User´s Manual

Model RAKD
Small Metal ROTAMETER

IM 01R01B30-00E-E

vigilantplant.™

YOKOGAWA

Rota Yokogawa GmbH & Co. KG
Rheinstr. 8
D-79664 Wehr
Germany

IM 01R01B30-00E-E

5th edition, January 2013 (Rü)

Blank Page

Contents

Blank Page

1. Introduction

Before use, read this manual thoroughly and familiarize yourself fully with the features, operations and handling of Rotameter RAKD to have the instrument deliver its full capabilities and to ensure its efficient and correct use.

Notices Regarding This Manual

- This manual should be passed to the end user.
- The contents of this manual are subject to change without prior notice.
- All rights reserved. No part of this document may be reproduced or transmitted in any form or by any means without the written permission of Rota Yokogawa (hereinafter simply referred to as Yokogawa).
- This manual neither does warrant the marketability of this instrument nor it does warrant that the instrument will suit a particular purpose of the user.
- Every effort has been made to ensure accuracy in the contents of this manual. However, should any questions arise or errors come to your attention, please contact your nearest Yokogawa sales office that appears on the back of this manual or the sales representative from which you purchased the product.
- This manual is not intended for models with custom specifications.
- Revisions may not always be made in this manual in conjunction with changes in specifications, constructions and/or components if such changes are not deemed to interfere with the instrument's functionality or perfor-mance.

Notices Regarding Safety and Modification

- For the protection and safety of personnel, the instrument and the system comprising the instrument, be sure to follow the instructions on safety described in this manual when handling the product. If you handle the instrument in a manner contrary to these instructions, Yokogawa does not guarantee safety.
- If this instrument is used in a manner not specified in this manual, the protection provided by this instrument may be impaired.
- As for explosion proof model, if you yourself repair or modify the instrument and then fail to return it to its original form, the explosion protected construction of the instrument will be impaired, creating a hazardous condition. Be sure to consult Yokogawa for repairs and modifications.

The following safety symbols and cautionary notes are used on the product and in this manual:

WARNING

This symbol is used to indicate that a hazardous condition will result which, if not avoided, may lead to loss of life or serious injury. This manual describes how the operator should exercise care to avoid such a risk..

CAUTION

This symbol is used to indicate that a hazardous condition will result which, if not avoided, may lead to minor injury or material damage. This manual describes how the operator should exercise care to avoid a risk of bodily injury or damage to the instrument.

IMPORTANT

This symbol is used to call your attention to a condition that must be observed in order to avoid the risk of damage to the instrument or system problems.

NOTE

This symbol is used to call your attention to information that should be referred to in order to know the operations and functions of the instrument.

For Safe Use of Rotameter RAMC

WARNING

- If the process fluid is harmful to personnel, handle Rotameter RAKD carefully even after it has been removed from the process line for maintenance or other purposes. Exercise extreme care to prevent the fluid from coming into contact with human flesh and to avoid inhaling any residual gas.
- In case of Explosion proof type instrument, further requirements and differences are described in Chapter 8 " INSTRUCTIONS FOR EXPLOSION PROTECTED RAKD". The description in Chapter 8 is prior to other descriptions in this instruction manual.

CAUTION

- When carrying Rotameter RAKD around, exercise extreme care to avoid dropping it accidentally and causing bodily injury.

Warranty

- The warranty of this instrument shall cover the period noted on the quotation presented to the Purchaser at the time of purchase. The Seller shall repair the instrument free of charge when the failure occurred during the warranty period.
- All inquiries on instrument failure should be directed to the Seller's sales representative from whom you purchased the instrument or your nearest sales office of the Seller.
- Should the instrument fail, contact the Seller specifying the model and instrument number of the product in question. Be specific in describing details on the failure and the process in which the failure occurred. It will be helpful if schematic diagrams and/or records of data are attached to the failed instrument.
- Whether or not the failed instrument should be repaired free of charge shall be left solely to the discretion of the Seller as a result of an inspection by the Seller.

The Purchaser shall not be entitled to receive repair services from the Seller free of charge, even during the warranty period, if the malfunction or damage is due to:

- improper and/or inadequate maintenance of the instrument in question by the Purchaser.
- handling, use or storage of the instrument in question beyond the design and/or specifications requirements.
- use of the instrument in question in a location not conforming to the conditions specified in the Seller's General Specification or Instruction Manual.
- retrofitting and/or repair by an other party than the Seller or a party to whom the Seller has entrusted repair services.
- improper relocation of the instrument in question after delivery.
- reason of force measure such as fires, earthquakes, storms/ floods, thunder/lightning, or other reasons not attributable to the instrument in question.

WARNING

- When removing the instrument from hazardous processes, avoid contact with the fluid and the interior of the meter.
- In case of Explosion proof type instrument, further requirements and differences are described in Chapter 8 " INSTRUCTIONS FOR EXPLOSION PROTECTED RAKD". The description in Chapter 8 is prior to other descriptions in this instruction manual..

Restriction on Use of Radio Transceiver

IMPORTANT

Although the transmitter has been designed to resist high frequency electrical noise, if a radio transceiver is used near the transmitter or it external wiring, the transmitter may be affected by high frequency noise pickup. To test for such effects, bring the transceiver in use slowly from a distance of several meters from the transmitter, and observe the measurement loop for noise effects. Thereafter, always use the transceiver outside the area affected by noise.

1.1 ATEX Documentation

This is only applicable to the countries in European Union.

GB

All instruction manuals for ATEX Ex related products are available in English, German and French. Should you require Ex related instructions in your local language, you are to contact your nearest Yokogawa office or representative.

DK

Alle brugervejledninger for produkter relateret til ATEX Ex er tilgængelige på engelsk, tysk og fransk. Skulle De ønske yderligere oplysninger om håndtering af Ex produkter på eget sprog, kan De rette henvendelse herom til den nærmeste Yokogawa afdeling eller forhandler.

I

Tutti i manuali operativi di prodotti ATEX contrassegnati con Ex sono disponibili in inglese, tedesco e francese. Se si desidera ricevere i manuali operativi di prodotti Ex in lingua locale, mettersi in contatto con l'ufficio Yokogawa più vicino o con un rappresentante.

E

Todos los manuales de instrucciones para los productos antiexplosivos de ATEX están disponibles en inglés, alemán y francés. Si desea solicitar las instrucciones de estos artículos antiexplosivos en su idioma local, deberá ponerse en contacto con la oficina o el representante de Yokogawa más cercano.

NL

Alle handleidingen voor producten die te maken hebben met ATEX explosiebeveiliging (Ex) zijn verkrijgbaar in het Engels, Duits en Frans. Neem, indien u aanwijzingen op het gebied van explosiebeveiliging nodig hebt in uw eigen taal, contact op met de dichtstbijzijnde vestiging van Yokogawa of met een vertegenwoordiger.

SF

Kaikkien ATEX Ex -tyyppisten tuotteiden käyttöhjeet ovat saatavilla englannin-, saksan- ja ranskankielisinä. Mikäli tarvitsette Ex -tyyppisten tuotteiden ohjeita omalla paikallisella kielellännne, ottakaa yhteyttä lähimpään Yokogawa-toimistoon tai -edustajaan.

P

Todos os manuais de instruções referentes aos produtos Ex da ATEX estão disponíveis em Inglês, Alemão e Francês. Se necessitar de instruções na sua língua relacionadas com produtos Ex, deverá entrar em contacto com a delegação mais próxima ou com um representante da Yokogawa.

F

Tous les manuels d'instruction des produits ATEX Ex sont disponibles en langue anglaise, allemande et française. Si vous nécessitez des instructions relatives aux produits Ex dans votre langue, veuillez bien contacter votre représentant Yokogawa le plus proche.

D

Alle Betriebsanleitungen für ATEX Ex bezogene Produkte stehen in den Sprachen Englisch, Deutsch und Französisch zur Verfügung. Sollten Sie die Betriebsanleitungen für Ex-Produkte in Ihrer Landessprache benötigen, setzen Sie sich bitte mit Ihrem örtlichen Yokogawa-Vertreter in Verbindung.

S

Alla instruktionsböcker för ATEX Ex (explosionssäkra) produkter är tillgängliga på engelska, tyska och franska. Om Ni behöver instruktioner för dessa explosionssäkra produkter på annat språk, skall Ni kontakta närmaste Yokogawakontor eller representant.

GR

Όλα τα εγχειρίδια λειτουργίας των προϊόντων με ATEX Ex διατίθενται στα Αγγλικά, Γερμανικά και Γαλλικά. Σε περίπτωση που χρειάζεστε οδηγίες σχετικά με Ex στην τοπική γλώσσα παρακαλούμε επικοινωνήστε με το πλησιέστερο γραφείο της Yokogawa ή αντιπρόσωπο της.

SK

Všetky návody na obsluhu pre prístroje s ATEX Ex sú k dispozícii v jazyku anglickom, nemeckom a francúzskom. V prípade potreby návodu pre Ex-prístroje vo Vašom národnom jazyku, skontaktujte prosím miestnu kanceláriu firmy Yokogawa.

CZ

Všechny uživatelské příručky pro výrobky, na něž se vztahuje nevýbušné schválení ATEX Ex, jsou dostupné v angličtině, němčině a francouzštině. Požadujete-li pokyny týkající se výrobků s nevýbušným schválením ve vašem lokálním jazyku, kontaktujte prosím vaši nejbližší reprezentační kancelář Yokogawa.

LT

Visos gaminiø ATEX Ex kategorijos Eksploatavimo instrukcijos teikiami anglø, vokieèiø ir prancûzø kalbomis. Norëdami gauti prietaisø Ex dokumentacijà kitomis kalbomis susisiekite su artimiausiu bendrovës "Yokogawa" biuru arba atstovu.

LV

Visas ATEX Ex kategorijas izstrâdâjumu Lietoðanas instrukcijas tiek piegâdâtas angïu, vâcu un franèu valodâs. Ja vçlaties saòemt Ex ierîèu dokumentâciju citâ valodâ, Jums ir jâsazinâs ar firmas Jokogava (Yokogawa) tuvâko ofisu vai pârstâvi.

EST

Kõik ATEX Ex toodete kasutamisjuhendid on esitatud inglise, saksa ja prantsuse keeles. Ex seadmete muukeelse dokumentatsiooni saamiseks pöörduge lähima lokagava (Yokogawa) kontori või esindaja poole.

PL

Wszystkie instrukcje obsługi dla urządzeń w wykonaniu przeciwwybuchowym Ex, zgodnych z wymaganiami ATEX, dostępne są w języku angielskim, niemieckim i francuskim. Jeżeli wymagana jest instrukcja. obsługi w Państwa lokalnym ję zyku, prosimy o kontakt z najbliższym biurem Yokogawy.

SLO

Vsi predpisi in navodila za ATEX Ex sorodni pridelki so pri roki v angliščini, nemščini ter francoščini. Če so Ex sorodna navodila potrebna v vašem tukejnjem jeziku, kontaktirajte vaš najbliši Yokogawa office ili predstaunika.

H

Az ATEX Ex mûszerek gépkönyveit angol, német és francia nyelven adjuk ki. Amennyiben helyi nyelven kérik az Ex eszközök leírásait, kérjük keressék fel a legközelebbi Yokogawa irodát, vagy képviseletet.

BG

Всички упътвания за продукти от серията ATEX Ex се предлагат на английски, немски и френски език. Ако се нуждаете от упътвания за продукти от серията Ex на родния ви език, се свържете с най-близкия офис или представителство на фирма Yokogawa.

RO

Toate manualele de instructiuni pentru produsele ATEX Ex sunt in limba engleza, germana si franceza. In cazul in care doriti instructiunile in limba locala, trebuie sa contactati cel mai apropiat birou sau reprezentant Yokogawa.

M

Il-manwali kollha ta' l-istruzzjonijiet għal prodotti marbuta ma' ATEX Ex huma disponibbli bl-Ingliż, bil-Ġermaniż u bil-Franċiż. Jekk tkun teħtieġ struzzjonijiet marbuta ma' Ex fil-lingwa lokali tiegħek, għandek tikkuntattja lill-eqreb rappreżentan jew uffiċċju ta' Yokogawa.

1.2 General description

This manual describes installation, operation and maintenance of the RAKD. Please read it carefully before using this device.
Further, please note that customer features are not described in this manual. When modifying specifications, construction or parts, this manual is not necessarily revised unless it can be assumed that these changes will impair RAKD functions or performance.
All units are thoroughly tested before shipping. Please check the received units visually to ensure that they have not been damaged during transport. In case of defects or questions please contact your nearest YOKOGAWA service centre or sales office. Please describe any defect precisely and indicate model code as well as com. no. number.
YOKOGAWA refuses any liability for units which have been repaired by the user without prior consent and do not meet the specifications as a consequence..

1.3 Principle of measurement

The RAKD is a Variable Area Flow Meter for volume and mass measurements of gases and liquids.
A float, whose movement is nearly independent of viscosity is guided concentrically in a specially shaped cone. The position of the float is transferred magnetically to the indicator, which shows the measurement values by a pointer on a scale. The indicator can be equipped with limit switches and an electronic transmitter.

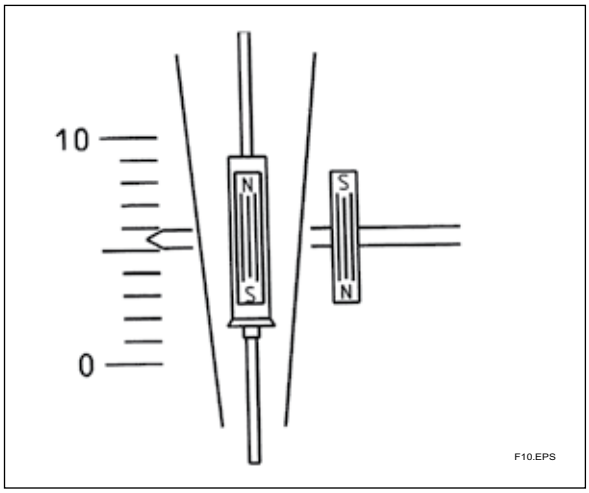
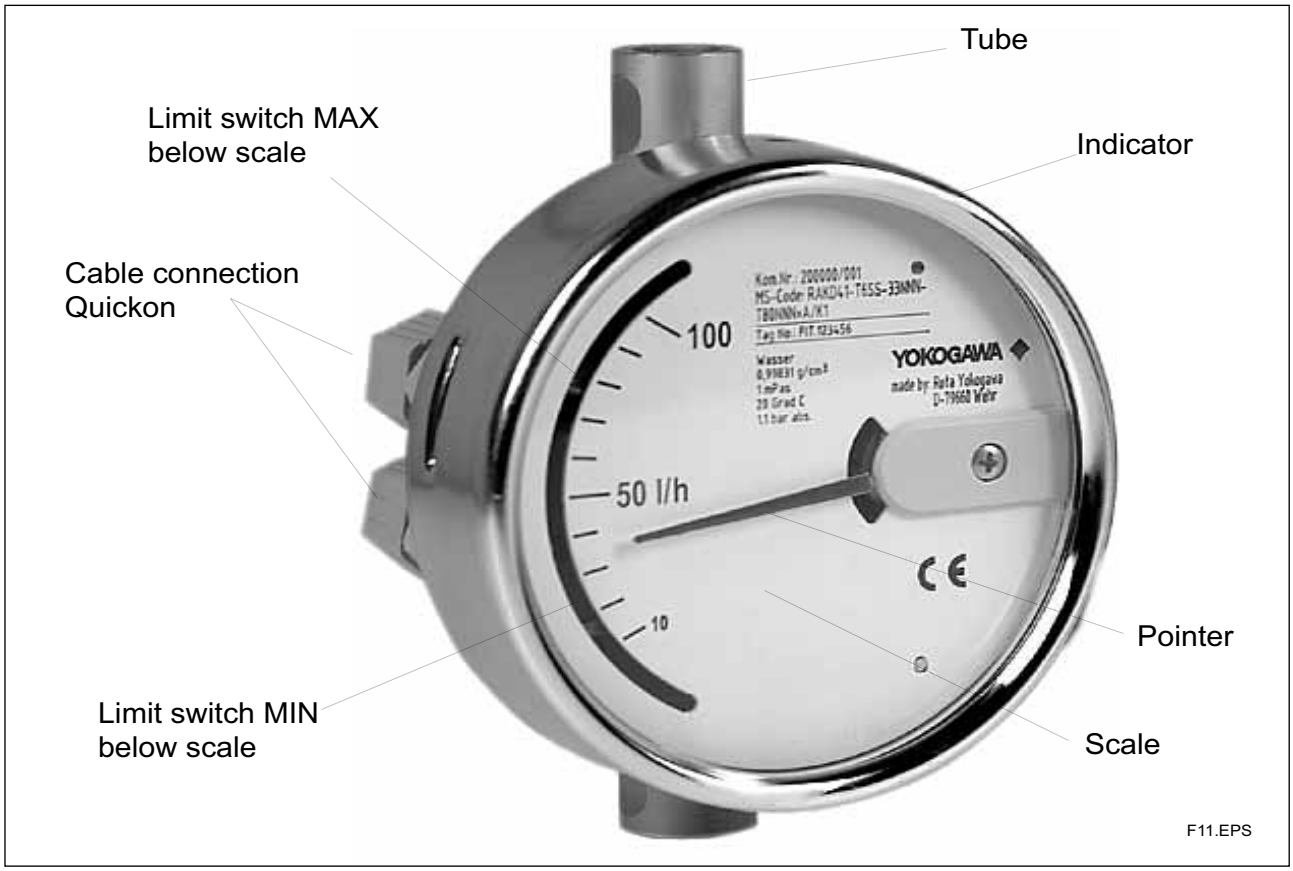


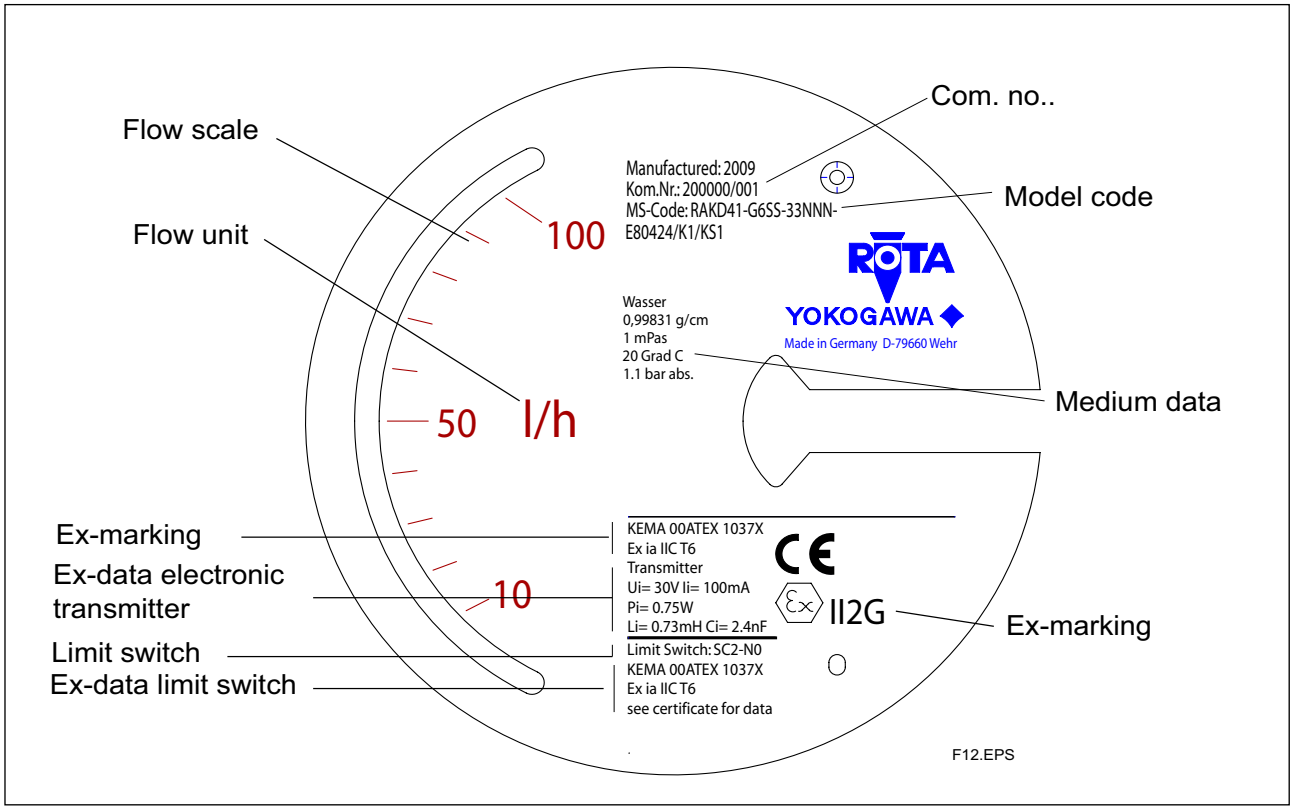
Fig. 1.1

All units are calibrated with water or air by the manufacturer. By adjusting the calibration values to the measured substance's state of aggregation (density, viscosity), the flow rate scale for each measuring tube can be determined.

1.4 Overview



Example for scale :



Blank Page

2. Precautions

2.1 Transportation and Storage

Before transporting the unit, it is recommended to fix the float with a card-board strip in the same way as when shipped from factory. Prevent foreign objects from entering the tube (e.g. by covering openings).
To protect the unit and especially the tube's interior from soiling, store it only at clean and dry locations

2.2 Installation

Ambient temperature and humidity of the installation location must not exceed the specified ranges. Avoid locations in corrosive environments. If such environments are unavoidable, ensure sufficient ventilation.
Although the RAKD features a very solid construction, the instrument should not be exposed to strong vibration or impact stress.
Please note that the RAKD is magnetic sensing system can be influenced by external inhomogeneous magnetic fields (such as solenoid valves). Alternating magnetic fields (≥ 10Hz) as well as homogeneous, static magnetic fields (in the area of the RAKD), like the geomagnetic field have no influence. Asymmetric ferromagnetic bodies of considerable mass (e.g. steel girders) should be kept at a distance of at least 250 mm from the RAKD.
To avoid interference, the distance between two adjacent RAKDs must be at least 120 mm.
Do not expose the unit to pressures higher than the indicated maximum operating pressure (refer to specifications)
Make sure that wetted parts are resistant against the process medium.
Ambient- and process-temperature may exceed specified maximum values. Note the temperature curves in fig. 2-1 and chapter 7 "Technical data".
The Rotameter must be mounted vertically. The flow direction is upwards.

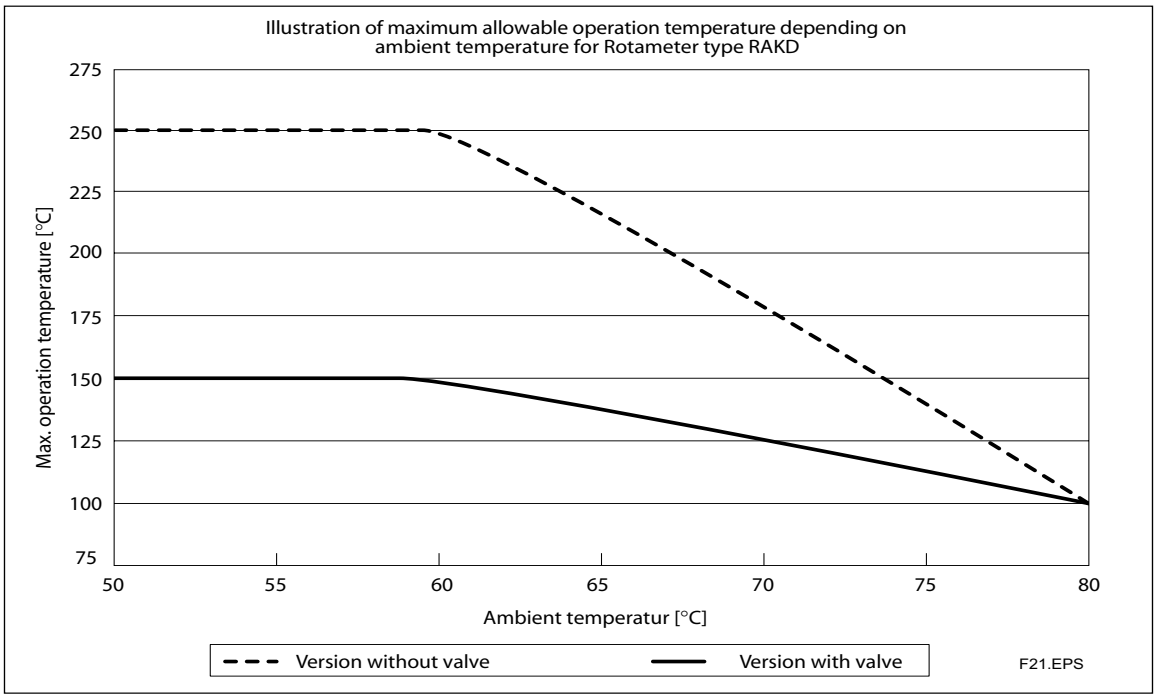


Fig. 2-1. For option /KS1or /KN1 (Ex-version) the maximum values for ambient and process temperature according to the respective temperature class mentioned in fig. 3-2 and tables 7-2 to 7-5 must be regarded. The minimum ambient temperature is -25°C.

