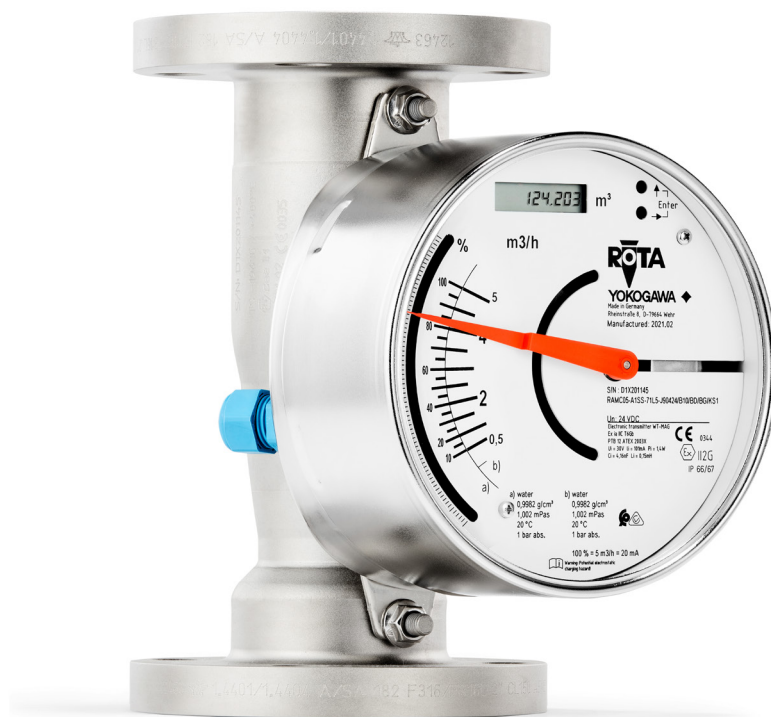


ROTAMETER RAMC
Metal Variable Area Flowmeter

IM 01R01B02-00E-E



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1. Introduction

1.1 Target group

The following persons are the target group of this manual:

- Technicians
- Engineers

This manual along with its applicable documents enable the target group to complete the following steps:

- Installation
- Commissioning
- Configuration (parametrization)
- Integration of the flow meter into a process control system
- Troubleshooting
- Maintenance and repair

1.2 Applicable documents

The following documents supplement this manual:

- General Specifications (GS) GS01R01B02-00E-E

1.3 Explanation of safety instructions and symbols

Warning notices are intended to alert users to potential hazards when working with the flow meter. There are four hazard levels that can be identified by the signal word:

Signal word	Meaning
WARNING	Indicates 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	Indicates 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	Calls your attention to a condition that must be observed in order to avoid the risk of damage to the instrument or system problems.
NOTE	Calls your attention to information that should be referred to in order to know the operations and functions of the instrument.

Symbols	Meaning
	Indicates a hazard, documentations must be consulted.
	Indicates important information.
	Placeholder
	Warning that requires reading the documentation.

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

Notices Regarding This Manual

- 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 might not cover all aspects and conditions, if customized specifications were required.
- 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 performance.

QR Code®

The product has a QR Code pasted for efficient plant maintenance work and asset information management. It enables confirming the specifications of purchased products and user's manuals.

For more details, please refer to the following URL.

<https://www.yokogawa.com/qr-code>

1.4 Safety

Intended use

The short-tube Rotameter is used for measurement of flow rates of liquids and gases. Its special application is in turbulent, opaque or aggressive fluids. The flow value is indicated by a pointer with the aid of a magnet enclosed in the float and a magnet in the indicator unit which follows the movements of the float. Use of the flow meter is limited primarily by the necessary homogeneity of the fluid and chemical resistance of the wetted parts. Details can be obtained from the responsible Yokogawa sales organization. Operational safety cannot be ensured in the event of any improper or not intended use. Rota Yokogawa is not liable for damage arising from such use. The flow meter described in this user's manual is a class A device according to IEC 61326-1 and may only be used in an industrial environment.

Technical conditions

At normal conditions, the flow meter does not release any poisonous gases or substances. If the flow meter is operated in faulty conditions, its safety and function may be impaired.

For this reason, the following must be observed:

- Operate the flow meter only when in good working order.
- If its operational performance changes unexpectedly, check flow meter for faults.
- Do not undertake unauthorized conversions or modifications on the flow meter.
- Eliminate faults immediately.
- Use only original spare parts.

General safety instructions



WARNING

Use of fluids that are a health hazard may result in caustic burns or poisoning

- When removing the flow meter, avoid touching the fluid and breathing gas residues left in the sensor.
 - Wear protective clothing and a breathing mask.
-



WARNING

Use of improper materials through the customer may result in heavy corrosion and/or erosion

- The customer is fully responsible to select proper materials to withstand his corrosive or erosive conditions.
 - Yokogawa will not take any liability regarding damage caused by corrosion/erosion.
-



WARNING

High fluid temperatures may result in hot surfaces and therefore a risk of burns

- Apply thermal insulation to the metering tube.
 - Attach warning labels to the metering tube.
 - Wear protective gloves.
-



WARNING

Risk of injury from electrical shock due to inadequate clothing

- Wear protective clothing as required by regulations.
-

The following basic safety instructions must be observed when handling the flow meter:

- Carefully read the user's manual prior to operating from the flow meter.
- When using the flow meter in areas at risk of explosion, compliance with chapter 9 is mandatory.
- Only qualified personnel must be charged with the tasks described in this user's manual.
- Ensure that personnel complies with locally applicable regulations and rules for working safely.
- Do not remove or cover safety markings and nameplates from the flow meter.
- Replace soiled or damaged safety markings on the flow meter. For replacing please contact the Yokogawa Service Center.
- When performing welding tasks on the tube, it is important not to ground the welding equipment by way of the flow meter. Soldering and welding work on parts of the flow meter is prohibited.
- The operator is responsible for ensuring that design limits (pressure, temperature) are not exceeded in the event unstable fluids decay.
- External influences may result in failure of threaded connections. The operator is responsible for providing suitable protective measures.
- Compression and shock waves in the tubes can cause damage to the device. For this reason it is important to avoid exceeding the design limits (pressure, temperature).
- Fires may result in increased process pressure (caused by temperature-related volume changes) and failure of gaskets. The operator is responsible for taking suitable measures to prevent fire-related damage.
- Manufacturing methods and technologies have been successfully field-tested for decades. Erosion and/or corrosion are not taken into account.
- Removal of material from the flow meter with power tools such as drills or saws is not permitted.
- Any repair, modification, replacement or installation of replacement parts is permitted only so long as it is in keeping with this user's manual. Other work must be first authorized by Rota Yokogawa. Rota Yokogawa does not assume liability for damage caused by unauthorized work on the flow meter or by improper use.
- The RAMC flowmeter is a heavy instrument. Be careful that no damage is caused through accidentally dropping it, or by exerting excessive force on the RAMC flowmeter.
- All procedures relating to installation must comply with the electrical code of the country where it is used.
- When connecting the wiring, check that the supply voltage is within the range of the voltage specified for this instrument before connecting the power cable. In addition, check that no voltage is applied to the power cable before connecting the wiring.
- The protective grounding must be connected securely at the terminal with the PE- or  mark to avoid danger to personnel (only 4-wire unit).
- Always conform to maintenance procedures outlined in this manual. If necessary, contact a Yokogawa representative.
- Build up of dirt, dust or other substances on the display panel glass should be prevented. If these surfaces do get dirty, wipe them clean with a soft dry cloth.
- Don't open the cover during rain.
- The electronic assembly contains sensitive parts. Be aware not to directly touch the electronic parts or circuit patterns on the board, and by preventing static electrification using grounded wrist straps when handling the assembly.
- When using the instrument as a PED-compliant product, be sure to read Chapter 10 before use.
- For explosion proof type instruments the description in chapter 9 has priority to the other descriptions in this instruction manual.
- All instruction manuals for ATEX Ex related products are available in English and German. Should you require an Ex related instruction in your local language, you should please contact your Yokogawa representative.

1.5 Warranty



NOTE

Please contact the Yokogawa sales organization if the device needs to be repaired.

The warranty terms for this device are described in the quotation.

If a defect for which Yokogawa is responsible occurs in the device during the warranty period, Yokogawa will repair that defect at its own cost. If you believe that the device is defective, please contact us and provide a detailed description of the problem. Please also tell us how long the defect has already occurred and list the model code and serial number. Additional information, such as drawings, simplifies the identification of the cause and repair of the defect. Based on our test results, we determine whether the device can be repaired at Yokogawa's expense or at the expense of the customer.

The warranty does not apply in the following cases:

- If the adhesion, blockage, deposit, abrasion or corrosion is the result of the device's actual use.
- If the device is mechanically damaged through solids in the fluid, hydraulic shock, or similar influences.
- If the instructions in the corresponding General Specifications or user's manual that must be met have not been followed.
- In case of problems, errors or damage that result from unprofessional installation by the customer, for example due to insufficient tightness of the pipe fittings.
- In case of problems, errors or damage that result from operation, handling or storage in rough ambient conditions that are beyond the specifications of the device.
- In case of problems, errors or damage that result from unprofessional or insufficient maintenance by the customer, for example, if water or foreign particles enter the device due to opening the device cover.
- In case of problems, errors or damage that result from use or from performing maintenance work on the device in a location other than the installation location specified by Yokogawa.
- In case of problems, errors or damage that result from modification or repair work that was not performed by Yokogawa or by a person authorized by Yokogawa.

- In case of problems, errors or damage that result from unprofessional installation, if the location of the device has been changed.
- In case of problems, errors or damage that result from external factors, such as other devices that are connected to this device.
- In case of problems, errors or damage that result from catastrophic external influences, such as fire, earthquake, storm, flooding or lightning.

1.6 Principle of measurement

The RAMC is a variable area flow meter for volume flow or mass flow for clean gases and liquids. It is build in vertically, the flow direction must be bottom-up. A float is guided in a concentrically shaped cone. The flowing fluid exert a lifting force to the float generated at the lower edge of the float and lifts it to a certain height, which is proportional to the flow value. The position of the float is magnetically transmitted to the indicator, which indicates the flow value by a pointer on a scale. The indicator can be equipped with limit switches and an electronic transmitter.

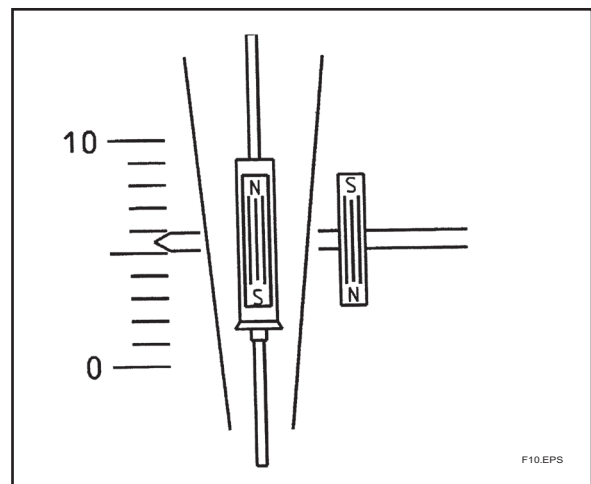


Fig. 1-1

For gases and low viscosity liquids with constant density, the lifting force only depends on the flow value. With increasing viscosity, however, additional friction forces act on the float. For each float/cone combination, a viscosity value is set at which the height of the float becomes dependent on the viscosity (see flow tables in GS01R01B02-00E-E). The viscosity values between "zero" and the specified viscosity value are referred to as the "viscosity-independent range". The RAMC is usually calibrated with water. The user must specify the process values of the fluid: density, temperature and viscosity. These values are used to calculate the user-specific scale from the calibration data.

1.7 Overview

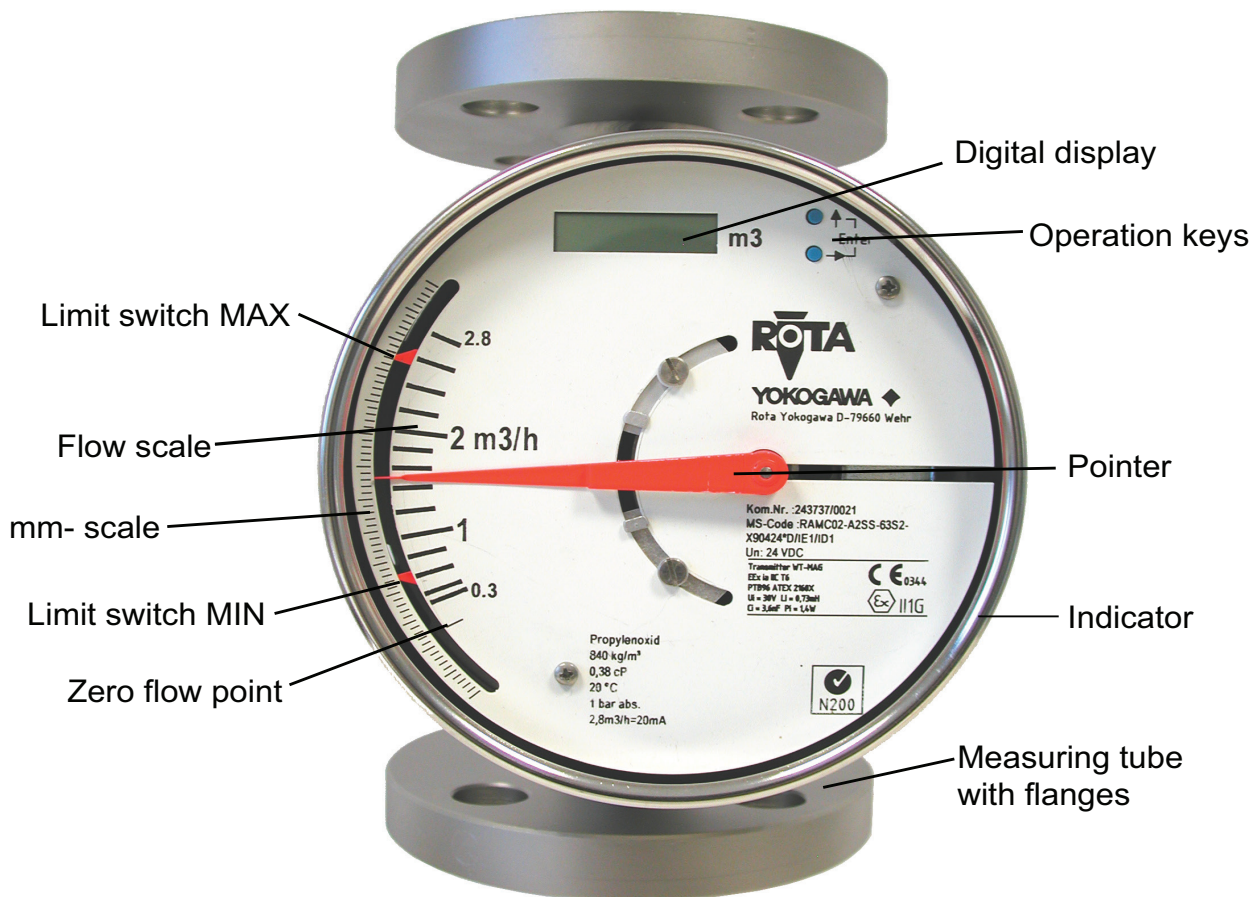


Fig. 1-2

Explanation of the inscription of the flanges

- type of flange e.g. DIN
- size of flange e.g. DN15
- Pressure range of the flange and measuring tube e.g. PN40
- Material of wetted parts e.g. 1.4404
- Manufacturing code of the flange manufacturer
- Lot. No.

Scale examples

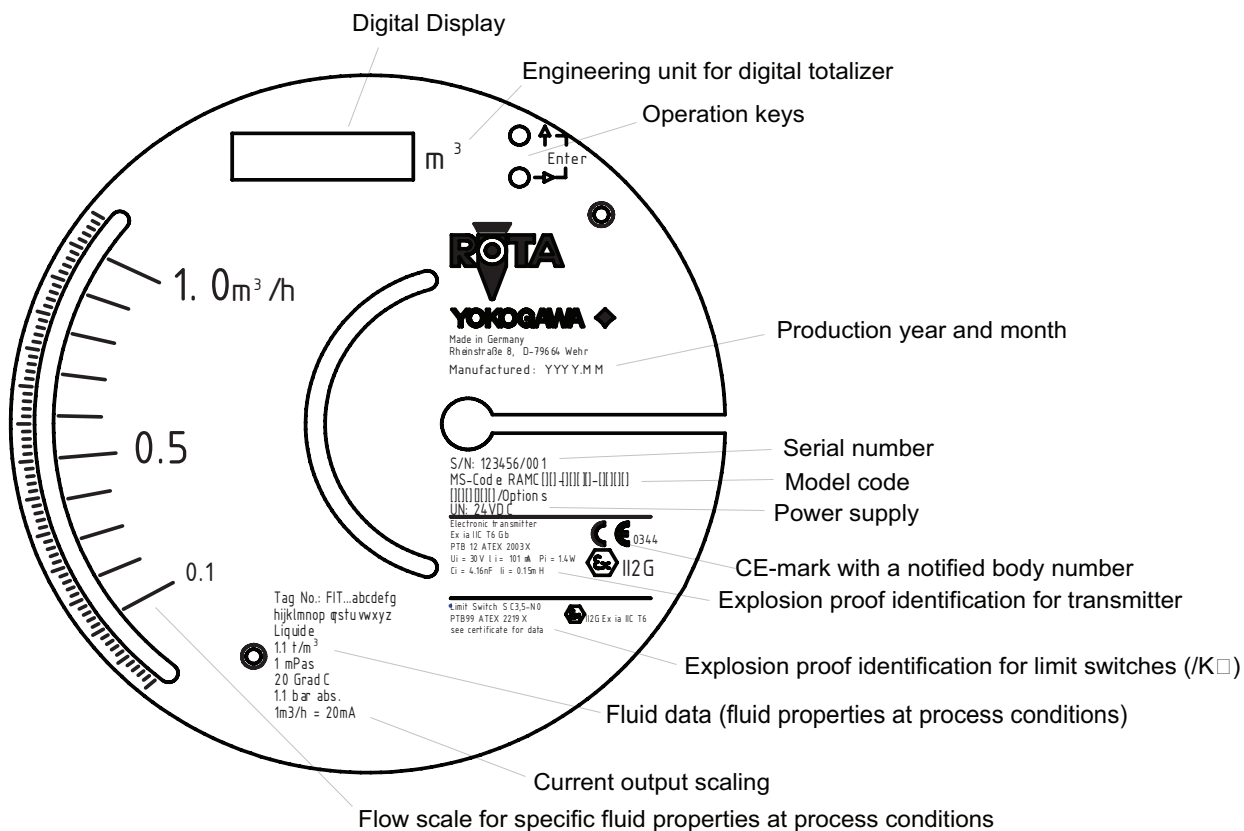


Fig. 1-3 Scale example for -E or -J -type (electronic transmitter)

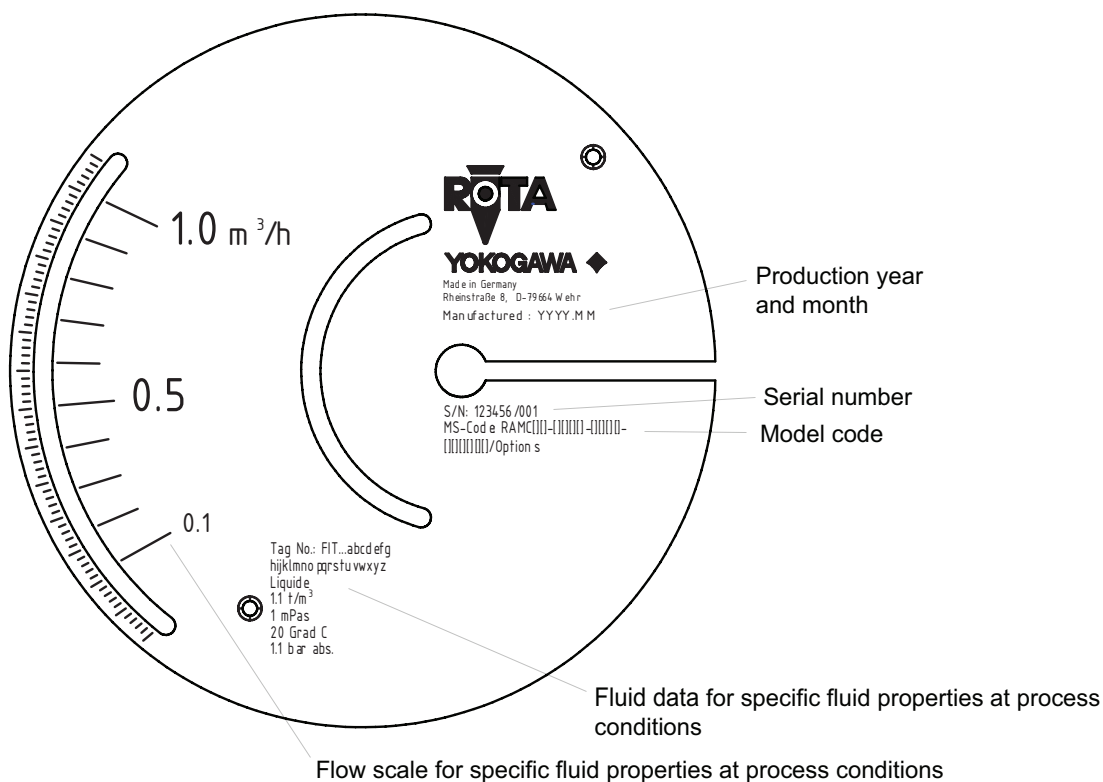


Fig. 1-4 Scale example for -T -type

3. Installation

3.1 Installation in the pipeline

The Rotameter RAMC must be installed in a vertical pipeline, in which the fluid flows upwards (see fig. 3-1). The vertical position has to be checked at the outer edge of the flanges. Larger nominal sizes (> RAMC08) require a straight inlet section of at least five times and a straight outlet section of at least three times of the nominal size of the RAMC.

The nominal diameter of the RAMC should correspond to the nominal diameter of the pipeline.

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. Center gaskets and tighten nuts with a torque appropriate for the pressure range.

If contamination or soiling of the RAMC 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.

Tightening of the flange threads for RAMC with PTFE- liner with the following torques:

Nominal Size				Bolts			Maximum Torque			
EN 1092-1		ASME B 16.5		EN 1092-1	ASME		EN 1092-1		ASME 150 lbs	
DN	PN	Inches	lbs		150 lbs	300 lbs	Nm	ft*lbf	Nm	ft*lbf
15	40	½	150/300	4 x M12	4 x ½"	4 x ½"	9.8	7.1	5.2	3.8
25	40	1	150/300	4 x M12	4 x ½"	4 x ½"	21	15	10	7.2
50	40	2	150/300	4 x M16	4 x 5/8"	8 x 5/8"	57	41	41	30
80	16	3	150/300	4 x M16	4 x 5/8"	8 x ¾"	47	34	70	51
100	16	4	150/300	4 x M16	8 x 5/8"	8 x ¾"	67	48	50	36



Fig. 3-1 Position of the flow-direction arrow

3.2 Notices regarding EMC

The Rotameter RAMC is conform to the European EMC Guideline and fulfils the following standards:

- EN 61326-1
- EN 55011
- NAMUR recommendation NE 21

The RAMC is intended for use in an electromagnetic environment according to EN 55011, Class A. Electro-magnetic compatibility may not be ensured in another electromagnetic operating environment.

Requirement during immunity tests:

The output signal fluctuation is specified within the ± 4 % output span.



CAUTION

Although the transmitter has been designed to resist high frequency electrical noise, if a radio transceiver is used near the transmitter or its 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. Mount the attached ferrite core as shown in chapter 3.3

3.3 Wiring of the electronic transmitter (-E, -J) and limit switches (/K□)

Please regard the drawings on the following pages.

On the rear of the RAMC are two openings for cable glands for round cables with a diameter of 6 to 9 mm (not for Ex-d-type option /□F1). Unused glands must be closed with a blind plug M16x1.5. (housing type 90) or with a blind plug M20x1.5 (housing type 91).

For wiring of RAMC with option/□F1 see chapter 9.

Wires should not be bent directly at terminal screws. Do not expose wires to mechanical pressure. Wires must be arranged according to common installation rules, especially signal and power lines must not be bundled together. Cables should not be bent directly after the cable gland. Do not fix cable at the measuring tube.

The RAMC terminals accept wires with a maximum sectional area of 1.5 mm².

The attached ferrite core must be mounted on the cable as shown in Fig. 3-2 Distance "L" < 2 cm.

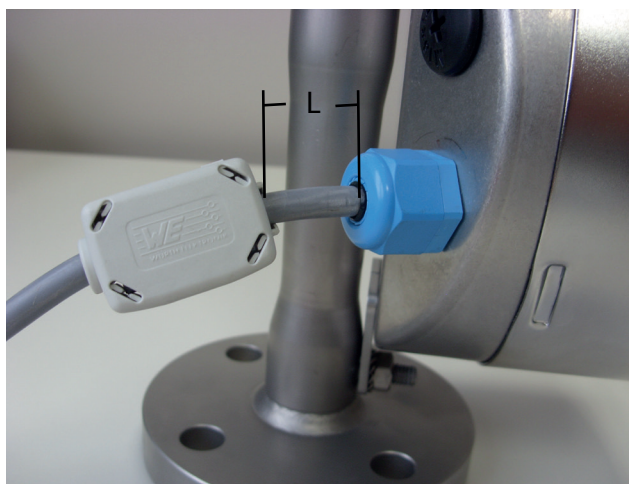


Fig. 3-2 Mounting ferrite core

Measuring and indicating instruments, connected in series to the output of the electronic transmitter, must not exceed a load impedance of $R_L = (U - 14 \text{ V}) / 20 \text{ mA}$ for 2-wire RAMC.

2-wire units are connected to the terminals marked "+", "-", and "A" of the power connector.

For 2-wire instruments the terminals "-" and "A" have to be shorted with a jumper. Pay attention not to loose that jumper when mounting wires.

Wiring inside the case should be kept as short as possible to avoid that moving parts are blocked.

Hints for Unit Safety (according IEC 61010-1)

- Do not connect cables outdoors in rainy conditions in order to prevent damage from condensation and to protect the insulation, e.g. inside the terminal box of the flowmeter.
- Heed the nominal voltage indicated on the scale.
- Use the cables which fulfill specification and check before wiring.
- The electrical connections have to be executed according to VDE 0100 "Errichten von Starkstromanlagen mit Nennspannungen bis 1000 V" (Installation of high current assemblies with nominal voltages of up to 1000 V) or equivalent national regulations.
- Units with a nominal voltage of 24 V may only be connected to a protected low voltage circuit (SELV-E according to VDE 0100/VDE 0106 or IEC 364/IEC 536).
- The indicator housing must be grounded to ensure electromagnetic interference protection. This can be done by grounding the pipeline.
- Once all wiring is complete, check the connections before applying power to the instrument. Improper arrangements or wiring may cause a unit malfunction or damage.
- This unit does not include a power switch. Therefore, a switch has to be prepared at the installation location in the vicinity of the unit. The switch should be marked as the power separation switch for the RAMC.

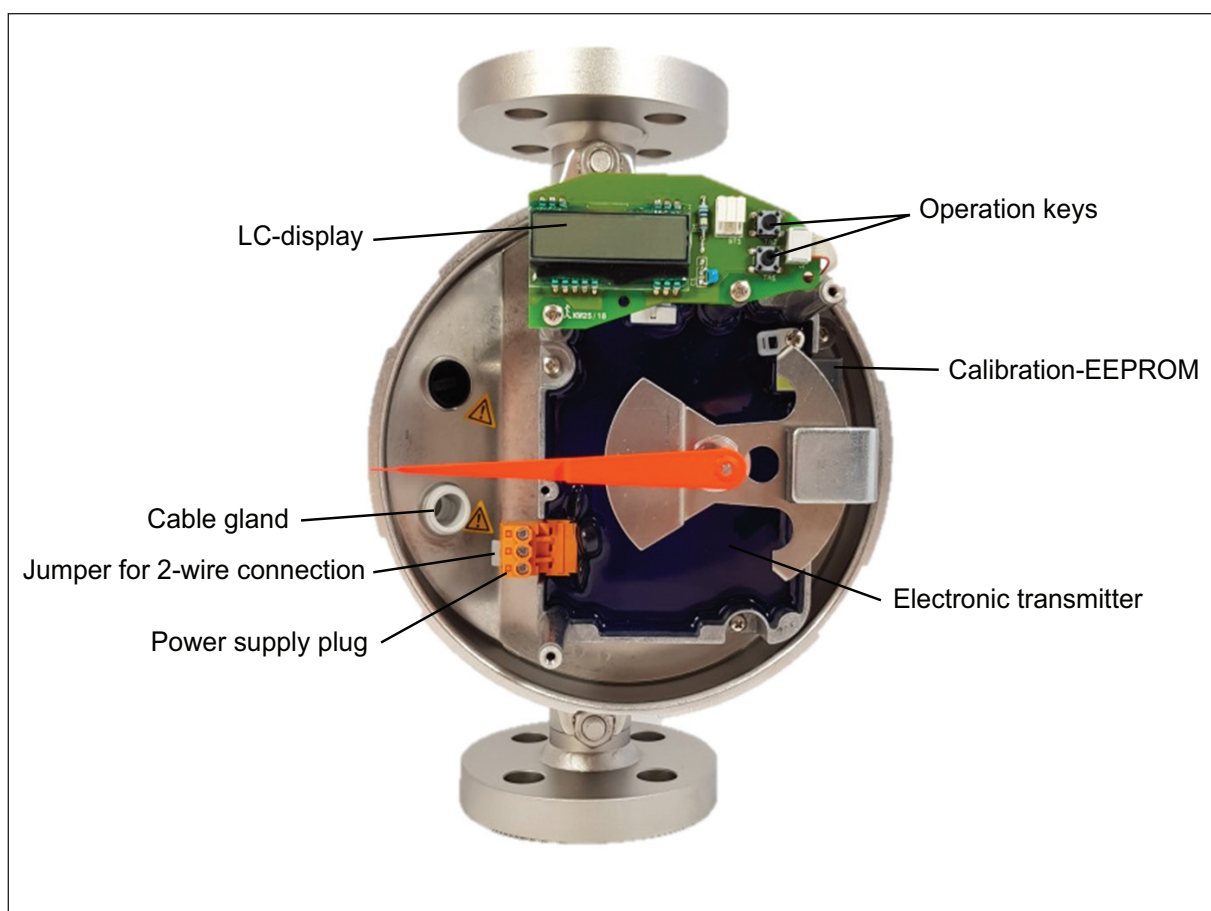


Fig. 3-3 2-wire unit

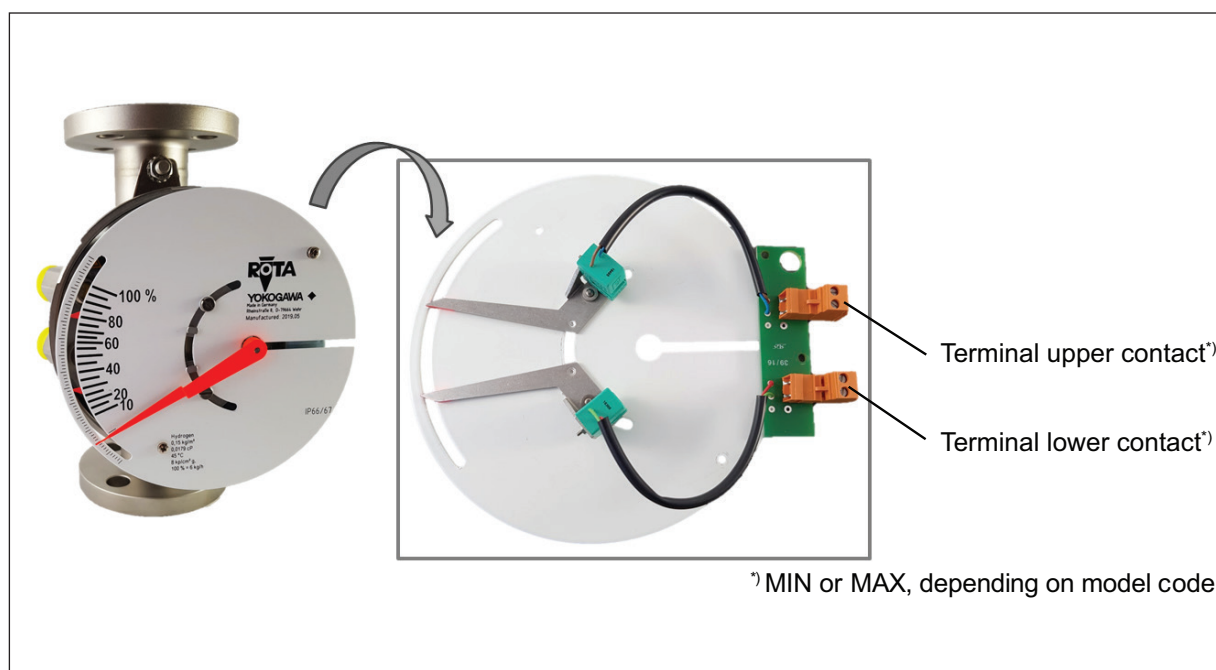


Fig. 3-4 RAMC with 2 limit switches

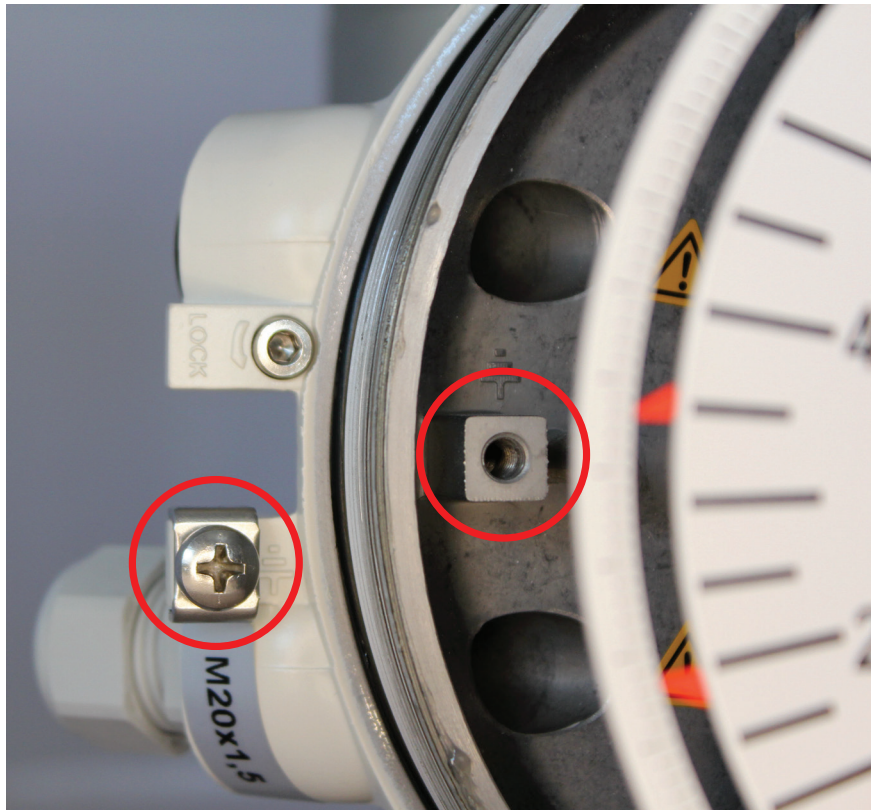


Fig. 3-5 External or alternatively internal grounding clamp (only housing type 91)

