OPTIMASS 6400 Supplementary Instructions

Coriolis mass flowmeter

Safety manual

SIL 2/3
Safety Integrity Level

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1.1 Scope of the document

This document supplies functional safety data and instructions for an OPTIMASS 6400 SIL device.

INFORMATION!
The data in this supplement only contains the data applicable to the SIL approval. The technical data for the standard version in the handbook (document [N1]) shall be valid, provided that it is not rendered invalid or replaced by this supplement.

INFORMATION!
Installation, commissioning and maintenance may only be carried out by properly trained and authorised personnel.

1.2 Revision history (Firmware)

Release date	Electronic revision	Changes and compatibility
01.07.2016	ER 2.0.0_	Initial version

1.3 Device description

The OPTIMASS 6400 is a 4-wire Coriolis mass flowmeter measuring mass flow rate, total mass, density, temperature, volume flow rate, flow velocity, total volume and concentration of liquids and gases.

The device can be used in safety applications measuring mass flow, volume flow or density of liquids using the safe current output at terminal C. The safe current output is available as intrinsically safe and non-intrinsically safe variant according to IEC 60079-11.

INFORMATION!
The manufacturer designed and developed the device for safety integrity level (SIL) 2 [and 3 in homogeneous redundancy architecture] according to IEC 61508 [N3].

1.4 Device variants

1.4.1 Signal converter

The signal converter variant is identified by the CG number on the nameplate:

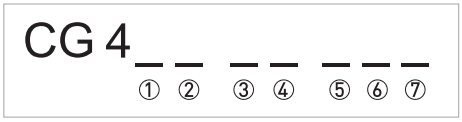


Figure 1-1: Marking (CG number) of the electronics module and input/output variants

① ID number: always 3
② ID number: always 0
③ Power supply option
④ Display: always 1
⑤ Input/output version (I/O)
⑥ 1st optional module for connection terminal A
⑦ 2nd optional module for connection terminal B

Power supply option

③	Power supply
1	100...230 VAC
8	12...24 VDC

I/O options

⑤ - ⑦	Connection terminals								
	A+	A	A-	B	B-	C	C-	D	D-
2 _ _	-	I active		P / S NAMUR C passive		I + HART® active		P / S NAMUR passive	
3 _ _	-	I passive		P / S NAMUR C passive		I + HART® passive		P / S NAMUR passive	
4 _ _	-	max. 2 optional modules for term. A + B				I + HART® active/passive		P / S active/passive	

- I/O option 2 and 3 are intrinsic safe I/Os
- Details of the CG number decoding are provided in the handbook [N2].
- The current output at terminal C is the safety relevant output for "Safe Operation".

1.4.2 Flow sensor

The flow sensor variant is identified by the V number on the nameplate:

Code	VE	ab	c	d	e	fg	h	j	k	l	m	n	p	q	r	s	t	u	v	w
Position	1-2	3-4	5	6	7	8-9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Functional safety relevant		x						x						x			x			

Valid flow sensor codes for SIL device variant: OPTIMASS 6000

Code	Description	Valid flow sensor codes for SIL device variant
VE	Prefix to code	VE
ab	**Flow sensor type and size**	71, 72, 73, 74, 75, 76 or 77
c	Manufacturer specific	-
d	Tube material	-
e	Surface finish	-
fg	Connection size - flanges	-
h	Sealing face	-
j	**Design**	K only
k	Options	-
l	Hazardous area approval	-
m	Sanitary and material approvals	-
n	Configuration	-
p	Calibration	-
q	**Process requirements**	0 or 1
r	Extended options	-
s	**Customer specific**	0
t	**Signal converter type**	6 or 7
u	Destination	-
v	Spare	-
w	Spare	-

-: all variants are valid

1.5 Related documentation

[N1] OPTIMASS 6000 Handbook R05

[N2] MFC 400 Handbook R04

[N3] IEC 61508-1 to 7:2010 Functional safety of electrical / electronic / programmable electronic safety-related systems