Check movability of the float (5)* by watching the pointer. The pointer should follow the movement of the float. If this is not the case, float and measuring tube (1;21) should be cleaned.
Check the movability of the pointer by careful moving it with your fingers and watching whether it responds to the scale value. If it does not work properly, the mechanical display unit (14) must be changed.
To avoid damage of the float and of the stopper do not use magnetic valves. In the phase of start up increase the flow slowly to the desired flow rate. If a sudden rise of the pressure can not be avoided (with use of magnetic valves) the flow must be limited to the maximum used value (e.g. by valve).

*: Position numbers are illustrated in the explosion drawings in chapter 6.

3. Installation

3.1 Installation in the pipeline

The pipe has to be so stabilized that vibrations on the pipe are avoided. Additional recommendations can be found in guideline VDI/VDE 3513 sheet 3.
If pollution of the metering tube may appear a bypass-pipe is recommended, which permits the removal (see. chapter 6 “maintenance”) of the Rotameter for cleaning without interruption of the flow.

Before installing the Rotameter, make sure there are no parts of packing or securing inside the Rotameter.
It has to be taken care at the connection of units with internal thread that no residues of the sealing compound come into the tube (e.g. remains of the PTFE sealing compound).

To avoid stress in the connecting pipes, the connecting flanges must be aligned in parallel and axial direction. Bolts and gaskets have to be selected according to the maximum operating pressure, the temperature range and corrosion conditions. Centre gaskets and tighten nuts with a torque appropriate for the pressure range.
If contamination or soiling of the RAKD is to be expected, a bypass should be installed to allow the removal of the instrument without interruption of the flow.
Please read also chapter 2.2. For further instructions on installation please refer to VDI/VDE3513.

In case of devices without valve but with process connection internal thread the float shaft of tubes with cone 44 and bigger sizes may move into the range of the threaded joint. Keep attention not to bend the guide bar when screwing up the connection. The inner diameter of the connector must be at least 8 mm for cone sizes 44 - 51 resp. 10 mm for cone sizes 52 and 53.

To avoid float bouncing in case of gas applications, attend to VDI/VDE 3515 sheet 3.
For devices without valve use a throttle either in the inlet or outlet (to install at that side with the bigger volume).
For installation of several instruments in parallel tubes take care that the distance between the middle axis is at least 120 mm to avoid magnetic influence. The distance to other ferritic material should not be less than 60 mm. Take care that the strength of external magnetic fields is approximately 0 mT.

3.2 Wiring

3.2.1 Connecting diagrams

Please regard the drawings of this chapter.

RAKD with electronic transmitter or with limit switches have one or two Quickon connectors at the rear.
In the connecting diagrams he lower one is named "S" and the upper one "T".
Not used connector positions are closed with a blind plug.
The following table shows the connections for the respective equipment configuration.

	Type T without contact	**Type T with MIN** contact **/K1 or /K6**	**Type T with MAX** contact **/K2 or /K7**	**Type T with MIN/MAX** contact **/ K3 or /K8**	**Type E without** contact **without pulse**	**Type E with MIN** contact **/K1 or /K6**	**Type E with MAX** contact **/K2 or /K7**	**Type E with** pulse output **/CP**
Quickon upper "T"	---	---	MAX contact	MAX contact	Current output	Current output	Current output	Current output
Quickon lower "S"	---	MIN contact	---	MIN contact	---	MIN contact	MAX contact	Puls output

T31.EPS

The load resistance of metering or indicating instruments, which are connected serial to the current output, may not exceed (U- 13.5 V) / 20 mA .

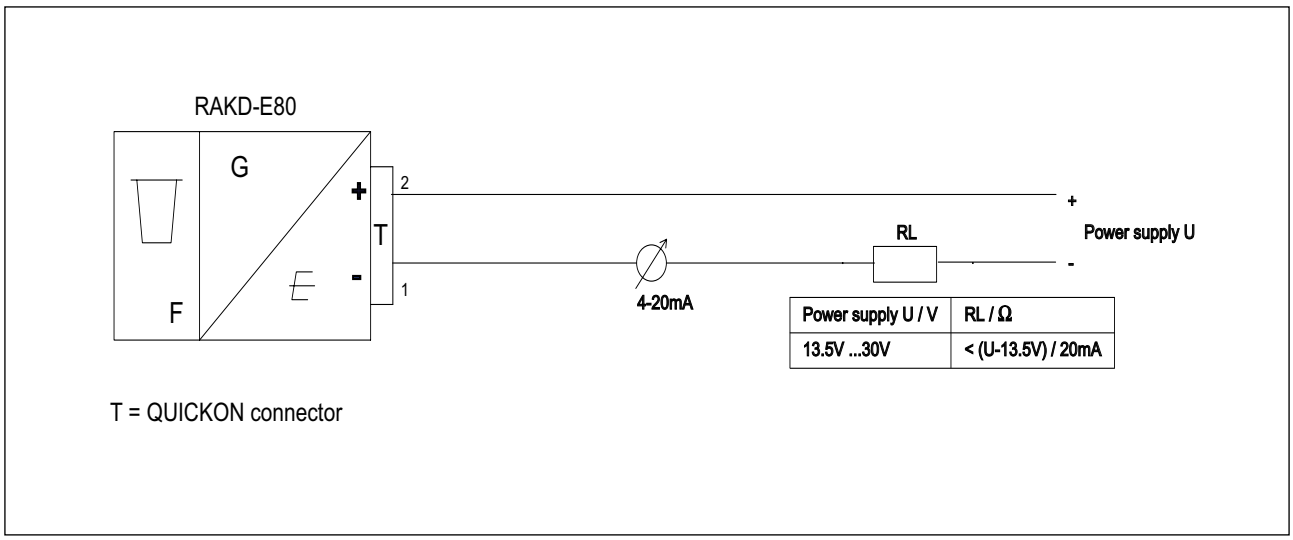


Fig. 3-1 RAKD with electronic Transmitter

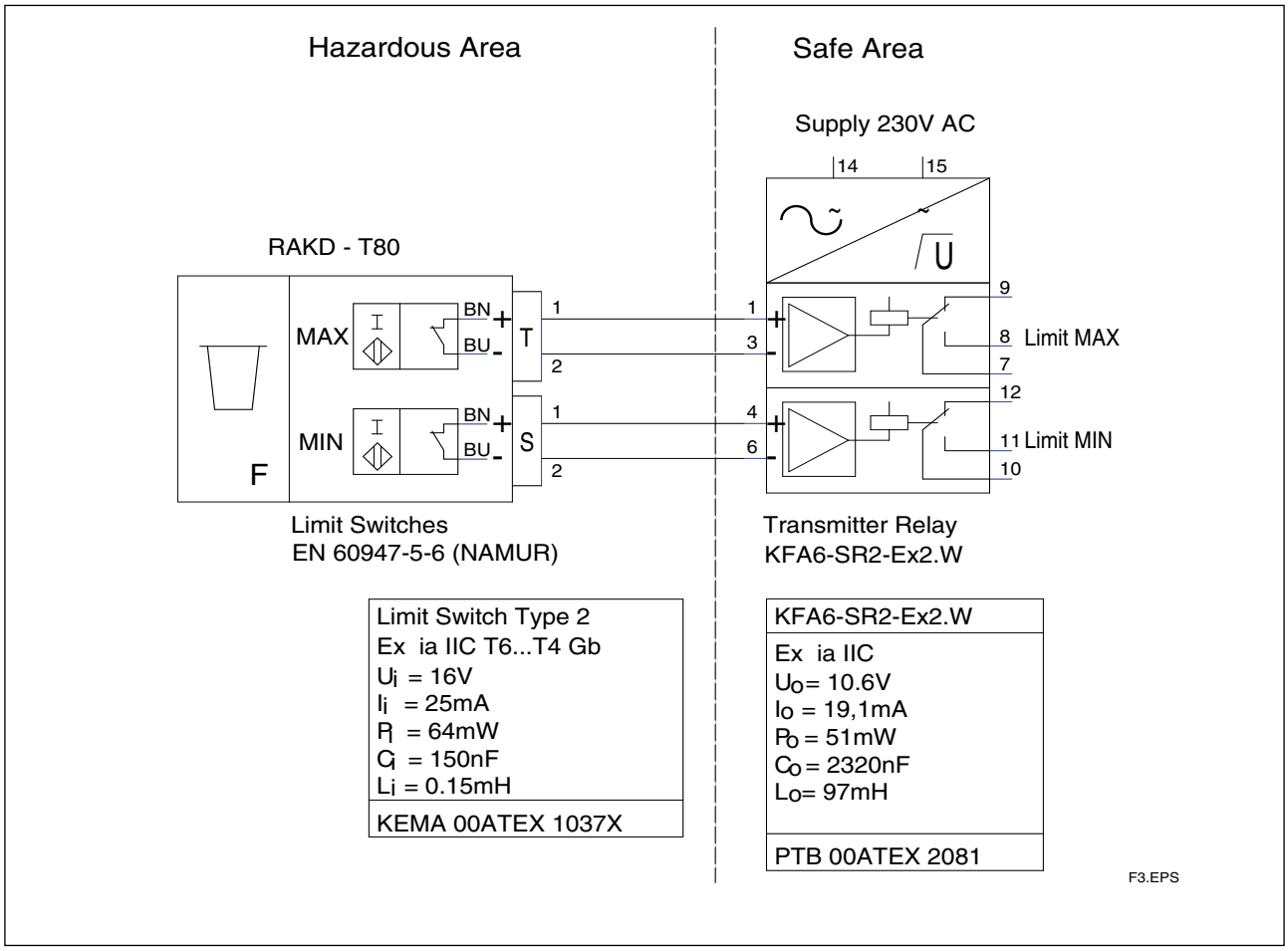


Fig. 3-2 RAKD with 2 limit switches in combination with transmitter relay in Ex- version

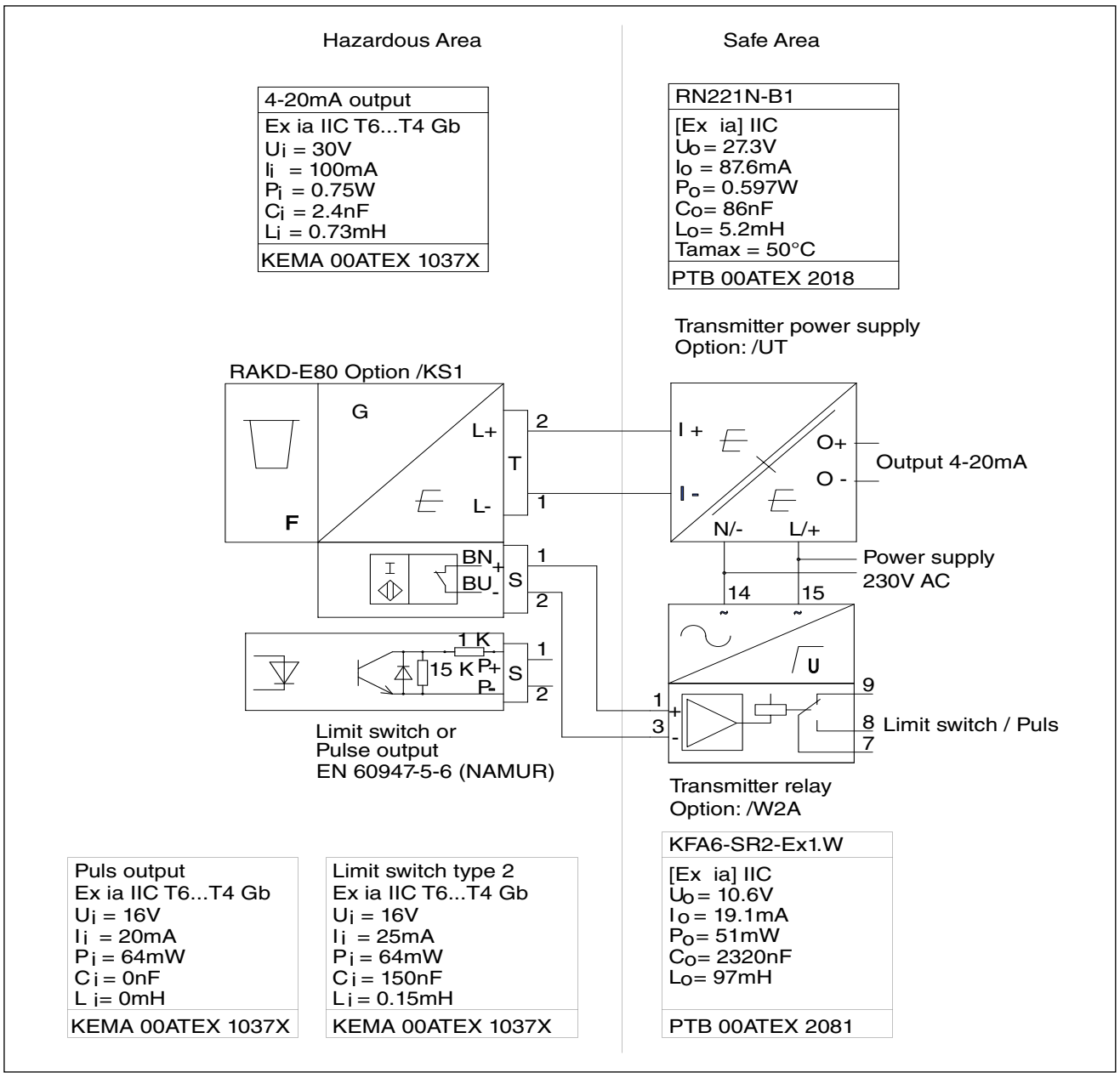


Fig. 3-3 RAKD in Ex-version with electronic transmitter in combination with power supply and additional limit switch or pulse output with transmitter relay.

3.2.2 Conductor connection with Quickon

To connect the conductor, please observe in particular the following steps :

- Strip the sheath to a length of approx. 15 mm (fig. 3-4) and slide the union nut (1), the cap (2) and the rubber seal (3) onto the conductor.

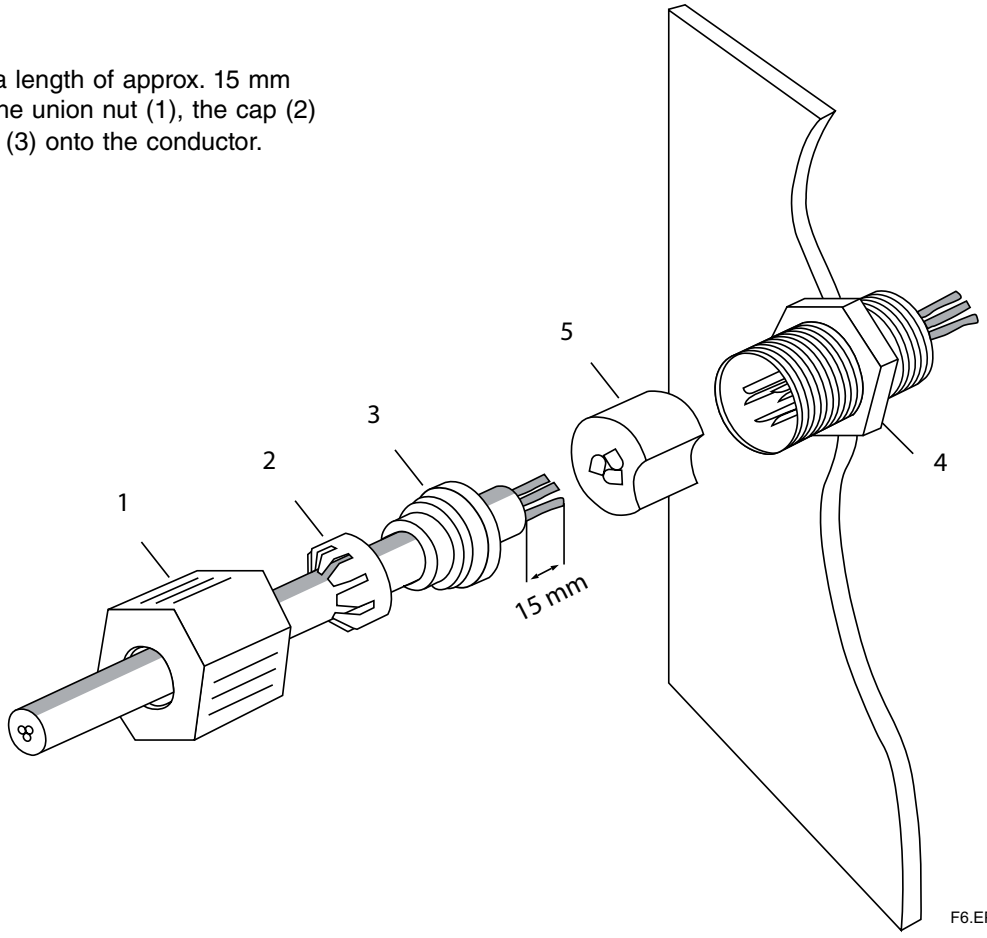


Fig. 3-4

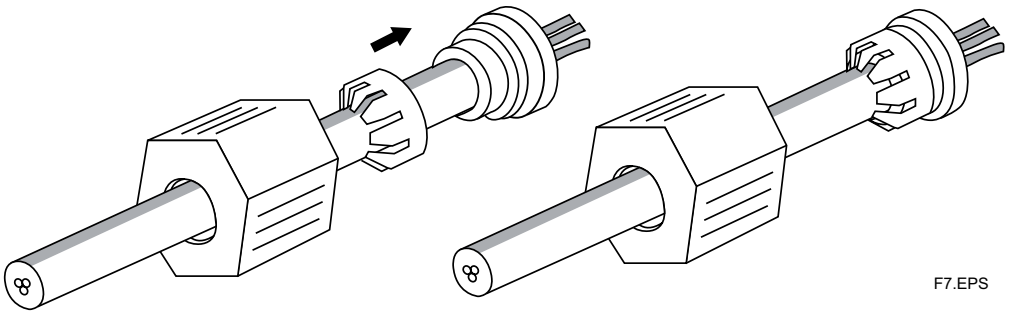
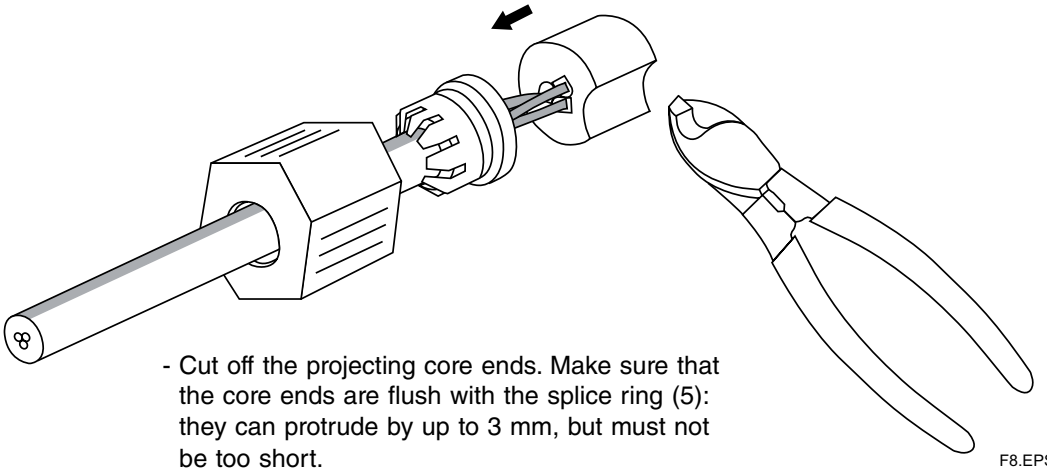


Fig. 3-5

- Slide the rubber seal as far as the rim of the insulation and then slide the cap onto the rubber seal. This provides the strain relief for the conductor (fig. 3-5).

- insert the core ends into the feed through of the splice ring (fig. 3-6). In order to guarantee a clear assignment of the cores, the individual core feed thorough of the splice ring are numbered (1, 2,…).

Fig. 3-6

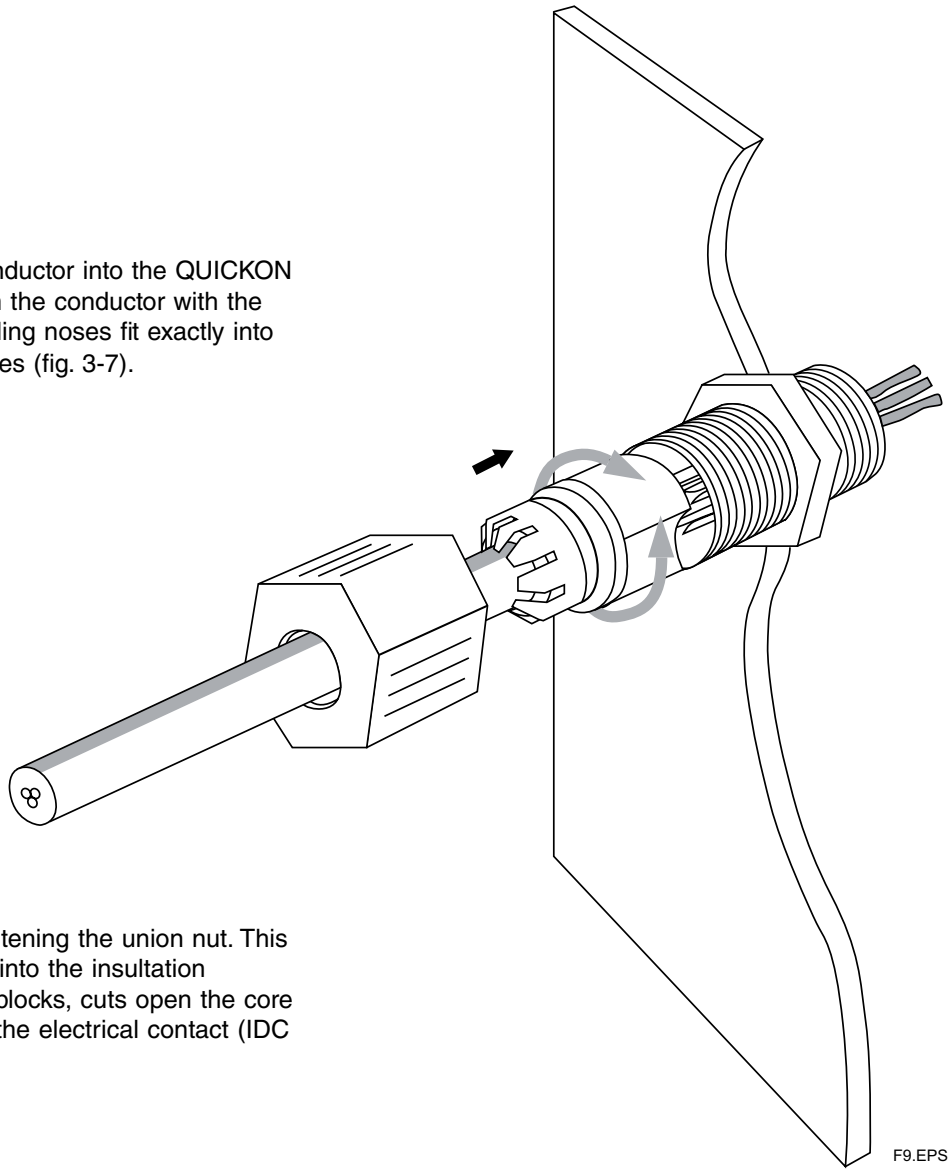


F8.EPS

- Cut off the projecting core ends. Make sure that the core ends are flush with the splice ring (5): they can protrude by up to 3 mm, but must not be too short.

- Insert the prepared conductor into the QUICKON contact carrier (4). Turn the conductor with the splice ring until the coding noses fit exactly into the corresponding guides (fig. 3-7).