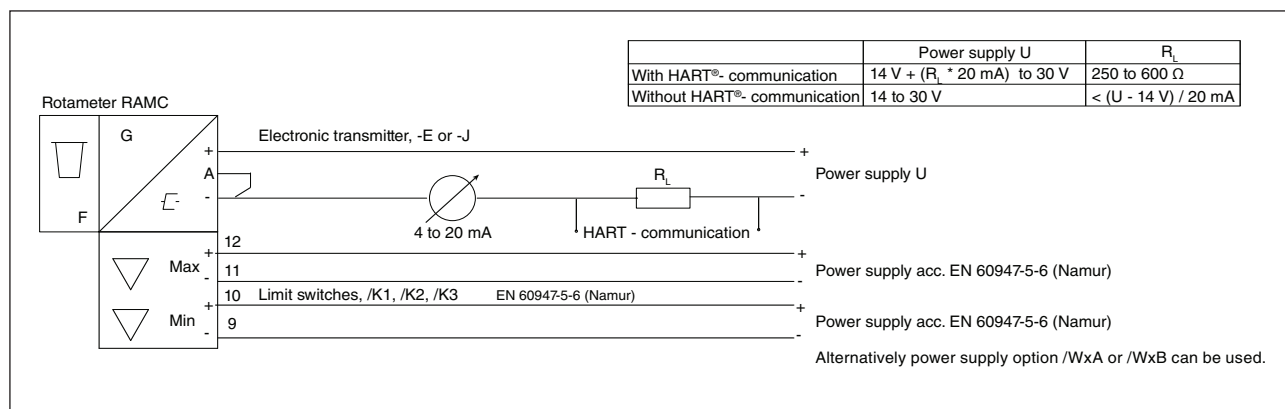


Fig. 3-6 RAMC 2-wire unit with standard limit switches

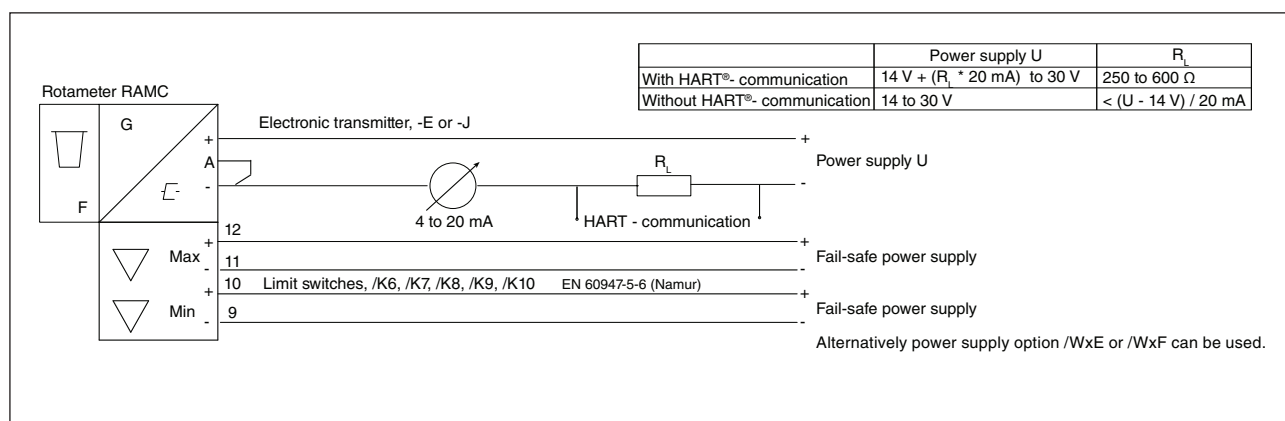


Fig. 3-7 RAMC 2-wire unit with fail- safe limit switches

Installation diagrams for Ex- approved units see chapter 9.

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 RAMC 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 replace the scale. This depends on several factors:

- If the device 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 ($\leq 0.5\%$), the present scale can be used.
- If the device 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.

4.2 Pulsation and pressure shock

Pressure shock waves and pulsating flow influence measurement significantly or can destroy the meter.

Surge conditions should be avoided (open valves slowly, raise operating pressure slowly).

If float bouncing occurs in gases increase the line pressure until the phenomena stops. If this is not possible provide the float with a damper. A damping kit is available as spare part.

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 device is now ready for operation.

The digital display shows as default the totalizer value in the measuring unit, indicated on the right side of the display.

Unit graduation, measuring unit, damping, etc. can be adjusted by an operating menu (refer to chapter 6.2). In case of an error, the bars beneath the 8 digits of the display will flash. The corresponding error message can be checked using the operating menu and then appropriate countermeasures can be taken (refer to chapter 6.2.8 "Error Messages").

The transmitter has been prepared and calibrated according to the model code as a 2-wire unit.

In 2-wire units, a jumper connects "A" and "-".

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). Maximum two switches can be installed. The option (/W□□) includes the respective power supplies.

These switches have been specified for the use in a hazardous area. However, the power supply must be installed in the safe area (associated apparatus).

The terminals for the limit switches are on a small board on top of the transmitter case, see fig. 3.2.

The limit switches are connected to the power supply as indicated in fig. 3.4 and fig. 3.5.

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 RAMC. The MIN-MIN or MAX-MAX function is set by adjusting the switching direction of the power supply.

The concerning 2- channel power supplies are:

Option /W1B: KFA5-SR2-Ex2.W or

Option /W1B: KFU8-SR-Ex1.W

Option /W2B: KFA6-SR2-Ex2.W or

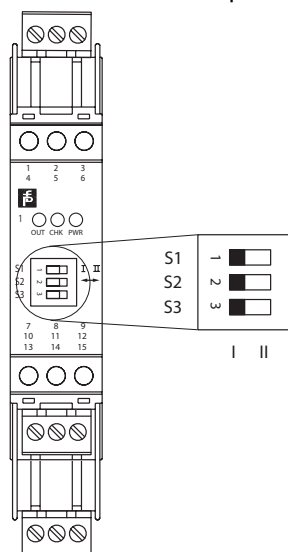
Option /W2B: KFU8-SR-Ex2.W

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 the power supply.



Use of Fail Safe limit switches (option /K6 to /K10):

For fail-safe application only 1- channel power supplies 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 power supplies are used as the above mentioned types, the power supply has to be applied as protection technology to ensure functional safety.

Please notice General Specifications (GS) GS01R01B02-00E-E for technical data.

For more information regarding Safety Instrumented Systems (SIS) application, please see appendix 2.

6. Electronic Transmitter (-E)

6.1 Operation principle

The position of the float is magnetically transferred to a magnetic follow up system. The position angle of this magnetic rocker is detected by magnetic field sensors. A micro controller determines the angle by means of a reference value table in the memory and calculates the flow rate by the angle with calibration and operation parameters of the calibration- EEPROM. The flow rate is given as a current 4 to 20 mA, and, in addition, if required, indicated on the digital display (refer also to section 6-2). The electronic transmitter has been electronically adjusted before shipping and, therefore, are mutually exchangeable. Calibration data of the metering tube as well as customer specific data are entered into a calibration- EEPROM, inserted on the board. This calibration- EEPROM and the indication scale are assigned to the respective metering tube.

When replacing an indicator (e.g. because of a defect) the scale and calibration- EEPROM of the old unit have to be inserted in the new unit. Then, no calibrations or adjustments are necessary.

If an indicator with electronic transmitter is installed to a new metering tube, the calibration- EEPROM of that tube has to be inserted into the transmitter and the indicator scale for that particular tube has to be mounted.

A change in the fluid data (e.g. specific gravity, pressure, etc.) requires the generation and mounting of a new calibration EEPROM and scale.

Normally the range of the current output is equal to the measuring range of the tube (end value on scale). The customer can position the 20 mA point between 60 % and 100 % of the end value on scale. The set of the 20 mA point is shown on the scale (refer to Fig. 1-3). The flow cut off is positioned at 5 % of the end value. Below 5 % flow the current output shows 4 mA. For meters with option /A16 it is 7 %.

6.2 Parameter setting

The displays allows indication of various parameters:

- Flow rate (8 mass or volume units in combination with 4 time units)
- Totalizer (8 mass or volume units)
- Flow rate indication in percent
- Special functions
- Setting of different damping times
- Indication of error messages
- Manual adjustment
- Service functions
- Detection of float blockage

The setting of these parameters is done by two buttons.

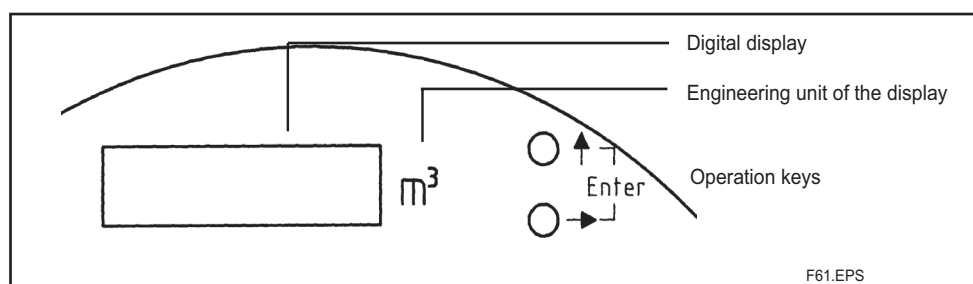


Fig. 6-1 Operation keys

The buttons access three functions:

- upper button ($\uparrow$): Exit setting mode
- lower button ($\rightarrow$): Scroll through menu/selection of parameters
- both buttons ($\uparrow + \rightarrow$) = Enter: Entering parameters/selecting setting mode

If no button is pressed for one minute while the operating menu is active, the indication reverts to the measuring indication. This does not apply to subfunctions F32, F33, F52, F63.

For indication of volume or mass values at maximum 6 digits in front of the decimal point and 7 decimals are used. This format allows an indication range for flow rates from 0.0000001 unit/time to 106000 unit/time. Flow rate values exceeding 106000 are shown as '————' on the display. In this case the next bigger flow rate unit (next smaller time unit) has to be selected.

For the indication of totalizers values 8 digits are used at maximum of which 7 digits can be assigned for decimal values. The decimal point setting is determined by the selected unit. Therefore, possible totalizer offsets are:

Unit *1

Unit *1/10

Unit *1/100

The totalizer counts up to 99999999 or 9999999.9 or 999999.99 and is reset to zero.

The next page shows the operating menu.

The following describes the selection and execution of functions.

Menu:

Indication meas .val	F1- Indication	F11: Selection	F11-1: Flow rate
			F11-2: Totalizer
			F11-3: %
			F11-4: Temperature
			Euro/US
		F12: Flow rate unit	F12-1: m ³ /m ³
			F12-2: l/acf
			F12-3: Nm ³ /Nm ³
			F12-4: NL/scf
			F12-5: t/ton
			F12-6: kg /kg
			F12-7: scf/lb
			F12-8: gal/usg
			Euro/US
		F13: Time unit	F13-1: h/h
			F13-2: min/min
			F13-3: s/s
			F13-4: day/day
		F14: Reset Totalizer	F14-1: Execute
		F15: Temperature unit	F15-1: degC
			F15-2: degF
		F21: Selection	F21 0: 0 s
			F21 1: 1 s
			F21 5: 5 s
			F21 10: 10 s
	F2-: Damping		

F3-: Output	F31: Selection	F31 0-20: 0-20 mA
		F31 4-20: 4-20 mA
	F32: Offset adjustment	F32 00
	F33: Span adjustment	F33 00
	F34: Pulse output *)	F34-1: not active
		F34-2: last digit
		F34-3: last but one digit
F4-: Error messages	F41: Indication	F41 Enn
F5-: Manual adjustment	F51: On/Off	F51-1: off
		F51-2: on
	F52: Adjustment table	F52 5: 5 % point
		F52 15: 15 % point
		F52 25: 25 % point
		F52 35: 35 % point
		F52 45: 45 % point
		F52 55: 55 % point
		F52 65: 65 % point
		F52 75: 75 % point
		F52 85: 85 % point
		F52 95: 95 % point
		F52 105: 105 % point
F6-: Service	F61: Revision indicator	H.. F..
	F62: EEPROM revision	A.. C..
	F63: Current output test	F63 04: 0 or 4 mA
		F63 20: 20 mA
	F64: Calibration table	F64-1: Standard
		F64-2: Remote version
	F65: Master Reset	F65-1: Execute
F7-: Float Block. Ind.	F71: Off/On	F71-1: Off/On
		F71-2: On/Off
	F72: Lower limit	F72-1: 5 % of Qmax
		F72-2: 15 % of Qmax
		F72-3: 30 % of Qmax
	F73: Supervision time	F73-1: 5 Minutes
		F73-2: 15 Minutes
	F74: Autozero	F74-1: Execute

Bold type = Factory Pre-setting

*) Option /CP

6.2.1 Selection of indication function (F11)

The function F11 selects the display's indication function.

The following indications can be set: flow rate, totalizer, % value or temperature.

At the factory the display is preset to totalizer indication.

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting function		Enter	F11
Selection or or or	Flow rate	Enter	F11 -1
		Enter	F11
	Totalizer	→	F11 -2
		Enter	F11
	%	2 x →	F11 -3
		Enter	F11
	Temperature	3 x →	F11 -4
		Enter	F11
Back to display mode		↑ ↑	F1- Display mode

Note: If you press "↑" instead of "Enter", you can return from the selected point to the previous menu without activating the displayed parameter.

When selecting "Flow rate" the measuring unit is set with function F12 and F13. When selecting "Totalizer" the measuring unit is set with F12. If % indication is selected, F12 and F13 have no effect. The internal totalizer is updated, if "Flow rate" or "Totalizer" is selected. In case of setting to "%" the internal totalizer is not updated and keeps its previous value.

If "Temperature" is selected the unit can be set by function F15. The indicated value is the temperature in the indicator housing.

After changing the indicating function and measuring units the corresponding measuring unit label should be fixed on the right side next to the display. A preselection of matching stickers is included with the device.

6.2.2 Setting the unit (F12/F13)

When ordering the transmitter two sets of metering units are available. It is not possible to switch between them. These two sets comprise the following metering units:

European unit set, Standard

	Standard	Description	Unit	Menu/Index
Flow rate unit	SI	Cubic meter	m ³	-1
	SI	Liter	l	-2
	SI	Norm cubic meter (0 °C; 1 Atm.abs = 1.013 bar)	Nm ³	-3
	SI	Norm Liter	Nl	-4
	SI	Ton	t	-5
	SI	Kilogram	kg	-6
	---	Standard cubic feet (60 °F; 1 Atm.abs = 14,69 psi)	scf	-7
	---	Gallon (imperial, UK)	gal	-8
Time unit	SI	Hour	h	-1
	SI	Minute	min	-2
	SI	Second	s	-3
	---	Day	d	-4

US unit set, Option /A12

	Standard	Description	Unit	Menu/Index
Flow rate unit	SI	Cubic meter	m ³	-1
	---	Actual cubic feet	acf	-2
	SI	Norm cubic meter (0 °C; 1 Atm.abs = 1.013 bar)	Nm ³	-3
	---	Standard cubic feet (60 °F; 1 Atm.abs = 14.69 psi)	scft	-4
	---	Long ton	ton	-5
	SI	Kilogram	kg	-6
	---	Pound	lb	-7
	---	Gallon (US)	usg	-8
Time unit	SI	Hour	h	-1
	SI	Minute	min	-2
	SI	Second	s	-3
	---	Day	d	-4

With functions F12 and F13, the measuring unit for the displayed value is selected.

F12 selects volume and mass units, while F13 sets the corresponding time unit.

When selecting the indication function "totalizer" the set time unit is not taken into account and only the selected mass or volume unit is effective. When choosing the "%" indication F12 and F13 have no effect.

The selection of the measuring unit is performed as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting Mass/Volume unit	unit set Euro US	Enter → Enter	F11 F12 F12 -1
Selection unit	m3 m3 l acf Nm3 Nm3 Nl scf t ton kg kg scf lb gal usg	Enter → Enter 2 x → Enter 3 x → Enter 4 x → Enter 5 x → Enter 6 x → Enter 7 x → Enter	F12 F12 -2 F12 F12 -3 F12 F12 -4 F12 F12 -5 F12 F12 -6 F12 F12 -7 F12 F12 -8 F12
Setting Time unit		→ Enter	F13 F13 -1
Selection time unit	h h min min s s day day	Enter → Enter 2 x → Enter 3 x → Enter	F13 F13 -2 F13 F13 -3 F13 F13 -4 F13
Back to display mode		↑ ↑	F1- Display mode

Note: If you press "↑" instead of "Enter", you can return from the selected point to the previous menu item without activating the displayed parameter.

After changing the measuring unit the corresponding measuring unit label should be fixed on the right side next to the display. A preselection of matching stickers is included with the device.

Attention: When switching the mass/volume unit the totalizer is reset to zero.
When changing the time unit the totalizer value remains unchanged.

6.2.3 Totalizer reset (F14)

Function F14 resets the totalizer to zero.

The totalizer reset is performed as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		Enter 3 x → Enter	F11 F14 F14 -1
Selection	Reset	Enter	F14
Back to display mode		↑ ↑	F1- Display mode

Note: If you press "↑" instead of "Enter", you can return from the selected point to the previous menu item without activating the displayed parameter.

6.2.4 Selection of temperature unit (F15)

The function F15 sets the unit of temperature indication.

The following indications can be set: degC (Celsius) or degF (Fahrenheit).

At the factory the display is set to degC indication.

The selection of the indication is as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		Enter 4 x → Enter	F11 F15 F15 -1
Selection	degC degF	Enter → Enter	F15 F15 -2 F15
Back to display mode		↑ ↑	F1- Display mode

Note: If you press "↑" instead of "Enter", you can return from the selected point to the previous menu item without activating the displayed parameter.

6.2.5 Setting of damping (F2-)

Function F21 allows damping the output with a certain time constant (63 % value). Normally the time constant is set to 1 sec.

The selection of the time constant is as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		→ Enter	F2- F21
Selection damping constant	0 s 1 s 5 s 10 s	Enter Enter → Enter 2 x → Enter 3 x → Enter	F21 0 F21 F21 1 F21 F21 5 F21 F21 10 F21
Back to display mode		↑ ↑	F2- Display mode

Note: If you press "↑" instead of "Enter", you can return from the selected point to the previous menu item without activating the displayed parameter.

6.2.6 Selection/Adjustment 4 to 20 mA or 0 to 20 mA (F3-)

Function F3- sets the current output to 4 to 20 mA or 0 to 20 mA. In addition, offset and span have to be readjusted. Offset compensation is for fine tuning the 0 or 4 mA point. Span or range compensation is for precise adjustment of the 20 mA point.

For adjusting the output, an ampere metre (mA) should be connected to the circuit loop. For wiring refer to the diagrams in chapter 3.

The current output is set according to customer specifications at the factory.

Adjustment of the output is executed as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode Output selection		2 x → Enter Enter	F3- F31 F31 0 to 20
Selection	0 to 20 4 to 20	Enter → Enter	F31 F31 4 to 20 F31
Setting function Offset-Adjustment		→ Enter	F32 F32 00
Offset-Adjustment (Setting current to 0/4 mA)	Increase Decrease if 0/4 mA	↑ → Enter	F32 in steps of +1 (+20 µA) F32 in steps of -1 (-20 µA) F32
Setting function Span setting		Enter	F33 F33 0
Span setting (Setting current to 20 mA)	Increase Decrease if 20 mA	↑ → Enter	F33 in steps of +1 (+20 µA) F33 in steps of -1 (-20 µA) F33
Back to display mode		↑ ↑	F3- Display mode

An adjusting step corresponds to 20 μ A. The complete adjusting range is ± 0.62 mA (31 steps). If the adjusting range is not sufficient, change to display F32 or F33 by pressing ENTER when display shows F32 31 or F33 31, press ENTER again and continue adjusting at F32 00 or F33 00.

3 wire connection:

With this configuration of the ranges 0 to 20 mA and 4 to 20 mA are possible. With a change between the two ranges with F31 the current output is automatically adjusted. A perhaps necessary fine adjustment can be carried out with F32 or F33.

2 wire connection:

With this configuration the range of 4 to 20 mA is meaningful. The range of 0 to 20 mA is not closed however. At the change to 0-20 mA with F31 the equipment assumes a remodelling on 3 wire connection and the current output is adjusted according to this. A perhaps necessary fine adjustment can be carried out with F32 or F33.



WARNING

Since YOKOGAWA does not have any influence on the custom-designed connection, the current output is not automatically adapted, if the connection is changed from 2 wire to 3 wire or vice versa. This must be manually carried out with the functions F32 and F33.

Preset values:

Current range	Connection	2- wire	3-wire
0 - 20 mA		-----	$I_0 = 0$ mA $I_{20} = 20$ mA
4 - 20 mA		$I_4 = 0.4$ mA + 3.6 mA $I_{20} = 16.4$ mA + 3.6 mA	$I_0 = 4$ mA $I_{20} = 20$ mA
Note		Do not use F31	Use F31 for changing

6.2.7 Pulse output (F34) (Option /CP)

Pulse output is not available.

6.2.8 Error messages (F4-)

If the 8 bars beneath the digits start flashing, an error has occurred in the measuring transmitter/current output. Since the pointer indication is independent from the electric measuring transmitter, it shows the correct measuring value even if the transmitter is defective. Function F41 allows checking of the assigned error codes.

Error codes are called onto the display as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		3 x → Enter Enter Enter	F4- F41 F41 Enn F41
Back to display mode		↑ ↑	F4- Display mode

List of error messages:

Code	Meaning	Remedy
01	RAM-error	Indication unit needs service
02	ADC-error	Indication unit needs service
03	Internal EEPROM faulty	Indication unit needs service
04	Calibration-EEPROM faulty	If EEPROM is missing insert, -otherwise order new EEPROM
05	Wrong totalizer value in EEPROM	Reset totalizer
06	Overflow (flow rate too high)	Reduce flow rate
07	Internal EEPROM faulty	Indicator unit needs service
08	Float blocking indication realized, supervision time gone off	Deactivate float-blocking-indication (possibly remove float and clean) or run Autozero function

In case of error the appropriate remedy has to be taken.

6.2.9 Manual adjustment (F5-)

During manufacturers adjustment and calibration process the relation between flow rate with water (or with air) and float position (indicated as angle on the mm-scale) is determined. Based on the properties of the customers fluid at expected operating conditions the flow scale and the corresponding EEPROM is calculated.

If the fluid properties are changing (by change of the fluid or by change of the process conditions) the scale as well as the EEPROM has to be adapted. Easiest and recommended way to do this is to order a new scale and EEPROM for the new properties from the manufacturer and to replace both.

A second possibility is to readjust the meter by the user. This readjustment procedure will only adjust the current output and the display indication (but only in % of the new flow range). At least the readjustment by the user is possible by two different procedures:

Manual "dry" readjustment based on recalculated original scale:

The following steps have to be performed:

- Calculate the new of flow rate to mm (on scale) relation based on original manufacturers calibration certificate.
- Place the device (with the measuring tube) horizontally on a table (Note: the distance to any ferro-magnetic parts must be at least higher than 250 mm).
- Go to menu function F51 and press ENTER to switch to manual adjustment mode. (Switching back to the original adjustment is possible by pressing ENTER again).
- Go to menu function F52 in order to start the manual adjustment.
- Move the float to a position where the pointer is indicating on mm-scale the mm-value belonging to 5 % of the new flow rate (Note: these values have to be calculated in step a first).
- Press ENTER to adjust the first 5 % point.
- Repeat above steps for the 15 %; 25 %; 35 %; 45 %; 55 %; 65 %; 75 %; 85 %; 95 % and 105 % points. (Note: The whole loop from 5 % to 105 % has to be adjusted in the requested order without interruption. It is not possible to skip or stop and restart the adjustment.)
- The adjustment has to be finished and stored by pressing "↑".

After storage the new adjustment is permanently available and can be switched "on" or "off" by function F51.



NOTE

When manually adjustment is active, the user is responsible for the measurement accuracy.

Activating/deactivating manual adjustment table (F51)

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		4 x → Enter	F5- F51
Selection	Change state Take state	Enter → Enter	F51 -1 or -2 (*) F51 -2 or -1 F51
Back to display mode		↑ ↑	F5- Display mode

(*) -1: manual adjustment OFF;

-2: manual adjustment ON

Input of manual adjustment table (F52)

The manual adjustment table is input as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		4 x → Enter →	F5- F51 F52
Selection	5 %- point 15 %- point 25 %- point 35 %- point 45 %- point 55 %- point 65 %- point 75 %- point 85 %- point 95 %- point 105 %- point	Enter Enter Enter Enter Enter Enter Enter Enter Enter Enter Enter	F52 F52 -5 F52 -15 F52 -25 F52 -35 F52 -45 F52 -55 F52 -65 F52 -75 F52 -85 F52 -95 F52 -105
Back to display mode		↑ ↑	F5- Display mode

Manual "wet" adjustment by comparison to a reference master meter with the real process fluid at operating conditions:

This adjustment is useful under the following conditions:

- The original manufacturer's calibration is not available or needs to be renewed.
or
- The user is not able to recalculate the new mm to flow rate table.
and
- The user has the possibility to compare the meter indication with a master meter with the process fluid at process conditions.

In these cases the following steps have to be performed:

- Place the device in line with the master meter in an installation allowing controlled flow with the process fluid at process conditions in a flow range from 5 % to 105 % of the expected flow range.
- Go to menu function F51 and press ENTER to switch to manual adjustment mode. (Switching back to the original adjustment is possible by pressing ENTER again).
- Go to menu function F52 in order to start the manual adjustment.
- Set the flow to 5 % of the new flow rate indicated by the master.
- Press ENTER to adjust the first 5 % point.
- Repeat above steps for the 15 %; 25 %; 35 %; 45 %; 55 %; 65 %; 75 %; 85 %; 95 % and 105 % points. (Note: The whole loop from 5 % to 105 % has to be adjusted in the requested order without interruption. It is not possible to skip or stop and restart the adjustment.)
- The adjustment has to be finished and stored by pressing "↑".

After storage the new adjustment is permanently available and can be switched "on" or "off" by function F51.

For the manual adjustment procedure according to the two cases described the following remarks have to be taken into account:

- After manual adjustment the original flow-scale of the indicator is no longer valid.
- The display will only indicate in % of the new flow range
- Switching of units is impossible.
- The indicator can be always resetted to the original adjustment according to manufacturers calibration at any time.
- The described procedures will only adjust the current output and the display to the new measuring range for a different fluid and/or new process conditions.
- The result of this adjustment is NOT a calibration. If proof of the new adjustment is requested a real calibration by comparison to a standard has to be made after adjustment.
- The following interactions with other functions apply:

Interaction with other functions:

	Action	Function	Effect
1.	Setting of manual adjustment values	F52 -5...	Manual adjustment table is overwritten
2.	Activating of manual adjustment table	F51 -2	• Manual adjustment table active • %-indication only • Totalizer does not count • No other flow rate unit selectable • Function F64 for option /A2 has no effect, with manual adjustment
3.	Deactivating of manual adjustment table	F51 -1	• Standard adjustment table active • F11 is set to flow rate • Flow unit is the same as before activating manual adjustment • Totalizer value is the same as before activating manual adjustment

Due to the limitations described, it is strongly recommended to order a new scale and EEPROM from manufacturer (a real new flow scale without new calibration) or to order a new calibration by the manufacturer together with a new scale and EEPROM for the new fluid and/or new process conditions (new adjustment plus new calibration).

6.2.10 Revision indication (F61/F62)

Functions F61 and F62 enable the indication of revision states for hardware, software of calibration EEPROM and internal EEPROM.

The indication is called up as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode Revision		5 x → Enter 2 x →	F6- F61 Hhh ¹ Fff ²
Setting mode EEPROM Revision		Enter Enter Enter	F61 F62 Aaa ³ Ccc ⁴
Back to display mode		↑ ↑	F6- Display mode

¹ H = Hardware ² F = Firmware ³ A = Internal EEPROM ⁴ C = Calibration-EEPROM

6.2.11 Current output test (F63)

Function F63 sets the output current to 0/4 mA or 20 mA respectively.

With this you can determine whether output current correction by function F32 is required.

The adjustment of the current output is as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		5 x → Enter Enter	F6- F61 F63
Selection	Output 0/4 mA Output 20 mA	Enter → Enter	F63 0/4 F63 20 F63
Back to display mode		↑ ↑	F6- Display mode

Note: During selection you can switch between 0/4 mA and 20 mA with the "→"-key.
If you press "↑" instead of "Enter", you can return from the selected point to the previous menu item without activating the displayed parameter.

6.2.12 Switching between standard or Indicator on extension (F64)

F64 allows switching between the standard calibration table and a calibration table for the indicator on extension (option /A16 for high temperatures). The adjustment has to be performed according to the RAMC type (MS code).

This is done as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		5 x → Enter 3 x →	F6- F61 F64
Selection	Standard Remote Version	Enter → Enter	F64 -1 F64 -2 F64
Back to display mode		↑ ↑	F6- Display mode

Note: If you press "↑" instead of "Enter", you can return from the selected point to the previous menu item without activating the displayed parameter.

6.2.13 Master Reset (F65)

If the unit shows aberrant behavior or does not execute functions any longer, function F65 allows a master reset of the micro controller.

Attention: All parameter settings are reset to factory settings (see operation menu).

The master reset is executed as follows:

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		5 x → Enter 4 x →	F6- F61 F65
Selection	Reset	Enter Enter	F65 -1 F65
Back to display mode		↑ ↑	F6- Display mode

Note: If you press "↑" instead of "Enter", you can return from the selected point to the previous menu item without activating the displayed parameter.

6.2.14 Float blocking indication (F7-)

6.2.14.1 Functionality

Float

Pulsating movements of the fluid (gasses/liquids) lead to fluctuations of the float and with that to fluctuations of the tap system/pointer. Therefore the electrical measuring signal permanently changes and with that the display value and the output current value.

The fluctuations can be reduced with the help of the damping function "F21". That shows however that the fluid still flows and the float/the tap system is not blocked. This means that in most applications there is a permanently changing measuring signal which can be used for the recognition of the movement or the blockage of the float.

Basic noise

Since it is an electronic evaluation circuit, permanently minimal fluctuations of the measuring signal appear. The basic noise is caused by vibrations in the plant as well as by temperature influences or external magnetic fields. The basic noise also appears, if

- no fluid flows through the measuring pipe
- the float and with that the tap system are in the rest position
- the float/the tap system is blocked.