[N4] Corrosion & Abrasion Guidelines for Coriolis Meter, OPTIMASS Corrosion R02

[N5] NAMUR Recommendation NE43: Standardization of the Signal Level for the Failure Information of Digital Transmitters, Feb. 2003

[N6] NAMUR Recommendation NE107: "Requirements to Self-Monitoring and Diagnosis of Field Devices", October 2006

1.6 Terms and definitions

Term	Description
Firmware	Software embedded in the device
FIT	Failure In Time ($1x10^{-9}$ failures per hour)
HFT	Hardware Fault Tolerance
I/O	Input / output
λ_{DD}	Rate for dangerous detected failure
λ_{DU}	Rate for dangerous undetected failure
λ_{SD}	Rate for safe detected failure
λ_{SU}	Rate for safe undetected failure
PFD_{AVG}	Average Probability of Failure on Demand
PFH	Probability of a dangerous Failure per Hour
PTC	Proof Test Coverage
Safe Current Output (SCO)	Current output at terminal C
SFF	Safe Failure Fraction
SIL	Safety Integrity Level
SIS	Safety Instrumented Systems
Type A system	"Non-complex" system (all failure modes are well defined). For more data, refer to subsection 7.4.3.1.2 of IEC 61508-2.
Type B system	"Complex" system (all failure modes are not well defined). For more data, refer to subsection 7.4.3.1.2 of IEC 61508-2.
T_{Proof}	Proof Test Interval
1oo1	1 out of 1 channel architecture (single channel architecture performs the safety function)

2.1 Preconditions

The device must be operated within the process and ambient conditions specified in the handbooks ([N1], [N2]) of the device.

In addition the device has the following restrictions for safety applications:

- Ensure that entrained gas, cavitation of two-phase flows do not occur in the flowmeter.
- Corrosive products must be excluded according to [N4].
- Erosive products must be excluded.
- Coating inside the measurement tube must be avoided.

In order to execute the safety function the device must be switched to safe operation (for further information refer to *Switch to safe operation* on page 11).

2.2 Definition of the safety function

The safety function of the device is:
Put out a correct mass flow or volume flow or density measurement on safe current output (4 to 20 mA) with a tolerance of ±2% within the process response time of the device (for further information refer to *Process response time* on page 8).

2.2.1 Process response time

The process response time is defined as the T90 for a response to a step change between process input and safe current output. It depends on the configured time constant of the damping in the safe current output (C7.1.16):

Damping [s]	0	1	2	5	10	20	50	100
T90 [s]	0.90	2.38	4.16	9.58	18.63	36.75	91.12	181.74

2.2.2 Measurement uncertainties

The measurement uncertainty of the device in safe operation equals to those in non-SIL operation as described in the handbooks ([N1], [N2]). It consists of the uncertainty of measurement function and current output.

Concerning random errors in the device, the safety tolerance must be considered. The safety tolerance is the tolerable error before setting the safe state of the device. A random fault can cause an error of up to 2% of the present measurement value or output current before it is signalled.

WARNING!
In safety-related applications you must follow the installation instructions given in the handbooks of the sensor and the converter ([N1], [N2]). The device must be installed by properly trained and authorised personnel.

- The operator must carefully select the correct tube diameter with respect to the expected flow rates.
- The device must not be exposed to excessive vibration during operation.
- It is the responsibility of the operator to ensure that wetted material is compatible with process fluid.
- Correctly sized cables for the cable glands must be used and the cable glands and the lid must be tightened sufficiently. Furthermore the device (lid, cable glands) must not be opened during safe operation.
- If the safe current output is used in passive configuration an overvoltage at the terminal can lead to a leakage current in the device's input protection circuit and loss of the safety function of the device. It is necessary to use a power supply with voltage limitation or voltage monitoring.

4.1 Condition of use

INFORMATION!
Only properly trained and authorised personnel shall change device settings. Keep a report of changes to the device settings. These reports must include the date, the menu item, the old setting and the new setting.

