OPTIMASS / 400

Supplementary Instructions

1000 / 2000 / 3000 / 6000 / 7000 series of meters and
MFC 400 converter

Hazardous areas

KROHNE

1.1 General

The OPTIMASS flowmeter system consist of a mass flow sensor and a mass flow converter, or a mass flow sensor and associated equipment.

The seperate mass flow sensor with a mass flow converter is identified as:

- OPTIMASS 1000F flow sensor with MFC 400F flow converter
- OPTIMASS 2000F flow sensor with MFC 400F flow converter
- OPTIMASS 3000F flow sensor with MFC 400F flow converter
- OPTIMASS 6000F flow sensor with MFC 400F flow converter
- OPTIMASS 7000F flow sensor with MFC 400F flow converter

The flowmeter in a compact configuration is identified as:

- OPTIMASS 1400C (OPTIMASS 1000 + MFC 400(S))
- OPTIMASS 2400C (OPTIMASS 2000 + MFC 400(S))
- OPTIMASS 3400C (OPTIMASS 3000 + MFC 400(S))
- OPTIMASS 6400C (OPTIMASS 6000 + MFC 400(S))
- OPTIMASS 7400C (OPTIMASS 7000 + MFC 400(S))

The OPTIMASS x000 is the general terminology for the OPTIMASS x000F and the MFC 400(S) is the converter module of the MFC 400F

1.2 EN standards compliance

As part of the hazardous areas approval, the OPTIMASS flowmeter system satisfies the requirements of the following standards:

- BS EN 60079-0:2012+A11:2013 - Explosive atmospheres. Equipment. General requirements
- BS EN 60079-1:2014 - Explosive atmospheres. Equipment protection by flameproof enclosures "d"
- BS EN 60079-7:2015 - Explosive atmospheres. Equipment protection by increased safety "e"
- BS EN 60079-11:2012 - Explosive atmospheres. Equipment protection by intrinsic safety "i"
- BS EN 60079-26:2015 - Explosive atmospheres. Equipment with Equipment Protection Level (EPL) Ga
- BS EN 60079-31:2014 - Explosive atmospheres. Equipment dust ignition protection by enclosure "t"

1.3 Hazardous areas approvals

The hazardous areas approvals for the OPTIMASS flowmeter system, relating to this supplementary manual, are as follows:

- ATEX - PTB12 ATEX 2013X, PTB12 ATEX 2014X and PTB12 ATEX 2015X
- IECEx - PTB 12.0041X, PTB 12.0042X and PTB 12.0043X
- cFMus - 3046766

1.4 Identification of OPTIMASS flowmeter systems

The complete OPTIMASS flowmeter system is identified by the models of the flow sensor and the flow converter.

The VE codes are unique and are used to identify the models and variants of the OPTIMASS flow sensor and flow converter and therefore the complete flowmeter system; through the original order specification and manufacture of the system. The VE codes for each flowmeter system are included on the product data label/s. Please refer to the nameplates section.

On integral / compact systems, where the converter is mounted directly to the sensor, the data label is on the converter housing. On remote systems, where the converter housing is separate to the sensor and linked by a dedicated cable, the data label is on the remote converter housing and essential data is duplicated on the junction box of the sensor.

Not all elements of the VE code are Ex safety relevant. The following tables describe the VE code structure and define the hazardous area relevant options.

1.5 Flow sensor VE code

The flow sensor variant is identified by the VE code 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
Haz areas relevant	x	√	x	x	x	x	x	x	√	√	x	√	x	x	x	√	√	x	x	x

Code	Description
VE	Prefix to code
ab	Flow sensor type and size
c	Manufacturer specific
d	Wetted part material
e	Surface finish
fg	Flange size and rating
h	Flange sealing face
j	Outer case material / secondary containment / operating pressure
k	Options
l	Hazardous area approval
m	Sanitary and material approvals
n	Configuration
p	Calibration
q	Cleaning / degreasing / process requirements
r	Extended options / custody transfer approval
s	"0"
t	Converter type
u	Destination
v	Functional safety
w	Spare

1.6 Flow converter VE code

The flow converter variant is identified by the VE code number on the nameplate:

Code	VE	ab	c	d	e	f	g	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
Haz areas relevant	x	√	x	√	√	√	x	x	x	x	x	x	√	√	√	x	x	√	x	x	x

Code	Description
VE	Prefix to code
ab	Converter type ①
c	Manufacturer specific
d	Type
e	power supply
f	Hazardous areas approval
g	Cable connection
h	Languages
j	Custody transfer
k	Process diagnostics
l	Converter housing
m	"0"
n	Outputs (base I/O module)
p	Outputs (first I/O module)
q	Outputs (second I/O module)
r	measuring functions
s	Manuals
t	Remote option: signal cable
u	Destination
v	Sensor type
w	Spare

① 53 refers to MFC 400 and 54 refers to MFC 400S

1.7 Additional markings

For installation in aggressive environments, OPTIMASS meters and converters are available with a painted finish. These meters have the word “Painted” after the model number.

Example: OPTIMASS 1400C – Painted

The VE code for the MFC 400F converter contains details about the output configuration: VE5b……npq… (“b” = 3 or 4) and is shown on the data label. Please refer to the section on converter codes for details.

Meter	Intended use	
	Zone 0 category 1	Zone 1 category 2
1000F	√	√
1400C	√	√
2000F	√	√
2400C	√	√
3000F	x	√
3400C	x	√
6000F	√	√
6400C	√	√
7000F	√	√
7400C	√	√

1.8 MFC 400F

The MFC 400F is defined by the VE code VE5b…d…f…npq… where “f” defines the hazardous area approval and "b" = 3 or 4 and “d” = H

The MFC 400F has intrinsically safe connections to the mass flow sensor with either increased safety or intrinsically safe signal outputs. The signal output connection compartment can be configured with protection type Ex d or Ex e. The marking is as follows:

Ex i outputs (where the VE code VE5b...d...f...npq and "n" = 2, 3, D or E and "p" = 0, 1 or 2)	
Ex d connection compartment ①	II 2(1) G Ex db [ia Ga] IIC T6 Gb
	II 2(1) D Ex tb [ia Da] IIIC T75°C Db
Ex e connection compartment ②	II 2 (1) G Ex db eb [ia Ga] IIC T6 Gb
	II 2(1) D Ex ia tb [ia Da] IIIC T75°C Db
Non Ex i outputs (where the VE Code VE5b...d...f...npq and "n" ≠ 2, 3, or "n" = D or E and "p" ≠ 0, 1 or 2)	
Ex d connection compartment ①	II 2 G Ex db [ia] IIC T6 Gb
	II 2 D Ex tb IIIC T75°C Db
Ex e connection compartment ②	II 2 G Ex db eb [ia] IIC T6 Gb
	II 2 D Ex tb IIIC T75°C Db

① Where "f" = 1
② Where "f" = 2

1.9 OPTIMASS 1000F / 1400C

The OPTIMASS 1000F is defined by the sensor VE code VEab…k…l…n… where “l” defines the hazardous area approval, “ab” = 83, 84, 85 or 86 and “n” = 1 or 2

The OPTIMASS 1400C is defined by the sensor VE code VEab…k…l…n…, where “l” defines the hazardous areas approval, “ab” = 83, 84, 85 or 86 and “n” = 0

The markings for the the OPTIMASS 1000F / 1400C are shown in the following tables:

OPTIMASS 1000F with ("k" = 1 or 2) or without ("k" = 0 or 3) heating jacket / insulation	
Intrinsically safe	II 1 G Ex ia IIC T6...T1 Ga
	II 1 D Ex ia IIIC T185°C Da
OPTIMASS 1400C Non Ex i signal outputs (where the converter VE code VE5b…f…npq… and n ≠ 2 or 3, or n = D or E when “p” ≠ 0, 1 or 2) with (“k” = 1 or 2) or without (“k” = 0 or 3) sensor heating jacket / insulation (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2 G Ex db ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T185°C Db
Ex e connection compartment ②	II 1/2 G Ex db eb ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T185°C Db
OPTIMASS 1400C Ex i signal outputs (where the converter VE code VE5b…f…npq… and “n” = 2, 3, D or E and “p” = 0, 1 or 2) with (“k” = 1 or 2) or without (“k” = 0 or 3) sensor heating jacket / insulation. (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2(1) G Ex db ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T185°C Db
Ex e connection compartment ②	II 1/2(1) G Ex db eb ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T185°C Db