Float-Blocking-Indication

The function of the Float-Blocking-Indication allows the electronic transmitter to distinguish the fluctuations, which are caused by a moving float, with the fluctuations of the basic noise to state a fault status. If the measuring signal does not exceed the autozero value during a defined supervision time, this is recognized as blockage and an error condition is shown.

6.2.14.2 Operation

Switching on

At delivery of the equipment the Float-Blocking-Indication is turned off. By the function "F71 2" the Float-Blocking-Indication can be activated.

Autozero function

The autozero function is called to find out the level of basic noise in the application. This is started with the function "F74 1" and lasts for 90 seconds. While the autozero function is running the value "0.000" is displayed and the 4 bars will flash below the numbers. After approx. 80 seconds the current autozero value appears on the display. This value gets stored and will not be lost after power off/on the RAMC or after switching off/on the Float-Move-Detection-function. The stored value is typed over first after a renewed autozero.

Autozero without flow

To execute the autozero function the following cycle is recommended:

- Plant in operation (measuring tube filled with fluid)
- Drive flow to zero (place float into rest position)
- Raise the pointer to 10 % to 20 % of the flow and fix it on the scale with adhesive tapes or underlaid paper stripe.
- Start Autozero function by menu.
- Check Autozero value after approx. 80 seconds.

During the Autozero function it absolutely has to be ensured that:

- the RAMC is not moved by touching or using the 2 buttons.
- the pointer is protected against slipping.
- the tube is not exposed to strong tremors

If these prerequisites are not adhered, this leads to the inquiry of too high autozero results. Then even quiet flow will trigger the Float-Blocking-Indication.

Autozero with flow

The Autozero function can be carried out also under flow, if the flow cannot be switched off. To this the following expiry is recommended:

- Plant in operation (measuring tube filled with fluid)
- Move flow to constant value (preferably between 10 % and 40 %)
- Fix pointer on the oriented scale factor with adhesive tapes or underlaid paper stripe
- Start Autozero function by menu.
- Check Autozero value after approx. 80 seconds.

It has to be ensured that there is absolute constant flow during the Autozero duration. Normally at this variant higher Autozero results must be expected.

Autozero range

The factory default autozero value is zero (0.000).

At the inquiry of the autozero value it has to be ensured that the pointer/tap system are not in the rest position. In this case the autozero value is zero and the Float-Move-Detection does not work.

Normally the autozero value is smaller than 0.200. If higher results should appear in the application, a multiple inquiry of the autozero value is recommended to confirm the value.

Supervision range (measuring range)

The measuring range in which Float-Move-Detection is active lies between 5 % and 105 % of the maximum flow Q_{max} (Factory Setting). With the help of the function "F72" this range can be reduced if a supervision is not possible or not desired in the lower flow range. The range can be restricted to 15 % or 30 % to 105 % (see point 3.1 to 3.3).

Supervision time (Time Out)

The supervision time of the measuring signal is 5 minutes (Factory Setting). If the measuring signal should not exceed the autozero value during this period, this is recognized as blockage and an error condition is shown.

The supervision time can be increased with the function "F73" up to 15 minutes.

Indication of a blocking condition

After the recognition of the blockage the error code "08" is produced and the bars under the displayed measurement value are flashing (see fault behavior). Simultaneously the current output is set to a value, which enables a clear fault detection of a connected evaluation unit:

- 2 - wire 4 to 20 mA: Error condition: $I_A (I_G) < 3.6 \text{ mA}$

6.2.14.3 Unsuitable applications

It is possible, that the Float-Blocking-Indication - Function does not work satisfactory. This can be caused by different factors which are explained briefly here. In these cases the function of the Float-Blocking-Indication is not suitable for the respective application and it should not be used.

Applications with gases

At applications with gases and float-damping it can happen, that the pulsating movements of the fluid (and with that of the float) are damped so strongly in the measuring tube, that the measuring signal lies under the autozero value and a Float-Blocking-Indication is not possible.

Applications with high viscous media

If a high viscous fluid is used in the plant, the damping can get so high by the high viscosity of the flow that the measuring signal lies below the autozero value, and a Float-Blocking-Indication is not possible.

Applications with quiet flow

If the plant has an extremely quiet flow (gases or liquids), the supervision range can be limited in the lower flow range. Normally greater flow (> 30 %) causes greater fluid flow deviations. The duration of the supervision can be put to 15 minutes to reach a longer supervision time.

6.2.13.4 Parameter setting

Error message (F41)

Code	Meaning	Remedy
08	Float blockage Supervision time gone off	Check float in tube, clean tube if necessary. Deactivate float blocking indication or run Autozero function.

Factory defaults/Master Reset (F65)

The RAMC is adjusted at delivery (Factory Setting):

• F71 - 1	Float-Move-Detection		OFF
• F72 - 1	Lower limit value of the supervision area	5 %	
• F73 - 1	Supervision time (Time Out)		5 min
• F74	Autozero inactive		Autozero value = 0

After Master Reset the following attitudes are given:

• F71 - 1	Float-Blocking-Indication	OFF	
• F72 - 1	Lower limit value of the supervision area	5 %	
• F73 - 1	Supervision time (Time Out)		5 min
• F74	Autozero inactive		Autozero value not changed

Damping (F21)

The selection of the damping value has no influence on the autozero value or the measurement value of the Float-Blocking-Indication.

Float-Blocking-Indication (F7x)

Function F71: On-/Off- switching of the float-blocking-indication

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		6 x → Enter	F7- F71
Selection	FBI OFF/ON FBI ON/OFF	Enter → Enter	F71 -1 or -2 F72 -2 or -1 F71
Back to display mode		↑ ↑	F7- Display mode

Function F72: Selection of the lower limit value of the supervision range

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		6 x → Enter →	F7- F71 F72
Selection	5 % of Qmax 15 % of Qmax 30 % of Qmax	Enter Enter → Enter → Enter	F72 -5 F72 F72 -15 F72 F72 -30 F72
Back to display mode		↑ ↑	F7- Display mode

Function F73: Selection of the supervision time

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		6 x → Enter 2 x →	F7- F71 F73
Selection	5 Minutes 15 Minutes	Enter Enter → Enter	F73 -5 F73 F73 -15 F73
Back to display mode		↑ ↑	F7- Display mode

Function F74: Start Autozero function and storage

Description	Selection	Key	Indication
Change to setting mode		Enter	Display mode F1-
Setting mode		6 x → Enter 3 x →	F7- F71 F74
Selection Inquire autozero value (80 s) Display autozero value (10 s)	Autozero	Enter Enter	F74 -1 0.000 0.xxx
Back to display mode		↑ ↑	F7- Display mode

7. HART- Communication

7.1 General

RAMC with indicator type -J have, additional to the current output, the possibility for HART-communication. Also without HART- communication the units are fully able to work. The HART- communication does not influence the current output, except in Multidrop-Mode (see below).

Standard versions and explosion proof versions are physical the same. For use in the hazardous area a HART-able transmitter power supply is required.



NOTE

The HART- communication is only available with plugged calibration- EEPROM



NOTE

The HART- communication is only available for 2-wire units, 4 to 20mA. Therefore the short-circuit bridge must be connected between "A" and "-".

Deviations in the RAMC- Menu

In HART devices the operating menu according chapter 6 is not available.

Pressing the ↑ -button the indication can be changed between flow, totalizer, percent and temperature.

Factory default is totalizer.

Pressing → button an error indication appears on display.

00000000 or 00000000

A detailed explanation see chapter 7.4.2 and 7.6.2.

7.1.1 Multidrop Mode

"Multidropping" transmitters refer to the connection of several transmitters to a single communication transmission line. Up to 63 transmitters can be connected when set in the multidrop mode. To activate multidrop communication, the transmitter address must be changed to a number from 1 to 63. This change does not deactivate the 4 to 20 mA analog output. The level at current output can be set by Lop current mode.

Setting of Multidrop Mode

Device Setup

Detailed setup

Configure output

HART output

Poll addr

Enter the number from 1 to 63 (Def.: 0)

Enabling the Multidrop Mode

About the procedure to call up the Polling display, please refer to the User's Manual of each configuration tool. When Loop current mode is set to "Enabled" an analog signal output is available for one device in a loop.

Device Setup

Detailed setup

Configure output

Analog output

Loop Current mode

Enable mode of variable output current



NOTE

When the same Polling address is set for two or more transmitters in multidrop mode, communication with these transmitters is disabled.

Communication when set in multidrop mode

The HART configuration tool searches for a transmitter that is set in multidrop mode when it is turned on. When the HART configuration tool is connected to the transmitter, the polling address and the tag will be displayed.

Select the desired transmitter. After that, normal communication to the selected transmitter is possible. To release multidrop mode, call up the Poll addr display and set the address to "0".

7.2 Connection

The wiring is made according to the following figure.

A protected twisted two-core cable is recommended as connection cable.

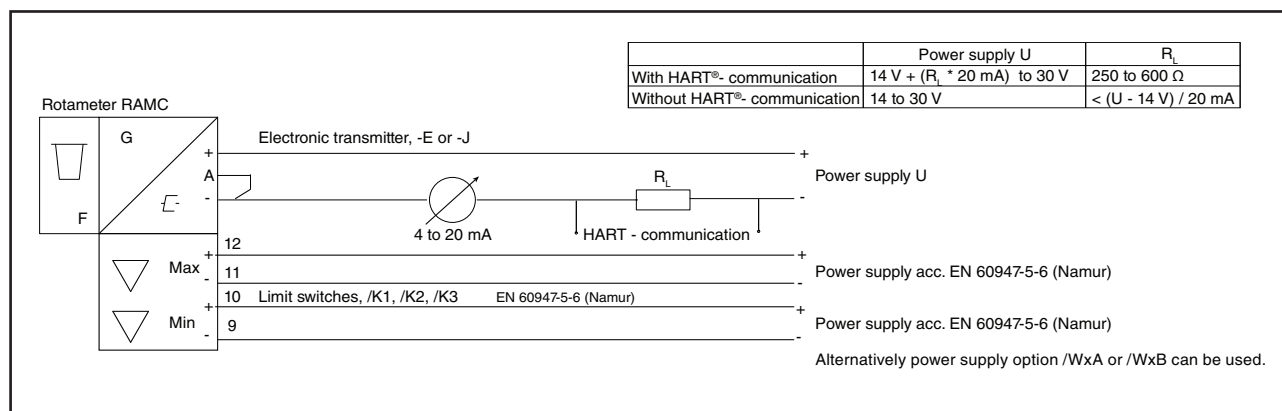


Fig. 7-1 RAMC 2-wire unit with Hart- communication

7.3 HART 7- Menu (Rev 10 DD rev 01)

		R=Read (Lesen) W=Write (Schreiben) S=Set (Setzen) T=Test P=perform			
Device Setup	Process Variables	Flow [unit]			R
		Flow Data Quality			R
		Flow Limit Status			R
		Total [kg]			R
		Total Data Quality			R
		Total Limit Status			R
		Percent [%]			R
		Percent Data Quality			R
		Percent Limit Status			R
		Temp [°C]			R
		Temp Data Quality			R
		Temp Limit Status			R
		Loop current [mA]			R
		Loop current Data Quality			R
		Loop current Limit Status			R
		Time Stamp			R
PV	PV Data Quality				R
					R
PV Limit Status	PV %				R
					R
PV Loop range	PV Loop current				R
					R
PV LRV	PV URV				R
					R
Diag/Service	Test device	Device status	Device Status	PV Out of Limits Non-PV Out of Limits PV Analog Channel Saturated PV Analog Channel Fixed More Status Available Cold Start Configuration Changed Device Malfunction	R R R R R R R R
			Ext dev status	Maintenance required Device variable alert Critical Power Failure	R R R
			Device Diagnostic Status 0	Simulation active Non-Volatile memory failure Volatile memory error Watchdog reset executed Voltage conditions out of range Environmental conditions out of range Electronic failure Device configuration locked	R R R R R R R R
			Status group 0	RAM error ADC error ADJ-EE error CAL-EE error Totalizer false Flow Overrun ADJ-EE error 2 Float blocked	R R R R R R R R
			Status group 1	Temp over limit Max flow1 active Max flow2 active FB autozero active Power fail warning Operate timer error Man. adjust act. FB indicat. act.	R R R R R R R R
			Cfg chng count		R
		Event Status	Event Status	Configuration changed event pending Device status event pending More status available event pending	R R R
			First time Unack Event Triggered		R

		Reset all errors	perform		P
		Self test	perform		P
		Squawk	perform Change number of Squawks Squawk Exit		P R/W P P
		Master reset	perform		P
		Device reset	perform		P
		Lock/Unlock device	perform		p
		Reset Cfg chng flag	perform		p
	Loop test	4/20/other/end			T
	Calibration	Apply URV/LRV	4 mA 20 mA Exit	Set as 4 mA value Read new value Leave as found Set as 20 mA value Read new value Leave as found	S S S S S S
		Reset URV/LRV	LRV (4 mA) URV (20 mA) Exit	Perform Perform	P P
		D/A trim	4 mA/20 mA		S
		Calib table	Standard version Distance version		R R
		Manual adjustment	Status man. adjustment Activate/deactiv Selected adjustm. point Set adjustm. points Reset adjustment table	ON / OFF ON / OFF 5 % 15 % 25 % 35 % 45 % 55 % 65 % 75 % 85 % 95 % 105 % Perform	R S S S S S S S S S S S p
	Diagnostics	Temp max log	Temp max log Time/value Old time/value Clear values	ON / OFF Days Hours Minutes Temp max Days Hours Minutes Temp max perform	p R R R R R R R R P
		Flow URV log	Flow URV log URV overrun time URV underrun time Min overrun time Clear values	ON OFF Days Hours Minutes Days Hours Minutes 15 sec 30 sec 1 min 5 min 10 min perform	R/S R/S R R R R R R R/S R/S R/S R/S P

		Power monitoring	Float blocking	Float blocking	ON OFF	R/S R/S
				Set lower limit	5 % 15 % 30 %	R/S R/S R/S
				Set supervis. time for	Turbulent flow Smooth flow	R/S R/S
				Start autozero	Perform	P
				Autozero value		R
			Operation time	Days; Hours; Minutes		R
			Oper time shadow	Days; Hours; Minutes		R
			Reset power fail	perform		P
		Real-Time Clock	Current Date	MM/DD/YYYY		R
			Current Time	HH:MM:SS		R
			Set Clock Date	MM/DD/YYYY		R
			Set Clock Time	HH:MM:SS		R
			Real Time Clock Flags	Non-Volatile Clock Clock Uninitialized		R R
			Set Real-time Clock	perform		P
	Basic Setup	Tag Long tag Flow units select [unit] Temperature unit [unit] Flow damp	(See Detailed Setup/Configure Signal/Flow units select) (See Detailed Setup/Configure Signal/Temperature unit)			R/S R/S R/S R/S R/S
	Detailed Setup	Characterize meter	Operating conditions	Density [Unit] Viscosity [Unit] Temperature [Unit] Pressure [Unit] Reference Pressure [Unit]		R R R R R
				Pressure Conditions	Absolute Gage Vacuum	R R R
			Medium data	Fluid Name		R
				Fluid Phase	Liquid Gas in Operation Gas in Normal Cond Gas in Standard Cond	R R R R
				Flow Reference	Volume Flow Mass Flow	R R
			Flow scale unit Scale USL [Unit] MS-Code RAMC s/n RAMC firmware rev.			R R R R R

			Configure signal	Flow damp [Sec]		R/S
				Flow units select	L/s	R/S
					L/min	R/S
					L/h	R/S
					Cum/s	R/S
					Cum/min	R/S
					Cum/h	R/S
					Cum/d	R/S
					gal/s	R/S
					gal/min	R/S
					gal/h	R/S
					gal/d	R/S
					Impgal/s	R/S
					Impgal/min	R/S
					Impgal/h	R/S
					Impgal/d	R/S
					Cuft/s	R/S
					Cuft/min	R/S
					Cuft/h	R/S
					Cuft/d	R/S
					bbl/s	R/S
					bbl/min	R/S
					bbl/h	R/S
					bbl/d	R/S
					Nml L/min	R/S
					Nml L/h	R/S
					Nml Cum/min	R/S
					Nml Cum/h	R/S
					Std L/min	R/S
					Std L/h	R/S
					Std Cum/min	R/S
					Std Cum/h	R/S
					Std Cuft/min	R/S
					Std Cuft/h	R/S
					g/s	R/S
					g/min	R/S
					g/h	R/S
					kg/s	R/S
					kg/min	R/S
					kg/h	R/S
					kg/d	R/S
					MetTon/min	R/S
					MetTon/h	R/S
					MetTon/d	R/S
					lb/s	R/S
					lb/min	R/S
					lb/h	R/S
					lb/d	R/S
					STon/h	R/S
					STon/min	R/S
					STon/d	R/S
					LTon/h	R/S
					LTon/min	R/S
					LTon/d	R/S
					Spcl	R/S
			Total reset	perform		P
			Temperature unit	degC		R/S
				degF		R/S

Configure output	Analog output	PV Loop current [Unit]		R
		PV LRV [Unit]		R/S
		PV URV [Unit]		R/S
		PV Alrm typ	Hi Lo	R/S
		Loop current mode	Disabled Enabled	R/S
		Loop test		R/S
		D/A trim		T
				T
	HART output	Poll addr		R/W
		Num req preams		R
		Num resp preams		W
		Burst Configuration	Burst Message 1	
			Burst 1 mode	Off
				Wired HART Enabled
			Burst 1 Command	Cmd 1: PV
				Cmd 2: %range/ current
				Cmd 3: Dyn vars/ current
				Cmd 9: Device vars /w status
				Cmd 33: Device variables
				Cmd 48: Read Addi- tional Device Status
			Classifica- tion	Device Va- riable not classified Tempera- ture
			Update Period	
			Max Update Periode	
			Trigger Mode	Continuous
				Window Rising Falling On-change
			Trigger Units	
			Trigger Level	
			Set Burst 1 Period	Perform
			Set Burst 1 Trigger	Perform
			Burst 1 variables	Burst Vari- able Code 1...8
				Flow
				Total
				Percent
				Temp
				Percent range
				Loop current
				Primary variable
				Secondary variable
				Tertiary variable
				Quaternary variable
				Not used

						Burst Message 2	Burst 2 mode	Off	R/S
								Wired HART Enabled	R/S
							Burst 2 Command	Cmd 1: PV	R/S
								Cmd 2: %range/ current	R/S
								Cmd 3: Dyn vars/ current	R/S
								Cmd 9: Device vars /w status	R/S
								Cmd 33: Device variables	R/S
								Cmd 48: Read Addti-onal Device Status	R/S
							Classifica-tion	Device Va-riable not classified	R
								Tempera-ture	R
							Update Period		R/W
							Max Update Period		R/W
							Trigger Mode	Continuous	R
								Window	R
								Rising	R
								Falling	R
								On-change	R
							Trigger Units		R
							Trigger Level		R
							Set Burst 2 Period	Perform	P
							Set Burst 2 Trigger	Perform	P
							Burst 2 variables	Burst Vari-able Code 1...8	R/S
								Flow	R/S
								Total	R/S
								Percent	R/S
								Temp	R/S
								Percent range	R/S
								Loop current	R/S
								Primary variable	R/S
								Secondary variable	R/S
								Tertiary variable	R/S
								Quaternary variable	R/S
								Not used	R/S

						Burst Message 3	Burst 3 mode	Off	R/S		
								Wired HART Enabled	R/S		
								Burst 3 Command	Cmd 1: PV	R/S	
									Cmd 2: %range/ current	R/S	
									Cmd 3: Dyn vars/ current	R/S	
									Cmd 9: Device vars /w status	R/S	
									Cmd 33: Device variables	R/S	
									Cmd 48: Read Additional Device Status	R/S	
								Classification	Device Variable not classified Temperature	R	
										R	
								Update Period		R/W	
								Max Update Period		R/W	
								Trigger Mode	Continuous Window Rising Falling On-change	R	
										R	
										R	
										R	
								Trigger Units		R	
								Trigger Level		R	
								Set Burst 3 Period	Perform	P	
								Set Burst 3 Trigger	Perform	P	
								Burst 3 variables	Burst Variable Code 1...8	Flow	R/S
										Total	R/S
										Percent	R/S
										Temp	R/S
										Percent range	R/S
										Loop current	R/S
										Primary variable	R/S
										Secondary variable	R/S
										Tertiary variable	R/S
										Quaternary variable	R/S
										Not used	R/S

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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				Flow Update Time Period	R
				Total Update Time Period	R
				Percent Update Time Period	R
				Temp Update Time Period	R
			Trend Configuration	Number of Trends supported	R
			Trend Control	Disable	R/S
				Enable single data point trending	R/S
				Enable filtered trending	R/S
				Enable average trending	R/S
			Trend Device Variable	Flow	R/S
				Percent	R/S
				Temp	R/S
			Trend Sample Interval	HH:MM:SS	R/W
			Trend data	Refresh Trend Data	P
				perform	
				Trend Device Variable	R
				Trend Units	R
				Trend Classification	R
				Trend 0 Date Stamp	R
				Trend 0 Time Stamp	R
				Trend Value (1, newest to 12, oldest)	R
				Trend Value (x) Data Quality	R
				Trend Value (x) Limit Status	R
			PV is		R
			SV is		R
			TV is		R
			QV is		R
	Display selection	Standard	ManCal		
		Flow	Percent		R/S
		Totalizer	Temperature		R/S
		Percent			R/S
		Temperature			R/S
	Device information	Model			R
		Dev Id			R
		Manufacturer			R
		Distributor			R
		Final asmbly num			R/W
		Write protect			R
		Cfg chng count			
		Tag			R/W
		Long tag			R/W
		Descriptor			R/W
		Message			R/W
		Date			R/W
		Poll addr			R/W
		Loop current mode	Enabled		R/S
			Disabled		R/S
		Num req preams			R
		Num resp preams			W
		MS-Code			R
		RAMC s/n			R
		RAMC firmware rev.			R
		Device Profile			R
		Revisions #'s	Universal rev		R
			Fld Dev. rev		R
			Hardware rev		R
			Software rev		R
			ADJ-EE rev		R
			CAL-EE rev		R

Write protect Menu	Write protect		R	
	Enable wt 10min New password		W W	
Review	Model Dev Id Manufacturer Distributor Final asmbly num Write protect Ctg chng count Max dev vars Tag Long tag Descriptor Message Date Poll addr AO Alrm typ Loop current mode Num req preams Num resp preams MS-Code RAMC s/n RAMC firmware rev. Universal rev Fld. Dev. rev Hardware rev Software rev ADJ-EE rev CAL-EE rev			R
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7.4 Description of the Parameter

Online

This menu shows current process data

Device Setup	Device setup menu
PV	Flow in measurement unit
PV Data Quality	Quality of flow value
PV Limit Status	Limit status of flow value
PV % rng	%-value related to span
PV Loop current	Current output in mA
PV LRV	Lower range value related to the current output of 4 mA or 0%
PV URV	Upper range value related to the current output of 20 mA or 100%

7.4.1 Process variables

Device Setup

Process variables

Flow	Flow in measurement unit
Flow Data Quality	Quality of flow value
Flow Limit Status	Limit status of flow value
Total	Totalized value
Total Data Quality	Quality of total
Total Limit Status	Limit status of total
Percent Flow	Percent value of flow
Percent Data Quality	Quality of percent
Percent Limit Status	Limit status of percent
Temp	Temperature in transmitter
Temp Data Quality	Quality of temperature
Temp Limit Status	Limit status of temperature
Loop current	Current output in mA
Loop current Data Quality	Quality of current value
Loop current Limit Status	Limit status of current value
Time stamp	Real-Time clock time stamp

7.4.2 Diagnostic- and Service-Menu

Device Setup

Diag/Service

Test device

Device status

Device status

Process applied to primary variable is outside the operating limits of the field device
 Process applied to non-primary variable is outside the operating limits of the field device
 PV Analog Channel Saturated
 PV Analog Channel Fixed
 Field Device has more status available
 A reset or self test of the field device has occurred, or power has been removed or reapplied
 A modification has been made to the configuration of the field device
 Field device has malfunction due to a hardware error or failure

Ext dev status

Maintenance required
 Device variable alert
 Critical Power failure

Device Diagnostic Status 0

Simulation active
 Non-Volatile memory failure
 Volatile memory error
 Watchdog Reset executed
 Voltage condition out of range
 Environmental condition out of range
 Electronic failure
 Device configuration locked

Status group 0

RAM Error	OFF/ON	Memory error
ADC Error	OFF/ON	Error at A/D converter
ADJ-EE-Error	OFF/ON	Error in adjustment-EEPROM
CAL-EE Error	OFF/ON	Error in calibration-EEPROM
Totalizer false	OFF/ON	Totalizer value fault
Flow Overrun	OFF/ON	Flow too high
ADJ-EE Error 2	OFF/ON	Adjustment-EEPROM fault
Float blocked	OFF/ON	Float-Move-Detection recognized, supervision time passed

Status group 1

Temp over limit	OFF/ON	Temperature exceeds 70 °C
Max flow1 active	OFF/ON	URV overrun
Max flow2 active	OFF/ON	URV underrun
FB autoz active	OFF/ON	Float blocking autozero on
Power fail warn	OFF/ON	Power off has happened
Oper timer error	OFF/ON	Operation timer fault
Man adjust act.	OFF/ON	Manual adjustment activated
FB indicat. act.	OFF/ON	Float-Move-Detection activated

Cfg chng count

Actual configuration changed counter value

Legend for table on next page:

1) On every Power Up, this warning occurs; it is NOT SHOWN ON DISPLAY.

2) If this function is active, the bars are NOT BLINKING ON DISPLAY.

Type: The information will be divided into errors and warnings.

Current: An error will change the output current to the selected error current level.

The level is selectable by "Alarm select" in HART (default: LOW).

Bars blinking: All 8 bars are blinking in case of an error or warning if not otherwise denoted.

HART: The marked errors/warnings are displayed on the HHT375/475 and DD/DTM.

Clear all: The indicated error/warning can be reset or disabled by the clear all function.

Status	Type	Current output Current value	Display		Clear all	HART					
			Bars blinking	Error on Display		Device status	Ext. device status	Device diag. status 0	PV Value	PV Data Quality	PV Limit Status
Status group 0											
RAM error	error	<3.6 mA / >21 mA	----- 00000001		no	More status available Device malfunction	no change	Volatile memory error	Flow: meas. Total: hold Percent: meas. Temp: meas.	Flow: Bad Total: Bad Percent: Bad Temp: Bad	Flow: Not limited Total: Constant Percent: Not limited Temp: Not limited
ADC error	error	<3.6 mA / >21 mA	----- 00000010		no	More status available Device malfunction	no change	Electronic failure	Flow: meas. Total: hold Percent: meas. Temp: meas.	Flow: Bad Total: Bad Percent: Bad Temp: Bad	Flow: Not limited Total: Constant Percent: Not limited Temp: Not limited
ADJ-EE error	error	<3.6 mA / >21 mA	----- 00000100		no	More status available Device malfunction	no change	Non-Volatile memory failure	Flow: meas. Total: hold Percent: meas. Temp: meas.	Flow: Bad Total: Bad Percent: Bad Temp: Bad	Flow: Not limited Total: Constant Percent: Not limited Temp: Not limited
CAL-EE error	error	<3.6 mA / >21 mA	----- 00001000		no	More status available Device malfunction	no change	Non-Volatile memory failure	Flow: meas. Total: hold Percent: meas. Temp: meas.	Flow: Bad Total: Bad Percent: Bad Temp: no change	Flow: Not limited Total: Constant Percent: Not limited Temp: no change
Totalizer false	warning	no change	----- 00010000		yes	More status available	no change	no change	measured	no change	no change
Flow overrrun	warning	no change	----- 00100000		yes	PV out of limits More status available	Device variable alert	no change	Flow: hold Total: measured Percent: hold Temp: meas.	Flow: Bad Total: Bad Percent: Bad Temp: no change	Flow: High limited Total: Not limited Percent: High limited Temp: no change
ADJ-EE error 2	warning	no change	----- 01000000		no	More status available	no change	Non-Volatile memory failure	measured	no change	no change
FB time elapsed	error	<3.6 mA / >21 mA	----- 10000000		yes	More status available Device malfunction	no change	no change	Flow: meas. Total: hold Percent: meas. Temp: meas.	Flow: Bad Total: Bad Percent: Bad Temp: no change	Flow: Not limited Total: Constant Percent: Not limited Temp: no change
Status group 1											
Temp over limit	warning	no change	----- 00000001		yes	Non-PV out of limits More status available	Device variable alert	Environmental conditions out of range	measured	no change	no change
Max flow 1 active	warning	no change	----- 00000010		yes	More status available	no change	no change	measured	no change	no change
Max flow 2 active	warning	no change	----- 00000100		yes	More status available	no change	no change	measured	no change	no change
FB autozero active	warning	no change	----- 00001000		yes	no change	no change	no change	measured	no change	no change
Power fail warning	warning	no change	*1) 00010000		yes	no change	no change	no change	measured	no change	no change
Operate timer error	warning	no change	----- 00100000		yes	More status available	no change	no change	measured	no change	no change
Man. Adjust act.	warning	no change	*2) 01000000		no	no change	no change	no change	Flow: zero Total: zero Percent: meas. Temp: meas.	Flow: Manual/Fixed Total: Manual/Fixed Percent: no change Temp: no change	Flow: Low limited Total: Low limited Percent: no change Temp: no change
FB indicat. act.	warning	no change	*2) 10000000		no	no change	no change	no change	measured	no change	no change

Device Setup**Diag/Service****Test device****Event Status**

Configuration changed event pending

Device status event pending

More status available event pending

Time First Unack Event Trigger**Device Setup****Diag/Service****Test device****Reset all errors**

Reset all resettable errors and warnings according to table on page 7-31

Device Setup**Diag/Service****Test device****Self test**

Execute a self-test to find existing errors.

Device Setup**Diag/Service****Test device****Squawk**

Indicates squawking by blinking bars on display ("-- --").

Device Setup**Diag/Service****Test device****Master reset**

Execute master reset. Selected parameters are set to default.

Parameter	Data form	Data range	R: read; W: Write	After Master Reset
Disp select	Select	Flow, Totalizer, Percent, Temperature	R/W	Totalizer
Temperature unit	Select	degC, degF	R/W	degC
Flow damp	Decimal	0 to 10 sec	R/W	1.0 sec
PV URV	Decimal	Flow unit	R/W	100 %
PV LRV	Decimal	Flow unit	R/W	0 %
Float Blocking	Select	OFF, ON	R/W	OFF
Set lower limit	Select	5 %, 15 %, 30 %	R/W	5 %
Set supervision time	Select	Turbulent Flow, Smooth Flow	R/W	Turbulent Flow
Autozero value	Decimal	0.000 to 9.999	R	0.000

Device Setup**Diag/Service****Test device****Device reset**

Execute device reset. No parameters are changed (warm start).

Device Setup**Diag/Service****Lock/Unlock device**

Locks the upper selection key on the display and the write access of a second master. Changes can only be made by the first HART master.

The first master can switch to normal operation by unlock the device.

Device Setup**Diag/Service****Reset Cfg chng flag**

Resets the Configuration changed flag.

Device Setup**Diag/Service****Loop Test**

Set the analogue output fix to 4 mA, 20 mA or arbitrary current.
Finish with "End".

Device Setup**Diag/Service****Calibration****Apply URV/LRV**

4 mA	Assignment of the 4 mA value
Set as 4 mA value:	Current flow is set to 4 mA.
Read new value:	Read current flow for 4 mA.
Leave as found:	No change
20 mA	Assignment of the 20 mA value
Set as 20 mA value:	Current flow is set to 20 mA.
Read new value	Read current flow for 20 mA
Leave as found:	No change
Exit	Leave parameter

Device Setup**Diag/Service****Calibration****Reset URV/LRV**

Reset 4 mA	Set 4 mA to factory set LRV
Reset 20 mA	Set 20 mA to factory set URV
Exit	Leave parameter

Device Setup**Diag/Service****Calibration****D/A Trim**

Adjustment of the current output to 4 mA and 20 mA.

Device Setup**Diag/Service****Calibration****Calib table**

Selection of calibration table: Standard/Distance version
(Depends on ordered device; only readable)

Device Setup**Diag/Service****Calibration****Manual adjustment**

Status man.adjustment	ON/OFF	Show status of manual adjustment table
Activate/deactivate	ON/OFF	Activate or deactivate manual adjustment table
Set adjustm. points	5 %...105 %	Set manual adjustment points
See description of manual adjustment in chapter 6.2.9		
Reset adjustment table	Resets manual adjustment table to factory defaults	

Device Setup

Diag/Service

Diagnostics

Temp max log

Temp max log	ON/OFF	Activate or deactivate Temp max Logging function
Time/value	Days Hours Minutes	Time stamp of appearance of ... maximum temperature
Temp max	Max.temperature value	
Old time/value	Days Hours Minutes Temp max	Time stamp of appearance of... ... maximum temperature before... ... clear or reset Max. temperature value before clear or reset
Clear values	The values in parameter Time/value are written to parameter Old time/value.	

