Technical manual BA 0424

KAK / KLK

Filling level limit switch

for conductive filling level supervision
in electrically conductive liquids

Detects up to two limit values

Useable

- for filling level resp. limit value detection in liquid container
- as overflow protection in container
- as dry run protection for pumps in pipelines
- for two-position-control in plants

Wide application range

- for process temperatures from -40 °C to +100 °C
- for process pressures from -1 bar to +10 bar
- materials for aggressive filling liquids

Measuring range adjustable up to 200kΩ resp. 5µS/cm

Wide range power supply 20 to 253V AC/DC / Relay output

DC supply voltage 24V DC / PNP switching output

FEEL FREE TO
CONTACT US

ACS Control-System GmbH
Lauterbachstr. 57
D- 84307 Eggenfelden

info@acs-controlsystem.de
www.acs-controlsystem.de
+49 8721 / 9668-0

Index

Application field

The filling level limit switch **KAK** / **KLK** is used, to evaluate one or two filling levels resp. limit levels in electrically conductive liquids with a conductivity of minimum 5µS/cm resp. a resistance of maximum 200kΩ.

The device is also useable as overflow protection in container with liquids, for the realization of a two-position-control e.g. for pump control or also as dry run protection.

The conductivity also of aggressive filling liquids can be detected, at process temperatures from -40 °C to +100 °C, at pressures from -1 bar to +10 bar.

The version **KAK** is the standard type for general applications, whereas the version **KLK** is especially conceived for food applications.

The following variants are available:

- Relay output version with wide range power supply from 20...253$V_{AC/DC}$, for two-channel or ∆s mode with two relay changeover contacts, resp.
- Relay output version with wide range power supply from 20...253$V_{AC/DC}$, for one-channel or ∆s mode with two relay changeover contacts, resp.
- Switching output version with direct voltage power supply 24V_{DC} ±10%, for one-channel or ∆s mode with one PNP switching output.

Function

Measuring principle

The filling level limit switch **KAK** resp. **KLK** is mounted in the wall of the container or of the pipe by using the respective process connection or installed over the filling liquid by using a suitable mount.

The alternating voltage, that is generated by the integrated electronic is than applied either between the electrode rods or between the electrode rods and the metallic wall of the container resp. pipe that is connected to the metallic process connection.

Due to the use of a alternating voltage the corrosion at the electrode rod and the electrolytic decomposition of the filling liquid is avoided.

As soon as the electrically conductive filling liquid makes a connection between the electrodes resp. between the electrode and the metallic wall of the container resp. pipe, an alternating current flows, that causes a decrease of the alternating voltage.

Signal evaluation

An evaluation circuit supervises this alternating voltage. A voltage drop is detected and the evaluation circuit switches the relay resp. relays resp. the PNP switching output, depending on the set safety function.

The switching state of the output resp. outputs is indicated at the top side of the device with one resp. two yellow LED's.

Switching delay

In some applications it is necessary to compensate heavy signal fluctuations that may be produced by mixing machines or at fill-in resp. emptying of containers, to avoid spurious switching actions.

The device is equipped with a switching delay of one second.
This delay time effects both channels separately, at activation and deactivation of the output signals.

Sensitivity range

For the adjustment of the response threshold to the conductivity of the liquid the filling level limit switch can be adjusted by a multi-turn-trimmer
The detectable resistance is from 0 Ω and 200,0 kΩ resp. 5µS/cm at the relay output version resp. 0 Ω and 100,0 kΩ resp. 10µS/cm at the PNP switching output version.

Safety notes

Authorized personnel

Installation, electrical connection, commissioning, operation, maintenance, dismounting and disposal of the device must be made by a qualified and authorized expert according to the information's in the Operating manual and the relevant standards and rules.

This expert must have read and understood the Operating manual and especially the safety instructions. During work on and with the device, the required personal protective equipment must always be worn.

Appropriate use

The device is an electronic filling level sensor for fill level control resp. limit level detection of filling levels in liquid media.

The operational reliability of the device is ensured only at the intended use. Inappropriate or incorrect use of this product can give risk to application specific hazards, e.g. vessel overflow through incorrect mounting or adjustment. Damage to property and persons or environmental contamination can result. Also, the characteristics of the instrument can be impaired.

An inappropriately use, disregarding the Operating manual and the technical rules, using under-qualified personnel, making unauthorized alterations as well as damage of the device releases the manufacturer from liability for any resulting damage. This renders the manufacturer warranty null and void.

Operational safety

The device is safely built and tested according to state-of-the-art technology. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.
The device may only be used within the permitted operation limits. Every use besides these limits as agreed can lead to serious dangers.

The materials of the device must be checked for compatibility with the respective application requirements before use. An unsuitable material can lead to damage, abnormal behavior or destruction of the device and to the resulting dangers.

The sensors may not be used as sole device for prevention of dangerous conditions in machines and plants.

For safety and warranty reasons, any invasive work on the device beyond that described in the Operating manual may be carried out only by personnel authorized by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by the manufacturer must be used.

The device meets the legal requirements of all relevant EU directives. This is confirmed by attaching the CE mark to the device. The associated EU-Declaration of Conformity can be ordered or downloaded from the homepage.