① Where "f" = 1 from the converter VE code

② Where "f" = 2 from the converter VE code

1.10 OPTIMASS 2000F / 2400C

The OPTIMASS 2000F is defined by the sensor VE code VEab…k…l…n… where “l” defines the hazardous areas approval, “ab” = 87, 88, 89 or 90 and “n” = 1 or 2

The OPTIMASS 2400C is defined by the sensor VE code VEab…k…l…n… where “l” defines the hazardous areas approval, “ab” = 87, 88, 89 or 90 and “n” = 0

The marking for the the OPTIMASS 2000F / 2400C is shown in the following tables:

OPTIMASS 2000F with ("k" = 1, 2, C or D) or without ("k" = 0, 3 or B) heating jacket / insulation	
Intrinsically safe	II 1 G Ex ia IIC T6...T1 Ga
	II 1 D Ex ia IIIC T160°C Da
OPTIMASS 2400C Non Ex i signal outputs (where the converter VE code VE5b…f…npq… and n ≠ 2 or 3, or n = D or E when “p” ≠ 0, 1 or 2) with (“k” = 1, 2, C or D) or without (“k” = 0, 3 or B) sensor heating jacket / insulation (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2 G Ex db ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T160°C Db
Ex e connection compartment ②	II 1/2 (1) G Ex db eb ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T160°C Db
OPTIMASS 2400C Ex i signal outputs (where the converter VE code VE5b…f…npq… and “n” = 2, 3, D or E and “p” = 0, 1 or 2) with (“k” = 1, 2, C or D) or without (“k” = 0, 3 or B) sensor heating jacket / insulation. (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2(1) G Ex db ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T160°C Db
Ex e connection compartment ②	II 1/2(1) G Ex db eb ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T160°C Db

① Where "f" = 1 from the converter VE code

② Where "f" = 2 from the converter VE code

1.11 OPTIMASS 3000F / 3400C

The OPTIMASS 3000F is defined by the sensor VE code VEab…k…l…n… where “l” defines the hazardous areas approval, “ab” = 01, 03 or 04 and “n” = 1 or 2

The OPTIMASS 3400C is defined by the sensor VE code VE0b…k…l…n… where “l” defines the hazardous areas approval, “ab” = 01, 03 or 04 and “n” = 0

The marking for the the OPTIMASS 3000F / 3400C is shown in the following tables:

OPTIMASS 3000F with ("k" = 2) or without ("k" = 0 or 3) heating jacket / insulation)	
Intrinsically safe	II 1 G Ex ia IIC T6...T1 Ga
	II 1 D Ex ia IIIC T165°C Da
OPTIMASS 3400C Non Ex i signal outputs (where the converter VE code VE5b…f…npq… and n ≠ 2 or 3, or n = D or E when “p” ≠ 0, 1 or 2) with (“k” = 2) or without (“k” = 0 or 3) sensor heating jacket / insulation (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2 G Ex db ia IIC T6...T1 Ga / Gb
	II 2 D Ex tb IIIC T165°C Db
Ex e connection compartment ②	II 1/2 G Ex db eb ia IIC T6...T1 Ga / Gb
	II 2 D Ex tb IIIC T165°C Db
OPTIMASS 3400C Ex i signal outputs (where the converter VE code VE5b…f…npq… and “n” = 2, 3, D or E and “p” = 0, 1 or 2) with (“k” = 2) or without (“k” = 0 or 3) sensor heating jacket / insulation. (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2(1) G Ex db ia [ia Ga] IIC T6...T1 Ga / Gb
	II 2(1) D Ex tb [ia Da] IIIC T165°C Db
Ex e connection compartment ②	II 1/2(1) G Ex db eb ia [ia Ga] IIC T6...T1 Ga / Gb
	II 2(1) D Ex tb [ia Da] IIIC T165°C Db

① Where "f" = 1 from the converter VE code

② Where "f" = 2 from the converter VE code

1.12 OPTIMASS 6000F / 6400C

Standard temperture version ("j" = K and "q" ≠ T)

The OPTIMASS 6000F is defined by the sensor VE code VEab…j…k…l…n…q… where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “n” = 1 or 2, "j" = K and "q" ≠T

The OPTIMASS 6400C is defined by the sensor VE code VEab…j…k…l…n…q… where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “n” = 0, "j" = K and "q" ≠T

The markings for the OPTIMASS 6000F / 6400C are shown in the following tables:

OPTIMASS 6000F with ("k" = 1, 3 or 5) or without ("k" = 0 or A) heating jacket / insulation)	
Intrinsically safe	II 1 G Ex ia IIC T6...T1 Ga
	II 1 D Ex ia IIIC T270°C Da
OPTIMASS 6400C Non Ex i signal outputs (where the converter VE code VE5b…f…npq… and n ≠ 2 or 3, or n = D or E when “p” ≠ 0, 1 or 2) with (“k” = 1, 3 or 5) or without (“k” = 0 or A) sensor heating jacket / insulation (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2 G Ex db ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T270°C Db
Ex e connection compartment ②	II 1/2 G Ex db eb ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T270°C Db
OPTIMASS 6400C Ex i signal outputs (where the converter VE code VE5b…f…npq… and “n” = 2, 3, D or E and “p” = 0, 1 or 2) with (“k” = 1, 3 or 5) or without (“k” = 0 or A) sensor heating jacket / insulation. (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2(1) G Ex db ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T270°C Db
Ex e connection compartment ②	II 1/2(1) G Ex db eb ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T270°C Db

① Where "f" = 1 from the converter VE code

② Where "f" = 2 from the converter VE code

Short stem version ("j" = 0)

The OPTIMASS 6000F is defined by the sensor VE code VEab…j...k…l…n…q... where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “n” = 1 or 2, and "j" = 0

The OPTIMASS 6400C is defined by the sensor VE code VEab…j...k…l…n…q... where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “n” = 0, and "j" = 0

The markings for the OPTIMASS 6000F / 6400C are shown in the following tables:

OPTIMASS 6000F with ("k" = 1, 3 or 5) or without ("k" = 0 or A) heating jacket / insulation)	
Intrinsically safe	II 1 G Ex ia IIC T6...T1 Ga
	II 1 D Ex ia IIIC T190°C Da
OPTIMASS 6400C Non Ex i signal outputs (where the converter VE code VE5b…f…npq… and n ≠ 2 or 3, or n = D or E when “p” ≠ 0, 1 or 2) with (“k” = 1, 3 or 5) or without (“k” = 0 or A) sensor heating jacket / insulation (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2 G Ex db ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T190°C Db
Ex e connection compartment ②	II 1/2 G Ex db eb ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T190°C Db
OPTIMASS 6400C Ex i signal outputs (where the converter VE code VE5b…f…npq… and “n” = 2, 3, D or E and “p” = 0, 1 or 2) with (“K” = 1, 3 or 5) or without (“k” = 0 or A) sensor heating jacket / insulation. (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2(1) G Ex db ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T190°C Db
Ex e connection compartment ②	II 1/2(1) G Ex db eb ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T190°C Db

① Where "f" = 1 from the converter VE code
② Where "f" = 2 from the converter VE code

High tempertaure version ("q" = T)

The OPTIMASS 6000F is defined by the sensor VE code VEab…j...k…l…n…q... where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “n” = 1 or 2, and "q" = T

OPTIMASS 6000F with ("k" = 1, 3 or 5) sensor heating jacket / insulation	
Intrinsically safe	II 1 G Ex ia IIC T6...T1 Ga
	II 1 D Ex ia IIIC T440°C Da

1.13 OPTIMASS 7000F / 7400C

The OPTIMASS 7000F is defined by the sensor VE code VEab…k…l…n… where “l” defines the hazardous area approval, “a” = 1, 2, 3 or 4 and "b" = 1, 2, 3, 4, 5, 6 or 7 and "n" = 1 or 2