Fig. 3-7



F9.EPS

- Close the gland by tightening the union nut. This presses the core ends into the insultation displacement terminal blocks, cuts open the core insulation and creates the electrical contact (IDC connection system).

3.2.3 Conductor M12 connection (Option /A29 or /A30)

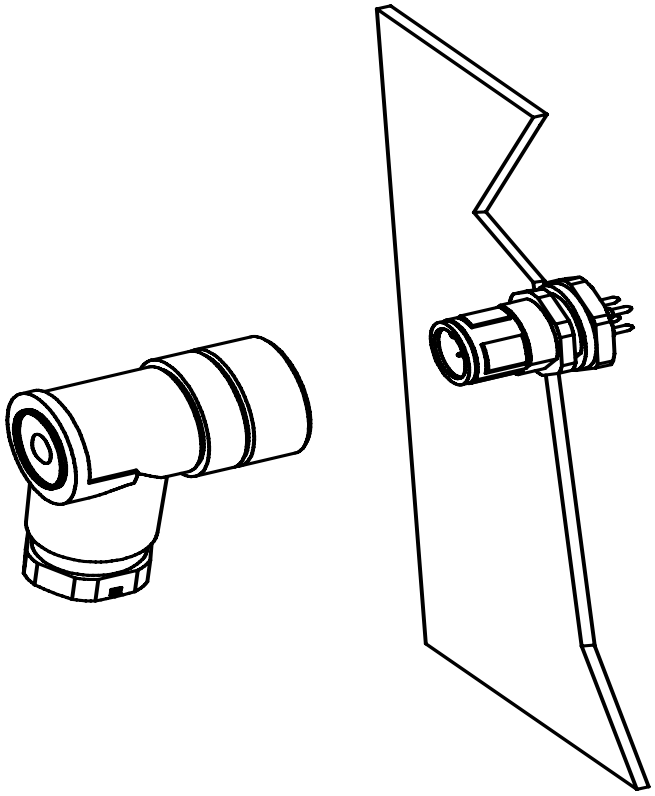
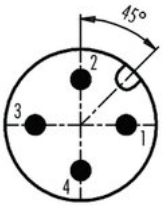


Fig. 3-8

Angular mating connector is only factory delivered with option /A30.

Pin assignment:



Connection	Signal
Upper connector 1 (+) 2 (-)	One limit switch /K1, /K2, /K6, /K7 Two limit switches /K3, /K8, /K9, /K10: lower switch, e.g. MIN MAX ==> MIN
Upper connector 3 (+) 4 (-)	Two limit switches /K3, /K8, /K9, /K10: upper switch, e.g. MIN MAX ==> MAX
Lower connector 1 (+) 2 (-)	Electronic transmitter, 4-20 mA supply
Lower connector 3 (+) 4 (-)	Electronic transmitter, pulse output (option /CP)

4. Start of operation

4.1 Hints on flow rate measurement

The measured fluid should neither consist of a multi-phase mixture nor contain ferrite ingredients or large solid mass particles.
The RAKD scale is adjusted to the state of operation/aggregation of the measured fluid by the manufacturer. If the state of operation changes, it might become necessary to establish a new scale.
This depends on several factors:

- If the RAKD is operated in the given viscosity independent range, only the density of the float as well as the operational density of the previous and new substance have to be considered. In case the operational density only changes marginally (≤ 0.5%), the present scale can be used.
- If the RAMC is operated outside the given viscosity independent range, the viscosities at the previous and new state of operation as well as the mass and diameter of the float have to be taken into account.

To establish a new scale, please refer to the folder "Anweisung zur Skalenumrechnung" (Instructions for Scale Conversion) as well as the conversion table or order a new scale.

4.2 Pulsation and pressure shock

Strong pressure impact or flow pulsations can impair measuring operation considerably and should be avoided open valves slowly, raise operating pressure slowly).

4.3 Start of operation of electronic transmitter

Ensure that the device has been connected correctly according to section 3-2 and that the used power supply meets the requirements indicated on the scale.
Switch on the power supply..
The RAMC is now ready for operation..

The transmitter is prepared and calibrated according to its model code as a 2 wire unit.

Blank Page

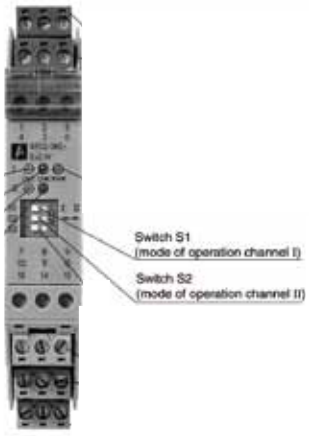
5. Limit switches (Option /K1 to /K10)

The optional limit switches are available as maximum or minimum type switches. They are proximity switches according to EN 60947-5-6 (NAMUR). Maximal two switches can be installed. The option (/Wnn) includes the respective transmitter relay.
These switches have been specified for hazardous area. However, the transmitter relay must be installed in safe area.
The limit switches are connected to the transmitter relays as indicated in chapter 3.2.
The terminals for the limit switches are on a small board on top of the transmitter case.

Use of 2 standard limit switches (option /K3):
The MIN-MIN and MAX-MAX functions have been integrated at the factory as MIN-MAX switches in the RAKD
The MIN-MIN or MAX-MAX function is set by adjusting the switching direction of the transmitter relay. The concerning 2- channel transmitter relays are:
Option /W1B: KFA5-SR2-Ex2.W
Option /W2B: KFA6-SR2-Ex2.W
Option /W4B: KFD2-SR2-Ex2.W
The following table shows the assignment:

Function		Switching direction of transmitter relay *	
Channel 1	**Channel 2**	**Channel 1**	**Channel 2**
MIN	MAX	S1 position I	S2 position I
MIN	MIN	S1 position I	S2 position II (ON)
MAX	MAX	S1 position II (ON)	S2 position I

* see following figure for S1 and S2 on transmitter relay.



Use of Fail Safe limit switches (option /K6 ... /K10):
For Fail Safe application only 1- channel transmitter relays are available.
Option /W2E: KHA6-SH-Ex1.W
Option /W2F: 2 x KHA6-SH-Ex1.W
Option /W4E: KFD2-SH-Ex1.W
Option /W4F: 2 x KFD2-SH-Ex1.W
If other transmitter relays are used as the above mentioned types, the transmitter relay has to be applied as protection technology to ensure functional safety.

Please notice chapter 7.2 "Standard specifications".

For questions regarding protection technology, please consult your YOKOGAWA service center.

Blank Page

6. Service

6.1 Maintenance

6.1.1 Function test

Checking free movement of pointer:
- Remove housing cover (4 screws).
- After deflecting the pointer by hand, it must return to measurement value. If the pointer pivots to different values upon repeated deflections, there is too much friction in the bearings. In this case, send indication unit to service.

Checking free movement of float:
- First, free movement of pointer has to be ascertained.
- Check visually if pointer follows each flow rate change. If not, clean float and measuring tube.

Unit with electronic transmitter:
- Without flow, the output current must be 4 mA. At a flow rate of 100% the current must be 20 mA. If only the pointer is moved to 100%, the current may not exeed 17mA.

6.1.2 Measuring tube, float

The Rotameter does not normally require any maintenance. However cleaning is necessary if the measuring cone or flat has been contaminated by the process. To clean, the Rotameter must be removed from the pipeline.
For all kind of intervention in the Rotameter like tightening the packing of the valve the pressures in pressurized pipelines has to be reduced. Take care that the counter screw is tighten after screwing the valve.

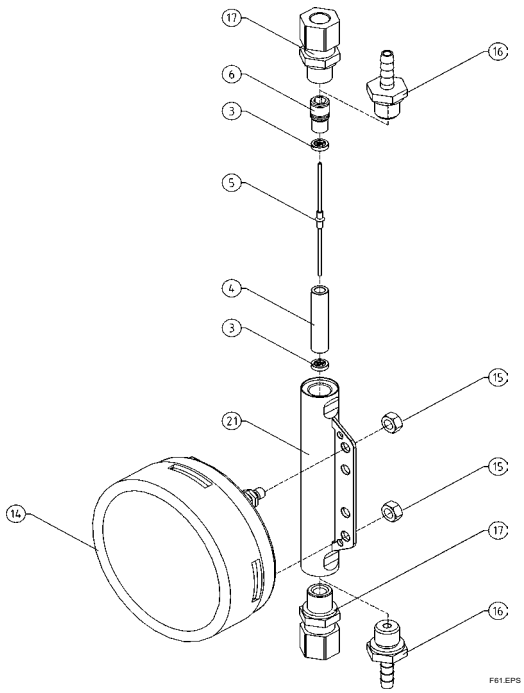
Disassembling the tube
Please perform the following steps to clean the measuring tube and the float:
• Disassemble the Rotameter from the pipe
• Unscrew hollowed top threaded bolt (6) (for cone 31 – 43)
resp. remove top snap ring and socket (for cone 44 – 51)
resp. only top snap ring (for cone 52 – 53)
• Remove top float stop (3)
• Disassemble float – Attention: Do not bend the float
• For version with valve in the inlet remove first the top head pipe plug (8)
• For version with valve in the outlet remove first the lower head pipe plug;
in that case the disassembling of all parts start from down to top
• Cleaning of metering tube and float
• To clean the valve loose screw nut (10) in the head. Afterwards you can unscrew spindle (12) with PTFE packing box plus thrust collar (9)

IMPORTANT

Please don't expose the float to any strong magnetic alternating fields. The floating body and particularly its measuring edge may not be damaged.

Assembling the tube
Mounting starts in opposite sequence.
Assembling the float take care that the lower guide bar of the float is fixed in the middle boring of the lower stop. The guide bar should not be bended.

6.1.3 Explosion drawings



No. in Fig. 6-1 and 6-2	Part
1	Tube for unit with valve and controller
2	Socket
3	Float stop
4	Cone
5	Float
6	Threaded bold
7	Gasket
8	Screw sealing plug
9 ; 10; 11; 12; 13	Packing for valve
14	Indicator
15	Nut M5
16; 19	Nozzle
17; 20	Cutting ring fitting
18	Controller
21	Tube for unit without valve and controller

Fig. 6-1 RAKD without valve and controller

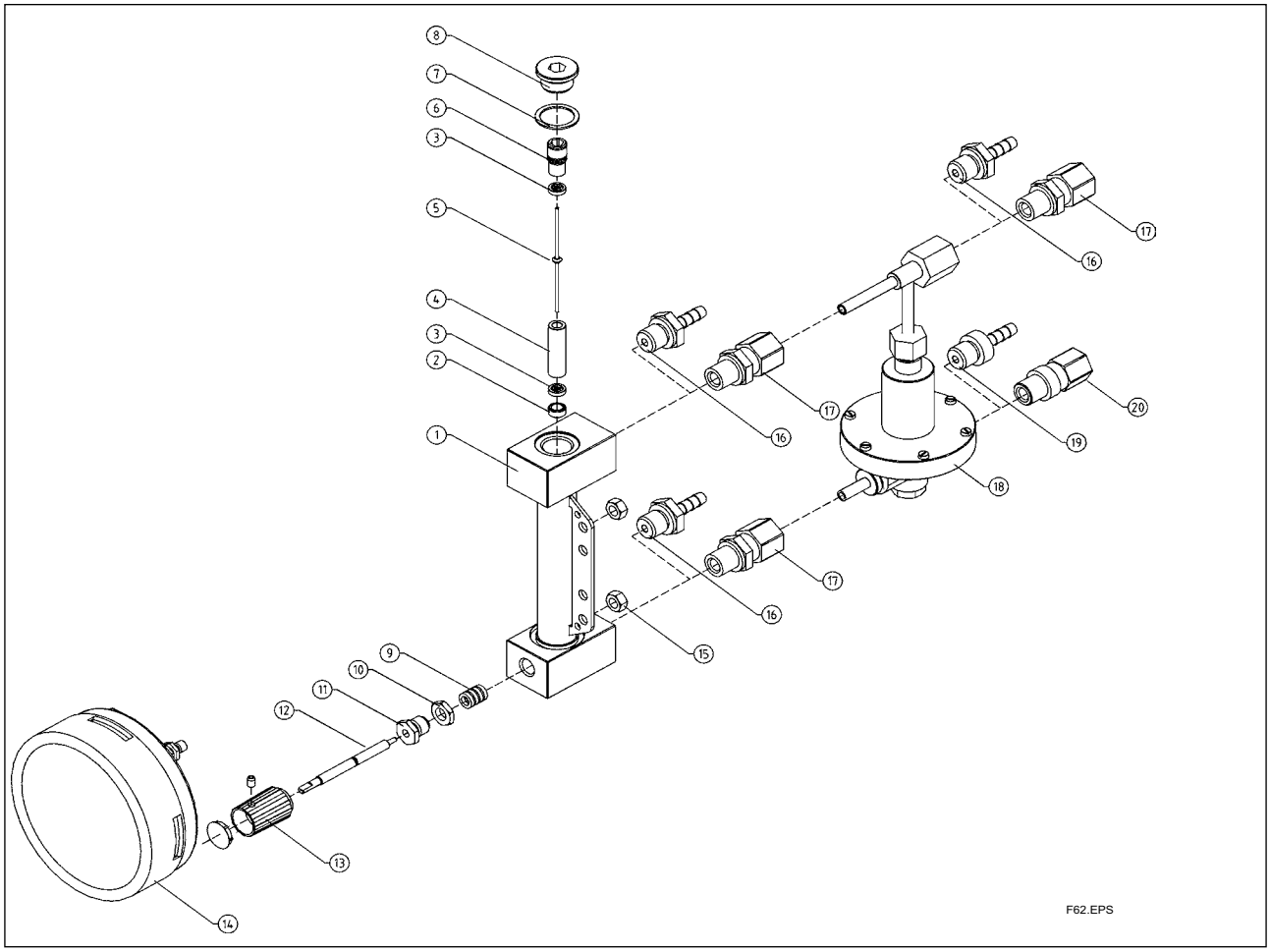


Fig. 6-2 RAKD with valve and controller

6.1.4 Electronic transmitter

The electronic transmitter is maintenance-free. The electronic section is sealed and can not be repaired. The transmitter is tuned with the mechanical components in factory, therefore single components can be replaced only by loss of accuracy.

6.1.5 Exchange of scale

Preparations :

· Check commision no., code, and data of new parts.
· Switch off power supply.
· Remove the cover of the indicator

IMPORTANT

Do not bend or twist the pointer on its axis !

Exchange of scale:

- Untighten the screw of the scale.
- Remove the screw and the small cover.
- Pull the scale out of the indicator to the left in which the scale raised on the right to raise it from the 2 pins.
- Shove the new scale correspondingly below the pointer from the left until the 2 pins click into the accompanying holes.
- Establish the small cover and fix the scale with the screw.

Final actions:

· Fix the cover of the indicator.
· Switch power on.
· Check the unit for a faultless function.

6.1.6 Exchange of indicator

The indicator can be replaced by the same type if the scale of the old unit is put into the new indicator, Procedure with RAKD with electronic transmitter (type "E"):

· Switch off power supply.
· Remove the cover of the indicator
- Disconnect the cables from the Quickon connectors.
- Remove the old scale and put in the new one.

IMPORTANT

- Please not the hints for exchange of scale
- Remove the old indicator from the tube and replace it by the new one. Please take care to mount the washers and spacers in the same positions as they were before dismantling.

6.1.7 Troubleshooting

In case the RAMC does not work properly, use the following flow charts for troubleshooting, then check, isolate and remedy the fault.
Precision problems with "T" unit: execute test acc. fig. 6-3

If the indicated countermeasure do not remedy the fault or in case of troubles which cannot be remedied by the user, please contact your YOKOGAWA service centre.

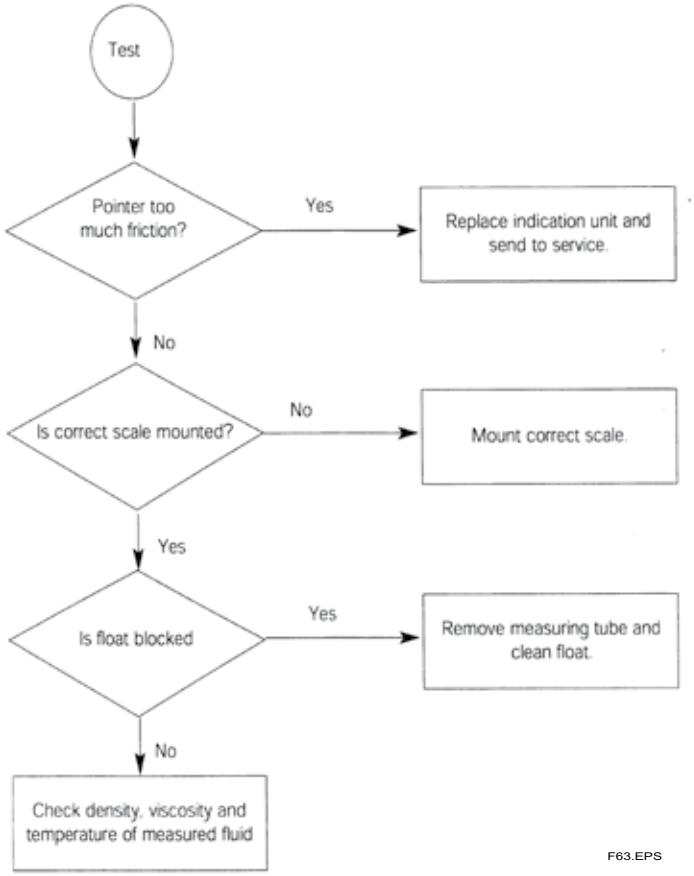


Fig. 6-3

6.2 Template for sending back to service

Sending an instrument back to service
Installation and operation of the Rotameter RAKD in compliance with this manual is generally trouble-free.
In case a RAKD has to be sent for repairs or checking to our service, please observe the following:
Due to legislation for the protection of the environment and for the safety of our staff, YOKOGAWA may only ship, repair and check sent devices on the condition that this does not constitute any risk to environment and staff.
YOKOGAWA can only process your returned RAKD if you attach a certificate of harmlessness according to the following sample.
If the unit has been in contact with corrosive, poisonous, flammable or water polluting substances, you must,
- ensure that all parts and hollow spaces of the unit are free of these dangerous substances.
- attach a certificate of harmlessness to the returned unit.

Please understand that YOKOGAWA cannot process your returned unit without such a certificate.

ROTA YOKOGAWA GmbH & Co. KG
Service & Repair Department
Rheinstraße 8; D - 79664 Wehr
Phone no.: +49 (0)7761-567-190
Fax no.: +49 (0)7761-567-285
e-Mail: services.flow@de.yokogawa.com

Declaration of Decontamination

Legal regulations for the safety of our employees and operating equipment determine that we need the declaration of decontamination before your order can be handled.
Please make sure to include it with the shipping documents, attached to the outside of the packaging you use for shipment.

Customer data		
Company:		
Address:		
Contact person:		E-Mail:
Phone no.:		Fax no.:
Reference/Order no.:		
Instrument data*		
Type:		Serial no.:
Type:		Serial no.:
*If not enough, note on separate sheet		
Process data		
Process medium:		
Medium is:	[ ] toxic [ ] corrosive [ ] explosive [ ] biological hazardous [ ] unknown if dangerous [ ] non hazardous	Remarks:
Cleaning agent:		
Kind of cleaning :		
Other remarks / Reason of return:		

We hereby confirm that this statement is filled in completely and truthfully. The returned instruments were carefully cleaned and are thus free from product residue and dirt. I agree that if this arrangement does not match with the instruments, they will be sent back to the above mentioned customer address at our expenses.

Name Date Signature

7. Technical Data

7.1 RAKD Type-, Suffix-codes and Options

RAKD with valve and controller (option /R1 and /R3) 1.0 - 100 l/h water / 40 - 3250 l/h air

RAKD		SS			80		/ options

Process connection		
Internal thread:		
Rp 1/4 PN 25	41	R3
1/4 NPT PN 25	41	T3
Cutting ring:		
Ø 6 PN 25	53	C3
Ø 8 PN 25	54	C3
Ø 10 PN 25	55	C3
Ø 12 PN 25	56	C3
Nozzle:		
Ø 6 PN 10	53	P1
Ø 8 PN 10	54	P1
Swagelok:		
Ø 6 PN 25	53	W3
Ø 8 PN 25	54	W3
Ø 10 PN 25	55	W3
Ø 12 PN 25	56	W3

Material: 1.4571 / AISI 316Ti	SS

Max. Flow		Cone
Water (l/h)	Air (l/h)	
1	40	31
1.6	60	32
1.5	100	33
4	150	34
6	200	37
10	325	41
16	500	42
25	800	43
40	1400	44
60	2000	47
100	3250	51

Cone	Dp mbar
31 - 37	6
41 - 43	8
44 - 51	11

Version			
With valve in inlet			
Gasket	Valve seat		
PTFE	Sliver	VSE	
PTFE	PCTFE	VPE	
With valve in outlet			
Gasket	Valve seat		
PTFE	Sliver	VSA	
PTFE	PCTFE	VPA	

Indicator		
Type:		
Local indicator		T
Indicator wit electronic output		E
Housing type:		
Stainless steel		80
Power supply:		
none, for type ´T´		NNN
24V, 2- wire, 4 - 20mA, for type ´E´		424

RAKD with valve 1.0 - 250 l/h water / 40 - 8000 l/h air

RAKD		SS				/ options
						80	

Process connection	
Internal thread:	
G 1/4 PN 40	41 G4
G 1/4 PN 100	41 G6
1/4 NPT PN 40	41 T4
1/4 NPT PN 100	41 T6

Cutting ring:	
Ø 6 PN 40	53 C4
Ø 6 PN 100	53 C6
Ø 8 PN 40	54 C4
Ø 8 PN 100	54 C6
Ø 10 PN 40	55 C4
Ø 10 PN 100	55 C6
Ø 12 PN 40	56 C4
Ø 12 PN 100	56 C6

Nozzle:	
Ø 6 PN 10	53 P1
Ø 8 PN 10	54 P1

Swagelok:	
Ø 6 PN 40	53 W3
Ø 6 PN 100	53 W6
Ø 8 PN 40	54 W3
Ø 8 PN 100	54 W6
Ø 10 PN 40	55 W3
Ø 10 PN 100	55 W6
Ø 12 PN 40	56 W3
Ø 12 PN 100	56 W6

Material: 1.4571 / AISI 316Ti	SS

Max. Flow	Cone
Water (l/h)	Air (l/h)	
1	40	31
1.6	60	32
1.5	100	33
4	150	34
6	200	37
10	325	41
16	500	42
25	800	43
40	1400	44
60	2000	47
100	3250	51
160	5000	52
250	8000	53

Cone	Dp mbar
31 - 37	6
41 - 43	8
44 - 51	11
52 - 53	13

Version			
With valve in inlet			
Gasket	Valve seat		
PTFE	Silver	VSE	
PTFE	PCTFE	VPE	
With valve in outlet			
Gasket	Valve seat		
PTFE	Silver	VSA	
PTFE	PCTFE	VPA	

Indicator		
Type:		
Local indicator		T
Indicator wit electronic output		E
Housing type:		
Stainless steel		80
Power supply:		
none, for type ´T´		NNN
24V, 2- wire, 4 - 20mA, for type ´E´		424

RAKD without valve 1.0 - 100 l/h water / 40 - 3250 l/h air

RAKD		-------		SS	----------		NNN	----------		80		/	options

Process connection		
Flange: *)		
DN 15 PN 40	01	D4
DN 25 PN 40	02	D4
ANSI 1/2 150 lbs	01	A1
ANSI 1 150 lbs	02	A1
ANSI 1/2 300 lbs	01	A2
ANSI 1 300 lbs	02	A2
Internal thread:		
G 1/4 PN 100	41	G6
G 1/4 PN 160	41	G7
1/4 NPT PN 100	41	G6
1/4 NPT PN 160	41	G7
Cutting ring:		
Ø 6 PN 100	53	C6
Ø 6 PN 160	53	C7
Ø 8 PN 100	54	C6
Ø 8 PN 160	54	C7
Ø 10 PN 100	55	C6
Ø 10 PN 160	55	C7
Ø 12 PN 100	56	C6
Ø 12 PN 160	56	C7
Nozzle:		
Ø 6 PN 10	53	P1
Ø 8 PN 10	54	P1
Swagelok:		
Ø 6 PN 100	53	W6
Ø 6 PN 160	53	W7
Ø 8 PN 100	54	W6
Ø 8 PN 160	54	W7
Ø 10 PN 100	55	W6
Ø 10 PN 160	55	W7
Ø 12 PN 100	56	W6
Ø 12 PN 160	56	W7

