TRICOR®

Coriolis Mass Flow Meter with TCE 8000 transmitter

TRICOR Coriolis Technology

Manual-Version

TCM_E80_CLASSIC_M_EN_190215_E010

SW-Version

This manual is valid for

Main SW: Mv3.40 and higher

Display SW: Dv3.40 and higher

Index

1. General Information

1.1. Features

The TRICOR CLASSIC product line meets general industrial requirements with out-of-the-box ease of use. Lower cost and lower performance specs meet broader application needs. Typically used in paint, coatings and dosing of non-corrosive fluid requiring 0.3 % accuracy and low to zero maintenance.

Features

- FlushableTCE 8000 transmitters with an easy-to-use interface
- Economically-priced, non-calibrated but with excellent repeatability
- Optional custom-calibrated meters with high performance specifications
- No moving parts
- Simultaneous measuring of mass flow, density and temperature
- Calculation of volume flow as well as mass and volume total
- Flushable

The TRICOR CLASSIC Mass Flow Meters are available as compact versions with onsite display and as meter with remote display for wall or panel mount.

All versions are available as standard version as well as Ex certified for hazardous locations (ATEX, IECEx, cCSAus).

The meters provide the following features:

- A graphic display
- Menu driven control with soft keys for easy operation (also without manual)
- Magnet hall switches for Ex areas
- Two freely programmable 4 … 20 mA outputs
- One freely programmable frequency output
- One control input and one control output
- RS485 interface

Available options are:

- HART® interface
- One 4 … 20 mA input for pressure measurement
- Pressure compensation
- Foundation Fieldbus® communications

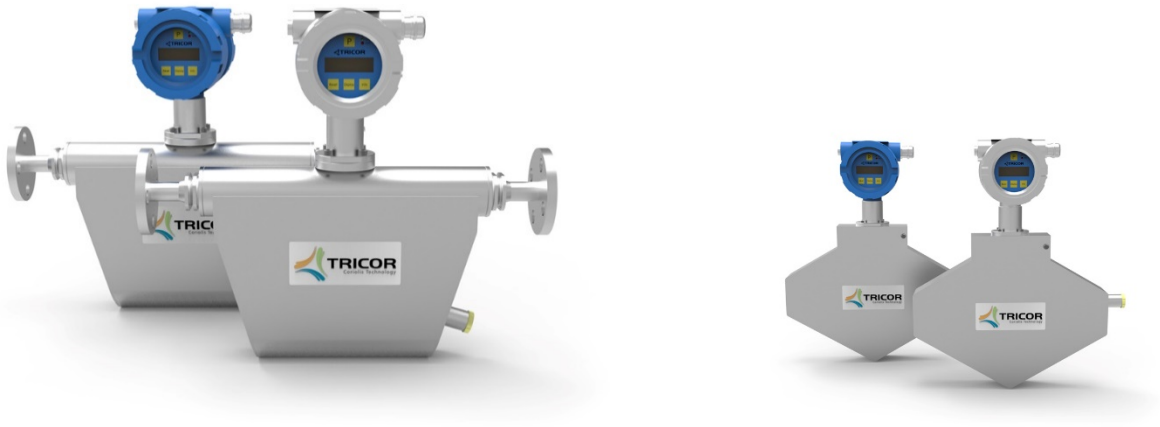


Fig. 1: Compact versions

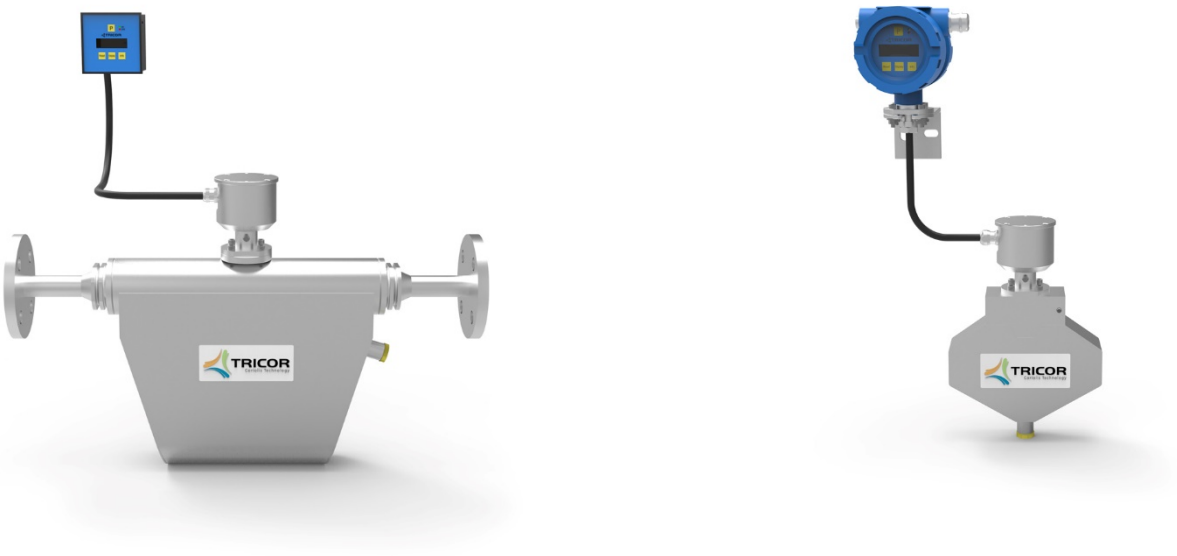


Fig. 2: Separate version with panel mount (left) or wall mount (right) transmitter

1.2. Safety

1.2.1. General Safety

All statements regarding safety of operation and technical data in this manual will only apply when the TRICOR CLASSIC Mass Flow Meter is operated correctly in accordance with this manual.

The specification for Ingress Protection (IPxx) will only apply when all connectors are caped properly with the corresponding counterpart with the same or better IP rating. Cable glands must be populated with cables with the specified diameter and closed properly. The display cover must be closed.

To guarantee the degree of Ingress Protection, ensure that cable entries are properly sealed. Thread seal or cable glants with gasket should be used.

During operation all openings of the housing must be closed unless otherwise is noted in this manual.

All electrical connections to the load and to the supply must be made with shielded cables unless otherwise is noted in this manual. The TCM must be grounded.

As a protection against fire in the positive supply, a fuse with a current rating not higher than the current carrying capacity of the cable used is required.

Before installing the Flow Meter and transmitter, the user is responsible to ensure that all wetted parts are compatible with the fluid or gas to be measured.

The user has to adhere to the instructions for installing electrical devices and corresponding instructions.

The devices described in this manual may only be connected and operated by authorized and qualified personnel.

1.2.2. Special Condition of Use for Ex Installations

Before installing and using TRICOR CLASSIC Mass Flow Meters in hazardous locations it is absolutely needed to read and to observe this Installation Manual and “Control drawing for hazardous areas”.

In hazardous locations the enclosure lids of the transmitter must not be opened under any circumstances if the supply voltage is alive. For operating the keys the magnet must be used.

The analog and digital I/O signals are not specified for driving Ex i circuits.

When using long cables make sure that the maximum inductances and capacitances for the respective voltage or gas group are not exceeded.

WARNING!

All specified limiting values and parameters stated in “Control drawing for hazardous areas” must be adhered to at all times. Failure to do so can cause equipment failure and can lead to serious injury or death.

WARNING!

Potential risk of sparking from aluminum alloy enclosure due to impact and friction. This shall be considered during installation.

WARNING!

The equipment contains a shunt Zener diode interface, which requires connection to a suitable earth in accordance with IEC/EN 60079-14.

WARNING!

The installer shall ensure that the maximum ambient temperature of the equipment when installed is not exceeded.

WARNING!

Process temperature range is determined by temperature class for remote version TRICOR transmitter (see "Control drawing for hazardous areas ").

1.2.3. Rupture Disc Handling

All TRICOR CLASSIC flow meters are fitted with a rupture disc installed on the case. A rupture disc, also known a "burst disc," is a pressure relief device to protect systems from over-pressurization. In a Coriolis flow meter, the rupture disc prevents pressure from building up inside the welded case. In the event of an extreme failure where the internal flow tubes leak, the rupture disc element will open up once the internal case pressure exceeds approximately 4 bar [58 psi].

To avoid personal injury or property damage, connect a pipe or hose to the rupture disc housing in order to direct the relieved liquid and/or gas from the meter's case through the rupture disc to a safe location, away from operators in the area. It is the user's sole responsibility for the design of adequate venting and installation of adequate vent piping or directional flow after rupture occurs with the rupture disc as intended.

Particles may discharge when the rupture disc ruptures. These particles may be part of the rupture disc itself, or other environmental matter in the system. It is the user's sole responsibility to ensure that the particles are directed to a safe location to prevent personal injury or property damage.

WARNING!

Take care not to puncture the rupture disc when installing a pipe or fitting to the rupture disc housing, which could cause premature failure of the rupture disc.

The flow meter case is filled with a dry inert gas to prevent moisture from building up. Any puncture or other physical damage to the rupture disc would allow moisture into the meter case, compromising the integrity of the meter and potentially resulting in inaccurate measurement results or total meter failure over time.

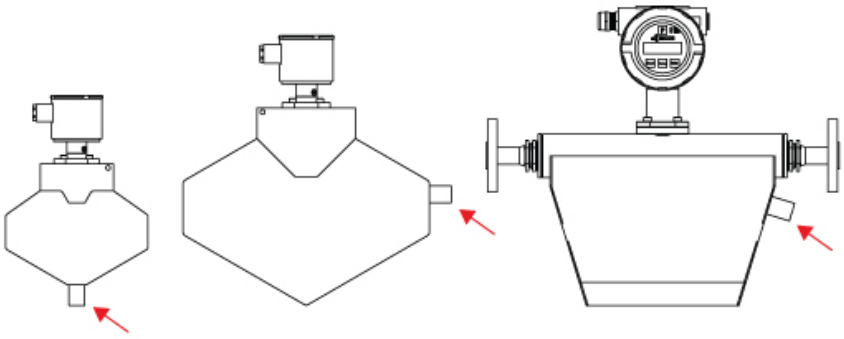


Fig. 3: Rupture disc locations vary by the meter size and style

Fig .4: Warning sticker found near the rupture disc on all meters

1.2.4. Warnings in this Manual

NOTE:

Notes provide important information for the correct usage of the equipment. If the notes are not observed, a malfunction of the equipment is possible.

WARNING!

Warnings provide very important information for the correct usage of the equipment. Not observing the warnings may lead to danger for the equipment and to danger for health and life of the user

1.3. Ordering Codes and Accessories

1.3.1. Ordering Codes (other options available)

TCE	8	X	X	X	-	X	-	X	X	X	X	-	XX	-	XX
Housing material: Aluminum	8	0													
Housing material: stainless steel 1.4404 [AISI 316L]	8	1													
Electronics for TCM 0325 to TCM 7900			0	1											
Electronics for TCM 028K to TCM 065K			1	1											
Electronics for TCM 230K			1	2											
Housing															
Wall mount (housing for ½" NPT cable glands)						W									
Wall mount (housing for M20x1.5 cable glands)						I									
Panel mount[1)]						S									
Options															
Interface[2)]															
RS485 (Modbus RTU)								S							
R485 (Modbus RTU) + HART®								A							
Supply Voltage															
24 V DC + 90 ... 264 V AC (only housing S)									B						
24 V DC									D						
90 ... 264 V AC (only housing W, I)									M						
Electronic Options															
Standard										S					
Pressure compensation, 4 ... 20 mA input										A					
Cable Length															
3 Meters [≈ 10 ft.], Standard (high temperature)											S (H)				
6 Meters [≈ 20 ft.] (high temperature)											B (I)				
10 Meters [≈ 33 ft.] (high temperature)											C (J)				
15 Meters [≈ 49 ft.] (high temperature)											D (O)				
20 Meters [≈ 65 ft.] (high temperature)											E (P)				
3 Meters [≈ 10 ft.], offshore cable											F				
D-SUB Connector (housing S), seperate cable required											N				
Ex-Protection															
ATEX + IECEx (Zone 1)													Ex		
ATEX (Zone 2)													Exn		
cCSAus[3)]													Ex1		
cCSAus (TCE 6000)													Ex2		
ATEX + IECEx + cCSAus triple approval[3)]													Ex3		
EAC (TR-CU)													ExR		
KGS (Korean)													ExK		
Special Options															
NOC (Net Oil Computer)															01

[1)] Only for TCE 80**.
[2)] Other interfaces on request.
[3)] For Ex1 and Ex3 the transmitter is only available in aluminum housing.

TCM XXXX - XX - X X X X - X X X X - Ex - XX	
Process Connections[4]	
see page 17 ff	XX
Mechanical Options	
Medium Temperature Range	
-40 °C ... +100 °C [-40 °F ... +212 °F]	S
-40 °C ... +150 °C [-40 °F ... +302 °F], Ex_{max}: 135 °C [275 °F]	H
-40 °C ... +70 °C [-40 °F ... +158 °F], Ex, compact	E
-60 °C ... +200 °C [-76 °F ... +392 °F]	T
Pressure Range	
With rupture disc max. 4 bar [58 psi]	G
Mechanical Design	
Standard	S
Face to Face Length	
Standard (other length on request)	S
Electronics Options	
Electronics Type	
Junction box, 1.4404 [316L]	H
Meter mount, die cast aluminum housing for ½" NPT cable glands[5]	C
Meter mount, die cast aluminum housing for M20x1.5 cable glands[5]	K
Meter mount, stainless steel housing for ½" NPT cable glands[5]	M
Meter mount, stainless steel housing for M20x1.5 cable glands[5]	O
Meter mount electronics TCE 6000[6]	F
Interface[7]	
RS485 (Modbus RTU)	S
RS485 (Modbus RTU) and HART®	A
RS485 (Modbus RTU) + FF (not with Ex)	B
FF (Foundation Fieldbus®)	D
RS485 (Modbus RTU) + USB (only TCE 6000)	F
Not used	Z
Supply Voltage	
24 V DC	D
90 ... 264 V AC	M
Not used	Z
Options	
Pressure compensation, 4 ... 20 mA input	A
8 pin I/O connector (TCE 6000 only)	B
Optical I/O (TCE 6000 only)	C
No option	S
EX-Protection	
ATEX + IECEx (Zone 1)	Ex
ATEX (Zone 2)	Exn
cCSAus[8]	Ex1
cCSAus (TCE 6000)	Ex2
ATEX + IECEx + cCSAus triple approval[8] [9]	Ex3
EAC (TR-CU)	ExR
KGS (Korea)	ExK
Special Options	
NOC (Net Oil Computer)	01

4) For connections not indicated with installation length, please contact manufacturer.
5) For TCM compact version with Ex-protection temperature class T4 only.
6) Ex-protection only available in the option Exn. TCE 6000 transmitter is not applicable for TCM 230K.
7) Other interfaces on request.
8) For Ex1 and Ex3 the transmitter is only available in aluminum housing.
9) Only with remote transmitter.

1.3.2. Process Connections

1.3.2.1. Slip on, process connection dim. + facing acc. ANSI B16.5, Installation length in mm [inch]

Process connection[10)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
½" ANSI flange class 150	AA	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
½" ANSI flange class 300	AB	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
½" ANSI flange class 600	AC	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
½" ANSI flange class 900	AD	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
½" ANSI flange class 1500	BV	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]				
½" ANSI flange class 2500	BE	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
¾" ANSI flange class 150	BA	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
¾" ANSI flange class 300	BB	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
¾" ANSI flange class 600	BC	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
¾" ANSI flange class 900	BD	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
¾" ANSI flange class 1500	AI	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
1" ANSI flange class 150	AE	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]	625 [24.61]		
1" ANSI flange class 300	AF	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]	625 [24.61]		
1" ANSI flange class 600	AG	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]	625 [24.61]		
1" ANSI flange class 900	AH	390 [15.35]	390 [15.35]			460 [18.11]	460 [18.11]	625 [24.61]		
1" ANSI flange class 1500	AQ	390 [15.35]	390 [15.35]			460 [18.11]				
1" ANSI flange class 2500	BN	390 [15.35]	390 [15.35]							
1½" ANSI flange class 150	AJ					460 [18.11]	460 [18.11]	625 [24.61]		
1½" ANSI flange class 300	AK					460 [18.11]	460 [18.11]	625 [24.61]		
1½" ANSI flange class 600	AL					460 [18.11]	460 [18.11]	625 [24.61]		
1½" ANSI flange class 900	AM					460 [18.11]	460 [18.11]	625 [24.61]		
1½" ANSI flange class 1500	BI					460 [18.11]				

[10)] Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.2.2. Slip on, process connection dim. + facing acc. ANSI B16.5, Installation length in mm [inch]

Process connection[11)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
2” ANSI flange class 150	AN							625 [24.61]	830 [32.68]	
2” ANSI flange class 300	AO							625 [24.61]	830 [32.68]	
2” ANSI flange class 600	AP							625 [24.61]	830 [32.68]	
2” ANSI flange class 900	AR							625 [24.61]	830 [32.68]	
2” ANSI flange class 1500	BU								830 [32.68]	
2½” ANSI flange class 150	BT								830 [32.68]	
2½” ANSI flange class 300	BY								830 [32.68]	
2½” ANSI flange class 600	BQ								830 [32.68]	
2½” ANSI flange class 900	BW								830 [32.68]	
3” ANSI flange class 150	AS							625 [24.61]	830 [32.68]	915 [36.02]
3” ANSI flange class 300	AT								830 [32.68]	915 [36.02]
3” ANSI flange class 600	AU								830 [32.68]	915 [36.02]
3” ANSI flange class 900	AV								830 [32.68]	915 [36.02]
4” ANSI flange class 150	AW								830 [32.68]	915 [36.02]
4” ANSI flange class 300	AX								830 [32.68]	915 [36.02]
4” ANSI flange class 600	AY								830 [32.68]	915 [36.02]
4” ANSI flange class 900	AZ								830 [32.68]	915 [36.02]
5” ANSI flange class 150	BF									915 [36.02]
5” ANSI flange class 300	BG									915 [36.02]
5” ANSI flange class 600	BH									915 [36.02]
5” ANSI flange class 900	BJ									915 [36.02]
6” ANSI flange class 150	BM									915 [36.02]
6” ANSI flange class 600	BX									915 [36.02]

[11)] Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.2.3. Slip on, process connection dim. + facing acc. EN 1092-1 Form B, Installation length in mm [inch]

Process connection[12)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
DN 10, EN flange PN 40	DS	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
DN 10, EN flange PN 63	DZ	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
DN 10, EN flange PN 100	EA	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
DN 10, EN flange PN 160	EB	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
DN 10, EN flange PN 250	EC	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
DN 10, EN flange PN 400	ED	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]					
DN 15, EN flange PN 40	DA	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
DN 15, EN flange PN 63	EF	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
DN 15, EN flange PN 100	DB	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]			
DN 15, EN flange PN 160	EG	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]				
DN 15, EN flange PN 250	EH	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]				
DN 15, EN flange PN 400	EI	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]				
DN 20, EN flange PN 40	DT					460 [18.11]	460 [18.11]			
DN 25, EN flange PN 40	DC	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]	625 [24.61]		
DN 25, EN flange PN 63	EJ	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]	625 [24.61]		
DN 25, EN flange PN 100	DD	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]	460 [18.11]	625 [24.61]		
DN 25, EN flange PN 160	DW	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]				
DN 25, EN flange PN 160 Mat.: 2.4602	DW							625 [24.61]		
DN 25, EN flange PN 250	DP	390 [15.35]	390 [15.35]	420 [16.54]	420 [16.54]	460 [18.11]				
DN 25, EN flange PN 400	DV	390 [15.35]	390 [15.35]			460 [18.11]				
DN 32, EN flange PN 40	DR					460 [18.11]	460 [18.11]	625 [24.61]		

