DIN 2512	316L	3,0 kg
4F	DN 32 PN 40 N		DIN 2512	316L	1,8 kg
4H	DN 40 PN 40 N		DIN 2512	316L	2,2 kg
4L	DN 50 PN 40 N		DIN 2512	316L	3,0 kg
5A	1" 150 lbs,	RF,	ANSI B16.5	316L	0,7 kg
5B	1" 300 lbs,	RF,	ANSI B16.5	316L	1,2 kg
5E	1½" 150 lbs,	RF,	ANSI B16.5	316L	1,3 kg
5F	1½" 300 lbs,	RF,	ANSI B16.5	316L	2,5 kg
5G	2" 150 lbs,	RF,	ANSI B16.5	316L	2,2 kg
5H	2" 300 lbs,	RF,	ANSI B16.5	316L	3,0 kg
6A	1" 150 lbs,	RF,	ANSI B16.5	PTFE >316L	0,7 kg
6B	1" 300 lbs,	RF,	ANSI B16.5	PTFE >316L	1,2 kg
6E	1½" 150 lbs,	RF,	ANSI B16.5	PTFE >316L	1,3 kg
6F	1½" 300 lbs,	RF,	ANSI B16.5	PTFE >316L	2,5 kg
6G	2" 150 lbs,	RF,	ANSI B16.5	PTFE >316Ti	2,2 kg
6H	2" 300 lbs,	RF,	ANSI B16.5	PTFE >316L	3,0 kg

only DC 11, 16 TEN/TES and DC 21 TEN

7A	10 K 25 A	RF,	JIS B2210	316L
7B	10 K 40 A	RF,	JIS B2210	316L
7C	10 K 50 A	RF,	JIS B2210	316L
7D	10 K 80 A	RF,	JIS B2210	316L
7L	10 K 100 A	RF,	JIS B2210	316L
8A	10 K 25 A	RF,	JIS B2210	PTFE >316L
8B	10 K 40 A	RF,	JIS B2210	PTFE >316L
8C	10 K 50 A	RF,	JIS B2210	PTFE >316L
8D	10 K 80 A	RF,	JIS B2210	PTFE >316L
8L	10 K 100 A	RF,	JIS B2210	PTFE >316L

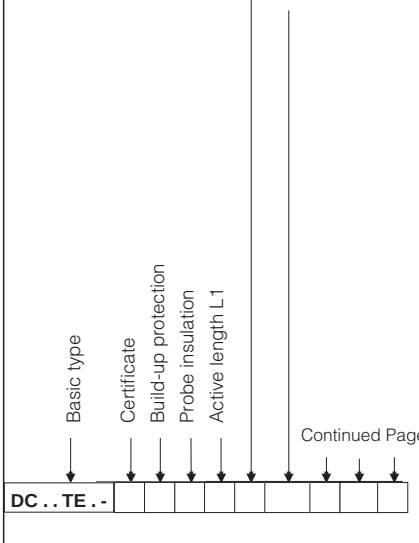
DC 21 TES

7C	10 K 50 A	RF,	JIS B2210	316L
8A	10 K 25 A	RF,	JIS B2210	PTFE >316L

DC 26 TEN/TES

7A	10 K 25 A	RF,	JIS B2210	316L
7C	10 K 50 A	RF,	JIS B2210	316L
8A	10 K 25 A	RF,	JIS B2210	PTFE >316L

9Y Special version



Product designation (second part)

Electronic insert Additional weight

A	prepared for ECxx electronic insert with low housing cover	
B	with EC 61 Z, 3-wire insert	0,2 kg
C	with EC 11 Z, 3-wire Tx, 33 kHz	0,2 kg
D	with EC 72 Z, 3-wire Tx, 1 Mhz	0,2 kg
E	with EC 17 Z, 2-wire PFM	0,2 kg
G	with EC 37 Z, 2-wire PFM, 33 kHz	0,2 kg
H	with EC 47 Z, 2-wire PFM, 1 MHz	0,2 kg
K	with FEC 12, 2-wire 4-20 mA HART	0,3 kg**+ 0,3 kg
M	with FEC 22, 90…253 V AC, DPDT relay	0,3 kg**+ 0,3 kg
N	with FEC 22, 10…55 V DC, 3-wire PNP	0,3 kg**+ 0,3 kg
P	with FEC 14, PROFIBUS PA	
V	with FEC 14, Local operation FHB 20 and PROFIBUS PA	
Y	Special version	
2	prepared for FECxx electronic insert with raised housing cover	0,3 kg**

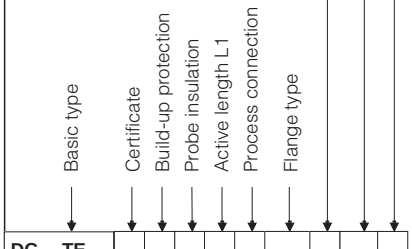
**) Additional weight for raised cover

Housing

A	Polyester	F10 Housing	gland Pg16	IP66	
E	Polyester	F10 Housing	HNA24x1,5	IP66	
F	Aluminium	F6 Housing	HNA24x1,5	IP66	
G	Aluminium	T3 Housing	HNA24x1,5	IP66	
K	Polyester	F10 Housing	gland M20x1,5	IP66	
L	Aluminium	F6 Housing	gland M20x1,5	IP66	
M	Aluminium	T3 Housing	gland M20x1,5	IP66	1,0 kg
N	Aluminium	T3 Housing	PA-plug M12	IP66	1,0 kg
O	316L	F8 Housing	PA-plug M12	IP66	1,0 kg
P	Polyester	F10 Housing	Nema4X, NPT ½"		
S	Aluminium	T3 Housing	Nema4X, NPT ¾"		
T	Aluminium	T3 Housing	entry G ½ A	IP66	
Y	Special version				
1	316L	F8 Housing	gland Pg13,5	IP66	
2	316L	F8 Housing	entry G ½"	IP66	
3	316L	F8 Housing	gland M20x1,5	IP66	
4	316L	F8 Housing	entry NPT ½"	IP66	
5	Polyester	F10 Housing	PA-plug M12	IP66	
6	Aluminium	F6 Housing	PA-plug M12	IP66	

Option

1	Basic version	
2	TAG number	
3	Temperature spacer	0,2 kg
4	Temperature spacer and TAG number	0,2 kg
9	Special version	



Complete product designation for DC . . TEN / TES

Please don't forget:

Length of

Screening L3 ☐☐☐☐ mm

Partial insulation L2 ☐☐☐☐ mm

Active probe length L1 ☐☐☐☐☐ mm

Europe

Austria
❑ Endress+Hauser Ges.m.b.H.
Wien
Tel. (0222) 88056-0, Fax (0222) 88056-35

Belarus
Belorgsintez
Minsk
Tel. (0172) 263166, Fax (0172) 263111

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Budapest
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Naarden
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Endress+Hauser Polska Sp. z o.o.
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Portugal
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Romania
Romconseng SRL
Bucharest
Tel. (01) 4101634, Fax (01) 4101634