The OPTIMASS 7400C is defined by the sensor VE code VEab...k…l…n…q where “l” defines the hazardous areas approval, “a” = 1, 2, 3 or 4 and "b" = 1, 2, 3, 4, 5, 6 or 7 and "n" = 0

The markings for the OPTIMASS 7000F / 7400C are shown in the following tables:

OPTIMASS 7000F with ("k" = 1 or 2) or without ("k" = 0 or 3) sensor heating jacket / insulation)	
Intrinsically safe	II 1 G Ex ia IIC T6...T1 Ga
	II 1 D Ex ia IIIC T165°C Da
OPTIMASS 7400C Non Ex i signal outputs (where the converter VE code VE5b…f…npq… and n ≠ 2 or 3, or n = D or E when “p” ≠ 0, 1 or 2) with (“k” = 1 or 2) or without (“k” = 0 or 3) sensor heating jacket / insulation (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2 G Ex db ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T165°C Db
Ex e connection compartment ②	II 1/2 G Ex db eb ia IIC T6...T1 Ga/Gb
	II 2 D Ex tb IIIC T165°C Db
OPTIMASS 7400C Ex i signal outputs (where the converter VE code VE5b…f…npq… and “n” = 2, 3, D or E and “p” = 0, 1 or 2) with (“k” = 1 or 2) or without (“k” = 0 or 3) sensor heating jacket / insulation. (“k” is from the sensor VE code.)	
Ex d connection compartment ①	II 1/2(1) G Ex db ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T165°C Db
Ex e connection compartment ②	II 1/2(1) G Ex db eb ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2(1) D Ex tb [ia Da] IIIC T165°C Db

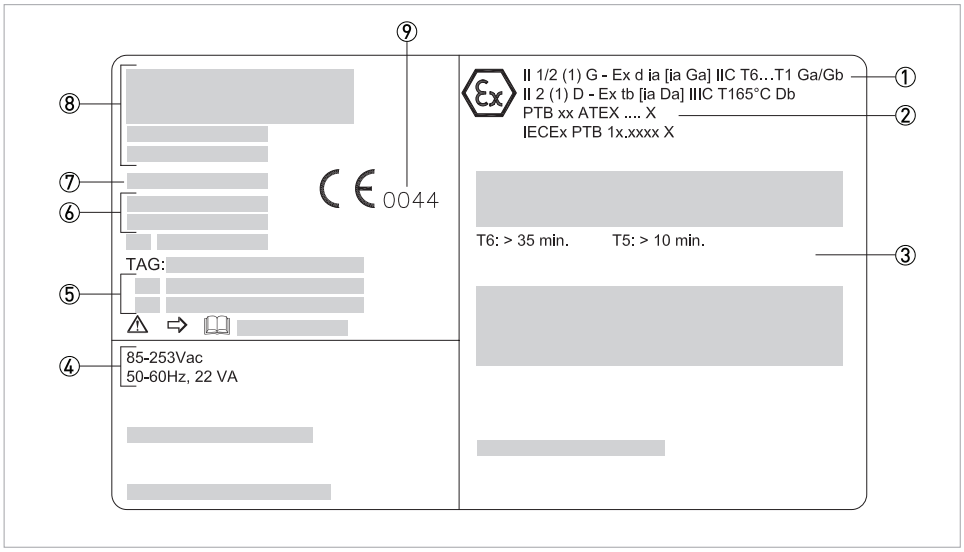
① Where "f" = 1 from the converter VE code

② Where "f" = 2 from the converter VE code

1.14 Nameplates

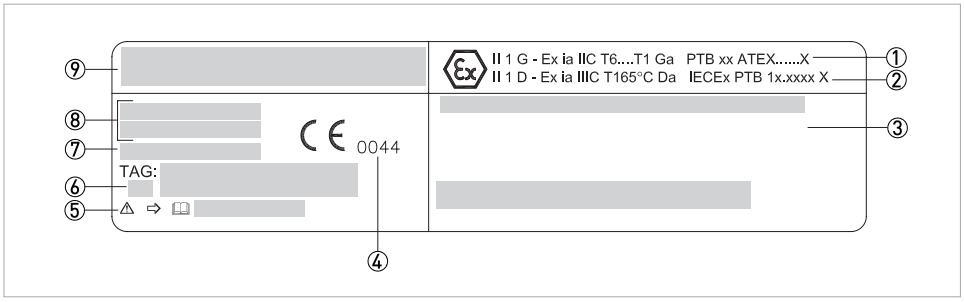
The nameplate contains information about the sensor and converter. Below are examples of both compact and field versions of the nameplate.

Converter nameplate (compact and remote versions)



① Ex marking (example shown)
② Certificate number
③ Ex specific requirement
④ Power supply data
⑤ VE Codes for sensor and converter / manual document number
⑥ Year of manufacture / serial number
⑦ Model type (OPTIMASS x400 C or OPTIMASS x400C - painted)
⑧ Logo and address of manufacturer
⑨ Indentification number of the notified body

Sensor nameplate (remote version only)



① Ex marking (example shown)
② Certificate number
③ Ex specific requirement
④ Indentification number of the notified body
⑤ Manual document number
⑥ VE Code for x000 sensor
⑦ Serial number
⑧ Model type (OPTIMASS x000F or OPTIMASS x000F - painted)
⑨ Logo and address of manufacturer

2.1 Equipotential bonding

The MFC 400F (field) converter and the OPTIMASS X400C (compact) must be included in the equipotential bonding of the installation. Use the bonding terminal on the converter housing, wall bracket or mass flow meter housing mounting stem.

In separated systems, a screened cable is used and is earthed at the meter and converter ends. Fit an equalisation cable with a minimum cross section area of 4mm^2 to the equipotential bonding terminals on the mass flow converter housing bracket and the mass flow sensor electronics stem.

2.2 Temperature limits

2.2.1 Introduction

Because of the effect that the process temperature has on the meter, mass flow sensors and compact mass flow meters are not given a fixed temperature class. The tables in this section give details of the temperature class for each meter.

Notes

- Make sure that the flowmeter is installed and operated as shown in the relevant Handbook.
- Make sure that the flowmeter is not exposed to a source of heat (for example direct sunlight or heat from adjacent equipment) that causes the ambient temperature to rise above the ambient temperature range for the meter.
- Make sure that insulation is not preventing ventilation of the meter housing.

2.2.2 MFC 400F

The MFC 400F is defined by the converter VE code VEab…d…f…l…npq… where “f” defines the hazardous area approval and “ab” = 53 or 54 and “d” = H

The MFC 400F mass flow converter is suitable for temperature classes T6…T1 and has a maximum surface temperature of 75ºC

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

Converter housing	Ambient temp. T_{amb} °C	
	Standard converter	SIL capable converter
Aluminium (VE code option "I" = 1)	-40...+65°C / -40...+149°F	-40...+55°C / -40...+131°F
Stainles Steel (VE code option "I" = 3)	-40...+60°C / -40...+140°F	-40...+55°C / -40...+131°F