[12)] Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.2.4. Slip on, process connection dim. + facing acc. EN 1092-1 Form B, Installation length in mm [inch]

Process connection[13)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
DN 40, EN flange PN 40	DE					460 [18.11]	460 [18.11]	625 [24.61]		
DN 40, EN flange PN 63	EK					460 [18.11]	460 [18.11]	625 [24.61]		
DN 40, EN flange PN 100	DF					460 [18.11]	460 [18.11]	625 [24.61]		
DN 40, EN flange PN 160	EL					460 [18.11]				
DN 40, EN flange PN 250	EM					460 [18.11]				
DN 40, EN flange PN 400	EN					460 [18.11]				
DN 50, EN flange PN 16	EO							625 [24.61]	830 [32.68]	
DN 50, EN flange PN 40	DG							625 [24.61]	830 [32.68]	
DN 50, EN flange PN 63	EP							625 [24.61]	830 [32.68]	
DN 50, EN flange PN 100	DH							625 [24.61]	830 [32.68]	
DN 65, EN flange PN 16	EQ								830 [32.68]	
DN 65, EN flange PN 40	DQ								830 [32.68]	
DN 65, EN flange PN 63	ER								830 [32.68]	
DN 65, EN flange PN 100	ES								830 [32.68]	
DN 80, EN flange PN 16	ET								830 [32.68]	915 [36.02]
DN 80, EN flange PN 40	DJ								830 [32.68]	915 [36.02]
DN 80, EN flange PN 63	EU								830 [32.68]	915 [36.02]
DN 80, EN flange PN 100	DK								830 [32.68]	915 [36.02]

[13)] Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.2.5. Slip on, process connection dim. + facing acc. EN 1092-1 Form B, Installation length in mm [inch]

Process connection[14)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
DN 100, EN flange PN 16	EV								830 [32.68]	915 [36.02]
DN 100, EN flange PN 40	DL								830 [32.68]	915 [36.02]
DN 100, EN flange PN 63	EW								830 [32.68]	915 [36.02]
DN 100, EN flange PN 100	DM								830 [32.68]	915 [36.02]
DN125, EN flange PN 16	EX									915 [36.02]
DN125, EN flange PN 40	DN									915 [36.02]
DN125, EN flange PN 63	EY									915 [36.02]
DN125, EN flange PN 100	DO									915 [36.02]
DN150, EN flange PN 16	DI									915 [36.02]
DN150, EN flange PN 40	DX									915 [36.02]

1.3.2.6. EN flange weld neck, Installation length in mm [inch]

Process connection[14)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
DN 32, PN40 DIN 2635 – 1.4404/316L Type C Face	VO					460 [18.11]	460 [18.11]	625 [24.61]		
DN 32, PN64 DIN 2636 – 1.4404/316L Type E Face	VP					460 [18.11]	460 [18.11]	625 [24.61]		
DN 32, PN100 DIN 2637 – 1.4404/316L Type E Face	VQ					460 [18.11]	460 [18.11]	625 [24.61]		

1.3.2.7. Triclamp, Installation length in mm [inch]

Process connection[14)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
½" Triclamp	TA	220 [8.66]	220 [8.66]	250 [9.84]	250 [9.84]					
DN 25 Triclamp PN 16 DIN 32676	TL	210 [8.27]	210 [8.27]	240 [9.45]	240 [9.45]	460 [18.11]	460 [18.11]	625 [24.61]		

[14)] Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.2.8. Female Thread, Installation length in mm [inch]

Process connection[15)]	Code	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
¼" NPT female thread	FJ	110 [4.33]	110 [4.33]	140 [5.51]	140 [5.51]					
¾" NPT female thread	FL	110 [4.33]	110 [4.33]	140 [5.51]	140 [5.51]	460 [18.11]	460 [18.11]			
½" NPT female thread	FK	110 [4.33]	110 [4.33]	140 [5.51]	140 [5.51]	460 [18.11]	460 [18.11]			
2" NPT female thread	FQ								880 [34.65]	
¼" G, female thread	FB	110 [4.33]	110 [4.33]	140 [5.51]	140 [5.51]					
⅜" G, female thread	FR	110 [4.33]	110 [4.33]	140 [5.51]	140 [5.51]					
¾" G, female thread	FC	110 [4.33]	110 [4.33]	140 [5.51]	140 [5.51]	460 [18.11]	460 [18.11]			
½" G, female thread	FA	110 [4.33]	110 [4.33]	140 [5.51]	140 [5.51]	460 [18.11]	460 [18.11]			

1.3.3. Accessories

1.3.3.1. TRICOR Connection Cable (TCC) for panel-mounted housing

			TCC	X	X	-	X	X
Cable Specifications/Connections								
Cable	**Connector TCE**	**Connector TCM**	**Devices**					
Standard cable	SUB-D, 9-pin	cable end sleeves (8-pol.)	TCE 8**1-S-	0	2			
Standard cable	SUB-D, 9-pin/ Din-Rail mounting	cable end sleeves (8-pol.)	TCE 8**1-S-	0	4			
High temperature cable	SUB-D, 9-pin	cable end sleeves (8-pol.)	TCE 8**1-S-	0	9			
High temperature cable	SUB-D, 9-pin/ Din-Rail mounting	cable end sleeves (8-pol.)	TCE 8**1-S-	1	0			
Length								
3 meter (Standard)	[≈ 10 ft.]						0	3
6 meter	[≈ 20 ft.]						0	6
10 meter	[≈ 33 ft.]						1	0
15 meter	[≈ 49 ft.]						1	5
20 meter	[≈ 66 ft.]						2	0

[15)] Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.3.2. Additional Accessories

Accessories for TCE 8*** transmitter	Ordering Code
USB interface cable to RS485, 1.8 m (TRICOR configurator)	CON.USB.RS-ISO
IP65 Protection for TCE-80**-S	IPS 9-9
adapter TCE-80**-S for rail mounting	HSA 96
Service and calibration	**Ordering Code**
DAkkS-Calibration (ILAC) according to DIN EN ISO/IEC 17025:2005	DAkkS-Calibration
Oxygen cleaning TCM	Oxygen cleaning TCM
Inspection certificate 3.1 according to DIN 50 049/EN 10204	3.WKZ-0100
TAG Plate 1.4404 [AISI 316L]	TCM-Tag-Plate-1.4404

1.4. Measuring Principle TCM

Two parallel flow tubes inside the TCM Flow Meter are vibrating at their natural frequency in opposite direction. Any mass flow passing through the tubes will delay the vibration at the incoming side and accelerate the vibration at the outgoing side. This causes a small time shift between both ends of the tube. This time shift is measured and used to calculate the mass flow through the tubes.

By measuring the natural frequency of the tubes the density of the medium can be calculated.

As both effects are temperature dependent, the temperature is measured by means of an accurate temperature sensor for correcting the temperature effects on flow and density measurement.

As a result a Coriolis Mass Flow Meter measures directly mass flow, density and temperature of the medium. Knowing the mass flow and the density, also the volume flow can be calculated.

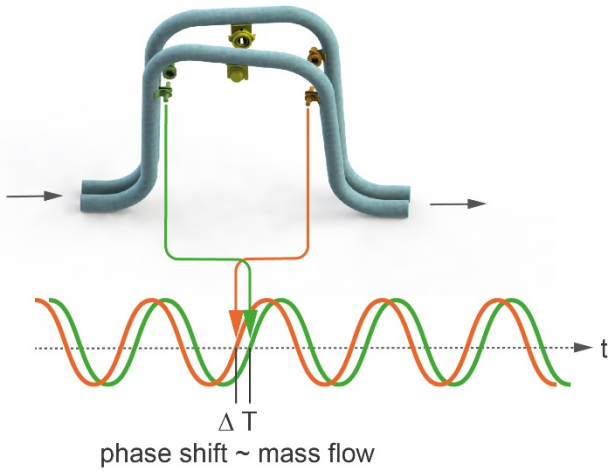


Fig. 5: Principle of operation Coriolis Mass Flow Meter

2. Getting Started

2.1. Unpacking

Verify that you have received the following items:

When you ordered a compact version:

- TCM **** with mounted transmitter
- Instruction manual (printed booklet or www.tricorflow.com/manuals/)

When you ordered a remote version:

- TCM **** with junction box
- TCE 8***
- Connecting cable (for TCE 8***-wall mounted just fixed to the TCE, TCE 8*** with separated cable)
- Instruction manual (printed booklet or www.tricorflow.com/manuals/)

2.2. Operating Elements

2.2.1. TCE 8***-wall mounted and compact version

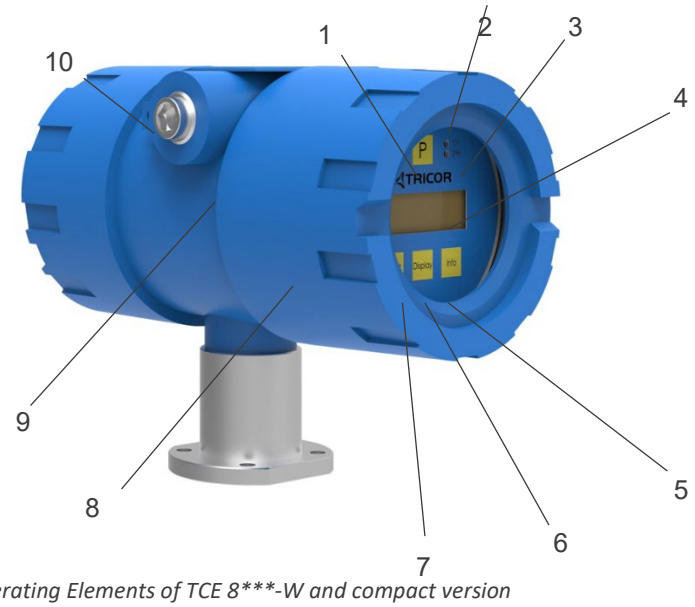


*Fig. 6: Operating Elements of TCE 8***-W and compact version*

1 = Pushbutton “P”, activates/selects the different menus and confirms the settings

2 = LED “OK”, flashes green when there is no error

3 = LED “ERR”, flashes red when an error occurs

4 = Display

5 = Pushbutton “Info”, normal: selects the error menu, setup mode: softkey

6 = Pushbutton “Display”, normal: toggles the display, setup mode: softkey

7 = Pushbutton “Reset”, normal: resets the BATCH TOTAL counter, setup mode: softkey

8 = Front cover

9 = Set screw for front cover (varying position)

10 = Screw for protective ground

Wall mount electronics only (not shown on the picture):

- Cable to the TCM sensor, length as ordered (standard: 3 m [10 ft.])
- Wall mounting bracket

2.2.2. TCE 8***-panel mounted

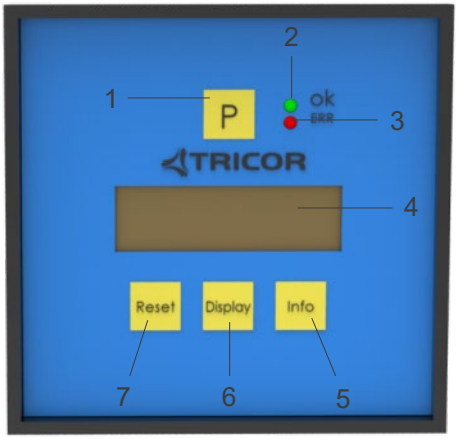


*Fig. 7: Operating Elements of TCE 8***-S*

1 = Pushbutton “P”, activates/selects the different menus and confirms the settings

2 = LED “OK”, flashes green when there is no error

3 = LED “ERR”, flashes red when an error occurs

4 = Display

5 = Pushbutton “Info”, normal: selects the status menu, setup mode: softkey

6 = Pushbutton “Display”, normal: toggles the display, setup mode: softkey

7 = Pushbutton “Reset”, normal: resets the batch counter, setup mode: softkey

For the rear view see chapter 2.3.3.

2.2.3. TCM **** (remote version) terminal

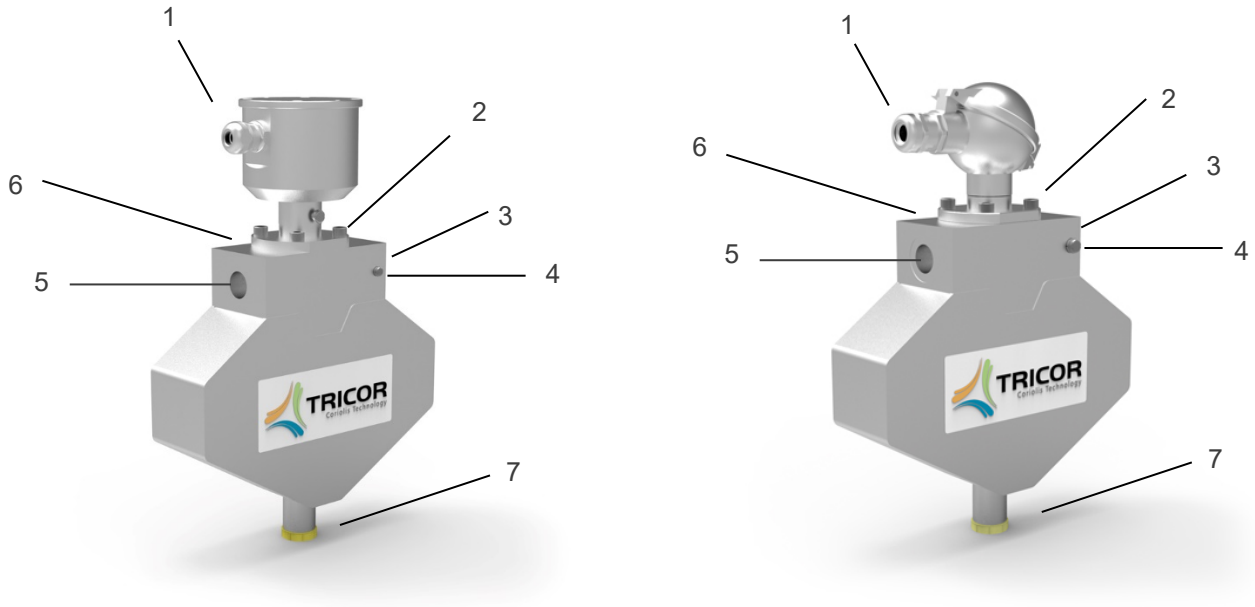


Fig. 8: Operating Elements TCM

1 = Cable gland for cable to the TCE

2 = Locking screw for screw type terminals

3 = Screw for protective ground (TCM 0325 through 3100 only)

4 = Fluid output, flange/thread as ordered

5 = Fluid input, flange/thread as ordered

6 = M6 mounting threads (back side, option, TCM 0325 through 3100 only)

7 = Rupture Disc (burst pressure: 4 bar [58 psi])

Terminal	Signal	Color/Mark	
		Temperature range ≤100 °C [212 °F]	Temperature range >100 °C [212 °F]
1	Driver +	Gray/1	Gray/1
2	Driver -	Pink/2	Gray/2
3	Sensor A +	Blue/3	Gray/3
4	Sensor A -	Red/4	Gray/4
5	Sensor B +	White/5	Gray/5
6	Sensor B -	Brown/6	Gray/6
7	PT1000 +	Green/7	Gray/7
8	PT1000 -	Yellow/8	Gray/8

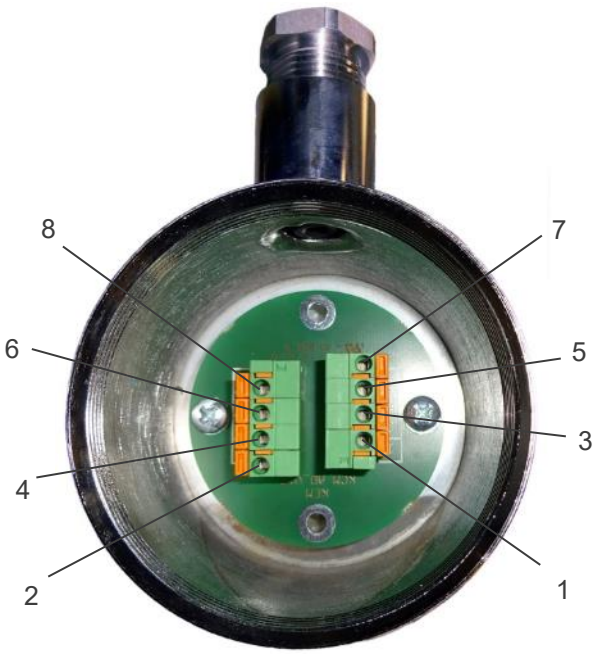
*Tab. 1: Connections TCM ****

Junction box – Type A (Aluminum)

Fig. 9: Electrical terminals Junction box – Type A (Alu)

Junction box – Type H (1.4404 [316L])

Medium temperature range ≤ 100 °C [212 °F]



Junction box – Type H (1.4404 [316L])

Medium temperature range >100 °C [212 °F]

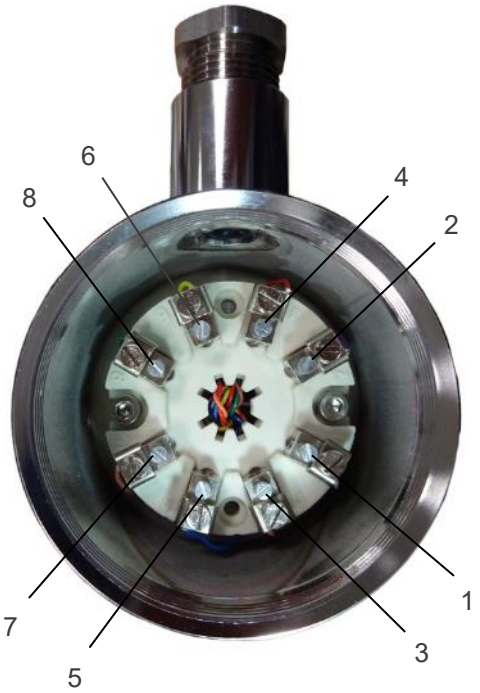


Fig. 10: Electrical terminals Junction box – Type H (1.4404 [316L])

2.3. Pin Assignments

2.3.1. TCE 8***-wall mounted and compact version, non-Ex

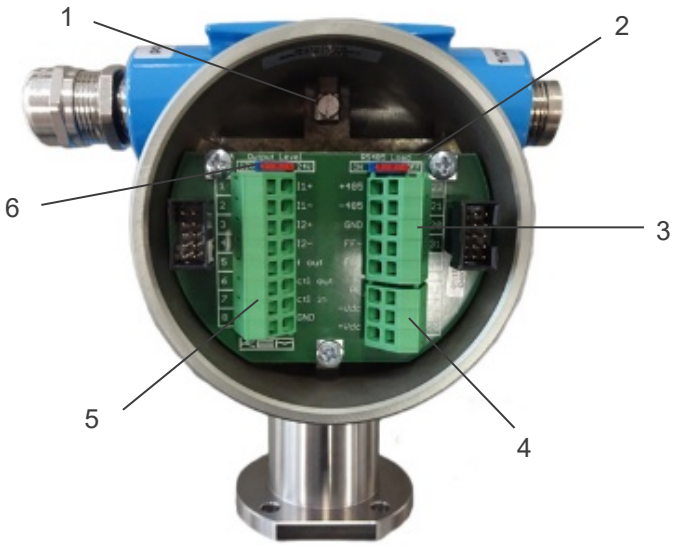


*Fig. 11: Electrical terminals TCE 8***-W and compact version*

1 = Terminal screw for protective ground

2 = Switch for terminating resistor for the RS485 interface

3 = Terminal block for interface

4 = Terminal block power supply

5 = Terminal block for I/O signals

6 = Switch for output level (12 V/24 V) of the frequency and control output

TCE Terminal Connections

1	+I1	Current loop 1 positive terminal
2	-I1	Current loop 1 negative terminal
3	+I2	Current loop 2 positive terminal
4	-I2	Current loop 2 negative terminal
5	F_{OUT}	Frequency/pulse output
6	CTL_{OUT}	Control output
7	CTL_{IN}	Control input
8	GND	Ground (for pins 5 through 7)
20	COMMON	Common (for pins 21 and 22)
21	-RS485	RS485 negative line
22	+RS485	RS485 positive line
30	COMMON	Common (for pins 31 and 32)
31	FF-	Foundation Fieldbus® negative line
32	FF+	Foundation Fieldbus® positive line

24 V DC Supply

50	+V DC	Positive supply voltage (24 V DC)
51	-V DC	Supply ground
52	PE	Protective Ground

100 … 240 V AC Supply

90	L	Phase (AC voltage)
91	N	Neutral
52	PE	Protective Ground

NOTE:

With option “PRESSURE COMPENSATION“ the current loop 1 (Terminal 1 and 2) is an input.