Russia
Avtomatika-Sever Ltd.
St. Petersburg
Tel. (0812) 5550700, Fax (0812) 5561321

Slovak Republic
Transcom technik s.r.o.
Bratislava
Tel. (7) 52131 61, Fax (7) 52131 81

Slovenia
Endress+Hauser D.O.O.
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Buenos Aires
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Tel. (02) 840748

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Ciudad de Guatemala, C.A.
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Asuncion
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Hong Kong
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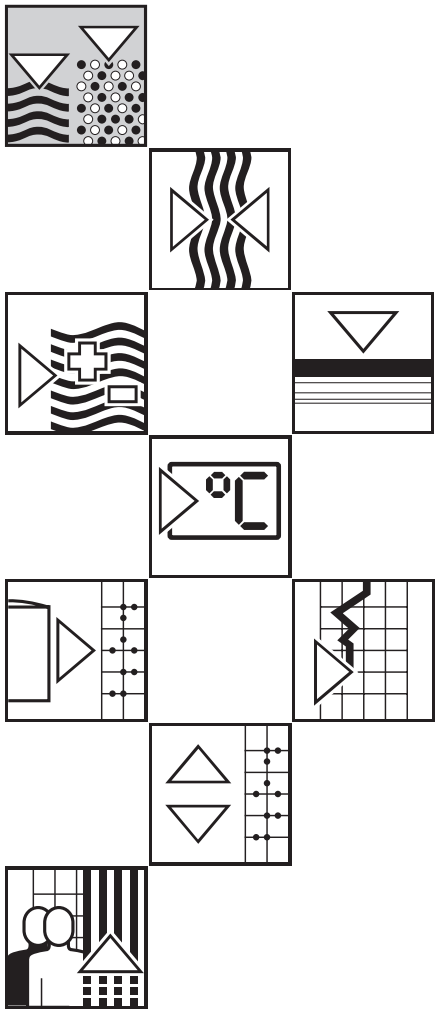
BA 158F/00/en/06.03
016705-1000
CCS/CV8

016705- 1000

BA 148F/00/en/07.95 (b)
Software Version 1.x
Part No. 016700-1000

Electronic insert FEC 12 with HART Protocol Level Measurement

Operating Instructions



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The Power of Know How

Short Instructions

The short instructions are intended for trained personnel who have read and understood the operating instructions in this manual. They allow a quick standard calibration of the electronic insert using the its own operating elements. A detailed description of calibration and operation is given in Sections 3 - 5.

Abb. 1
Short instructions for calibrating the FEC 12 electronic insert using its own operating elements

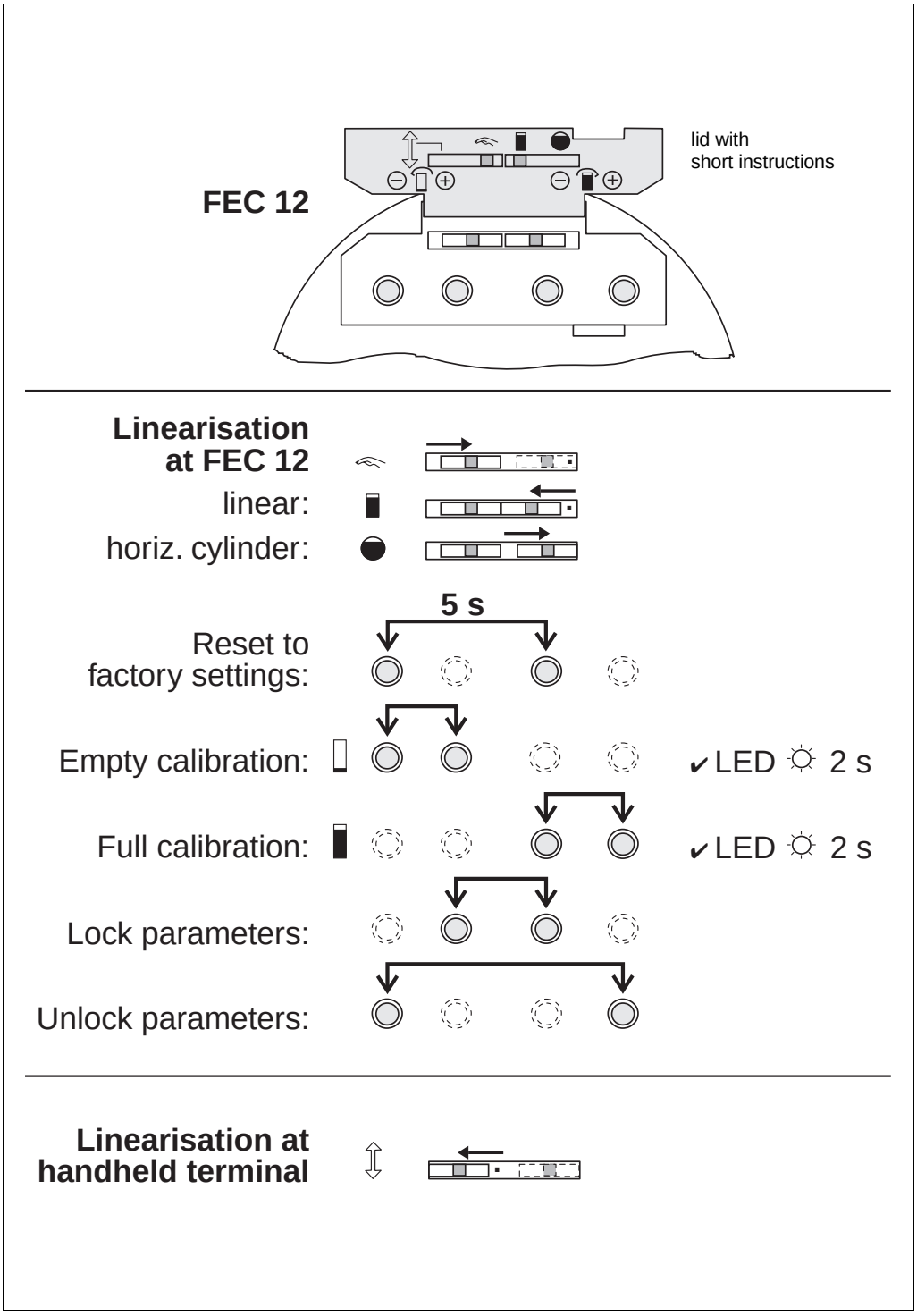


Table of Contents

Supplementary documentation

In addition to these operating instructions, the following documentation is also available on the use of the FEC 12 electronic insert:
- Technical Information TI 242F/00/e: Multicap Probes DC ... E
- Technical Information TI 243F/00/e: Multicap Probes DC ... A
- Technical Information TI 240F/00/e: Multicap Probes DC ... T
- Operating instructions for the HART handheld terminal DXR 275

Notes on Safety

Approved usage

The electronic insert FEC 12 may be used for level measurement in connection with capacitive Multicap probes only. It has been designed to operate safely in accordance with current technical and safety standards and must be installed by qualified personnel according to the instructions in this manual.