2.2.3 OPTIMASS 1000F / 1400C

The OPTIMASS 1000F / 1400C is suitable for temperature classes T6...T1

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

	Ambient temp. T_{amb} °C	Max medium temp. T_m °C	Temp. class	Max. Surface temp. °C
OPTIMASS 1000F is defined by the sensor VE code VEab…k…l…n… where "l" defines the hazardous areas approval, "ab" = 83, 84, 85, or 86 and "n" = 1 or 2 with ("k" = 1 or 2 or without ("k" = 0 or 3) heating jacket / insulation	-40...+40	45	T6 - T1	T80
		60	T5 - T1	T95
		95	T4 - T1	T130
		130	T3 - T1	T165
		150	T3 - T1	T185
	-40...+50	60	T5 - T1	T95
		95	T4 - T1	T130
		130	T3 - T1	T165
		150	T3 - T1	T185
	-40...+65	95	T4 - T1	T130
		130	T3 - T1	T165
		150	T3 - T1	T185
	Minimum medium temp: -50°C			
OPTIMASS 1400C – aluminium converter housing is defined by the sensor VE code VEab…k…l…n… where "l" defines the hazardous areas approval, "ab" = 83, 84, 85, or 86 and "n" = 0 – with ("k" = 1 or 2) or without ("k" = 0 or 3) heating jacket / insulation and the converter VE code VE5b…d…f…l…npq – where "b" = 3 or 4 and "d" = 4 and "l" = 1	-40...+40	45	T6 - T1	T80
		60	T5 - T1	T95
		95	T4 - T1	T130
		130	T3 - T1	T165
		150	T3 - T1	T185
	-40...+50	60	T5 - T1	T95
		95	T4 - T1	T130
		130	T3 - T1	T165
		150	T3 - T1	T185
	-40...+65	65	T4 - T1	T100
	Minimum medium temp: -45°C			
OPTIMASS 1400C – SS converter housing is defined by the sensor VE code VEab…k…l…n… where "l" defines the hazardous areas approval, "ab" = 83, 84, 85, or 86 and "n" = 0 – with ("k" = 1 or 2) or without ("k" = 0 or 3) heating jacket / insulation and the converter VE code VE5b…d…f…l – where "b" = 3 or 4 and "d" = 4 and "l" = 2	-40...+40	45	T6 - T1	T80
		60	T5 - T1	T95
		95	T4 - T1	T130
		130	T3 - T1	T165
		150	T3 - T1	T185
	-40...+50	60	T5 - T1	T95
		95	T4 - T1	T130
	-40...+60	60	T5 - T1	T95
	Minimum medium temp: -45°C			

2.2.4 OPTIMASS 2000F / 2400C

The OPTIMASS 2000F / 2400C is suitable for temperature classes T6...T1

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

	Ambient temp. T_{amb} °C	Max medium temp. T_m °C	Temp. class	Max. Surface temp. °C
OPTIMASS 2000F - with or without heating jacket / insulation is defined by the sensor VE code VEab…k…l…n…, where "l" defines the hazardous areas approval, "ab" = 87, 88, 89, or 90 and "n" = 1 or 2 with ("k" = 1, 2, C or D) or without ("k" = 0, 3 or B) heating jacket / insulation	-40...+40	40	T6 - T1	T70
		55	T5 - T1	T85
		90	T4 - T1	T120
		130	T3 - T1	T160
	-40...+50	55	T5 - T1	T85
		90	T4 - T1	T120
		130	T3 - T1	T160
	-40...+65	65	T5 - T1	T95
		90	T4 - T1	T120
		130	T3 - T1	T160
	Minimum medium temp: -50°C			
OPTIMASS 2400C – aluminium converter housing is defined by the sensor VE code VEab…k…l…n… , where "l" defines the hazardous areas approval, "ab" = 87, 88, 89, or 90 and "n" = 0 – with ("k" = 1, 2, C or D) or without ("k" = 0, 3 or B) sensor heating jacket / insulation and the converter VE code VE5b…d…f…l…npq – where "b" = 3 or 4 and "d" = 4 and "l" = 1	-40...+40	40	T6 - T1	T70
		55	T5 - T1	T85
		90	T4 - T1	T120
		130	T3 - T1	T160
	-40...+50	55	T5 - T1	T85
		90	T4 - T1	T120
		130	T3 - T1	T160
	-40...+60	65	T5 - T1	T95
		100	T4 - T1	T130
	-40...+65 ①	65	T5 - T1	T95
	Minimum medium temp: -45°C			
OPTIMASS 2400C – SS converter housing is defined by the sensor VE code VEab…k…l…n…, where "l" defines the hazardous areas approval, "ab" = 87, 88, 89, or 90 and "n" = 0 – with ("k" = 1, 2 C or D) or without ("k" = 0, 3 or B) heating jacket / insulation and the Converter VE Code VE5b…d…f…l...npq… - where and "b" = 3 or 4 and "d" = 4 and "l" = 2	-40...+40	40	T6 - T1	T70
		55	T5 - T1	T85
		90	T4 - T1	T120
		130	T3 - T1	T160
	-40...+50	55	T5 - T1	T85
		90	T4 - T1	T120
	-40...+60	60	T5 - T1	T90
	Minimum medium temp: -45°C			

① Depending on I/O option. Please call for more information.

2.2.5 OPTIMASS 3000F / 3400C

The OPTIMASS 3000F / 3400C is suitable for temperature classes T6...T1

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

	Ambient temp. T_{amb} °C	Max medium temp. T_m °C	Temp. class	Max. Surface temp. °C
OPTIMASS 3000F is defined by the sensor VE code VEab…k…l…n…, where "l" defines the hazardous areas approval, "ab" = 01, 03 or 04 and "n" = 1 or 2 - with ("k" = 2) or without ("k" = 0 or 3) heating jacket / insulation	-40...+40	65	T6 - T1	T80
		80	T5 - T1	T95
		115	T4 - T1	T130
		150	T3 - T1	T165
	-40...+50	65	T6 - T1	T80
		80	T5 - T1	T95
		115	T4 - T1	T130
		150	T3 - T1	T165
	-40...+65	65	T6 - T1	T80
		80	T5 - T1	T95
		115	T4 - T1	T130
		130	T3 - T1	T145
	Minimum medium temp: -50°C			
OPTIMASS 3400C – aluminium converter housing is defined by the sensor VE code VEab…l…k...n… , where "l" defines the hazardous areas approval, "ab" = 01,03 or 04 and "n" = 0 – with ("k" = 2) or without ("k" = 0 or 3) sensor heating jacket / insulation and the converter VE code VE5b…d…f…l…npq – where "b" = 3 or 4 and "d" = 4 and "l" = 1	-40...+40	65	T6 - T1	T80
		80	T5 - T1	T95
		115	T4 - T1	T130
		150	T3 - T1	T165
	-40...+50	65	T6 - T1	T80
		80	T5 - T1	T95
		115	T4 - T1	T130
		150	T3 - T1	T165
	-40...+65	65	T6 - T1	T80
	Minimum medium temp: -45°C			
OPTIMASS 3400C – SS converter housing is defined by the sensor VE code VEab…l…k…n…, where "l" defines the hazardous areas approval, "ab" = 01, 03 or 04 and "n" = 0 – with ("k" = 2) or without ("k" = 0 or 3) heating jacket / insulation and the Converter VE Code VE5b…d…f…l...npq… - where and "b" = 3 or 4 and "d" = 4 and "l" = 2	-40...+40	65	T6 - T1	T80
		80	T5 - T1	T95
		115	T4 - T1	T130
		150	T3 - T1	T165
	-40...+50	65	T6 - T1	T80
		80	T5 - T1	T95
		115	T4 - T1	T130
		130	T3 - T1	T145
	-40...+60	60	T6 - T1	T75
	Minimum medium temp: -45°C			

2.2.6 OPTIMASS 6000F / 6400C - standard temperature ("j" = K & "q" ≠ T)

The OPTIMASS 6000F / 6400C standard temperature is suitable for temperature classes T6...T1

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

	Ambient temp. T_{amb} °C	Max medium temp. T_m °C	Temp. class	Max. Surface temp. °C
OPTIMASS 6000F is defined by the sensor VE code VEab…j...k…l…n…, where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and "j" = K and "n" = 1 or 2 and "q" = 0 or 1 - with ("k" = 1, 3 or 5) or without ("k" = 0 or A) sensor heating jacket / insulation	-40...+40	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
	-40...+50	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
	-40...+65	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
	Minimum medium temp: -50°C			
	Cryogenic version ("q" = C or D and "k" = 0, 2 or A)			
	-25...+65	-140...+40	T6 - T1	T80
		-160...+40		
	-20...+65	-180...+40		
		-200...+40		
	Minimum medium temp: <-50°C			