2.3.2. TCE 8***-wall mounted and compact version, Ex certified

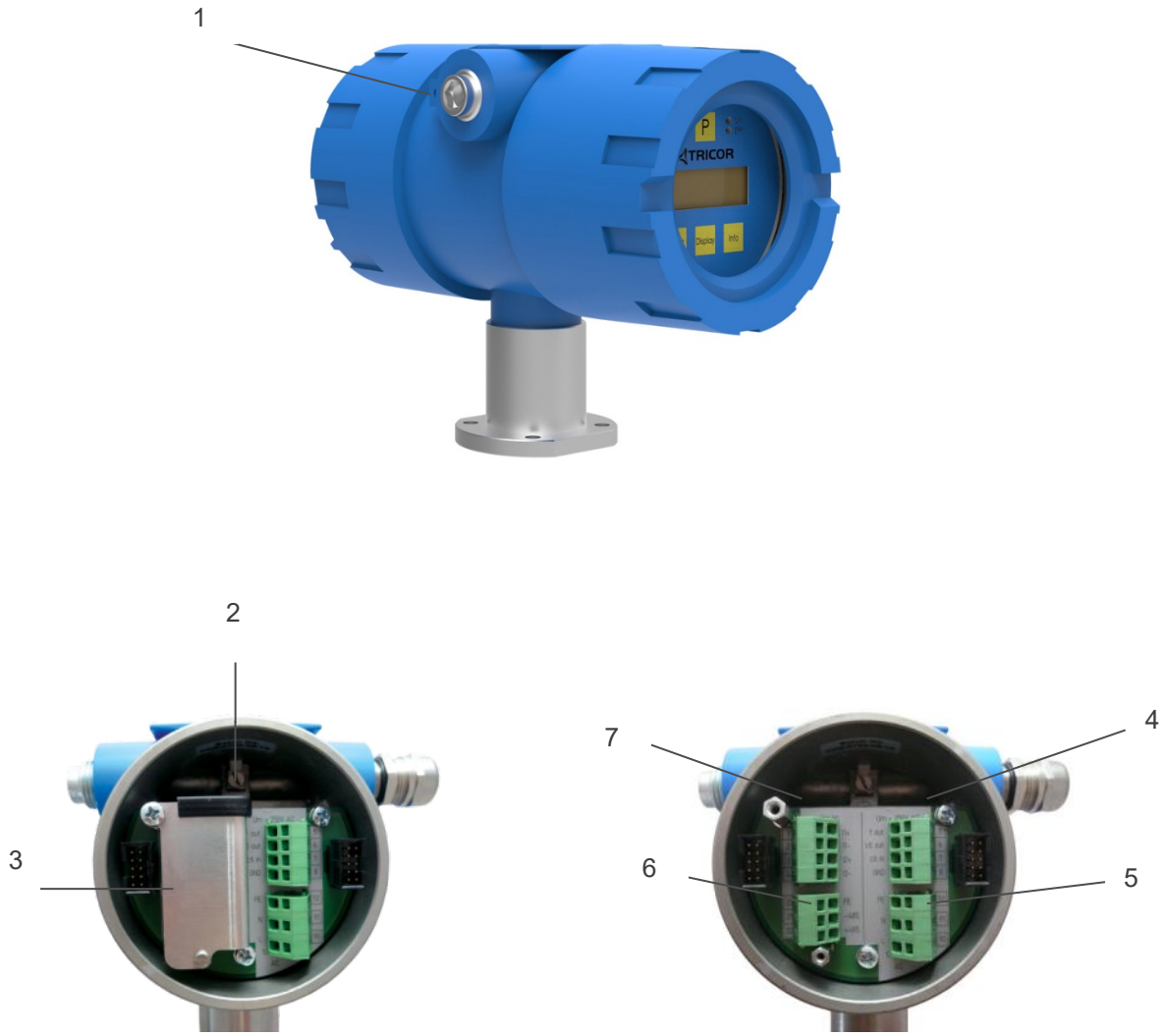


*Fig. 12: Electrical terminals TCE 8***-W-*-Ex*

1 = Terminal screw for protective ground

2 = Terminal screw for protective ground

3 = Protective cover

4 = Terminal block for digital I/O signals (U_M = 250 V DC)

5 = Terminal block power supply (U_M = 250 V DC)

6 = Terminal block for interface (U_M = 30 V DC)

7 = Terminal block for analog I/O signals (U_M = 30 V DC)

TCE Terminal Connections

Terminals with U_M = 30 V DC

1	+I1	Current loop 1 positive terminal
2	-I1	Current loop 1 negative terminal
3	+I2	Current loop 2 positive terminal
4	-I2	Current loop 2 negative terminal
20	COMMON	Common (for pins 21 and 22)
21	-RS485	RS485 negative line
22	+RS485	RS485 positive line
30	COMMON	Common (for pins 31 and 32)
31	FF-	Foundation Fieldbus® negative line
32	FF+	Foundation Fieldbus® positive line

Terminals with U_M = 250 V DC

5	F_{OUT}	Frequency/pulse output
6	CTL_{OUT}	Control output
7	CTL_{IN}	Control input
8	GND	Ground (for pins 5 through 7)

24 V DC Supply

50	+V DC	Positive supply voltage (24 V DC)
51	-V DC	Supply ground
52	PE	Protective Ground

100…240 V AC Supply

90	L	Phase (AC voltage)
91	N	Neutral
52	PE	Protective Ground

NOTE:

With option “PRESSURE COMPENSATION“ the current loop 1 (Terminal 1 and 2) is an input.

2.3.3. Panel Mount version, non-Ex

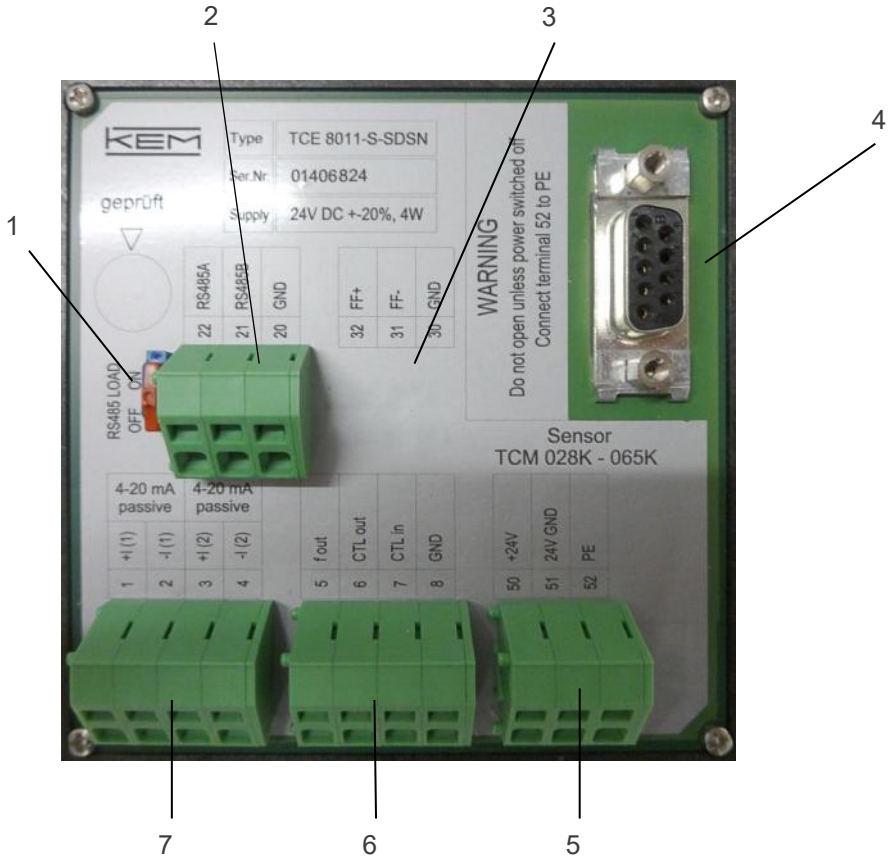


*Fig. 13: Electrical terminals TCE 8***-S*

1 = Sliding switch for activating the 120 Ω terminal resistance for RS485

2 = Cage clamp terminals for interface RS485

3 = Cage clamp terminals for interface Foundation Fieldbus® (option) or relay terminals (option)

4 = Connector to the meter, D-SUB, 9-pin, female

5 = Cage clamp terminals for power supply

6 = Cage clamp terminals for digital I/O signals

7 = Cage clamp terminals for analog I/O signals

TCE Terminal Connections

1	+I1	Current loop 1 positive terminal
2	-I1	Current loop 1 negative terminal
3	+I2	Current loop 2 positive terminal
4	-I2	Current loop 2 negative terminal
5	F_{OUT}	Frequency/pulse output
6	CTL_{OUT}	Control output
7	CTL_{IN}	Control input
8	GND	Ground (for pins 5 through 7)
20	COMMON	Common (for pins 21 and 22)
21	-RS485	RS485 negative line
22	+RS485	RS485 positive line
30	COMMON	Common (for pins 31 and 32)
31	FF-	Foundation Fieldbus® negative line
32	FF+	Foundation Fieldbus® positive line
50	+24 V DC	Positive supply voltage (24 V DC)
51	-24 V DC	Supply ground
52	PE	Protective Ground
90	L	Phase (AC voltage)
91	N	Neutral
52	PE	Protective Ground

Without Foundation Fieldbus® interface there are no terminals 30 … 32.

With option “Relay Out” there are the relay terminals:

40	REL NO	Relay normally open contact
41	REL COM	Relay common
42	REL NC	Relay normally closed contact

NOTE:

With option “PRESSURE COMPENSATION“ the current loop 1 (Terminal 1 and 2) is an input.

2.4. Device Marking

2.4.1. Compact Version

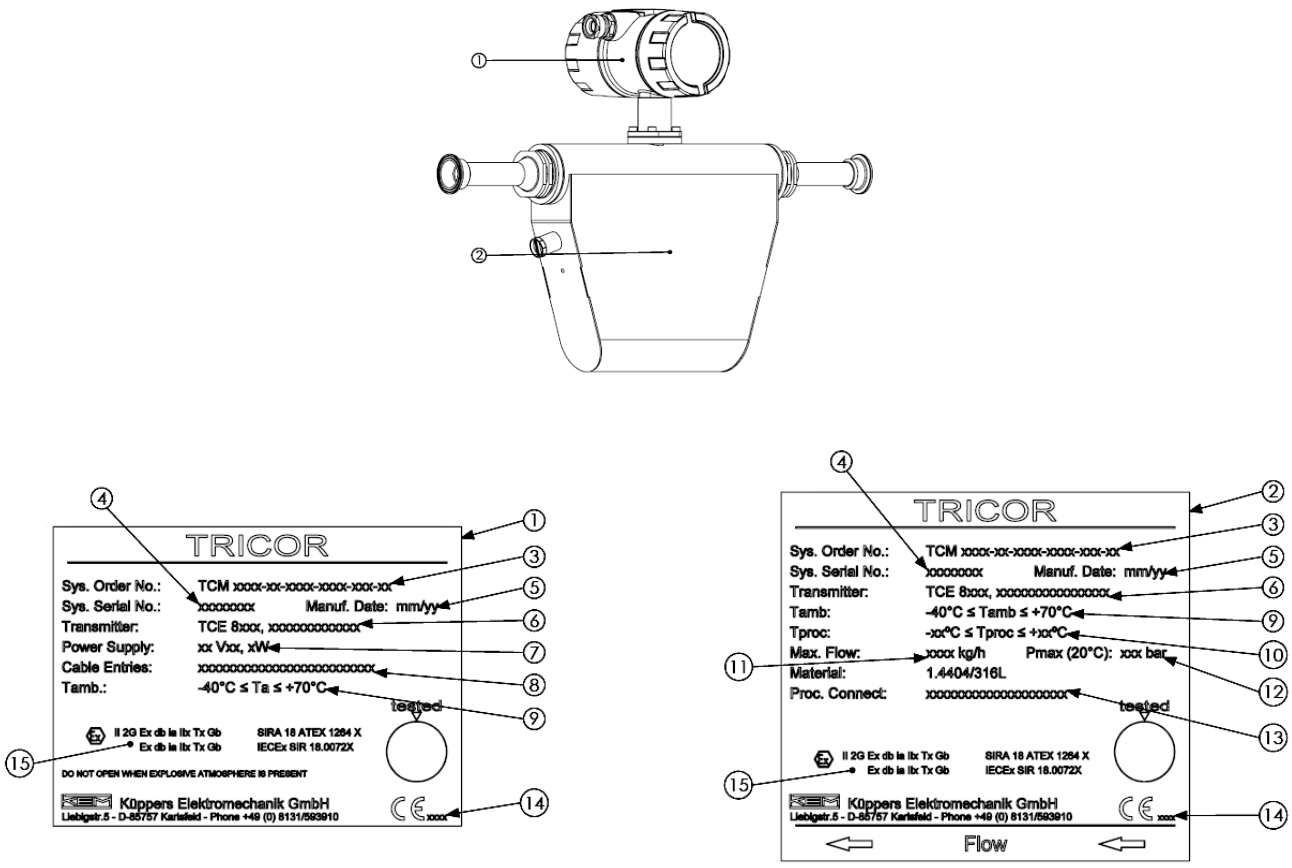


Fig. 14: Device marking TCM compact version

① Transmitter Label
② Sensor Label
③ System Order No.
④ System Serial No.
⑤ Manufacturing Date
⑥ Transmitter
⑦ Transmitter Power Supply
⑧ Cable Entry
⑨ Ambient Temperature Range
⑩ Process Temperature Range
⑪ Maximum Rated Flow
⑫ Maximum Rated Pressure 20 °C [68 °F]
⑬ Process Connection
⑭ ID of the Notification Body
⑮ Certification (optional)

2.4.2. Remote Version

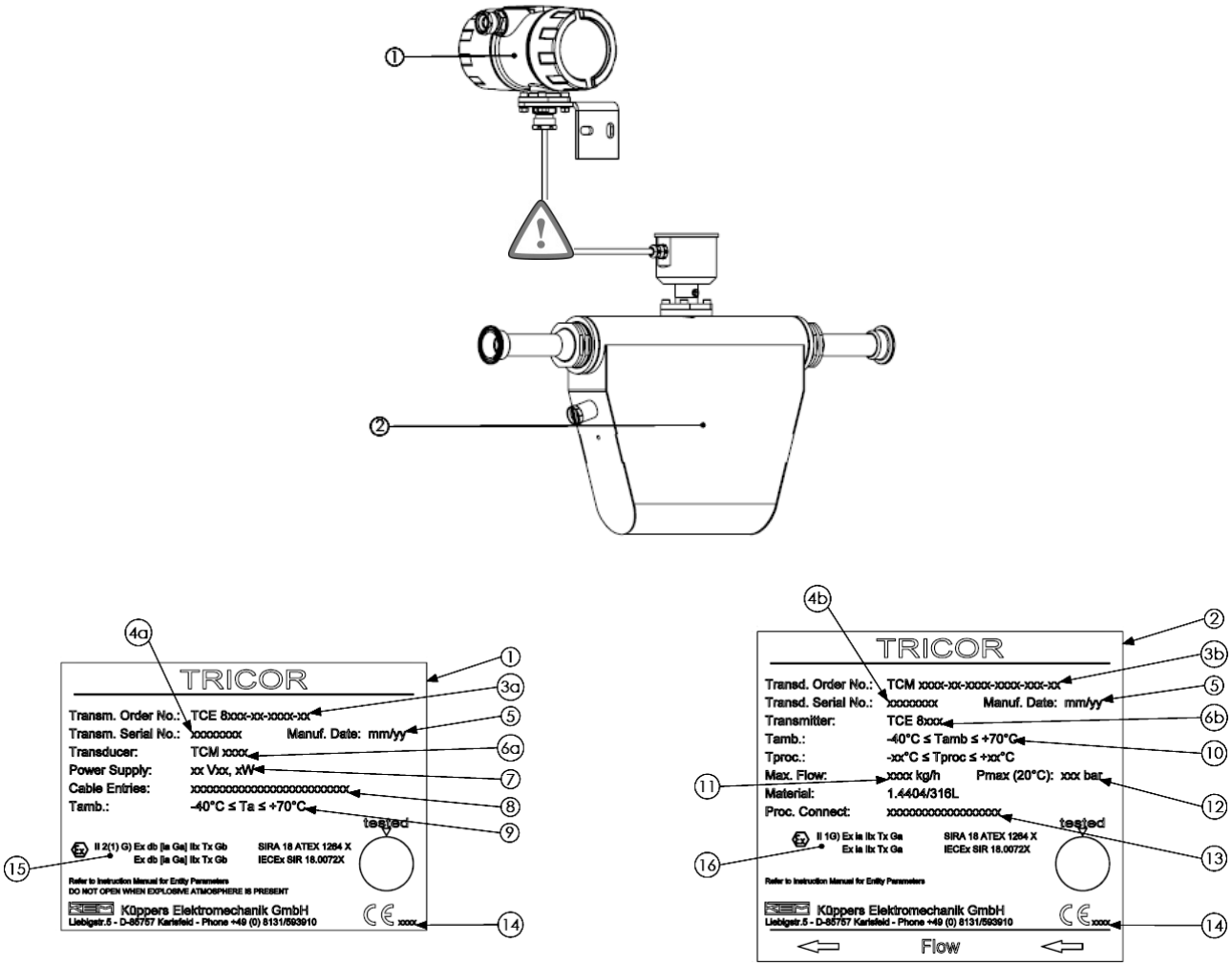


Fig. 15: Device marking TCM remote version

① Transmitter Label
② Sensor Label
③ a: Transmitter Order No.
b: Sensor Order No.
④ a: Transmitter Serial No.
b: Sensor Serial No.
⑤ Manufacturing Date
⑥ a: Sensor Type
b: Transmitter Type
⑦ Transmitter Power Supply
⑧ Cable Entry
⑨ Ambient Temperature Range
⑩ Process Temperature Range
⑪ Maximum Rated Flow
⑫ Maximum Rated Pressure 20 °C [68 °F]
⑬ Process Connection
⑭ ID of the Notification Body
⑮ Certification Ration TCE (optional)
⑯ Certification Ration TCM (optional)

NOTE:

The symbol ⚠ indicates the use of wires that have a higher rating than 60 °C [140 °F].