Parameter Time/value is set to actual time stamp and temp max is set to actual temperature.

Description of temperature maximum logging function (see Fig. 7-4):

The temperature value is supervised constantly. As soon as the value exceeds the actual maximum value, the point of time will be recognized. The actual maximum value is overwritten by a higher value automatically, if it lasts more than 30 seconds.

The determined values (max temperature/time stamp) can be cleared by the user. They are written into the parameter "Old time/value" after "Clear values" or after power off/on, "Master Reset" or "Device Reset". The time/value is set to the actual time stamp, the max temperature value is set to the actual temperature value.

By switching Temp max log off the values are not cleared, but the displayed values are set to zero.

When exceeding the maximum temperature of 70 °C the error message "Temp over limit" appears.

By changing the unit (from degC to degF or vice versa) the Temp max log values are cleared.

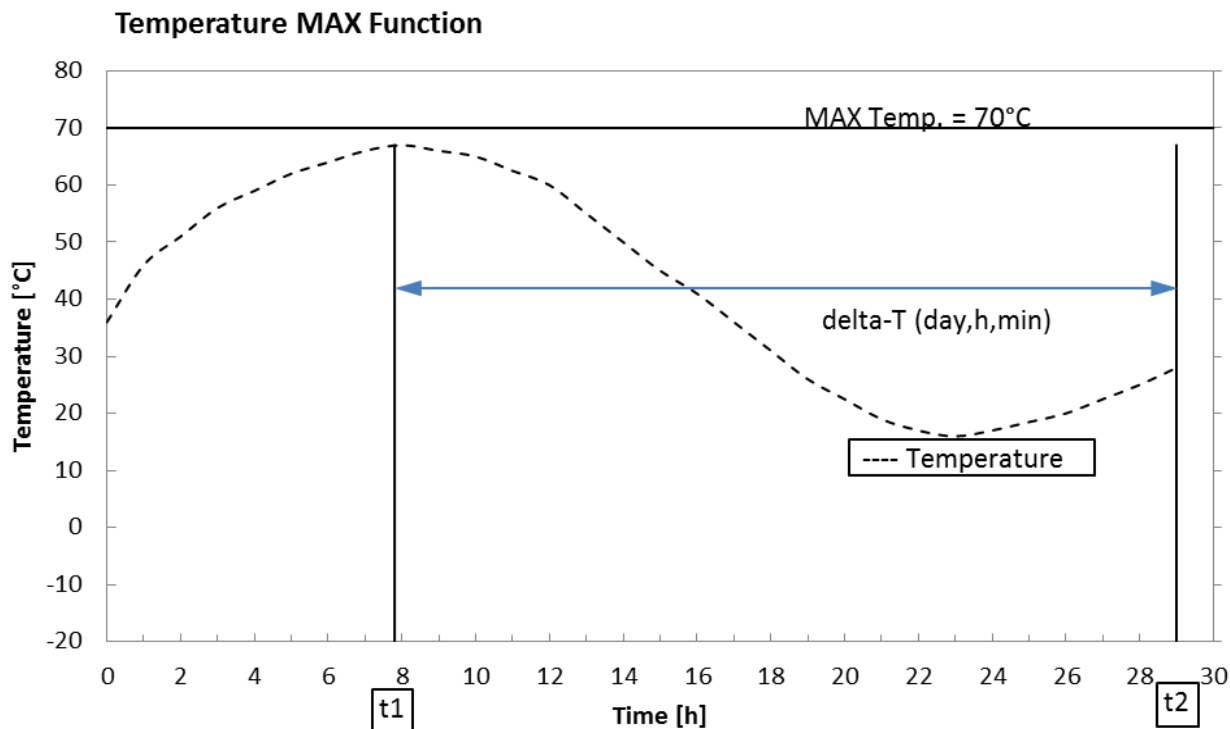


Fig. 7-4

Device Setup

Diag/Service

Diagnostics

Flow URV log

Flow URV log	ON/OFF	Activate or deactivate Flow URV Logging function
URV overrun time	Days/Hours Minutes	Time since... ... exceeding URV
URV underrun time	Days/Hours Minutes	Time since... ... fall below URV
Min overrun time	Selection of hysteresis time	
Clear values	Clears the values in URV overrun time and URV underrun time	

Description of Flow URV logging function (see Fig. 7-5):

The flow value is supervised constantly. As soon as the value reaches the upper limit value (103 %; 20.5 mA) event 1 is recognized. If this error condition remains actively longer than the hysteresis value, the limiting value recognition is activated, the overrun condition and the time stamp is stored.

As soon as the flow value falls below the limit value, the supervision ends, the underrun condition and the event 2 time stamp is stored. For a new cycle the hysteresis time must pass.

After the recognition you can request the passed time:

Time stamp from event1 till time stamp from event2: delta-Time

The time difference is the time the upper limit was exceeded: $\text{hysteresis} \leq t \leq \text{delta-time}$

The actual cycle is overwritten automatically by a new one. The stored values will be cleared after power off. The default value for hysteresis is 30 seconds.

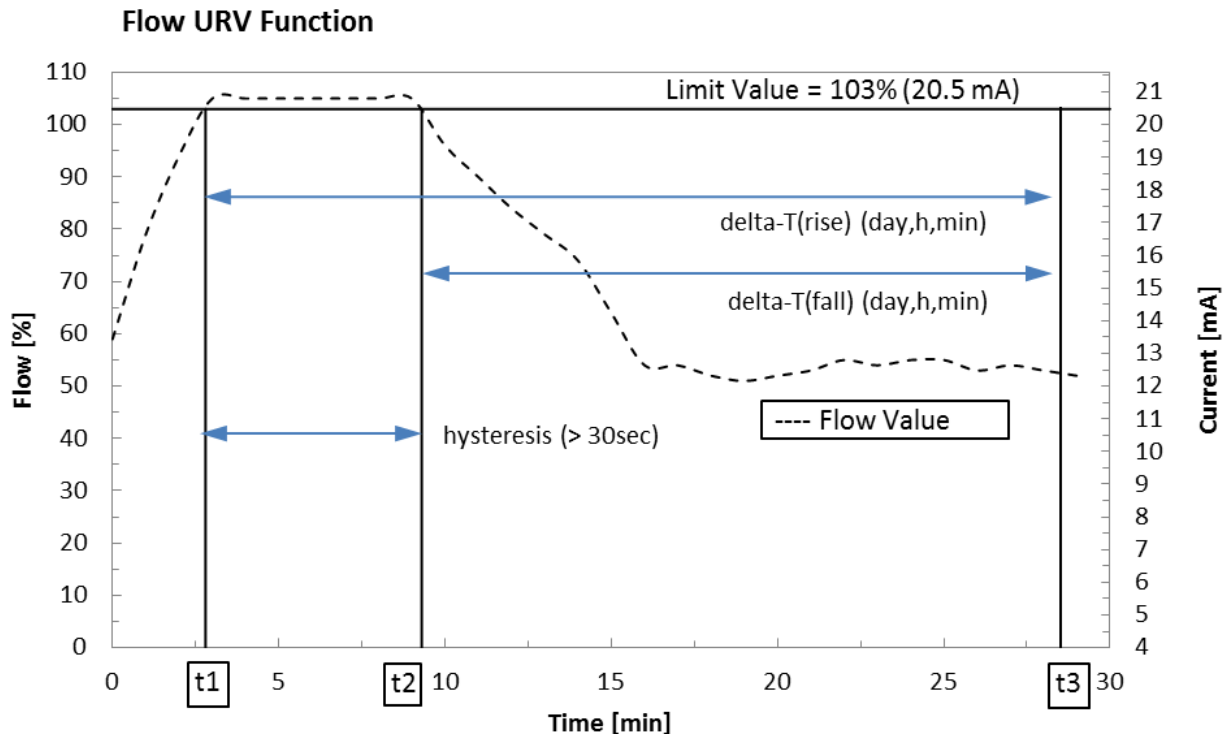


Fig. 7-5

Device Setup**Diag/Service****Diagnostics****Float blocking**

Float blocking	ON/OFF	Activate or deactivate float blocking
Set lower limit	5 %/15 %/30 %	Set lower limit of supervision range
Set supervise time	Turbulent flow Smooth flow	
Start autozero	Start	
Autozero value	Shows autozero value	
See description of float blocking function in chapter 6.2.14		

Device Setup**Diag/Service****Power monitoring****Operation time**

Days	Count of days since operation starts.
Hours	Count of hours since operation starts.
Minutes	Count of minutes since operation starts.

Oper time shadow

Days	Counts of days until last reset.
Hours	Counts of hours until last reset.
Minutes	Counts of minutes until last reset.

Reset power fail

Power fail warning is cleared.

Description of power monitoring function:

This function counts up the operation minutes and stores the time in the parameter "Operation time". After "Power on", "Master Reset" or "Device Reset" the actual time stamp is stored in parameter "Oper time shadow". The time difference to "Operation Time" returns the last point in time of reset.

After power off/on the power fail warning is set. It can be cleared by "Reset power fail" or "Reset all errors".

The "Operation time" is the base for the time stamps of "Temp max log" and "Flow URV log".

Device Setup**Diag/Service****Real-Time Clock**

Current Date	Current calendar date
Current Time	Current day time
Set Clock Date	Last entered current calendar date
Set Clock Time	Last entered current day time
Real Time Clock flags	Counts changes on Real-time Clock.
Set Real-time Clock	Enter current calendar date and day time.

Description of real time clock function:

The real-time clock has to be set by the parameter "Set Real-time Clock"

This function counts up the operating time and stores the values in the parameter "Current Date" and "Current Time". "Set Clock Date" and "Set Clock Time" stores the last entered date/time.

The time value is reset to "00:00:00" after 24 hours (23:59:59).

After "Power on", "Master Reset" or "Device Reset" the Real-time Clock is set to its initial value:

01/01/1900 00:00:00

Customers, who connect a "475 Communicator" from Emerson to the RAMC, have to consider that the following function might be faulty:

Setting the time with "Set Clock Time" as well as the date with "Set Clock Date" with the "475" will fail in setting the "Real Time Clock". The "Real Time Clock" is only readable by this tool.

Remedy

Setting the time and the date with the "DTM" under Yokogawa's "Fieldmate Tool" will succeed in setting the "Real Time Clock".

7.4.3 Basic- Setup Menu

Device Setup

Basic setup

Tag	Tag Number (8 characters)
Long tag	Long Tag Number (32 characters)
Flow unit select	Flow measurement unit
Temperature unit	Temperature measurement unit (degC/degF)
Flow damp	Damping time for flow value

7.4.4 Detailed- Setup Menu

Device Setup

Detailed setup

Characterize meter

Operating Conditions

Density	User's density on scale
Viscosity	User's viscosity on scale
Temperature	User's temperature on scale
Pressure	User's pressure on scale
Reference Pressure	User's pressure reference
Pressure conditions	User's pressure conditions

Medium data

Fluid name	User's fluid name
Fluid phase	User's fluid phase
Flow Reference	User's flow reference

Flow scale unit Flow measurement unit in accordance with scale

Scale USL Upper sensor limit related to scale unit

MS Code Ordering code of the device

RAMC s/n Serial number of the measuring tube

RAMC firmware rev Firmware revision of the device

Device Setup

Detailed setup

Configure signal

Flow damp	Set damping time for flow value
Flow unit select	Select flow measurement unit
Total reset	Set totalized value to zero
Temperature unit	Select temperature unit (degC/degF)

Device Setup**Detailed setup****Configure signal****Flow unit select**

L/s	L/min	L/h	
Cum/s	Cum/min	Cum/h	Cum/d
gal/s	gal/min	gal/h	gal/d
Impgal/s	Impgal/min	Impgal/h	Impgal/d
Cuft/s	Cuft/min	Cuft/h	Cuft/d
bbbl/s	bbbl/min	bbbl/h	bbbl/d
	NL/min	NL/h	
	NCum/min	NCum/h	
	StdL/min	StdL/h	
	StdCum/min	StdCum/h	
	StdCuft/min	StdCuft/h	
g/s	g/min	g/h	
kg/s	kg/min	kg/h	kg/d
	t/min	t/h	t/d
lb/s	lb/min	lb/h	lb/d
	LTon/min	LTon/h	LTon/d

Device Setup**Detailed setup****Configure output****Analog output**

PV Loop current
 PV LRV
 PV URV
 PV Alrm typ
 Loop Current mode
 Loop Test

Current output in mA
 Lower range value related to 4 mA or 0%
 Upper range value related to 20 mA or 100%
 Current level at error
 Enable mode of variable output current
 Set the analogue output fix to 4 mA, 20 mA or arbitrary current.
 Adjustment of current output to 4 mA and 20 mA.

D/A Trim

Device Setup**Detailed setup****Configure output****HART output**

Poll addr
 Num req preams
 Num resp pream
 Burst configuration
 Trend configuration
 PV is
 SV is
 TV is
 QV is

Poll Address (Function see above) (Def.: 0)
 Number of leading FF to HART unit (Def.: 5)
 Number of leading FF from HART unit (Def.:5)
 See chapter 7.6.7
 See chapter 7.6.9
 Assignment of primary variable
 Assignment of secondary variable
 Assignment of tertiary variable
 Assignment of quaternary variable

Device Setup**Detailed setup****Configure output****HART output****Burst configuration****See chapter 7.6.7**

Burst Message 1

Burst Message 2

Burst Message 3

Event Notification

See chapter 7.6.8

Flow Update Time Period

Time between 2 measurements

Total Update Time Period

Time between 2 measurements

Percent Update Time Period

Time between 2 measurements

Temp Update Time Period

Time between 2 measurements

Device Setup**Detailed setup****Configure output****HART output****Trend configuration****See chapter 7.6.9**

Number of trends supported

Trend Control

Trend Device Variable

Trend Sample Interval

Trend Data

Device Setup**Detailed setup****Display selection**

Selection of measuring value on display:

For standard calibration table: Flow - Totalizer - Percent - Temperature

For manual calibration table: Percent - Temperature

Device Setup**Detailed setup****Device Information**

Model

Model name

Dev ID

Device ID

Manufacturer

Manufacturer

Distributor

Distributor

Final asmbly no

Number of final assembly

Write protect

Write protection

Cfg chng count

Number of configuration changes

Tag

Type in Tag-Number

Long tag

Type in Long Tag-Number

Descriptor

Type in description

Message

Type in message

Date

Type in Date

Poll addr

Type Poll Address

Loop Current mode

Enable mode of variable output current

Num req pream

Number of leading FF to HART unit

Num rsp pream

Number of leading FF from HART unit

MS Code

Ordering code of the device

RAMC s/n

Serial number of the measuring tube

RAMC firmware rev

Firmware Version of the Device

Device Profile

Process automation device

Revision #'s

Revision numbers

Universal rev

HART Universal Revision (7)

Fld. dev. rev

Field device Revision

Hardware rev

Hardware Revision

Software rev

Software Revision

ADJ-EE rev

Adjustment-EEPROM Revision

CAL-EE rev

Calibration-EEPROM Revision

Operation conditions

(s.7.6.4 Detail-Setup)

Medium data

(s.7.6.4 Detail-Setup)

7.4.5 Write protect Menu

Write protect menu

Write protect Enable wrt 10min

Read Status of write protection
Enable writing for 10 minutes by entering password.
After writing a parameter the time of 10 minutes starts again.

New password

Selection of a new password by entering up to 8 character
If 8 blanks are entered as new password, write protection is disabled. If the user password is lost, a joker password is available from the YOKOGAWA service department.

7.4.6 Review Menu

Review

Model	Model name
Dev id	Device ID
Manufacturer	Manufacturer
Distributor	Distributor
Final asmbly num	Number of final assembly
Write Protect	Write protection
Cfg chng count	Number of configuration changes
Max dev vars	Max number of device variables
Tag	Tag Number
Long tag	Long Tag Number
Descriptor	Description
Message	Message
Date	Date
Poll address	Poll address
AO Alrm typ	Current level at error (PV Alrm typ)
Loop Current mode	Enable mode of variable output current
Num req pream	Number of leading FF to HART - unit
Num rsp pream	Number of leading FF from HART - unit
MS Code	Ordering code of the device
RAMC s/n	Serial number of the measuring tube
RAMC firmware rev	Firmware Version of the Device
Universal rev	HART Universal Revision (7)
Fld. dev. rev	Field device Revision
Hardware rev	Hardware Revision
Software rev	Software Revision
ADJ-EE rev	Adjustment-EEPROM Revision
CAL-EE rev	Calibration-EEPROM Revision
Operation conditions	(s.7.6.4 Detail-Setup)
Medium data	(s.7.6.4 Detail-Setup)

7.4.7 Burst Mode

When the **Burst mode** is set to "Wired HART Enabled", the transmitter continuously sends up to three data listed in table on page 7-42 Refer to the chapter 7.6.7 (1) Burst Message for details.

When the **Burst mode** is set to "Wired HART Enabled", the transmitter can continuously sends alarm signal also. Refer to chapter 7.6.8 Event Notification for activating this function.

When changing the setting of **Burst mode**, set "Off" to the **Burst mode**. Default setting is "Off".

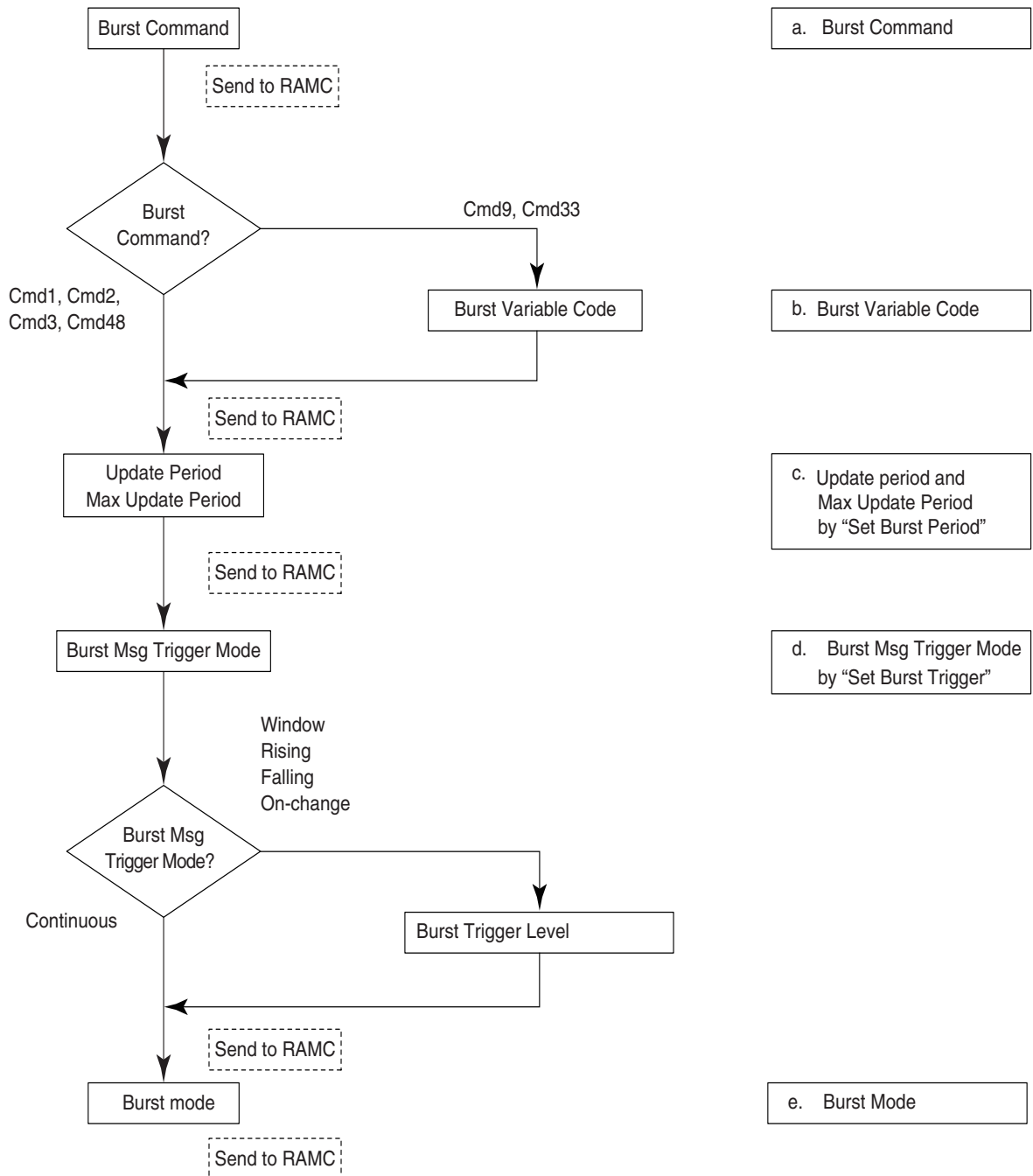
(1) **Burst message**

RAMC transmitter can transmit three burst messages at the maximum. The parameters for **Burst Message** are as follows.

- Burst Command
- Update Period and Max Update Period
- Burst Msg Trigger Mode

(2) **Burst mode setting procedure**

DD (HART7)	[Root Menu] → Device setup → Detailed setup → Configure output → HART output → Burst configuration → Burst Message 1,2 or 3 → Burst Command
------------	---



a) **Burst Command**

Select the transmission data at **Burst Command** parameter.

Burst Command	Command Parameter
Cmd1: PV	Variable assigned to PV
Cmd2: % range/current	% range/current (Percent range, Loop current)
Cmd3: Dyn vars/current	Process vars/current (Loop current, PV, SV, TV,QV)
Cmd9: Device vars w/ status	Process vars/% range/current with status
Cmd33: Device variables	Process vars (PV, SV, TV, QV)
Cmd48: Read additional device status	Self-diagnosis information

Burst parameters

Command parameter	Burst Command	Burst Msg Trigger Mode	Burst Trigger Source	Burst Trigger Units
PV (Either of from flow, total, percent, temp)	Cmd1: PV	Continuous	---	---
		Window	PV	Depend on the assigned variable to PV
		Rising		
		Falling		
		On-change		
% range/current (Percent range, Loop current)	Cmd2: % range/current	Continuous	---	---
		Window	% range	%
		Rising		
		Falling		
		On-change		
Process vars/current (Loop current, PV, SV, TV,QV)	Cmd3: Dyn vars/current	Continuous	---	---
		Window	PV	Depend on the assigned variable to PV
		Rising		
		Falling		
		On-change		
Process vars/% range/current with status *1 (Select up to eight variables from flow, total, percent, temp, percent range, loop current)	Cmd9: Device vars w/Status	Continuous	---	---
		Window	Top of Burst Device Variables	Depends on mapping
		Rising		
		Falling		
		On-change		
Process vars (Select up to four variables from flow, total, percent, temp)	Cmd33: Device variables	Continuous	---	---
		Window	Top of Burst Device Variables	Depends on mapping
		Rising		
		Falling		
		On-change		
Self-diagnosis information	Cmd48: Read Additional Device Status	Continuous	---	---

*1: Output the data with time and status.

b) Burst Variable Code

This parameter need to be set when **Burst Command** is Cmd9:

Device variables with status (up to eight items).

DD (HART 7)	[Root Menu] → Device setup → Detailed setup → Configure output → HART output → Burst configuration → Burst Message 1,2 or 3 → Burst device variables → Burst variables
Display item	Contents
Flow	Select the flow rate
Total	Select the totalized flow
Percent	Select the flow % rate
Temp	Select the onboard temperature
Percent range	Select the current % rate
Loop current	Select the output current value
Primary variable	Select the flow rate
Secondary var.	Select the totalized flow
Tertiary variable	Select the flow % rate
Quarternary var.	Select the onboard temperature
Not used	All items up to this selection are transmitted

c) Burst Update Period and Max Update Period

Set the **Update Period** and the **Max Update Period**.

The **Update Period** specifies the rate at which data is transmitted as long as the trigger conditions of the **Burst Msg Trigger Mode** are met. The **Max Update Period** specifies the rate at which data is transmitted as long as the trigger conditions of the **Burst Msg Trigger Mode** are not met.

DD (HART 7)	[Root Menu] → Device setup → Detailed setup → Configure output → HART output → Burst configuration → Burst Message 1,2 or 3 → (Max) Update Period
Update Period /Max Update Period	0.5 s
	1 s
	2 s
	4 s
	8 s
	16 s
	32 s
	60 s – 3600 s any value

d) Burst Msg Trigger Mode

Set the **Burst Msg Trigger Mode** from the parameters shown below. When **Burst Msg Trigger Mode** is Window, Rising or Falling, set the **Burst Trigger Level**.

DD (HART 7)	[Root Menu] → Device setup → Detailed setup → Configure output → HART output → Burst configuration → Burst Message 1,2 or 3 → Burst Msg Trigger Mode
Display item	Contents
Continuous	Burst message is transmitted continuously
Window	In "Window" mode, the Trigger Value must be a positive number and is the symmetric window around the last communicated value
Rising	In "Rising" mode, the Burst Message must be published when the source value exceeds the threshold established by the trigger value.
Falling	In "Falling" mode, the Burst Message must be published when the source value fall below the threshold established by the trigger value.
On-change	In "On-change" mode, the Burst Message must be published when the source value on change established by the trigger value.

e) **Burst Mode**

DD (HART 7)	[Root Menu] → Device setup → Detailed setup → Configure output → HART output → Burst configuration → Burst Message 1,2 or 3 → Burst mode → Wired HART Enabled
--------------------	--

When the **Burst mode** is set to "Wired HART Enabled", the transmitter starts to send the data.

Detailed Burst Menu Structure

Device Setup**Detailed setup****Configure output****HART output****Burst configuration**

Burst Message 1	
Burst 1 Mode	R/S
Burst 1 Command	R/S
Update Period	R
Max Update Period	R
Classification	R
Trigger Mode	R
Trigger Units	R
Trigger Level	R
Set Burst 1 Period	Perform
Method to select update/max update period	
Set Burst 1 Trigger	Perform
Method to select trigger conditions	
Burst 1 variables	R/S
Burst Message 2	
Burst 2 Mode	R/S
Burst 2 Command	R/S
Update Period	R
Max Update Period	R
Classification	R
Trigger Mode	R
Trigger Units	R
Trigger Level	R
Set Burst 2 Period	Perform
Method to select update/max update period	
Set Burst 2 Trigger	Perform
Method to select trigger conditions	
Burst 2 variables	R/S
Burst Message 3	
Burst 3 Mode	R/S
Burst 3 Command	R/S
Update Period	R
Max Update Period	R
Classification	R
Trigger Mode	R
Trigger Units	R
Trigger Level	R
Set Burst 3 Period	Perform
Method to select update/max update period	
Set Burst 3 Trigger	Perform
Method to select trigger conditions	
Burst 3 variables	R/S

7.4.8 Event Notification

When a setting change and a change of the Self- diagnostics occur, the device detects it as an event and can transmit an alarm signal continuously. Up to three events that occurred can be stored. When using this function, set to **Burst mode** as "Wired HART Enabled".

(1) Set Event Notification

- Procedure to call up the display

DD (HART 7)	[Root Menu] → Device setup → Detailed setup → Configure output → HART output → Burst configuration → Event Notification →
→ Event Control	Stop the event monitor: Off Shift to the monitor state: Enable event notification on token- passing data link layer
→ Event Retry Time	Set the retry time when the event occurs.
→ Max Update Time	Set the retry time when the event does not occur.
→ Event Debounce Interval	The setting of the minimum event duration
→ Event Mask	Set the status to detect

a) Event Notification Control

Select "Enable event notification on token-passing data link layer" in the **Event Notification Control** parameter to shift to the monitor state.

b) Event Notification Retry Time/Max Update Time/Event Debounce Interval

Set to Event Notification Retry Time, Max Update Time and Event Debounce Interval. For **Event Notification Retry Time**, set the value that is smaller than **Max Update Time**.

Event Notification Retry Time / Max Update Time	Event Debounce Interval
0.5 s	0.5 s
1 s	1 s
2 s	2 s
4 s	4 s
8 s	8 s
16 s	16 s
32 s	32 s
>60 s – 3600 s any value	>60 s – 3600 s any value

c) Event Status

Indicates the type of the pending events. The bits will be cleared after the appropriate latched value and the trigger time is acknowledged by **Clear Event Data**.

Event Status	Code	Description
Configuration changed event pending	0x01	The pending event is caused by a configuration change
Device status event pending	0x02	The pending event is caused by a device status change
More status available event pending	0x04	The pending event is caused by a more status available change

d) Event Mask

Set the status to be detected in the **Event Mask** parameter.

Device Status Mask	Bit mask assignment (see table on page 7-47)
Ext Dev Status Mask	
Device Diagnostic Status 0 Mask	
Device Specific Status 0 Mask	
Device Specific Status 1 Mask	

e) Event Report

Read the detected status in the appropriate Event Report parameter.

Device Status Latched Value	Latched value assignment (see table on page 7-47)
Ext dev status Latched Value	
Device Diagnostic Latched Value	
Device Specific Status 0 Latched Value	
Device Specific Status 1 Latched Value	
Time First Unack Event Triggered	Time of event trigger (Default when cleared: 13:16:57)
Config Change Counter Latched Value	Latched configuration changed counter value
Event Status	Status of pending events
Read Event Data	Perform reading of the oldest pending event data
Clear Event Data	Acknowledge of the oldest pending event data

Detailed Event Notification Menu Structure

Device Setup

Detailed setup

Configure output

HART output

Burst configuration

Event Notification

Event Control	R/S
Event Retry Time	R/S
Max Update Time	R/S
Event Debounce Interval	R/S

Event Mask

Device Status Mask	S
Ext Dev Status Mask	S
Device Diagnostic Status 0 Mask	S
Device Specific Status 0 Mask	S
Device Specific Status 1 Mask	S

Event Report

Device Status Latched Value	R
Ext Dev Status Latched Value	R
Device Diag. Status 0 Latched Value	R
Device Spec. Status 0 Latched Value	R
Device Spec. Status 1 Latched Value	R

Time First Unack Event Triggered	R
Cfg Change Counter Latched Val	R
Event Status	R

Read Event Data	Perform
Clear Event Data	Perform

Table: Status bit (code) assignment

Device status	Code	Mask	Latched Value
Process applied to primary variable is out of range	0x01	OFF/ON	OFF/ON
Process applied to non-primary variable is out of range	0x02	OFF/ON	OFF/ON
PV Analog Channel Saturated	0x04	OFF/ON	OFF/ON
PV Analog Channel Fixed	0x08	OFF/ON	OFF/ON
Field Device has more status available	0x10	OFF/ON	OFF/ON
A reset or self test of the field device has occurred	0x20	OFF/ON	OFF/ON
A modification has been made to the configuration	0x40	OFF/ON	OFF/ON
Field device has malfunction due to a hardware problem	0x80	OFF/ON	OFF/ON

Ext dev status	Code	Mask	Latched Value
Maintenance required	0x01	OFF/ON	OFF/ON
Device variable alert	0x02	OFF/ON	OFF/ON
Critical Power failure	0x04	OFF/ON	OFF/ON
PV Analog Channel Fixed	0x08	OFF/ON	OFF/ON

Device Diagnostic Status 0	Code	Mask	Latched Value
Simulation active	0x01	OFF/ON	OFF/ON
Non-Volatile memory failure	0x02	OFF/ON	OFF/ON
Volatile memory error	0x04	OFF/ON	OFF/ON
Watchdog Reset executed	0x08	OFF/ON	OFF/ON
Voltage condition out of range	0x10	OFF/ON	OFF/ON
Environmental condition out of range	0x20	OFF/ON	OFF/ON
Electronic failure	0x40	OFF/ON	OFF/ON
Device configuration locked	0x80	OFF/ON	OFF/ON

Status group 0	Code	Mask	Latched Value
RAM Error	Memory error	0x01	OFF/ON
ADC Error	Error at A/D converter	0x02	OFF/ON
ADJ-EE-Error	Error in adjustment-EEPROM	0x04	OFF/ON
CAL-EE Error	Error in calibration-EEPROM	0x08	OFF/ON
Totalizer false	Totalizer value fault	0x10	OFF/ON
Flow Overrun	Flow too high	0x20	OFF/ON
ADJ-EE Error 2	Adjustment-EEPROM fault	0x40	OFF/ON
Float blocked	Float-Move-Detection recognized	0x80	OFF/ON

Status group 1	Code	Mask	Latched Value
Temp over limit	Temperature exceeds 70°C	0x01	OFF/ON
Max flow1 active	URV overrun	0x02	OFF/ON
Max flow2 active	URV underrun	0x04	OFF/ON
FB autoz active	Float blocking autozero on	0x08	OFF/ON
Power fail warn	Power off has happened	0x10	OFF/ON
Oper timer error	Operation timer fault	0x20	OFF/ON
Man adjust act.	Manual adjustment activated	0x40	OFF/ON
FB indicat. act.	Float-Move-Detection activated	0x80	OFF/ON

7.4.9 Trend configuration

Data Trending is intended to reduce the number of transmissions to get data from a device. This can be useful for monitoring applications that do not need to get all data with low latency.

The RAMC supports the transmission of 1 trend information of a desired device variable.