Packaging, transport, storage

The device is protected by packaging. It can handle normal loads during transport. Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Dispose of the packaging material via specialized recycling companies.
Up to the time of installation, the packages must be left closed and, unless otherwise indicated, must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration
- Storage and transport temperature -20…+85°C
- Relative humidity 20…85%

Installation

Ambient and process conditions

The correct function of the device within the specific technical data can only be guaranteed, if the permitted ambient and process conditions at the installation place (» chapter Technical Data) will not be exceeded. Hence make sure before mounting that all parts of the instrument exposed to the process are suitable for the existing process conditions (e.g. process pressure, process temperature, chemical properties of the medium, abrasion, mechanical influences).

Installation place

Drive the system pressure free prior installation resp. deinstallation of the sensor and avoid high temperatures to avoid injuries.

Consider enough installation space outside the container or the pipeline to insert the filling level limit switch into the plant without the use of force.

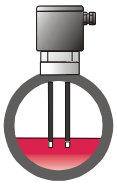
Install the device, if necessary, into a bypass if dense heavy foam, wild turbulences or foamed liquids can occur.

Install the filling level limit switch in such a position in the container, where no strong forces to the side, like e.g. by mixer or near fill-in openings, can have an effect to the electrode rods.
This is especially important for filling level limit switches with especially long electrode rods.

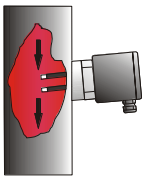
If a metallic wall of a container resp. pipeline should be uses as reference electrode (REF) there must be paid attention that the metallic process connection of the filling level limit switch is safe electrically conductive connected with the container resp. the pipeline. Use conductive gaskets like e.g. copper or lead. Isolation measures like e.g. the wrap of the thread with teflon band or a paper gasket can interrupt the electric contact.

The non-isolated tips of the electrode rods, when mounted, may not make a contact to the wall of the container, if this is made of metal or electrically conductive plastic.

Electrode rods longer than 0,5 m must be stabilized among each other or against the wall of the container, especially if the filling liquid is strongly fluctuating.
Use for the stabilization suitable spacers.
The distance between the spaces should be not more than 0,5 m.



At horizontal pipelines the length of the electrodes is limited by that way, that in a empty pipe, also in the case of liquid residues, the electrically conductive liquid connection between electrode and wall resp. between the two electrode rods can disconnect. Otherwise an empty pipe can be detected as filled.



At horizontal side mounting into a container or also into a pipe for stability reasons the length of the electrode rods should be not more than 200 mm.
At electrode rods with diameter 8 mm the length can be longer.
At a horizontal mounting the electrode rods should be installed at an angel with the electrode rod tip below (approx. 20...30°), to allow an easier flow-off of filling material residues and by this to avoid the coat-forming.

Installation notes

WARNING: Let the system cool down sufficiently before installing the device. There is a risk of dangerous and hot media escaping.

Do not remove packaging until just before mounting and check the device for any damage.

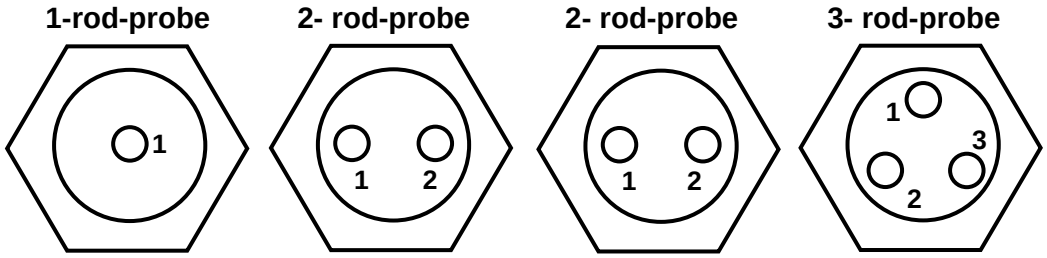
Sealing faces on the device and at the mounting point must be clean and without damage.
Parallel threads must be sealed by a suitable O-ring, flat or profile gasket. An additional sealing material such as yam, hemp or PTFE tape should not be used. Tapered threads should be wound with additional sealing material, e.g. PTFE tape for sealing.

NOTE: The tightening of the thread process connection may only be done at the hexagon by a suitable spanner at most with the maximum permitted torque strength (» chapter Technical Data)

Installation

Shortening of the electrode rods

Before the installation into the plant the electrode rods must be shortened acc. to the needed filling level limits. The numbering that is stamped at the bottom side of the process connection gives an information for the function of the respective rod.



Function	Numbering	Numbering	Numbering	Numbering
CH1 (Δs ➔ short rod)	1	1	1	1
CH2 (Δs ➔ long rod)	not available	not available	2	2
Reference electrode REF (longest rod)	process connection thread	2	process connection thread	3

The isolation of the electrode rod may not be damaged resp. removed excepted at the electrode tip.
The electrode rods can be shortened arbitrary by a tong or a saw
After shortening the electrode rod remove at least 10 mm of the isolation.
At shortening the electrode may not be stressed mechanically to avoid damaging of the isolation.

Electrical connection

The electrical connection of the device must be carried out according to the respective country specific standards. Incorrect installation or adjustment could cause applicationally conditioned risks.

Use only suitable cables with max. 25 Ω per wire, that fulfills the requirements e.g. regarding temperature, resistance or laying at the place of installation.

The cable gland is suitable for cable diameters from 4 to 10 mm. After installation of the cable the cable gland must be fix screwed to ensure the tightness of the connection housing.

For inauguration it is suggested to switch off all connected control devices to avoid unintended control actions.