The manufacturer accepts no responsibility for any damage arising from incorrect use, installation or operation of the equipment. Changes or modifications to the equipment not expressly approved in the operating instructions or by the bodies responsible for compliance may make the user's authority to use the equipment null and void. Damaged instruments which may be a safety hazard must not be operated and are to be marked as defective.

Use in hazardous areas

When used in explosion hazardous areas, the equipment must be installed in accordance with local regulations as well as with the technical and safety requirements on the measuring point as specified in the accompanying certificate.

Installation, commissioning and operation

Installation, electrical connection, commissioning, operation and maintenance may be carried out by trained and authorised personnel only. The operating instructions must have read and understand before the equipment is installed: instructions are to be followed exactly.

Safety Conventions

In order to highlight safety-relevant procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.

Note!

Note!
A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.

Caution!

Caution!
A caution indicates actions or procedures which, if not performed correctly, may lead to personal injury or incorrect function of the instrument.

Warning!

Warning!
A warning indicates actions or procedures which, if not performed correctly, may lead to personal injury, a safety hazard or destruction of the instrument.

1 Introduction

1.1 Application

The FEC 12 electronic insert is a transmitter for capacitive level measurement. It converts changes in capacitance resulting from changes in level into a capacitance-proportional impressed current. In vessels with a uniform cross section, the level or quantity (volume) can be thus displayed as a percentage of full level or, if a handheld terminal is used, in technical units. A pre-stored linearisation program also allows volumes to be measured in horizontal cylinders.

The FEC 12 electronic insert is installed in the housing of the Multicap probe. It can be used for applications in explosion hazardous areas.

Versions

Versions with corresponding features
Two versions of the FEC 12 electronic insert are available:
- With HART protocol to be used with the Universal HART Communicator (described in these operating instructions) and
- With INTENSOR protocol to be used with the Commulog VU 260 Z (see operating instructions BA 149F/00/e).
  The version with the INTENSOR protocol can also be used for communication with the Silometer FMX 770.

Features

- Analogue output signal: standard 4...20 mA current.
- Easy on-site settings: Settings "empty calibration" (= 4 mA) and "full calibration" (= 20 mA) using pushbuttons on the electronic insert.
- Operates with a linear characteristic as well as with a stored linearisation curve for horizontal cylinders.
- The adjustable integration time ensures stable measured values even with agitated materials.

1.2 Measuring System

The measuring system consists of a capacitive Multicap level probe and an FEC 12 electronic insert. A DC power supply is also required. The two-wire power cable is also used for signal transmission, and delivers a 4...20 mA signal with a superimposed bidirectional digital signal conforming to the HART protocol. The superimposed signal has no influence on the follow-up instrumentation.

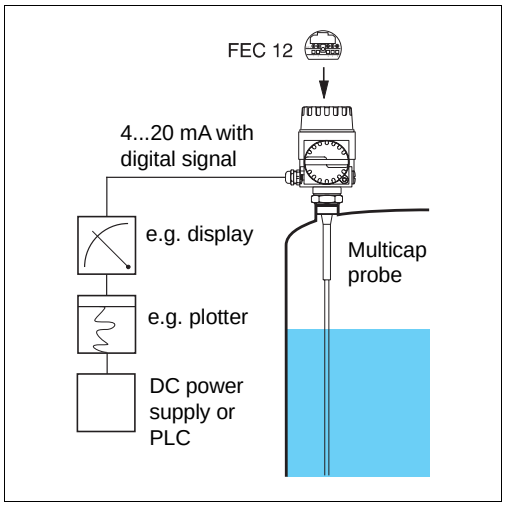


Fig. 2
Measuring system: the electronic insert is used in a Multicap probe for capacitive measurement.

1.3 Operating Principle

Capacitive measurement functions as follows: the probe and vessel wall form a capacitor. Depending on the level, the space between these "capacitor plates" is filled either with air (empty vessel) or an unspecified quantity of material. The initial capacitance for the empty vessel is low but increases proportionally to the amount of material covering the probe.

2 Installation

This section describes the electrical connection of the electronic insert. See Section 6 for instructions on replacing the electronic insert.

2.1 Electrical Connection

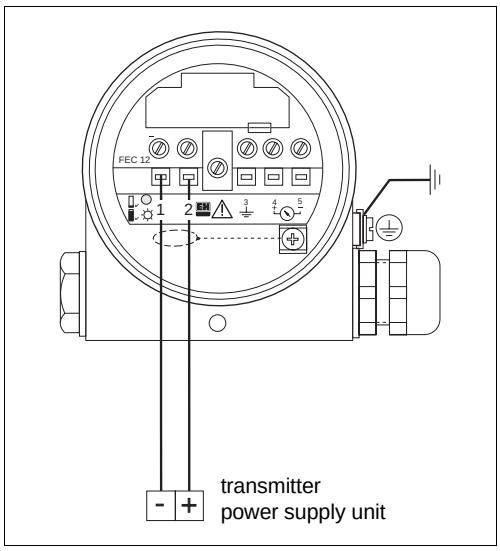


Fig. 3
Connecting the FEC 12 electronic insert to the power supply

Insert the power cable through the cable entry on the probe housing. Unscreened or general purpose multi-core cable can be used as the connecting cable. If strong electromagnetic interference occurs due to, e.g. machinery or radios, then screened cable, grounded at the probe end, should be used. Connect the screening to the ground terminal on the probe housing.

The power cable is connected to Terminals 1 - and 2 + of the electronic insert. The electronic insert has built-in polarity protection. The black ground wire in the probe is always connected to Terminal 3.


Warning!

Warning!
- When using the probe in explosion-hazardous areas, ensure that the type and routing of the intrinsically safe power and signal line is in accordance with the certificate and local regulations.
- See the certificate of conformity for maximum permissible values for capacitance and inductance.


Note!

Note!
After connection, ensure that the cover is screwed down securely and that the cable gland of the probe housing is screwed tight.