<table>
<tr><td rowspan="20">OPTIMASS 6400C – aluminium converter housing

is defined by the sensor VE code VEab…j…k…l…n… , where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “j” = K and "n" = 0 and "q" = 0 or 1 - with (“k” = 1, 3 or 5) or without (“k” = 0 or A) sensor heating jacket / insulation and the converter VE code VE5b…d…f…l…npq – where “b” = 3 or 4 and “d” = 4 and “l” = 1</td><td rowspan="5">-40...+40</td><td>40</td><td>T6 - T1</td><td>T80</td></tr>
<tr><td>55</td><td>T5 - T1</td><td>T95</td></tr>
<tr><td>90</td><td>T4 - T1</td><td>T130</td></tr>
<tr><td>150</td><td>T3 - T1</td><td>T190</td></tr>
<tr><td>230</td><td>T2 - T1</td><td>T270</td></tr>
<tr><td rowspan="5">-40...+50</td><td>40</td><td>T6 - T1</td><td>T80</td></tr>
<tr><td>55</td><td>T5 - T1</td><td>T95</td></tr>
<tr><td>90</td><td>T4 - T1</td><td>T130</td></tr>
<tr><td>150</td><td>T3 - T1</td><td>T190</td></tr>
<tr><td>230</td><td>T2 - T1</td><td>T270</td></tr>
<tr><td>-40...+65</td><td>65</td><td>T4 - T1</td><td>T105</td></tr>
<tr><td colspan="4">Minimum medium temp: -45°C</td></tr>
<tr><td colspan="4">Cryogenic version ("q" = C or D and "k" = 0, 2 or A)</td></tr>
<tr><td rowspan="3">-35...+65</td><td>-140...+40</td><td rowspan="4">T6 - T1</td><td rowspan="4">T80</td></tr>
<tr><td>-160...+40</td></tr>
<tr><td>-30...+65</td><td>-180...+40</td></tr>
<tr><td>-25...+65</td><td>-200...+40</td></tr>
<tr><td colspan="4">Minimum medium temp: <-50°C</td></tr>
<tr><td rowspan="20">OPTIMASS 6400C – SS converter housing

is defined by the sensor VE code VEab…j…k…l…n…, where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “j” = K and "n" = 0 and "q" = 0 or 1 – with (“k” = 1, 3 or 5) or without ("k" = 0 or A) heating jacket / insulation and the Converter VE Code VE5b…d…f…l…npq… - where and “b” = 3 or 4 and “d” = 4 and “l” = 2</td><td rowspan="5">-40...+40</td><td>40</td><td>T6 - T1</td><td>T80</td></tr>
<tr><td>55</td><td>T5 - T1</td><td>T95</td></tr>
<tr><td>90</td><td>T4 - T1</td><td>T130</td></tr>
<tr><td>150</td><td>T3 - T1</td><td>T190</td></tr>
<tr><td>230</td><td>T2 - T1</td><td>T270</td></tr>
<tr><td rowspan="5">-40...+50</td><td>40</td><td>T6 - T1</td><td>T80</td></tr>
<tr><td>55</td><td>T5 - T1</td><td>T95</td></tr>
<tr><td>90</td><td>T4 - T1</td><td>T130</td></tr>
<tr><td>150</td><td>T3 - T1</td><td>T190</td></tr>
<tr><td>230</td><td>T2 - T1</td><td>T270</td></tr>
<tr><td>-40...+60</td><td>60</td><td>T4 - T1</td><td>T100</td></tr>
<tr><td colspan="4">Minimum medium temp: -50°C</td></tr>
<tr><td colspan="4">Cryogenic version ("q" = C or D and "k" = 0, 2 or A)</td></tr>
<tr><td>-35...+60</td><td>-140...+40</td><td rowspan="4">T6 - T1</td><td rowspan="4">T80</td></tr>
<tr><td>-30...+60</td><td>-160...+40</td></tr>
<tr><td rowspan="2"></td><td>-180...+40</td></tr>
<tr><td>-25...+60</td><td>-200...+40</td></tr>
<tr><td colspan="4">Minimum medium temp: <-50°C</td></tr>
</table>

2.2.7 OPTIMASS 6000F / 6400C - short stem ("j" = 0)

The OPTIMASS 6000F / 6400C short stem is suitable for temperature classes T6...T1

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

	Ambient temp. T_{amb} °C	Max medium temp. T_m °C	Temp. class	Max. Surface temp. °C
OPTIMASS 6000F short stem is defined by the sensor VE code VEab…j...k…l…n…, where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and "j" = 0 and "n" = 1 or 2 and "q" = 0 or 1 - without ("k" = 0 or A) sensor heating jacket / insulation.	-40...+40	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
	-40...+50	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
	-40...+65	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		135	T3 - T1	T175
	Minimum medium temp: -50°C			
	Cryogenic version ("q" = C or D and "k" = 0 or A)			
	+10...+65	-140...+40	T6 - T1	T80
	+20...+65	-160...+40		
	+30...+65	-180...+40		
	+40...+65	-200...+40		
	Minimum medium temp: <-50°C			
OPTIMASS 6400C short stem with aluminium converter housing is defined by the sensor VE code VEab…j...k...l...n… , where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “j” = 0 and "n" = 0 and "q" = 0 or 1 - without (“k” = 0 or A) sensor heating jacket / insulation and the converter VE code VE5b…d…f…l…npq – where “b” = 3 or 4 and “d” = 4 and “l” = 1	-40...+40	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
	-40...+50	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		145	T3 - T1	T185
	-40...+65	65	T4 - T1	T105
	Minimum medium temp: -50°C			
	Cryogenic version ("q" = C or D and "k" = 0 or A)			
	-20...+65	-140...+40	T6 - T1	T80
	-15...+65	-160...+40		
		-180...+40		
	-10...+65	-200...+40		
	Minimum medium temp: <-50°C			

<table>
<tr><td rowspan="15">OPTIMASS 6400C short stem with SS converter housing

is defined by the sensor VE code VEab…j…k…l…n…, where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “j” = 0 and "n" = 0 and "q" = 0 or 1 – without (“k” = 0 or A) heating jacket / insulation and the Converter VE Code VE5b…d…f…l…npq… - where “b” = 3 or 4 and “d” = 4 and “l” = 2</td><td rowspan="4">-40...+40</td><td>40</td><td>T6 - T1</td><td>T80</td></tr>
<tr><td>55</td><td>T5 - T1</td><td>T95</td></tr>
<tr><td>90</td><td>T4 - T1</td><td>T130</td></tr>
<tr><td>150</td><td>T3 - T1</td><td>T190</td></tr>
<tr><td rowspan="4">-40...+50</td><td>40</td><td>T6 - T1</td><td>T80</td></tr>
<tr><td>55</td><td>T5 - T1</td><td>T95</td></tr>
<tr><td>90</td><td>T4 - T1</td><td>T130</td></tr>
<tr><td>145</td><td>T3 - T1</td><td>T185</td></tr>
<tr><td>-40...+60</td><td>60</td><td>T4 - T1</td><td>T100</td></tr>
<tr><td colspan="4">Minimum medium temp: -50°C</td></tr>
<tr><td colspan="4">Cryogenic version ("q" = C or D and "k" = 0 or A)</td></tr>
<tr><td>-10...+65</td><td>-140...+40</td><td rowspan="4">T6 - T1</td><td rowspan="4">T80</td></tr>
<tr><td>-5...+65</td><td>-160...+40</td></tr>
<tr><td>0...+65</td><td>-180...+40</td></tr>
<tr><td>+10...+60</td><td>-200...+40</td></tr>
<tr><td colspan="4">Minimum medium temp: <-50°C</td></tr>
</table>

2.2.8 OPTIMASS 6000F high temperature ("q" = T)

The OPTIMASS 6000F high temperature is suitable for temperature classes T6...T1

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

	Ambient temp. T_{amb} °C	Max medium temp. T_m °C	Temp. class	Max. Surface temp. °C
OPTIMASS 6000F high temperature with aluminium junction box and heating jacket is defined by sensor VE code VEab…j...k…l…n…, where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and "j" = K and "n" = 1 and "q" = T with ("k" = 3 or 5) sensor heating jacket.	-40...+40	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	-40...+55	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	-40...+60	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	-40...+65	350		T390
	Minimum medium temp: -50°C			

OPTIMASS 6000F high temperature with stainless steel junction box and heating jacket is defined by sensor VE code VEab…j…k…l…n…, where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and "j" = K and "n" = 2 and "q" = T with ("k" = 3 or 5) sensor heating jacket.	-40...+40	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	-40...+50	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	-40...+55	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	-40...+60	350		T390
	Minimum medium temp: -50°C			
OPTIMASS 6000F high temperature with aluminium or stainless steel junction box and no heating jacket is defined by the sensor VE code VEab…j…k…l…n…, where “l” defines the hazardous areas approval, “ab” = 71, 72, 73, 74, 75, 76, 77, 78, 79 or 80 and “j” = K and "n" = 1 or 2 and "q" = T with (“k” = 1) insulation	-40...+40	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	440
	-40...+55	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	-40...+65	40	T6 - T1	T80
		55	T5 - T1	T95
		90	T4 - T1	T130
		150	T3 - T1	T190
		230	T2 - T1	T270
		400	T1	T440
	Minimum medium temp: -50°C			

2.2.9 OPTIMASS 7000F / 7400C

The OPTIMASS 7000F / 7400C is suitable for temperature classes T6...T1

Note:

These temperature classes are subject to the following temperature limits. For information on cable parameters, please refer to the ELECTRICAL CONNECTIONS chapter.