Version UB / UC – relay output

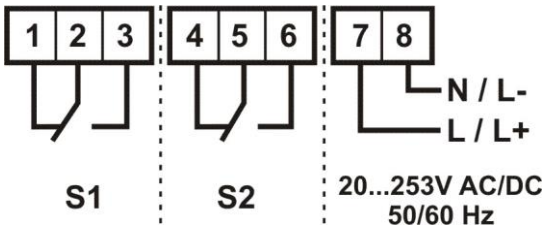
Power supply input, electrode circuit and relay outputs are safe galvanically isolated.

A fuse is integrated internally at the power supply circuit. Due to this the installation of a fine protection is not necessary.

Inductive loads at the relay contacts, e.g. auxiliary contactors or magnetic vents may only be used with a free-wheeling diode or a RC protection circuit to avoid high voltage peaks.

Connection terminals: 8x maximum 1,5 mm² rigid / flexible

Terminal assignment clamp



Version GA – PNP switching output

The power supply voltage and the PNP switching output are galvanically separated from the electrode circuit.

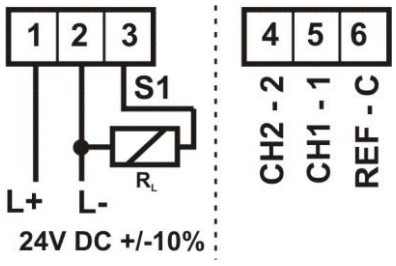
The power supply voltage may not exceed 27 V to avoid damage of the electronic.
The power supply voltage connection is polarity protected.

The load at the PNP switching output will be connected contactless and by this bounce-free to the positive terminal of the power supply voltage by a semiconductor switch. At activated switching state a positive signal near power supply voltage is produced at the terminal Out.
At deactivated switching state and at failure of power supply voltage the semiconductor switch is shut off.
The PNP switching output is current limited to 0,5 A.

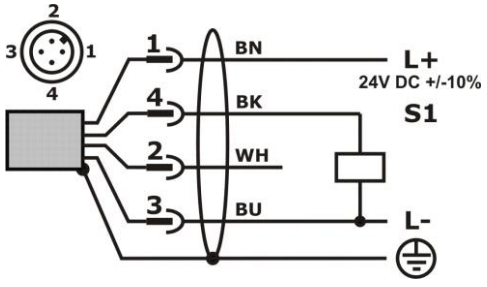
Inductive loads at the PNP switching output, e.g. relays or contactors may only be used with a free-wheeling diode or a RC protection circuit to avoid high voltage peaks.

Connection terminals: 3x maximum 2,5 mm² rigid / flexible

Terminal assignment clamp

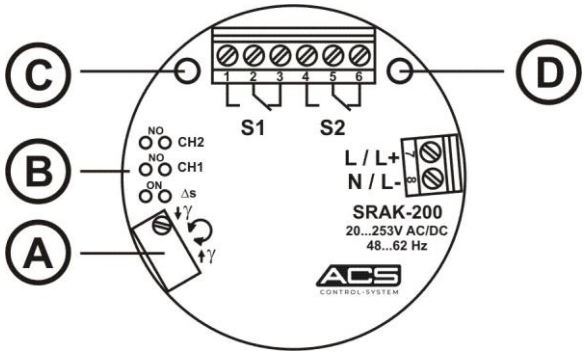


Terminal assignment plug M12-A-4P



Operation

Operation elements version UB / UC – relay output



Adjustment trimmer (A)

Fine adjustment of the response sensitivity within the sensitivity range.

Turn to the left: switching reaction at a higher liquid resistance resp. lower conductivity.
Turn to the right: switching reaction at a lower liquid resistance resp. higher conductivity.

For adjustment proceed like follows (Safety function – Maximum safety – nc):

- Liquid must create an electrically conductive connection between measuring and reference electrode
- Turn adjustment trimmer to the right (clockwise), till the output switches off – LED off
- Turn adjustment trimmer to the left (counterclockwise), till the output switches on – LED on
- Turn adjustment trimmer by an additional half turn to the left (counterclockwise)

Configuration jumper (B)

CH 1 Safety function channel 1 (CH1)
- Minimum safety = jumper plugged no – normally open
- Maximum safety = jumper open nc – normally closed

CH 2 Safety function channel 2 (CH2)
- Minimum safety = jumper plugged no – normally open
- Maximum safety = jumper open nc – normally closed

Δs Relay function output relay S1
- Limit value function CH1 = Jumper open OFF
- Two-position control Δs = Jumper plugged ON

  At two-position-control Δs both jumper for the safety function channel 1 and channel 2 (CH1 and CH2) must be set identically

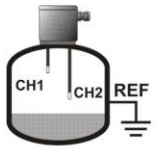
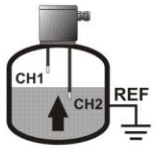
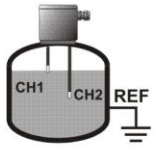
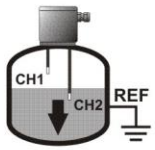
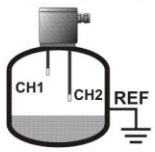
Function indicator

- LED yellow ➔ output relay S1 switched on
- LED yellow ➔ output relay S2 switched on

Safety function version UB / UC – relay output

The safety function defines the operation principle of the relays.
The safety function is selected by one jumper per channel, inside the housing of the device.