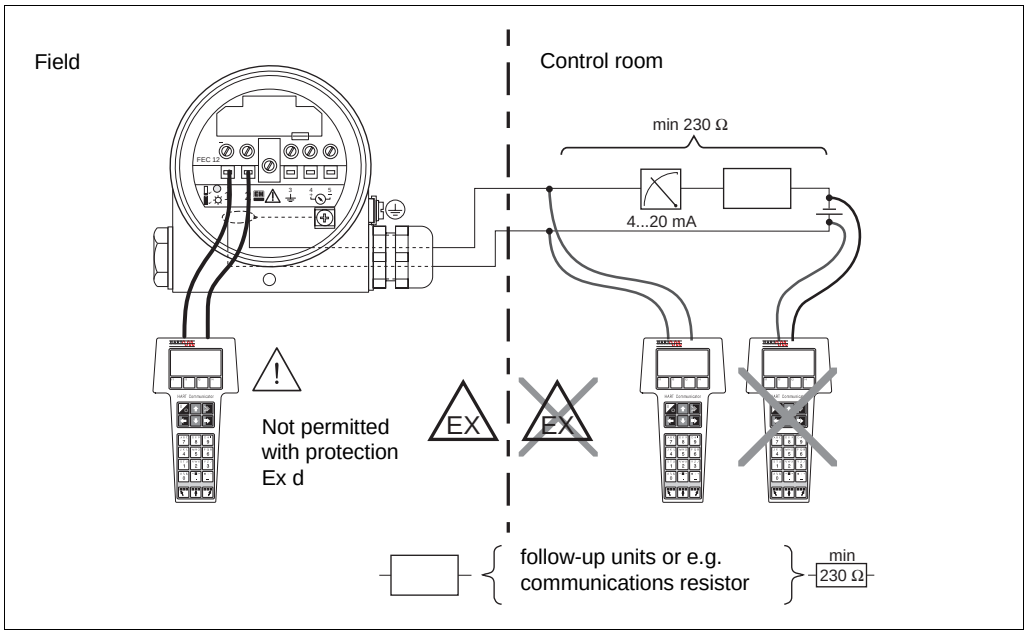


Fig. 4
Connecting the handheld terminal to the load or power cable

Load for handheld terminal

A load should be connected into the power cable when connecting a handheld terminal. The handheld terminal can now be connected at any point along the power cable for communication with the electronic insert. The size of the load is given in the following table.

FEC 12 electronic insert	Load resistance minimum	Load resistance maximum (U_B=30V)
Version HART	230 Ω	720 Ω
Without communication	0 Ω	720 Ω

Maximum cable length: 1000 m.
Maximum capacitance for screened cabling: 100 nF.

2.2 Technical Data

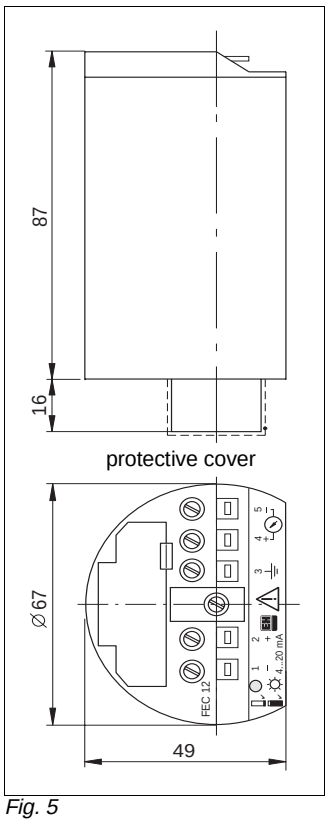


Fig. 5
Construction and dimensions of the FEC 12 electronic insert

Construction

Weight : approx. 170 g
Housing: plastic, potted electronics,
Colour: light grey RAL 7035, protection to DIN 40050: IP 20

Power Supply

Interlock diode with jumper: 13.0 V ... 30 V,
With Interlock diode: 13.8 V ... 30 V
for Ex d with Zener diode module: 13.8 V ... 30 V
Permissible superimposed AC voltage (50 Hz ... 400 Hz): 100 mV_{pp}
Without communication: 3 % of power supply voltage,
No understepping of minimum voltage!
Integrated polarity protection
Current consumption 3.8 ... 22 mA

Load

Load for HART: 230 ... 720 Ω,
Without communication: 0 ... 720 Ω

Capacitance Ranges

Initial capacitance (‘offset’) for empty vessel
(probe free): 0 pF ... 350 pF
Change in capacitance (‘span’) for full vessel
(probe covered): 10 pF ... 2000 pF
Total capacitance resulting from initial capacitance plus
change in capacitance: maximum 2000 pF

Analogue Output

Output signal: superimposed direct current
for initial capacitance: 4 mA
for total capacitance: 20 mA
Resolution: 14 µA
Alarm signal for error indication (can be switched off):
22 mA ± 0.1 mA, to NAMUR

Output damping

Adjustable time constant: 0 ... 40 s
Factory set: 1 s

Accuracy

Output current from power supply voltage:
smaller than 0.05 % / V of full scale value at 24 V
Output current from load:
smaller than 0.1 % / 100 Ω of full scale value at 24 V

Communication Interface

Type of signal: quasi-sine curve superposed on measuring current without DC component

Additional Signal Output

With Interlock diode: for ammeter

Environmental Conditions

According to DIN 40040, HOE, condensation not permitted
Permitted ambient temperature:
Nominal operating range: 0 ... +70 °C
Limiting operating range: -20 ... +80 °C
Storage temperature: -40 ... +85 °C
Protection against electrostatic build-up: up to 15 kV
RFI immunity (depending on type of housing): up to 10 V/m
Electromagnetic Compatibility:
Interference Emission to EN 61326; Electrical Equipment Class B
Interference Immunity to EN 61326; Annex A (Industrial) and
NAMUR Recommendation EMC (NE 21)

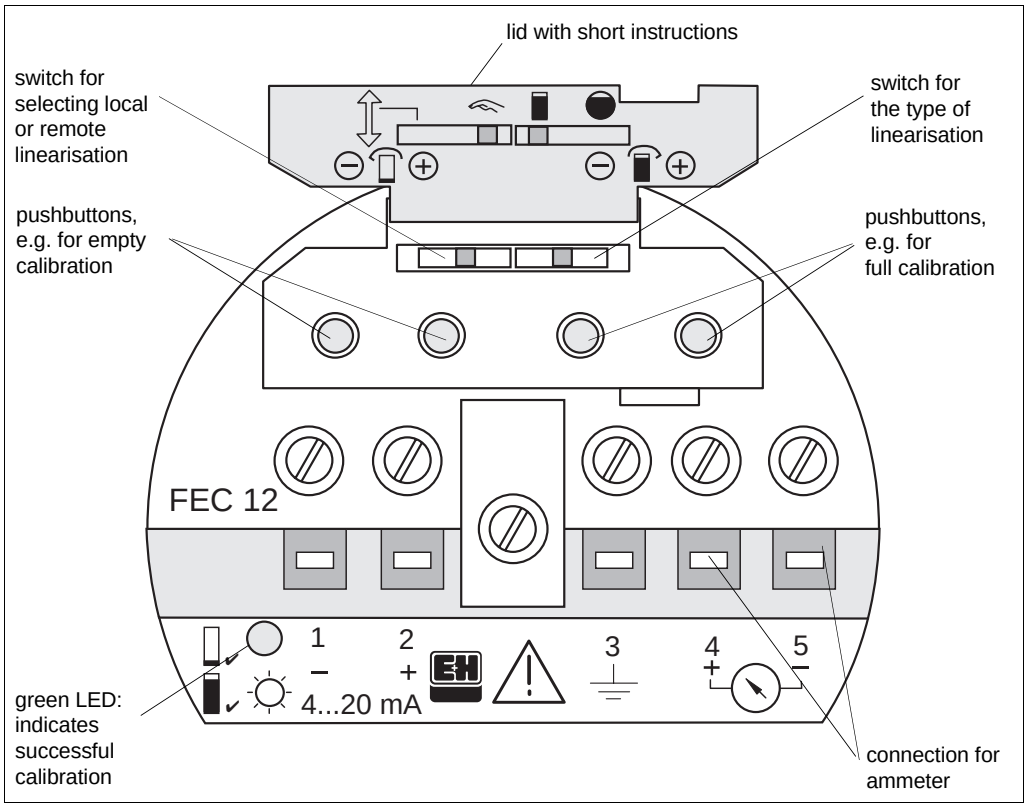
3 Operating Elements

This Section describes the operating elements of the electronic insert. It also describes the menu structure of the HART protocol used with the Universal HART Communicator DXR 275.