	Ambient temp. T_{amb} °C	Max medium temp. T_m °C	Temp. class	Max. Surface temp. °C
OPTIMASS 7000F is defined by sensor VE code VEab...k…l…n…, where “l” defines the hazardous areas approval, “a” = 1, 2, 3 or 4 and "b" = 1, 2, 3, 4, 5, 6 or 7 and "n" = 1 or 2 - with ("k" = 1 or 2) or without (“k” = 0 or 3) sensor heating jacket / insulation.	-40...+40	65	T6	T80
		80	T5	T95
		100	T4	T115
		115		T130
		150	T3 - T1	T165
	-40...+50	80	T5	T95
		100	T4	T115
		115		T130
		150	T3 - T1	T165
	-40...+65	100	T4	T115
		115		T130
		130	T3 - T1	T145
	Minimum medium temp: -50°C			
OPTIMASS 7400C with aluminium converter housing is defined by sensor VE code VEab...k…l…n…, where “l” defines the hazardous areas approval, “a” = 1, 2, 3 or 4 and "b" = 1, 2, 3, 4, 5, 6 or 7 and "n" = 0 - with ("k" = 1 or 2) or without (“k” = 0 or 3) sensor heating jacket / insulation and the converter VE code VE5b…d…f…l…npq… - where “b” = 3 or 4 and “d” = 4 and “l” = 1.	-40...+40	65	T6	T80
		80	T5	T95
		100	T4	T115
		115		T130
		150	T3 - T1	T165
	-40...+50	100	T4	T115
		115		T130
		150	T3 - T1	T165
	-40...+65	65	T6 - T1	T80
	Minimum medium temp: -45°C			
OPTIMASS 7400C with Stainless Steel converter housing is defined by the sensor VE code VEab…j…k…l...n…, where “l” defines the hazardous areas approval, “a” = 1, 2, 3 or 4 and "b" = 1, 2, 3, 4, 5, 6 or 7 and "n" = 0 - with ("k" = 1 or 2) or without (“k” = 0 or 3) sensor heating jacket / insulation and the converter VE code VE5b…d…f…l…npq… - where “b” = 3 or 4 and “d” = 4 and “l” = 2	-40...+40	65	T6	T80
		80	T5	T95
		100	T4	T115
		115		T130
		130	T3 - T1	T145
	-40...+50	80	T5	T95
		100	T4	T115
		115	T4 - T1	T130
	-40...+60	60	T6 - T1	T75
	Minimum medium temp: -45°C			

2.2.10 Painted options

A painted finish helps to prevent corrosion in aggressive environments.
The following meters are available with a painted finish

OPTIMASS	1000F
	1400C
OPTIMASS	2000F
	2400C
OPTIMASS	3400F
	3000C
OPTIMASS	6000F without insulation (short stem only)
	6400C without insulation (short stem only)
OPTIMASS	7000F
	7400C

Temperature limits

	Ambient temp. T_{amb} °C	Max. medium temp. T_m °C
Meter	-40...+40	110
Stainles Steel converter	-40...+40	-

Note

These temperature limts are subject to the maximum temperature class / limit of the meter, which might be lower.

2.3 Electronics compartment

Let the electronics de-energise before opening the electronics compartment. Please wait for the following times according to the temperature class of the meter.

Temp. class	**Time required to de-energise**
T6	35 minutes
T5	10 minutes

2.4 Certified cable glands

Meters supplied with an Ex d terminal compartment (“f” = 1) are also supplied with one Ex d stopping plug and two temporary plugs for shipping and storage. When installing the meter, remove the temporary plugs and use suitable Ex d certified cable glands, plugs or conduit.

All unused openings must be closed with suitable, certified plugs.

2.5 Cable protection

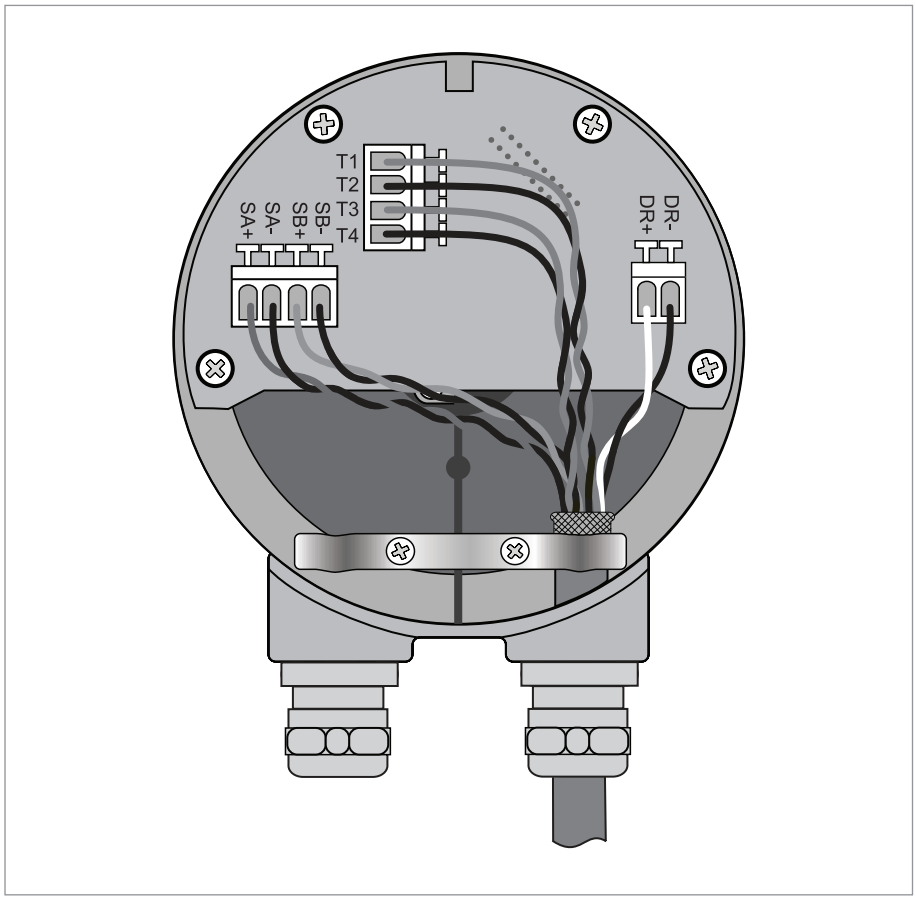
Install the connecting cables as fixed wiring so that they are protected from damage.

2.6 Aluminium junction box

If the meter has an aluminium junction box and if it has been installed in an area classified as Zone 0, then you MUST protect the meter from ignition hazards caused by impact and / or friction.

3.1 Remote / field terminal connections

The information below is based on cable supplied by the manufacturer.



Cable pair / terminal block configuration.

Circuit	Terminal	Cable colour
Signal	SB-	Black
	SB+	Green
	SA-	Black
	SA+	Yellow
Strain Guage and temperature sensor	T1	Blue
	T2	Black
	T3	Red
	T4	Black
Driver	DR+	White
	DR-	Black

Screening

Fit the cable screen as shown in the above illustration.