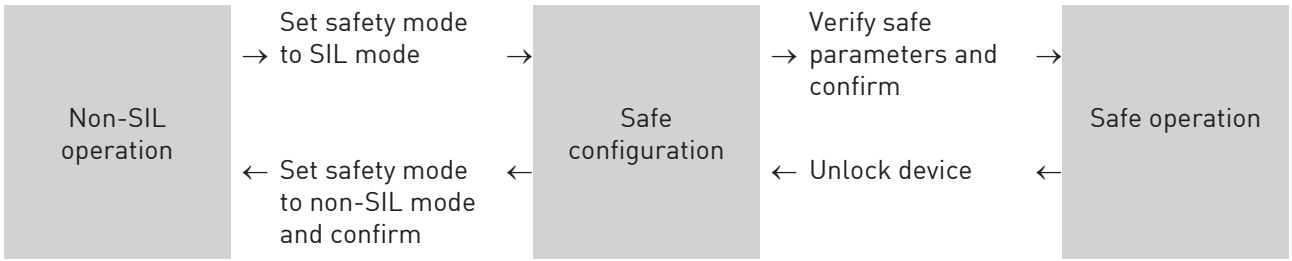
The configuration is protected by a password. For more information on password protection and device configuration refer to *Unlock of device* on page 15.

The current output at terminal C is the safety relevant output for safe operation.

4.2 Configuration of device for usage in safety application

Safety relevant parameters are write-locked and cannot be changed during safe operation. Parameters which are not safety relevant can be changed in safe operation. If they are supposed to be write protected, please use the protection in menu C6.3.4.

4.2.1 Change of safety mode



State	Description	Safe current output
Non-SIL operation	Device can be used in non-SIL application and all parameters can be changed.	Measurement signal or failure signal
Safe configuration	Device can be configured for safe operation or device can device can be switched to non-SIL mode.	Failure signal
Safe operation	Device performs the safe measurement according to its configuration and all safety relevant parameters are locked.	Measurement signal or failure signal

4.2.2 Switch to safe operation

WARNING!
The device cannot be switched to safe configuration or safe operation if expert mode is enabled or a lock jumper is present at the local display.

In order to switch the device from non-SIL operation to safe operation several steps have to be performed.

1. Switch the device to safe configuration state by setting safety mode to "SIL Mode" (menu C7.2).
2. Configure the device for safe operation (for further information refer to *Safe configuration* on page 11).
3. Perform safe parameter verification (for further information refer to *Safe parameter verification* on page 13).

4.2.3 Switch to non-SIL operation

In order to switch the device from safe operation to non-SIL operation several steps have to be performed.

1. Switch the device to safe configuration state by unlocking the device (for further information refer to *Unlock of device* on page 15).
2. Change of safety mode to "Non-SIL Mode" (menu C7.2).
3. Perform confirmation (for further information refer to *Confirmation* on page 14).

4.2.4 Safe configuration

In safe configuration state some parameters are reset to their factory value and locked because they have direct impact on the safety function of the device. Following parameters are reset to factory configuration:

Fixed parameters in safe operation

Parameter	Value
Safe Current Output Current Span	4-20 mA
Safe Current Output Polarity	both
Safe Current Output Trim Values	disabled
Safe Current Output Loop Current Mode	enabled
Safe Current Output Operation Mode	enabled
Density Calibration	factory calibration
Operation Mode	measurement
Pressure Suppression	disabled
Density Mode	process
Sensor Low Flow Cutoff	factory setting (0.2% of nom. mass flow)
Process Noise Damping	1.0 s
Flow Offset	0 kg/s
Flow Correction	0%

Parameter	Value
Simulation functions for mass flow, volume flow, density and temperature	disabled
Simulation function for safe current output	disabled

Following parameters must be configured for safe operation of the device (menu C7.1):