When the **Trend control** is set from "Disabled", to one of the following three settings the transmitter continuously calculates the trend data to be transmitted to the host.

Trend Control	Function
Disabled	No trend information will be calculated
Enable single data point trending	Only the value that was read during the occurrence of the sampling will be kept in the ring buffer.
Enable filtered trending	A filtered trend uses a time constant equal to one-third of the trend sample period to smooth the data. Consider a step change in the device variable value, this averaging time constant allows the returned trend value to reach 95 % of the step change in one trend sample period.
Enable average trending	The device averages the values that were taken during the trend sample period.

The values to be transmitted are the following:

Trend Device Variable	Parameter
Flow	Flow in measurement unit
Percent	Percent value of flow
Temperature	Temperature in transmitter

The sampling interval is selectable in the range of 1 s up to 2 h. The internal measurement cycle is 250 ms. The RAMC supports one ring buffer with 12 samples in length. The ring buffer is updated with samples of the desired device variable value at the rate indicate by the sample period.

The trend data can be displayed in the following menu by applying the parameter "Refresh Trend Data" to the device.

All 12 trend data values will be displayed.

When a Trend is not used it transmits NAN for the values and as status "bad/constant".

Device Setup

Detailed setup

Configure output

HART output

Trend configuration

Number of Trend Supported

Trend Control

Trend Variable

Trend Time Stamp

Trend Data

Refresh Trend Data Perform

Trend Device Variable R/S

Trend Classification R

Trend Units R

Trend 0 Date Stamp R

Trend 0 Time Stamp R

Trend Value (x) R

Trend Value (x) Data Quality R

Trend Value (x) Limit Status R

(x) = 12 values

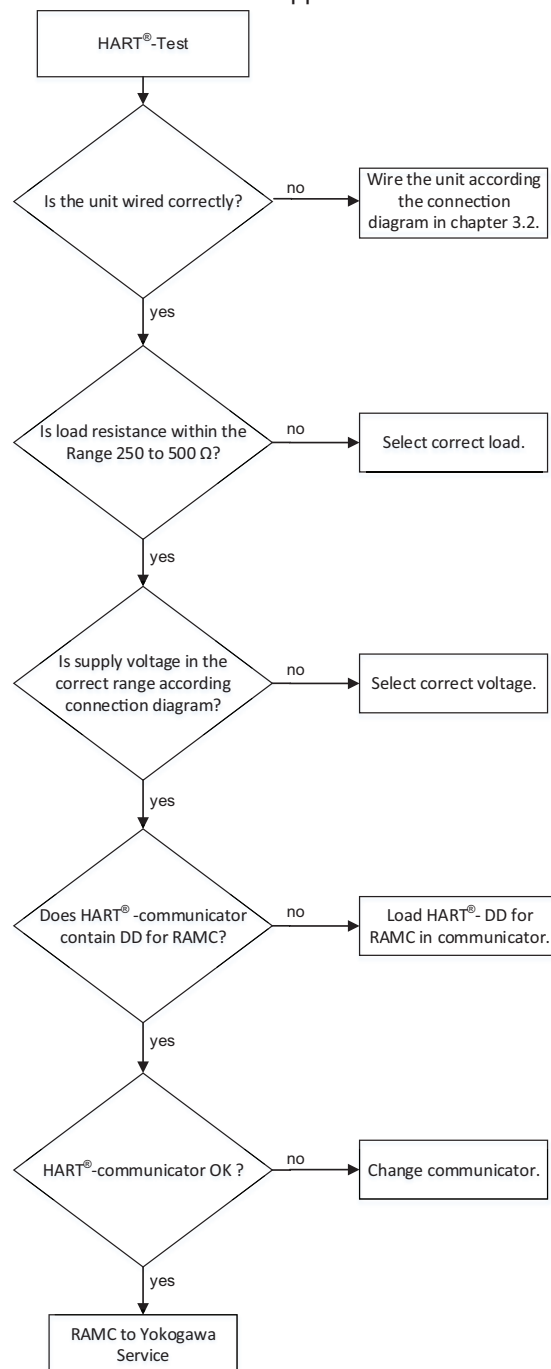
7.5 Maintenance

7.5.1 Function test

- Wire the unit according to the connection diagram.
- Check HART- communication with HART- communicator or with PC with HART- ability communication program.
- Setting: Device setup/Process variables.
- PV AO shows the current value; compare this value with the measured current.

7.5.2 Troubleshooting

Do the following test if problems with HART units appear:



8. Service

8.1 Maintenance

8.1.1 Function test

Checking free movement of pointer:

- Remove housing cover.
- After deflecting the pointer by hand, it must return to the 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 YOKOGAWA 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:

- The display must show values corresponding to indication function and measuring unit settings.
- The bars under the 8 digits must not flash. If an error occurs, the corresponding countermeasure (refer to chapter 6.2.8 error messages) has to be taken or the unit has to be sent to service.
- Without flow, the output current must be 4 mA. At a flow rate of 100 % the current must be 20 mA.

Additional function test for HART® units (-J)

- check HART®-communication using a HART®-Handheld terminal or a PC with HART®-communication software.
- Setting: Device setup/Process variables
- PV AO shows the current value that should be delivered at output – Check this value using a multimeter.

8.1.2 Measuring tube and float

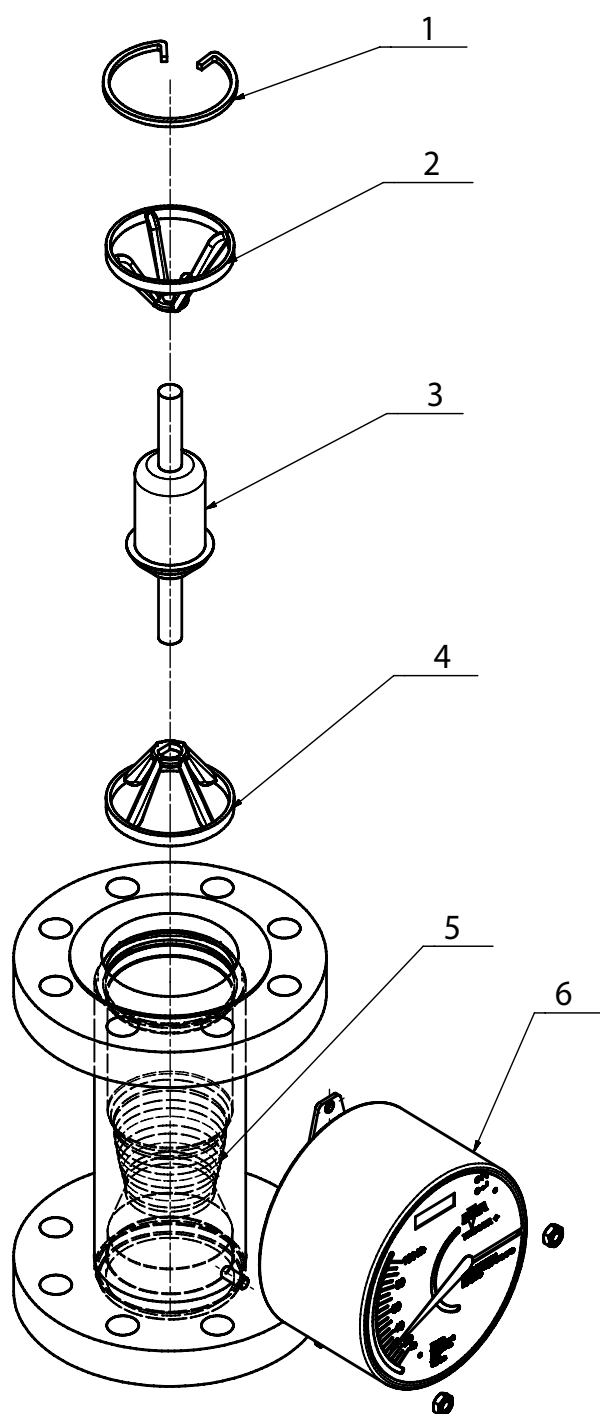
The RAMC is maintenance-free. If contamination of the measuring tube impairs the mobility of the float, the tube and the float have to be cleaned. To do this, the RAMC has to be removed from the pipe.

Replacement or cleaning of the float:

- Remove RAMC from the pipe.
- Remove upper retainer from metering tube.
- Take float stopper and float out through the top of metering tube.
- Clean float and metering cone.
- Insert float and float stopper into the metering tube.
- Set retainer into tube.
- Check float for free movement.
- Install RAMC to the pipe.

Attention: Do not expose float to strong alternating magnetic fields. The float and especially its measuring edge must not be damaged.

8.1.3 Explosion drawing



Number	Part
1	Circlip (retainer)
2	Float stop
3	Float
4	Float stop welded in
5	Cone
6	Indicator

8.1.4 Electronic transmitter

The electronic transmitter is maintenance-free. The electronic section is sealed and cannot be repaired. Since the transmitter has been adjusted fully to the mechanical components at the factory, single components can only be replaced with a reduction of the accuracy.

Solely the display and operation unit (LCD PCB) can be replaced. For this the unit has to be sent to Yokogawa service.

The current output can be adjusted by means of software. The current output test in chapter 6.2.11 or chapter 7, if HART® is available, determines whether an adjustment is necessary. The adjustment is carried out according to chapter 6.2.6.

8.1.5 Exchange of EEPROM and scale

Preparations:

- Check the serial-no., the key-code and the data of the new parts.
- Switch off power supply.
- For units with option /□F1 wait more than 2 minutes before opening the indicator.
- For RAMC with housing type 91 unlock the safety screw at the cover.
- Remove the cover of the indicator unit.
- Make sure that all accessible parts are not under voltage.



IMPORTANT

The pointer may not be twisted or bent on the axis.

Exchange of EEPROM:



WARNING

The calibration-EEPROM can be damaged by electro-static discharge (ESD). Therefore, only touch insulate parts and never terminals.

The EEPROM is plugged in on the right side of the electrical angle transmitters and safeguarded with a latch (s. fig 3-1 / 3-2).

- Unscrew the screw of the securing latch, but only a few turns.
- Turning the securing latch up, so that the EEPROM can be pulled out.
- Put in the new EEPROM (no wrong positioning possible).
- Turn the securing latch to below above the EEPROM and fix it with the screw.

Only for HART7 units, type -J:



WARNING

When replacing a calibration EEPROM with the same serial no. Proceed as follows:

- Switch off the power supply.
- Remove the inserted calibration EEPROM as described above.
- Switch on the power supply without the calibration EEPROM until the display flashes.
- Switch off the power supply again. • Insert the new calibration EEPROM and fasten it.
- Switch the power supply back on. The display should stop flashing.

Exchange of scale at units without limit switches:

- Unscrew the 2 screws of the scale.
- Pulling out the scale of the indicator unit to the left by raising the scale. For units with electronic transmitter the scale must additional raised above the 2 buttons.
- Sliding the new scale from the left under the pointer correspondingly until the 2 buttons click in in the accompanying holes for unit with electronic transmitter.
- Fasten the scale with the 2 screws.

Exchange scale at units with limit switches:

Please, consult to this the service department of ROTA YOKOGAWA.

Final works:

- Connect the cover of the indicator
- For RAMC with housing type 91 lock the safety screw
- Switch on power supply
- Check function of the unit

8.1.6 Exchange of the indicator

The indicator unit may be replaced by a unit of the same type, on the condition that the scale of the measuring tube as well as the calibration EEPROM (in case of electronic transmitter) are mounted on the new unit.

Operation for units with electronic transmitter (-E, -J):

- Switch off power.
- For units with option /□F1 wait more than 2 minutes before opening the indicator.
- For RAMC with housing type 91 unlock the safety screw at the cover.
- Unscrew cover of indication unit.
- Disconnect cables and pull them through the cable glands out of the RAMC.
- Remove scale and calibration EEPROM from old indication unit and mount them to new indication unit.

**WARNING**

The calibration- EEPROM can be damaged by electrostatic discharge (ESD). Therefore, only touch insulated parts and never terminals.

- Do not bend pointer when mounting.
- Mount cover of indication unit.
- Dismount old indication unit from the measuring tube and replace it with a new one. Be sure to mount shims and distance rollers in the same sequence as before disassembled.

8.1.7 Troubleshooting

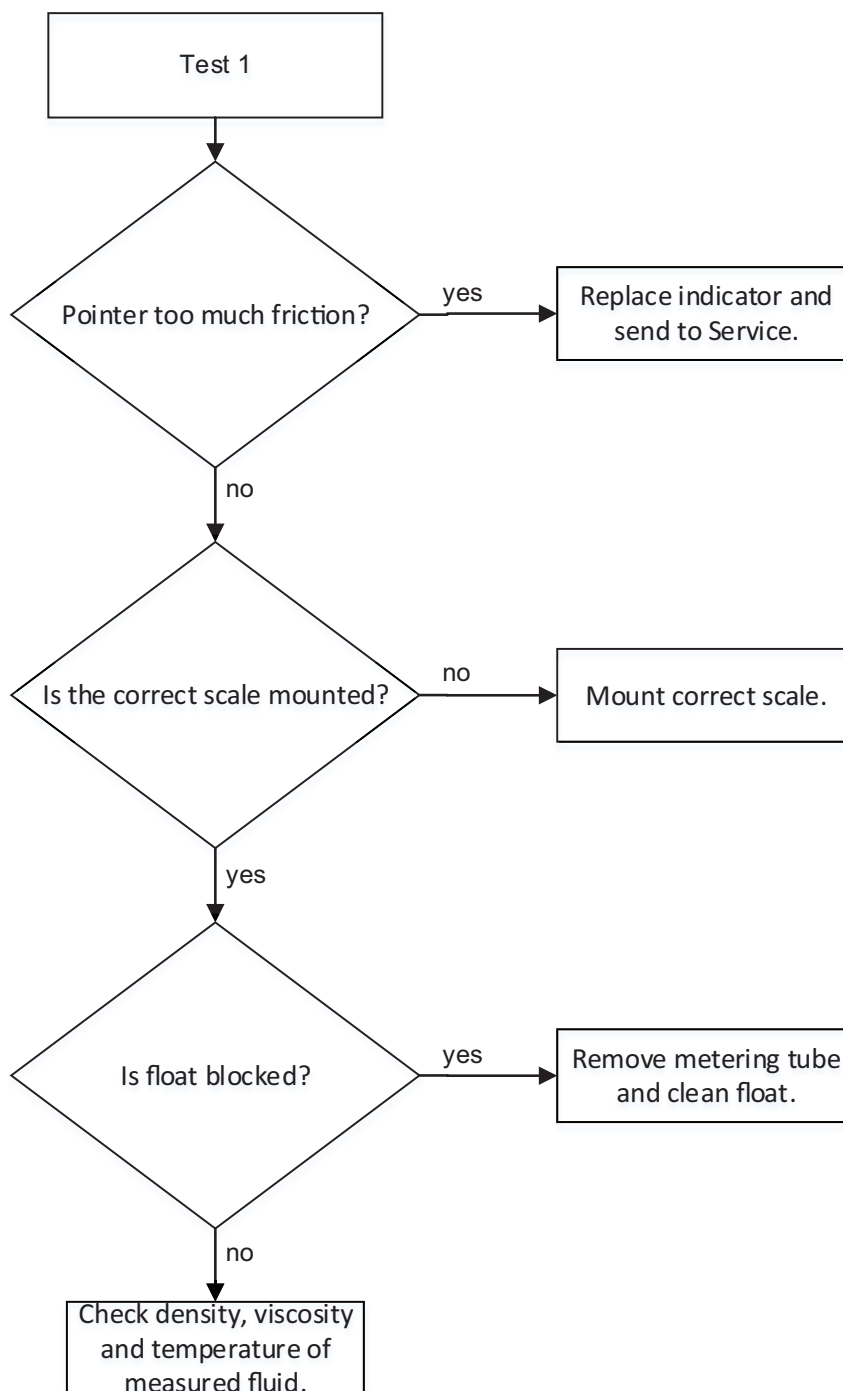
In case the RAMC does not work properly, use the following flow charts for troubleshooting, then check, isolate and remedy the fault.

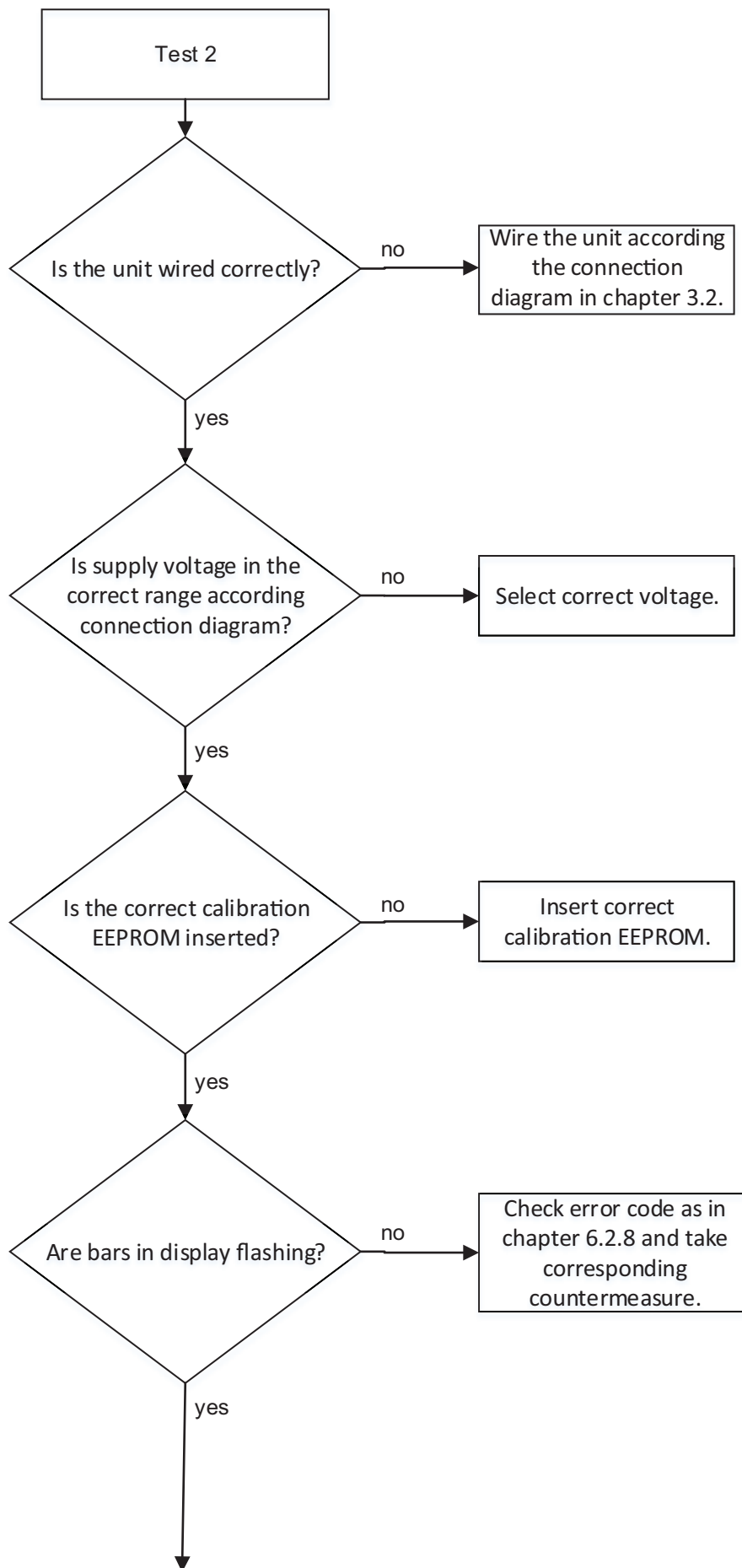
Precision problems with "T" unit: execute test 1

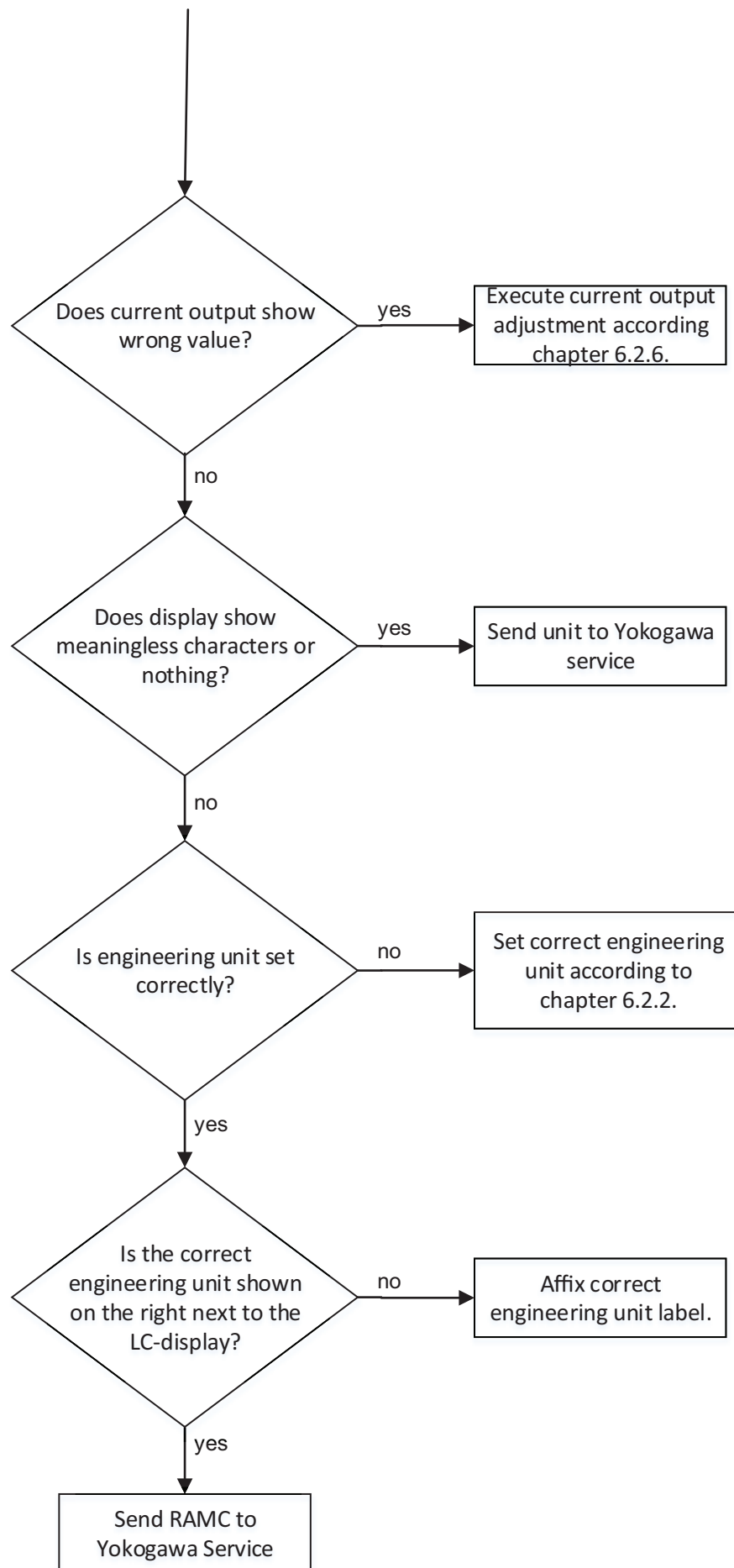
Precision problems with "E" or "J" unit: execute test 1 and test 2

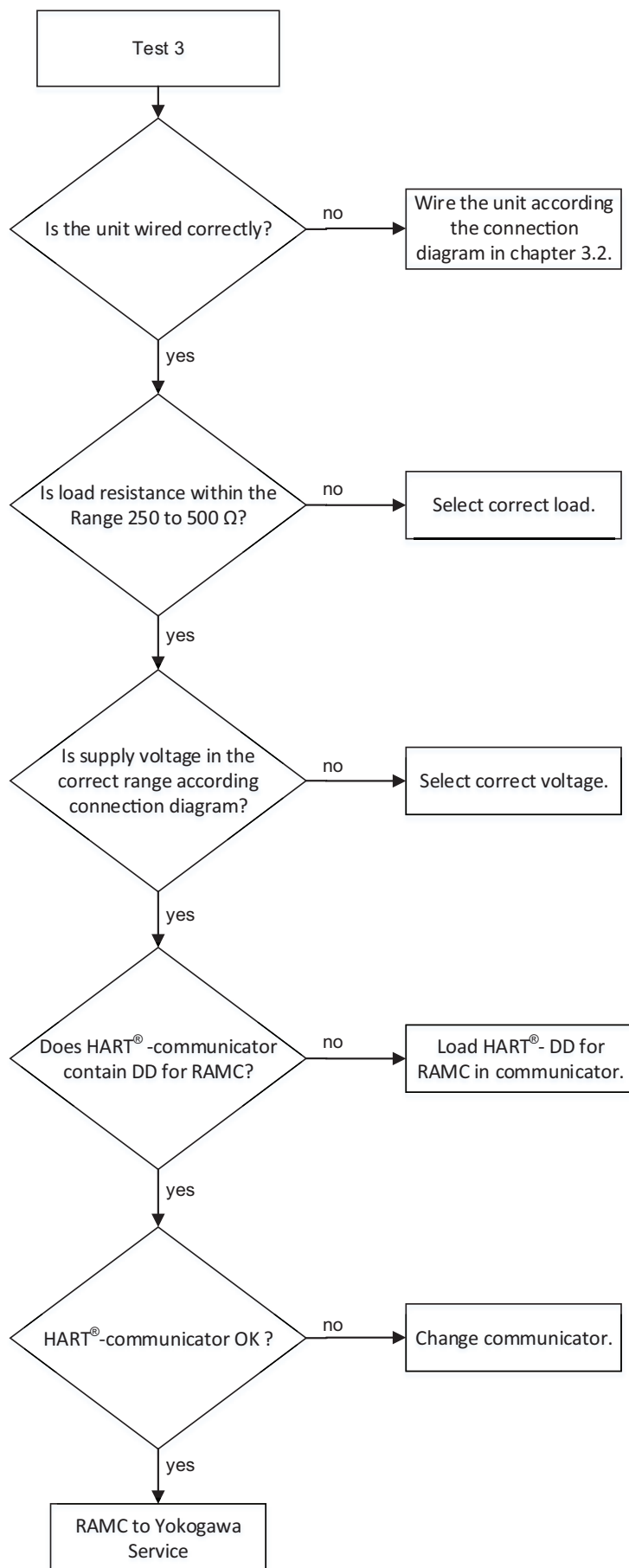
HART®-communication problems with "J" unit: execute test 3 and see chapter 7.5.

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









8.2 Dismantling and disposal

8.2.1 Decontamination and return shipment



WARNING

Use of fluids that are a health hazard may result in caustic burns or poisoning

- When removing the flow meter, avoid touching the fluid and breathing gas residues left in the sensor.
 - Wear protective clothing and a breathing mask.
-

Note the following items before returning the shipment:

- Clean flow meter thoroughly. No harmful chemicals must remain in or on the flow meter. Rota Yokogawa only accepts completely drained and cleaned flow meters.
- The form "Decontamination Declaration" must be filled in completely and sent to Yokogawa along with the flow meter.
- Package flow meter in a shockproof manner for transport. Use original packaging, if possible.

8.2.2 Disposal

Prior to disposal of the flow meter, please take note of the following:

- Comply with the applicable national regulations in the event of disposal or recycling.
- Do not dismantle flow meter until all fluid residues have been removed and dispose the parts individually.



Devices described in this manual should be recycled. They may not be disposed of in the municipal waste disposal services according to the Directive 2012/19/EC on waste electronic and electrical equipment (WEEE). Devices can be returned to the supplier within the EU and UK, or to a locally approved disposal service for eco-friendly recycling. Observe the specific regulations valid in your country.



CAUTION

Special disposal required

The device includes components that require special disposal.

Dispose of the device properly and environmentally through a local waste disposal contractor.

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: YEF-RYG-Flow.Services@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

9. Explosion-protected Type Instruments

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.	SK	Všetky návody na obsluhu pre prístroje s ATEX sú k dispozícii v jazyku anglickom, nemeckom a francúzskom. V prípade potreby návodu pre Ex-prístroje vo Vašom národnom jazyku, skontaktuj prosím miestnu kanceláriu firmy Yokogawa.
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.	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.
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.	LT	Visos gaminių ATEX Ex kategorijos Eksploatavir instrukcijos teikiama anglų, vokiečių ir prancūzų kalbomis. Norėdami gauti prietaisų Ex dokumentaciją kitomis kalbomis susisieki su artimiausiu bendrovės "Yokogawa" biuru arba atstovu.
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.	LV	Visas ATEX Ex kategorijas izstrādājumu Lietošanas instrukcijas tiek piegādātas angļu, vā un franču valodās. Ja vēlaties saņemt Ex ierīšu dokumentāciju citā valodā, Jums ir jāsazinās ar firmas Yokogawa (Yokogawa) tuvāko ofisu vai pārstāvi.
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.	EST	Kõik ATEX Ex toodete kasutamishendid on esitatud inglise, saksa ja prantsuse keeles. Ex seadmete muukeelse dokumentatsiooni saamiseks pöörduge lähima lokagava (Yokogawa) kontori või esindaja poole.
SF	Kaikkien ATEX Ex -tyyppisten tuotteiden käyttöohjeet ovat saatavilla englannin-, saksan- ja ranskankielisinä. Mikäli tarvitsette Ex -tyyppisten tuotteiden ohjeita omalla paikallisella kielellänne, ottakaa yhteyttä lähimpään Yokogawa-toimistoon tai -edustajaan.	PL	Wszystkie instrukcje obsługi dla urządzeń w wykonaniu przeciwybuchowym Ex, zgodnych z wymaganiami ATEX, dostępne są w języku angielskim, niemieckim i francuskim. Jeżeli wymagana jest instrukcja obsługi w Państwa lokalnym języku, prosimy o kontakt z najbliższym biurem Yokogawy.
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.	SLO	Vsi predpisi in navodila za ATEX Ex sorodni pridelki so pri roki v angleščini, nemščini ter francoščini. Če so Ex sorodna navodila potrebna vašem tujejnem jeziku, kontaktirajte vaš najbliž Yokogawa office ili predstavnika.
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.	H	Az ATEX Ex műszerek gépkönyveit angol, né és francia nyelven adjuk ki. Amennyiben he nyelven kéri az Ex eszközök leírásait, kérj keressék fel a legközelebbi Yokogawa irodát, ve képviseletet.
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.	BG	Всички упътвания за продукти от серията ATE 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.
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.	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 apropi birou sau reprezentant Yokogawa.
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.	M	Il-manwali kollha ta' l-istruzzjonijiet għal prodotti marbuta ma' ATEX Ex huma disponibbli bl-Ingliż, bil-Germaniż u bil-Franċiż. Jekk tkun tehtieg struzzjonijiet marbuta ma' Ex fil-lingwa lokali tiegħel għandek tikkuntattja lill-eqreb rappreżentant jew ufficiju ta' Yokogawa.

9.1 General



WARNING

- Only trained personnel may use the instrument in industrial location.
- The instrument modification or parts replacement by other than an authorized Representative of Yokogawa is prohibited and will void the certification.
- Electrostatic charge on painted or other non-metallic surfaces may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on painted surface of the indicator or on potting of electronic transmitter.
- Ignition risks caused by pressure surges, impact or friction must particularly be avoided when light metal measuring units are used.
- If the meter is mounted in an area where the use of category 2D apparatus is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust is avoided.

9.1.1 Intrinsic safety



WARNING

To ensure intrinsic safety it is not permitted to repair or to modify the electronic transmitter, the display, the limit switches or the calibration EEPROM.

The electronic transmitters type -E /KS1, -J /KS1, -E /KS2, -J /KS2, -E /ES1, -J /ES1, -E /ES2, -J /ES2, -E /FS1, -J /FS1, -E /NS1, -J /NS1, -E /GS1, -J /GS1, -E /US1, -J /US1 as well as the limit switches option /K□ with option /KS1, /KS2, /FS1, /NS1, /GS1, /US1 are intrinsically safe devices.

Power supply for the electronic transmitter and transmitter relay for the limit switches are associated apparatus and should be installed outside the hazardous area.

The electronic transmitter must be connected to an intrinsically safe, certified power supply with a maximum voltage and output power below the maximum values of the electronic transmitter (refer to Technical data, in the concerning chapters). The combined internal inductance and capacity of the electronic transmitter and connecting cables must be less than the permitted external inductance and capacity of the power supply.

Accordingly, the limit switches have to be connected to intrinsically safe, certified isolating switching amplifiers. The relevant maximum safety values must be heeded at all times.

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 General Specifications (GS) GS01R01B02-00E-E). If necessary, order an indicator with distance.

9.1.2 Flame proof

In the RAMC with option /KF1, /EF1, /NF1, /GF1, /UF1 the transmitter and the limit switches are mounted in a flame proof housing.

Wait 15 minutes after switching power off before opening the cover.

The cover cannot be opened until the locking screw has been loosened.