3.1.1 Separated systems

In the case of field and remote meters, the sensor and converter are connected using a cable that has five pairs and an outer screen. Each pair of cables carries an intrinsically safe circuit

When using cable not supplied by the manufacturer, the following points should be noted:

- The cable MUST NOT have capacitance and / or inductance levels higher than those shown in the cable parameters section.
- You MUST obey IEC / EN 60079-14 when installing an OPTIMASS meter.

3.1.2 Cable parameters

Cable supplied by the manufacturer		
Capacitance	<78 ρF/m	
Inducatnce	<0.8 µH/m	
Temperature range	-40°C...+85°C	
Maximum length	20 meters ①	
Cable supplied by the customer		
Capacitance	90 nF (for total cable length)	②
Inducatnce	36 µH (for total cable length)	
Temperature range	≥ Max temperature range of the installation ③	
Test voltage	≥ 1000 VAC	
Insulation thickness	≥ 0.2mm (IEC / EN 60079-14 S. 12.2.2.7)	
Casing colour	Blue	

① No further intrinsic safety analysis is necessary if the cable length is not more than the maximum
② No further intrinsic safety analysis is necessary if the cable used is within maximum limits
③ When calculating the temperature range, give consideration to the flow sensor temperature gradients. Please refer to the Temperature limits section.

3.2 Electronics and I/O terminal compartments

When working on the MFC 400 converter electronics and / or the I/O terminal compartments, the following points must be noted:

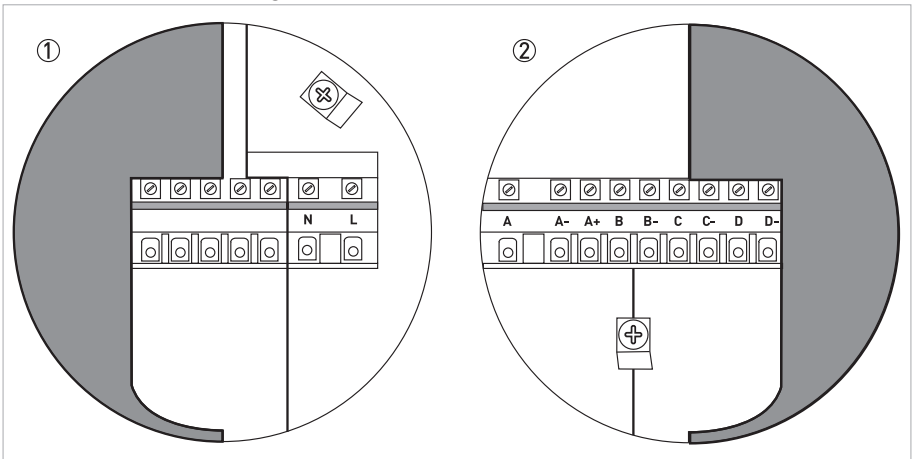
- The covers on the electronics compartment have a flameproof thread that is a tight fit. When removing / re-fitting the covers, take care and do not use a lot of force.
- Keep the threads clean and apply Teflon grease (for example NONTRIBOS® type Li EP) before re-fitting the cover. The grease will help to prevent corrosion that will cause the threads to lock together.
- To open the compartment covers, first remove the hexagonal retention lock using a 2.5mm hex-head tool. After re-fitting the cover, re-fit the retention lock.

3.2.1 I/O terminal compartment

The I/O terminal compartment can be opened for a short period of time, where the electronics are energised and the meter is in a hazardous area. For example, to check the wiring configuration. However the following conditions MUST all be met:

1. the I/O terminal compartment has an “increased safety” ignition protection type (standard), and;
2. the I/O circuits have an “intrinsic safety” protection type, and;
3. the touch guard (cover) for the power supply terminals (L,N) is closed (see illustration).

Power supply touch guard (cover)



① Touch guard (cover) open
② Touch guard (cover) closed

Work on I/O terminals A…D can be done with the electronics energised, but you MUST follow the regulations regarding intrinsically safe circuits.

When the work has been finished, replace the cover and re-fit the retention lock.

Terminal	Function / electrical data
L, N L+, N-	Connection for main supply. Always non-Ex i
	100...230 VAC, +10% / -15%, 22VA
	12...24 VDC, +30% / -25%, 12W
	24 VAC +10% / -15%, 22VA
	24 VDC +30% / -25%, 12W
	U_m = 253V
A, A-, A+ B, B- C, C- D, D-	Intrinsic safety of I/O circuits is determined by the I/O options chosen by the customer. I/O configuration of the MFC 400 is defined in the converter VE code VE5b where "b" = 3 or 4. See below for details.

3.2.2 Converter VE code for I / O options

The converter VE number is defined in the Introduction section at the beginning of this Handbook

Overviews of the converter VE code I / O option defined by “n”, “p” and “q” can be found in the following section. However, the overviews do not show all details. The exact connection diagram can be found on the label on the inside cover of the connection compartment.

If the meter is being installed in a gas hazardous area, the terminal compartment cable glands must have the appropriate protection type: increased safety (Ex e) or flameproof (Ex d).

Meters supplied with an Ex e terminal compartment (“f” = 2) are also supplied with two Ex e certified cable glands and one Ex e or Ex d stopping plug.

All wiring must comply with current, relevant national or regional standards for electrical installations (for example IEC / EN 600079-14). If you are using IEC / EN 600079-14 please pay attention to sections: 9, 10, 11 and 12.

The torque settings for the terminals is 0.7 Nm. Maximum conductor or ferrule size is 4mm^2

"p" and "q" functions

Option code	Function "p"	Function "q" ①
0	Without, no module possible (only with "n" = F)	Without, no module possible (only with "n" = F)
8	Without, no module possible (only with "n" ≠ F)	Without, no module possible
A	Current output: active	Current output: active
B	Current output: passive	Current output: passive
C	Current output: active, high current	Current output: active, high current
E	Current output: passive, high current	Current output: passive, high current
F	Current output: passive, Namur	Current output: passive, Namur
G	Control input: active, high current (only with "n" = F)	Control input, active high current
H	Control input: active, Namur (only with "n" = F)	Control input: active, Namur
K	Control input: passive, high current (only with "n" = F)	Control input: passive, high current

① unless otherwise stated only with "n" ≠F

3.2.3 Converter VE code I / O overviews

Non intrinsically safe I/O connections

I/O PCB	**Input / output functions** (U_n<32 VDC, I_n <100 mA U_m = 253 V)
Basic I/O	Active / passive current output with HART
	Status output / control input
	Status output
	Pulse / status output
Modular I/O	Active or passive current output with HART (according to options selected)
	Active or passive pulse status output, highC or Namur (according to options selected)
Modular carrier with 1 or 2 I/O modules	Each module can have one of the three following I/O functions: • Active or passive current output • Active or passive status / pulse output, high current or Namur • Active or passive control input, high current or Namur
Profibus DP I/O	Profibus DP, active
Fieldbus I/O	Profibus PA or Foundation Fieldbus
RS485 Modbus	Modbus, with or without termination

Overview of possible combinations					
Character "n", "p" and "q"	Name I/O circuits	Terminals A, A-	Terminals B, B-	Terminals C, C-	Terminals D, D-
100	OPTIMASSBasic I/O ①	CO (CO (a) over A+)	SO / CI	SO	PO / SO
4pq	Modular I/O ②	"p" ③	"q" ③	CO (a)	PO(a) / SO
6pq					PO / SO
6pq					PO (Namur) / SO
8pq				CO	PO(a) / SO
Bpq					PO / SO
Cpq					PO (Namur) / SO
D88	Fieldbus I/O Profibus PA	Not connected	Not connected	PA	PA
Dpq	Fieldbus I/O Profibus PA ②	"p" ③	"q" ③	FF	FF
E88	Fieldbus I/O Foundation Fieldbus	Not connected	Not connected	FF	FF
Epq	Fieldbus I/O Foundation Fieldbus ②	"p" ③	"q" ③	FF	FF
F00	Profibus DP I/O	Not connected	DP(a)	DP(a)	DP(a)
Fp0	Profibus DP I/O with one module	"p" ③	DP(a)	DP(a)	DP(a)
Gpq	RS485 Modbus	"p" ③	"q" ③	RS485	RS485
Hpq	Modbus with one or two modules				

① VE53 only

② With module carrier and with one or two modules

③ See section on converter VE codes above.