2.5. Quick Start

WARNING!

As for safety and accuracy reasons many precautions must be taken, read chapter 3 carefully before installing the TCM.

In case the TCM has only to be operated without flow for testing or learning purpose, at least the following connections have to be made (see chapter 3.3):

- Connect the TCE to the TCM (only required with the separate version)
- Connect the supply voltage
- The various inputs and outputs as well as the interface may be connected as well, if those features are required.

WARNING!

If the TRICOR CLASSIC Mass Flow Meter is connected to a bigger system, for your personal safety connect the protective ground as well!

WARNING!

In hazardous areas it is not allowed to operate the TRICOR CLASSIC Coriolis Mass Flow Meter without proper wiring in accordance with chapter 3.3.8 and with the housing not properly closed!

2.5.1. First Operation

Make sure that all mechanical and electrical connections are made properly.

Switch on the power supply. The LED “OK” will flash green.

After the power up sequence the display shows the preselected values (ex factory: “FLOW” and “BATCH”)

Switch on the flow. The value indicated in the display should be positive.

In case of an error the LED “ERR” will flash red.

As soon as the TCM has reached the operating temperature, make the zero point calibration (see chapter 4.2.2 and 4.5.3 for detailed information):

- Switch off the flow
- Wait until the flow through the TCM is zero
- Start the zero offset calibration in the “ZERO OFFSET” menu
- Wait until the offset procedure is finished
- Switch on the flow again

The display can be altered by pressing the pushbutton “Display”.

The internal device status can be viewed by pressing the pushbutton “Info”.

If the function is activated, the BATCH reading can be reset to zero by pressing the pushbutton “Reset”.

To open the control menu press button “P” for three seconds.

2.5.2. CONTROL Menu

In the “CONTROL“ menu all configurations can be made. This includes configuration of the analog and digital outputs, customizing the display and other settings.

The menu itself is self-explaining; the function of the softkeys is indicated in the display above the pushbuttons.

To enter the “CONTROL“ menu press the pushbutton “P” for three seconds.

If a global access code is set, the “CONTROL“ menu is completely locked (see chapter 6.7).

With no global access code the submenu “DISPLAY” can be entered without a password as any changes in this submenu will not affect the operation of the TCM.

The submenus “ZERO OFFSET”, “SETUP”, “I/O-TEST” and “SERVICE” are password protected for avoiding unintentional changes of the operating parameters.

For “ZERO OFFSET”, “SETUP” and “I/O-TEST” the password is “2207”, for “SERVICE” refer to chapter 6.

Change the indicated number “2206” with the softkey “UP” to “2207” and confirm with “P”.

Select the desired submenu with the softkeys and confirm with “P”.

Every setting must be confirmed with “P” for storing the setting or with “EXIT” for exiting without storing.

For leaving the “SETUP” menu press “EXIT” until the TCE returns to the main level.

2.5.3. Using the magnet

The explosion-proof variants with the blue Ex d housings provide a magnet to be able to operate the pushbuttons without opening the display cover.

In hazardous, wet and dusty areas the display cover must not be opened to operate the pushbuttons.

Beside every pushbutton there is a hall sensor which can be operated via the magnet attached to the housing.

For operating the pushbuttons hold the magnet to the glass.

The best positions for operating the keys are:

Pushbutton	**Position**
P	left upper edge of the yellow area
Reset	lower edge of the yellow area
Display	lower edge of the yellow area
Info	lower edge of the yellow area

3. Installation

3.1. Important Installation Guidelines

Coriolis Mass Flow Meters measure the flow of a liquid or gas by vibrating the medium perpendicular to the flow direction and measuring the effect of the inertial force of the medium. Consequently, for best performance the meter must be decoupled from external vibrations and the medium must be homogenous.

It is recommended to install a valve before and after the meter. For the zero calibration both valves should be closed.

3.1.1. External Vibrations

In case of (possible) external vibrations connect the meter mechanically rigidly to a non-vibrating point or – if this is not possible – connect it by means of vibration dampers.

The meters TCM 0325 through TCM 3100 can be mounted via mounting threads or mounting holes (TCMH 0450) on the back side. All other meters must not be fixed directly, but via holders connected to the external tubing, as close as possible to the flanges of the meter.

In case of vibrating tubes a decoupling via flexible hoses might be recommended.

Piston pumps and other pumps producing a strongly pulsating flow should be decoupled hydraulically via longer pipes, flexible tubes or other measures.

High pressure changes in short intervals over long time period should be avoided! If it is though an application requirement, please contact our internal sales for technical support!

3.1.2. Inhomogeneous Media

If a liquid might contain gas bubbles or solid particles, care must be taken that the gas bubbles or the solid particles will not remain in the meter.

If a pure liquid or a liquid with possible gas bubbles is to be measured, the meter should be installed horizontally with the meter tubes down. This assures that gas bubbles will not accumulate in the measuring tubes. Meters with U-shaped tubes (TCM 5500 and bigger) can also be mounted vertically.

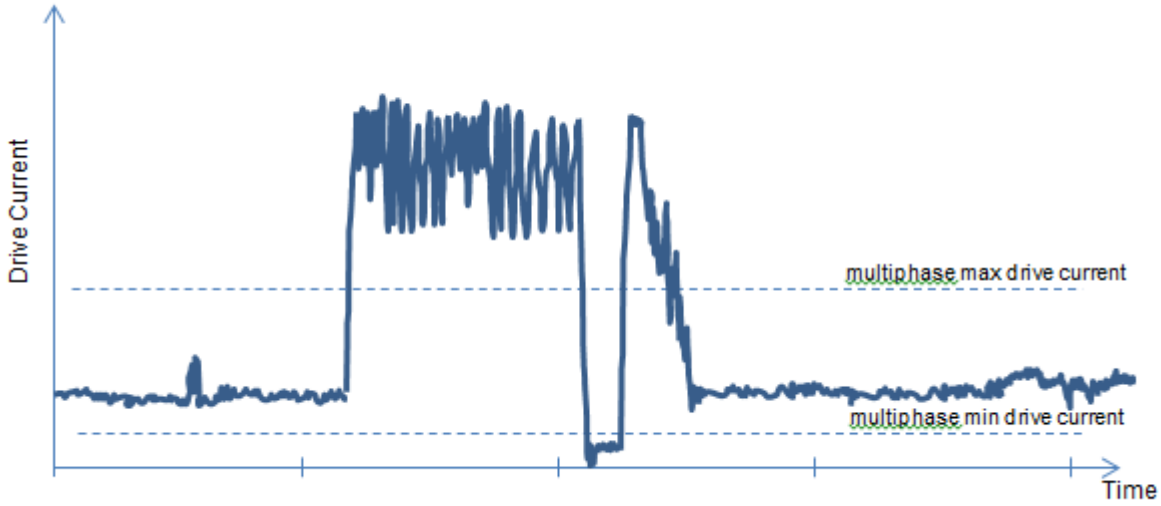
If a liquid might contain solid particles, the meter should be installed horizontally with the meter tubes up. This assures that the solid particles will not accumulate in the measuring tubes. Meters with U- shaped tubes (TCM 5500 and bigger) can also be mounted vertically.

The TCM 0325 through TCM 3100 and TCMH 0450 must not be mounted vertically, as according to the diamond shaped tube geometry gas bubbles as well as solid particles would accumulate in the meter.

Two phase media with gas bubbles (like foam) or solid particles (like paints or slurry) can be measured without any problems, if the gas bubbles or solid particles are small compared to the tube diameter and evenly distributed. The mounting guidelines, must be observed.

If the amount of gas in the measured fluid or vice versa the amount of fluid in the measured gas goes to high, the flow and density readings get significantly disturbed. The disturbances can be properly detected by means of the measured drive current.

To suppress the faulty measurements, you can define a valid drive current range by specifying drive current thresholds “max drive current” and “min drive current”, as shown in the picture below:



As long as the current drive current stays within the valid range, the flowrate and density will be calculated based on the analog inputs. Otherwise the input signals will be suppressed and the process parameter flow rate and density are set to 0 g/s and 0.001 g/cc.

The drive current thresholds can be specified by means of TRICOR Configurator. The software is license free and can be downloaded from our web site:

www.kem-kueppers.com/en/service/downloads/software.html

3.1.3. Density CUT OFF for Gas

If you change from liquid applications to gas applications make sure to change to the DENSITY CUT OFF to 0.0 [units] (see chapter 4.5.6.3).

3.2. Mechanical Installation

In accordance with this manual the user should select the installation position which fits the application best. To ensure the highest degree of accuracy and repeatability, care should be taken to affix the TRICOR CLASSIC products in a stable process site and minimize the amount of vibration in the installation environment.

3.2.1. Basic Safety Notes

CAUTION!

Hot surfaces resulting from hot process media
Risk of burns resulting from surface temperatures above 70 °C [155 °F].
Take appropriate protective measures, for example contact protection.

Make sure that protective measures do not cause the maximum permissible ambient temperature to be exceeded. Refer to the information in “Technical Data” (see chapter 7.4).

NOTE:

Hot surface is only an issue for media or ambient temperature above 50 °C [122 °F].

WARNING!

Wetted parts unsuitable for the process media
Risk of injury or damage to device.
Hot, toxic and corrosive media could be released if the process medium is unsuitable for the wetted parts.

Ensure that the material of the device parts wetted by the process medium is suitable for the medium. Refer to the information in “Technical Data” (see chapter 7.4).

NOTE:

Material compatibility

The manufacturer can provide you with support concerning selection of sensor components wetted by process media. However, you are responsible for the selection of components. The manufacturer accepts no liability for faults or failures resulting from incompatible materials.

WARNING!

Unsuitable process connections
Risk of injury or poisoning.
In case of improper mounting hot, toxic and corrosive process media could be released at the connections.

Ensure that process connections (such as flange gaskets and bolts) are suitable for connection and process media.

WARNING!

Exceeded maximum permissible operating pressure
Risk of injury or poisoning.
The maximum permissible operating pressure depends on the device version, pressure limit and temperature rating. The device can be damaged if the operating pressure is exceeded. Hot, toxic and corrosive process media could be released.

Ensure that maximum permissible operating pressure of the device is not exceeded. Refer to the information on the sensor nameplate and/or in “Technical Data” (see chapter 7.4).

WARNING!

Unprotected cable ends

Risk of explosion through unprotected cable ends in hazardous areas.

Protect unused cable ends in accordance with IEC/EN 60079-14.

WARNING!

Loss of explosion protection

Risk of explosion in hazardous areas if the device is open or not properly closed.

Close the device as described in “Electrical Installation” (see chapter 3.3).

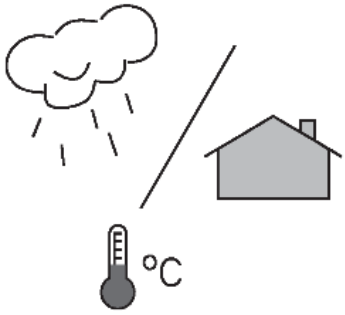
CAUTION!

External stresses and loads

Damage to device by severe external stresses and loads (e.g. thermal expansion or pipe tension). Process media can be released.

Prevent severe external stresses and loads from acting on the device.

3.2.2. Installation Location Requirements



TRICOR TCMP Series Flow Meters has IP65 rating by default. With the optional IP67/NEMA 4X enclosure rating the meters are suitable for indoor and outdoor installations.

Process pressure and medium temperature

If applicable, make sure that specifications for rated process pressure (PS) and medium temperature (TS) plus ambient temperature that are indicated on the device nameplate/label will not be exceeded.

Aggressive atmospheres

Ensure that the device is suitable for the application and that it is installed where there is no risk of penetration of aggressive vapors.

Direct sunlight

Prevent the device from overheating or materials becoming brittle due to UV exposure by protecting it from direct sunlight. Make sure that the maximum permissible ambient temperature is not exceeded. Refer to the information in “Technical Data” (see chapter 7.4).

WARNING!

Equipment used in hazardous areas

Risk of explosion in hazardous areas.

Special requirements apply to the location and installation of the device. See “Electrical Installation” (chapter 3.3.1 to 3.3.5).

WARNING!

Strong vibrations

Risk of explosion in hazardous areas.

In plants with strong vibrations, mount the transmitter in a low vibration environment.

CAUTION!

Strong vibrations

Damage to device

In plants with strong vibrations, mount the transmitter in a low vibration environment away from the sensor.

3.2.3. Horizontal Installation

The horizontal installation is the recommended installation.

If the medium might contain solid particles, mount the meter as shown in position “A”, in all other cases as shown in position “B”.

Install the meter to a solid, non-vibrating surface as close to the meter as possible. With the TCM 0325 through TCM 3100 this could be done via the optional mounting threads or with the TCMH 0450 via the mounting holes.

If no non-vibrating surface is available, vibration dampers might be recommended.

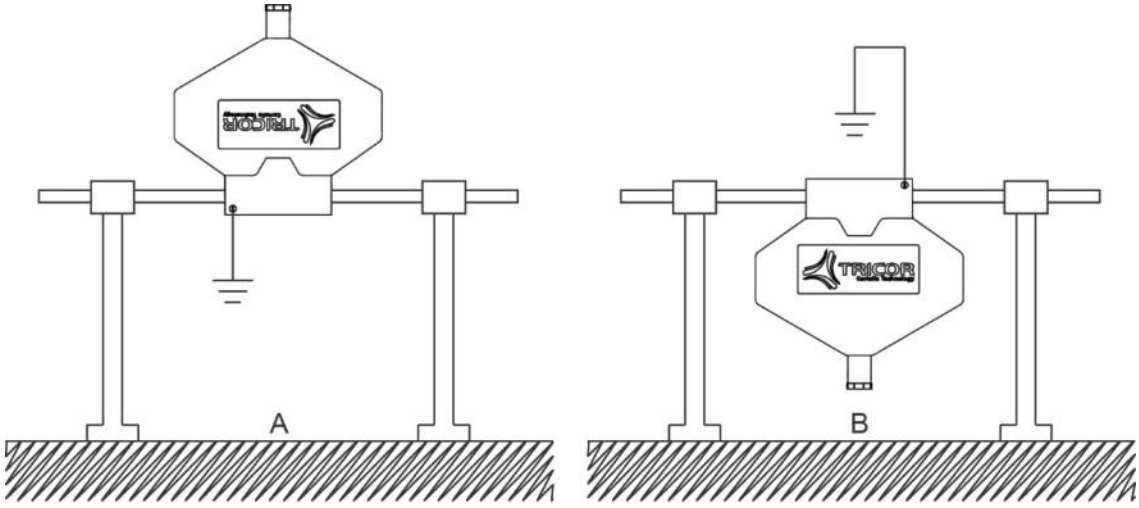


Fig. 16: Recommended horizontal Installation

3.2.4. Vertical Installation

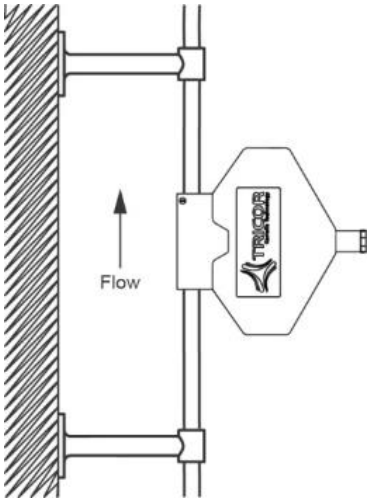


Fig. 17: Vertical Installation

TCMH Mass Flow Meters for high pressure applications (>400 bar [5,800 psi]) should not be mounted in vertical position.

The diamond shaped TCM 0325 through TCM 3100 should not be mounted vertically except you are sure that the medium contains neither gas bubbles nor solid particles.

All other meters can be mounted vertically. This would be the recommended position, if the medium might contain gas bubbles and solid particles.

It is recommended to mount the meter in an upstream position for avoiding that it runs empty during operation.

Fix the meter to a solid, non-vibrating surface as close to the meter as possible.

If no non-vibrating surface is available, vibration dampers might be recommended.

3.2.5. Installation in a Drop line

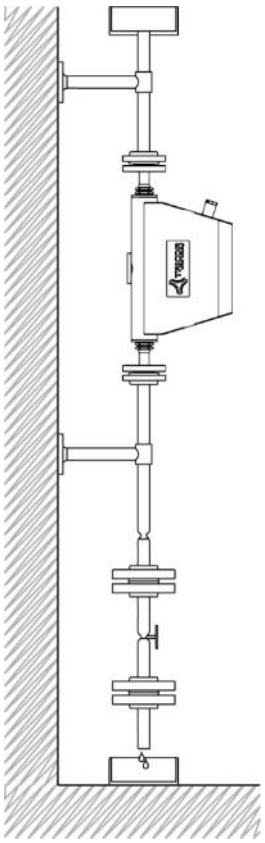


Fig. 18: Installation in a Drop Line

The diamond shaped TCM 0325 through TCM 3100 should not be mounted vertically except you are sure that the medium contains neither gas bubbles nor solid particles.

TCMH Mass Flow Meters for high pressure applications (>400 bar [5,800 psi]) should not be mounted in vertical position.

All other meters can be mounted vertically, but flow going down is only allowed as long as there is significant backpressure on the meter to prevent any type of waterfall effect and to assure the meter remains constantly full of the liquid.

3.2.6. Critical Installations

The meters must not be mounted at the highest point of the tubing (A), if gas bubbles are to be expected, or at the lowest point (B), if solid particles are to be expected, as in both cases also the right mounting position might not help.

Also the meters must not be mounted in a drop line near the open end (C), as in that case the meter might run empty.

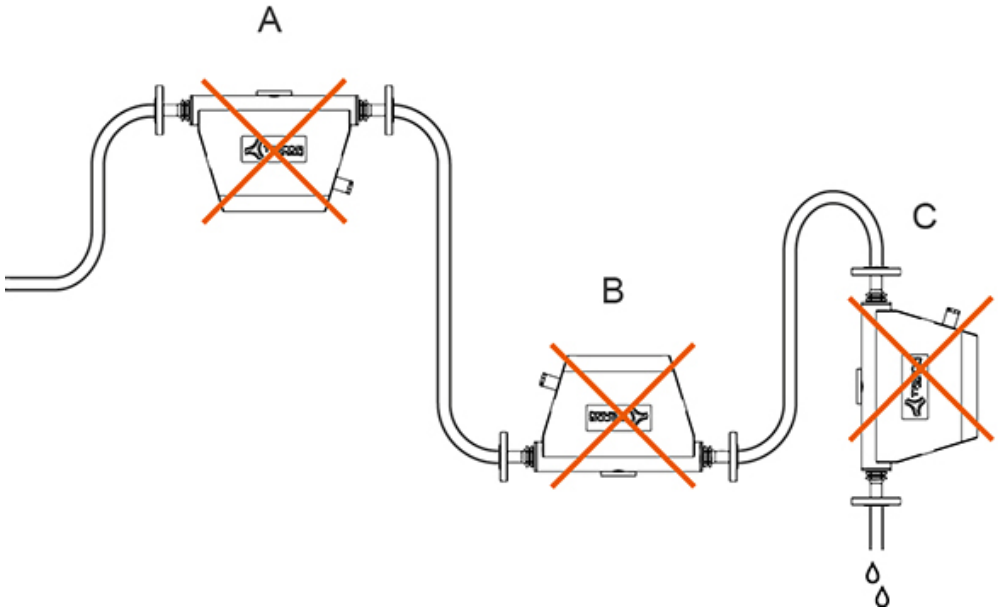


Fig. 19: Critical Installations

3.2.7. Mechanical Installation of the Transmitter

TCE 8*-W**

The wall mount TCE is to be mounted on the wall with 2 screws with 5 mm diameter, about 40 mm apart. For exact dimensions refer to chapter 7.4.7.