After closing the cover the safety screw must be fixed before switching power on.

The RAMC with option /KF1, /EF1, /NF1, /GF1, /UF1 shall be connected via suitable cable glands and/or conduit systems that satisfy the requirements of IEC 60079-1 sections 13.1 and 13.2 for which a separate test certificate is available. Cable glands and entry fittings (screwed conduit entries) as well as blanking plugs of simple design may not be used. On connection of the RAMC /KF1, /EF1, /NF1, /GF1, /UF1 using a conduit entry approved for the purpose, the associated sealed facility must be arranged directly on the housing.

Unused openings must be closed as defined in IEC 60079-1 section 11.9 (e.g. certified blanking elements).

The RAMC with option /KF1, /EF1, /NF1, /GF1, /UF1 shall be connected to the local equipotentially grounding system.

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 General Specifications (GS) GS01R01B02-00E-E). If necessary, order an indicator with distance.

9.2 Intrinsically safe ATEX certified components (/KS1)

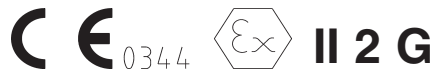
9.2.1 Technical data

Data of electronic transmitter type -E, -J:

The electronic transmitter 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 homologized for zone 0 (category 1). The classifications in brackets are given according to the Directive 2014/34/EU (ATEX).

EU-Type Examination Certificate Nr.: PTB 12ATEX2003 X

Identification in accordance with Directive 2014/34/EU (ATEX):



Type of protection:	Intrinsically safe Ex ia IIC T6 Gb
Ambient temperature:	-40 °C to +70 °C
Safety relevant maximum values:	
Maximum voltage:	$U_i = 30 \text{ V}$
Maximum current (IIC):	$I_i = 101 \text{ mA}$
Maximum power:	$P_i = 1.4 \text{ W}$
Inner inductance:	$L_i = 0.15 \text{ mH}$
Inner capacity:	$C_i = 4.16 \text{ nF}$

Data of limit switches:

The following table shows the maximum safety parameters for intrinsic safe limit switches according the certificates PTB 99 ATEX 2219X (Standard) and PTB 99 ATEX 2049X (Fail-safe).

Table 9-1

	Standard /K1 to /K3 Ex ia IIC T6		Fail-safe /K6 to /K10 Ex ia IIC T6	
	Type 2	Type 3	Type 2	Type 3
U_i [V]	16	16	16	16
I_i [mA]	25	52	25	52
P_i [mW]	64	169	64	169
C_i [nF]	150	150	30	30
L_i [μH]	150	150	100	100
max. ambient temp. [°C] for T6	66	45	66	45
max. ambient temp. [°C] for T5	81	60	81	60
max. ambient temp. [°C] for T1 to T4	100	89	100	89

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 transmitter as specified above.

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.

9.2.2 Installation

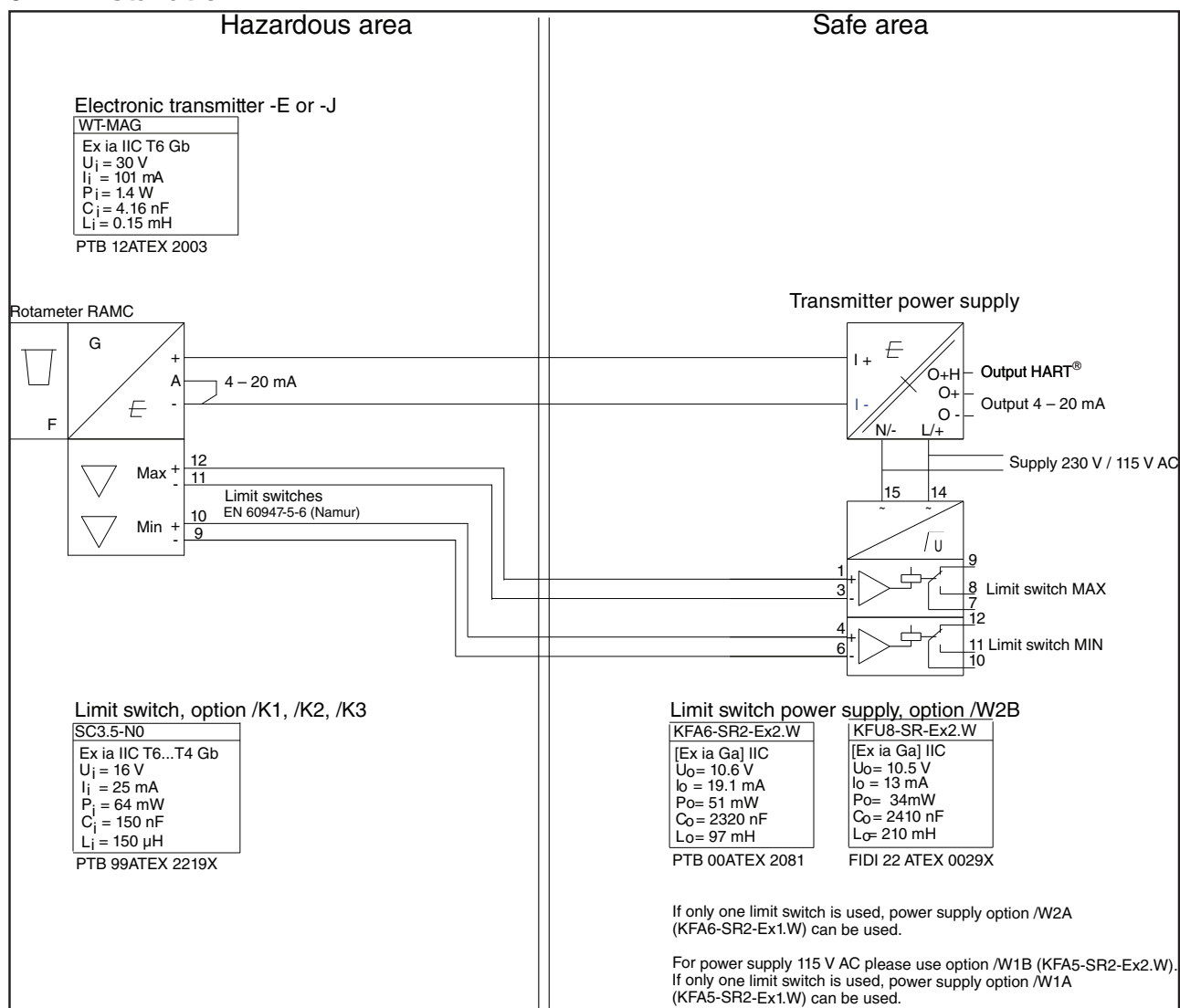


Fig. 9-1 RAMC with ATEX approval (option /KS1) with electronic transmitter, standard limit switches and power supply units with AC power supply.

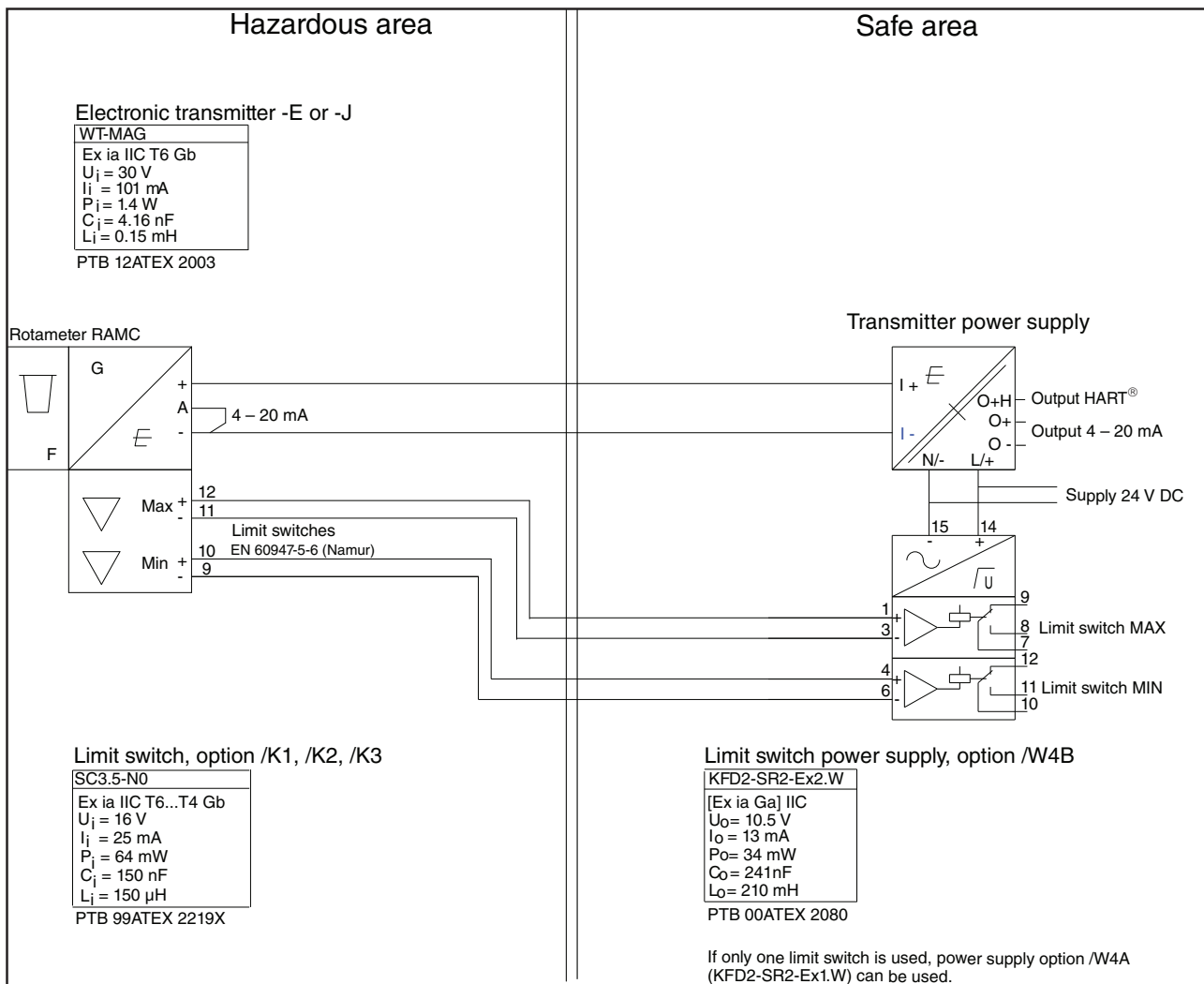


Fig. 9-2 RAMC with ATEX approval (option /KS1) with electronic transmitter, standard limit switches and power supply units with DC power supply.

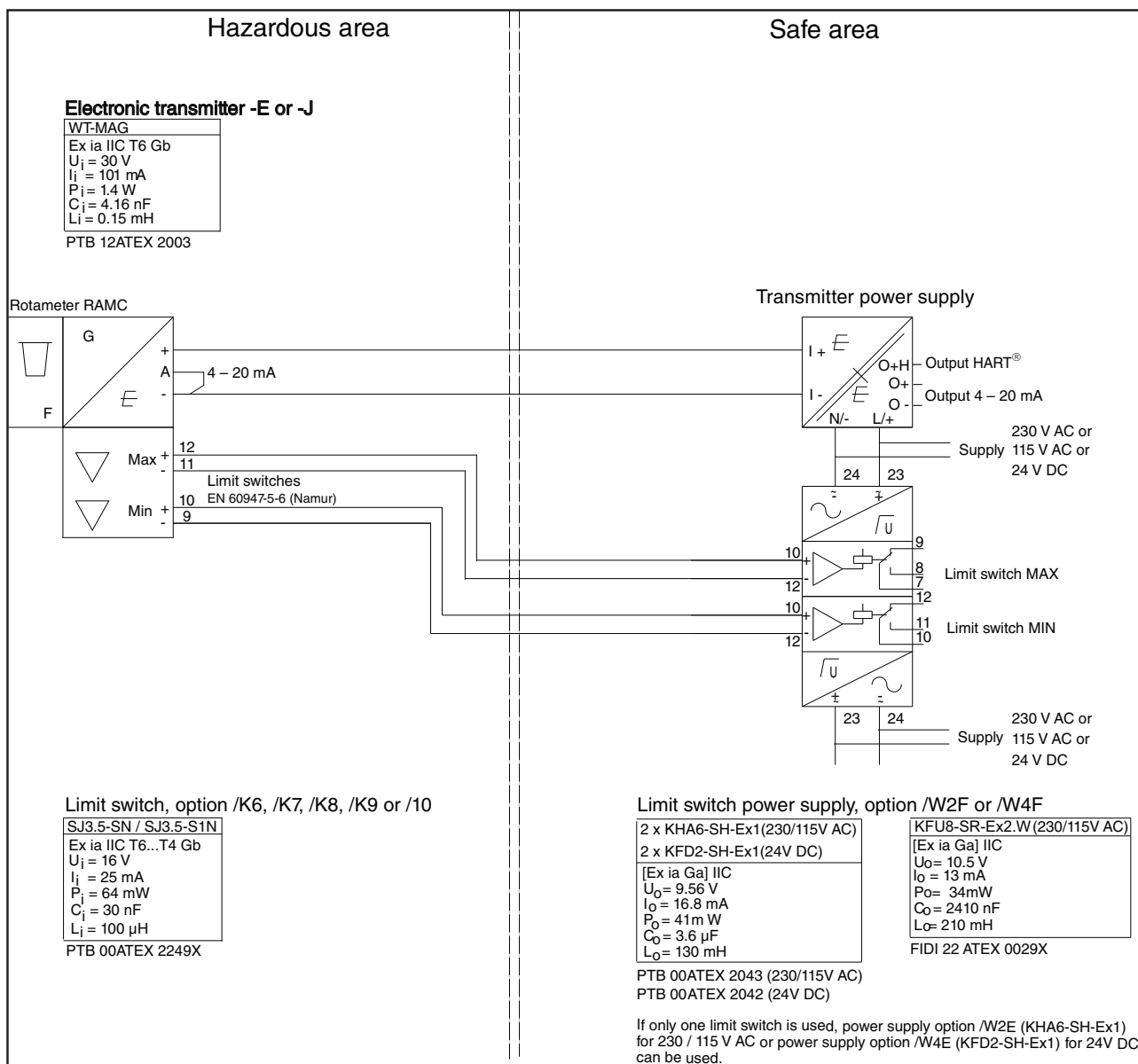


Fig. 9-3 RAMC with ATEX approval (option /KS1) with electronic transmitter, fail-safe limit switches and power supply units with AC/DC power supply.

9.2.3 Marking

Name plates of the electronic transmitter:

Rota Yokogawa Rheinstr. 8 D-79664 Wehr WT-MAG Mat. No. 16-8040 Serial No, xxxxxxxx	Ex ia IIC T6 Gb PTB 12ATEX2003 X $U_i=30\text{V}$ $I_i=101\text{mA}$ $P_i=1.4\text{W}$ $L_i=0.15\text{mH}$ $C_i=4.16\text{nF}$   II 2G
--	---

9.3 Intrinsically safe IECEx- certified components (/ES1)

9.3.1 Technical data

Data of electronic transmitter type -E, -J:

The electronic transmitter is an intrinsically safe device. This device is certified for hazardous areas of zone 1 (category 2) und zone 2 (category 3). It is not homologized for zone 0 (category 1).

Certificate Nr.: IECEx PTB 12.0020 X

Type of protection:	Intrinsically safe Ex ia IIC T6 Gb
Ambient temperature:	-40 °C to +70 °C
Safety relevant maximum values:	
Maximum voltage:	$U_i = 30 \text{ V}$
Maximum current (IIC):	$I_i = 101 \text{ mA}$
Maximum power:	$P_i = 1.4 \text{ W}$
Inner inductance:	$L_i = 0.15 \text{ mH}$
Inner capacity:	$C_i = 4.16 \text{ nF}$

Data of limit switches:

The following table shows the maximum safety parameters for intrinsic safe limit switches according the certificates IECEx PTB 11.0091X (Standard) and IECEx PTB 11.0092X (Fail-safe).

Table 9-2

	Standard /K1 to /K3 Ex ia IIC T6		Fail-safe /K6 to /K10 Ex ia IIC T6	
	Type 2	Type 3	Type 2	Type 3
U_i [V]	16	16	16	16
I_i [mA]	25	52	25	52
P_i [mW]	64	169	64	169
C_i [nF]	150	150	30	30
L_i [μH]	150	150	100	100
max. ambient temp. [°C] for T6	66	45	66	45
max. ambient temp. [°C] for T5	81	60	81	60
max. ambient temp. [°C] for T1 to T4	100	89	100	89

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 transmitter as specified above.

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 (230 V AC supply) or the type KFD2-SR2-Ex... (option (W4□) according certificate IECEx PTB 11.0032 (24 V DC supply) can be used.

9.3.2 Installation

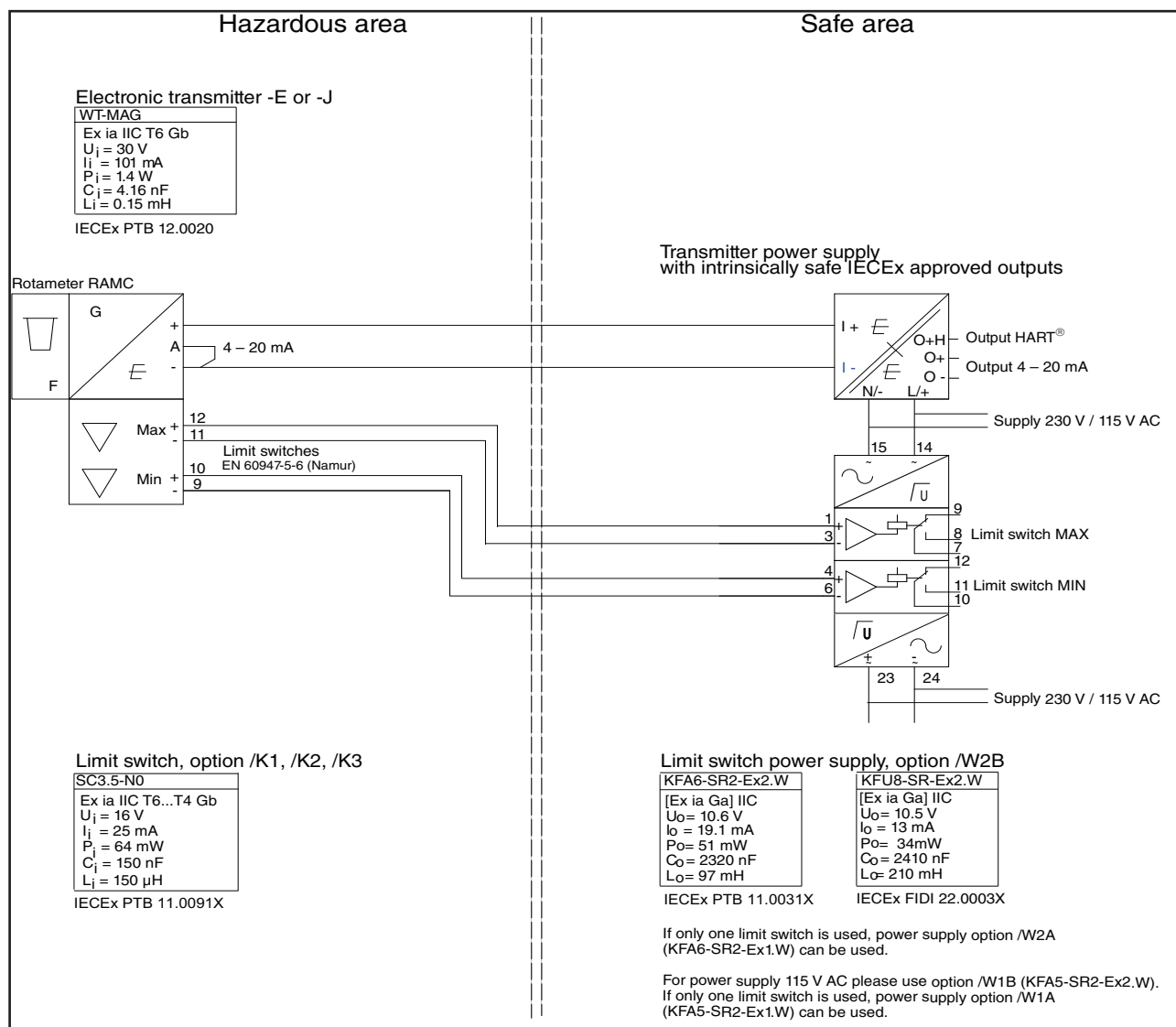


Fig. 9.4 RAMC with IECEx approval (Option /ES1) with electronic transmitter, standard limit switches and power supply units with AC power supply.

9.3.3 Marking

Name plates of electronic transmitter:

Rota Yokogawa Rheinstr. 8 D-79664 Wehr WT-MAG Mat. No. 16-8040 Serial No, xxxxxxxx	Ex ia IIC T6 Gb IECEx PTB 12.0020 X $U_i=30\text{V}$ $I_i=101\text{mA}$ $P_i=1.4\text{W}$ $L_i=0.15\text{mH}$ $C_i=4.16\text{nF}$
---	---

9.4 Intrinsically safe FM / UL (USA + Canada) components (/FS1)

9.4.1 Electronic transmitter (for USA and Canada)

Technical data:

Certificate No.:	FM 3027471
Applicable Standards:	FM3600, FM3610, FM3611, FM3810 C22.2 No. 157, C22.2 No. 213
Type of protection:	intrinsic safe Cl. I, Div. 1, GP. A, B, C, D T6 intrinsic safe Cl. I, Zone 0, AEx ia IIC T6 non incandive Cl. I, Div. 2, GP. A, B, C, D T6
Ambient temperature:	-25 °C to +70 °C
Maximum Entity and Non incandive Field Wiring Parameters:	Vi = 30 V Ii = 100 mA Pi = 1.4 W Ci = 40 nF Li = 150 µH

Installation:

For installation see Control Drawings on page 9-11 and 9-12.



WARNING

- Installation should be in accordance with National Electrical Code, ANSI / NPFA70.
- For intrinsic safe application a safety barrier or FM approved power supply must be used which meet the above mentioned entity parameters.
- For non incandive application the general purpose equipment must be FM approved which non field wiring which meet the above mentioned non incandive field wiring parameters.
- The FM Approved Hand Held Communicator may be connected at any point in the loop between the electronic transmitter and the Control Equipment.

Maintenance and repair:

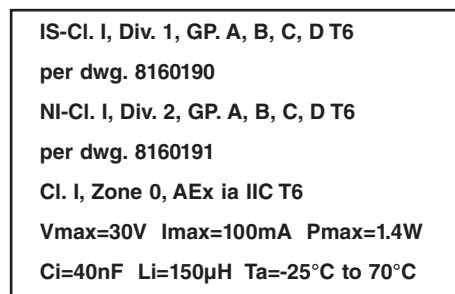


WARNING

The instrument modification or part replacements by other than authorized representative of Rota Yokogawa is prohibited and will void the approval of FM Approvals.

Marking:

Name plates of electronic transmitter:



Control Drawing electronic transmitter intrinsically safe

Intrinsically Safe Entity																													
Hazardous (Classified) Location Class I, Division 1, Groups A, B, C, D, T6 or Class I, Zone 0, IIC T6					Nonhazardous Location																								
V_{max} = 30V I_{max} = 100mA P_{max} = 1.4W C_i ≤ 40nF L_i ≤ 150μH T_{amax} = 70°C					V_{oc} = 30V I_{sc} = 100mA P_o = 1.4W C_a ≥ 40nF + C_{cable} L_a ≥ 150μH + L_{cable}																								
WT-MAG					Associated Apparatus																								
+ - A																													
FM Entity approved associated apparatus necessary. Used in a configuration where associated apparatus Voc or Vt does not exceed WT-MAG Vmax and associated apparatus Isc or It does not exceed WT-MAG Imax. Ci of WT-MAG plus capacitance of interconnecting wiring may not exceed associated apparatus Ca. Li of WT-MAG plus inductance of interconnecting wiring may not exceed associated apparatus La. For guidance on installation see ANSI/ISA RP 12.06.01 "Installation of Intrinsically Safe Instruments Systems for Hazardous (Classified) Locations". The nonintrinsically safe terminals (power rail) must not be connected to any device which uses or generates more than 250V rms or d.c. unless it has been determined that the voltage has been adequately isolated. WARNING : Substitution of components may impair intrinsic safety. For installation, maintenance, or operation instructions see instruction manual. Install in accordance with the National Electrical Code NFPA 70 for US jurisdictions. Install in accordance with the Canadian Electrical Code C22.1-02 for Canada jurisdictions.																													
<table border="1"><thead><tr><th></th><th>DATE</th><th>NAME</th></tr></thead><tbody><tr><td>DRAWN</td><td>07.11.2000</td><td>Amann</td></tr><tr><td>CHECKED</td><td>07.11.2000</td><td>Slotwinski</td></tr></tbody></table>						DATE	NAME	DRAWN	07.11.2000	Amann	CHECKED	07.11.2000	Slotwinski	TITEL: FM CONTROL DRAWING WT-MAG															
	DATE	NAME																											
DRAWN	07.11.2000	Amann																											
CHECKED	07.11.2000	Slotwinski																											
<table border="1"><thead><tr><th>Rev.</th><th>UPDATE No.</th><th>DATE</th><th>EDITOR</th><th>CHECKED</th></tr></thead><tbody><tr><td>c</td><td></td><td>08.09.06</td><td>Rü</td><td>HL</td></tr><tr><td>b</td><td></td><td>09.06.06</td><td>Rü</td><td></td></tr><tr><td>a</td><td></td><td></td><td></td><td></td></tr></tbody></table>					Rev.	UPDATE No.	DATE	EDITOR	CHECKED	c		08.09.06	Rü	HL	b		09.06.06	Rü		a					 ROTA YOKOGAWA 79664 WEHR GERMANY DWG. No.: 8160190 1/1				
Rev.	UPDATE No.	DATE	EDITOR	CHECKED																									
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b		09.06.06	Rü																										
a																													

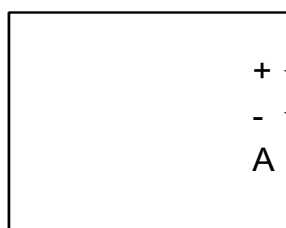
Control Drawing electronic transmitter nonincendive

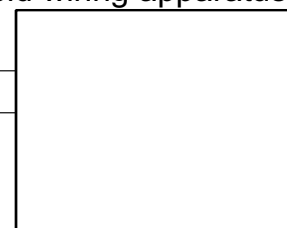
NonincendiveHazardous (Classified) Location

Class I, Division 2, Groups A, B, C, D, T6

$$\begin{aligned} V_{\max} &= 30V \\ I_{\max} &= 100mA \\ P_{\max} &= 1.4W \\ C_i &\leq 40nF \\ L_i &\leq 150\mu H \\ T_{\max} &= 70^{\circ}C \end{aligned}$$

WT-MAG

Nonhazardous Location

$$\begin{aligned} V_{oc} &= 30V \\ I_{sc} &= 100mA \\ P_o &= 1.4W \\ C_a &\geq 40nF + C_{cable} \\ L_a &\geq 150\mu H + L_{cable} \end{aligned}$$
Associated Nonincendive
field wiring apparatus

The nonincendive field wiring circuit concept allows interconnections of nonincendive field wiring apparatus with associated nonincendive field wiring apparatus, using any of the wiring methods permitted for unclassified locations.

 $V_{\max} \geq V_{oc} \text{ or } V_t$
 $C_a \geq C_i + C_{cable}$
 $L_a \geq L_i + L_{cable}$

For this current controlled circuit the parameter $I_{\max}$ is not required and need not be aligned with parameter I_{sc} or I_t of the barrier or associated field wiring apparatus.

For guidance on installation see ANSI/ISA RP 12.06.01 "Installation of Intrinsically Safe Instruments Systems for Hazardous (Classified) Locations".

Install in accordance with the National Electrical Code NFPA 70 for US jurisdictions.

Install in accordance with the Canadian Electrical Code C22.1-02 for Canada jurisdictions.

WARNING : Substitution of components may impair intrinsic safety. For installation, maintenance, or operation instructions see instruction manual.

					DATE		NAME		TITEL: FM CONTROL DRAWING WT-MAG	
					DRAWED 07.11.2000		Amann			
					CKECKED 07.11.2000		Slotwinski			
									DWG. No.: 8160191	
									1/1	

9.4.2 Limit switches option /K1 to /K10 (/FS1 for USA)

Data of limit switches (UL-approval):**Certificate Number SC3,5-N0** 20190402-E501628**Certificate Number SJ3,5-S.N** 20190619-E501628

The limit switches are intrinsically safe devices. They are certified by Pepperl & Fuchs for:

USL – Class I, Zone 0, AEx ia IIC; Zone 20 AEx ia IIIC

CNL – Ex ia IIC Ga; Ex ia IIIC Da

Maximum Entity Field Wiring Parameters:

see UL-control Drawing 116-0453 on page 9-13 to 9-17 for standard type SC

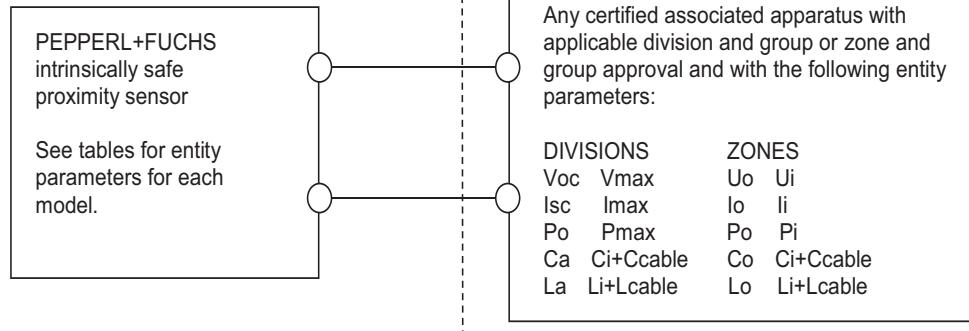
see UL-control Drawing 116-0454 on page 9-18 to 9-23 for fail safe type SJ

Connections

HAZARDOUS LOCATION

Class I, Division 1, Groups A, B, C, D
 Class II, Division 1, Groups E, F, G
 Class III, Division 1
 or
 Class I, Zone 0 IIC
 Zone 20 IIIC

NON-HAZARDOUS LOCATION



Notes

1. MARKING

- Listee's name or Trade Mark
 - Model number or designation
 - Class-Division marking:
 - Class I, Division 1, Group A, B, C, D, T6...T1
 - And/Or
 - Class II, Division 1, Group E, F, G, T 135 °C
 - And/Or
 - Class III, Division 1, T 135 °C
 - And/Or
 - Class-Zone marking for USA:
 - Class I, Zone 0, AEx ia IIC T6...T1 Ga
 - And/Or,
 - Zone 20, AEx ia IIIC T 135 °C Da
 - And/Or
 - Class-Zone marking for Canada:
 - Ex ia IIC T6...T1 Ga X
 - And/Or,
 - Ex ia IIIC T 135 °C Da X
- The following abbreviations are permitted to be used: Class – Cl, Division – Div, Group – Gp, Zone – Zn
- An indication that the apparatus is intrinsically safe
 - A reference to the control drawing number
 - A reference to ambient temperature range shown under suitable tables in the Control Drawing
 - "WARNING – AVOID ELECTROSTATIC CHARGE – SEE INSTRUCTIONS" and/or "AVERTISSEMENT – DANGER POTENTIEL DE CHARGES ÉLECTROSTATIQUES – VOIR INSTRUCTIONS" for apparatus models according to suitable table in the Control Drawing.
 - A serial number, date code or equivalent

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2. STANDARDS

Investigation acc. United States Standards: UL 913, UL 60079-0, UL 60079-11 and acc. Canadian National Standards CSA C22.2 NO. 60079-0, CSA C22.2 NO. 60079-11

3. The Entity Concept allows interconnection of an intrinsically safe apparatus with an associated apparatus not specifically examined in combination as a system when the approved values of V_{oc} (or U_o), I_{sc} (or I_o) and P_o for the associated apparatus are less than or equal to V_{max} (or U_i), I_{max} (or I_i) and P_{max} (or P_i) for the intrinsically safe apparatus and the approved values of C_a (or C_o) and L_a (or L_o) for the associated apparatus are greater than $C_i + C_{cable}$ and $L_i + L_{cable}$, respectively, for the intrinsically safe apparatus, where

$C_{cable} = 60 \text{ pF/ft}$ (197 pF/m) if unknown

$L_{cable} = 0.20 \text{ μH/ft}$ (0.66 μH/m) if unknown

4. The sum of all capacitances and inductances, including tolerance and a 10 m cable result to the given values for C_i and L_i for the respective sensor models, shown in Table 1 and Table 2.
5. Wiring methods must be in accordance with all applicable installation requirements of the country in use. For the U.S. see NFPA 70 (NEC) article 504. For Canada see CEC section 18.
6. **WARNING:** Substitution of components may impair intrinsic safety and suitability for hazardous (classified) locations.
AVERTISSEMENT - La substitution de composants peut compromettre la sécurité intrinsèque et l'adéquation à une utilisation en emplacements dangereux.