- Minimum safety - no: The relay switches off, if the switching level is underrun,
  (No liquid connection between measuring electrode CH1/CH2 and reference electrode REF)
  or at power supply fail.
- Maximum safety - nc: The relay switches off, if the switching level is overrun,
  (Liquid connection between measuring electrode CH1/CH2 and reference electrode REF)
  or at power supply fail.

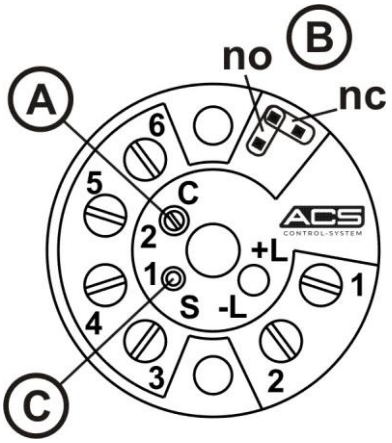
	Minimum - no			Maximum - nc		
	S1	S2	LED	S1	S2	LED
U_S = 0V	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ● S2 ●
	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE
	3 2 1	6 5 4	S1 ● S2 ☼ YE	3 2 1	6 5 4	S1 ☼ YE S2 ●
	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE	3 2 1	6 5 4	S1 ● S2 ●
	3 2 1	6 5 4	S1 ● S2 ☼ YE	3 2 1	6 5 4	S1 ☼ YE S2 ●
	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE

Two-position-control Δs version UB / UC – relay output

The activation of the two-position-control for the output S1 is made by a jumper inside the device.
The output relay S2 continues operation in limit value mode.
The safety function is selected by one jumper per channel, inside the housing of the device.

	Δs Minimum - no			Δs Maximum - nc		
	S1	S2	LED	S1	S2	LED
U_s = 0V	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ● S2 ●
Δs{ 	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE
Δs{ 	3 2 1	6 5 4	S1 ● S2 ☼ YE	3 2 1	6 5 4	S1 ☼ YE S2 ●
Δs{ 	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE	3 2 1	6 5 4	S1 ● S2 ●
Δs{ 	3 2 1	6 5 6	S1 ☼ YE S2 ☼ YE	3 2 1	6 5 4	S1 ● S2 ●
Δs{ 	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE

Operation elements version GA – PNP switching output



Adjustment trimmer (A)

Fine adjustment of the response sensitivity within the sensitivity range.

Turn to the right: switching reaction at a higher liquid resistance resp. lower conductivity.
Turn to the left: switching reaction at a lower liquid resistance resp. higher conductivity.

For adjustment proceed like follows (Safety function – Maximum safety – NC):

- Liquid must create an electrically conductive connection between measuring and reference electrode
- Turn adjustment trimmer to the left (counterclockwise), till the output switches off – LED off
- Turn adjustment trimmer to the right (clockwise), till the output switches on – LED on
- Turn adjustment trimmer by an additional half turn to the right (clockwise)

Configuration jumper (B)

Safety function

- Minimum safety = no
- Maximum safety = nc

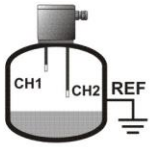
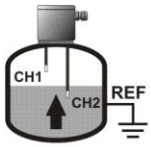
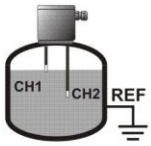
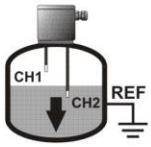
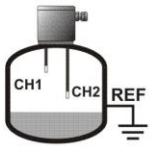
Function indicator (C)

- LED yellow ➔ PNP switching output active

Safety function – version GA with PNP switching output

The safety function defines the operation principle of the relays.
The safety function is selected by a jumper inside the housing of the device.

- Minimum safety - no: The output signal switches off, if the switching level is underrun, (No liquid connection between measuring electrode CH1 and reference electrode REF) or at power supply fail.
- Maximum safety - nc: The output signal switches off, if the switching level is overrun, (Liquid connection between measuring electrode CH1 and reference electrode REF) or at power supply fail.

	Minimum - no		Maximum - nc	
	S1	LED	S1	LED
U_S = 0V		S1 ●		S1 ●
		S1 ●		S1 ☼ YE
		S1 ●		S1 ☼ YE
		S1 ☼ YE		S1 ●
		S1 ●		S1 ☼ YE
		S1 ●		S1 ☼ YE

Two-position-control Δs version GA – PNP switching output

The two-position-control function is always active.
The safety function is selected by a jumper inside the housing of the device.

	Δs Minimum - no			Δs Maximum - nc		
	S1	S2	LED	S1	S2	LED
U_s = 0V	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ● S2 ●
Δs 	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE
Δs 	3 2 1	6 5 4	S1 ● S2 ☼ YE	3 2 1	6 5 4	S1 ☼ YE S2 ●
Δs 	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE	3 2 1	6 5 4	S1 ● S2 ●
Δs 	3 2 1	6 5 6	S1 ☼ YE S2 ☼ YE	3 2 1	6 5 4	S1 ● S2 ●
Δs 	3 2 1	6 5 4	S1 ● S2 ●	3 2 1	6 5 4	S1 ☼ YE S2 ☼ YE

Maintenance

At appropriate use, the device is free of maintenance.

The isolation of the electrodes should be checked regularly and also a possible coating at the electrode rods should be removed.

A non-conductive coating at the metallic electrode tip can lead to error behavior because no current can flow although the electrically conductive filling liquid makes a connection.