3.1 FEC 12 Electronic Insert

The operating elements of the electronic insert are protected by a cover. This can be raised by inserting a small screwdriver into a slit at the edge. The inside of the cover has symbols printed on it that serve as a quick operating manual.

Fig. 6
Operating elements on the FEC 12 electronic insert



Switches

The lefthand switch selects whether the linearisation is to be carried out remotely with the handheld terminal or locally with the FEC 12 operating elements. If linearisation at the FEC 12 is required, then one of two stored linearisation modes in the electronic insert is activated (vertical vessel with linear characteristics or horizontal cylinder) at the righthand switch.

Pushbuttons

Calibration, locking and reset to factory-set values are carried out at the FEC 12 by using the four pushbuttons (see Section 4).

Basic Operation:
The pushbuttons marked with (+) increase current and those marked (-) decrease current. Punching the pushbuttons produces a step-wise change. The smallest resolution possible is 0.014 mA. If the pushbutton is pressed continuously, then the current also changes continuously until the pushbutton is released. The change begins slowly and gradually increases in speed and so quickly passes through a wide range. Just before reaching the value required, the pushbutton should be released and the procedure completed by punching the pushbutton for fine resolution. If the value required is overrun, then correct for it by pressing the pushbutton for the other direction.

3.2 HART Communicator DXR 275

When the lefthand switch is set to remote linearisation (arrow symbol), the FEC 12 electronic insert can be calibrated using the HART Communicator handheld terminal. The terminal communicates with the electronic insert over the power/signal cable. The operating manual for the HART Communicator describes its operation. Some knowledge of operating the HART Communicator is assumed for the following section.

Note!
When calibrating the FEC 12 electronic insert, the following sections will assume the operating steps given below. They apply to all instructions and will, therefore, no longer be given in this manual:

- First step: Move from the "MATRIX GROUP SEL." menu to the next higher menu with the → arrow key.
- Last step: Return to the "Online" menu with F3 [HOME].

3.3 HART Menu Structure

All parameters of the FEC 12 can be addressed by the menu structure using the handheld terminal. The following diagram shows the menu structure of the HART protocol for the FEC 12 electronic insert. Each field in the menu structure can be selected using the arrow or numeric keys on the handheld terminal.

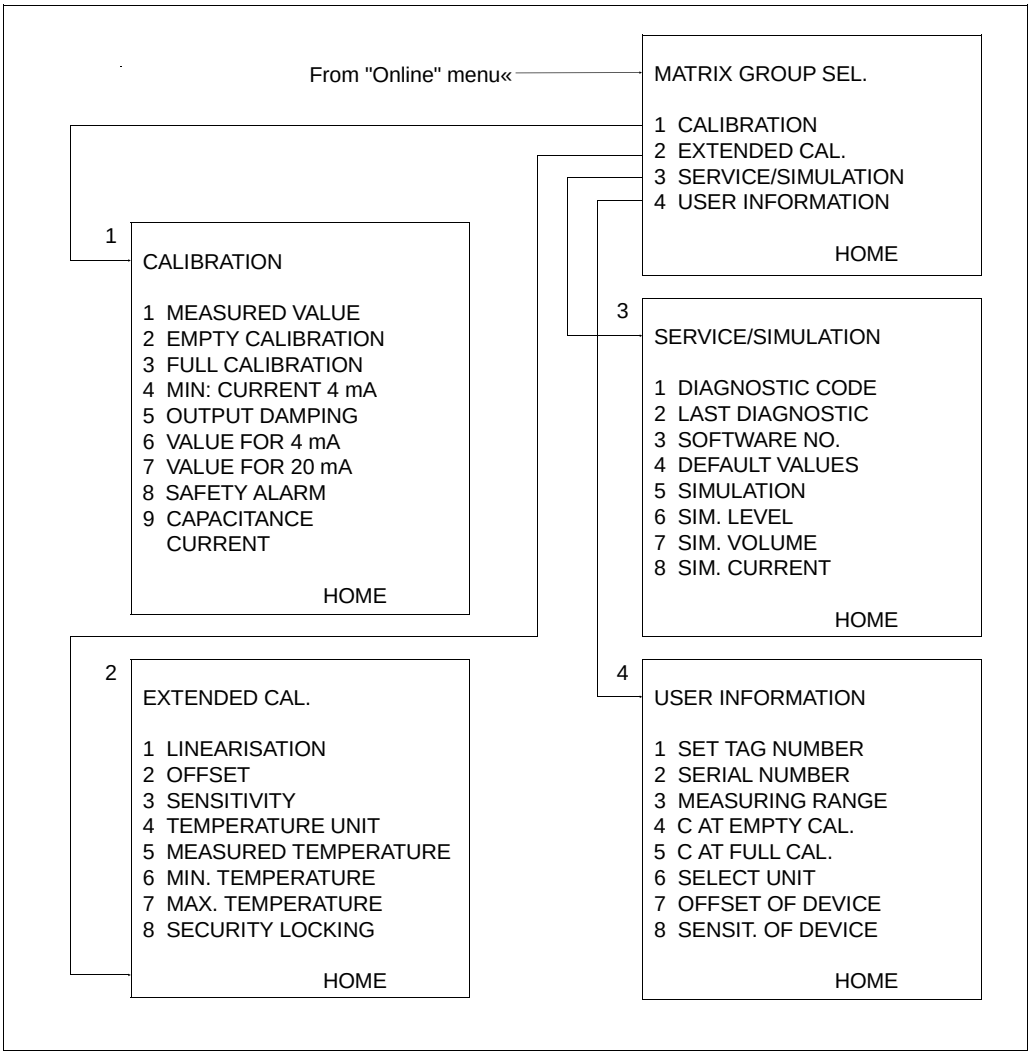


Fig. 7
Menu structure for the HART Communicator handheld terminal

4 Calibrating

This section deals with the basic settings necessary for the electronic insert to convert capacitance values into correct data on level or volume, which can then be shown on a display unit (e.g. meter or handheld terminal).
The electronic insert can carry out basic settings in two ways:

- On site at the electronic insert itself or
- On the handheld terminal.

The initial basic settings can also be carried out locally at the electronic insert and then later with the handheld terminal for, e.g. setting the type of linearisation (Note: the electronic insert must not be locked).

Note!
- After completing calibration the matrix should then be locked (see Section 5.1). After locking, all entries can be called up and displayed but no longer changed.
- The values entered can be written in the table below so that the identical values can again be entered if the electronic insert is replaced. A complete recalibration is not then required (see also Section 6).