Changeable safety relevant parameters in safe configuration

Parameter	Values	Description
Safety Mode	non-SIL Mode SIL Mode	Safety mode of the device
Device Tag	8 characters	Device tag for identification of device via HART®
Measurement	Mass Flow Volume Flow Density	Device variable which is assigned to the safe current output
Lower Range	Depends on device variable	Lower range value for safe current output (4 mA)
Upper Range	Depends on device variable	Upper range value for safe current output (20 mA). The upper range value must be bigger than the lower range value
Alarm Code	Low = 3.5 mA High = 21.5 mA	Preferred failure current
Low Flow Cutoff (Threshold)	0%...20%	Low flow cutoff threshold at safe current output referred to upper range value
Low Flow Cutoff (Hysteresis)	0%...20%	Low flow cutoff hysteresis at safe current output referred to upper range value. The hysteresis must be smaller than the threshold.
Damping	0...100 s	Damping for safe current output device variable. This parameter affects the process response time.
Terminal C Type	Active Passive	Hardware configuration of safe current output: active or passive (only displayed in non-Ex i version)
Flow Direction	Forwards Backwards	Definition of sign of flow value
Zero Calibration	-	Set by zero calibration procedure

4.2.5 Safe parameter verification

The safe configuration must be verified either via local display or via HART® interface in order to enter the safe operation state:

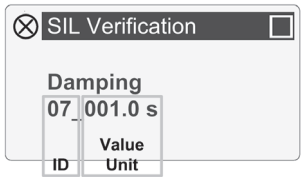
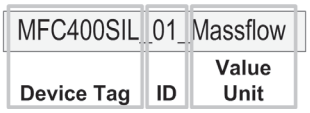
- Local display: Select menu item C7.3
- HART®: Use the device-specific DD or a DTM (only online mode)

During preparation of the safe parameter verification the following messages could be displayed:

Message	Description
Checking Parameters...	Configuration is checked for plausibility.
Not allowed	Device in safe operation or non-SIL operation. Therefore safe parameter verification is not allowed.
Config. invalid	Implausible configuration.
Press Return to Start	Configuration checked successfully and verification can start.
Remove Jumper	A lock jumper is set. Please remove it!

This process can only be started if the configuration is plausible. During verification of the safe configuration all safety relevant parameters must be reviewed guided by a wizard.

In the verification wizard all safety relevant parameters are displayed in the following format:

Local display	HART DD or DTM
	

The parameter ID is used for identification of the parameter as described in the following table.

WARNING!
Check that all parameters listed in the table for the respective safe measurement are shown in the verification process.
If the verification process is performed via HART® make sure that the correct device is addressed by checking the device tag. Please make sure that the device tag is unique.

Depending on the selected device variable the following parameters are display in verification:

ID	Parameter	Mass flow	Volume flow	Density
1	Measurement	x	x	x
2	Lower Range	x	x	x
3	Upper Range	x	x	x
4	Alarm Code	x	x	x
5	Low Flow Cutoff (Threshold)	x	x	
6	Low Flow Cutoff (Hysteresis)	x	x	
7	Damping	x	x	x
8	Terminal C Type*	x	x	x
9	Flow Direction	x	x	
10	Zero Calibration	x	x	

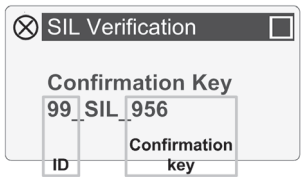
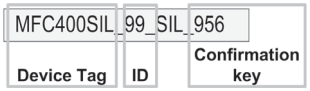
*: Not displayed in Ex i device variant
x: displayed in verification

4.2.6 Confirmation

In the last step for the safe parameter verification the device generates a random 3-digit confirmation key which is displayed as depicted below. By entering this confirmation:

- the safe configuration (only for safe operation) is confirmed
- the desired safety mode (non-SIL or SIL) is confirmed

After confirmation of SIL mode, all safety relevant parameters are write-locked and the device switches to safe operation state.