Material: 1.4571 / AISI 316Ti
SS

Max. Flow		Cone
Water (l/h)	Air (l/h)	
1	40	31
1.6	60	32
1.5	100	33
4	150	34
6	200	37
10	325	41
16	500	42
25	800	43
40	1400	44
60	2000	47
100	3250	51

Cone	Dp mbar
31 - 37	6
41 - 43	8
44 - 51	11

Version	
Without valve	NNN

Indicator	
Type:	
Local indicator	T
Indicator wit electronic output	E
Housing type:	
Stainless steel	80
Power supply:	
none, for type ´T´	NNN
24V, 2- wire, 4 - 20mA, for type ´E´	424

*) Gasket PTFE

IM 01R01B30-00E-E 5th edition January 01, 2013 -00

RAKD without valve 160 - 250 l/h water / 5000 - 8000 l/h air

RAKD		SS		NNN		80		/ options

Process connection	
Flange: *)	
DN 15 PN 40	D4
DN 25 PN 40	D4
ANSI 1/2 150 lbs	A1
ANSI 1 150 lbs	A1
ANSI 1/2 300 lbs	A2
ANSI 1 300 lbs	A2
Internal thread:	
G 3/8 PN 100	G6
G 3/8 PN 160	G7
3/8 NPT PN 100	G6
3/8 NPT PN 160	G7
Cutting ring:	
Ø 12 PN 100	C6
Ø 12 PN 160	C7
Swagelok:	
Ø 12 PN 100	W6
*) Gasket PTFE	
Ø 12 PN 160	W7

Material: 1.4571 / AISI 316Ti	SS

Max. Flow	Cone

Water (l/h)	Air (l/h)	
160	5000	52
250	8000	53

Cone	Dp mbar
52 - 53	13

Version	
Without valve	NNN

Indicator	
Type:	
Local indicator	T
Indicator wit electronic output	E

Housing type:	
Stainless steel	80

Power supply:	
none, for type ´T´	NNN
24V, 2- wire, 4 - 20mA, for type ´E´	424

OPTIONS

Options	Option code	Description	Restriction
Indicator	/A12	US- engineering units	Only for indicator E
	/A29	M12- connector acc. IEC 61076-2-101 (in preparation)	Only for indicator E or T with limit switches
	/A30	M12- connector with plug connector acc. IEC 61076-2-101 (in preparation)	Only for indicator E or T with limit switches
Marking	/B1	Tag plate (SS) fixed by wire and customer specified tag number on scale	Plate 12 x 40 mm; max. 45 digits
	/B4	Neutral version	Not with Ex-proof type
	/B8	Customer provided marking on label	
	/B10	Percent scale	
	/BG	With customer specified tag number on scale	Max. 45 digits
	/BD	Dual Scale	Adjustment only possible for 1 fluid
Limit switches	/K1	MIN- contact	
	/K2	MAX- contact	
	/K3	MIN-MAX- contact, MIN-MIN- contact, MAX-MAX- contact	Only for indicator T
	/K6	MIN- contact “Fail safe” version	
	/K7	MAX- contact “Fail safe” version	
	/K8	MIN-MAX- contact “Fail safe” version	Only for indicator T
	/K9	MIN-MIN- contact “Fail safe” version	Only for indicator T
	/K10	MAX-MAX- contact “Fail safe” version	Only for indicator T
Pulse output	/CP	Pulse output, acc. EN 60947-5-6 (NAMUR)	Only for indicator E; not with limit switches
Hazardous area approvals	/KS1	ATEX intrinsically safe „ia“	Not for indicator T without limit switches
	/KS2	ATEX gas and dust proof limit switches, category 2G 1D	Only for indicator T with limit switches
	/KS3	ATEX intrinsically safe „ic“	Not for indicator T without limit switches
	/KN1	ATEX category 3G „nL“ / 3D	Not for indicator T without limit switches
	/ES1	IECEx intrinsically safe „ia“	Not for indicator T without limit switches
	/ES3	IECEx intrinsically safe „ic“	
	/FS1	FM intrinsically safe / non incendive limit switches (USA)	For indicator T only with limit switches
	/CS1	CSA intrinsically safe / non incendive limit switches (Canada)	For indicator T only with limit switches; limit switches only /K1, /K2, /K3, only in combination with power supply /WxA or /WxB
	/NS1	NEPSI approval (China)	Not for indicator T without limit switches
Test and certificates	/H1	Oil + fat free for wetted surfaces	Not for /R1 and /R3
	/PP	Pressure test report measuring system	
	/P2	Certificate of Compliance with the order acc. to EN 10204: 2004- 2.1	
	/P3	As /P2 +Test report acc. to EN 10204: 2004- 2.2	Only for tube, connection heads, screw sealing plug
	/P6	Material certificate acc. to EN 10204: 2004- 3.1	
	/PM1	PAMI test (1 test point : metering tube)	Only for models with valve
	/PM4	PAMI test (4 test points : metering tube, connection heads, sealing plug)	Only for models with process connection D4, A1, A2
	/PM5	PAMI test (5 test points : metering tube, connection pieces, slip on flanges)	
Gost approval	/QR1	Primary Calibration and Test Confirmation valid in Russia	See page 4
	/QR2	Primary Calibration and Test Confirmation valid in Kazakhstan	See page 4
	/QR3	Primary Calibration and Test Confirmation valid in Uzbekistan	See page 4
Controller	/R1	Pre pressure controller 1.4571 (only with valve in inlet; for gas with variable pre pressure and liquids with variable pre and back pressure)	Only for process connection R3, T3, C3, W3, P1; only with valve
	/R3	Back pressure controller 1.4571 (only with valve in outlet; for gas with variable back pressure)	Only for process connection R3, T3, C3, W3, P1; only with valve
Delivery to Korea	/KC	With KC-mark for Korea	
Power supply for electronic transmitter	/UT	RN221N-B1, 20 ... 250V DC/AC, Ex i	Only for indicator E
Power supply for limit switches (transmitter relay)	/W1A	KFA5-SR2-Ex1.W / 115 V AC, 1 channel	Only for limit switches /K1, /K2, /K3 or /CP
	/W1B	KFA5-SR2-Ex2.W / 115 V AC, 2 channel	Only for limit switches /K1, /K2, /K3
	/W2A	KFA6-SR2-Ex1.W / 230 V AC, 1 channel	Only for limit switches /K1, /K2, /K3 or /CP
	/W2B	KFA6-SR2-Ex2.W / 230 V AC, 2 channel	Only for limit switches /K1, /K2, /K3
	/W2E	KHA6-SH-Ex1 / 115/230 V AC, 1 channel, Fail Safe	Only for limit switches /K6, /K7
	/W2F	2x KHA6-SH-Ex1 / 115/230 V AC, 1 channel, Fail Safe	Only for limit switches /K8, /K9, /K10
	/W4A	KFD2-SR2-Ex1.W / 24 V DC, 1 channel	Only for limit switches /K1, /K2, /K3 or /CP
	/W4B	KFD2-SR2-Ex2.W / 24 V DC, 2 channel	Only for limit switches /K1, /K2, /K3
	/W4E	KFD2-SH-Ex1 / 24 V DC, 1 channel, Fail Safe	Only for limit switches /K6, /K7
	/W4F	2x KFD2-SH-Ex1 / 24 V DC, 1 channel, Fail Safe	Only for limit switches /K8, /K9, /K10
Instruction manuals	/IEn	Quantity of instruction manuals in English	n = 1 to 9 selectable *)
	/IDn	Quantity of instruction manuals in German	n = 1 to 9 selectable *)
	/IFn	Quantity of instruction manuals in French	n = 1 to 9 selectable *)
Special order	/Z	Special design must be specification on extra sheet	
*) if no instruction manual is selected, only a DVD with instruction manuals is shipped with the flowmeter			

7.2 Standard Specifications

The responsibility with respect to the suitability and according application of our flowmeter is only situated by the customer.

MEASURING TUBE

Materials of wetted parts : Stainless steel AISI 316Ti (1.4571)
other materials on request
Fluids to be measured : Liquid or gas
Measuring range : see flow table
Measuring range ratio : 10:1
Process connections :
– Inner thread : G1/4; 1/4 NPT; G 3/8; 3/8; NPT
– Cutting ring : 6 mm; 8 mm; 10 mm; 12 mm
– Cutting ring (Swagelok) : 6 mm; 8 mm; 10 mm; 12 mm
– Nozzle : 6 mm; 8 mm
– Flange : - acc. EN 1092-1
DN15 and DN25 PN40;
- acc. ASME B 16.5 ½" and 1"
150 lbs, 300 lbs
- gasket PTFE
Process pressure : depends on process connection; see model code
Process temperature : without valve -25°C to 250°C
with valve -25°C to 150°C
See also fig. 6. Lower temperatures on request.
Measurement accuracy : acc. Directive VDI/VDE 3513 sheet 2 (q_G=50%) 4%
Installation :
– Installation position : vertical
– Flow direction : upwards
– Face to face length : 125 mm (with flange 250 mm)
Weight : see table 7-14

LOCAL INDICATOR

(Indicator/Code -T)
Principle :
The indication is made by magnetic coupling of a magnet enclosed in the float and a magnet in the indication unit, which follows the movements of the float.
Indication scale : Flow units
Indicator housing
– Material : Stainless steel AISI 304 (1.4301)
– Degree of Protection : IP66/67
Scales :
- Standard : removable aluminium plate with scale (double scale as option)
Transportation and storage condition
: - 40°C to +110°C

.

ELECTRONIC TRANSMITTER

(Indicator/Code -E)
Temperature range
: -25°C to +65°C
Transportation and storage condition
: -40°C to +70°C
Process-/ Ambient temperature :
The dependency of the process temperature from the ambient temperature is shown in fig.6.
Power supply : 14 ... 30 V DC
Load resistance : (U - 14V) / 20 mA, max. 500 Ω
Analog output : 4-20 mA
Linearity : ≤ ± 0.25% f.s.
Hysteresis : ≤ ± 0.15% f.s.
Repeatability : ≤ ± 0.16% f.s.
Influence of power supply
: ≤ ± 0.1% f.s.
Temp. coefficient of analog output
: ≤ ± 0.5% /10 K f.s.
AC-part of analog output
: ≤ ± 0.15% f.s.
Long time stability : ≤ ± 0.2% / year
Maximum output current
: 21.5 mA
Output current in case of failure
: ≤ 3.6 mA (NAMUR NE 43)
Response time (99%)
: approx. 1 s
Pulse output (Option /CP)
: Electronic switch with galvanic isolation
acc. EN 60947-5-6 (NAMUR)
- Pulse length : 200 ms
- Max. frequency : 4 Hz
- Pulse rate : Qmax ≤ 1 → 0.0001
: 1 < Qmax ≤ 10 → 0.001 etc.
e.g.. Qmax = 1 m3/h →
1 Puls = 0.0001 m^3 = 0.1
Electromagnetic compatibility (EMC)
- EN 61326-1: 2006, Class A, Table 2
EN 61326-2-3 : 2006

POWER SUPPLY FOR ELECTRONIC TRANSMITTER

(Option /UT)
Type :
Power supply with galvanically separated input and output
- RN221N-B1, HART- compatible
Supply voltage :
20 ... 250 V DC / AC 50/60 Hz
Maximum load :
700 Ω
Output signal :
4 - 20 mA

ELECTRICAL CONNECTION (Indicator/Code -E) :

Type : Quickon
Cable diameter : 4 – 6 mm
Maximum cross section of core
: Ø 0.34 to 0.75 mm^2

LIMIT SWITCHES IN STANDARD VERSION
(option /K1 to /K3)

Type : Inductive proximity switch SC2-NO acc. DIN EN 60947-5-6
Nominal voltage : 8V DC
Output signal : ≤ 1 mA or ≥ 3 mA
Hysteresis : < 0.5mm

LIMIT SWITCHES IN FAIL SAFE VERSION
(option /K6 to /K10)

Type : Inductive proximity switch SJ2-SN; SJ2-S1N acc. DIN EN 60947-5-6
Nominal voltage : 8V DC
Output signal : ≤ 1 mA or ≥ 3 mA
Hysteresis : < 0.5mm

HYSTERESIS OF LIMIT SWITCHES
Min-contact / Max-contact :
- pointer movement : ≈ 0.8 mm
- float movement : ≈ 0.8 mm

Minimum distance between 2 contacts
: ≈ 8 mm

ELECTRICAL CONNECTION (option /K1 to /K10) :
Type : Quickon
Cable diameter : 4 – 6 mm
Maximum cross section of core
: Ø 0.34 to 0.75 mm^2

POWER SUPPLY FOR LIMIT SWITCHES (Option /W__)
Type : Transmitter relay acc. DIN EN 50227 (NAMUR)
- KFA6-SR2-Ex1-W (230 V AC)
- KFA5-SR2-Ex1-W (115 V AC)
- KFD2-SR2-Ex1-W (24 V DC)
- KHA6-SH-Ex1 (115/230 V AC), Fail Safe, only one channel
- KFD2-SH-Ex1 (24 V DC), Fail Safe, only one channel

Power supply :
- 230 V AC ± 10%, 45-65Hz
- 115 V AC ± 10%, 45-65Hz
- 24 V DC ± 25%

Relay output : 1 or 2 potential-free change over contact(s)
Switching capacity
: max. 250V AC, max. 2 A

Note :
If Fail-Safe limit switch option /K6 or /K7 is ordered, for power supply option /W2E or /W4E must be selected.
If Fail-Safe limit switch option /K8, /K9 or /K10 is ordered, for power supply option /W2F or /W4F must be selected.

SWITCHING LEVELS FOR LIMIT SWITCHES

Table 7-1 Min, Max and Min-Max-contact in standard version

		Option /K1	Option /K2	Option /K3
Function	Pointer	Signal	Signal	Signal
		SC2-N0	SC2-N0	SC2-N0
MAX	above LV	----	1 mA	1 mA
	below LV	----	3 mA	3 mA
Function	Pointer	Signal	Signal	Signal
		SC2-N0	SC2-N0	SC2-N0
MIN	above LV	3 mA	----	3 mA
	below LV	1 mA	----	1 mA
Note: LV = Limit value				

Table 7-2 Min, Max and Min-Max-contact in fail-safe version

		Option /K6	Option /K7	Option /K8
Function	Pointer	Signal	Signal	Signal
		SJ2-SN	SJ2-SN	SJ2-SN
MAX	above LV	----	1 mA	1 mA
	below LV	----	3 mA	3 mA
	Fail Safe	----	1 mA	1 mA
Function	Pointer	Signal	Signal	Signal
		SJ2-SN	SJ2-SN	SJ2-SN
MIN	above LV	3 mA	----	3 mA
	below LV	1 mA	----	1 mA
	Fail Safe	1 mA	----	1 mA
Note: LV = Limit value				

Table 7-3 Limit switch as Min-Min-contact in fail-safe version

		Option /K9
Function	Pointer	Signal
		SJ2-S1N
MIN	above LV	3 mA
	below LV	1 mA
	Fail Safe	1 mA
Function	Pointer	Signal
		SJ2-SN
MIN	above LV	3 mA
	below LV	1 mA
	Fail Safe	1 mA
Note: LV = Limit value		

Table 7-4 Limit switch as Max-Max-contact in fail-safe version

		Option /K10
Function	Pointer	Signal
		SJ2-SN
MAX	above LV	1 mA
	below LV	3 mA
	Fail Safe	1 mA
Function	Pointer	Signal
		SJ2-S1N
MAX	above LV	1 mA
	below LV	3 mA
	Fail Safe	1 mA
Note: LV = Limit value		

CONTROLLER (Option /R1 and R3)

Differential pressure controller for a constant flow at fluctuations of the process pressure.
These are no valves to reduce the pressure.

- **Controller /R1** for liquids with variable inlet or outlet pressure and for gases with variable inlet pressure and constant back pressure.
- **Controller /R3** for gases with fluctuations of the back pressure.

Max. liquid flow : 100 l/h
Max. gas flow : 3250 l/h
Max. pressure : 25 bar
Recommended differential pressure : >400 mbar
Temperature range : -25°C to + 80°C
Materials :
Table 7-5

	Housing	Diaphragm	Springs
/R1 / /R3	CrNi-Steel	PTFE	CrNi-Steel

l/h air at 20°C ; 1.013 bar abs.

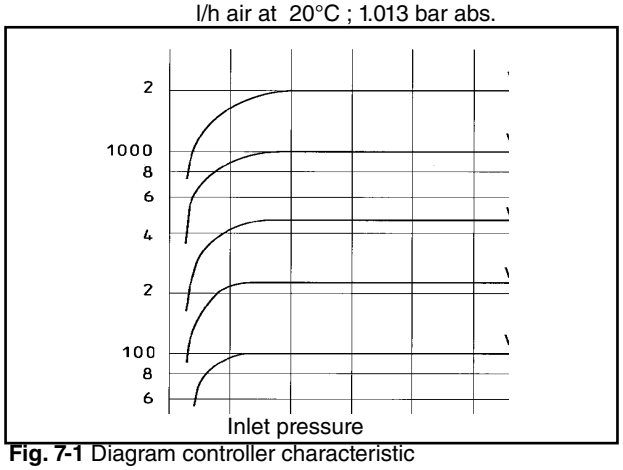


Fig. 7-1 Diagram controller characteristic

COMPLIANCE WITH IEC 61508

RAKD with local indicator and standard or fail safe limit switches (RAKD[][]-[][]SS-[][][][][]-T[][]NNN/K1…K10):
Suitable for application in safety functions up to and including SIL2.
RAKD with valve and controller with local indicator and standard or fail safe limit switches (RAKD[][]-[][]SS-[][]V[][]-T[][]NNN/R[]/K1…K10):
Suitable for application in safety functions up to and including SIL1.
Reliability data available on request in FMEDA report.

COMPLIANCE WITH ISO 13849

For Safety Metrics acc. to ISO 13849-2 please refer to the FMEDA report.

METROLOGICAL REGULATION IN CIS (GOST)

RAKD has “Pattern Approval Certificate of Measuring Instruments” and is registered as a measuring instrument in Russia, Kazakhstan, Uzbekistan, Belarus and Ukraine.
The calibration laboratory of Rota Yokogawa is approved by Federal Agency on Technical Regulating and Metrology in Russia and other Metrological Organizations in CIS countries to issue primary calibration confirmations for RAKD, option /QR[].
Furthermore RAKD is RTN (GGTN) approved for installation in hazardous areas.
For export to CIS countries please contact your Yokogawa representative.

HAZARDOUS AREA SPECIFICATIONS

RAKD with ATEX- certification “intrinsic safe” (option /KS1)

Certificate :
KEMA 00ATEX 1037X
Output signal :
4–20 mA / Pulse output / Limit switches
Explosion proof :
Ex ia IIC T6 ... T4 Gb
Entity parameter :
Table 7-6

	Analog output	Pulse output	Limit switch type 2 /K1-/K3	Limit switch type 3 /K1-/K3	Limit switch type 2 /K6-/K8	Limit switch type 3 /K6-/K8
Ui [V]	30	16	16	16	16	16
Ii[mA]	100	20	25	52	25	52
Pi [mW]	750	64	64	169	64	169
Li [mH]	0.73	0	0.15	0.15	0.1	0.1
Ci [nF]	2.4	0	150	150	30	30

Temperature specification :
Table 7-7

Configuration	Max. ambient temperature	Max. process temperature	Temperature class
Transmitter 4-20mA / Pulse	65°C	65°C	T6
	50°C	80°C	
	45°C	100°C	T5
	38°C	135°C	T4
Limit switch(es) type 2	65°C	65°C	T6
	80°C	80°C	T5
	59°C	100°C	
	100°C	100°C	T4
	73°C	135°C	
Limit switch(es) type 3	24°C	65°C	T6
	37°C	80°C	T5
	34°C	100°C	
	57°C	80°C	T4
	54°C	100°C	
	48°C	135°C	

For the configuration where a transmitter is combined with limit switches, the temperature class is determined by the most restrictive combinations of maximum ambient temperature and maximum process temperature.
Description of limit switch type 2 and 3 see ATEX certificates from Pepperl & Fuchs:

- PTB 99 ATEX 2219X (SC2-NO) for /K1 to /K3
- PTB 00 ATEX 2049X (SJ2-S.N) for /K6 to /K10

RAKD “non incendive” (option /KN1)

Type “n” (non incendive) acc. EN 60079-15.
Explosion proof :
Ex nL IIC T6 protection „nL”; group II ; category 3G
Dust proof :
Ex II 3D; group II ; category 3D
Max. surface temperature : 80°C
Entity parameter :
see table 7-6
Temperature specification :
see table 7-7

RAKD with ATEX- certification “intrinsic safe ic” (option /KS3)

Output signal :
4–20 mA / Pulse output / Limit switches
Explosion proof :
Ex ic IIC T6; Gc group II ; category 3G
Entity parameter :
see table 6
Temperature specification :
see table 7

RAKD with IECEx- certification “intrinsic safe” (option /ES1)

Certificate :
IECEx DEK 12.0003X
Output signal :
4–20 mA / Pulse output / Limit switches
Explosion proof :
Ex ia IIC T6 ... T4 Gb
Entity parameter :
Table 8

	Analog output	Pulse output	Limit switch type 2 /K1-/K3	Limit switch type 3 /K1-/K3	Limit switch type 2 /K6-/K8	Limit switch type 3 /K6-/K8
Ui [V]	30	16	16	16	16	16
Ii[mA]	100	20	25	52	25	52
Pi [mW]	750	64	64	169	64	169
Li [mH]	0.73	0	0.15	0.15	0.1	0.1
Ci [nF]	2.4	0	150	150	30	30

Temperature specification :
Table 9

Configuration	Max. ambient temperature	Max. process temperature	Temperature class
Transmitter 4-20mA / Pulse	65°C	65°C	T6
	50°C	80°C	
	45°C	100°C	T5
	38°C	135°C	T4
Limit switch(es) type 2	65°C	65°C	T6
	80°C	80°C	T5
	59°C	100°C	
	100°C	100°C	T4
	73°C	135°C	
Limit switch(es) type 3	24°C	65°C	T6
	37°C	80°C	T5
	34°C	100°C	
	57°C	80°C	T4
	54°C	100°C	
	48°C	135°C	

For the configuration where a transmitter is combined with limit switches, the temperature class is determined by the most restrictive combinations of maximum ambient temperature and maximum process temperature.
Description of limit switch type 2 and 3 see IECEx certificates from Pepperl & Fuchs:
- IECEx PTB 11.0091X (SC2-NO) for /K1 to /K3
- IECEx PTB 11.0092X (SJ2-S.N) for /K6 to /K10

RAKD with IECEx- certification “intrinsic safe ic” (option /ES3)

Output signal :
4–20 mA / Pulse output / Limit switches
Explosion proof :
Ex ic IIC T6; Gc group II ; category 3G
Entity parameter :
see table 8
Temperature specification :
see table 9

RAKD with NEPSI- certification “intrinsic safe” (China) (option /NS1) :

Certificate :
GYJ101552
Output signal :
4–20 mA
Explosion proof :
Ex ia IIC T5/T6
Max. Tamb. :
65°C
Limit switches :
option /K1 to /K8, see certificates GYJ11.1505X
Entity parameter :
Table 10

	Analog output	Pulse output	Limit switch type 2 /K1-/K3	Limit switch type 3 /K1-/K3	Limit switch type 2 /K6-/K8	Limit switch type 3 /K6-/K8
Ui [V]	30	16	16	16	16	16
Ii[mA]	100	20	25	52	25	52
Pi [mW]	750	64	64	169	64	169
Li [mH]	0.73	0	0.15	0.15	0.1	0.1
Ci [nF]	2.4	0	150	150	30	30

Temperature specification :
Table 11

Max. ambient temperature	Max. process temperature	Temperature class
65°C	65°C	T6
50°C	80°C	T6
45°C	95°C	T5

Description of limit switch type 2 and 3 see ATEX certificates from Pepperl & Fuchs:
- PTB 99 ATEX 2219X (SC2-NO) for /K1 to /K3
- PTB 00 ATEX 2049X (SJ2-S.N) for /K6 to /K10

RAKD with PESO- certification (India)

Option /KS1 must be selected. PESO- certificate is available at your Yokogawa Sales Office.

RAKD with KOSHA- certification (Korea)

Option /ES1 must be selected.
Same data as for IECEx certification.