TCE 8*-S**

The housing requires an opening in the panel of 92 x 92 mm (TCE 8***-S) at a maximum panel thickness of 2 mm.

Push the TCE 8*** into the opening. The springs will fix the unit automatically.

For removing the TCE 8*** press the springs towards the housing via a screwdriver.

WARNING!

For mounting the TCM in hazardous areas refer to the “Control drawing for hazardous areas”.

3.3. Electrical Installation

Make sure that the TCM is properly mounted and the process input and output are connected before making the electrical connections.

The TCM must be grounded.

The TCE requires a regulated power supply of 24 V DC or a mains voltage of 100 to 240 V AC, depending on the version.

WARNING!

Never connect a 24 V only version to the mains supply or vice versa!

The digital inputs and outputs are referred to GND and to the ground potential of the DC supply (= negative pole). The AC supply terminals are electrically isolated from all inputs and outputs.

The ground potential GND is connected to protective ground via a 1 kΩ resistor.The resistor will thermally withstand a potential difference of up to 30 V between PE and GND but for proper operation this difference should be limited to 5 V.

To connect the TCE, shielded cables must be used. The shield should be connected to the case. If the TCM is installed in bigger systems and the shield must not present a DC connection for avoiding high ground loop currents, make the ground connection of the shield via a capacitor of e.g. 100 nF.

WARNING!

Improper grounding and shielding may lead to bad EMC behavior or danger to your health!

NOTE:

Make sure that all cable and wires are connected and fixed properly before applying power to the TCE.

NOTE:

Only copper cables may be used for electrical installation.

WARNING!

Always switch off the voltage supply before you wire the analog or digital in- and outputs or communication interface.

3.3.1. Locating the Compact Version

The TCM ***-**-****-C (K, M or O) - **** -Ex is explosion proof with Ex d for the transmitter and Ex i for the meter.

The inputs and outputs are not power limited and must not be used to drive intrinsically save circuits.

WARNING!

Never open any cover of the transmitter in hazardous locations with any supply or I/O circuits alive!

3.3.2. Locating the Remote Version with TCE 8***-W(I)-****-Ex (wall mounted)

NOTE:

For use in hazardous locations the TCM as well as the TCE must be Ex versions!

The TCM ***-**-****-****-Ex is intrinsically safe when driven by the corresponding TCE 8***-Ex.

The TCE 8***-wall mounted-****-Ex is explosion proof “Ex d”. It contains the safety barriers for the TCM. The inputs and outputs of the TCE are not power limited and must not be used to drive intrinsically save circuits

The TCE 8***-wall mounted-****-Ex can be located inside and outside the hazardous area.

WARNING!

Never open any cover of the transmitters in hazardous locations with any supply or I/O circuits alive!

3.3.3. Connecting TCE and TCM

With the remote version the TCE and TCM must be connected before making the other electrical installations. If no TCM is connected to the TCE, the TCE will only show an error message after power on.

For connecting TCE and TCM, only the supplied special cable must be used. For best accuracy the maximum cable length is limited to 30 m.

NOTE:

Using different cables or any kind of extension will lead to a degradation of accuracy and stability.

Connecting the cable to the TCM

Open the junction box of the TCM.

Feed the cable from the TCE into the cable gland of the TCM and connect the single wires according to Tab. 2.

Adjust the position of the cable in the cable glands and close the cable gland.

Terminal	Signal	Color Mark USA	Color Mark (rest of the world)	
			≤150 ° C [302 ° F]	>150 °C [302 °F]
1	Driver +	Red	Gray	Gray/1
2	Driver -	Black w/ Red	Pink	Gray/2
3	Sensor A +	Blue	Blue	Gray/3
4	Sensor A -	Black w/ Blue	Red	Gray/4
5	Sensor B +	Green	White	Gray/5
6	Sensor B -	Black w/ Green	Brown	Gray/6
7	Pt1000 +	White	Green	Gray/7
8	Pt1000 -	Black w/ White	Yellow	Gray/8

*Tab. 2: Connections TCM **** (remote version)*

Close the top cover of the junction box and fix it with the screw.

Connecting the cable to the TCE 8*-S-***

Connect the D-SUB connector of the cable to the connector “sensor” on the back side of the housing.

Fasten the fixing screws of the D-SUB connector properly.

3.3.4. Electrical Installation of the Wall Mount Transmitter Version

Connect the TCM to the TCE (see chapter 3.3.3, remote version only).

Open the safety screw at the display cover of the TCE with the provided Allen key.

Remove the display cover of the TCE by turning it counter clockwise.

Pull out the display.

Prepare the cable for installation:

- Separate the single wires for about 12 cm [4¾ inches]
- Strip the end and cover it with a cable end sleeve
- Connect an about 7 cm [2¾ inches] long stranded wire to the shield

Feed the cable through the cable gland.

Connect the shield to the PE screw.

NOTE:

In bigger installations a separate PE connection with a high cross section (> 1.5 mm²) is recommended for avoiding high equalizing currents in the shield.

Connect the individual conductors to the cage clamp terminals as required.

Push a small screwdriver into the upper (smaller) opening of the terminal, feed the cable into the bigger opening and pull out the screwdriver.

For the right connections refer to chapter 2.3 and chapter 3.3.6 to 3.3.8.

Adjust the position of the cable in the cable gland in that way that the single conductors remain short but free of tension and fix the cable in the cable gland.

Put in the display again. The display can be positioned in four different orientations, separated by 90°.

Perform – if necessary – a function test and make the necessary settings (in non Ex area only , see chapter 4.5).

Close the display cover and tighten properly the cable glands before applying the power..

Fasten the safety screw if necessary.

WARNING!

The Ex d protection of the housing is void, if any of the cable glands is not closed properly!

NOTE:

The supply terminals and the digital I/O terminals are rated for U_M = 250 V whereas the analog input and output and the interface terminals are rated for U_M = 30 V DC.

WARNING! (FOR HAZLOC CSA INSTALLATION)

Unsuitable cables, cable glands and/or plugs
Risk of explosion in hazardous areas.
Use only cable glands/plugs that comply with the requirements for the relevant type of protection. Replace the cable gland for the supply and I/O-cables by a CSA or UL certified seal fitting within 18” from the housing.
Tighten the cable glands in accordance with the torques specified in “Technical Data TCE 8000/8100 Transmitter” (chapter 7.4.5).
Close unused cable inlets for the electrical connections.
When replacing cable glands use only cable glands of the same type.

After installation check that the cables are seated firmly.

3.3.5. Electrical Installation of the Panel Mount Version

Connect the TCM to the TCE (see chapter 3.3.3)

Prepare the cable for installation:

- Separate the single wires as required
- Strip the end and cover it with a cable end sleeve
- Connect an about 7 cm [2¾ inches] long stranded wire to the shield
- Connect the shield to the PE screw.

NOTE:

In bigger installations a separate PE connection with a high cross section (> 1.5 mm²) is recommended for avoiding high equalizing currents in the shield.

Connect the individual conductors to the cage clamp terminals as required.

Push a small screwdriver into the upper (smaller) opening of the terminal, feed the cable into the bigger opening and pull out the screwdriver.

For the right connections refer to chapter 2.3 and chapter 3.3.6 to 3.3.8.

Perform – if necessary – a function test and make the necessary settings (see chapter 4.5).

3.3.6. Power Supply and Grounding

3.3.6.1. 24 V DC Power Supply

The TCE requires a regulated power supply of 24 V DC.

The power supply input of the TCE is protected by a fuse. As a protection against fire in case of a short in the supply cable, the output of the power supply must be equipped with a fuse with a rating not higher than the current carrying capacity of the cable used.

For connecting the TCE use shielded cables. If several cables are used, each cable should be shielded properly.

For operation in hazardous areas a good connection of PE of PE is mandatory. The cross section of the PE cable should be at least equivalent to the cross section of the supply cable or to 1 mm², whichever is higher.

Connect the ground of your power supply to terminal 51 and the 24 V DC to terminal 50 (see Fig. 20).

WARNING!

Applying 250 V AC to the DC supply terminals (50, 51) will not affect the Ex safety of the TCE or TCM, but will damage the supply circuit of the TCE!

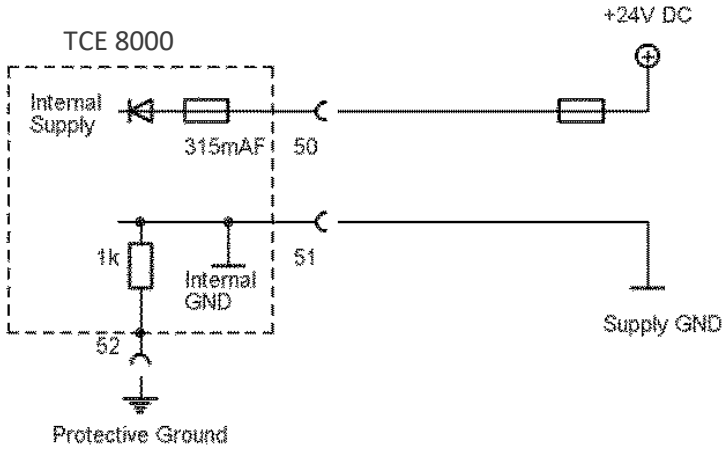


Fig. 20: Wiring diagram for power connections, DC operation

Terminal	Description
50	Positive supply voltage, 24 V DC, referred to pin 51
51	Negative supply voltage
52	Protective ground

The ground terminals 8 and 51 are internally connected together.

Ground and protective ground are internally connected via a 1 kΩ resistor. The resistor will thermally withstand a potential difference of up to 30 V between PE and GND but for proper operation this difference should be limited to 5 V.

3.3.6.2. 100…240 V AC Mains Supply

The AC version of the TCE requires a nominal power supply of 100…240 V AC and operates over a range of 90 … 264 V AC.

The power supply input of the TCE is protected by a 1 A slow blow fuse. As a protection against fire in case of a short in the supply cable, the output of the power supply must be equipped with a fuse with a rating not higher than the current carrying capacity of the cable used.

For the mains powered TCE a good connection of PE is mandatory. The cross section of the PE cable should be at least equivalent to the cross section of the supply cable or to 1 mm², whichever is higher.

3.3.6.3. Finishing the transmitter connection

Connect the supply to terminal 91 (neutral) and 90 (phase) (see Fig. 21).

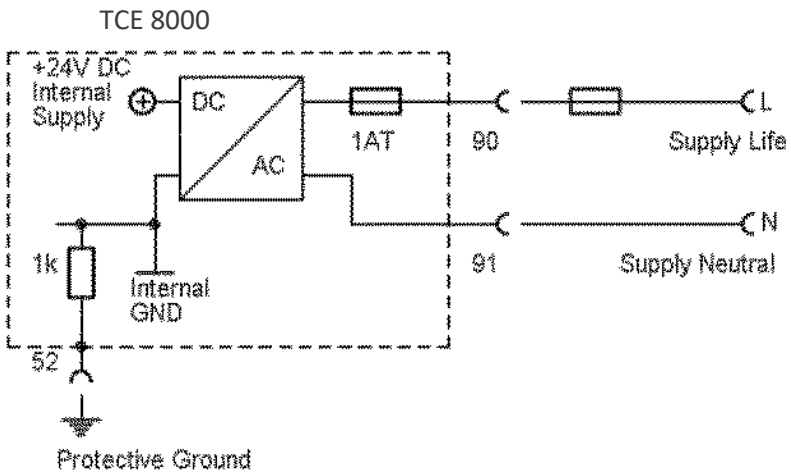


Fig. 21: Wiring diagram for power connections, AC operation

Terminal	Description
90	Mains phase, referred to pin 91
91	Mains neutral
52	Protective ground

The ground terminal 8 is not connected to terminal 91.

3.3.6.4. DC and AC supply

The TCE 8***-S-*B** can be connected to a 24 V DC and a mains supply simultaneously. The unit will operate properly as long as one of the two supplies is present.

3.3.7. Control Inputs and Outputs

The digital I/O terminals are designed for a rated voltage of 250 V AC.

WARNING!

Applying 250 V AC to the digital I/O terminals (5, 6, 7, 8) will not affect the Ex safety of the TCE or TCM, but will damage the I/O board of the TCE!

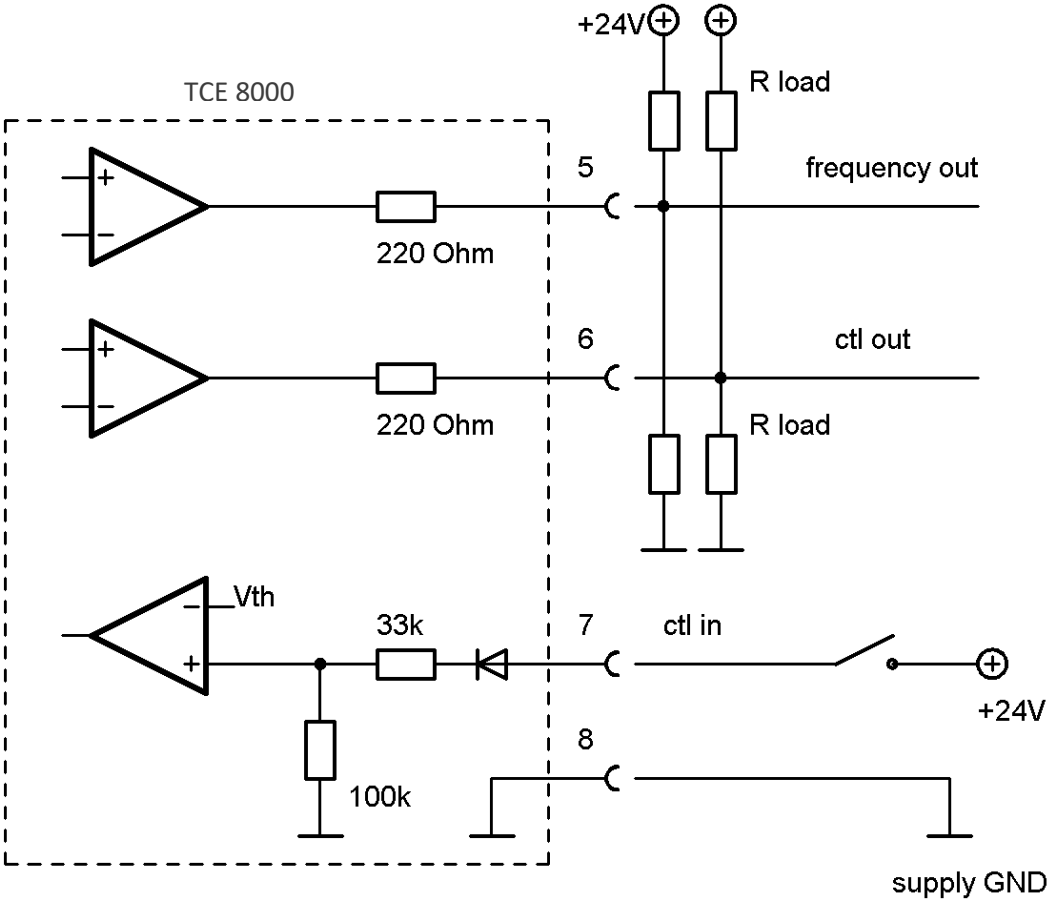


Fig. 22: Wiring diagram for digital I/O connections

Terminal	Description
5	Frequency output, active, referred to pin 8
6	Status output, active, referred to pin 8
7	Control input, active “HIGH”, referred to pin 8
8	Ground potential for digital I/O- pins.

The frequency and control outputs are active push-pull outputs with an output resistance of 220 Ω. They can be loaded to the positive supply or to ground. For a high output swing the load resistors R_{load} should not be lower than 1 kΩ.

In case of a load resistor to ground the output voltages are:

$$V_{high} = V_{supply} * \frac{R_{load}}{220\ \Omega + R_{load}}$$

$$V_{low} < 1\ V$$

In case of a load resistor to the positive supply the output voltages are:

$$V_{high} > V_{supply} - 1\ V$$

$$V_{low} = V_{supply} - V_{supply} * \frac{R_{load}}{220\ \Omega + R_{load}}$$

The control input requires a high voltage of minimum 6.5 V and a minimum input current of 0.1 mA.

The ground terminals 8 and 51 are internally connected together.

Ground and protective ground are internally connected via a 1 kΩ resistor. The resistor will thermally withstand a potential difference of up to 30 V between PE and GND but for proper operation this difference should be limited to 5 V.

3.3.8. Analog Outputs

The TCE 8000 provides two independent passive 4 … 20 mA current loops CURRENT 1 and CURRENT 2.

The current loops are isolated from each other and from the power supply.

For operation an external supply of 8 … 30 V DC (nominal 24 V DC) is required.

The minimum voltage between terminal 1 and 2 or 3 and 4 respectively is 8 V.

The minimum load resistance is 0 Ω, the maximum is determined by the supply voltage.

At a given supply voltage the maximum load resistance can be calculated as:

$$R_{load}\ (max) = \frac{V_{supply} - 8\ V}{22\ mA}$$

For +24 V DC minus 10 % supply this gives a maximum value of 620 Ω.

With a given load resistance, the minimum supply voltage can be calculated as:

$$V_{supply}\ (min) = 8\ V + R_{load} * 22\ mA$$

WARNING!

Applying more than 30 V to any of the inputs or outputs will damage the TCE and destroy the protection of the TCM!

If more than 30 V have been applied to any of the analog output pins, the unit must be returned to KEM/AWL for repair as the safety barrier might be destroyed!

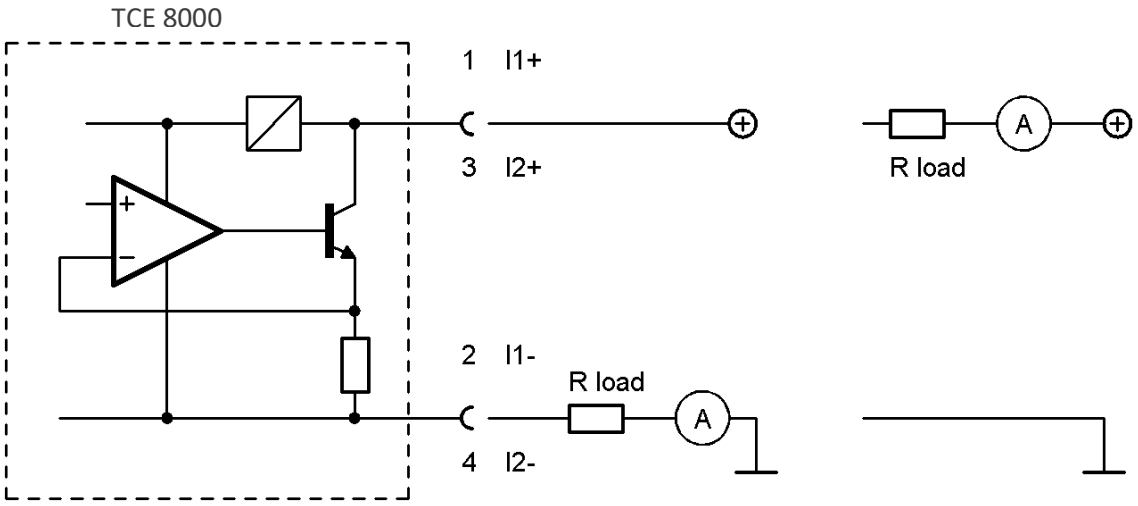


Fig. 23: Wiring diagram for 4 … 20 mA current loop

Terminal	Description
1	Positive terminal of the passive 4 … 20 mA loop 1
2	Negative terminal of the passive 4 … 20 mA loop 1
3	Positive terminal of the passive 4 … 20 mA loop 2
4	Negative terminal of the passive 4 … 20 mA loop 2

As the terminals are floating, the load resistor and the current meter can be placed in the positive or in the negative supply rail.