7. The correlation between the type of connected circuit and the maximum permissible ambient temperature are indicated at the top of Table 1 and Table 2 below.

When assigning the actual sensor to the respective table, use the type description, which describes the sensor best. Letters and digits describe the different types according to the type description key.

The dots in this type description represent free definable parameters. These free definable parameters can be omitted or replaced by letters or digits.

8. Appropriate measures need to be taken to protect the proximity sensors against mechanical damage due to impact, if they are used within an ambient temperature range between - 60 °C and - 20 °C. An ambient temperature below - 60°C is not permissible.

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9. When the following types of proximity sensors are applied acc. to the following classification

Class I, Division 1, Class II, Division 1 or Class III Division 1 or
Class I, Zone 0 or Zone 20

as tabulated below, inadmissible electrostatic charge of the plastic housing has to be prevented.

Model	Division Classification			Zone Classification	
	Class I, Division 1 for Groups	Class II, Division 1 for Groups	Class III, Division 1 for Class	Class I, Zone 0 for Groups	Zone 20 for Group
SC2-N0...	-	-	-	-	-
SC3,5-N0-Y...	-	E, F, G	III	-	III
SC3,5...-N0...	-	E, F, G	III	-	III
SJ2-N...	-	-	-	-	-
SJ3,5...-N...	-	E, F, G	III	-	III
SJ5-...-N...	-	E, F, G	III	-	III
SJ5-K...	A, B	E, F, G	III	IIC	III
SJ10-N...	A, B	E, F, G	III	IIC	III
SJ15-N...	A, B	E, F, G	III	IIC	III
SJ30-N...	A, B, C, D	E, F, G	III	IIA/IIB/IIC	III

WARNING – AVOID ELECTROSTATIC CHARGE – SEE INSTRUCTIONS

AVERTISSEMENT – DANGER POTENTIEL DE CHARGES ÉLECTROSTATIQUES – VOIR INSTRUCTIONS

Do not mount the supplied nameplate in dust hazardous areas that can be electrostatically charged.

Information on electrostatic hazards can be found in the technical specification IEC/TS 60079-32-1.

10. For the application of the following types of proximity sensors in hazardous locations appropriate measures need to be taken to protect the free resin surface against mechanical damage, if the free resin surface is accessible after installation:

SC2-N0...	SJ2-N-Y43896	SJ5-K...
SC3,5-N0-Y...	SJ2-N-Y43897	SJ10-N...
SC3,5...-N0...	SJ3,5-...-N...	SJ15-N...
SJ2-N-Y34361	SJ5-...-N...	SJ30-N...

11. The proximity sensors may be provided with a permanently connected cable having the following characteristics:

Type: flexible jacketed power supply cord

Rated Voltage: 500 V

Rated Current: min. 76 mA

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Entity Parameters

**Table 1, Proximity sensors for use in
Class I, Division 1
Class I, Zone 0**

			Type 1			Type 2			Type 3			Type 4		
			Ui = 16 V li = 25 mA Pi = 34 mW			Ui = 16 V li = 25 mA Pi = 64 mW			Ui = 16 V li = 52 mA Pi = 169 mW			Ui = 16 V li = 76 mA Pi = 242 mW		
			Maximum permissible ambient temperature in °C for application in temperature class											
Model	Ci / nF	Li / µH	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1
SC2-N0...	150	150	72	87	100	65	80	100	40	55	75	23	38	54
SC3,5-N0-Y...	150	150	72	87	100	65	80	100	40	55	75	23	38	54
SC3,5...-N0...	150	150	73	88	100	66	81	100	45	60	89	30	45	74
SJ2-N...	30	100	73	88	100	67	82	100	45	60	78	30	45	57
SJ3,5-...-N...	50	250	73	88	100	66	81	100	45	60	89	30	45	74
SJ5-...-N...	50	250	73	88	100	66	81	100	45	60	89	30	45	74
SJ5-K...	50	550	72	87	100	66	81	100	42	57	82	26	41	63
SJ10-N...	50	1000	72	87	100	66	81	100	42	57	82	26	41	63
SJ15-N...	150	1200	72	87	100	66	81	100	42	57	82	26	41	63
SJ30-N...	150	1250	72	87	100	66	81	100	42	57	82	26	41	63

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**Table 2, Proximity sensors for use in
Class II, Division 1, Class III, Division 1 or
Zone 20**

			Type 1 Ui = 16 V Ii = 25 mA Pi = 34 mW	Type 2 Ui = 16 V Ii = 25 mA Pi = 64 mW	Type 3 Ui = 16 V Ii = 52 mA Pi = 169 mW	Type 4 Ui = 16 V Ii = 76 mA Pi = 242 mW
Model	Ci / nF	Li / µH	maximum permissible ambient temperature in °C			
SC2-N0...	150	150	100	100	75	54
SC3,5-N0-Y...	150	150	100	100	75	54
SC3,5...-N0...	150	150	100	100	89	74
SJ2-N...	30	100	100	100	78	57
SJ3,5-...-N...	50	250	100	100	89	74
SJ5-...-N...	50	250	100	100	89	74
SJ5-K...	50	550	100	100	82	63
SJ10-N...	50	1000	100	100	82	63
SJ15-N...	150	1200	100	100	82	63
SJ30-N...	150	1250	100	100	82	63

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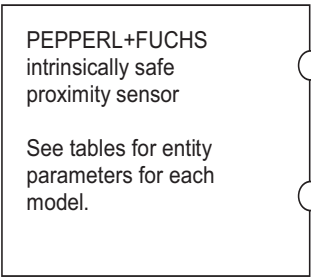
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■ Connections

HAZARDOUS LOCATION
Class I, Division 1, Groups A, B, C, D
Class II, Division 1, Groups E, F, G
Class III, Division 1
or
Class I, Zone 0 IIC
Zone 20 IIIC



NON-HAZARDOUS LOCATION

Any certified associated apparatus with applicable division and group or zone and group approval and with the following entity parameters:

DIVISIONS		ZONES	
Voc	Vmax	Uo	Ui
Isc	Imax	Io	Ii
Po	Pmax	Co	Pi
Ca	Ci+Ccable	Lo	Ci+Ccable
La	Li+Lcable	Lo	Li+Lcable

■ Notes

1. MARKING

- Listee's name or Trade Mark
 - Model number or designation
 - Class-Division marking:
 - Class I, Division 1, Group A, B, C, D, T6...T1
 - And/Or
 - Class II, Division 1, Group E, F, G, T 135 °C
 - And/Or
 - Class III, Division 1, T 135 °C
 - And/Or
 - Class-Zone marking for USA:
 - Class I, Zone 0, AEx ia IIC T6...T1 Ga
 - And/Or,
 - Zone 20, AEx ia IIIC T 135 °C Da
 - And/Or
 - Class-Zone marking for Canada:
 - Ex ia IIC T6...T1 Ga X
 - And/Or,
 - Ex ia IIIC T 135 °C Da X
- The following abbreviations are permitted to be used: Class – Cl, Division – Div, Group – Gp, Zone – Zn
- An indication that the apparatus is intrinsically safe
 - A reference to the control drawing number
 - A reference to ambient temperature range shown under suitable tables in the Control Drawing
 - "WARNING – AVOID ELECTROSTATIC CHARGE – SEE INSTRUCTIONS" and/or "AVERTISSEMENT – DANGER POTENTIEL DE CHARGES ÉLECTROSTATIQUES – VOIR INSTRUCTIONS" for apparatus models according to suitable table in the Control Drawing.
 - A serial number, date code or equivalent

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2. STANDARDS

Investigation acc. United States Standards: UL 913, UL 60079-0, UL 60079-11 and acc. Canadian National Standards CSA C22.2 NO. 60079-0, CSA C22.2 NO. 60079-11

3. The Entity Concept allows interconnection of an intrinsically safe apparatus with an associated apparatus not specifically examined in combination as a system when the approved values of V_{oc} (or U_o), I_{sc} (or I_o) and P_o for the associated apparatus are less than or equal to V_{max} (or U_i), I_{max} (or I_i) and P_{max} (or P_i) for the intrinsically safe apparatus and the approved values of C_a (or C_o) and L_a (or L_o) for the associated apparatus are greater than $C_i + C_{cable}$ and $L_i + L_{cable}$, respectively, for the intrinsically safe apparatus, where

$C_{cable} = 60 \text{ pF/ft}$ (197 pF/m) if unknown

$L_{cable} = 0.20 \text{ }\mu\text{H/ft}$ (0.66 $\mu\text{H/m}$) if unknown

4. The sum of all capacitances and inductances, including tolerance and a 10 m cable result to the given values for C_i and L_i for the respective sensor models, shown in Table 1 and Table 2.
5. Wiring methods must be in accordance with all applicable installation requirements of the country in use. For the U.S. see NFPA 70 (NEC) article 504. For Canada see CEC section 18.
6. **WARNING:** Substitution of components may impair intrinsic safety and suitability for hazardous (classified) locations.
AVERTISSEMENT - La substitution de composants peut compromettre la sécurité intrinsèque et l'adéquation à une utilisation en emplacements dangereux.
7. The correlation between the type of connected circuit and the maximum permissible ambient temperature are indicated at the top of Table 1 and Table 2 below.

When assigning the actual sensor to the respective table, use the type description, which describes the sensor best. Letters and digits describe the different types according to the type description key.

The dots in this type description represent free definable parameters. These free definable parameters can be omitted or replaced by letters or digits.

8. Appropriate measures need to be taken to protect the proximity sensors against mechanical damage due to impact, if they are used within an ambient temperature range between - 60 °C and - 20 °C. An ambient temperature below - 60°C is not permissible.

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9. When the following types of proximity sensors are applied acc. to the following classification

Class I, Division 1, Class II, Division 1 or Class III Division 1 or

Class I, Zone 0 or Zone 20

as tabulated below, inadmissible electrostatic charge of the plastic housing has to be prevented.

Type	Division Classification			Zone Classification	
	Class I, Division 1 for Groups	Class II, Division 1 for Groups	Class III, Division 1 for Class	Class I, Zone 0 for Groups	Zone 20 for Group
NJ2-11-SN...	-	-	-	-	-
NJ2-11-SN-G...	-	-	-	-	-
NJ2-12GK-SN...	-	-	-	-	-
NJ3-18GK-S1N...	A, B	E, F, G	III	IIC	III
NJ4-12GK-SN-Y197959	A, B	-	-	IIC	-
NJ4-12GK-SN-Y197960	A, B	-	-	IIC	-
NJ4-12GK-SN...	-	-	-	-	-
NJ5-18GK-SN...	A, B	E, F, G	III	IIC	III
NJ5-30GK-S1N...	A, B	E, F, G	III	IIC	III
NJ6-22-SN...	A, B	E, F, G	III	IIC	III
NJ6-22-SN-G...	-	-	-	-	-
NJ6S1+U...+N...	A, B	E, F, G	III	IIC	III
NJ8-18GK-SN...	A, B	-	-	IIC	-
NJ10-30GK-SN...	A, B	E, F, G	III	IIC	III
NJ15-30GK-SN...	A, B	E, F, G	III	IIC	III
NJ15S+U...+N...	A, B	E, F, G	III	IIC	III
NJ20S+U...+N...	A, B	E, F, G	III	IIC	III
SJ2-SN...	-	-	-	-	-
SJ2-S1N...	-	-	-	-	-
SJ3,5-S1N...	-	E, F, G	III	-	III
SJ3,5-SN...	-	E, F, G	III	-	III

WARNING – AVOID ELECTROSTATIC CHARGE – SEE INSTRUCTIONS

AVERTISSEMENT – DANGER POTENTIEL DE CHARGES ÉLECTROSTATIQUES – VOIR INSTRUCTIONS

Do not mount the supplied nameplate in dust hazardous areas that can be electrostatically charged.

Information on electrostatic hazards can be found in the technical specification IEC/TS 60079-32-1.

10. Inadmissible electrostatic charge of parts of the metal housing has to be avoided for the following types of proximity sensors. Dangerous electrostatic charge of parts of the metal housing can be avoided by grounding of these parts whereas very small parts of the metal housing (e.g. screws) do not need to be grounded:

NJ2-11-SN-G...	NJ6S1+U3+N...	NJ15S+U3+N...	NJ20S+U3+N...
NJ6-22-SN-G...	NJ6S1+U4+N...	NJ15S+U4+N...	NJ20S+U4+N...

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11. For the application of the following types of proximity sensors in hazardous locations appropriate measures need to be taken to protect the free resin surface against mechanical damage, if the free resin surface is accessible after installation:

SJ2-SN...	SJ3,5-S1N...
SJ2-S1N...	SJ3,5-SN...

12. When the following types of proximity sensors are applied acc. to the following classification

Class I, Division 1 or

Class I, Zone 0

the maximum permissible mass fractions of metallic materials are exceeded for the following types of proximity sensors.

In hazardous areas requiring the application of Class I, Division 1 equipment, resp. Class I, Zone 0 equipment, it shall be ensured by appropriate measures that an ignition hazard due to impact or friction effects cannot occur.

NJ6S1+U3+N...	NJ15S+U3+N...	NJ20S+U3+N...
NJ6S1+U4+N...	NJ15S+U4+N...	NJ20S+U4+N...

13. The proximity sensors may be provided with a permanently connected cable having the following characteristics:

Type: flexible jacketed power supply cord

Rated Voltage: 500 V

Rated Current: min. 76 mA

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Entity Parameters

**Table 1, Proximity sensors for use in
Class I, Division 1
Class I, Zone 0**

			Type 1			Type 2			Type 3			Type 4		
			Ui = 16 V li = 25 mA Pi = 34 mW			Ui = 16 V li = 25 mA Pi = 64 mW			Ui = 16 V li = 52 mA Pi = 169 mW			Ui = 16 V li = 76 mA Pi = 242 mW		
			Maximum permissible ambient temperature in °C for application in temperature class											
Model	Ci / nF	Li / µH	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1	T6	T5	T4-T1
NJ2-11-SN...	50	150	73	88	100	66	81	100	45	60	89	30	45	74
NJ2-11-SN-G...	50	150	76	91	100	73	88	100	62	77	81	54	63	63
NJ2-12GK-SN...	50	150	73	88	100	69	84	100	51	66	80	39	54	61
NJ3-18GK-S1N...	70	200	73	88	100	69	84	100	51	66	80	39	54	61
NJ4-12GK-SN...	70	150	73	88	100	69	84	100	51	66	80	39	54	61
NJ5-18GK-SN...	120	200	73	88	100	69	84	100	51	66	80	39	54	61
NJ5-30GK-S1N...	100	200	73	88	100	69	84	100	51	66	80	39	54	61
NJ6-22-SN...	110	150	73	88	100	69	84	100	51	66	80	39	54	61
NJ6-22-SN-G...	110	150	76	91	100	73	88	100	62	77	81	54	63	63
NJ6S1+U...+N...	180	150	73	88	100	69	84	100	51	66	80	39	54	61
NJ8-18GK-SN...	120	200	73	88	100	69	84	100	51	66	80	39	54	61
NJ10-30GK-SN...	120	150	73	88	100	69	84	100	51	66	80	39	54	61
NJ15-30GK-SN...	120	180	73	88	100	69	84	100	51	66	80	39	54	61
NJ15S+U...+N...	180	150	73	88	100	66	81	100	45	60	89	30	45	74
NJ20S+U...+N...	200	150	73	88	100	66	81	100	45	60	89	30	45	74
SJ2-SN...	30	100	73	88	100	66	81	100	45	60	78	30	45	57
SJ2-S1N...	60	100	73	88	100	66	81	100	45	60	78	30	45	57
SJ3,5-S1N...	30	100	73	88	100	66	81	100	45	60	89	30	45	74
SJ3,5-SN...	30	100	73	88	100	66	81	100	45	60	89	30	45	74

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**Table 2, Proximity sensors for use in
Class II, Division 1, Class III, Division 1 or
Zone 20**

			Type 1 Ui = 16 V li = 25 mA Pi = 34 mW	Type 2 Ui = 16 V li = 25 mA Pi = 64 mW	Type 3 Ui = 16 V li = 52 mA Pi = 169 mW	Type 4 Ui = 16 V li = 76 mA Pi = 242 mW
Model	Ci / nF	Li / μH	maximum permissible ambient temperature in °C			
NJ2-11-SN...	50	150	100	100	89	74
NJ2-11-SN-G...	50	150	100	100	81	63
NJ2-12GK-SN...	50	150	100	100	80	61
NJ3-18GK-S1N...	70	200	100	100	80	61
NJ4-12GK-SN...	70	150	100	100	80	61
NJ5-18GK-SN...	120	200	100	100	80	61
NJ5-30GK-S1N...	100	200	100	100	80	61
NJ6-22-SN...	110	150	100	100	80	61
NJ6-22-SN-G...	110	150	100	100	81	63
NJ6S1+U...+N...	180	150	100	100	80	61
NJ8-18GK-SN...	120	200	100	100	80	61
NJ10-30GK-SN...	120	150	100	100	80	61
NJ15-30GK-SN...	120	180	100	100	80	61
NJ15S+U...+N...	180	150	100	100	89	74
NJ20S+U...+N...	200	150	100	100	89	74
SJ2-SN...	30	100	100	100	78	57
SJ2-S1N...	60	100	100	100	78	57
SJ3,5-S1N...	30	100	100	100	89	74
SJ3,5-SN...	30	100	100	100	89	74

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9.5 Intrinsically safe NEPSI (China) certified RAMC (/NS1)

The RAMC with electronic transmitter (-E, -J) with or without limit switches is certified as intrinsic safe unit with NEPSI approval.

Certificate Nr.:	GYJ20.1088
Explosion proof:	Ex ia IIC T6 Gb
Ambient temperature:	-40 °C to +70 °C
Safety relevant maximum values of electronic transmitter:	
Maximum voltage:	$U_i = 30 \text{ V}$
Maximum current:	$I_i = 101 \text{ mA}$
Maximum power:	$P_i = 1.4 \text{ W}$
Inner inductance :	$L_i = 150 \text{ } \mu\text{H}$
Inner capacity:	$C_i = 4.16 \text{ nF}$

Data of limit switches option /K1 to /K10:

The following table shows the maximum safety parameters for intrinsic safe limit switches according the certificate

2020322315002306 (/K1 to /K3)

2020322315002308 (/K6 to /K10)

Table 9-3

	Standard /K1 to /K3 Ex ia IIC T6		Fail-safe /K6 to /K10 Ex ia IIC T6	
	Type 2	Type 3	Type 2	Type 3
U_i [V]	16	16	16	16
I_i [mA]	25	52	25	52
P_i [mW]	64	169	64	169
C_i [nF]	150	150	30	30
L_i [μH]	150	150	100	100
max. ambient temp. [°C] for T6	66	45	66	45
max. ambient temp. [°C] for T5	81	60	81	60
max. ambient temp. [°C] for T1 to T4	100	89	100	89

9.6 Intrinsically safe EAC (EAEU- countries) certified RAMC (/GS1)

Certificate Nr.:	RU C-DE.AA87.B.01500/25
Explosion proof:	1Ex h ia IIC T6 Gb X
Ambient temperature:	-40 °C to +70 °C
Safety relevant maximum values of electronic transmitter:	
Maximum voltage:	$U_i = 30 \text{ V}$
Maximum current:	$I_i = 101 \text{ mA}$
Maximum power:	$P_i = 1.4 \text{ W}$
Inner inductance :	$L_i = 150 \text{ } \mu\text{H}$
Inner capacity:	$C_i = 4.16 \text{ nF}$

9.7 Intrinsically safe PESO (India) certified RAMC

Certificate: PESO Ref. No.: P505974/1
 Option /KS1 + option /Q11 must be selected.
 Same data as ATEX-certified type (/KS1) in chapter 9.2.

9.8 Intrinsically safe Ukraine Ex certified RAMC (/KS1)

Certificate No.: CL16.0017X
 Same data as for ATEX certification, option /KS1.

9.9 Intrinsically safe ECAS certified electronic transmitter WT-MAG

Certificate No.: 25-07-24092/Q25-07-050486/NB0010
 Same data as for IECEx certification, option /ES1.

9.10 Intrinsically safe INMETRO- certified components (/US1)

9.10.1 Technical data

Data of electronic transmitter type -E, -J:

The electronic transmitter is an intrinsically safe device. This device is certified for hazardous areas of zone 1 (category 2) und zone 2 (category 3). It is not homologized for zone 0 (category 1).

Certificate Nr.:	DNV 24.0059 X
Type of protection:	Intrinsically safe Ex ia IIC T6 Gb
Ambient temperature:	-40 °C to +70 °C
Safety relevant maximum values:	
Maximum voltage:	$U_i = 30 \text{ V}$
Maximum current (IIC):	$I_i = 101 \text{ mA}$
Maximum power:	$P_i = 1.4 \text{ W}$
Inner inductance:	$L_i = 0.15 \text{ mH}$
Inner capacity:	$C_i = 4.16 \text{ nF}$

Data of limit switches:

The following table shows the maximum safety parameters for intrinsic safe limit switches according the certificates TÜV 13.1131 X (Standard) and TÜV 14.0352 X (Fail-safe).

Table 9-4

	Standard /K1 to /K3 Ex ia IIC T6		Fail-safe /K6 to /K10 Ex ia IIC T6	
	Type 2	Type 3	Type 2	Type 3
U_i [V]	16	16	16	16
I_i [mA]	25	52	25	52
P_i [mW]	64	169	64	169
C_i [nF]	150	150	30	30
L_i [μH]	150	150	100	100
max. ambient temp. [°C] for T6	66	45	66	45
max. ambient temp. [°C] for T5	81	60	81	60
max. ambient temp. [°C] for T1 to T4	100	89	100	89

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 transmitter as specified above.

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:

KFD2-SR2-Ex... (option /W4□) according to certificate TÜV 13.1125 (24V DC supply) oder

KFU8-SR-Ex... (option /W1□ and /W2□) according to certificate TÜV 23.0468 X (115/230 V AC supply)

9.10.2 Installation

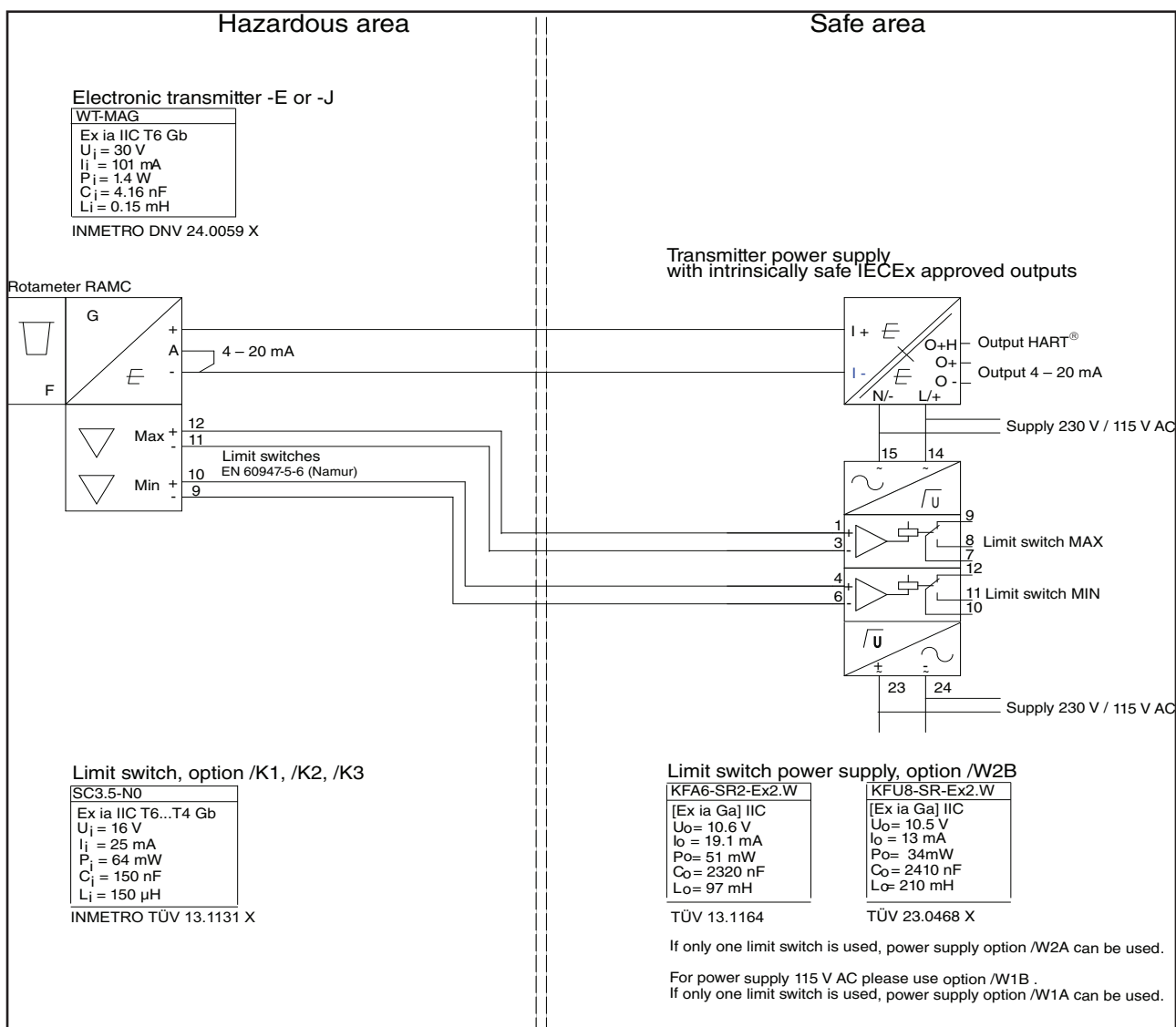


Fig. 9.5 RAMC with INMETRO approval (Option /US1) with electronic transmitter, standard limit switches and power supply units with AC power supply.

9.10.3 Marking

Name plates of electronic transmitter:

Rota Yokogawa
Rheinstr. 8
D-79664 Wehr
WT-MAG Mat. No. 16-8040
Serial No, xxxxxxxx

Ex ia IIC T6
DNV 24.0059 X
 $U_i=30\text{V}$ $I_i=101\text{mA}$ $P_i=1.4\text{W}$
 $L_i=0.15\text{mH}$ $C_i=4.16\text{nF}$
 Segurança
 DNV
 INMETRO

9.11 Flame proof and dust proof ATEX certified RAMC (/KF1)

9.11.1 Technical data

Certificate:	IBExU 05 ATEX 1086X
Flame proof:	Ex db IIC T6 Gb
Dust proof:	Ex tb IIIC 85°C...370°C Db
Housing:	Painted aluminium casting, type 91
Output signal (with electronic transmitter -E, -J):	4 to 20 mA (2- wire)
Power supply (with electronic transmitter -E, -J):	2- wire
Limit switches:	Options /K1 to /K10 possible
Ambient temperature:	-20 °C to 60 °C
Minimum process temperature:	-20 °C
Threads for cable glands:	• M20x1.5 (standard) • ½" NPT (option /A5)
Degree of protection:	IP66/67
Marking:	

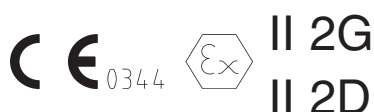


Table 9-5 Temperature classification for gas application

Temperature class	Standard	On extension (option /A16)	On extension (option /A16) and thermal insulation
T6	85 °C	85 °C	85 °C
T5	100 °C	100 °C	100 °C
T4	120 °C	135 °C	135 °C
T3	120 °C	200 °C	200 °C
T2	120 °C	300 °C	300 °C
T1	120 °C	370 °C	350 °C

9.11.2 Installation

For use in zone 1 and zone 2 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands and/or conduit systems that satisfy the requirements of EN 60079-1 sections 13.1 and 13.2 and for which a separate test certificate is available. The cables, cable glands and blind plugs must be specified for an ambient temperature of 100 °C. Cable glands and entry fittings (screwed conduit entries) as well as blind plugs of simple design may not be used. On connection of the RAMC /KF1 using a conduit entry approved for the purpose, the associated sealing facility must be arranged directly on the housing.

For use in zone 21 and zone 22 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands certified to the concerning dust category.

Unused openings shall be closed with certified blind plugs in type of protection Ex db/tb (100 °C).

Secure cable glands, blind plugs and the safety screw for the cover against twisting.

For installation EN 60079-14 must be considered.



CAUTION

The RAMC with option /KF1 shall be connected to the local equipollent grounding system. Therefore a grounding screw is available outside on the indicator housing and inside the indicator.

The electronic transmitter and the limit switches shall be wired as described in chapter 3.2.

9.11.3 Operation

If the cover of the indicator unit has to be opened, following instructions must be followed.



CAUTION

-
- Switch off the power supply.
 - Wait 15 minutes after power is turned off before opening the cover.
 - The cover is fixed with a special screw.
 - Be sure to lock the cover with special screw after tightening the cover.
 - Before starting the operation again, be sure to lock the cover with the locking screw.
 - Users are prohibited from making any modifications of specifications or physical configuration, such as adding or changing the configuration of external wiring ports.
-



WARNING

The instrument modification or parts replacement by other than authorized representatives of YOKOGAWA is prohibited and will void the certification.



WARNING

If the window of the cover is damaged the RAMC must be set out of operation.

9.12 Flame proof and dust proof IECEx certified RAMC (/EF1)

9.12.1 Technical data

Certificate:	IECEx IBE12.0007
Flame proof:	Ex db IIC T6 Gb
Dust proof:	Ex tb IIIC TX Db
Max. surface temperature TX:	Corresp. process temperature
Housing:	Painted aluminium casting, type 91
Output signal (with electronic transmitter -E, -J):	4 to 20 mA (2- wire)
Power supply (with electronic transmitter -E, -J):	2- wire
Limit switches:	Options /K1 to /K10 possible
Ambient temperature:	-20 °C to 60 °C
Minimum process temperature:	-20 °C
Threads for cable glands:	• M20x1.5 (standard) • ½" NPT (option /A5)
Degree of protection:	IP66/67

Table 9-6 Temperature classification for gas application

Temperature class	Standard	On extension (option /A16)	On extension (option /A16) and thermal insulation
T6	85 °C	85 °C	85 °C
T5	100 °C	100 °C	100 °C
T4	120 °C	135 °C	135 °C
T3	120 °C	200 °C	200 °C
T2	120 °C	300 °C	300 °C
T1	120 °C	370 °C	350 °C

9.12.2 Installation

For use in zone 1 and zone 2 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands and/or conduit systems that satisfy the requirements of IEC 60079-1 and for which a separate test certificate is available. The cables, cable glands and blind plugs must be specified for an ambient temperature of 100 °C. Cable glands and entry fittings (screwed conduit entries) as well as blind plugs of simple design may not be used. On connection of the RAMC /EF1 using a conduit entry approved for the purpose, the associated sealing facility must be arranged directly on the housing.

For use in zone 21 and zone 22 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands certified to the concerning dust category.

Unused openings shall be closed with certified blind plugs in type of protection Ex db/tb (100 °C).

Secure cable glands, blind plugs and the safety screw for the cover against twisting.

For installation EN 60079-14 must be considered.



CAUTION

The RAMC with option /EF1 shall be connected to the local equipollent grounding system. Therefore a grounding screw is available outside on the indicator housing and inside the indicator (see fig. 3-6).

The electronic transmitter and the limit switches shall be wired as described in chapter 3.3.

9.12.3 Operation

If the cover of the indicator unit has to be opened, following instructions must be followed.



CAUTION

- Switch off the power supply.
- Wait 15 minutes after power is turned off before opening the cover.
- The cover is fixed with a special screw.
- Be sure to lock the cover with special screw after tightening the cover.
- Before starting the operation again, be sure to lock the cover with the locking screw.
- Users are prohibited from making any modifications of specifications or physical configuration, such as adding or changing the configuration of external wiring ports.



WARNING

The instrument modification or parts replacement by other than authorized representatives of YOKOGAWA is prohibited and will void the certification.



WARNING

If the window of the cover is damaged the RAMC must be set out of operation.

9.13 Intrinsically safe ATEX certified components in dust proof RAMC-housing (/KS2)

Certificate:

PTB 12 ATEX 2003 (Intrinsically safe electronic transmitter)
PTB 99 ATEX 2219X (Intrinsically safe limit switches) (Pepperl&Fuchs)
PTB 00 ATEX 2049X (Intrinsically safe fail-safe limit switches) (Pepperl&Fuchs)
IBExU 05 ATEX 1086 (Dust proof RAMC)

Intrinsic safety:

Group II; category 2G
See chapter 9.2

Dust proof:

Group II; category 2D
See chapter 9.11

**CAUTION**

RAMC with /A5 (threads for cable gland 1/2" NPT) are delivered without cable glands. Please install suitable cable glands or blind plugs according to the dust category where the flowmeter is installed.