Repair

The device is not intended for repair by the user. A repair may only be carried out by the manufacturer.

Dismounting

Use suitable protective clothing, e.g. goggles, gloves.

WARNING Let the device and the system cool down sufficiently fore dismounting it. There is a risk of hot surfaces as well as dangerous and hot media escaping.

Return

Returns can only be accepted if the device has been equipped with a Decontamination declaration enclosed. The decontamination declaration is available at https://www.acs-controlsystem.com at the download area and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

Disposal

As required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), products of ACS are marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Such products may not be disposed of as unsorted municipal waste and can be returned to ACS for disposal.
The return follows the conditions stipulated in the General Terms and Conditions or as individually agreed by ACS.

Technical Data

Auxiliary power supply

Version UB / UC – relay output

Supply voltage	20V bis 253V AC / DC 48...62Hh, reverse polarity protected
Power consumption	≤ 1,75VA / 1W
Over voltage category	II, DIN EN 61010-1
Protection classification	II, double or reinforced insulation
Isolation voltage	2,5kVac (Auxiliary power – relay outputs – electrode circuit)

Version GA – PNP switching output

Supply voltage	24V DC ±10%, verpolungsgeschützt
Ripple voltage	≤ ±0,5V
Power consumption	≤ 1 W (PNP switching output 0mA)
Over voltage category	II, DIN EN 61010-1
Protection classification	II, double or reinforced insulation
Isolation voltage	1kVac (Auxiliary power / PNP switching output – electrode circuit)

Switching output

Version UB / UC – relay output

Function	1x / 2x potential-free changeover contact
Switching values	≤ 250Vac / 220Vdc – 2A – 62,5VA / 60W (ohmic load)
	≥ 100µV
Delay time	1s
Switching cycles	≥ 100.000 (max. contact load)

Version GA – PNP switching output

Function	PNP switching to +Vs
Output voltage	$V_{OUT} \geq +V_s - 2$ V
Output current	≤ 500mA, current limited, short circuit protected
Rise up time	< 30µs
Delay time	1s
Switching cycles	≥ 100.000.000

Measuring input

Measuring principle	conductive
Output values	$9V_{PP}$ ±1V / ≤ 90Hz ±15Hz / ≤ 1,5mA (potential-free alternating voltage)
Measuring range (FSI)	≤ 200 kΩ / ≥ 5µS/cm (Version UB / UC – relay output)
	≤ 100kΩ / ≥ 10µS/cm (Version GA – PNP switching output)
Temperature deviation	≤ 0,5% (FSI) / 10K

Process conditions

Process temperature	– 40°C ...+100°C
Process pressure	– 1bar ... 10bar

Environmental conditions

Ambient temperature	– 40°C ...+85°C
Protection level	IP65 (DIN EN 60529)
EM – compatibility	Operation device class B / Industrial range (EN/IEC 61326)
Torque strength	≤ 80Nm
Weight	0,5kg (Enclosure CrNi steel)
	0,2kg (Enclosure POM / PC / PTFE)
	0,1kg / 1000mm (Rod D4mm)
	0,4kg / 1000mm (Rod D8mm)

Materials

Process wetted

Electrode rod	CrNi steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)
	Hastelloy C22
	Titan

Electrode isolation	KAK	PA / ETFE resp. E-CTFE
	KLK	ETFE, FDA listed

Process gasket	KAK	FPM
	KLK	EPDM, FDA listed

Process connection	CrNi steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)

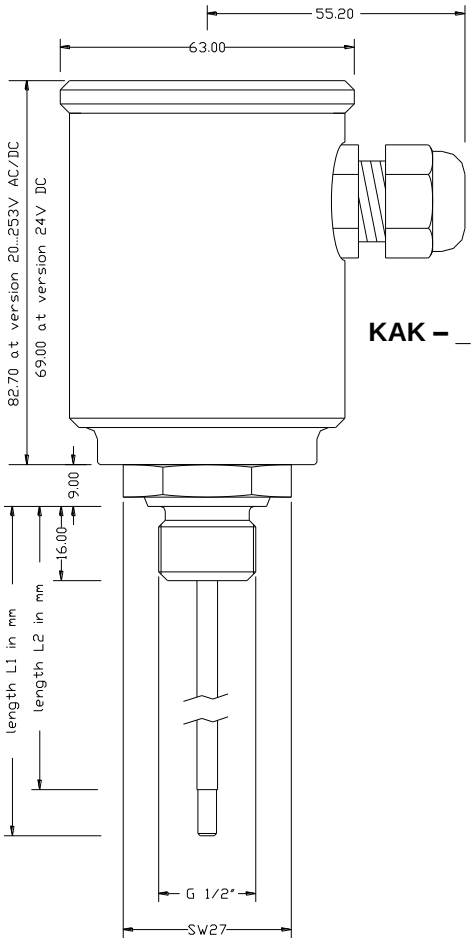
Not process wetted

Terminal enclosure	CrNi steel 1.4404 (AISI 316L)
	POM
	PC
	PTFE
	Indication window PC