Local display	HART DD or DTM
	

Message	Description
Timeout occured	The safe parameter verification must be completed within 1 hour. Please restart safe parameter verification.
Wrong Key	The entered confirmation key was incorrect. Please restart safe parameter verification.
Successful	Device is in safe operation or non-SIL operation.

INFORMATION!
All safety relevant parameters are locked during safe operation. If not safety relevant parameters shall be locked please set the operator password ([N2]).

4.2.7 Unlock of device

Safety relevant parameters cannot be changed in safe operation. The device must be set to the safety state safe configuration in order to change safety relevant parameters. Therefore unlock the device (C7.4) by entering the configurable unlock key (C7.5). Within this state the current output is set to the failure signal.

Default Unlock Key: 9999

4.2.8 Current safety state of the device

Current safety state of the device is displayed at local display with an icon in the upper right corner:

Icon	State
SIL	Safe configuration
SIL	Safe operation

Furthermore check menu entry B1.6 for present safety state.

4.3 Safe current output states

Current output state	Description
Measurement (4-20 mA)	Output of safe measurement.
Extended Range (3.8…20.5 mA)	Output according to NE43 [N5]. If the limits of the extended range are reached, the device sets the signal "Out of Specification" (current output) however it does not enter the safe state.
Safe State (≥ 21 mA or ≤ 3.6 mA)	For any type of safe or dangerous detected failure, the device sets the safe current output to the preferred failure current (failure signal). Although this value can also be set to high failure current (≥ 21 mA) some hardware failures will always cause the device to set a low failure current (≤ 3.6 mA). Thus, the output signal for the safe state is less than 3.6 mA.

WARNING!
If the device is used in a safety loop both the high and low failure current must be monitored.

4.4 Device failures

4.4.1 Error handling

Error condition	Description
Safety Rel. Failures	Only safety relevant failures result in safe state.
Failures	Safety relevant failures and not safety relevant device faults classified as NE 107 [N6] failure result in safe state.
Out Of Specification	Safety relevant failures and not safety relevant device faults classified as NE 107 [N6] failure or out of specification result in safe state.

INFORMATION!

If 2 phase flow detection is configured according to the handbook [N2], it can be either used to

- *set the safe state at the safe current output by setting "Proc: 2 Phase Flow" (C7.2.11) to "Failure" or*
- *signal it via any not safety relevant I/O by setting "Proc: 2 Phase Flow" (C7.2.11) to "Out of Specification"*

4.4.2 Error messages

Besides the standard error conditions in safe operation, the device has additional conditions:

Error message	Cause	Action
Electr.Temp.Out of Spec	Electronics temperature exceeds limits.	Protect electronics from heat by process or direct sunlight.
Flow Out of Range	Flow above max. flow rate for flow sensor.	Check process conditions.
IO Connection	Load for safe current output too high (e.g. open circuit) or hardware error in safe current output.	Check connection at safe current output, reduce load and perform reset errors (A2.1).
Int. Comm. Error IO C	Internal communication error in the device.	Perform power reset. If the status returns, contact the manufacturer.
IO C Failure	Hardware failure in safe current output.	Perform power reset, reset errors (A2.1). If the status returns, contact the manufacturer.
Process Input Failure	Sensor electronics failure.	Perform power reset, reset errors (A2.1). If the status returns, contact the manufacturer.
Safe Config. Invalid	Safe configuration are invalid.	Reset to factory configuration.
Safety Rel. Failure	Safety relevant failure occurred described by additional error messages.	Check additional error messages.
Sensor Error	Flow sensor is defect.	Replace flow sensor.
Temp. Or Strain Res. Def.	Hardware failure in temperature or strain measurement.	Check cabling in case of remote device or replace flow sensor.

5.1 Periodic maintenance

You must follow the maintenance instructions given in the handbook [N1].

5.2 Keep the device clean

For further information refer to "Service" in the handbook ([N1]).

5.3 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

5.4 Proof test

WARNING!
SIS engineers must calculate the interval of proof tests based on the required PFD_{AVG}.