Intrinsically safe and dust proof limit switches with ATEX-certification (only for indicator T with option /K1 ... /K10) (option /KS2) :

Certificate :
- PTB 99 ATEX 2219X (SC2-NO)
- PTB 00 ATEX 2049X (SJ 2-S.N)
- ZELM 03 ATEX 0128X (for dust proof)

Explosion proof :
EEx ia IIC T6, group II category 2G

Dust proof:
Ex iaD 20 T 108 °C, group I I category 1D
Max. surface temperature : T108°C

Entity parameter :
see certificate of conformity

Intrinsically safe / non incendive limit switches with FM- certification (USA) (only for indicator T with option /K1 ... /K10) (option /FS1) :

Explosion proof :
IS : Cl. I, Div. 1, Gp. ABCD, T6, Ta = 60°C,
NI : Cl. I, Div. 2, Gp. ABCD, T5, Ta = 50°C
Cl. II, Div. 1, Gp. EFG
Cl. III, Div. 1

Entity parameter :
see FM-control drawing 116-0165 for IS
see FM-control drawing 116-0155 for NI

Intrinsically safe limit switches with CSA- certification (Canada) (only for indicator T with option /K1 ... /K3) (option /CS1) :

Explosion proof :
Cl. I, II, III, Div. 1, Gp. ABCDEFG

Entity parameter :
see drawing 116-0047

Only in combination with option /WxA or /WxB.

Power Supply for the intrinsically safe electronic transmitter (option /UT)

Type :
Power supply with galvanically separated input and output
- RN221N-B1, HART- compatible

Certificate :
PTB 00 ATEX 2018

Supply voltage :
20 ... 250 V DC / AC 50/60 Hz

Maximum load impedance :
700 Ω

Output signal :
4 - 20 mA

Control circuit :
Intrinsically safe [Ex ia] IIC; group II ; category (1)GD

Entity parameters :
see fig. 5

Power supply for intrinsically safe limit switches (option W__) :

Type : acc. DIN EN 50227 (NAMUR)
- KFA5-SR2-Ex*-W (115 V AC)
- KFA6-SR2-Ex*-W (230 V AC)
- KFD2-SR2-Ex*-W (24 V DC)
- KHA6-SH-Ex1 (115/230 V AC), Fail Safe, 1 channel
- KFD2-SH-Ex1 (24 V DC), Fail Safe, 1 channel

Certificates :

- KFA5-SR2-Ex*-W:	ATEX	: PTB 00 ATEX 2081
	CSA	: 1029981 (LR 36087-19)
	FM	: ID 3011578
	IECEx	: PTB11.0031
	PESO	
	KOSHA	: 2009-BO-0157
- KFA6-SR2-Ex*-W:	ATEX	: PTB 00 ATEX 2081
	CSA	: 1029981 (LR 36087-19)
	FM	: ID 3011578
	IECEx	: PTB11.0031
	PESO	
	KOSHA	: 2009-BO-0157
- KHA6-SH-Ex1:	ATEX	: PTB 00 ATEX 2043
- KFD2-SR2-Ex*-W:	ATEX	: PTB 00 ATEX 2080
	CSA	: 1029981 (LR 36087-19)
	FM	: ID 3011578
	IECEx	: PTB11.0034
	PESO	
	KOSHA	: 2009-BO-0157
	NEPSI	: GYJ12.1081
- KFD2-SH-Ex1:	ATEX	: PTB 00 ATEX 2042
	NEPSI	: GYJ091350

Control circuit (ATEX): [Ex ia] IIC; group II; category (1)GD
Entity parameter: see fig. 5 **(**ATEX) and certificate

Power supply :
- 230 V AC ± 10%, 45-65Hz
- 115 V AC ± 10%, 45-65Hz
- 24 V DC ± 25%

Relay output : 1 or 2 potential-free changeover contact(s)

Switching capacity : max. 250V AC, max. 2 A

7.3 Dimensions and weights

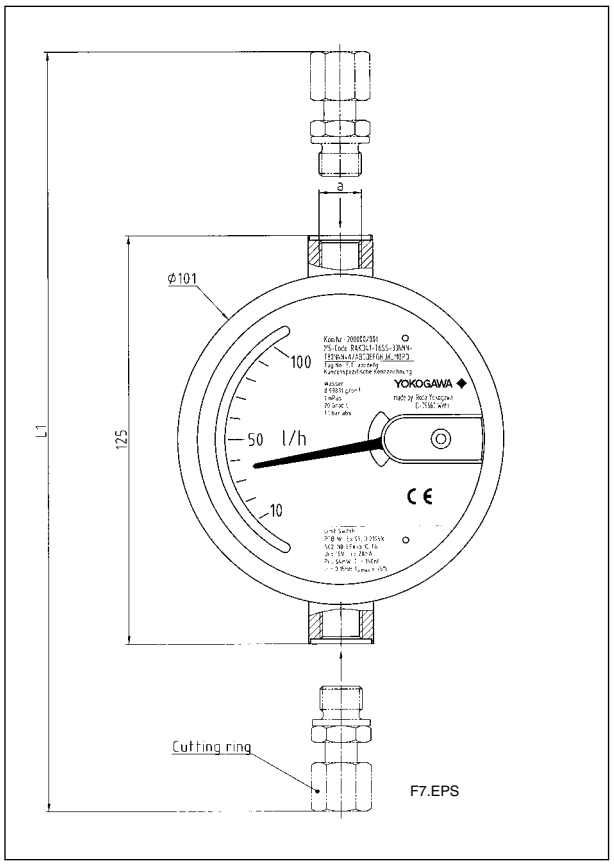


Fig. 7-2 Version without valve

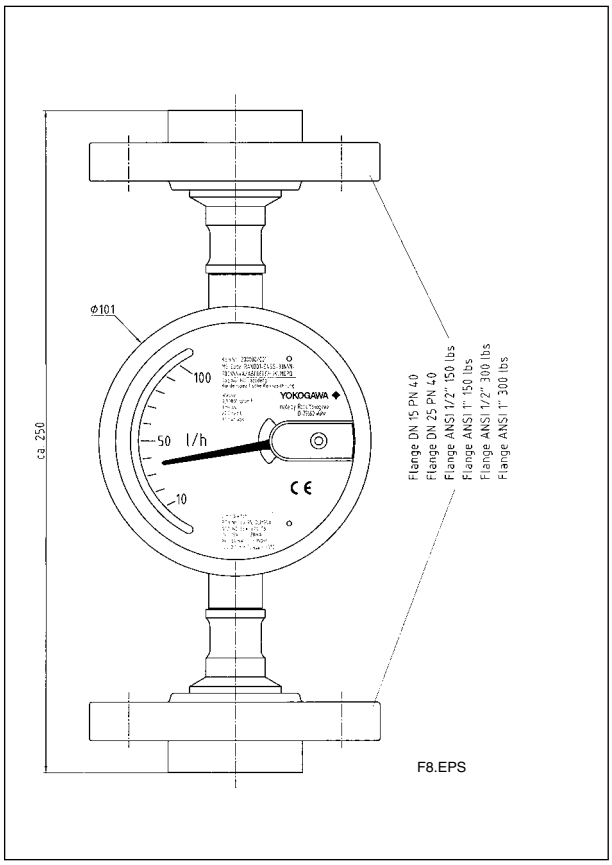


Fig. 7-3 Version with flange connection

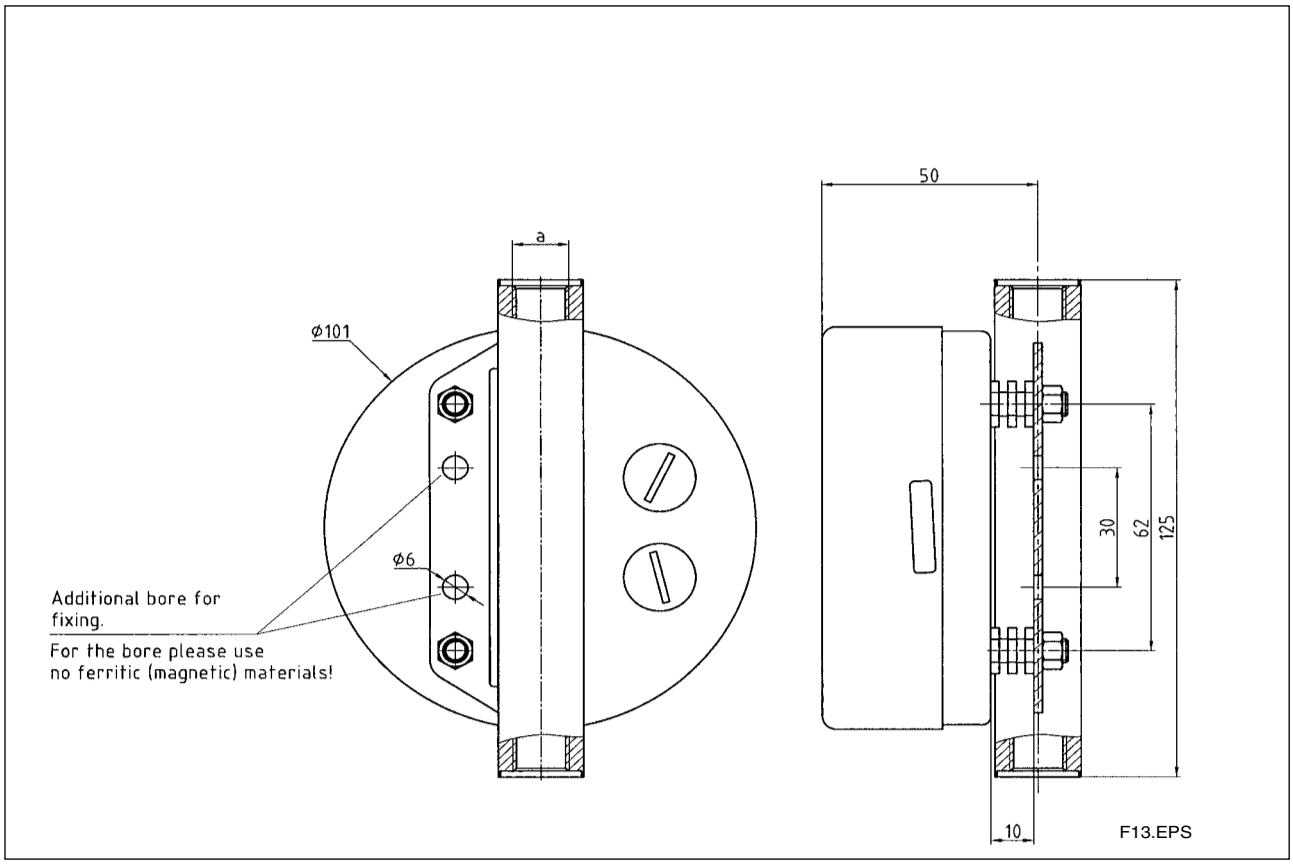


Fig. 7-4 Back view with mounting

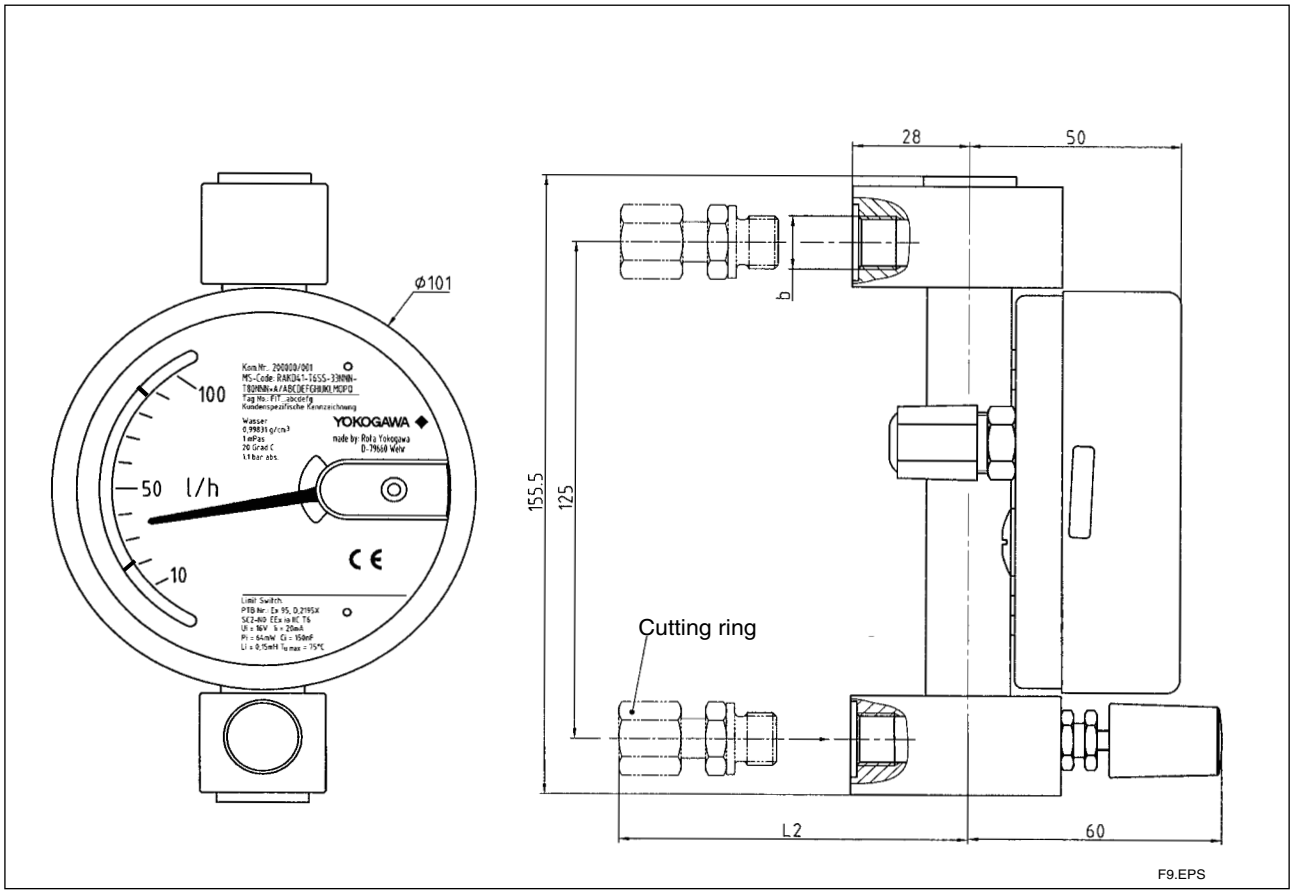


Fig. 7-5 Version with inlet valve

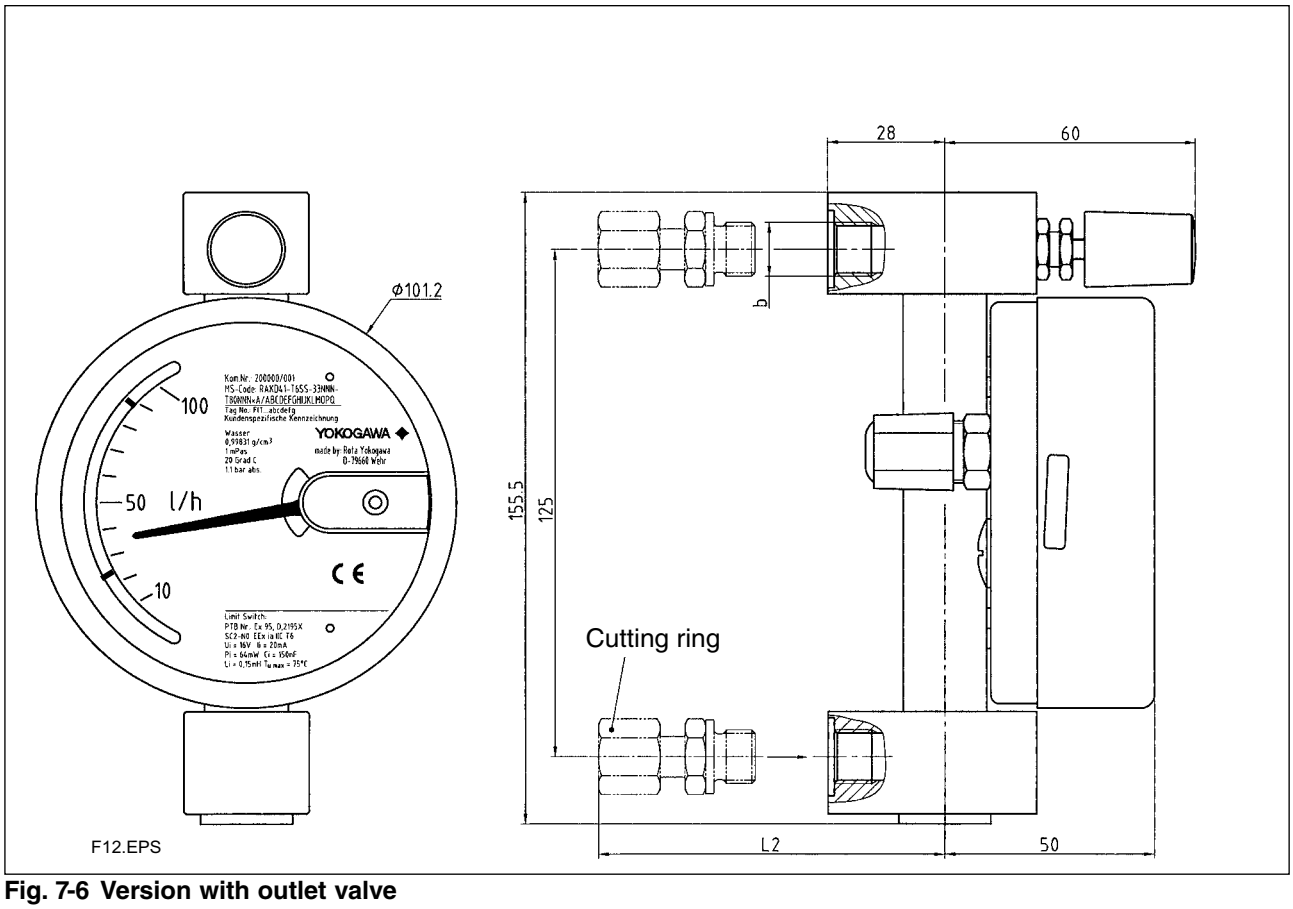


Fig. 7-6 Version with outlet valve

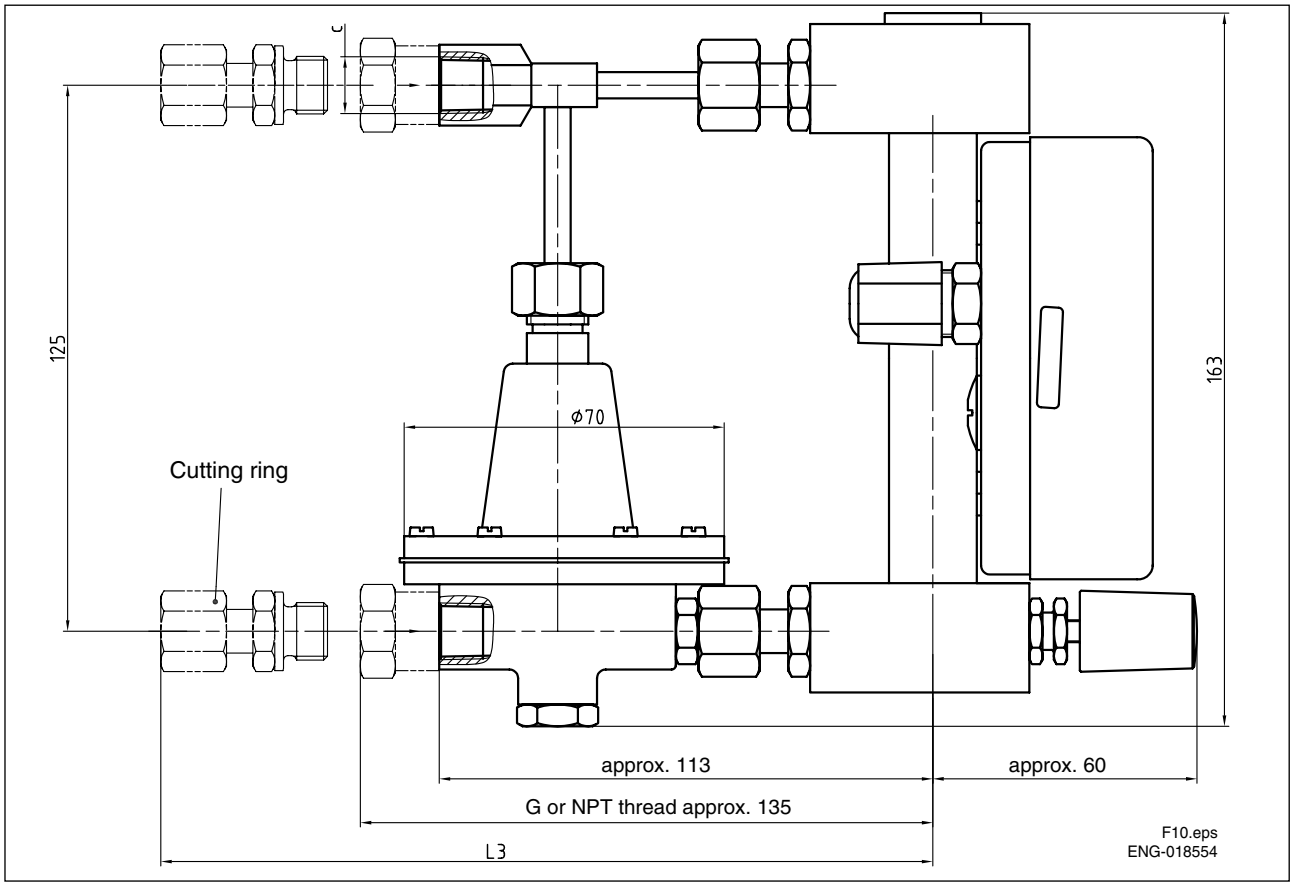


Fig. 7-7 Version with inlet valve and inlet controller

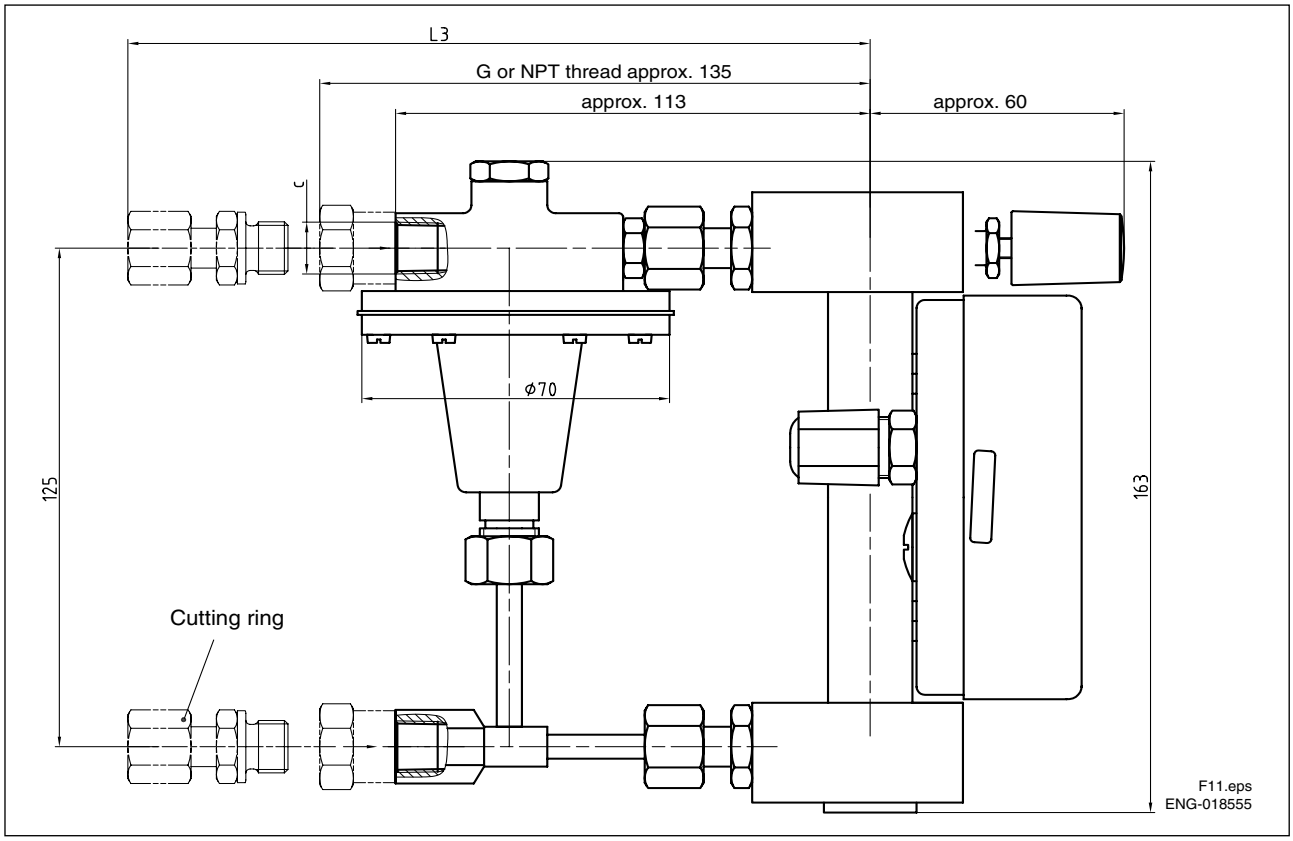


Fig. 7-8 Version with outlet valve and back pressure controller

CONNECTION TYPES

TABLE 7-12

Size	a		b	c
	Cone 31-51	Cone 52-53	Cone 31-53	Cone 31-51
Thread	G 1/4	G 3/8	G 1/4	G 1/4
	1/4 NPT	3/8 NPT	1/4 NPT	1/4 NPT