4.1 Basic Calibration at the FEC 12 Electronic Insert

The following entries are required for basic calibration of the electronic insert:

- Type of linearisation
- Empty calibration
- Full calibration

Note!
- If an initial calibration is not to be carried out, but instead a recalibration of the system, then a reset the electronic insert first.
- This also applies when it is not clear if the electronic insert is calibrated with factory settings (see following section). Unwanted settings may result and lead to incorrect measured values.

Reset (recall of factory settings)

Press the pushbuttons for empty calibration (-) and for full calibration (-) simultaneously for approx. 5 s. This produces the following factory settings:

Significance	**Factory settings**	Entered values
Empty calibration [%]	0.0	
Full calibration [%]	100.0	
Min. current 4 mA	off	
Output damping [s]	1	
Value for 4 mA [%]	0.0	
Value for 20 mA [%]	100.0	
Safety alarm	max (110 %)	
Linearisation	linear	
Offset [pF]	349.90	
Sensitivity [pF/%]	16.49	
Set tag number	'--------'	
Select unit	%	

Selecting linearisation

Two types of linearisation can be selected:

- Vessel characteristics as linear
- Vessel characteristics as a horizontal cylinder

Use the lefthand switch to select whether linearisation is to be carried out at the electronic insert or by the handheld terminal. If the switch is moved to the right, then linearisation is carried out at the electronic insert. The handheld terminal cannot now change the setting. If the switch is moved to the left, then linearisation must be carried out with the handheld terminal and the switch on the right remains inactive.

Select the type of linearisation for local calibration using the righthand switch. When it is moved to the left, then the level (output current) is proportional to volume, i.e. the cross-section of the vessel should be constant over its entire length. When it is moved to the right, then linearisation is set for a horizontal cylinder, and the measured value supplied corresponds directly to a percent of full volume.

Empty calibration

With the vessel empty (0 %) both pushbuttons on the left (-) and (+) are pressed simultaneously in order to set the signal current to the 4 mA lower value. The green LED lights up to acknowledge that the setting has been accepted. Only when the green LED goes out is the correct current value of 4 mA shown on the ammeter.

Full calibration

With the vessel full (100 %) both pushbuttons on the right (-) and (+) are pressed simultaneously in order to set the signal current to the 20 mA upper value. The green LED lights up to acknowledge that the setting has been accepted. Only when the green LED goes out is the correct value of 20 mA shown on the ammeter.

Alternative procedure: calibration with the vessel almost empty

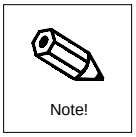
In this case, the level of product in the vessel must be known as accurately as possible and should not be too high. A level which is too high reduces the accuracy of the zero point (corresponding to an empty vessel). An ammeter must be connected to the electronic insert at Terminals 4 - 5.

Assuming that the level is at 15 %, the current value corresponding to a 15% level must now be determined. The lower current value can be varied by pressing the two pushbuttons on the left. The following calculation is used:

① The lower current value (= empty vessel, 0 %) is 4 mA.
② The upper current value (= full vessel, 100 %) is 20 mA.
③ This gives a measuring range (‘span’) of 16 mA for a change from 0 to 100 % or a 0.16 mA increase in current for every 1 % rise in level.
④ For a 15 % level, this is 15 % x 0.16 mA/% or 2.4 mA. This must be added to the 4 mA to give the current value required:
2.4 mA + 4 mA = 6.4 mA
⑤ The value 6.4 mA (check with the ammeter) is set by pressing the two pushbuttons on the left. Pressing pushbutton (+) increases the current and pressing pushbutton (-) decreases the current.

Note!

- No indication is given on the green LED when using this procedure.
- If the operating status is unclear due to an incorrect setting, then all settings should be reset to factory-set values and the basic calibration carried out again.



Alternative procedure: calibration with the vessel almost full

The level of the vessel must be known as accurately as possible and should be as high as possible. A level which is too low reduces the accuracy of the upper point (corresponding to a full vessel). An ammeter must be connected to the electronic insert at Terminals 4 - 5.

Assuming that the level is at 90 %, the current value corresponding to a 90 % level must now be determined. The upper current value can be varied by pressing the two pushbuttons on the right. The following calculation is used:

① The lower current value (= empty vessel, 0 %) is 4 mA.
② The upper current value (= full vessel, 100 %) is 20 mA.
③ This gives a measuring range ('span') of 16 mA for a change from 0 to 100 % or a 0.16 mA increase in current for every 1 % rise in level.
④ For a 90 % level this is 90 % x 0.16 mA/% or 14.4 mA. This must be added to the 4 mA to give the current value required:
14.4 mA + 4 mA = 18.4 mA
(The upper current value can also be used and
10 % x 0.16 mA/% = 1.6 mA is to be subtracted from 20 mA)
⑤ The value 18.4 mA (check with the ammeter) is set by pressing the two pushbuttons on the right. Pressing pushbutton (+) increases the current and pressing pushbutton (-) decreases the current.

Note!
- No indication is given on the green LED when using this variation.
- If the operating status is unclear due to an incorrect setting, then all settings should be reset to factory-set values and the basic calibration carried out again.

Locking the parameters

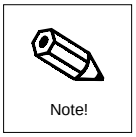
Press simultaneously the pushbutton for empty calibration (+) and the pushbutton for full calibration (-). The settings of the electronic insert can now be called up at any time using the handheld terminal but not changed. This condition is indicated in the handheld terminal by the appearence of the code 9999 in Menu Level 2 "EXTENDED CALIBRATION", Field 8 "SECURITY LOCKING" (see Section 5).

Unlocking the parameters

Press simultaneously the pushbutton for empty calibration (-) and the pushbutton for full calibration (+). All settings of the electronic insert can now be called up and changed using the handheld terminal. This condition is indicated in the handheld terminal by the appearence of the code 12 in Menu Level 2 "EXTENDED CALIBRATION", Field 8 "SECURITY LOCKING" (see Section 5).

4.2 Basic Settings using the HART Communicator DXR 275

The FEC 12 allows calibration in % only. A remote calibration from the handheld allows, e.g. technical units to be displayed. If a recalibration is to be carried out, then a reset should be done first. The parameters of the electronic insert must not be locked, see above!



Note!
When calibrating the FEC 12 electronic insert, the following sections will assume the operating steps given below. They apply to all instructions and will, therefore, no longer be given in this manual:

- First step: Move from the "MATRIX GROUP SEL." menu to the next higher menu with the → arrow key.
- Last step: Return to the "Online" menu with F3 [HOME].