9.14 Intrinsically safe IECEx certified components in dust proof RAMC-housing (/ES2)

Certificate:

IECEx PTB12.0020 (Intrinsically safe electronic transmitter)
IECEx PTB11.0091X (Intrinsically safe limit switches) (Pepperl&Fuchs)
IECEx PTB11.0092X (Intrinsically safe fail-safe limit switches) (Pepperl&Fuchs)
IECEx IBE12.0007 (Dust proof RAMC)

Intrinsic safety:

Group II; category 2G
See chapter 9.3

Dust proof:

Group II; category 2D
See chapter 9.12

**CAUTION**

RAMC with /A5 (threads for cable gland 1/2" NPT) are delivered without cable glands. Please install suitable cable glands or blind plugs according to the dust category where the flowmeter is installed.

9.15 Flame proof and dust proof NEPSI (China) certified RAMC (/NF1)

9.15.1 Technical data

Certificate:	GYJ23.1013X
Flame proof:	Ex db IIC T... T6 Gb
Dust proof:	Ex tb IIIC T80°C Db
Max. surface temperature TA:	Corresponding process temperature
Housing:	Painted aluminium casting type 91
Output signal (with electronic transmitter-E, -J):	4 to 20 mA (2- wire)
Power supply (with electronic transmitter -E, -J):	2- wire
Limit switches:	Options /K1 to /K10 possible
Ambient temperature:	-20 °C to +60 °C
Minimum process temperature:	-20 °C
Threads for cable glands:	• M20x1.5 (standard) • ½" NPT (option /A5)
Degree of protection:	IP66/67

Table 9-7 Temperature classification for gas application

Temperature class	Standard	On extension (option /A16)	On extension (option /A16) and thermal insulation
T6	85 °C	85 °C	85 °C
T5	100 °C	100 °C	100 °C
T4	120 °C	135 °C	135 °C
T3	120 °C	200 °C	200 °C
T2	120 °C	300 °C	300 °C
T1	120 °C	370 °C	350 °C

9.15.2 Installation

For use in zone 1 and zone 2 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands and/or conduit systems that satisfy the requirements of IEC 60079-1 and for which a separate test certificate is available. The cables, cable glands and blind plugs must be specified for an ambient temperature of 100 °C. Cable glands and entry fittings (screwed conduit entries) as well as blind plugs of simple design may not be used. On connection of the RAMC with option /NF1 using a conduit entry approved for the purpose, the associated sealing facility must be arranged directly on the housing.

For use in zone 21 and zone 22 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands certified to the concerning dust category.

Unused openings shall be closed with certified blind plugs in type of protection Ex db/tb (100 °C).

Secure cable glands, blind plugs and the safety screw for the cover against twisting.



CAUTION

The RAMC with option /NF1 shall be connected to the local equipollent grounding system. Therefore a grounding screw is available outside on the indicator housing and inside the indicator (see fig. 3-6).

The electronic transmitter and the limit switches shall be wired as described in chapter 3.3.

9.15.3 Operation

If the cover of the indicator unit has to be opened, following instructions must be followed.



CAUTION

- Switch off the power supply.
 - Wait 15 minutes after power is turned off before opening the cover.
 - The cover is fixed with a special screw.
 - Be sure to lock the cover with special screw after tightening the cover.
 - Before starting the operation again, be sure to lock the cover with the locking screw.
 - Users are prohibited from making any modifications of specifications or physical configuration, such as adding or changing the configuration of external wiring ports.
-



WARNING

The instrument modification or parts replacement by other than authorized representatives of YOKOGAWA is prohibited and will void the certification.



WARNING

If the window of the cover is damaged the RAMC must be set out of operation.

9.16 Flame proof and dust proof EAC (EAEU- countries) certified RAMC (/GF1)

9.16.1 Technical data

Certificate:	RU C-DE.AA87.B.01500/25
Flame proof:	1Ex db IIC T6...T1 Gb X
Dust proof:	Ex tb IIIC T80°C...370°C Db X
Housing:	Painted aluminium casting type 91
Output signal (with electronic transmitter -E, -J):	4 to 20 mA (2- wire)
Power supply (with electronic transmitter -E, -J):	2- wire
Limit switches:	Options /K1 to /K10 possible
Ambient temperature:	-20 °C to 60 °C
Minimum process temperature:	-20 °C
Threads for cable glands:	• M20x1.5 (standard) • ½" NPT (option /A5)

Table 9-8 Temperature classification for gas application

Temperature class	Standard	On extension (option /A16)	On extension (option /A16) and thermal insulation
T6	80 °C	80 °C	80 °C
T5	95 °C	95 °C	95 °C
T4	120 °C	130 °C	130 °C
T3	----	195 °C	195 °C
T2	----	290 °C	290 °C
T1	----	370 °C	350 °C

9.16.2 Installation

see 9.11.2

9.16.3 Operation

see 9.11.3

9.17 Flame proof and dust proof Ukraine Ex certified RAMC (/KF1)

Certificate No.: CL16.0017X
 Same data as for ATEX certification, option /KF1.

9.18 Flame proof and dust proof INMETRO certified RAMC (/UF1)

9.18.1 Technical data

Certificate:	DNV 24.0058 X
Flame proof:	Ex db IIC T6 Gb
Dust proof:	Ex tb IIIC T85°C...T370°C Db
Housing:	Painted aluminium casting, type 91
Output signal (with electronic transmitter -E, -J):	4 to 20 mA (2- wire)
Power supply (with electronic transmitter -E, -J):	2- wire
Limit switches:	Options /K1 to /K10 possible
Ambient temperature:	-20 °C to 60 °C
Minimum process temperature:	-20 °C
Threads for cable glands:	• M20x1.5 (standard) • ½" NPT (option /A5)
Degree of protection:	IP66/67

Table 9-9 Temperature classification for gas application

Temperature class	Standard	On extension (option /A16)	On extension (option /A16) and thermal insulation
T6	85 °C	85 °C	85 °C
T5	100 °C	100 °C	100 °C
T4	120 °C	135 °C	135 °C
T3	120 °C	200 °C	200 °C
T2	120 °C	300 °C	300 °C
T1	120 °C	370 °C	350 °C

9.18.2 Installation

For use in zone 1 and zone 2 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands and/or conduit systems that satisfy the requirements of ABNT NBR IEC 60079-1 and for which a separate test certificate is available. The cables, cable glands and blind plugs must be specified for an ambient temperature of 100 °C. Cable glands and entry fittings (screwed conduit entries) as well as blind plugs of simple design may not be used. On connection of the RAMC /UF1 using a conduit entry approved for the purpose, the associated sealing facility must be arranged directly on the housing.

For use in zone 21 and zone 22 the electrical connections of the electronic transmitter and of the limit switches must be made via suitable cable glands certified to the concerning dust category.

Unused openings shall be closed with certified blind plugs in type of protection Ex db/tb (100 °C).

Secure cable glands, blind plugs and the safety screw for the cover against twisting.

For installation ABNT NBR IEC 60079-14 must be considered.



CAUTION

The RAMC with option /UF1 shall be connected to the local equipollent grounding system. Therefore a grounding screw is available outside on the indicator housing and inside the indicator (see fig. 3-6).

The electronic transmitter and the limit switches shall be wired as described in chapter 3.3.

9.18.3 Operation

If the cover of the indicator unit has to be opened, following instructions must be followed.



CAUTION

- Switch off the power supply.
- Wait 15 minutes after power is turned off before opening the cover.
- The cover is fixed with a special screw.
- Be sure to lock the cover with special screw after tightening the cover.
- Before starting the operation again, be sure to lock the cover with the locking screw.
- Users are prohibited from making any modifications of specifications or physical configuration, such as adding or changing the configuration of external wiring ports.



WARNING

The instrument modification or parts replacement by other than authorized representatives of YOKOGAWA is prohibited and will void the certification.



WARNING

If the window of the cover is damaged the RAMC must be set out of operation.

9.19 Flame proof and dust proof RAMC with TS mark approval (Taiwan)

Registration Document: ML041200702782

Option /EF1 must be selected.

Same data as IECEx-certified type (/EF1)

For export to Taiwan please contact your Yokogawa representative regarding Taiwan Safety Mark.

9.20 Flame proof and dust proof PESO (India) certified RAMC

PESO Ref. No.: P567442/1

Option /EF1 + option /Q11 must be selected.

Same data as IECEx- certified type, option /EF1.

9.21 Flame proof KOSHA (Korea) certified RAMC

Certificate: 12-AV4BO-0721X

Option /EF1 + option /KC must be selected.

Same data as IECEx-certified type, option /EF1, but without dust proof.

9.22 Flame proof and dust proof ECAS (UAE) certified RAMC

Certificate: 25-07-24091/Q25-07-050485/NB0010

Same data as IECEx-certified type, option /EF1.

9.23 ATEX non-electrical RAMC (/KC1)

9.23.1 Technical data

Applicable Standards:	EN ISO 80079-36: 2016
Archive No.:	IBExU 099/15
Explosion proof:	II2G Ex h IIC TX Gb TX = temperature class determined by the process temperature II2D Ex h IIIC TX°C Db TX°C = max. surface temperature determined by the process temperature
Ambient temperature:	• -25 °C to +90 °C (standard) • -40 °C to +90 °C (option /A26)
Max. process temperature	• +220 °C (standard) • +370 °C (option /A16)
Heat tracing:	Same as process temperature



NOTE

The maximum surface temperature depends on the process temperature and for meters with option /T1 to /T6 additional on the heat tracing temperature.

9.23.2 Safety Instructions

Identified hazards:	• Flammable products inside tube • Static electricity
---------------------	--



WARNING

Operation with flammable products is only permitted as long as no explosive mixture builds up on the inside of the flowmeter under operating conditions. The operator is responsible for ensuring that the flowmeter is operated safely as regards the temperature and pressure of the products used. In case of operation with flammable products the measuring units must be included in the periodic pressure tests of the system.

If conductive fluids are used with metal as material of wetted parts the Rotameter must be connected to the potential equalization.

If conductive fluids are used with Teflon as material of wetted parts:

1. Ensure potential equalization between Rotameter and tubes or fluid (e.g. Grounding Rings or Lining Protectors).
2. Ensure a fluid conductivity ≥ 12 nS/m in use.
3. Ensure connection of Rotameter with potential equalization system of hazardous area.
4. Ensure that the tube is under normal operation always filled with fluid.



CAUTION

1. Supply grounding connection.
2. In hazardous areas, only operate the indicator with a closed cover.
3. Ignition risks caused by process pressure surges, impact or friction must be avoided.
4. Use of the equipment is not permitted in areas where the following occur: processes that generate strong charges, machine grinding and separation processes, electronic spraying (e.g. near electrostatic painting systems) or pneumatically conveyed dust.

9.23.3 Marking



Archive No.: IBExU 099/15

II2G Ex h IIC TX Gb

II2D Ex h IIIC TX°C Db

T_{amb.} -25 °C to +90 °C or T_{amb.} -40 °C to +90 °C for option/A26

9.24 EAC certified non-electrical RAMC (EAEU- countries) (/GC1)

9.24.1 Technical data

Applicable Standard:

Gost 32407: 2013

Certificate:

RU C-DE.AA87B.01500/25

Explosion proof:

1 Ex h IIC T* Gb X

Ex h IIIC T**°C Db X

T* and T** see table 9-10

Table 9-10 Temperature classification

Temp. class T*	Ambient temp. range in °C	Max. surface temperature T** in °C		Max. process temperature in °C	
		No extension	With extension	No extension	With extension
T6	-40 to 80	+80	+80	+80	+80
T5	-40 to 90	+95	+95	+95	+95
T4	-40 to 90	+130	+130	+130	+130
T3	-40 to 90	+195	+195	+195	+195
T2	-40 to 90	+220	+290	+220	+290
T1	-40 to 90	----	+370	----	+370

Heat tracing:

Same as process temperature



NOTE

The maximum surface temperature depends on the process temperature and for meters with option /T1 to /T6 additional on the heat tracing temperature.

Protection:

IP66/67

9.24.2 Safety Instructions

Identified hazards:

- Flammable products inside tube
- Static electricity



WARNING

Operation with flammable products is only permitted as long as no explosive mixture builds up on the inside of the flowmeter under operating condition. The operator is responsible for ensure that the flowmeter is operated safely as regards the temperature and pressure of the products used. In case of operation with flammable products the measuring units must be included in the periodic pressure tests of the system.

If conductive fluids are used with metal as material of wetted parts the Rotameter must be connected to the potential equalization.

If conductive fluids are used with Teflon as material of wetted parts:

1. Ensure potential equalization between Rotameter and tubes or fluid (e.g. Grounding Rings or Lining Protectors).
2. Ensure a fluid conductivity ≥ 12 nS/m in use.
3. Ensure connection of Rotameter with potential equalization system of hazardous area.
4. Ensure that the tube is under normal operation always filled with fluid.

**CAUTION**

-
1. Supply grounding connection:
 2. In hazardous areas, only operate the indicator with a closed cover.
 3. Ignition risks caused by process pressure surges, impact or friction must be avoided.
 4. Use of the equipment is not permitted in areas where the following occur: processes that generate strong charges, machine grinding and separation processes, electron spraying (e.g. near electrostatic painting systems) or pneumatically conveyed dust.
-

9.24.3 Marking

RU C-DE.AA87.B.01500/25

1 Ex h IIC T* Gb X

Ex h IIIC T**°C Db X

see certificate for data

10. Instructions for PED

RAMC is produced according the directive 2014/68/EU (Directive for Pressure Equipment PED).

Measuring tubes:

- Type of equipment: piping
- Type of fluid: liquid and gas
- Group of fluid: 1 and 2
- Module: H
- Model RAMC01/02/23: SEP
- Model RAMC03/04/05/06/08/09/10/12/15: category III

Heating (options /T1 to /T6):

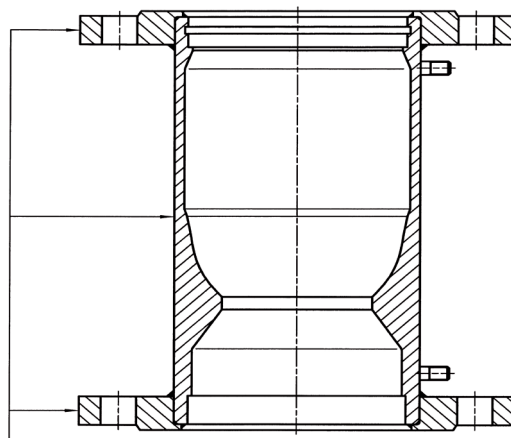
- Type of equipment: vessel
- Type of fluid: liquid and gas
- Group of fluid: 2
- Module: H

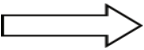


IMPORTANT

The user is responsible for the use of our flowmeters regarding suitability and use as agreed.

PED-Data on RAMC



Marking	Example
Cone	Konus 82
Material	1.4404 / 316L
Flow direction	
Made by	RY
CE marking	 0035
Charge	Ch. xxxxxx
Serial No.	S/N xxxxxxxxxx
Nominal Size	DN 100
Nominal Pressure	PN 40
Year and month of production	2019/03
Temperature data	TS-180 °C/ +370 °C see Instruction Manual

Dependence of the permissible max. effective pressure of the operating temperature:

The pressure relevant temperature limits of the RAMC are:

- -196 °C to 370 °C for units made of stainless steel.
- -80 °C to 130 °C for units made from PTFE.

Table 10-1

Process connection		Process pressure p(T) in bar									
Code	Description	-196 °C	RT(20 °C)	50 °C	100 °C	150 °C	200 °C	250 °C	300 °C	350 °C	370 °C
A1 ¹⁾	Flange ASME Class 150 RF	19	19	18.4	16.2	14.8	13.7	12.1	10.2	8.4	7.4
A2 ¹⁾	Flange ASME Class 300 RF	49.6	49.6	48.1	42.2	38.5	35.7	33.4	31.6	30.3	24.8
A3 ¹⁾	Flange ASME Class 600 RF	99.3	99.3	96.2	84.4	77	71.3	66.8	63.2	60.7	49.5
D2	Flange EN PN16	16	16	15.6	15.1	13.7	12.7	11.9	11.0	10.5	10.2
D4	Flange EN PN40	40	40	38.9	37.9	34.4	31.8	29.9	27.6	26.4	25.7
D5	Flange EN PN63	63	63	61.5	59.7	54.3	50.1	47.1	43.5	41.7	40.5
D6	Flange EN PN100	100	100	97.8	94.7	86.1	79.5	74.7	69.0	66.1	64.2
T4/R4	Internal thread ½" (RAMC01-...)	25	25	25	25	20	20	20	20		
T4/R4	Internal thread ¾" (RAMC23-...)	25	25	25	25	20	20	20	20		
T4/R4	Internal thread 1" (RAMC02-...)	16	16	16	16	16	16	16	16		
T4/R4	Internal thread 2" (RAMC05-...)	10	10	10	10	10	10	10	10		
T4/R4	Internal thread 2½" (RAMC06-...)	10	10	10	10	10	10	10	10		
T6/G6	Internal thread ½" (RAMC01-...)	40	40	40	40	40	40	40	40		
T6/G6	Internal thread ¾" (RAMC23-...)	40	40	40	40	40	40	40	40		
T6/G6	Internal thread 1" (RAMC02-...)	40	40	40	40	40	40	40	40		
T6/G6	Internal thread 1¼" (RAMC03-...)	40	40	40	40	40	40	40	40		
T6/G6	Internal thread 1½" (RAMC04-...)	40	40	40	40	40	40	40	40		
T6/G6	Internal thread 2½" (RAMC06-...)	40	40	40	40	40	40	40	40		
Code	Description	-	RT(20 °C)	50 °C	100 °C	140 °C	-	-	-	-	-
S2	Fitting DIN 11851 (RAMC02-...)		40	40	40	40					
S2	Fitting DIN 11851 (RAMC05-...)		25	25	25	25					
S2	Fitting DIN 11851 (RAMC06-...)		25	25	25	25					
S2	Fitting DIN 11851 (RAMC08-...)		25	25	25	25					
S2	Fitting DIN 11851 (RAMC10-...)		25	25	25	25					
S2	Fitting DIN 11851 (RAMC12-...)		16	16	16	16					
S4	TRI-CLAMP DIN 32676 (RAMC02-...)		25	25	25	25					
S4	TRI-CLAMP DIN 32676 (RAMC03-...)		25	25	25	25					
S4	TRI-CLAMP DIN 32676 (RAMC04-...)		25	25	25	25					
S4	TRI-CLAMP DIN 32676 (RAMC05-...)		16	16	16	16					
S4	TRI-CLAMP DIN 32676 (RAMC08-...)		10	10	10	10					
S4	TRI-CLAMP DIN 32676 (RAMC10-...)		10	10	10	10					
S5	Flange Rosista (RAMC02-...)		10								
S5	Flange Rosista (RAMC04-...)		10								

¹⁾ Dual certified AISI 316/316L

For special connections with Z-No. other values may be valid.

The data are marked on the flowmeter.

Special connection	Process temperature									
	-196 °C	RT (20 °C)	50 °C	100 °C	150 °C	200 °C	250 °C	300 °C	350 °C	370 °C
Flange ASME > 300lbs	100 %	100 %	94.20 %	83.30 %	75.80 %	69.50 %	64.30 %	60.80 %	58.00 %	56 %
Flange EN PN...	100 %	100 %	97.70 %	89 %	80 %	73.20 %	68 %	64.50 %	61.70 %	60 %
Other connections *)	100 %	100 %	97.70 %	89 %	80 %	73.20 %	68 %	64.50 %	61.70 %	60 %

*) The figures relate only to the connection on the meter. Further restrictions by gaskets and customer connected parts are to be considered separately.

Change of the process connections:

Former naming: DIN 2526 facing form V

Actual naming: EN 1092-1 facing form B1

The dimensions of the flanges are the same. That means that DIN and EN fit one to another.

The facing of the flanges has changed. This may effect the gaskets.

Operation reductions:

The operator is responsible, that no corrosion and/or erosion is caused by the fluid, which reduces the safety of the unit as as pressure containing element. In addition the user has to take care, that no decomposition of unstable fluids may happen.

Corrosion and erosion can lead to the failure of the device and can endanger personnel and systems. If corrosion and erosion is possible, the adherence to the wall thicknesses must be checked on the dismantled device.

Note	In the following only the dangers, which may appear with the pressure load of the unit, are considered. In connection with the accompanying electronics additional risks may appear, which requires corresponding precautions. Also precautions to reach the measuring precision are not considered.		
	Endangering by:	Description	Remarks
Fluid	Surface temperature	Surface temperature is hot in case of high process temperature. It is the sole responsibility of the user to establish proper means to prevent touching of the measuring tube.	
	max. / min. process temperature	see GS01R01B02-00E-E and chapter10	
	max. process pressure	see GS01R01B02-00E-E and chapter10	
	Tightness of the wetted, PED relevant volume	A factory test is done before delivery	
	Corrosion and erosion effects	It is the sole responsibility of the user to select proper wetted materials for the fluidintended to use (see chapter 10)	
	Life time evaluation	Experience shows that the lifetime of the measuring tube within the allowed operation conditions is more than 10 years.	Without erosion and corrosion.
	Temperature shock	Permanent temperature cycles of more than 100 °C temp. difference have to be avoided. Tube failure can occur because of material wearing.	
Installation	Instable fluids	If instable fluids are transported it is the sole responsibility of the user that in case of decomposition the design limits are not exceeded. (see chapter 10)	
	Process pressure / temp. relation	see chapter 10	
	Piping and support forces	see chapter 2.3 and 3.1	
	Choice of gaskets and pre-stress of the process connections	It is the sole responsibility of the user to select suitable gaskets and to screw the process connections with the necessary torques.	Refer to EN 1591 -1
	Use of closing and openings	see chapter 2.3	
	Pressure shock, water hammer and pressure surges	Dynamical exceeding of the given max. pressure at process temp. has to be avoided.	Water hammer can lead to tube failures.
	Filling and emptying of the pipe work	The measuring tube is part of a pipe work. The pipe work has to be filled slowly (see chapter 4.2)	
	Disposal, cleaning and return	see chapter 1.1	
	Flow direction of the unit	upwards	
	Installation position of the unit	see chapter 2.2 and 3.1	A wrong installation position leads to measuring disturbances
Outer influence	Pipe stress by weight of the instrument	see GS01R01B02-00E-E	
	Permitted ambient conditions (temperature, humidity)	see chapter 2.2 and GS01R01B02-00E-E	
	External fire	External fire can result in - Rise in pressure by temperature - Damage of gaskets It is in the sole responsibility of the user to implement suitable means to prevent large damage in the case of fire.	The instrument itself does not contain flammable materials.
	Earthquake resistance	- Damage of the mounting screws	Check by user

T111.EPS

The following usages of the instruments are not permitted:

- use as climbing aid (e.g. during assembling work on pipe system)
- use as support for external load (e.g. support for piping) or tray surface for heavy tools (e.g. during piping work)
- Material removal by any kind of machining (e.g. drilling, sawing etc.)
- Painting of the name-plate/scale
- Brazing or welding of parts to the instrument
- Any repair, modification or supplements or the installation of spare-parts is only permitted if it is done in accordance to this instruction manual. Other work must be agreed by YOKOGAWA beforehand.

YOKOGAWA will not take over any liability for damages caused by unauthorized work on the instrument or prohibited usage of the instrument.

APPENDIX 1. CHANGE HISTORY

Table A1-1 Software Change History for electronic transmitter without HART®- communication

Release date	Material number ¹⁾	Index ¹⁾	SW Rev ²⁾	Changes	Instruction Manual
24.10.1996	16-8039	B	1.00	Initial Firmware	IM 1R1B2-E-H ed. 1
03.12.1996	16-8039	C	1.10	Angle adjustment improved	IM 1R1B2-E-H ed. 1
25.03.1997	16-8039	D	1.20	Measuring range changed	IM 1R1B2-E-H ed. 1
08.08.1997	16-8039	E	1.30	Totalizer value saving debugged	IM 1R1B2-E-H ed. 1
20.10.1997 11.11.1997	16-8039	F G	1.40	Totalizer saving concept improved	IM 1R1B2-E-H ed. 1
03.08.1998	16-8039	I	1.50	Pulse output as option implemented	IM 1R1B2-E-H ed. 2
21.10.1998	16-8039	J	1.60	Support of new micro controller	IM 1R1B2-E-H ed. 2
16.02.1999	16-8039	K	1.70	Float- Blocking- Detection function implemented	IM 1R1B2-E-H ed. 2
11.12.2001	16-8040	C	2.00	Support of new micro controller	IM 1R1B2-E-H ed. 3
07.03.2002	16-8040	E	2.20	3- wire version improved	IM 1R1B2-E-H ed. 4
07.11.2002	16-8040	G	2.30	Temperature measurement implemented	IM 1R1B2-E-H ed. 5
06.09.2007 11.01.2011 21.05.2013	512-16-8040	H 1 2	2.50	Support of new COG display	IM 01R01B02-00E-E ed. 9
01.04.2018	512-16-8040	3	2.50	Assembly instruction revised, no functional changes	IM 01R01B02-00E-E ed. 14
01.10.2019	512-16-8040	4	2.60	Debugging of wrong totalizer limit	IM 01R01B02-00E-E ed. 15

¹⁾ on label of electronic transmitter

²⁾ in software parameter F61: display e.g. F2.50, see also chapter 6.2.10

Table A1-2 Software Change History for electronic transmitter with HART® 7 - Communication

Release date	Material number ¹⁾	Index ¹⁾	SW Rev ²⁾	DD Rev ³⁾	Changes	Instruction Manual
18.04.2016	M3811HY	8	1.30	Dev Rev 10 DD Rev 01	HART 7 functionality added	IM 01R01B02-00E-E ed. 14
01.01.2020	M3811HY	9	1.30	Dev Rev 10 DD Rev 01	Adjustments due to discontinuation of components	IM 01R01B02-00E-E ed. 16

¹⁾ on label of electronic transmitter

²⁾ in HART®- parameter „Detailed Setup / Device information / RAMC firmware rev.“: Vx.xx (e.g. Vx.xx = V1.30), see also chapter 7.6.4

³⁾ in HART®- communicator

APPENDIX 2. Safety Instrumented Systems Installation



WARNING

The contents of this appendix are cited from exida.com safety manual on the Rotameter RAMC Flowmeter specifically observed for the safety transmitter purpose. When using the RAMC 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.

A2.1 Scope and Purpose

This document provides an overview of the user responsibilities for installation and operation of the Rota Yokogawa RAMC 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.

A2.2 Using RAMC for a SIS Application

A2.2.1 Safety Function

Suitable for use in Safety Instrumented Systems are the versions listed in Tab. A2-1 only. The safety related data listed in this manual does not apply to other versions of RAMC.

Tab. A2-1 Versions of RAMC suitable for Safety Instrumented Systems

[V1]	RAMC with fail-safe inductive limit switches
[V2]	RAMC with standard inductive limit switches

This variable area flow meter is intended for use as a volume flow monitoring component in a Safety Instrumented System. It has either fail-safe inductive limit switches [V1] or standard inductive limit switches [V2]. 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 Fig. A2.1. The fault annunciation mechanism is a trip of one of the limit switches [V1] or [V2].

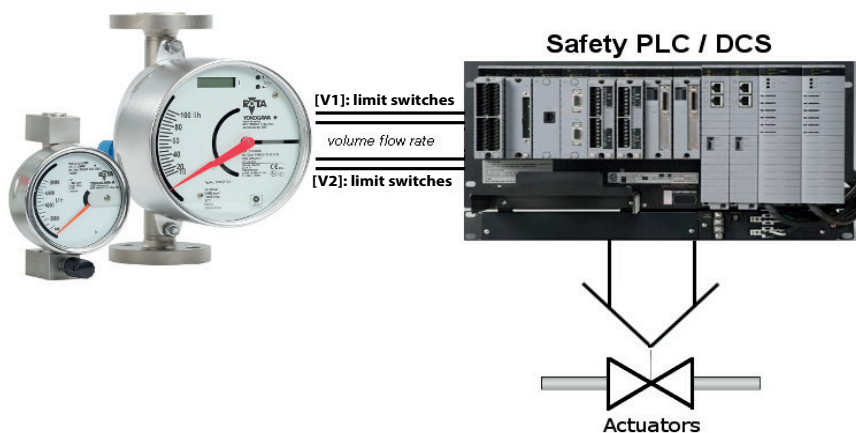


Fig. A2-1 Example Safety Instrumented Function

A2.2.2 Diagnostic Response Time

[V1] or [V2]: The limit switch will go to its safe fail state immediately.

A2.2.3 Setup

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

A2.2.4 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.

Tab. A2-2 Proof test for variable area flow meter RAMC with inductive limit switches [V1]

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 RAMC to reach a defined "MAX" threshold value and verify that the inductive limit switch goes into the safe state.
4	Force the variable area flow meter RAMC to reach a defined "MIN" threshold value and verify that the inductive limit switch goes into the safe state
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 RAMC can be claimed.

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

- Measurement instrument to verify output status [V1] or [V2]

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

A2.2.5 Repair and replacement

Maintenance information can be found in chapter 8. If repair is to be performed with the process online RAMC 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 RAMC variable area flow meter should have a sufficient skill level.

A2.2.6 Startup Time

The flow meter will generate a valid signal within 3 seconds of power-on startup with the default 1 second dampening time. Increasing the configurable dampening time adds to the startup time.

A2.2.7 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 RAMC 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 RAMC variable area flow meter is suitable for application in safety functions up to and including SIL2 for use in a simplex (1oo1) configuration, depending on the PFDAVG calculation of the entire Safety Instrumented Function.

A2.2.8 Lifetime limits

The expected lifetime of the Yokogawa Rota Yokogawa RAMC variable area flow meter is 10 years. The reliability data listed in A2.2.7 is only valid for this period. The failure rates of the Rota Yokogawa RAMC variable area flow meter may increase sometime after this period. Reliability calculations based on the data listed in A2. 2.7 for Rota Yokogawa RAMC 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.

A2.2.9 Environmental limits

The environmental limits of Rota Yokogawa RAMC variable area flow meter are specified in this manual.

A2.2.10 Application limits

The application limits of the Rota Yokogawa RAMC variable area flow meter are specified in this manual. If the flow meter is used outside of the application limits the reliability data listed in A2.2.7 becomes invalid.

A2.3 Definitions and Abbreviations

A2.3.1 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.

A2.3.2 Abbreviations

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

A2.4 Assessment results

A2.4.1 Safety related parameters

The following results have been obtained from the assessment report Report No.:
ROTA YOKOGAWA 05/04-20 R001 Version V5, Revision R0; May 2014
issued by exida.

Average PFD values have been calculated considering a proof test coverage of 99 %, a mission time of 10 years and a Mean Time To Restoration of 24 hours.

Tab. A2-3: Summary for RAMC ([V1]) with fail-safe limit switches ¹ – Failure rates

	Profile 3
Fail-safe Detected (λ_{SD})	0 FIT
Fail-safe Undetected (λ_{SU})	45 FIT
Fail Dangerous Detected (λ_{DD})	10 FIT
Fail Dangerous Undetected (λ_{DU})	35 FIT
SFF ²	61 %
MTBF	530 years
SIL AC ³	SIL2

Safety metrics according to ISO 13849-1 ⁴:

MTTF _d (years)	2556
DC	23 %
Category (CAT)	CAT 1
Performance Level (required)	PL _r = c
Performance Level (calculated)	3.45E-08 1/h

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFD _{AVG} = 1.65E-04	PFD _{AVG} = 7.63E-04	PFD _{AVG} = 1.51E-03

Tab. A2-4: Summary for RAMC ([V2]) with standard limit switches ⁵ – Failure rates

	Profile 3
Fail-safe Detected (λ_{SD})	0 FIT
Fail-safe Undetected (λ_{SU})	45 FIT
Fail Dangerous Detected (λ_{DD})	10 FIT
Fail Dangerous Undetected (λ_{DU})	73 FIT
SFF ²	42 %
MTBF	401 years
SIL AC ³	SIL1

Safety metrics according to ISO 13849-1 ⁴:

MTTF _d (years)	1371
DC	12 %
Category (CAT)	CAT 1
Performance Level (required)	PL _r = c
Performance Level (calculated)	7.32E-08 1/h

T[Proof] = 1 year	T[Proof] = 5 years	T[Proof] = 10 years
PFD _{AVG} = 3.49E-04	PFD _{AVG} = 1.62E-03	PFD _{AVG} = 3.20E-03

¹ The switching contact output is connected to a fail-safe switch amplifier. The failure rates of the amplifier are not included in the listed failure rates.

² The complete sensor subsystem will need to be evaluated to determine the overall Safe Failure Fraction. The number listed is for reference only.

³ 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.

⁴ Depending on the application and possible external diagnostics a higher DC_d and therefore also a higher category might be possible to achieve.

⁵ 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.

REGISTERED TRADEMARKS

Rotameter™ is a trademark of Rota Yokogawa GmbH & Co. KG, a subsidiary of Yokogawa Electric Corporation, Japan.
In the United Kingdom Rotameter™ is a trademark of Emerson Electric Co.

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Manufacturer:

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

For the actual manufacturing location of your device refer to the model code and/or serial number.