INSTALLATION LENGTHS DEPENDING ON CONNECTION TYPE AND SIZE

TABLE 7-13

		L1		L2	L3
Process connection	Size	Cone 31-51	Cone 52-53	Cone 31-53	Cone 31-51
Cutting ring	6 mm	178 mm	------	54.5 mm	164 mm
	8 mm	172 mm	------	51.5 mm	161 mm
	10 mm	174 mm	------	52.5 mm	162 mm
	12 mm	174 mm	177 mm	52.5 mm	162 mm
Nozzle	6 mm	182 mm	------	56.5 mm	166 mm
	8 mm	182 mm	------	56.5 mm	166 mm

WEIGHTS

TABLE 7-14

	without valve	with valve	with controller
Weight	approx. 600g	approx. 1000g	approx. 1800g

7.4 Temperature curves

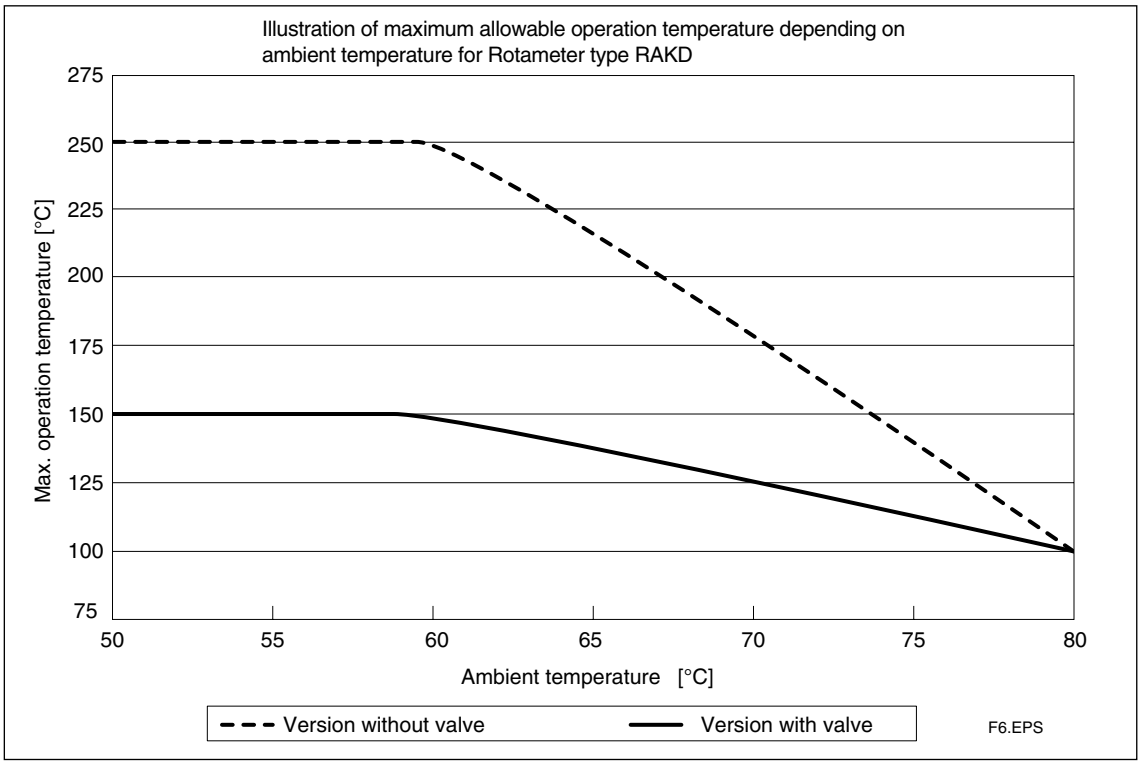


Fig. 7-9

For option /KS1 or /KN1 (Ex-i-versions ATEX) the maximum values for ambient and process temperature according to the respective temperature class mentioned in fig. 5 and table 7 must be regarded.
For option /ES1 (Ex-i-versions IECEx) the maximum values for ambient and process temperature according to the respective temperature class mentioned table 9 must be regarded.
For option /NS1 (Ex-i-version NEPSI) the maximum values for ambient and process temperature according to the respective temperature class mentioned in table 11 must be regarded.
The minimum ambient temperature is -25°C. Lower temperatures on request.

Blank Page

8. Explosion-protected Type Instruments

8.1 General

WARNING

To ensure intrinsically safety, it is not permitted to repair or to modify the electronic transmitter and the limit switches

The RAKD with electronic transmitter type "E" as well the limit switches (option/ K_) are intrinsically safe devices.

The RAKD with option /KS1 is ATEX certified for hazardous areas of zone 1 (category 2) and zone 2 (category 3). It is not homologated for zone 0 areas (category 1) (option /KS1 for category 2 and 3, option /KS3 and /KN1 only for category 3G). The classification in brackets is given according to the EU regulation ATEX, 94/9/EG.

The limit switches but not the electronic transmitter are ATEX dust proof certified (option /KS2).

The RAKD with option /KS1 and /ES1 are certified for hazardous areas of EPL Gb.
The RAKD with option /KS3 and /ES3 are for use in hazardous areas of EPL Gc.

The RAKD with option /FS1 is FM- certified for USA and Canada for hazardous classified locations Class I, Division 1, Groups A, B, C, D.

The RAKD with option /NS1 is NEPSI- certified.

The RAKD must be connected to an intrinsically safe, certified power supply with a maximum voltage and output power below the maximum values of the RAKD (refer to Technical data, section 7). The combined internal inductance and capacity of the RAKD and connecting cables must be less than the permitted external inductance and capacity of the power supply. Accordingly, the limit switches and the pulse output have to be connected to intrinsically safe, certified isolating switching amplifiers. The relevant maximum safety values must be heeded at all times. Power supply and transmitter relay are assigned devices and should be installed outside any hazardous zone.

Especially in the case of high fluid temperatures, heated metering tubes or heat radiation by heat tracing, make sure that the temperature in the indicator housing does not exceed the permissible maximum ambient temperature of the transmitter (refer to Technical data, section 7).

To ensure intrinsically safety, it is not permitted to repair or modify the measuring transmitter.

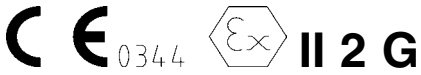
8.2 Intrinsically safe ATEX certified RAKD (/KS1)

8.2.1 Technical data

EC-Type Examination Certificate Nr.: KEMA 00ATEX1037X
Used standards:
- EN 60079-0: 2009
- EN 60079-11: 2007

The RAKD with electronic transmitter and limit switches is an intrinsically safe device. This device is certified for hazardous areas of zone 1 (category 2) and zone 2 (category 3). It is not homologated for zone 0 (category 1). The classifications in brackets are given according to EC- Directive 94/9/EG (ATEX).

Identification in accordance with regulation 94/9/EG (ATEX) :



Data of electronic transmitter type -E :
Type of protection : Intrinsically safe Ex ia IIC T6-T4 Gb
Ambient temperature: -25°C ... +65°C
Safety relevant maximum values:
Supply (current output):
Maximum voltage: U_i= 30 V
Maximum current: I_i = 100 mA
Maximum power: P_i = 750 mW
Inner inductance: L_i = 0.73 mH
Inner capacity: C_i = 2.4 nF
Pulse output:
Maximum voltage: U_i= 16 V
Maximum current: I_i = 20 mA
Maximum power: P_i = 64 mW
Inner inductance: L_i = 0 mH
Inner capacity: C_i = 0 nF

Data of limit switches :
Type of protection : Intrinsically safe Ex ia IIC T6 Gb
Safety relevant maximum values:

	SC2-NO (/K1.../K3)		SJ2-S.N (/K6.../K10)	
	Type 2	Type 3	Type 2	Type 3
Maximum voltage:	U_i = 16 V	16 V	U_i = 16 V	16 V
Maximum current:	I_i = 25 mA	52 mA	I_i = 25 mA	52 mA
Maximum power:	P_i = 64 mW	169 mW	P_i = 64 mW	169 mW
Inner inductance:	L_i = 0.15 mH	0.15 mH	L_i = 0.1 mH	0.1 mH
Inner capacity:	C_i = 150nF	150nF	C_i = 30nF	30nF

Temperature specification:

Table 8-1

Configuration	Max. ambient temperature	Max. process temperature	Temperature class
Transmitter 4-20mA / Pulse	65°C	65°C	T6
	50°C	80°C	
	45°C	100°C	T5
	38°C	135°C	T4
Limit switch(es) type 2	65°C	65°C	T6
	80°C	80°C	T5
	59°C	100°C	
	100°C	100°C	T4
	73°C	135°C	
Limit switch(es) type 3	24°C	65°C	T6
	37°C	80°C	T5
	34°C	100°C	
	57°C	80°C	T4
	54°C	100°C	
	48°C	135°C	

For the configuration where a transmitter is combined with limit switches, the temperature class is determined by the most restrictive combinations of maximum ambient temperature and maximum process temperature.
Description of limit switch type 2 and 3 see ATEX certificates from Pepperl & Fuchs:
- PTB 99 ATEX 2219X (SC2-NO) for /K1 to /K3
- PTB 00 ATEX 2049X (SJ2-S.N) for /K6 to /K10

Intrinsic safe power supply for the electronic transmitter :
The power supply for the electronic transmitter is an associated apparatus that may not be installed in the hazardous area, and it may not exceed the safety relevant maximum values for voltage, current and power of the electronic transmitters as specified above.
For example the type RN221N-B1 (option (U__) according certificate PTB 00 ATEX 2018 can be used.

Intrinsic safe power supply for the limit switches :
The power supply (transmitter relay) for the limit switches is an associated apparatus that may not be installed in the hazardous area, and it may not exceed the safety relevant maximum values for voltage, current and power of the connected limit switch as specified above.
For example the type KFA6-SR2-Ex... (option (W2_) according certificate PTB 00 ATEX 2081 (230V AC supply) or the type KFD2-SR2-Ex... (option (W4_) according certificate PTB 00 ATEX 2080 (24V DC supply) can be used.

8.2.2 Installation

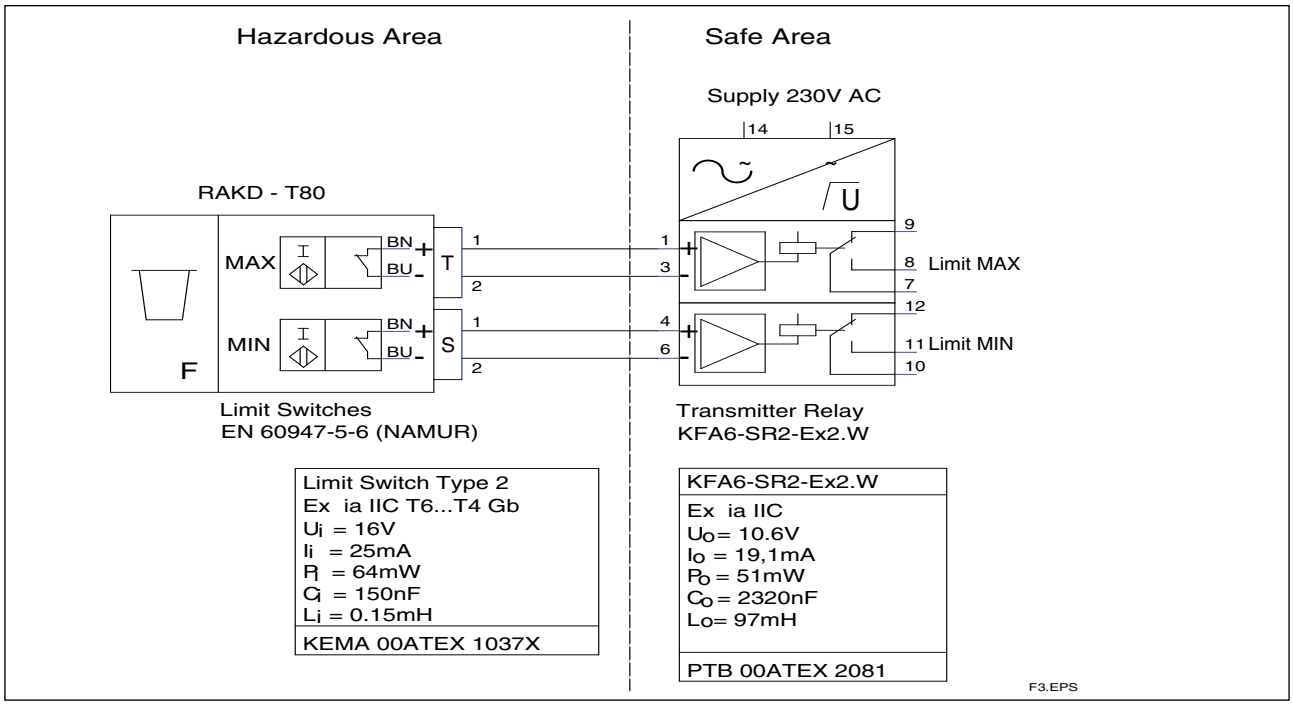


Fig. 8-1 Ex-Version acc. ATEX (Option /KS1) with 2 limit switches and transmitter relay

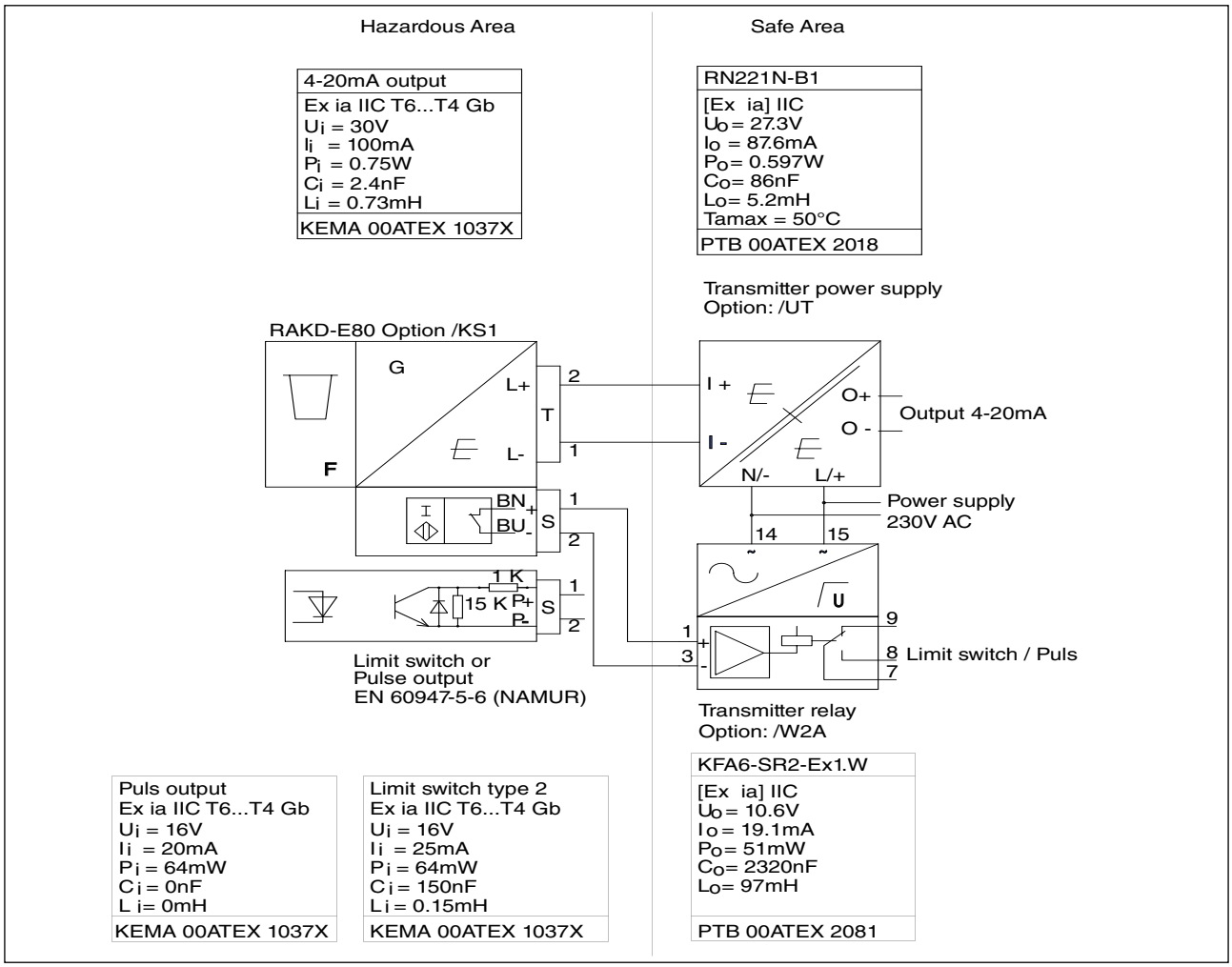


Fig. 8-2 Ex-Version acc. ATEX (Option /KS1) with electronic transmitter in combination with power supply and additional limit switch or pulse output with transmitter relay

8.3 Intrinsically safe IECEx certified RAKD (/ES1)

8.3.1 Technical data

Certificate Nr.: IECEx DEK 12.0003X
Used standards:
- IEC 60079-0: 2011
- IEC 60079-11: 2011

The RAKD with electronic transmitter and limit switches is an intrinsically safe device. This device is certified for EPL Gb.

Data of electronic transmitter type -E :
Type of protection : Intrinsically safe Ex ia IIC T6 -T4 Gb
Ambient temperature: -25°C ... +65°C
Safety relevant maximum values:
Supply (current output):
Maximum voltage: U_i= 30 V
Maximum current: I_i = 100 mA
Maximum power: P_i = 750 mW
Inner inductance: L_i = 0.73 mH
Inner capacity: C_i = 2.4 nF
Pulse output:
Maximum voltage: U_i= 16 V
Maximum current: I_i = 20 mA
Maximum power: P_i = 64 mW
Inner inductance: L_i = 0 mH
Inner capacity: C_i = 0 nF

Data of limit switches :
Type of protection : Intrinsically safe Ex ia IIC T6
Safety relevant maximum values:

	SC2-NO (/K1.../K3)		SJ2-S.N (/K6.../K10)	
	Type 2	Type 3	Type 2	Type 3
Maximale Spannung:	U_i = 16 V	16 V	U_i = 16 V	16 V
Maximaler Strom:	I_i = 25 mA	52 mA	I_i = 25 mA	52 mA
Maximale Leistung:	P_i = 64 mW	169 mW	P_i = 64 mW	169 mW
Innere Induktivität:	L_i = 0.15 mH	0.15 mH	L_i = 0.1 mH	0.1 mH
Innere Kapazität:	C_i = 150nF	150nF	C_i = 30nF	30nF

Temperature specification:

Table 8-2

Configuration	Max. ambient temperature	Max. process temperature	Temperature class
Transmitter 4-20mA / Pulse	65°C	65°C	T6
	50°C	80°C	
	45°C	100°C	T5
	38°C	135°C	T4
Limit switch(es) type 2	65°C	65°C	T6
	80°C	80°C	T5
	59°C	100°C	
	100°C	100°C	T4
	73°C	135°C	
Limit switch(es) type 3	24°C	65°C	T6
	37°C	80°C	T5
	34°C	100°C	
	57°C	80°C	T4
	54°C	100°C	
	48°C	135°C	

For the configuration where a transmitter is combined with limit switches, the temperature class is determined by the most restrictive combinations of maximum ambient temperature and maximum process temperature.
Description of limit switch type 2 and 3 see ATEX certificates from Pepperl & Fuchs:
- IECEx PTB 11.0091X (SC2-NO) for /K1 to /K3
- IECEx PTB 11.0092X (SJ2-S.N) for /K6 to /K10

Intrinsic safe power supply for the electronic transmitter :
The power supply for the electronic transmitter is an associated apparatus that may not be installed in the hazardous area, and it may not exceed the safety relevant maximum values for voltage, current and power of the electronic transmitters as specified above. The internal capacity or inductivity of RAKD inclusive cable may not exceed the external capacity or inductivity of the power supply.
For example the type RN221N-B1 (Option /U__) with certificate PTB 00 ATEX 2018 can be used.

Intrinsic safe power supply for the limit switches :
The power supply (transmitter relay) for the limit switches is an associated apparatus that may not be installed in the hazardous area, and it may not exceed the safety relevant maximum values for voltage, current and power of the connected limit switch as specified above.
For example the type KFA6-SR2-Ex... (option (W2_) according certificate IECEx PTB 11.0031 (230V AC supply) or the type KFD2-SR2-Ex... (option (W4_) according certificate IECEx PTB 11.0034 (24V DC supply) can be used.