Connect the shield of the cables to protective ground (terminal 52).

3.3.9. Analog Input

The TCE 8000 with “PRESSURE COMPENSATION“ option provides one passive 4 … 20 mA output CURRENT 2 and one active 4 … 20 mA current input CURRENT 1.

The current input is designed to drive a 2-wire passive 4 … 20 mA pressure sensor. It provides a minimum driving voltage of 16 V.

The negative terminal (2) is internally connected to GND (non Ex version) or to PE (Ex version).

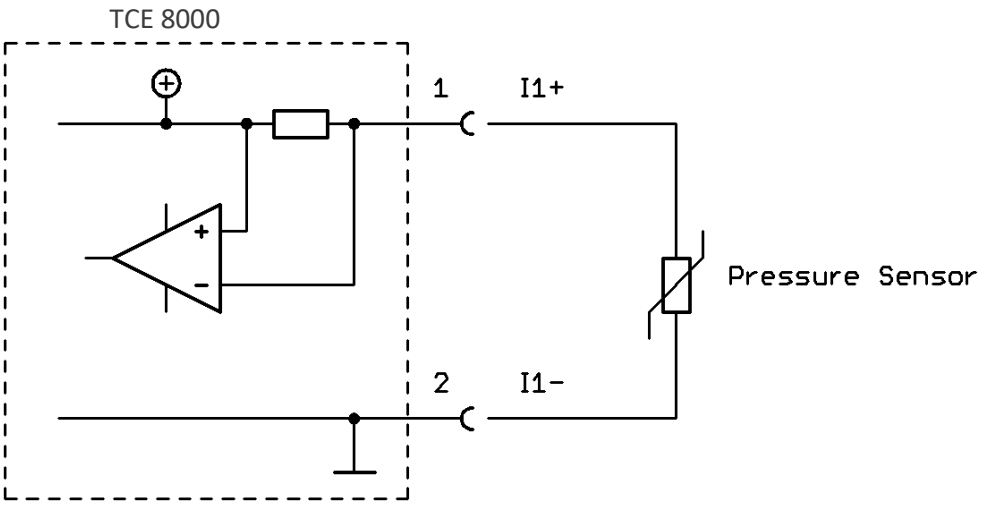


Fig. 24: Wiring diagram for 4 … 20 mA current input

Terminal	Description
1	Positive terminal for a passive 4 … 20 mA pressure sensor
2	Negative terminal for a passive 4 … 20 mA pressure sensor

Connect the shield of the cables to protective ground (terminal 52).

WARNING!

The analog input is not short-circuit proof. Load currents above 35 mA (permanent load) or above 50 mA (short-time load) can cause damages.

3.3.10. Connecting the Relay

Optionally the panel mount versions of the TCE 8000 series can be equipped with a relay output. The relay is a SPDT type with an nc (normally closed) and an no (normally open) contact.

Terminal	Description
40	Relay normally open contact
41	Relay common
42	Relay normally closed contact

The relay is specified for 125 V AC maximum.

4. Manual Operation

4.1. Power On Sequence and Principles of Manual Control

The power up sequence gives the following information, each for about two seconds:

CORIOLIS
TRICOR

TCE 8000

SENSOR TYPE
TCM 028K

Here appears the sensor type. Currently TCM 0325 (max. 325 kg/h) to TCM 230K (max. 230 t/h).

SW MAIN
Rev.: V3.40

This indicates the SW version of the main processor.

SW DISPLAY
Rev.: V3.40

This indicates the SW version of the display processor.

READY

If changes to the settings were made before the last power down and not saved to the backup EEPROM, the following message appears:

..... WARNING .....
NO ACTUAL RAM BACKUP
SEE MANUAL
OK

If no pushbutton is pressed the warning will disappear automatically after 10 seconds.

The absence of valid backup data has no influence on the reliability of operation of the meter. The backup is just used to restore the last operation setting in case important parameters of the TCE have misadjusted

For further information refer to chapter 4.5.9.

Now the TCE 8000 switches to the measuring mode, displaying the default screen:

The green LED “OK” flashes with a one second period. In case of an error the red LED “ERR” flashes.

In manual control the TCE is menu driven and provides two operational modes, the “Measuring Mode” and the “Control Mode”.

In the measuring mode the display shows the preselected measured values and all four pushbuttons have the function printed on them. The switch over between the different display views can be made at any time, by pressing the “Display” button, without influencing neither the measurement nor the digital or analog outputs.

In the control mode the three pushbuttons below the display have varying functions. The actual function is indicated in the display, just above the pushbutton.

In the control menu all necessary settings can be made.

The control menu contains the submenus “ZERO OFFSET”, “DISPLAY”, “SETUP”, “I/O-TEST”, “SERVICE” and “FACTORY”.

For protecting the TRICOR CLASSIC Mass Flow Meter against unintentional changes by unauthorized personnel, the menus “ZERO OFFSET”, “SETUP” and “I/O-TEST” are protected by a user password, the menu “SERVICE” by a service password and the menu “FACTORY” by a factory password.

Additionally, a global access code can be set that locks the TRICOR CLASSIC Mass Flow Meter completely.

For the description of the control menu see chapter 4.5.

4.1.1. Using the Magnet

The explosion-proof variants with the blue Ex d housings provide a magnet to be able to operate the pushbuttons without opening the display cover.

In hazardous, wet and dusty areas the display cover must not be opened to operate the pushbuttons.

Beside every pushbutton there is a hall sensor which can be operated via the magnet attached to the housing.

For operating the pushbuttons hold the magnet to the glass.

The best positions for operating the keys are:

Pushbutton	Position
P	left upper edge of the yellow area
Reset	lower edge of the yellow area
Display	lower edge of the yellow area
Info	lower edge of the yellow area

4.2. Setup Guidelines

Ex factory the TRICOR CLASSIC Mass Flow Meters come with a setup optimized for normal applications. In more than 90 % of the applications no further optimization except a zero offset adjustment is required.

The different possibilities for optimizing the settings are described below.

4.2.1. Meter Mode

A Coriolis Mass Flow Meter measures the mass flow and the density and can calculate the volume flow.

For avoiding strange effects with the total values when changing the engineering units, the TCE 8000 can be set up as a Mass Flow Meter, a Volume Flow Meter, a Gas Flow Meter or a Net Oil Computer.

When set up as Mass Flow Meter, only mass flow engineering units can be selected, when set up as Volume Flow Meter or Net Oil Computer, only volume flow engineering units can be selected and when set up as Gas Flow Meter, only standard volume flow engineering units can be selected

For changing the meter mode refer to chapter 4.5.6.1. For the detailed description of the operating modes „REF .VOLUME“ und „NET OIL“ please refer to the TRICOR CLASSIC Net Oil Computer Addendum, e.g. on the TRICOR website: www.tricorflow.com/manuals/

4.2.2. Offset Adjustment

In contrast to a positive displacement meter, a Coriolis Mass Flow Meter does not have a “natural” zero. At no flow the measured time shift is nearly zero, but not exactly. The offset adjustment determines this offset and corrects the measured value correspondingly.

As the offset depends slightly upon the temperature, the density of the medium and the operating pressure, it is strongly recommended to make the offset procedure under working conditions, i.e. with the medium to be measured and at operating pressure and temperature.

To execute an offset adjustment, please refer to chapter 4.3.5 and 4.5.3.

4.2.3. Flow Filter

The raw data of a Mass Flow Meter is relatively noisy. To get a stable reading a filtering of the calculated flow is required.

The filters in the TCE 8000 are set by means of the time constant t. The time constant is the time the output needs, after a jump from a value x to 0, to go to $x/e = x/2.72$. A higher time constant means more stable reading, but also a slower reaction to changing flows.

A rough relation between the time and the filtered flow value after a jump is:

Elapsed time	Remaining Error (% of the step)
1 * *t*	30
2 * *t*	10
3 * *t*	3
4 * *t*	1

A linear filter as it is realized in the TCE 8000 electronics just delays the flow reading and consequently the "TOTAL" value. Independent of the slope (fast or slow) of the rising and falling flow, the error of the internally calculated TOTAL and at the frequency output are canceled out, if the flow rises from zero (or any other value) and later goes back to the starting value. For getting a correct "TOTAL" via the display or the frequency output, it is just necessary to wait long enough after the flow is switched off.

For best results the TCE 8000 electronics provides two filters.

The "FLOW FILTER" filters the mass flow before calculating the TOTAL or the frequency and current outputs. For normal applications a moderate filtering with t = 1 s is recommended.

The "DISPLAY FILTER" filters the flow display additionally to the "FLOW FILTER". It does not affect any other parameter or any of the outputs. The default setting is t = 1 s.

If the flow is changing fast or sometimes makes a jump and the outputs have to react as fast as possible, set "FLOW FILTER" to t < 1 s. If nevertheless the flow display has to be stable for better readability, the "DISPLAY FILTER" can be increased.

For setting up the "FLOW FILTER" refer to chapter 4.5.7.1, for the "DISPLAY FILTER" to chapter 4.5.4.2.

4.2.4. CUT OFF

As mentioned above, a Mass Flow Meter has no natural zero and the raw data is noisy. Consequently, with no flow, a meter would indicate and give out continuously a small fluctuating flow.

The parameter "CUT OFF" is used to provide a clear zero. If the calculated and filtered flow is below "CUT OFF", the meter indicates zero, the "TOTAL" values remain unchanged and the outputs show zero flow as well.

The value for "CUT OFF" must be above the noise floor in the given application and well below the minimum flow to be measured. As a good compromise the default value for "CUT OFF" is 0.3 % of the full scale range of the meter.

For setting "CUT OFF" please refer to chapter 4.5.6.3.

4.2.5. STEP RESPONSE

Sometimes it is necessary to react fast to a fast changing flow, but also to have a stable output, if the flow is (mostly) constant. This cannot be achieved by adjusting the flow filter.

The parameter "STEP RESPONSE" provides a fast reaction at fast changing flow, also the filter constant is high.

If the difference between the measured flow and the filtered flow is smaller than the "STEP RESPONSE" value, the flow filter remains active. If the difference is higher than step response, the filter is cleared and filled with the new value.

The recommended value for constant or slowly changing flow is 99 % (the default value). If the unit has to react to fast changing flow, the optimum value depends on the individual situation. For ON/OFF operation a value of half the ON flow is recommended.

If “STEP RESPONSE” is set too low, even small changes in flow or even the internal noise will activate the step response function and partially or all the time deactivate the filter, leading to noisy readings and noisy output signals.

For setting “STEP RESPONSE” refer to chapter 4.5.6.4.

4.2.6. Interaction of the Parameters

As each of the three parameters affects the calculation of the flow in a different way, a bad combination of different parameters can lead to systematical errors.

FLOW FILTER and CUT OFF

If the filter constant is set to a high value, the calculated flow is delayed compared to the actual flow. In ON/OFF operation this leads to the fact that it takes a long time until the calculated flow settles to the ON or OFF value. The “TOTAL” value remains correct if the TCM measures long enough after the flow got switched off. If “CUT OFF” is set to a high value, the meters stops measuring too early and consequently the calculated “TOTAL” is too low. Also the number of pulses at the frequency output is too low. The error is systematic.

NOTE:

In ON-OFF operation high values for the flow filter combined with high values for “CUT OFF” must be avoided! Jumps of the flow not going down to zero are not affected by “CUT OFF”.

FLOW FILTER and STEP RESPONSE

A linear filter just delays the flow reading and consequently the total but does not alter the final “TOTAL”.

If the “STEP RESPONSE” is activated, a nonlinear term is added to the filter. The indicated flow will follow more closely the total flow, but the remaining deviation depends on the values for the filter and for “STEP RESPONSE”, but also on the slope of the flow change and on the size of a step.

If the flow changes slowly or a jump is smaller than “STEP RESPONSE”, the function will not be activated and remains linear all the time, producing the normal delay.

If the flow changes fast and the step is higher than “STEP RESPONSE”, the filter will be made faster, the indicated flow follows more closely the actual flow and the delay will be smaller.

In ON/OFF operation with a fast rising and slowly falling flow a systematic positive error is to be expected. If the rising is slow and the falling fast, the error will be negative.

WARNING!

If “STEP RESPONSE” is used (e.g. for good reaction to fast changing flow), checking the accuracy for the given application is strongly recommended!

4.3. Measuring Mode

4.3.1. Function of the Pushbuttons

In the measuring mode all pushbuttons have a fixed function:

P	Opens the Control Menu if pressed for about 2 - 3 seconds
Reset	Resets the “BATCH” counter to zero, if the function “KEY RESET” is enabled
Display	Toggles the display between the preselected settings.
Info	Opens the info menu

4.3.2. Display Selection

The TCE provides two presettable display views. Ex factory view 1 shows the flow and the “TOTAL” value, view 2 shows density and temperature.

In the “fixed mode” the display view selected by the user remains active until the other view is selected. For changing from one view to the other just press the pushbutton “Display”.

In the “alternate mode” the TCM toggles between display view 1 and 2 every seven seconds. In this mode the pushbutton “Display” is without function.

For changing the content of the display views, please refer to chapter 4.5.4.

4.3.3. Display Resolution

The measured values can be displayed with 8 digits, including decimal point and sign. The most positive value therefore is “9999999.” (7 digits), the most negative value is “-999999.” (6 digits).

If the decimal point is set in that way that one or more decimal points are displayed and the value to be displayed exceeds the display range, the decimal point will be shifted to the right.

Example:

Decimal point setting:	x.xxx	x.xxx
Measured value:	12345.6789	-12345.6789
DP setting changed to:	xx.xx	xxx.x
Displayed value:	12345.67	-12345.67

The new setting for the decimal point will remain, also if the measured value goes down again. It can only be reset to the original settings in the “DISPLAY” menu.

If the decimal point is at the most right position and the measured or calculated value is still too big for being displayed, the display shows “DISPLAY OVERFLOW”. As soon as the measured value returns into the displayable range, the error message disappears and the display shows the value.

If the display shows “DISPLAY OVERFLOW”, change the engineering units. If any “TOTAL” display shows “DISPLAY OVERFLOW”, you can also reset the “TOTAL” values. (see chapter 4.5.6.10).

4.3.4. Resetting the Batch (TOTAL-) Value

For easy batching in local operation the TCE provides the possibility to reset the Batch value by pressing the pushbutton “Reset”. For protecting the TRICOR CLASSIC Mass Flow Meter against unintentional resetting, this function can be disabled.

For changing the setting, please refer to chapter 4.5.6.5.

4.3.5. Event Logging

Starting with software version Mv3.40 and Dv3.40, all TRICOR CLASSIC mass flow meters include event logging that records events occurring at runtime with a timestamp and a unique code. These events can either be shown on the display or read/reset (erased) via Modbus. The use of event logging is explained below using the display as an example. For a description of access via Modbus, see the TRICOR CLASSIC Modbus manual (document: “Modbus (RTU) Manual”: chapter 3.6).

There are three event classes:

- INFO: Information that a permissible event has occurred (successful initialisation for example).
- WARN: Warning that a generally permissible but possibly problematic event has occurred
- ERR:ON or ERR:OFF: Indicates that an error state has occurred (ERR:ON) or is no longer active (ERR:OFF)

4.3.5.1. Event codes

All events codes are listed below and their meanings are explained.

Error (ERR codes)

Event Code		Message on display	Meaning
ERR: ON	ERR: OFF		
0	96	INITIALIZATION FAILED	Device initialisation could not be completed successfully.
1	97	AMP. SENSOR A	The voltage amplitude induced from Sensor A is too high or too low.
2	98	AMP. SENSOR B	The voltage amplitude induced from Sensor B is too high or too low.
3	99	MEAS. DELAY OVER 250	The measured time delay is above the specified allowable limit value
5	101	UNST. DRIVER CURRENT	Driver current is too unstable
6	102	PT1000 OUT OF RANGE	The value of the temperature sensor is too high or too low (often indicates a line break or short circuit)
7	103	TUBE FREQ. TOO LOW	The frequency of the oscillating tube is below the specified allowable limit value
8	104	TUBE FREQ. TOO HIGH	The frequency of the oscillating tube is above the specified allowable limit value
9	105	DRIVER CURRENT LOW	The driver current is below the specified allowable limit value
10	106	DRIVER CURRENT HIGH	The driver current is above the specified allowable limit value
17	113	MASS FLOW TOO HIGH	The mass flow is above the specified allowable limit value
18	114	MASS FLOW TOO LOW	The mass flow is below the specified allowable limit value
19	115	TEMPERATURE TOO HIGH	The temperature is above the specified allowable limit value
20	116	TEMPERATURE TOO LOW	The temperature is below the specified allowable limit value
21	117	DENSITY TOO HIGH	The density is above the specified allowable limit value

Event Code		Message on display	Meaning
ERR: ON	ERR: OFF		
22	118	DENSITY TOO LOW	The density is below the specified allowable limit value
23	119	PRESSURE TOO HIGH	The pressure is above the specified allowable limit value
24	120	PRESSURE TOO LOW	The pressure is below the specified allowable limit value

Tab. 3: List of errors (ERR Codes)

Warnings (WARN Codes)

Event code WARN	Message on display	Meaning
192	FACT. BACKUP MISSING	A factory backup has not been prepared yet
193	BACKUP NOT UP TO DATE	Settings have been changed but not yet saved in the backup
194	OFFSET IN PROGRESS	Zero point adjustment is currently in progress
195	GRAND TOTAL VOL OVFL	Overflow of the Grand Total on the display in modus: volume measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation
196	GRAND TOTAL MASS OVFL	Overflow of the Grand Total on the display in modus: mass measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation
197	BATCH TOTAL VOL OVFL	Overflow of the Batch Total on the display in modus: volume measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation
198	BATCH TOTAL MASS OVFL	Overflow of the Batch Total on the display in modus: mass measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation
199	FAIL. TOTAL VOL OVFL	Overflow of the Failure Total on the display in modus: volume measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation
200	FAIL. TOTAL MASS OVFL	Overflow of the Failure Total on the display in modus: mass measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation
192	FACT. BACKUP MISSING	A factory backup has not been prepared yet
193	BACKUP NOT UP TO DATE	Settings have been changed but not yet saved in the backup
194	OFFSET IN PROGRESS	Zero point adjustment is currently in progress

Tab. 4: List of warnings (WARN Codes)

Information (INFO Codes)

Event code INFO	Message on display	Meaning
224	FACT. BACKUP OK	A factory backup has been prepared
225	BACKUP IS UP TO DATE	All new settings have been saved in the backup
226	POWER ON SEQUENCE	The device has been powered up
227	INITIALIZATION PASSED	Device initialisation was completed successfully

Tab. 5: List of information (INFO Codes)

4.3.5.2. Info and event log menu

The TCE display has an info and event log menu for straightforward troubleshooting. The contents of this menu are not of interest for normal operation. It only contains information for trained personnel.