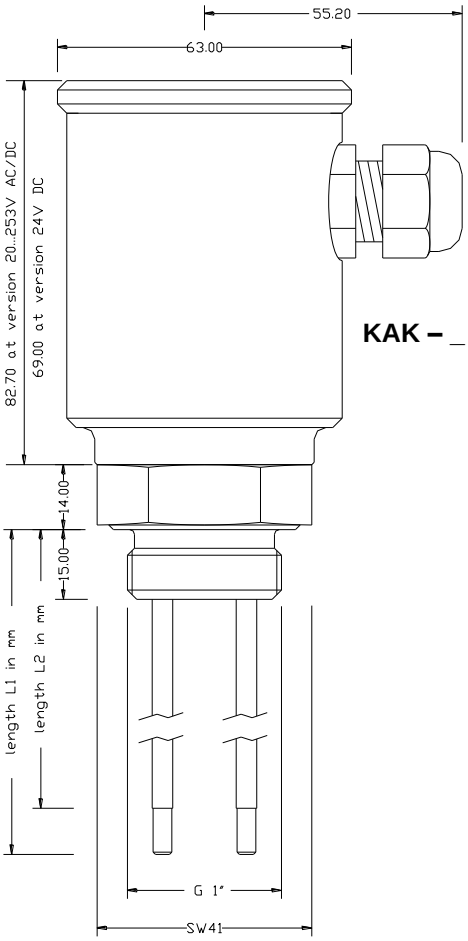
Gaskets	FPM, Silicone

Electrical connection	C.E.	CrNi steel (Enclosure CrNi steel) / PA (Enclosure POM / PC / PTFE)
		CR, NBR
	M12	CrNi steel, PUR, contacts gold-plated