8.3.2 Installation

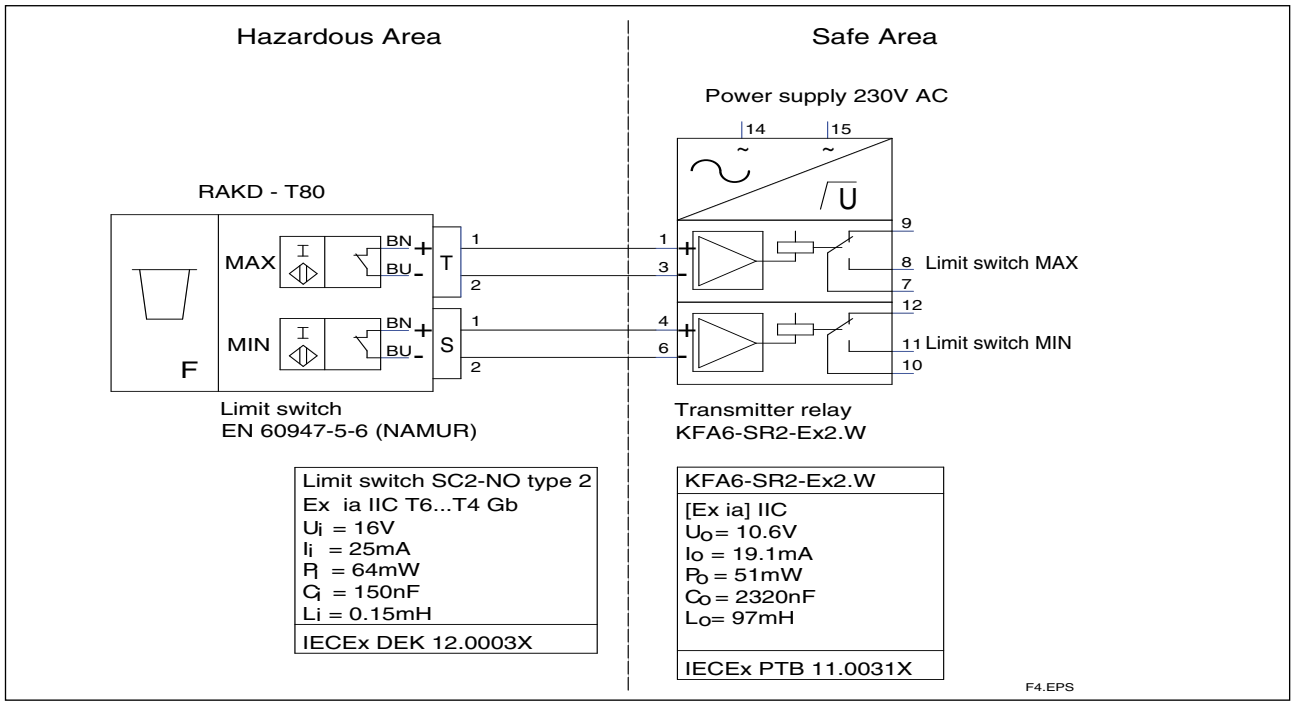


Fig. 8-3 Ex-Version acc. IECEx (Option /ES1) with 2 limit switches and transmitter relay

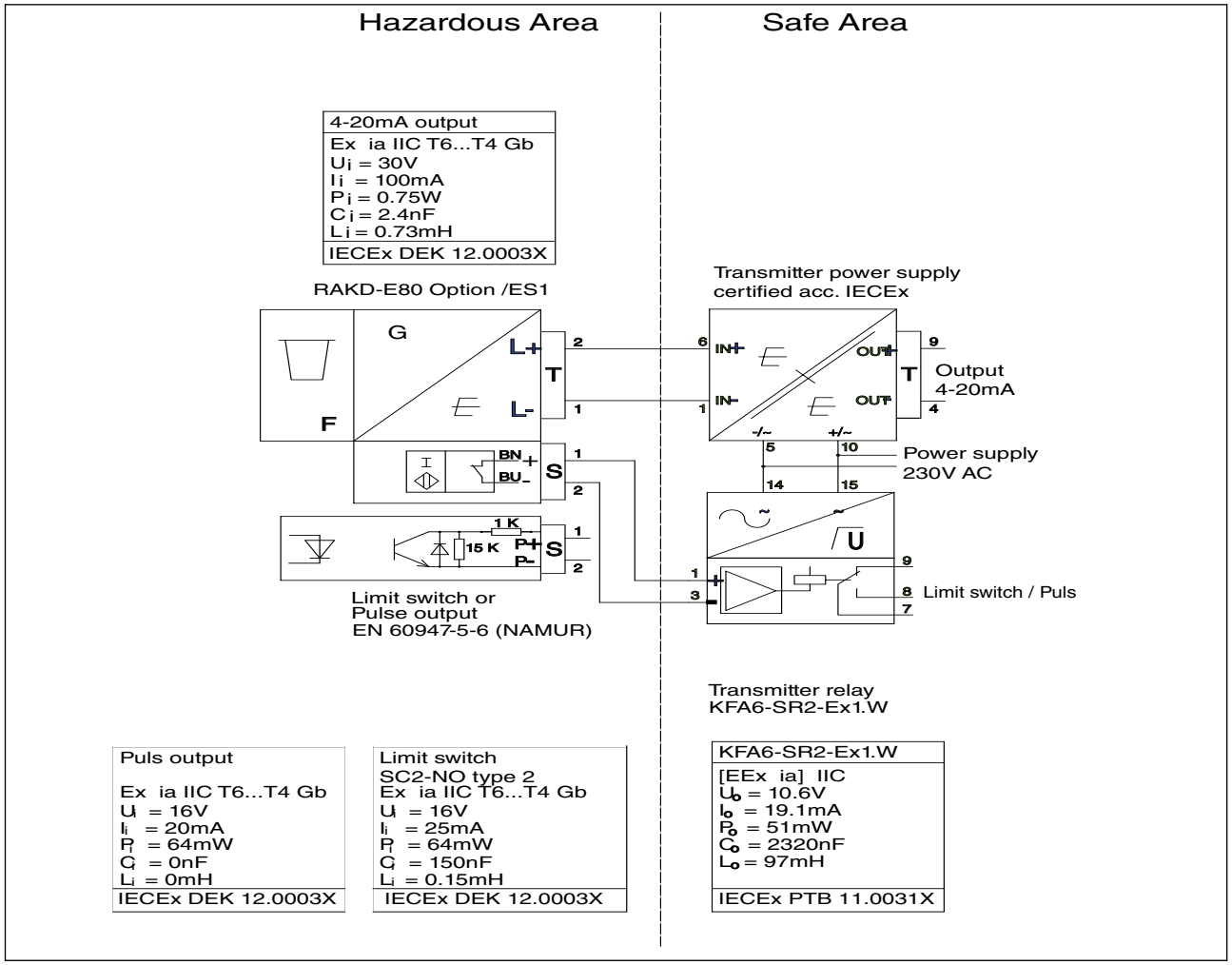


Fig. 8-4 Ex-Version acc. IECEx (Option /ES1) with electronic transmitter in combination with power supply and additional limit switch or pulse output with transmitter relay

8.4 Non incendive RAKD for Category 3 (ATEX) (/KN1)

Der RAKD with /KN1 is a unit with protection „nL"
It may be used in hazardous areas of zone 2 (category 3)
The classification in brackets is given according to the EC- Directive ATEX, 94/9/EG.
This version is same hardware as intrinsically safe type.

Protection : Ex nL IIC T6 X
n = non incendive
L = unit with limited energy

Explosion proof : Ex nL IIC T6 X protection „n"; group II ; category 3GD

Marking :

CE 0344 Ex II 3 GD

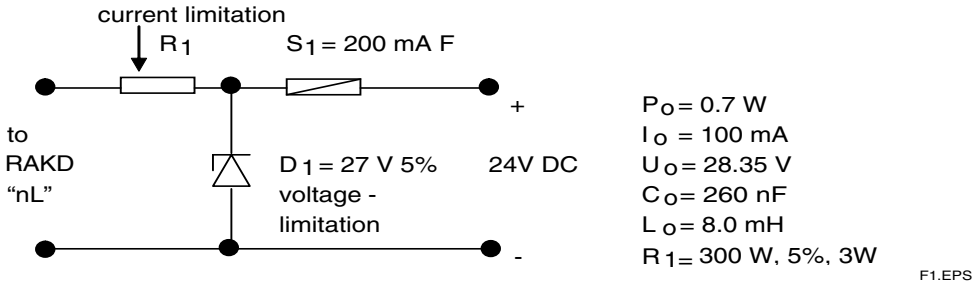
Ambient temperature : -25 °C < Ta < 65 °C :

Entity parameter :

Table 8-3

	Analog output	Pulse output /CP	Limit switch /K1 ... /K3	Limit switch /K6 ... /K10
Ui [V]	30	16	16	16
Ii [mA]	100	20	25	25
Pi [mW]	750	64	64	64
Li [µH]	730	0	150	100
Ci [nF]	2.4	0	150	30

Protection circuit for a power supply to meet the maximum values :



8.5 Dust proofed limit switches (ATEX) (/KS2)

Certification by Pepperl & Fuchs :
EC-Type Examination Certificate Nr.: ZELM 02 ATEX 0128X
Identification in accordance with regulation 94/9/EG (ATEX) :

Ex II 1 D

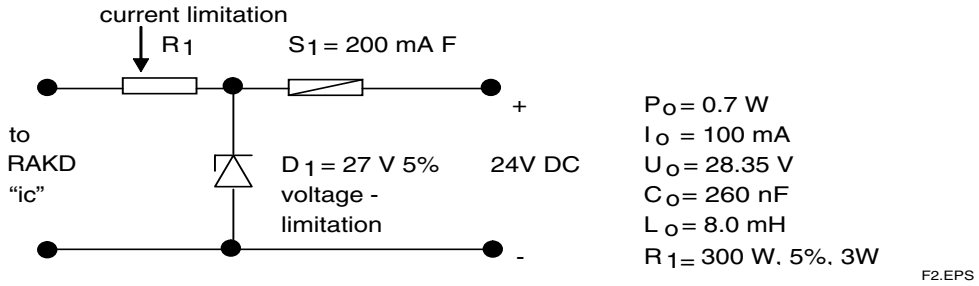
Type of protection : Ex iaD 20
Maximum surface temperature : 108°C.
The dust explosion proof for the limit switches is only available if ordered without electronic transmitter (only with housing type "T").

8.6 Intrinsically safe "ic" RAKD for Category 3G (ATEX /IECEx) (/KS3, /ES3)

The RAKD with /KS3 or /ES3 is a unit with protection „ic".
It may be used in hazardous areas of category 3G.
This version is same hardware as intrinsically safe "ia" type (/KS1, /ES1).

Data of electronic transmitter type -E :
Type of protection : Intrinsically safe Ex ic IIC T6-T4 Gc
Ambient temperature: -25°C ... +65°C
Safety relevant maximum values:
Supply (current output):
Maximum voltage: U_i= 30 V
Maximum current: I_i = 100 mA
Maximum power: P_i = 750 mW
Inner inductance: L_i = 0.73 mH
Inner capacity: C_i = 2.4 nF
Pulse output:
Maximum voltage: U_i= 16 V
Maximum current: I_i = 20 mA
Maximum power: P_i = 64 mW
Inner inductance: L_i = 0 mH
Inner capacity: C_i = 0 nF

Protection circuit for a power supply to meet the maximum values :



Data of limit switches :
Type of protection : Intrinsically safe Ex ic IIC T6 Gc
Safety relevant maximum values:

	SC2-NO (/K1.../K3)		SJ2-S.N (/K6.../K10)	
	Type 2	Type 3	Type 2	Type 3
Maximale Spannung:	U_i = 16 V	16 V	U_i = 16 V	16 V
Maximaler Strom:	I_i = 25 mA	52 mA	I_i = 25 mA	52 mA
Maximale Leistung:	P_i = 64 mW	169 mW	P_i = 64 mW	169 mW
Innere Induktivität:	L_i = 0.15 mH	0.15 mH	L_i = 0.1 mH	0.1 mH
Innere Kapazität:	C_i = 150nF	150nF	C_i = 30nF	30nF

8.7 Intrinsically safe FM / CSA (USA + Canada) components (/FS1, /CS1)

8.7.1 Limit switches option /K1 ... /K10 (/FS1 for USA)

Data of limit switches (FM-approval):
The limit switches are intrinsically safe devices. They are certified by Pepperl & Fuchs for:
Intrinsically safe : Cl. I, Div. 1, GP. A, B, C, D T6 Ta=60°C
Cl. II, Div. 1, GP. E, F, G
Cl. III, Div. 1

Non incendive: Cl. I, Div. 2, GP. A, B, C, D T5 Ta=50°C
Cl. II, Div. 1, GP. E, F, G
Cl. III, Div. 1

Maximum Entity Field Wiring Parameters :
see FM-control drawing 116-0165 on page 8-11 and 8-12 for intrinsic safety
see FM-control drawing 116-0155 on page 8-13 for non incendive

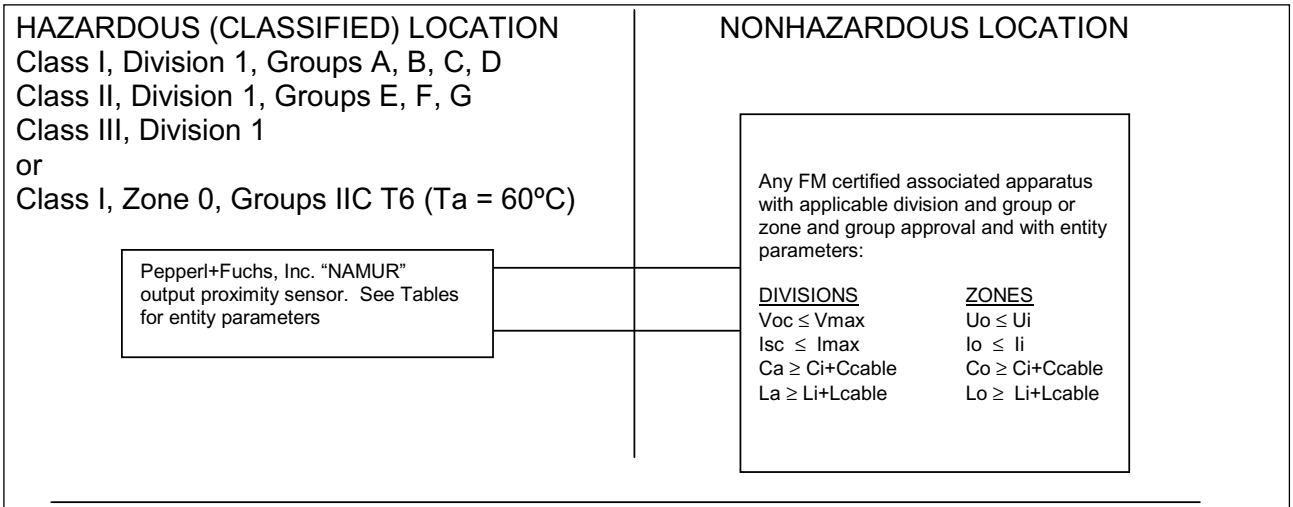
8.7.2 Limit switches option /K1 ... /K10 (/CS1 for Canada)

Data of limit switches (CSA-approval):
The limit switches are intrinsically safe devices. They are certified by Pepperl & Fuchs for:
Intrinsically safe : Cl. I, Div. 1, GP. A, B, C, D
Cl. II, Div. 1, GP. E, F, G
Cl. III, Div. 1
Maximum Entity Field Wiring Parameters :
see CSA drawing 116-0047 on page 8-14 and 8-15

WARNING
Only in combination with power supply option /WxA or /WxB.

Control Drawings

FM: Limit switches intrinsically safe (1)



Notes:

1. For installation in a Division 1 hazardous (classified) location, the wiring must be in accordance with the National Electrical Code, NFPA 70, Article 504. For installation in a Zone 0 hazardous (classified) location, the wiring must be in accordance with the National Electrical Code, NFPA 70, Article 505. For additional information refer to ISA RP-12.6.

2. The Entity Concept allows interconnection of intrinsically safe and associated apparatus not specifically examined in combination as a system when the approved values of Voc (or Uo) and Isc (or Io) for the associated apparatus are less than or equal to Vmax (or Ui) and Imax (or Ii) for the intrinsically safe apparatus and the approved values of Ca (or Co) and La (or Lo) for the associated apparatus are greater than Ci + Ccable, Li + Lcable, respectively for the intrinsically safe apparatus.

3. Barriers shall not be connected to any device that uses or generates in excess of 250V rms or DC unless it has been determined that the voltage is adequately isolated from the barrier.

4. Note associated apparatus with only Zone 1 approved connections limits the mounting of the sensors to Zone 1.

5. 'a' in model number indicates option not affecting safety.

6. NAMUR sensors are also nonincendive for Class I, Division 2, Groups A,B,C, and D; Class II, Division 1, Groups E,F, and G; Class III, Division 1; Class I, Zone 2, Groups IIC, IIB, IIA T5 hazardous (classified) locations and need not be connected to an associated apparatus when installed in accordance with Control Drawing 116-0155.

7. The correlation between type of connected circuit, maximum permissible ambient temperature and temperature class are indicated at the top of each Table.

8. Model number NMB8-SAE16GM27-N1-FE-V1 approved for Class I, Division 1, Groups C and D T4 (Ta = 85ºC). See Table 12.

9. **Warning** - Equipment with non-metallic enclosures shall not be installed in a location where the external conditions are conducive to the build-up of electrostatic charge on such surfaces. The equipment shall only be cleaned with a damp cloth.

Dieses Dokument enthält sicherheitsrelevante Angaben. Es darf nicht ohne Absprache mit dem Normenfachmann geändert werden!					
This document contains safety-relevant information. It must not be altered without the authorization of the norm expert!					
Confidential according to ISO 16016	Only valid as long as released in EDM or with a valid production documentation!			scale: 1:1	date: 2010-jun-03
PEPPERL+FUCHS	Control Drawing	change notice	respons.	US.DRL	116-0165F
	NAMUR SENSORS – FM	150- 1915	approved	US.DWR	
Twinsburg			norm	US.GAP	sheet 1 of 8

FM: Limit switches intrinsically safe (2)

NJ 15-30GM-N...	140	100	76	91	100	73	88	100	62	77	81	54	63	63
NJ 25-50-N...	150	140	73	88	100	69	84	100	51	66	80	39	54	61
NJ 20-40-N...	140	140	73	88	100	69	84	100	51	66	80	39	54	61

Table 10 – INDUCTIVE RING SENSORS

			Typ 1 Ui = 16 V Ii = 25 mA Pi = 34 mW			Typ 2 Ui = 16 V Ii = 25 mA Pi = 64 mW			Typ 3 Ui = 16 V Ii = 52 mA Pi = 169 mW			Typ 4 Ui = 16 V Ii = 76 mA Pi = 242 mW		
Model	Ci/ nF	Li/ µH	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1
RC10-a-N3a	90	120	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RC10-a-N0a	150	100	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RC15-a-N0-a	150	100	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RC15-a-N3a	90	70	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ10-Na	30	20	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ10-a-Na	30	20	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ10-Bia	90	20	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ10-a-Bia	90	20	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ15-Na	130	20	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ15-a-Na	130	20	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ15-Bia	90	50	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ15-a-Bia	90	50	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ21-Na	30	25	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ21-Bia	70	50	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A
RJ43-Na	40	50	75	90	100	70	85	100	55	70	90	N/A	N/A	N/A

TABLE 11 – INDUCTIVE SLOT SENSORS

			Typ 1 Ui = 16 V Ii = 25 mA Pi = 34 mW			Typ 2 Ui = 16 V Ii = 25 mA Pi = 64 mW			Typ 3 Ui = 16 V Ii = 52 mA Pi = 169 mW			Typ 4 Ui = 16 V Ii = 76 mA Pi = 242 mW		
Model	Ci/ nF	Li/ µH	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1
SC2-N0a	150	150	55	67	95	48	60	88	23	35	63	6	18	46
SC3.5a-N0a	150	150	56	68	96	49	61	89	28	40	68	13	25	53
SC3.5-N0-Ya	150	150	55	67	95	48	60	88	23	35	63	6	18	46
SJ1.8-N-Ya	30	100	73	88	100	67	82	100	45	60	78	30	45	57
SJ2-Na	30	100	56	68	96	49	61	89	28	40	68	13	25	53
SJ2-SNa	30	100	73	88	100	66	81	100	45	60	78	30	45	57
SJ2-S1Na	30	100	73	88	100	66	81	100	45	60	78	30	45	57
SJ2.2-Na	30	100	73	88	100	67	82	100	45	60	78	30	45	57
SJ3.5-a-Na	50	250	56	68	96	49	61	89	28	40	68	13	25	53
SJ3.5-H-a	50	250	73	88	100	66	81	100	45	60	89	30	45	74
SJ3.5-SNa	30	100	73	88	100	66	81	100	45	60	89	30	45	74
SJ3.5-S1Na	30	100	73	88	100	66	81	100	45	60	89	30	45	74
SJ5-a-Na	50	250	56	68	96	49	61	89	28	40	68	13	25	53
SJ5-Ka	50	550	55	67	95	48	60	88	25	37	65	9	21	49
SJ10-Na	50	100	55	67	95	48	60	88	25	37	65	9	21	49
SJ15-Na	150	1200	55	67	95	48	60	88	25	37	65	9	21	49
SJ30-Na	150	1250	55	67	95	48	60	88	25	37	65	9	21	49

FM: Limit switches non incendive

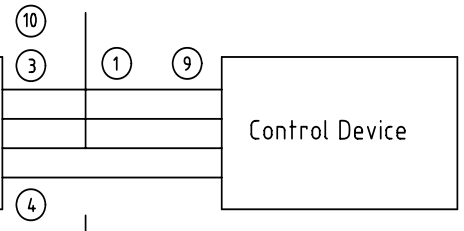
HAZARDOUS (CLASSIFIED) LOCATION

CLASS I, ZONE 2, GROUPS IIC, IIB, IIA (Ta = 50°C) T5
CLASS I, DIVISION 2, GROUPS A, B, C and D
CLASS II, DIVISION 1, GROUPS E, F and G
CLASS III DIVISION 1 HAZARDOUS LOCATIONS

NON-HAZARDOUS LOCATION

PROXIMITY SENSORS

Models C (Capacitive), I (Analog Inductive), M (Magnetic), N (Discrete Inductive), S (Slot), R (Ring) followed by combination of numbers and letters. "-" dashes and/or "+" pluses may be included.
(2) (10)



See Table 1. for sensors with nonincendive field wiring parameters.
See Table 2. for sensors with exceptions.

NOTES:

(1) Wiring methods must be in accordance with the National Electrical Code, ANSI/NFPA 70, Article 501-4(b) for Class I, Division 2; 502-4(a) for Class II, Division 1; 502-4(b) for Class II, Division 2; 503-3(a) for Class III, Division 1; 503-3(b) for Class III, Division 2. Zone 2 wiring requirements are equivalent to Division 2 wiring requirements. See manufacturer's instructions for connection of devices and electrical data.

(2) These proximity sensors are rated "Nonincendive". Proximity sensors without a provision for conduit connection (i.e. via a conduit adapter) or a sensor with a plastic base must be mounted in a tool secured enclosure meeting the requirements of ANSI/ISA S82. Alternatively, sensors in accordance with Table 1 may be wired according to nonincendive field wire methods (a conduit connection or enclosure is not needed).

(3) Proximity sensors, conduit, enclosures, and exposed noncurrent-carrying metal parts must be grounded and bonded in accordance with the National Electrical Code, ANSI/NFPA 70, Article 250.

(4) WARNING - DO NOT CONNECT OR DISCONNECT WHILE CIRCUIT IS LIVE UNLESS LOCATION IS KNOWN TO BE NONHAZARDOUS.

(5) The relay outputs of a proximity sensor must be supplied by a nonincendive source.

(6) Sensitivity adjustment should only be done when the area is known to be nonhazardous.

(7) A temperature rating of T5 applies for all nonincendive proximity sensors. SEE TABLE 2 for exceptions

(8) The nonincendive field wiring concept allows interconnection of nonincendive circuits with a nonincendive source when the approved values of Voc and Isc of the nonincendive source are less than or equal to Vmax and Imax of the nonincendive circuit and the approved values of Ca and La for the nonincendive source are greater than Ci + Ccable and Li + Lcable, respectively, for the nonincendive circuit.

(9) All Nonincendive sources must be approved.

(10) Sensors using V93, V94,V95 connectors ("mini" 7/8") with the locking clamp (P+F model V9-CL-D2) and V1, V12 connectors with locking clamp (P & F model V1-Clip) are suitable to be mounted outside the protective enclosure. Wiring methods must be in accordance to the National Electrical Code, ANSI/NFPA 70.