CAUTION!
Proof tests done by the customer must cover at least the tests given in this section.

Keep a report of each proof test. These reports must include the date, the tests results (performance of the safety function or faults found), a list of approved personnel who did the test and the report revision number. These reports must be put into storage and made easily available. If any test step fails because specified tolerances are exceeded, the safety function of the device is not fulfilled anymore. Please return the device to the manufacturer [N2].

Test procedure

Unlock device and set it to non-SIL operation.

Step	Measure
1	Perform power cycle (disconnect the device briefly from the power supply).
2	Perform a 4-point current output check for safe current output using the built-in simulation function (B3.9), by setting the simulated current to 3.6 mA, 4.0 mA, 20.0 mA and 21.5 mA. Measure the current at the current output with a traceably-calibrated ammeter or logic subsystem. The ammeter must have a DC current measurement uncertainty ±5 µA or better.
3	Compare the density reading with the expected density of your product. The measurement uncertainty must not exceed the maximum error specified in the handbook.
4	Check mass flow measurement accuracy with a calibration rig with at least at 2 measuring points or return the device to the manufacturer for recalibration. The measurement uncertainty must not exceed the maximum error specified in the handbook.

Set the device to safe operation.

Proof Test Coverage

Proof Test Coverage for steps 1-2 (partial proof test): 77%
Proof Test Coverage for steps 1-3 (partial proof test): 82%
Proof Test Coverage for steps 1-4 (full proof test): 97%

KROHNE OPTICHECK can be used to perform the tests 1-3 in a simple way.

WARNING!
Perform an optical inspection of the sealings, containment, housing and electrical wiring within every proof test.

5.5 Calibration procedure

It is recommended to perform a zero calibration during every proof test or safe configuration. The conditions for zero calibration in the handbook [N2] must be taken into account.

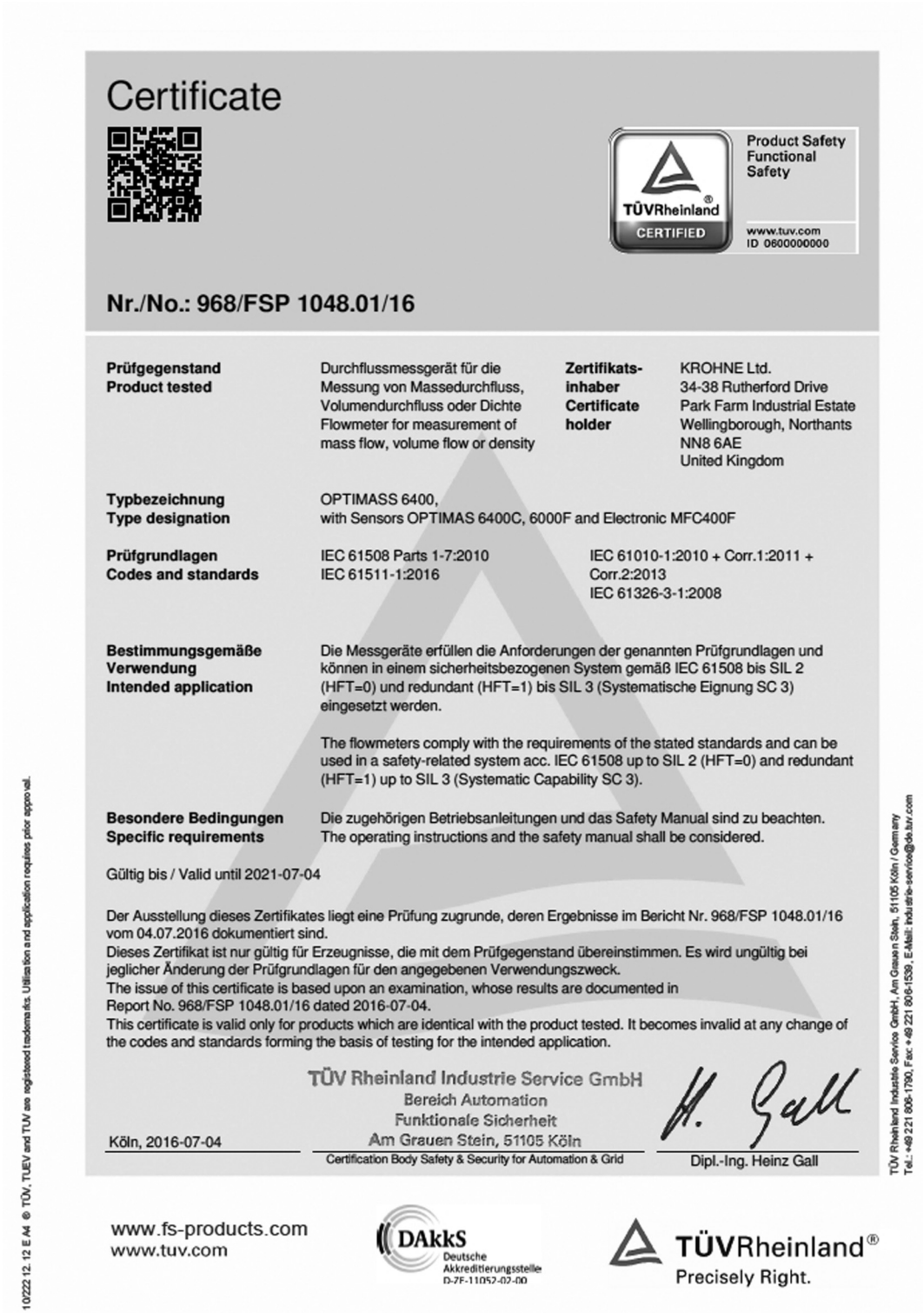
In safe operation density factory calibration is used.