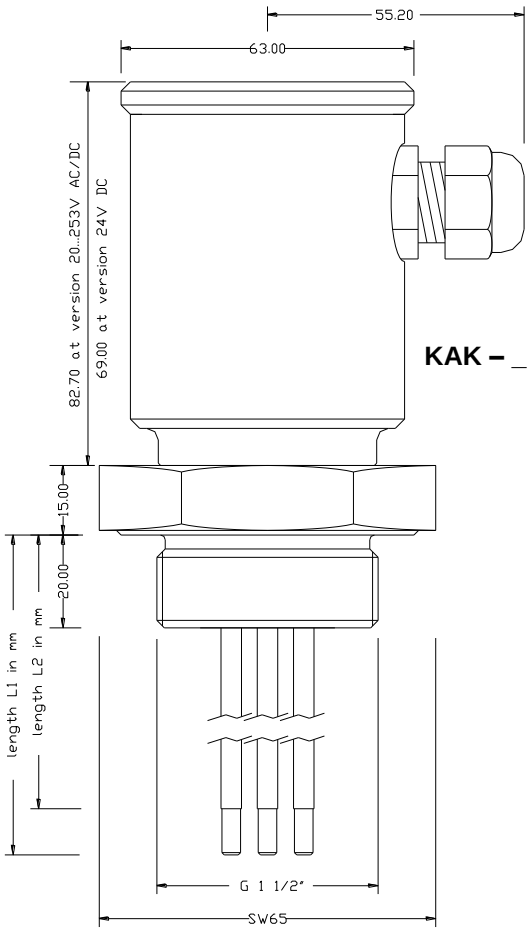
Dimension drawings KAK



KAK – _ _1G12_ _ _ _

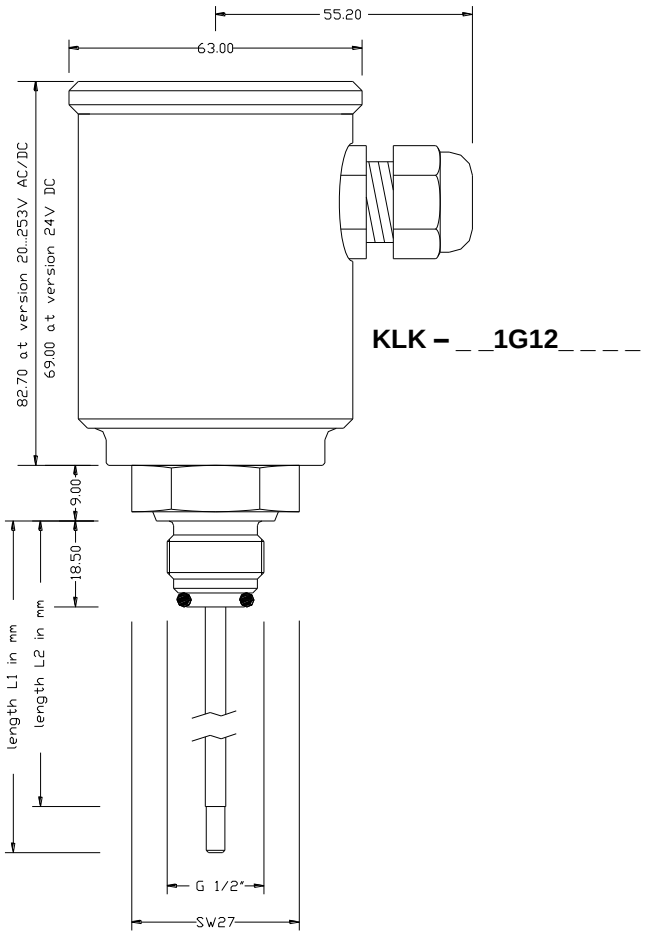


KAK – _ _2G10_ _ _ _

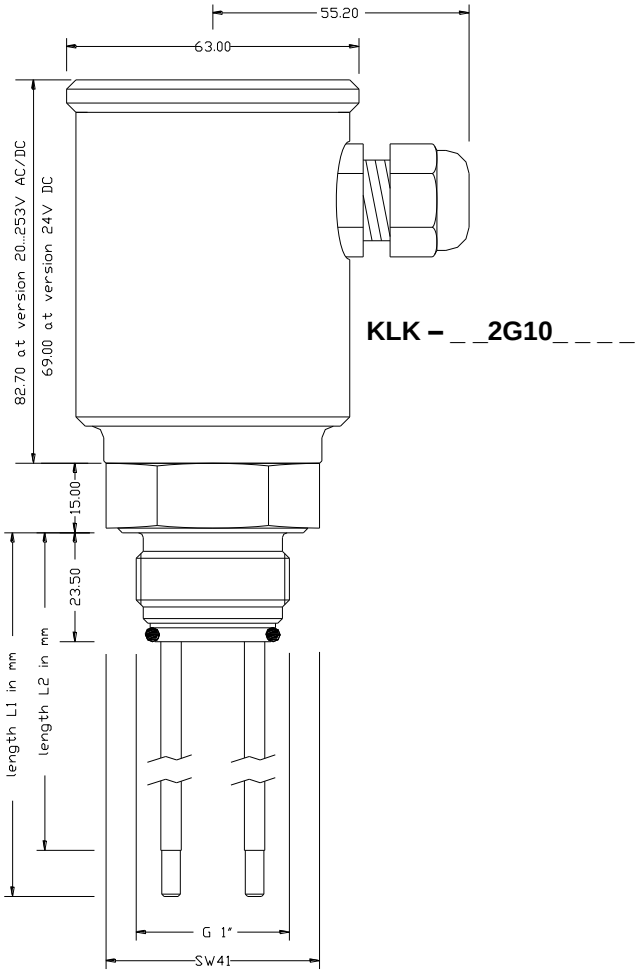


KAK – _ _3G15_ _ _ _

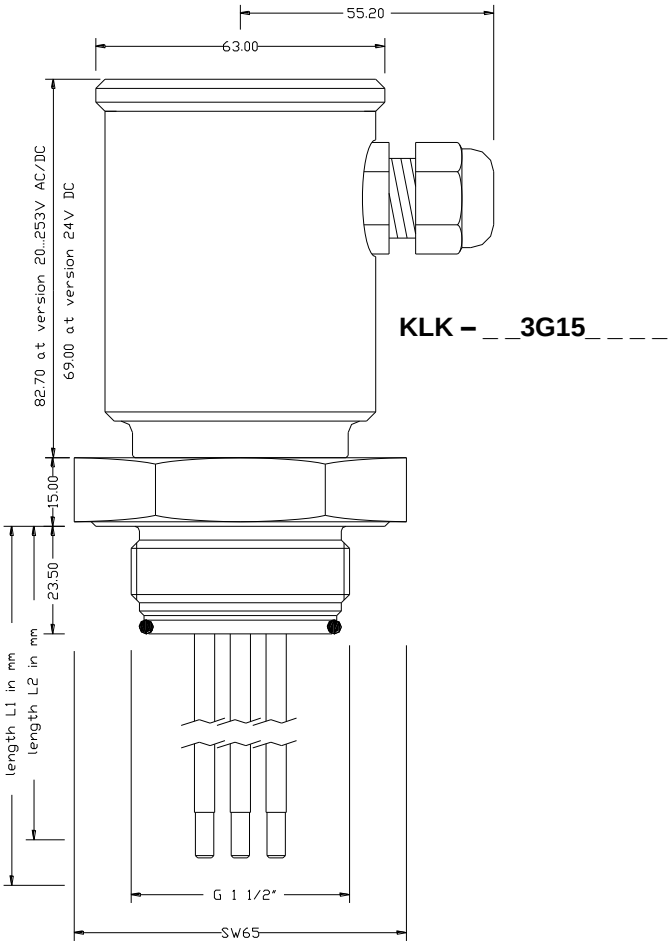
Dimension drawings KLK



KLK – _ _1G12_ _ _ _

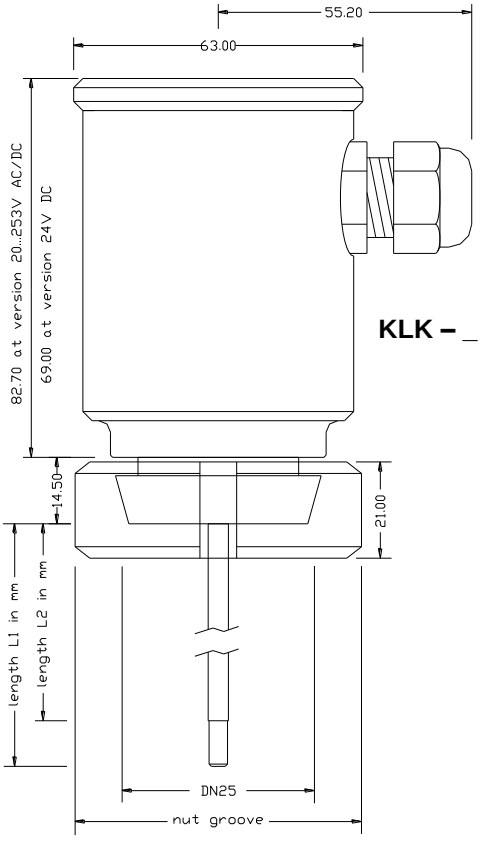


KLK – _ _2G10_ _ _ _

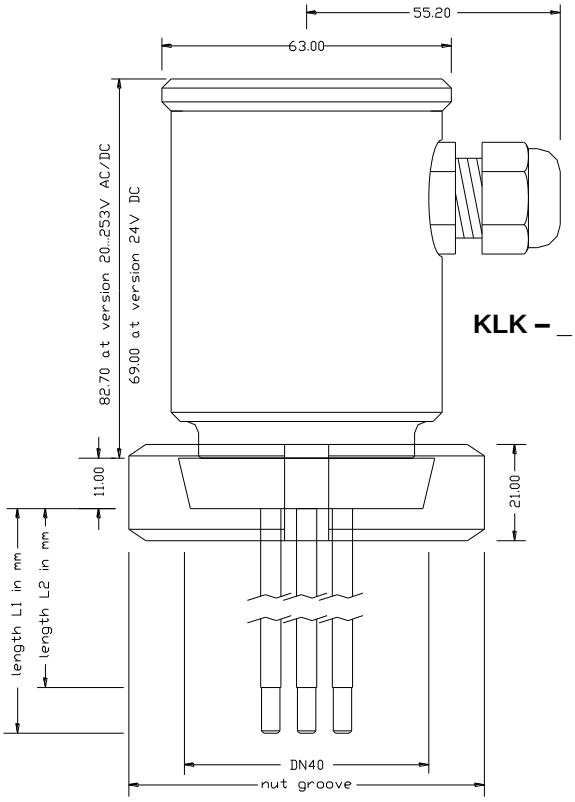


KLK – _ _3G15_ _ _ _

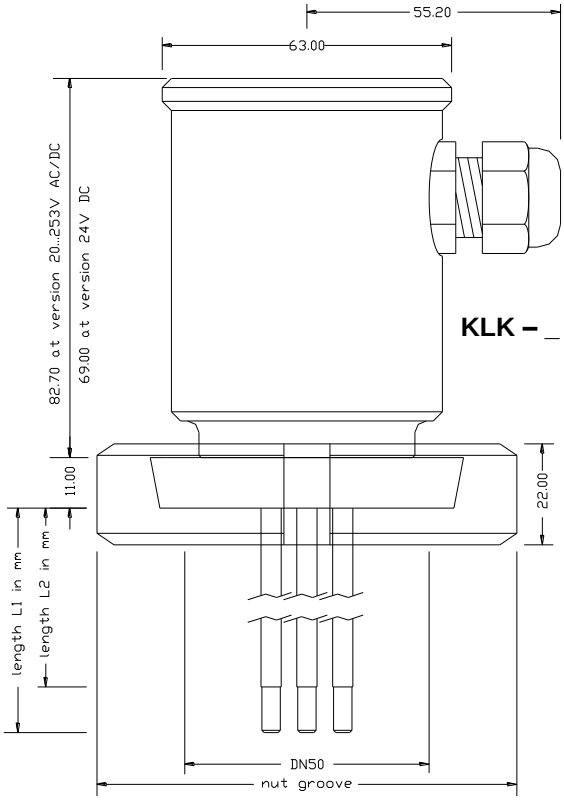
Dimension drawings KLK



KLK – _ _1D25_ _ _ _



KLK – _ _2D40_ _ _ _



KLK – _ _3D50_ _ _ _

Order code

Type
KAK Standard
KLK Food applications

Electrical connection
0 Terminal box
V Plug M12 x 1, A, 4pole — auxiliary power direct voltage 24 V DC

Auxiliary power
G Direct voltage 24 V DC
U Wide range power supply 20...253 V AC/DC

Output

A	1 x PNP switching output	auxiliary power direct voltage 24 V DC
B	1 x relay output	auxiliary power universal voltage 20...253 V AC/DC
C	2 x relay output	auxiliary power universal voltage 20...253 V AC/DC

Type measuring system