Reset (factory settings)

Step	Entry	Cursor in display at	Significance
1	3	SERVICE/SIMULATION	
2	4	DEFAULT VALUES	
3	12	12	Code number for reset
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value to be transmitted

The factory settings given on reset are shown in the following table:

Menu field	Significance	Factory setting	Values entered
1; 2	EMPTY CALIBRATION [%]	0.0	
1; 3	FULL CALIBRATION [%]	100.0	
1; 4	MIN. CURRENT 4 mA	OFF	
1; 5	OUTPUT DAMPING [s]	1	
1; 6	VALUE FOR 4 mA [%]	0.0	
1; 7	VALUE FOR 20 mA [%]	100.0	
1; 8	SAFETY ALARM	MAX (110 %)	
2; 1	LINEARISATION	LINEAR	
2; 2	OFFSET [pF]	349.90	
2; 3	SENSITIVITY[pF/%]	16.49	
4; 1	SET TAG NUMBER	'--------'	
4; 6	SELECT UNIT	%	

Selecting linearisation

Two vessel characteristics are available: linear or horizontal cylinder

Note!
- The switch on the left on the FEC 12 electronic insert must be moved to the left so that linearisation can be carried out remotely with the handheld terminal.

Step	Entry	Cursor in display at	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	1	LINEARISATION	Selecting linearisation
		e.g. LINEAR	Level is proportional to volume, i.e. the cross-section of the vessel remains constant over the entire distance
3		HORIZ. CYL.	Horizontal cylinder : the measured value directly corresponding to volume
4	F4 [ENTER]		Confirms entry, value to be transmitted

Empty and full calibration

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic calibration
2	2	EMPTY CALIBRATION	Empty calibration
3	0.0	0.0	Vessel is empty, a 4 mA signal is output at the entered level or volume
4	F4 [ENTER]		Confirms entry, value to be transmitted
5	3	FULL CALIBRATION	Full calibration
6	100.0	100.0	Vessel is full, a 20 mA signal is output at the entered level or volume
7	F4 [ENTER]		Confirms entry, value is transmitted

Note!
- You can also calibrate in technical units, see also 4 mA/20 mA value, p 13. In this case, if a horizontal cylinder is selected, the entries must be made in volume units!

4.3 Extended Calibration using the HART Communicator 275

4 mA threshold

The factory settings allow a current range from 3.8 mA to 20 mA and larger. Since a current less than 4 mA could result in unwanted responses by process control systems, it is possible to set a threshold of 4 mA on the current output, below which it cannot fall.

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic calibration
2	4	MIN. CURRENT 4 mA	Current output at minimum 4 mA
		ON	Threshold is at 4.0 mA
3		OFF	Current range begins at 3.8 mA
4	F4 [ENTER]		Confirms entry, value is transmitted

Note!
- At factory setting the 4 mA threshold is switched off

Output damping

The output damping is set in the factory at 1 s and affects the speed at which the current output responds to a change in level. When there is a sudden jump from empty to full in the vessel, after 1 s the current display reaches 63% or 14.08 mA of the set point (1*output damping). After 5 s (5*output damping) it reaches 99 % or 19.84 mA. If a larger output damping is set, then these display times are correspondingly longer.

The output damping can be selected between the range 0 and 40 s. For liquids, the turbulence can cause the display to be unstable. Increasing the output damping with the handheld terminal cancels this effect.

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic setting
2	5	OUTPUT DAMPING 1 s	Setting the output damping (Factory setting 1 s)
3	e.g. 2	2	Sets the output damping to 2 s
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value is transmitted

Value for 4 mA

If another value instead of 0 (= empty vessel) is to be displayed, then the value can be entered here. The units are changed from % in the "SELECT UNIT" menu.

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic setting
2	6	VALUE FOR 4 mA	Value for 4 mA
3	e.g. 20.0	20.0	Value is displayed if the current value is 4 mA
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value is transmitted

Value for 20 mA

If another value instead of 100 (= full vessel) is to be displayed, then the value can be entered here. The units are changed from % in the "SELECT UNIT" menu (see below).

Step	Entry	Cursor in Display at	Significance
1	1	CALIBRATION	Basic setting
2	7	VALUE FOR 20 mA	Value for 20 mA
3	e.g. 80.0	80.0	Value is displayed, if the current value is 20 mA
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value is transmitted

Selecting units

Instead of giving the results in %, the following units may be selected:

Level:	cm	dm	m	inch	ft			
Volume:	l	hl	cm3	dm3	m3	ft3	us_gal	i_gal
Weight:	ton	kg	t	lb.				

Step	Entry	Cursor in display at	Significance
1	4	USER INFORMATION	User information
2	6	SELECT UNIT %	Select units Factory setting
3	↓ e.g.10x	m3	Volume display in m3
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value to be transmitted

5 Entries for the Measuring Point

5.1 Locking/Unlocking Parameters

Locking

The parameters can be locked from the handheld terminal by entering a code number between 1 and 11 or between 13 and 9998: all settings in the electronic insert are protected from being altered. If the code number 9999 is shown in the display, then locking has been activated at the electronic insert by pushbutton.

Step	Entry	Cursor in Display at	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	8	SECURITY LOCKING	Locking
		12	No locking activated
3	e.g. 35	35	Selected code number for locking
4	F4 [ENTER]		Confirms entry, valueis transmitted

With the exception of "SECURITY LOCKING" all fields can be viewed but not changed..

Unlocking

Locking can be again cancelled by entering the code number 12. This does not apply if the locking was activated at the electronic insert. This is indicated by the code number 9999 in the menu field.

Step	Entry	Cursor in Display at	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	8	SECURITY LOCKING	Locking
	e.g. 35	35	Selected code number for locking
3	12	12	Code number for unlocking
4	F4 [ENTER]		Confirms entry, value to be transmitted

5.2 Tag Number

A measuring point number ("SET TAG NUMBER") can be assigned to the electronic insert by using the handheld terminal. This consists of 8 ASCII characters. This measuring point tag serves to identify different electronic inserts connected to the same power line as every electronic insert has to have its own unique tag number.

Step	Entry	Cursor in Display at	Significance
1	4	USER INFORMATION	User information
2	1	SET TAG NUMBER	Locking
3	e.g. LIC10	LIC10	Enter up to 8 characters
4	F4 [ENTER]		Confirms entry, value is transmitted

6 Diagnosis and Troubleshooting

6.1 Alarms

Output on alarm

The following response is set in the factory:
If the FEC 12 detects a fault, then the current output is set to 22 mA (=110 %) to enable process control systems to, e.g. assume a response.

Alarm indication

If no alarm indication is to be given on an alarm, then "CONTINUE" can be set. In this case the FEC 12 continues to measure although the measured value is possibly incorrect.

Step	Entry	Cursor in Display to	Significance
1	1	CALIBRATION	Basic setting
2	8	SAFETY ALARM	Output on alarm
		MAX (110%)	Output jumps to 22 mA (=110 %), factory set
3	↓	CONTINUE	Continue measuring, no alarm indication
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value to be transmitted

6.2 Simulation

Simulation enables the current value coming from the electronic insert to be simulated. It can be used for checking the correct processing of probe signals, e.g. in a process control system. Simulation may also be necessary for tracing faults. No change in level is required to produce a different current value. The various types of simulation

- Level (LEVEL)
- Volume (VOLUME)
- Current (CURRENT)

are independent from one another and therefore none affects the others.