5.6 Troubleshooting

INFORMATION!
- *Modifications to SIL capable devices by the user are not permitted.*
- *Only authorised personnel from manufacturer shall repair the device.*

Failures that are critical to functional safety should be reported to technical support of the manufacturer. If you find a problem, please contact your local representative. If the device must be returned to the manufacturer, refer to "Returning the device to the manufacturer" in [N2].

6.1 SIL certificate



Certificate

TÜVRheinland CERTIFIED
Product Safety
Functional Safety
www.tuv.com
ID 0800000000

Nr./No.: 968/FSP 1048.01/16

Prüfgegenstand **Product tested**	Durchflussmessgerät für die Messung von Massedurchfluss, Volumendurchfluss oder Dichte Flowmeter for measurement of mass flow, volume flow or density	**Zertifikats-inhaber** **Certificate holder**	KROHNE Ltd. 34-38 Rutherford Drive Park Farm Industrial Estate Wellingborough, Northants NN8 6AE United Kingdom
Typbezeichnung **Type designation**	OPTIMASS 6400, with Sensors OPTIMAS 6400C, 6000F and Electronic MFC400F		
Prüfgrundlagen **Codes and standards**	IEC 61508 Parts 1-7:2010 IEC 61511-1:2016		IEC 61010-1:2010 + Corr.1:2011 + Corr.2:2013 IEC 61326-3-1:2008
Bestimmungsgemäße Verwendung **Intended application**	Die Messgeräte erfüllen die Anforderungen der genannten Prüfgrundlagen und können in einem sicherheitsbezogenen System gemäß IEC 61508 bis SIL 2 (HFT=0) und redundant (HFT=1) bis SIL 3 (Systematische Eignung SC 3) eingesetzt werden. The flowmeters comply with the requirements of the stated standards and can be used in a safety-related system acc. IEC 61508 up to SIL 2 (HFT=0) and redundant (HFT=1) up to SIL 3 (Systematic Capability SC 3).		
Besondere Bedingungen **Specific requirements**	Die zugehörigen Betriebsanleitungen und das Safety Manual sind zu beachten. The operating instructions and the safety manual shall be considered.		