1	1-rod	1x limit value	Reference electrode REF – process connection
2	2- rod	1x limit value	Reference electrode REF – longest rod
3	3- rod	2x limit value	Reference electrode REF – longest rod
4	2- rod	2x limit value	Reference electrode REF – process connection

Process connection material CrNi steel

G12	Thread ISO 228-1 – G ½“, 1-rod	
G10	Thread ISO 228-1 – G 1“, 2-rod	
G15	Thread ISO 228-1 – G 1½“, 3-rod	
D25	Dairy coupling DIN 11851 – DN25, 1-rod	only type KLK
D40	Dairy coupling DIN 11851 – DN40, 2-rod	only type KLK
D50	Dairy coupling DIN 11851 – DN50, 3-rod	only type KLK

Material electrode rod
A4 CrNi steel, rod diameter 4 mm
A8 CrNi steel, rod diameter 8 mm
D Hastelloy C 22, rod diameter 4 mm
T4 Titan, rod diameter 4 mm
T8 Titan, rod diameter 8 mm
E CrNi steel, tip tantalum 50mm

Material terminal enclosure
D POM
P PP
L PTFE
V CrNi steel

Material electrode isolation

R	PA	only type KAK
H4	ETFE (KLK) resp. E-CTFE, rod diameter 4 mm	
H8	ETFE (KLK) resp. E-CTFE, rod diameter 8mm	

Diameter electrode rod
0 4 mm
W 8 mm

Length L1/L2/L3 electrode rod in mm, max. 2500 mm

KAK resp. KLK _ _ _ _ _ _ _ _ _ _