To open the menu, press the “Info” button for about three seconds. Then the event log menu (“LOG DISPLAY”) is displayed first. All recorded log entries are shown and can be reset (erased) here.

Display of log entries

“NO LOGS” is displayed if no events have been recorded or they have all been reset:

```
**   LOG DISPLAY   **
      NO LOGS
```

If events have been recorded, the most recent entry is always displayed first (the logged events are displayed in the order in which they occurred).

This is illustrated here with two log entries as an example:

```
**   LOG DISPLAY   **
LOG#: 2/2 INFO
TIMESTAMP: 4,800s
INITIALIZATION PASSED
```

Here the most recently recorded (most current) is an INFO event that is the second of a total of two existing log entries. It was recorded approximately 4.8 seconds after powering up the TCE and provides the information that initialisation of the TCE was completed successfully at that time (“INITIALIZATION PASSED”).

Resetting (erasing) event logs

Press the “Reset” button to reset (erase) the current log entry.

Provided the displayed event does not represent an active error state (“ERR:ON”), the following dialogue is displayed where you can confirm resetting the log entry by pressing the “Display” button or cancel by pressing the “Reset” button (attention: log entries cannot be restored once they have been reset):

```
**     LOG DISPLAY     **
      LOG#: 2/2 INFO
 CLEAR THIS LOG ENTRY?
YES                    NO
```

If the displayed log entry is of the type “ERR:ON”, it cannot be reset as long as the corresponding error state remains active. In this case the following warning is shown on the display when the “Reset” button is pressed:

```
**     LOG DISPLAY     **
      LOG#: 3/4 ERR:ON
LOG CANNOT BE CLEARED
 ERROR IS STILL ACTIVE
```

If you want to reset all log entries at once, you can do so in the setup menu under the menu item “CLEAR LOGS” (see chapter 4.5.11).

Navigating between log entries

Press the “Display” button to show the previous event (log entry) in chronological order:

```
**     LOG DISPLAY     **
      LOG#: 1/2 INFO
   TIMESTAMP: 0,005s
  POWER ON SEQUENCE
```

Press the “Info” button to navigate to the previous log entry. You can repeat this until you get to the last log entry.

Info menu

When the last log entry is displayed (for instance LOG#: 5/5 INFO), pressing the “Info” button again opens the Info menu that lists the following 7 internal device parameters:

Code	Value
SA	Sensor voltage A in mV
SB	Sensor voltage B in mV
DR	Drive current in mA
PT	Resistance value of the temperature sensor in Ω
FRE	Oscillating frequency in Hz
ZP	Zero point offset in µs
TSF	Filtered time shift in µs

Tab. 6: List of service parameters

Press “Info” again to get general information about the TCM:

Code	Value
TYPE:	Sensor type (TCM*)
SER.:	Serial number
SW1:	SW version main board
SW2:	SW version display
COMM:	Active interface: Modbus/baud rate/address HART®/address FF/address
CODE:	SW option code

Tab. 7: List of TCM device info

By pressing “Info” you can toggle between those info views. To return to the normal operation screen, press “DISPLAY”.

4.3.6. Totalizer

On the display the following three totalizer can be shown:

- Batch Total
- Grand Total
- Failure Total

The maximum number of places that can be shown on the display is limited to 7 („1234567“).

If a totalizer exceeds this limit, the representation of the total on the display will automatically switch to scientific (exponential) notation.

For example, if a totalizer has the value „9999999“ kg and then get incremented by another one kilogram, the totalizer will now display: „1.0000E7“ kg.

Thus ensures that no totalizer can be resetted by an overflow in the lifecycle of the device.

4.4. Offset Adjustment

For best accuracy the TRICOR CLASSIC Mass Flow Meter needs an in situ offset adjustment. This calibration zeroes out the ambient effects and increases the measuring accuracy at low flow.

The offset adjustment must be carried out with the medium to be measured and at a temperature and pressure as close to the normal operation as possible.

Proceed as follows:

Operate the TCM for a while under normal operating conditions to make sure that the actual temperature of the TRICOR CLASSIC Mass Flow Meter equals the normal operating temperature.

Switch off the flow. For best results use a valve in front and one behind the TCM. If the valves are not close to the TCM and/or only one valve is used, wait long enough to be sure that there is no more flow through the TCM.

NOTE:

If there is a residual flow through the TCM or it is exposed to mechanical shocks during the offset adjustment procedure, the resulting value will be wrong.

Start the offset procedure as follows (see also chapter 4.5.3):

- Press “P” for about three seconds
- The display shows “ZERO OFFSET”
- Press “P”
- Change the indicated number with “UP” to “2207“ and confirm with “P”
- Press “SLOW” (recommended) or “FAST”
- The display shows “MAKE ZERO” for 10 to 30 seconds and counts down to “0”
- Confirm with “Info”

Depending on the meter size and the density of the medium, the offset procedure takes about 10 -20 seconds (FAST) or 30…60 seconds (SLOW). During this procedure the red LED will flash.

For an automatic offset adjustment initiated by the central control unit, the control input can be configured as “Initiate offset”. In that case the TCE starts an offset procedure each time a high level is applied to the input.

To configure the input, please refer to chapter 4.5.8.4.

4.5. Control Mode

In the control mode the TCE 8000 can be adapted to the individual application. As unintentional changes of the settings might cause problems, some submenus are password protected. Additionally, using the “SERVICE” menu, a global access code can be set that locks the TRICOR CLASSIC Coriolis Mass Flow Meter completely.

To enter the control mode proceed as follows:

Press “P” for about three seconds

If a global access code is set the display shows

ENTER P-ACCESS CODE
0000
LEFT UP EXIT

Change the indicated number with “LEFT” and “UP” to the defined code and confirm with “P”.

If a wrong code is entered, the display shows “ERROR” for about two seconds and then returns to the measurement mode.

When the correct code is entered the display shows

MAIN MENU
ZERO OFFSET
UP DOWN EXIT

With the keys “UP” and “DOWN” you can scroll through the main list.

Select the desired submenu and confirm with “P”.

4.5.1. Function of the Pushbuttons

In the setup menu some pushbuttons have changing functions, indicated in the display above the pushbutton:

P	Confirms the selection in a list or any kind of inputs
Reset	Performs the indicated function
Display	Performs the indicated function.
Info (Exit)	Performs the indicated function. In most cases exits the current menu point without altering the original value

4.5.2. Submenus in the Main Menu

In the Main Menu the following submenus are addressable:

ZERO OFFSET:
Performing the automatic offset adjustment procedure.
This submenu is password protected.

DISPLAY:
Presetting the display.
Changes made in this submenu have no influence on the general function as well on the accuracy of the TCM.

SETUP:
Adjusting the TCE 8000 and configuring the inputs and outputs.
This submenu is password protected.

I/O-TEST:
Setting the outputs to defined values and displaying the actual status of the control inputs for testing the electrical connections.
This submenu is password protected.

SERVICE:
Calibrating the TCE 8000 with connected TCM.
This submenu is password protected.

FACTORY:
Service settings for TCE 8000 with connected TCM.
This submenu is password protected.

4.5.3. ZERO OFFSET Menu

Select in the main menu

MAIN MENU		
ZERO OFFSET		
UP	DOWN	EXIT

Press “P”. The display shows

ENTER MENU CODE !		
2206		
LEFT	UP	EXIT

Change the indicated number with “LEFT” and “UP” to “2207“ and confirm with “P”.

If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows

START OFFSET PROCEDURE		
SLOW	FAST	EXIT

Press “SLOW” or “FAST” to start the procedure or skip with “EXIT”.

A “SLOW” procedure lasts 30 s to 60 s, a “FAST” procedure 10 s to 20 s.

The display shows

MAKE ZERO (s): 9.5	
OLD ZERO:	0.000 µs
NEW ZERO:	µs

The time counter counts down to zero. The display shows e.g.

MAKE ZERO (s):	0.0
OLD ZERO:	0.000 µs
NEW ZERO:	0.123 µs
	EXIT

Press “EXIT” to return to the measuring mode.

4.5.4. DISPLAY Menu

Select in the main menu

MAIN MENU
DISPLAY
UP DOWN EXIT

Press “P”. The display shows

DISPLAY MENU
MASS TOTAL
UP DOWN EXIT

The following submenus are available:

MASS TOTAL:
Setting the mass TOTAL and Batch units and the mass TOTAL and Batch decimal point.

MASS FLOW:
Setting the mass flow units, the mass flow decimal point and a flow filter for the display.

VOL. TOTAL:
Setting the volume TOTAL and Batch units and the volume TOTAL and Batch decimal point.

VOL. FLOW:
Setting the volume flow units, the volume flow decimal point and a flow filter for the display.

DENSITY:
Setting the density units and the density decimal point.

TEMPERATURE:
Setting the temperature units and the temperature decimal point.

PRESSURE:
Setting the pressure units (only available with option “PRESSURE COMPENSATION“).

DISP MODE:
Setting the content of the two display views and the display mode (static or alternating).

4.5.4.1. DISPLAY - MASS TOTAL Menu

In the submenu “MASS TOTAL” the mass “TOTAL” and Batch engineering units and the flow decimal point can be set.

DISPLAY MENU
MASS TOTAL
UP DOWN EXIT

P ➔

MASS TOTAL DISPLAY
TOTAL UNITS
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

TOTAL UNITS:
Setting the “TOTAL” units.

TOTAL DP:
Setting the “TOTAL” decimal point.

TOTAL UNITS

The following units can be selected:

Mass-Unit	Description
GRAM	gram
KG	kilogram
POUNDS	pound
OUNCES	dry ounce
TONS	metric ton
STONES	stone
MT	metric ton

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

TOTAL DP

Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.2. DISPLAY - MASS FLOW Menu

In the submenu “MASS FLOW” the mass flow engineering unit, the flow decimal point and the flow filter for the display can be set.

Use the keys “UP” and “DOWN” to select the submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

FLOW UNITS:
Setting the flow units.

FLOW DP:
Setting the flow decimal point.

DISP FILTER:
Setting the display filter.

FLOW UNITS

MASS FLOW DISPLAY **FLOW UNITS** UP DOWN EXIT	P ➔	SELECT MASS FLOW UNITS **KG/S** UP DOWN EXIT

The following units (mass per time) can be selected:

Time-Unit	**Description**
S	second
MIN	minute
H	hour
D	day

Mass-Unit	**Description**
G	gram
KG	kilogram
LB	pound
OZ	dry ounce
T	metric ton
ST	stone
MT	metric ton

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

FLOW DP

MASS FLOW DISPLAY **FLOW DP** UP DOWN EXIT	P ➔	SELECT MASS FLOW DP **000.0 KG/S** LEFT EXIT

Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

DISP FILTER

MASS FLOW DISPLAY **DISP FILTER** UP DOWN EXIT	P ➔	DISP. FILTER (0-99.9s) **1.00000 s** RIGHT UP EXIT

The time constant t is the time the displayed value needs after a jump from a value x to 0 to go to $x/e = x/2.72$.

NOTE:

The display filter only filters the value in the display to provide a more stable reading. It has no influence on the outputs. It is only valid for the mass or volume flow display view!

As the display filter is additional to the global filter, the display can never react faster than the outputs.

Use the keys “RIGHT” and “UP” to select the desired time constant and confirm with “P” or skip with “EXIT”.

4.5.4.3. DISPLAY - VOL. TOTAL Menu

In the submenu “VOL.TOTAL” the volume “TOTAL” and Batch engineering units and the flow decimal point can be set.

DISPLAY MENU		VOLUME TOTAL DISPLAY
VOL. TOTAL	P ➔	**TOTAL UNITS**
UP DOWN EXIT		UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

TOTAL UNITS:
Setting the “TOTAL” units.

TOTAL DP:
Setting the “TOTAL” decimal point.

TOTAL UNITS

VOLUME TOTAL DISPLAY		SELECT TOTAL UNITS
TOTAL UNITS	P ➔	**LITER**
UP DOWN EXIT		UP DOWN EXIT

The following units can be selected:

Volume-Unit	**Standard volume** (if gas measuring mode activated see chapter 4.5.6.1)	**Description**
cm3	Ncm3	(Norm) Cubic Centimeter
LITER	NL	(Norm) Liter
GAL	SGAL	(Standard) US Gallon
BBL	STB	(Standard) US Barrel
LOZ	SLOZ	(Standard) Liquid Ounce
IGAL	SIGL	British (Standard) Gallon
IBBL	SIBL	British (Standard) Barrel
m3	Nm3	Cubic Meter
kM3	kNm3	(Norm) 1000 Cubic Meter
hL	hNL	(Norm) Hectoliter
kL	kNL	(Norm) Kiloliter
ML	MNL	(Norm) Megaliter
CF	SCF	Cubic Foot
MCF	MSCF	(Standard) 1,000 Cubic Feet
MMCF	MMSCF	1,000,000 (Standard) Cubic Feet

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

TOTAL DP

VOLUME TOTAL DISPLAY		SELECT VOLUME-DP
TOTAL DP	P ➔	**000.0 LITER**
UP DOWN EXIT		LEFT EXIT

Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.4. DISPLAY - VOL. FLOW Menu

In the submenu “VOL. FLOW” the volume flow engineering unit, the flow decimal point and the flow filter for the display can be set.

DISPLAY MENU **VOL. FLOW** UP DOWN EXIT	P ➔	VOLUME FLOW DISPLAY **FLOW UNITS** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

FLOW UNITS:
Setting the flow units.

FLOW DP:
Setting the flow decimal point.

DISP FILTER:
Setting the display filter.

FLOW UNITS

VOLUME FLOW DISPLAY **FLOW UNITS** UP DOWN EXIT	P ➔	SELECT VOL FLOW UNITS **L/S** UP DOWN EXIT

The following units (mass per time) can be selected:

Time-Unit	**Description**
S	second
MIN	minute
H	hour
D	day

Volume-Unit	**Standard volume**	**Description**
	(if gas measuring mode activatedsee chapter 4.5.6.1)	
cm3	Ncm3	(Norm) Cubic Centimeter
LITER	NL	(Norm) Liter
GAL	SGAL	(Standard) US Gallon
BBL	STB	(Standard) US Barrel
LOZ	SLOZ	(Standard) Liquid Ounce
IGAL	SIGL	British (Standard) Gallon
IBBL	SIBL	British (Standard) Barrel
m3	Nm3	Cubic Meter
kM3	kNm3	(Norm) 1000 Cubic Meter
hL	hNL	(Norm) Hectoliter
kL	kNL	(Norm) Kiloliter
ML	MNL	(Norm) Megaliter
CF	SCF	Cubic Foot
MCF	MSCF	(Standard) 1,000 Cubic Feet

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

FLOW DP

VOLUME FLOW DISPLAY **FLOW DP** UP DOWN EXIT	P ➔	SELECT VOLUME FLOW DP **000.0 L/S** LEFT EXIT

Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

DISP FILTER

VOLUME FLOW DISPLAY **DISP FILTER** UP DOWN EXIT	P ➔	DISP. FILTER (0-99.9s) **1.00000 s** RIGHT UP EXIT

The time constant t is the time the displayed value needs after a jump from a value x to 0 to go to $x/e = x/2.72$.

NOTE:

The display filter only filters the value in the display to provide a more stable reading. It has no influence on the outputs. It is only valid for the mass or volume flow display view!
As the display filter is additional to the global filter, the display can never react faster than the outputs.

Use the keys “RIGHT” and “UP” to select the desired time constant and confirm with “P” or skip with “EXIT”.

4.5.4.5. DISPLAY - DENSITY Menu

In the submenu “DENSITY” the density engineering unit and the decimal point for the display can be set.

DISPLAY MENU **DENSITY** UP DOWN EXIT	P ➔	SET DENSITY DISPLAY **DENS UNITS** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

DENS UNITS:
Setting the density units.

DENS DP:
Setting the density decimal point.

DENS UNITS

SET DENSITY DISPLAY **TEMP UNITS** UP DOWN EXIT	P ➔	SELECT DENS UNITS **KG/L** UP DOWN EXIT

The following engineering units (mass per volume) can be selected:

Unit	Description
G/cm3	Gram per Cubic Centimeter
G/L	Gram per Liter
KG/m3	Kilogram per Cubic Meter
KG/L	Kilogram per Liter
LB/FT3	Pounds per Cubic Feet
LB/GAL	Pounds per Gallon
BRIX	Brix

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

As BRIX specifies the sugar content in water, it is only calculated for densities between 990 and 1,130 g/l. If the measured density is outside that range, the display shows “INVALID”.

DENS DP

Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.6. DISPLAY - TEMPERATURE Menu

In the submenu “TEMPERATURE” the temperature unit and the temperature decimal point for the display can be set.

Use the keys “UP” and “DOWN” to select the submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

TEMP UNITS:
Setting the temperature units.

TEMP DP:
Setting the temperature decimal point.

TEMP UNITS

The following units can be selected:

Unit	Description
°C	Centigrade
°F	Fahrenheit
KELVIN	Kelvin

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

TEMP DP

SET TEMP DISPLAY **TEMP DP** UP DOWN EXIT	P ➔	SELECT TEMP DP **000.0 °C** LEFT EXIT

Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.7. DISPLAY - PRESSURE Menu

In the submenu “PRESSURE“ the pressure engineering unit and the decimal point can be set.

NOTE:
This menu is only visible with the option “PRESSURE COMPENSATION“.

DISPLAY MENU **PRESSURE** UP DOWN EXIT	P ➔	SET PRESSURE DISPLAY **PRESS. UNITS** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

PRESS. UNITS:
Setting the pressure units.

PRESSURE DP:
Setting the pressure decimal point.

PRESS. UNITS

SET PRESSURE DISPLAY **PRESS. UNITS** UP DOWN EXIT	P ➔	SELECT PRESS UNITS **KPA** UP DOWN EXIT

The following units can be selected:

Unit	Description
KPA	kilopascal
MPA	megapascal or N/mm²
PSI	pound per square inch
BAR	bar

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

PRESS DP

SET PRESSURE DISPLAY **PRESS DP** UP DOWN EXIT	P ➔	SELECT PRESSURE-DP **00000.0 KPA** LEFT EXIT

Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.8. DISPLAY - DISPLAY MODE Menu

In the submenu “DISP MODE” the display mode can be set.

DISPLAY MENU **DISP MODE** UP DOWN EXIT	P ➔	SET DISPLAY MODE **DISPLAY 1** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

DISPLAY 1:
Setting the content of display view 1.

DISPLAY 2:
Setting the content of display view 2.

BACKLIGHT:
Switching on and off the backlight.

TIME MODE:
Setting fixed or alternating display.

DISPLAY 1

SET DISPLAY MODE **DISPLAY 1** UP DOWN EXIT	P ➔	SET DISPLAY 1 MODE **DUAL LINE** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select dual line or single line and confirm with “P” or skip with “EXIT”.