(11) NJa-b-c-d-e. Inductive Cylinder Position Sensor is suitable for Class I, Div 2 only.
NI/I/2/ABCD/T5 Ta=50°C
a=1.5, 2, 3
b=C, D, F, PD, FD1
c=US, E02, E2, E0
d=any diameter
e=V1, V12, V93, V94, V95 connectors
NEMA 4X

Certification Status			
Agency		Pending	Final
FM	X		X
CSA			
UL			

TABLE 1 - NONINCENDIVE PARAMETERS (8)

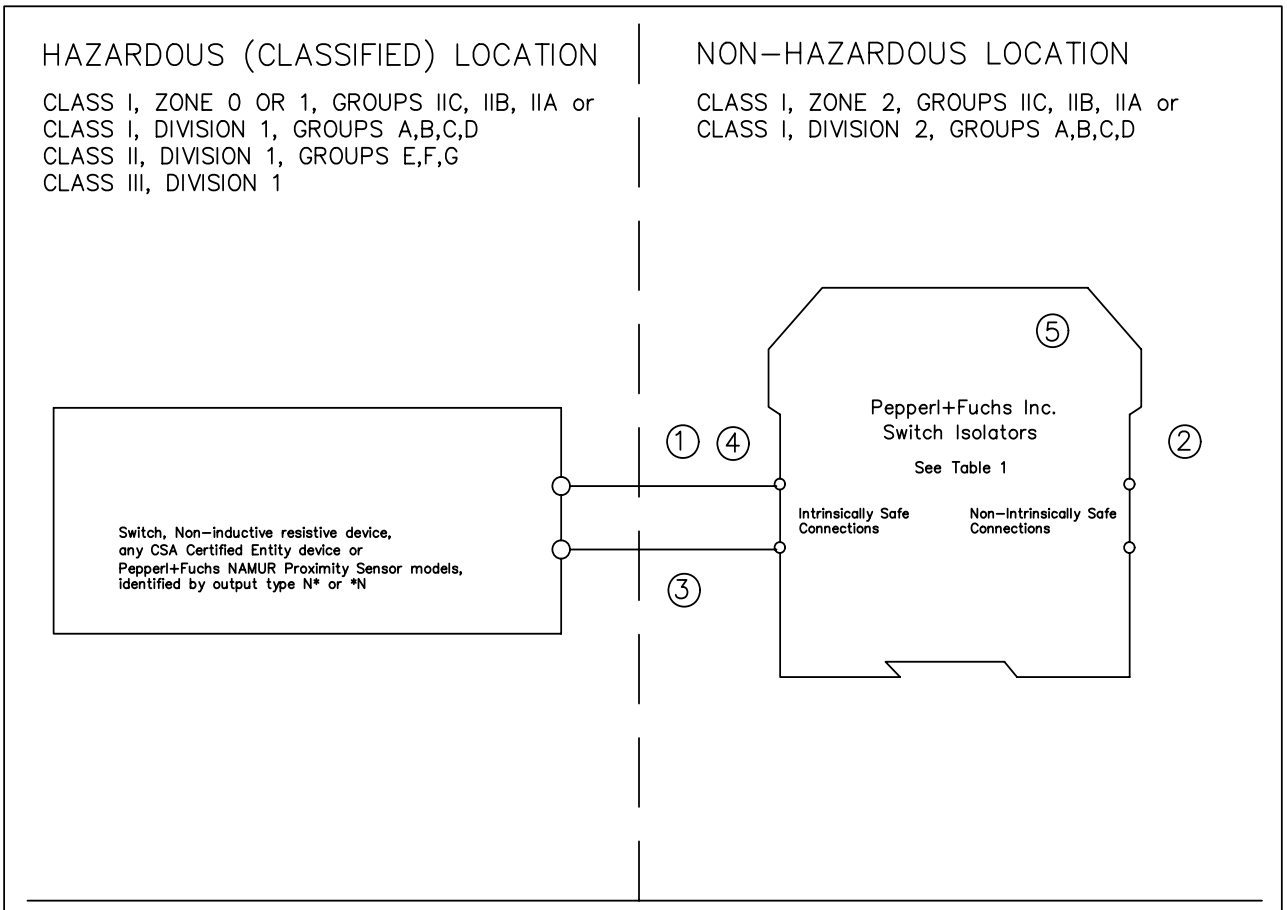
MODEL NUMBER	Vmax (V)	Imax (mA)	C_i(UF)	L_i(mH)
NJ2-12GM40-E2	60.0	200	0	0
NJ5-18GM50-E2	60.0	200	0	0

TABLE 2 - EXCEPTIONS

MODEL NUMBER	RESTRICTION
NBN3-F25-E8	Do not use in a Class II, Division 1, Group E Hazardous Location
V9-CL-D2 & V1-Clip	Not Approved for use in Class II or III locations
NJ type SENSOR See Note (11)	Class I, Div 2 ONLY
NJ2-FD1 type SENSOR See Note 11	Class I, Div 2 ONLY / Ta = 85C /T4A

scale: none	date: 2009-Feb-25				
PEPPERL+FUCHS	CONTROL DRAWING	change notice	respons.	US.DRL	116-0155E
	Nonincendive sensors FM	150-1681	approved	US.DWR	
Twinsburg			norm	US.GAP	sheet 1 of 1

CSA: **limit switches intrinsically safe (1)**



Notes:

① The intrinsically safe wiring must be installed in accordance with the Canadian Electrical Code CSA C22.1, Part 1, Appendix F.

② Barriers listed in Table 1 shall not be connected to any device that uses or generates in excess of 250Vrms or DC unless it has been determined that the voltage is adequately isolated from the barrier. Barriers listed in Table 2 shall not be connected to any device that uses or generates in excess of 60Vrms or DC unless the voltage is limited by an adequate means.

③ Any combination of up to 10 channels of the barriers listed in Table 1 or Table 2 may be connected in parallel and connected to a switch in a hazardous location.

④ The Entity concept allows interconnection of intrinsically safe apparatus with associated apparatus not specifically examined in combination as a system when the approved values of Voc and Isc for the associated apparatus are less than or equal to Vmax and Imax for the intrinsically safe apparatus and the approved values of Ca and La for the associated apparatus are greater than Ci + Ccable and Li + Lcable, respectively, for the intrinsically safe apparatus.

⑤ The following models with part number greater than 100000 are approved for mounting in a Class I, Zone 2, Groups IIC,IIB,IIA or Class I, Division 2, Groups A,B,C,D hazardous (classified) location: KF**-SR2-EX1.W, KF**-SR2-EX1.W.LB, KF**-SR2-EX2.W, KFD2-SR2-EX2.2S, KFD2-ST2-EX1.*, KFD2-ST2-EX2.*, KFD2-SOT2-EX1.*, KFD2-SOT2-EX2.*.

WARNING: Substitution of components may impair intrinsic safety and/or suitability for use in Class I, Division 2, Groups A,B,C,D or Class I, Zone 2, Groups IIC,IIB,IIA.
ADVERTISSEMENT: La substitution de composants peut compromettre la sécurité intrinsèque.

					No changes without prior permission CSA THIS DRAWING CONTAINS PROPRIETARY DATA. NO DISCLOSURE, REPRODUCTION, OR USE OF ANY PART MAY BE MADE EXCEPT BY WRITTEN PERMISSION.		Title Installation Drawing for CSA Certified Switch Isolators		
Revisions				ECO No.					
	2-20-2008				Pepperl+Fuchs® Inc. Twinsburg, OH 44087-2202	Repl.No. -	Draw. No. 116-0047j		Sh. 1 of 2
In.	Date	Cons.	Resp.	Appr.					

CSA: **limit switches intrinsically safe (2)**

TABLE 1: Barriers Certified to CSA Standard C22.2 No. 157 (Um = 250 V)

Model Numbers	Terminals	SYSTEM		ENTITY							
		V_{max}(V)	Res. (Ω)	V_{oc} (V)	I_{sc}(mA)	C_a(uF) GRPS			L_a(mH) GRPS		
						A,B	C,E	D,F,G	A,B	C,E	D,F,G
KFD2-SOT-Ex1*,KFD2-SOT-Ex2* KFD2-SR-Ex1*,KFD2-SR-Ex2* KFD2-SRT-Ex1* KFD2-ST-Ex1*,KFD2-ST-Ex2* KFA5-SR2-Ex1*,KFA5_SR2-Ex2* KFA6-SR2-Ex1*,KFA6-SR2-Ex2* KFD2-SR2-Ex1*,KFD2-SR2-Ex2*	1-3, 2-3; 4-6, 5-6	12.6	650	12.9	19.8	1.273	3.820	10.18	84.88	298.7	744.4
KFA5-SOT2-Ex1*,KFA5-SOT2-Ex2* KFA6-SOT2-Ex1*,KFA6-SOT2-Ex2*	1-3, 2-3; 4-6, 5-6	10.5	811	10.5	13.0	2.66	7.9	21.3	192	671	1000

TABLE 2: Barriers Certified to CSA Standard E79-11 (Um = 60 V)

Model Numbers	Terminals	Load Parameters							
		U_o (V_{oc})	I_o (I_{sc})	C_o(uF) GRPS			L_o(mH) GRPS		
				IIC (A,B)	IIB (C,E)	IIA (D,F,G)	IIC (A,B)	IIB (C,E)	IIA (D,F,G)
KFD2-SOT2-Ex1*,KFD2-SOT2-Ex2* KFD2-ST2-Ex1*,KFD2-ST2-Ex2*	1-3, 2-3; 4-6, 5-6	10.5	13.0	2.66	7.9	21.3	192	671	1000

Title Installation Drawing for CSA Certified Switch Isolators

Revisions				ECO No.	Pepperl+Fuchs® Inc. Twinsburg, OH 44087-2202	Repl.No. -	Draw. No. 116-0047j	Sh. 2 of 2
In.	Date	Cons.	Resp.	Appr.				
	2-20-2008							

8.8 Intrinsically safe NEPSI (China) certified RAKD (/NS1)

Certificate No. : GYJ101552
Type of protection : Intrinsically safe Ex ia
Group : IIC
Temperature Class : T6
Ambient temperature : -25°C ... +65°C
Safety relevant maximum values of electronic transmitter :
Maximum voltage : U_i = 30 V
Maximum current : I_i = 100mA
Maximum power : P_i = 750 mW
Inner inductance : L_i = 0.73 mH
Inner capacity : C_i = 2.4nF
Pulse output:
Maximum voltage : U_i= 16 V
Maximum current : I_i = 20 mA
Maximum power : P_i = 64 mW
Inner inductance : L_i = 0 mH
Inner capacity : C_i = 0nF

Data of limit switches option /K1 to /K10 :
The following table shows the maximum safety parameters for intrinsic safe limit switches according the certificate NEPSI GYJ06542X :

	Standard /K1 ... /K3		Fail Safe /K6 ... /K10	
	Type 2	**Type 3**	**Type 2**	**Type 3**
Ui [V]	16	16	16	16
Ii [mA]	25	52	25	52
Pi [mW]	64	169	64	169
Li [µH]	150	150	250	250
Ci [nF]	150	150	50	50
Max. ambient temperature for T6 [°C]	66	45	66	45
Max. ambient temperature for T5 [°C]	81	60	81	60
Max. ambient temperature for T4-T1 [°C]	100	89	100	89

APPENDIX 1. Safety Instrumented Systems Installation

WARNING

The contents of this appendix are cited from exida.com safety manual on the Rotameter RAKD Flowmeter specifically observed for the safety transmitter purpose. When using the RAKD for Safety Instrumented Systems (SIS) application, the instructions and procedures in this section must be strictly followed in order to preserve the meter for that safety level.

A1.1 Scope and Purpose

This document provides an overview of the user responsibilities for installation and operation of the Rota Yokogawa RAKD variable area flow meter in order to maintain the designed safety level. Items that will be addressed are proof testing, repair and replacement of the flow meter, reliability data, lifetime, environmental and application limits, and parameter settings.

A1.2 Using RAKD for a SIS Application

A1.2.1 Safety Function

Suitable for use in Safety Instrumented Systems are the versions listed in table 1 only. The safety related data listed in this manual does not apply to other versions of RAKD.

[V1]	RAKD standard – RAKD[][] - [][]SS - [][]NNN - T8[]NNN
[V2]	RAKD with head/valve– RAKD[][] - [][]SS - [][]V[][] - T8[]NNN
[V3]	RAKD with head/valve/controller – RAKD[][] - [][]SS - [][]V[][] - T8[]NNN/R[]

Table 1 Versions of RAKD suitable for Safety Instrumented Systems

This variable area flow meter is intended for use as a volume flow monitoring component in a Safety Instrumented System. It has inductive limit switches. The flow meter may be used with the limit switches to feed signals to a logic solver that is part of the safety instrumented function (SIF) as shown in Figure 1. The fault annunciation mechanism is a trip of one of the limit switches. In order to take credit for the automatic diagnostics in the flow meter, this annunciation mechanism must be connected.

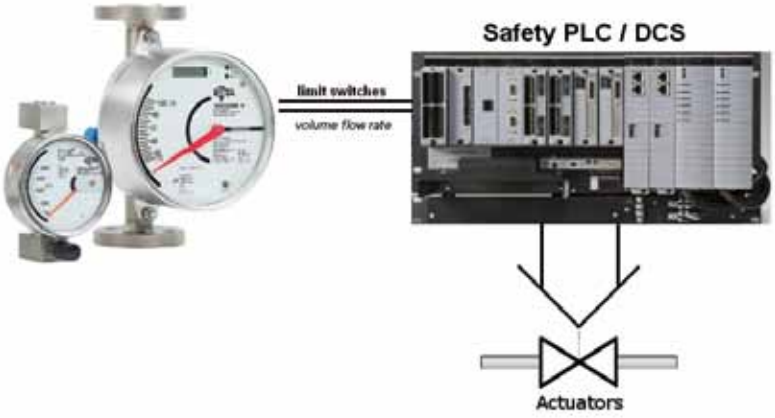


Figure 1 Example Safety Instrumented Function

A1.2.2 Diagnostic Response Time

In case of a fault the limit switches will go to their safe fail state immediately.

A1.2.3 Setup

A setup of the flow meter is not required. Installation shall be done according to the manual.

A1.2.4 Proof Testing

The objective of proof testing is to detect failures within the flow meter that are not detected by the diagnostics of the flow meter. Of main concern are undetected failures that prevent the safety instrumented function from performing its intended function.

The frequency of the proof tests (or the proof test interval) is to be determined in the reliability calculations for the safety instrumented functions for which the flow meter is applied. The actual proof tests must be performed more frequently or as frequently as specified in the calculation in order to maintain required safety integrity of the safety instrumented function.

The following tests need to be specifically executed when a proof test is performed. The results of the proof test need to be documented and this documentation should be part of a plant safety management system. Failures that are detected should be reported to Yokogawa.

Proof test for variable area flow meter RAKD with inductive limit switches:

Step	Action
1	Take appropriate action to avoid a false trip
2	Inspect the device for any visible damage, corrosion or contamination.
3	Force the variable area flow meter RAKD to reach a defined “MAX” threshold value and verify that the inductive limit switch goes into the safe state. Note: only applicable if RAKD is equipped with a “MAX” limit switch.
4	Force the variable area flow meter RAKD to reach a defined “MIN” threshold value and verify that the inductive limit switch goes into the safe state. Note: only applicable if RAKD is equipped with a “MIN” limit switch.
5	Restore the loop to full operation
6	Restore normal operation

When all the tests listed above are executed a proof test coverage of approximately 99% of possible DU failures in the variable area flow meter RAKD can be claimed.

The following tools need to be available to perform proof testing:

Measurement instrument to verify output status of the limit switches

The person(s) performing the proof test of the Yokogawa RAKD variable area flow meter should be trained in SIS operations including bypass procedures, flow meter maintenance and company management of change procedures.

A1.2.5 Repair and replacement

Maintenance information can be found in section 6, Maintenance of the User’s Manual Model RAKD Small Metal ROTAMETER, IM 01R01B30-00E-E.

If repair is to be performed with the process online the Rota Yokogawa RAKD variable area flow meter will need to be bypassed during the repair. The user should setup appropriate bypass procedures for that.

Contact the Yokogawa sales office if this instrument requires repair

The person(s) performing the repair and / or replacement of the Rota Yokogawa RAKD variable area flow meter should have a sufficient skill level.

A1.2.6 Startup Time

The flow meter will generate a valid signal within 0.5 seconds of power-on startup.

A1.2.7 Reliability data

A detailed Failure Mode, Effects, and Diagnostics Analysis (FMEDA) report is available from Rota Yokogawa with all failure rates and failure modes. Rota Yokogawa RAKD variable area flow meter is intended for use in a Low Demand Mode. Low Demand Mode means the average interval between dangerous conditions occurs infrequently.

The Rota Yokogawa RAKD variable area flow meter is certified up to SIL2 for use in a simplex (1oo1) configuration, depending on the PFD_{AVG} calculation of the entire Safety Instrumented Function.

A1.2.8 Lifetime limits

The expected lifetime of the Yokogawa Rota Yokogawa RAKD variable area flow meter is 10 years. The reliability data listed in 2.7 is only valid for this period. The failure rates of the Rota Yokogawa RAKD variable area flow meter may increase sometime after this period. Reliability calculations based on the data listed in A1.2.7 for Rota Yokogawa RAKD variable area flow meter lifetimes beyond 10 years may yield results that are too optimistic, i.e. the calculated Safety Integrity Level will not be achieved.

A1.2.9 Environmental limits

The environmental limits of Rota Yokogawa RAKD variable area flow meter are specified in the User's Manual, Model RAKD Small Metal ROTAMETER, IM 01R01B30-00E-E.

A1.2.10 Application limits

The application limits of the Rota Yokogawa RAKD variable area flow meter are specified in the User's Manual, Model RAKD Small Metal ROTAMETER, IM 01R01B30-00E-E. If the flow meter is used outside of the application limits the reliability data listed in A1.2.7 becomes invalid.

A1.3 Definitions and Abbreviations

A1.3.1 Definitions

Safety	Freedom from unacceptable risk of harm
Functional Safety	The ability of a system to carry out the actions necessary to achieve or to maintain a defined safe state for the equipment / machinery / plant / apparatus under control of the system
Basic Safety	The equipment must be designed and manufactured such that it protects against risk of damage to persons by electrical shock and other hazards and against resulting fire and explosion. The protection must be effective under all conditions of the nominal operation and under single fault condition
Verification	The demonstration for each phase of the life-cycle that the (output) deliverables of the phase meet the objectives and requirements specified by the inputs to the phase. The verification is usually executed by analysis and / or testing
Validation	The demonstration that the safety-related system(s) or the combination of safety-related system(s) and external risk reduction facilities meet, in all respects, the Safety Requirements Specification. The validation is usually executed by testing
Safety Assessment	The investigation to arrive at a judgment - based on evidence - of the safety achieved by safety-related systems

Further definitions of terms used for safety techniques and measures and the description of safety related systems are given in IEC 61508-4.

A1.3.2 Abbreviations

FMEDA	Failure Mode, Effects and Diagnostic Analysis
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System
SLC	Safety Lifecycle

A1.4 Assessment results

A1.4.1 Safety related parameters

The following results have been obtained from the assessment report Report No.: ROTA YOKOGAWA 08/07-23 R002 Version V2, Revision R1; August 2010 issued by exida.

Average PFD values have been calculated assuming a Diagnostic Coverage (DC) of 99%, a mission time of 10 years and a Mean Time To Restoration of 24 hours.

Table 2: Summary for RAKD ([V1]) with fail-safe limit switches [3] – Failure rates

	Profile 2	Profile 4
Fail Safe Detected (λSD)	**0 FIT**	**0 FIT**
Fail Safe Undetected (λSU)	**132 FIT**	**174 FIT**
Fail Dangerous Detected (λDD)	**4 FIT**	**19 FIT**
Fail Dangerous Undetected (λDU)	**62 FIT**	**108 FIT**

SFF [4]	**68.7%**	**64.1%**
MTBF	**486 years**	**310 years**

SIL AC [5]	**SIL2**	**SIL2**

Safety metrics according to ISO 13849-1 [6]:

$MTTF_d$ (years)	**1730**	**899**
DC	**6%**	**15%**
Category (CAT)	**CAT 1**	**CAT 1**
Performance Level (required)	**PL_r = c**	**PL_r = c**
Performance Level (calculated)	**6.60E-08 1/h**	**1.27E-07 1/h**

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFDAVG = 2.96E-04	PFDAVG = 1.37E-03	PFDAVG = 2.72E-03

Table 3: Summary for RAKD ([V1]) with standard limit switches [7] – Failure rates

	Profile 2	Profile 4
Fail Safe Detected (λSD)	0 FIT	0 FIT
Fail Safe Undetected (λSU)	163 FIT	205 FIT
Fail Dangerous Detected (λDD)	4 FIT	19 FIT
Fail Dangerous Undetected (λDU)	101 FIT	147 FIT
SFF [4]	62.4%	60.3%
MTBF	375 years	261 years
SIL AC [5]	SIL2	SIL2

Safety metrics according to ISO 13849-1 [6]:

$MTTF_d$ (years)	1730	899
DC	6%	15%
Category (CAT)	CAT 1	CAT 1
Performance Level (required)	PL_r = c	PL_r = c
Performance Level (calculated)	6.60E-08 1/h	1.27E-07 1/h

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFDAVG = 2.96E-04	PFDAVG = 1.37E-03	PFDAVG = 2.72E-03

Table 4: Summary for RAKD ([V2]) with fail-safe limit switches [3] – Failure rates

	Profile 2	Profile 4
Fail Safe Detected (λSD)	0 FIT	0 FIT
Fail Safe Undetected (λSU)	162 FIT	215 FIT
Fail Dangerous Detected (λDD)	4 FIT	19 FIT
Fail Dangerous Undetected (λDU)	84 FIT	139 FIT

SFF [4]	66.3%	62.7%
MTBF	399 years	259 years

SIL AC [5]	SIL2	SIL2

Safety metrics according to ISO 13849-1 [6]:

$MTTF_d$ (years)	1297	723
DC	5%	12%
Category (CAT)	CAT 1	CAT 1
Performance Level (required)	PL_r = c	PL_r = c
Performance Level (calculated)	8.80E-08 1/h	1.58E-07 1/h

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFDAVG = 4.01E-04	PFDAVG = 1.86E-03	PFDAVG = 3.68E-03

Table 5: Summary for RAKD ([V2]) with standard limit switches [7] – Failure rates

	Profile 2	Profile 4
Fail Safe Detected (λSD)	0 FIT	0 FIT
Fail Safe Undetected (λSU)	192 FIT	246 FIT
Fail Dangerous Detected (λDD)	4 FIT	19 FIT
Fail Dangerous Undetected (λDU)	123 FIT	178 FIT
SFF [4]	61.5%	59.8%
MTBF	321 years	346 years
SIL AC [5]	SIL2	SIL1

Safety metrics according to ISO 13849-1 [6]:

$MTTF_d$ (years)	899	579
DC	3%	10%
Category (CAT)	CAT 1	CAT 1
Performance Level (required)	PL_r = c	PL_r = c
Performance Level (calculated)	1.27E-07 1/h	1.97E-07 1/h

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFDAVG = 5.87E-04	PFDAVG = 2.72E-03	PFDAVG = 5.39E-03

Table 6: Summary for RAKD ([V3]) with fail-safe limit switches [3] – Failure rates

	Profile 2	Profile 4
Fail Safe Detected (λSD)	0 FIT	0 FIT
Fail Safe Undetected (λSU)	232 FIT	334 FIT
Fail Dangerous Detected (λDD)	4 FIT	19 FIT
Fail Dangerous Undetected (λDU)	164 FIT	256 FIT
SFF [4]	58.9%	58.1%
MTBF	262 years	168 years
SIL AC [5]	SIL1	SIL1

Safety metrics according to ISO 13849-1 [6]:

$MTTF_d$ (years)	679	415
DC	2%	7%
Category (CAT)	CAT 1	CAT 1
Performance Level (required)	PL_r = c	PL_r = c
Performance Level (calculated)	1.68E-07 1/h	2.57E-07 1/h

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFDAVG = 7.83E-04	PFDAVG = 3.63E-03	PFDAVG = 7.18E-03

Table 7: Summary for RAKD ([V3]) with standard limit switches [7] – Failure rate

	Profile 2	Profile 4
Fail Safe Detected (λSD)	**0 FIT**	**0 FIT**
Fail Safe Undetected (λSU)	**262 FIT**	**367 FIT**
Fail Dangerous Detected (λDD)	**4 FIT**	**19 FIT**
Fail Dangerous Undetected (λDU)	**203 FIT**	**295 FIT**

SFF [4]	**56.7%**	**56.7%**
MTBF	**226 years**	**153 years**

SIL AC [5]	**SIL1**	**SIL1**

Safety metrics according to ISO 13849-1 [6]:

$MTTF_d$ (years)	**551**	**364**
DC	**2%**	**6%**
Category (CAT)	**CAT 1**	**CAT 1**
Performance Level (required)	**PL_r = c**	**PL_r = c**
Performance Level (calculated)	**2.07E-07 1/h**	**3.14E-07 1/h**

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFDAVG = 9.69E-04	PFDAVG = 4.49E-03	PFDAVG = 8.89E-03

[3] The switching contact output is connected to a fail-safe NAMUR amplifier (e.g. Pepperl+Fuchs KF**-SH-Ex1). The failure rates of the amplifier are not included in the listed failure rates

[4] The complete sensor subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

[5] SIL AC (architectural constraints) means that the calculated values are within the range for hardware architectural constraints for the corresponding SIL but does not imply all related IEC 61508 requirements are fulfilled.

[6] Depending on the application and possible external diagnostics a higher DC_D and therefore also a higher category might be possible to achieve.

[7] The switching contact output is connected to a standard switching amplifier (e.g. Pepperl+Fuchs KF**-SR2-Ex*.W). The failure rates of the amplifier are not included in the listed failure rates.

Blank Page

YOKOGAWA ELECTRIC CORPORATION
World Headquarters
9-32, Nakacho 2-chome, Musashino-shi
Tokyo 180-8750
Japan
www.yokogawa.com

YOKOGAWA CORPORATION OF AMERICA
2 Dart Road
Newnan GA 30265
USA
www.yokogawa.com/us

YOKOGAWA EUROPE B.V.
Euroweg 2
3825 HD AMERSFOORT
The Netherlands
www.yokogawa.com/eu

YOKOGAWA ELECTRIC ASIA Pte. LTD.
5 Bedok South Road
Singapore 469270
Singapore
www.yokogawa.com/sg

YOKOGAWA CHINA CO. LTD.
3F Tower D Cartelo Crocodile Building
No.568 West Tianshan Road Changing District
Shanghai, China
www.yokogawa.com/cn

YOKOGAWA MIDDLE EAST B.S.C.(c)
P.O. Box 10070, Manama
Building 577, Road 2516, Busaiteen 225
Muharraq, Bahrain
www.yokogawa.com/bh

Yokogawa has an extensive sales and distribution network.
Please refer to the European website (www.yokogawa.com/eu) to contact your nearest representative.

YOKOGAWA

IM 01R01B30-00E-E 5th edition January 01, 2013 -00