Gültig bis / Valid until 2021-07-04

Der Ausstellung dieses Zertifikates liegt eine Prüfung zugrunde, deren Ergebnisse im Bericht Nr. 968/FSP 1048.01/16 vom 04.07.2016 dokumentiert sind.
Dieses Zertifikat ist nur gültig für Erzeugnisse, die mit dem Prüfgegenstand übereinstimmen. Es wird ungültig bei jeglicher Änderung der Prüfgrundlagen für den angegebenen Verwendungszweck.
The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1048.01/16 dated 2016-07-04.
This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln
Certification Body Safety & Security for Automation & Grid

Köln, 2016-07-04

Dipl.-Ing. Heinz Gall

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany
Tel.: +49 221 806-1790, Fax: +49 221 806-1539, E-Mail: industrie-service@de.tuv.com

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6.2 Declaration

KROHNE

Declaration of Conformity

Functional Safety according to IEC 61508:2010

Type:	OPTIMASS 6400C
Electronic Revision:	≥ ER 2.0.0_
Device Variants:	As specified in the safety manual

We as manufacturer declare that the device type listed above is developed, produced and tested according to a SIL2/3 compliant process, as defined in IEC 61508:2010. Additionally, the device is assessed, independently from the manufacturer, by TÜV Rheinland.

The instructions stated in the Safety Manual must be followed for correct operation.

KROHNE has its own, established, Functional Safety Management. The related certification can be examined under number Q4B 14 12 907 30 001 at TÜV Süd.

Wellingborough, 2016-06-03

Edward Jukes
Technical Director

Trevor Fawcett
Managing Director

KROHNE Ltd, 34-38 Rutherford Drive, Park Farm Industrial Estate, Wellingborough, Northants NN8 6AE
Tel.: +44 (0) 1933 408500, Fax: +44 (0) 1933 408501, www.krohne.co.uk
Registered in England No. 1254855 Registered Office as above

6.3 Safety-related characteristics

This data applies for devices switched to safe operation (for further information refer to *Change of safety mode* on page 10). For more data about device characteristics and performance, refer to "Technical data" in the handbook ([N1], [N2]).

OPTIMASS 6400 SIL safety-related characteristics

I/O option ①		2 or 3	4
Device Type		Type B	
Systematic Capability		3	
Safety Integrity Level	Single channel (HFT = 0)	SIL 2	
	Homogenous redundant (HFT = 1)	SIL 3	
Architecture		1oo1 with diagnostics	
HFT		0	
PFH		4.50E-08	4.42E-08
SFF		96.59%	96.65%
λ_{SD} ②		0.1 FIT	0.1 FIT
λ_{SU} ②		800.9 FIT	800.9 FIT
λ_{DD} ②		1750.2 FIT	1752.0 FIT
λ_{DU} ②		89.9 FIT	88.5 FIT
PFD_{AVG} (T_{Proof} = 1 years) ②		3.9E-04	3.9E-04
PFD_{AVG} (T_{Proof} = 3 years) ②		1.2E-03	1.2E-03
PFD_{AVG} (T_{Proof} = 5 years) ②		2.0E-03	2.0E-03
PTC ③		up to 97%	
Diagnostic Test Interval ④		1 min	
Fault Reaction Time		1 s	

① Position 5 in CG number (for further information refer to *Device variants* on page 5)

② Based on failure types specified in Siemens SN29500. Soft errors are taken into account. The values are valid for an averaged ambient temperature up to +40°C / +104°F.

③ Diagnostic coverage for manual proof tests

④ All diagnostic functions are carried out at least once during this time

Useful lifetime of electrical components

The established failure rates of electronic components apply within the useful lifetime according to IEC 61508-2, section 7.4.9.5 note 3.
The useful lifetime can only be extended under responsibility of the plant operator regarding special operation conditions and the employment of suitable intervals for testing and maintenance.

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Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.com

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com

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