Key: CO = current ouput, CI = control input, PO = pulse output, FF = Foundation Fieldbus, SO = status output

intrinsically safe I/O connections

Ex I/O	I/O functions	
Ex i I/O	Current output plus HART Pulse/ status output	Ex ia IIC U_i = 30 V, I_i = 100 mA (130 mA for VE54),P_i = 1.0 W, C_i = 10nF, L_i = not significant
	Active current output plus HART	Ex ia IIC linear characteristics: Uo = 21 V, I_o = 90 mA, P_o = 0.5 W C_o = 90 nF, L_o = 2.0 mH C_o = 110 nF, L_o = 0.5 mH
Ex i option or Ex i option 2	Passive current input Current output Pusle / status output / control input	Ex ia IIC Ui = 30 V, I_i = 100 mA (130 mA for VE54), P_i = 1.0 W Ci = 10 nF, L_i = not significant
	Active current output	Ex ia IIC linear characteristics: U_o = 21 V, I_o = 90 mA, P_o = 0.5W C_o = 90 nF, L_o = 2.0 mH C_o = 110 nF, L_o = 0.5 mH
	Active current input	Ex ia IIC linear characteristics: U_o = 24.1 V, L_o = 99 mA, P_o = 0.6 W C_o = 75 nF, L_o = 0.5mH
Fieldbus I/O	Profibus PA Foundation Fieldbus	Ex ia IIC U_i = 24 V, L_i = 380 mA, P_i = 5.32 W, C_i = 5 nF, L_i = 10 µH Intrinsically safe Fieldbus complies with the FISCO model.

Overview of possible combinations

Character "n", "p" and "q"	Name I/O circuits	Terminals A, A-	Terminals B, B-	Terminals C, C-	Terminals D, D-
200	Ex i I/O	Not connected	Not connected	CO (a)	PO /SO
300		Not connected	Not connected	CO	PO /SO
210	Ex i I/O with Ex i options	CO (a)	PO / SO / CI	CO (a)	PO /SO
220		CO	PO / SO / CI	CO	PO /SO
310		CO (a)	PO / SO / CI	CO	PO /SO
320		CO	PO / SO / CI	CO	PO /SO
D00	Profibus PA	Not connected	Not connected	PA	PA
D10	Profibus PA (with Ex i options)	CO (a)	PO / SO / CI	PA	PA
D20		CO	PO / SO / CI	PA	PA
E00	Foundation Fieldbus	Not connected	Not connected	FF	FF
E10	Foundation Fieldbus (with Ex i options)	CO (a)	PO / SO / CI	FF	FF
E20		CO	PO / SO / CI	FF	FF

The output connections to the mass flow sensor have the values shown in the table below. No further intrinsic safety evaluation is required if: a) cable length provided by manufacturer is not exceeded, or b) it is within maximum limits. See section on cable parameters.

Maximum converter values

VE53 type converters		
Driver circuit, intrinsically safe. Type of protection intrinsic safety: Ex ia IIC / Ex ib IIC		
Terminals PCB Board	Maximum values	
DR+, DR-	U_o	11.8 V
	I_o	1325 mA
	P_o	0.53 W
	C_o	500 nF
	L_o	36 µH
Sensor circuit, intrinsically safe. Type of protection intrinsic safety: Ex ia IIC / Ex ib IIC		
Terminals PCB Board	Maximum values	
SA+, SA-, SB+, SB-	U_o	11.8 V
	I_o	13 mA
	P_o	39 mW
	C_o	90 nF
	L_o	100 mH
	Linear characteristic	
RTD / DMS circuit, intrinsically safe. Type of protection intrinsic safety: Ex ia IIC / Ex ib IIC		
Terminals PCB Board	Maximum values	
T1, T2, T3, T4	U_o	11.8 V
	I_o	9 mA
	P_o	27 mW
	C_o	310 nF
	L_o	1 mH
	Linear characteristic	

VE54 type converters		
Driver circuit, intrinsically safe. Type of protection intrinsic safety: Ex ia IIC / Ex ib IIC		
Terminals PCB Board	Maximum values	
DR+, DR-	U_o	11.8 V
	I_o	1325 mA
	P_o	0.53 W
	C_o	1000 nF
	L_o	36 µH
Sensor circuit, intrinsically safe. Type of protection intrinsic safety: Ex ia IIC / Ex ib IIC		
Terminals PCB Board	Maximum values	

SA+, SA-, SB+, SB-	U_o	11.8 V
	I_o	13 mA
	P_o	39 mW
	C_o	90 nF
	L_o	100 mH
	Linear characteristic	
RTD / DMS circuit, intrinsically safe. Type of protection intrinsic safety: Ex ia IIC / Ex ib IIC		
Terminals PCB Board	Maximum values	
T1, T2, T3, T4	U_o	11.8 V
	I_o	10.5 mA
	P_o	31 mW
	C_o	340 nF
	L_o	100 mH
	Linear characteristic	

Notes:

- Options separated with "/" are set by the user in the converter.
- Options separated with "or" are hardware options and must be ordered.
- All outputs are passive unless marked differently.
- I/O circuits shows as Ex i are always in the intrinsically safe (Ex ia) protection category. Fieldbus I/O, Profibus, Fieldbus I/O and Foundation Fieldbus can all be in the intrinsically safe category.
- A maximum of four intrinsically safe (Ex ia) I/Os are possible. All intrinsically safe circuits are galvanically insulated, with respect to earth and each other. To prevent the possible hazard of combined voltages and currents, the wiring of Ex ia circuits must be separated and where applicable, local legislation / regulations should be followed. For example: IEC/EN 60079-14 clause 12.2.
- The Ex ia signal I/Os can only be connected to other Ex ia or ib certified devices (for example intrinsically safe isolation amplifiers) even if such devices are installed in the non-hazardous area.
- Connection to non Ex i devices will mean that the meter is no longer intrinsically safe ;
- Terminals L and N (or L+ and L-) for power supply connection are not intrinsically safe. To achieve the required separation between the non-Ex i and the Ex i circuits (IEC / EN 60079-11) the power supply terminals have a touch guard (cover) that can be closed and secured with a snap-in lock. The touch guard (cover) MUST be in the closed position before power is supplied to the converter.
- Do not try to repair flameproof joints. For more information regarding flameproof joints, please contact the manufacturer.

4.1 General

The manufacturer recommends that flowmeters installed in hazardous areas should be inspected at regular intervals. As part of the inspection procedure, check the flameproof converter housing and covers for any signs of damage or corrosion.

4.2 Replacing the power supply fuse

DANGER!
Work on the signal converter electronics may only be performed when disconnected from the power supply.

DANGER!
Observe the waiting period for Ex devices.

WARNING!
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

- Remove the front panel. Use a small screwdriver to open the plastic clips that hold the display.
- Remove the 2 locking screws.
- Carefully pull the electronics out of the housing.
- When the unit is almost removed from the converter housing, disconnect the rectangular (10 way) blue connector at the back of the unit. This connector is for the flow sensor circuits.
- The power supply fuse is contained in a fuse holder located at the back of the electronics unit.
- The table below gives the specifications for the correct fuse.

Cartrige fuse size 5 x 20mm (type H according to IEC 60127-2/V)		
Power supply	**Time lag**	**Krohne part No**
12...24 VDC	250 V / 2 A	5060200000
24 VAC	250 V / 2 A	5060200000
100...230 VAC	250 V / 0.8 A	5080850000

4.3 Returning the device to the manufacturer

4.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

WARNING!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

WARNING!
If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*

4.3.2 Form (for copying) to accompany a returned device

CAUTION!
To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:		Address:
Department:		Name:
Tel. no.:		Fax no. and/or Email address:Email address:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:		radioactive
		water-hazardous
		toxic
		caustic
		flammable
		We checked that all cavities in the device are free from such substances.
		We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

4.3.3 Disposal

LEGAL NOTICE!
Disposal must be carried out in accordance with legislation applicable in your country.

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:

According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.
The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
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- Process Analysis
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