Note!
- If simulation is activated, Warning E 613 is displayed to indicate this.
- The full simulation range is only available with a free probe, only a limited range is possible with a covered probe.
- On completion, switch off simulation again in order to continue normal measurement.

Simulation

Activate simulation as follows:

Step	Entry	Cursor in Display at	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	5	SIMULATION	Simulation
		OFF	Simulation switched off
3	↓	ON	Simulation switched on
4	F4 [ENTER]		Confirms entry, value to be transmitted

Simulation for level

Enter the level value to be simulated. The appropriate current is given by the electronic insert.

Step	Entry	Cursor in Display at	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	6	SIM. LEVEL	Simulation for level
		e.g. 77.06	Actual measured value is displayed
3	e.g. 35.00	35.00	Level to be simulated is entered
4	F4 [ENTER]		Confirms entry, value to be transmitted

Simulation for volume

Enter the volume value to be simulated. The appropriate current is given by the electronic insert.

Step	Entry	Cursor in Display to	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	7	SIM. VOLUME	Simulation of volume
		e.g. 77.06	Actual measured value is displayed
3	e.g. 5.00	5.00	Volume to be simulated is entered
4	F4 [ENTER]		Confirms entry, value to be transmitted

Simulation for current

Enter directly the current value to be simulated.

Step	Entry	Cursor in Display at	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	7	SIM. CURRENT	Simulation of current output
		e.g. 17.02	Actual measured value is displayed
3	e.g. 8.00	8.00	Current to be simulated is entered
4	F4 [ENTER]		Confirms entry, value to be transmitted

Note!
The values entered during simulation are stored until simulation is again switched off.

6.3 Description of Fault Responses, Error Messages

Error code	Significance
103	Initialisation activated
106	Check sum error This appears during the download, and remians if the download is not completed correctly. A new and successful download or reset deletes the error message.
116	Error in download format
204	Measuring capacitance too large (larger than 2000 pF)
613	Simulation switched on
615	The actual calibration at 4 mA produces an initial capacitance larger than 350 pF. It cannot be altered further. A reset deletes the error message.
616	The actual calibration at 20 mA produces a total capacitance larger than 2000 pF. It cannot be altered further. A reset deletes the error message.
617	The actual calibration produces a difference in capacitance ('span') of less than 10 pF between initial and total capacitance. It cannot be altered further. A reset deletes the error message.
618	Process-specific sensitivity too large
620	The current lies outside the permitted range (4.0 ... 20 mA or 3.8 ... 20 mA). It has no relationship to the measured value.

6.4 Replacing the FEC 12 Electronic Insert

Note!
If you want to transmit the settings of the old electronic insert into a new electronic insert, then please note the following section.

Removal

- Disconnect the power supply cable from the old electronic insert
- Loosen the central mounting screw
- Remove the electronic insert

Insertion

- Plug in the new electronic insert
- Screw down the central mounting screw securely
- Connect the power cable to the electronic insert

6.5 Transmitting Basic Settings

The recalibration procedure can be dispensed when replacing an electronic insert. Call up the setting for offset and sensitivity using the handheld terminal, replace the electronic insert, and then enter both settings in the new electronic insert.

Calling up offset and sensitivity

The offset value indicates zero point calibration and is given as the capacitance value (initial capacitance). The value for sensitivity is the difference between the initial and total capacitance ('span') divided by 100.

Calling up offset and sensitivity (cont.)

Step	Entry	Cursor in Display to	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	2	OFFSET	Offset of electronic insert
		e.g. 63.43	Record value for offset
3	F3 [ESC]	OFFSET	
4	3	SENSITIVITY	Sensitivity of electronic insert
		e.g. 2.02	Record value for sensitivity
5	F3 [ESC]	SENSITIVITY	

Entering offset and sensitivity

Step	Entry	Cursor in Display to	Significance
1	2	EXTEND. CALIBRATION	Extended calibration
2	2	OFFSET	Offset
	63.43	63.43	Enter recorded value for offset
3	F4 [ENTER]	OFFSET	Confirms entry
4	3	SENSITIVITY	Sensitivity
	2.02	2.02	Enter recorded value for sensitivity
5	F4 [ENTER]	SENSITIVITY	Confirms entry
6	F2 [SEND]		Value to be transmitted

All settings can be transmitted from one electronic insert to another. Please see following section.

6.6 Transmitting All Settings

All settings stored in an electronic insert can be transmitted to another electronic insert using the HART Communicator handheld terminal. The procedure begins with an upload with the data from the old FEC 12 to the handheld terminal. Once the upload has been completed, a download is is made and all data are transmitted from the handheld terminal to the new FEC 12.

Upload (loading data into the handheld terminal)

Step	Entry	Display	Significance
0		MATRIX GROUP SEL.	
1	←	Online	Higher menu level
2	3	Transfer	Data transfer
		Device to Memory	Upload: Loading data into the memory of the handheld terminal
3	1	Looking for a device	Looking for an electronic insert
		Save data from device to configuration memory	Ready for receiving data
4	F3 [SAVE]	Overwrite existing configuration memory	Prompts confirmation
5	F1 [YES]	Device to Memory	Data of the electronic insert now in memory of handheld terminal

Data loaded into the HART Communicator

1 Set Tag Number
2 Select Unit
3 Output Damping
4 Safety Alarm
5 Min Current 4 mA
6 Value for 4 mA
7 Value for 20 mA
8 Linearisation
9 Offset
10 Sensitivity
11 Temperature Unit
12 Descriptor
13 Message
14 Date
15 Poll addr

Download

You must first move to the "Offline Configure" menu before carrying out a download.

Step	Entry	Display	Significance
0		MATRIX GROUP SEL.	
1	←	Online	
2	1	Offline	
3	1	Offline Configure	
4	1	New Device or	
	2	Last Device	

The data you wish to be transmit to another electronic insert can be collected in this menu.

1 New Device	→	This option enables a new electronic insert to be calibrated.
2 Last Device	→	This option enables variables to be edited and changed after an upload.

There are four function keys within this menu:

HELP (F1)	-	Online help. Help describes the variable shown in the display
SEND (F2)	-	Marks the variable in the display for the download and then marks the next variable.
EDIT (F3)	-	The variable can be edited and is marked for download once RETURN (F4) is pressed.
SKIP (F4)	-	The variable is skipped (not marked for download). The next variable is then marked.

The "Offline" menu is displayed after the last variable. The parameters are now stored in the HART Communicator and are ready for a download into an electronic insert. After marking has been carried out, downloads can be carried out without first marking the variables again.

Download (loading data into the electronic insert)

Step	Entry	Display	Significance
0		MATRIX GROUP SEL.	
1	←	Online	Main menu level
2	3	Transfer	Data transfer
		Device to Memory	
3	2	Memory to Device	Download: Loading data into electronic insert
		Looking for a device	Looking for a device
		Download data from configuration memory to device	Ready for data transmission
4	F3 [SEND]	Sending data to device	Data now stored in electronic insert

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Belarus
Belorgsintez
Minsk
Tel. (017 2) 508473, Fax (017 2) 508583

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Hungary
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