The display shows:

SELECT LINE1 VALUE
RATE
UP DOWN EXIT

The following values can be selected:

Value	Description
RATE	Actual flow
BATCH TOTAL	Batch count
TEMPERATURE	Temperature
GRAND TOTAL	TOTAL count
FAIL. TOTAL	Failure total count
F-OUT	Actual frequency at the frequency output
mA-OUT I1	Actual current at the analog output 1
mA-OUT I2	Actual current at the analog output 2
mA-IN	Actual current at the analog input (optional)
PRESS ext.	Pressure value measured from the actual analog input current (optional)
comp PRESS	Pressure value used for compensation (optional)

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

If “DUAL LINE” was selected, the display shows

SELECT LINE2 VALUE
BATCH TOTAL
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The TCM returns to the “DISPLAY MODE” menu.

DISPLAY 2
See DISPLAY 1

BACKLIGHT

SET DISPLAY MODE
BACKLIGHT
UP DOWN EXIT

P ➔

SET BACKLIGHT MODE
ON
UP DOWN EXIT

Use the keys “UP” and “DOWN” to switch on or off the backlight and confirm with “P” or skip with “EXIT”.

TIME MODE

SET DISPLAY MODE
TIME MODUS
UP DOWN EXIT

P ➔

SET TIME MODE
FIXED
UP DOWN EXIT

In the “FIXED” mode the display shows constantly the defined display view 1 or 2. With the pushbutton “DISPLAY” it is possible to switch over between display view 1 or 2.

In the “ALTERNATE” mode the display switches over every 7 seconds between display view 1 and 2. The pushbutton “DISPLAY” is deactivated.

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

4.5.5. SETUP Menu

In the “SETUP” menu all settings can be made to adapt the meter to the individual requirements.

Select in the main menu

MAIN MENU		
	SETUP	
UP	DOWN	EXIT

Press “P”. The display shows

ENTER CODE		
	2206	
LEFT	UP	EXIT

Change the indicated number with “LEFT” and “UP” to “2207“ and confirm with “P”. If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows

SETUP MENU		
	PARAMETER	
UP	DOWN	EXIT

The following submenus are available:

PARAMETER:	
METER MODE	Selection between Mass Flow Meter and Volume Flow Meter
CUT OFF	Setting the flow CUT OFF value
STEP RESP	Set Step Response (option)
RESET KEY	Enable/disable the key “Reset”
FLOW-DIREC	Setting up the TCM for reverse flow
K-FACTOR	Factor for fine scaling the metric variable of the meter
FAULT TIME	Setting the error response time
PRESS. COMP.	Enable/disable the “PRESSURE COMPENSATION“ (option)
TOTAL COUNT	Setting up the mode of operation “TOTAL counter”
LANGUAGE	Selecting the display language
FILTER:	
FLOW	Setting the flow filter time constant
DENS	Setting the density filter time constant
IN/OUTPUTS:	
FREQ OUT	Configuring the frequency output
CTRL OUT	Configuring the control output
mA OUT	Configuring the analog output (4 … 20 mA)
CTRL IN	Configuring the control input
mA-IN I1	Configuring the analog input (option)
INTERFACE	Configuring the interface
DATA CONFIG:	
SAVE DATA	Saving the actual settings as backup
RECALL DATA	Recalling the last settings from the backup
RESET TOTAL:	
RESET TOTAL	Resets the TOTAL and the FAIL. TOTAL count to zero.

CLEAR LOGS:
CLEAR LOGS Acknowledge (delete) all logged events in the Log memory.

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.6. SETUP - PARAMETER Menu

In the submenu “SETUP - PARAMETER” all user settable internal parameter can be set for adjusting the TCM for a given application.

SETUP MENU **PARAMETER** UP DOWN EXIT	P ➔	PARAMETER MENU **CUT OFF** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.6.1. METER MODE Menu

In the submenu “METER MODE” the meter mode (“MASS METER” for Mass Flow Meter, “VOLUME METER for Volume Flow Meter, „REF.VOLUME“ for gas measuring mode under reference conditions or „NET OIL“ for Net Oil Computer) can be set.

If “MASS METER” was selected, no volume engineering units can be displayed and vice versa.

PARAMETER MENU **METER MODE** UP DOWN EXIT	P ➔	SELECT METER MODE **MASS METER** RIGHT UP EXIT

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

If the meter mode is changed, the display shows:

WARNING: CHANGING THE METER MODE WILL CAUSE ALL COUNTERS TO RESET PROCEED EXIT

Confirm with “PROCEED” or skip with “EXIT”.

If “PROCEED” is pressed, the display shows:

OPERATION MODE HAS BEEN CHANGED TO VOLUME METER OK

If “EXIT” is pressed, the display shows:

THE OPERATION MODE SETTINGS WERE NOT CHANGED OK

After “OK” the display returns to the “SETUP - PARAMETER” menu.

4.5.6.2. Gas measuring mode (optional)

PARAMETER MENU **METER MODE** UP DOWN EXIT	P ➔	SELECT METER MODE **REF. VOLUME** RIGHT UP EXIT

After confirming with “P“, you will be asked to make the settings required for the gas measuring mode.

Firstly, you have to enter the reference density to be used in determining the standard volume of gases ($V_n = m/\rho_{ref}$). Entries are made in the current density unit.

SELECT METER MODE **REF. VOLUME** UP DOWN EXIT	P ➔	REF. FLUID DENSITY **0.050000 g/cm3** RIGHT UP EXIT

The standardized volume flow and the total volume are displayed in standardized volume units. Chapter 4.5.4.5 explains the selection of the unit.

The TRICOR CLASSIC NetOil-Manual (www.tricorflow.com/manuals/), page 14 ff., shows additional settings for the gas measuring mode.

4.5.6.3. CUT OFF Menu

In the submenu “CUT OFF” the “CUT OFF” values can be set.

There are 2 different “CUT OFF” values:

FLOW:
If the absolute value of the measured and filtered flow is below the “CUT OFF” value, the calculated flow is set to zero and consequently all outputs show zero flow and the “TOTAL” and batch value remain unchanged.

DENSITY:
If the current density is below the “CUT OFF” value, the calculated flow is set to zero and consequently all outputs show zero flow and the total and batch value remain unchanged.

The density “CUT OFF” does not influence the density display. Also density below the cut off will be measured and displayed.

PARAMETER MENU **CUT OFF** UP DOWN EXIT	P ➔	CUT OFF MENU **FLOW** RIGHT UP EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

FLOW

Typical values for the flow “CUT OFF” are in the range 0.3 …1 %. With “CUT OFF” values set too low, noise or any external interference might be misinterpreted as real flow. Using too high “CUT OFF” values, low flows might not be correctly registered anymore.

The preset “CUT OFF” should always be significantly smaller than the lowest flow to be measured.

NOTE:

Flow “CUT OFF” is defined as mass flow. In volume meter mode recalculate the percentage to mass flow and/or use the density “CUT OFF”.

CUT OFF MENU			P ➔	FLOW CUT OFF (%)		
	FLOW				**0.5**	
UP	DOWN	EXIT		RIGHT	UP	EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “CUT OFF” menu.

DENSITY Liquid

CUT OFF MENU			P ➔	LOW DENSITY CUT OFF		
	DENSITY				**0.5 KG/L**	
UP	DOWN	EXIT		RIGHT	UP	EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “CUT OFF” menu.

DENSITY Gas

CUT OFF MENU			P ➔	LOW DENSITY CUT OFF		
	DENSITY				**0.0 KG/L**	
UP	DOWN	EXIT		RIGHT	UP	EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “CUT OFF” menu.

4.5.6.4. STEP RESPONSE Menu

In the submenu “RESP STEP” the reaction to fast changing flows can be optimized.

NOTE:

This submenu is disabled, if the option “FAST RESPONSE” is not implemented.

If the difference between the measured flow and the filtered flow is higher than “STEP RESPONSE”, the filter is cleared and filled with the new value. If it is smaller than the “STEP RESPONSE” value, the flow filter remains active.

The optimum value depends on the individual situation. For ON/OFF operation a value of half the ON flow is recommended.

For deactivating “STEP RESPONSE” set the value to 99 %.

NOTE:

A too low value leads to unstable readings for flow whereas too high values will disable the function.

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu

4.5.6.5. RESET KEY Menu

In the submenu “RESET KEY” the pushbutton “Reset” can be enabled or disabled.

If the pushbutton “Reset” is active, it can be used to reset the batch counter.

Use the keys “UP” and “DOWN” to enable or disable the key and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.6.6. FLOW DIRECTION Menu

In the submenu “FLOW-DIREC” the positive direction of the flow can be set.

If the flow direction is set to “FORWARD” (default setting), a flow through the meter in direction of the arrow, indicated on the type label of the meter, will be displayed positive and the opposite flow negative.

If for technical reasons the meter must be mounted in that way, that the normal flow is against the direction of the arrow, the sign of the flow can be inverted by setting flow direction to “REVERSE”.

Use the keys “UP” and “DOWN” to select the positive flow direction and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.6.7. K-FACTOR Menu

In the submenu “K-FACTOR” the K-factor for the fine tuning of the flow calculation can be set.

Ex works the TRICOR CLASSIC Mass Flow Meter is calibrated with a K-factor *k* = 1.0000. If for any reasons the flow measured by the Mass Flow Meter differs slightly from a flow measured with other means, the value calculated by the TCM can be adjusted by changing the K-factor without the need to perform a new flow calibration.

PARAMETER MENU		K-FACTOR
K-FACTOR	P ➔	**1.00000**
UP DOWN EXIT		RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.6.8. FAULT TIME Menu

In the submenu “FAULT TIME” the reaction time of the TCE 8000 in case of an error can be defined.

The “FAULT ON DELAY TIME” is the time an error must be present, before the red LED lights up and the error output signal is activated.

The “FAULT OFF DELAY TIME” is the time an error signal persists on the red LED and on the control output, after the error disappeared.

PARAMETER MENU		FAULT ON DELAY TIME
FAULT TIME	P ➔	**2.7000 SECONDS**
UP DOWN EXIT		RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display shows

FAULT OFF DELAY TIME
2.7000 SECONDS
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.6.9. PRESSURE COMPENSATION Menu

In the submenu “PRESS. COMP” the operational mode of the “PRESSURE COMPENSATION” (option) can be set.

NOTE:

This menu is only visible with the option “PRESSURE COMPENSATION“.

The following modes are possible:

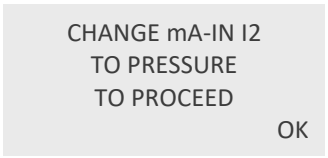
OFF:
No pressure compensation.

mA-IN I1:
The pressure measured via the analog 4 … 20 mA input is used for the compensation.

MANUAL:
The pressure set manually or via the interface is used for the compensation.

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

Is “mA-IN I1” selected but the status of the analog input is “OFF”, the display shows



Confirm with “OK“. Configure the analog input correspondingly (see chapter 4.5.8.5) and repeat the setting.

If “MANUAL” is selected, the display shows

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “PRESS. COMP”. menu.

4.5.6.10. TOTAL COUNT Menu

In the submenu “TOTAL COUNT” the “TOTAL” counter can be configured.

The following operating modes are available:

DEFAULT:
The “TOTAL” count includes flow in positive as well as in negative direction. With positive flow the TOTAL value increases, with negative flow it decreases.

FORWARD:
The “TOTAL” count includes only flow in positive direction. With negative flow the TOTAL value does not change.

BACKWARD:
The “TOTAL” count includes only flow in negative direction. With positive flow the TOTAL value does not change.

PARAMETER MENU **TOTAL COUNT** UP DOWN EXIT	P ➔	SELECT TOTALIZER MODUS **DEFAULT** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the mode and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.6.11. LANGUAGE Menu

In the submenu “LANGUAGE” the language used in the display can be selected.

For the time being, English and Russian can be selected.

PARAMETER MENU **LANGUAGE** UP DOWN EXIT	P ➔	SELECT LANGUAGE **ENGLISH** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the language and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.7. SETUP - FILTER Menu

In the submenu “SETUP - FILTER” the filters of TCE can be configured.

SETUP MENU **FILTER** UP DOWN EXIT	P ➔	FILTER MENU **FLOW** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.7.1. FLOW FILTER Menu

In the submenu “FLOW” the time constant for the flow filter can be set.

The time constant *t* is the time the output needs after a jump from *x* to 0 to go to $x/e = x/2.72$.

A rough relation between the time and the filtered flow value after a jump is

Elapsed time	**Remaining error (% of the step)**
1 * *t*	30
2 * *t*	10
3 * *t*	3
4 * *t*	1

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - FILTER” menu.

4.5.7.2. DENSITY FILTER Menu

In the submenu “DENS” the time constant for the density filter can be set.

The time constant *t* is the time the output needs after a jump from *x* to 0 to go to $x/e = x/2.72$.

A rough relation between the time and the filtered flow value after a jump is

Elapsed time	Remaining error (% of the step)
1 * *t*	30
2 * *t*	10
3 * *t*	3
4 * *t*	1

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - FILTER” menu.

4.5.8. SETUP - IN/OUTPUTS Menu

In the submenu “SETUP - IN/OUTPUTS” the input and output ports can be configured.

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.8.1. FREQUENCY OUT Menu

In the submenu “FREQ OUT” the frequency output can be configured.

The frequency output has two operating modes:

FREQUENCY:
A frequency proportional to the actual flow is generated. If a negative flow must be given out as well, the control output can be used as sign. Frequencies between 0.5 Hz and 10 kHz can be generated in this mode.

TOTAL COUNT:
Each time the “TOTAL” increments by the selected “TOTAL” increment step, the output produces a pulse. For having a 50 % duty cycle, the output changes its state each time after half the increment step. If the flow is negative in between, no pulses are generated until the following positive flow compensates for the negative flow in between. Thus the medium will not be counted twice, if in between a flow backwards occurs. The maximum output frequency which can be generated in this mode is about 100 Hz.

IN/OUTPUTS MENU **FREQ OUT** UP DOWN EXIT	P ➔	FREQ OUT MENU **FREQUENCY** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

FREQUENCY

FREQ OUT MENU **FREQUENCY** UP DOWN EXIT	P ➔	FULL SCALE FLOW **8000.0 G/S** RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired full scale value and confirm with “P” or skip with “EXIT”.

The display shows

FULL SCALE FREQUENCY
01000.0 HZ
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired frequency and confirm with “P” or skip with “EXIT”.

The display shows

OUTPUT NEGATIVE VALUES
YES NO

If “YES” is selected and the control output is not configured as “FLOW DIREC”, the display shows

CHANGE CONTROL OUTPUT
TO FLOW DIRECTION
TO PROCEED
OK

Confirm with “OK”, configure the control output correspondingly, (see chapter 4.5.8.2) and repeat the setting.

TOTAL COUNT

FREQ OUT MENU **TOTAL COUNT** UP DOWN EXIT	P ➔	SELECT VALUE **0.10000 KG** RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired step value and confirm with “P” or skip with “EXIT”.

4.5.8.2. CONTROL OUT Menu

In the submenu “CTRL OUT” the control output can be configured.
The control output has four operating modes:

FAULT:
In case of an error the control output goes to the active state.
“ACTIVE HIGH” means the output is low in normal operation, high in case of a fault.
For setting the on and off delay time, please refer to chapter 4.5.6.8.

FLOW DIR:
The flow direction is indicated. “ACTIVE HIGH“ means the output is high if a positive flow is measured.

BATCH:
In the batch mode the TCE 8000 operates as a batch counter. If the preset batch value is reached, the control output goes to the active state. With an active signal at the control input the batch counter can be reset to zero. For this mode the control input must be configured as “RESET BATCH”. “ACTIVE HIGH” means the output goes to “HIGH“ when the preset batch value is reached.

FLOW LIMIT:
If the actual flow becomes more positive than the “FLOW LIMIT“ plus hysteresis, the output goes to the active state. If the actual flow becomes more negative than the “FLOW LIMIT” minus hysteresis, the output goes to the inactive state. Between flow limit minus hysteresis and flow limit plus hysteresis, the output state does not change.

NOTE:

For negative flow limits the relation is: -99 is greater than -100.
“ACTIVE HIGH” means the output goes to “HIGH“ when the preset limit value is reached.

OFF:
The output is deactivated. “ACTIVE HIGH“ means the output is permanently at high.

FREQUENCY:
A frequency proportional to the current flow rate is generated. Frequencies between 0.5 Hz and 10 kHz can be generated in this mode.

DENS. LIMIT:
When the measured density exceeds the value for DENS. LIMIT plus the hysteresis, the output enters the active state. When the density becomes less than DENS. LIMIT minus the hysteresis, the output enters the inactive state. The output does not change in between the two thresholds.

PHASE SHIFT:
Prerequisite: the FREQ-OUT has been programmed for TOTAL COUNT. As soon as “TOTAL” has increased by the chosen amount, another pulse is generated on FREQ OUT. To have a frequency ratio of 50 % on the output, the state of the output changes respectively after half the amount. A pulse offset by 90° is also generated on CTRL OUT after each pulse on FREQ-OUT.
The maximum output frequency in this operating mode is about 50 Hz.

FAULT

CTRL OUT MENU **FAULT** UP DOWN EXIT	P ➔	SELECT ACTIVE STATE **ACTIVE HIGH** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

FLOW DIR

CTRL OUT MENU **FLOW DIR** UP DOWN EXIT	P ➔	SELECT ACTIVE STATE **ACTIVE HIGH** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

BATCH

CTRL OUT MENU **BATCH** UP DOWN EXIT	P ➔	BATCH VALUE **0.50000 KG** RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired step value and confirm with “P” or skip with “EXIT”.

The display shows

SELECT ACTIVE STATE
ACTIVE HIGH
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

FLOW LIMIT

CTRL OUT MENU **FLOW LIMIT** UP DOWN EXIT	P ➔	FLOW LIMIT VALUE **10.0000 KG/MIN** RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired step value and confirm with “P” or skip with “EXIT”.

The display shows

HYSTERESIS IN %
1.00000
UP DOWN EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display shows

SELECT ACTIVE STATE
ACTIVE HIGH
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

OFF

CTRL OUT MENU		SELECT ACTIVE STATE
OFF	P ➔	**ACTIVE HIGH**
UP DOWN EXIT		UP DOWN EXIT

Confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

FREQUENCY

FREQ OUT MENU		FULL SCALE FLOW
FREQUENCY	P ➔	**8000.0 G/S**
UP DOWN EXIT		RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired full scale value and confirm with “P” or skip with “EXIT”.

The display shows

FULL SCALE FREQUENCY
01000.0 HZ
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired frequency and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.8.3. ANALOG OUT Menu

In the submenu “mA-OUT” the 4 … 20 mA outputs can be configured.
Each analog output can show one of the following parameters:

FLOW:
The output current is proportional to the flow.

DENSITY:
The output current is proportional to the density.

TEMP:
The output current is proportional to the temperature.

BATCH COUNT:
The output current is proportional to the current batch value.
This mode is only possible, if the control input is configured as “RESET BATCH”

The value for 4 mA as well as the value for 20 mA can be freely selected. Thus it is possible to zoom in (e.g. temperatures from 20 °C to 30 °C [68 °F up to 86 °F]) or to show negative values as well (e.g. flow from -10 kg/min to +20 kg/min).

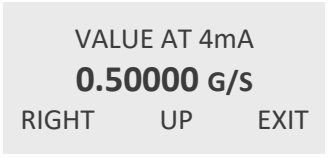
Use the keys “UP” and “DOWN” to select the desired output channel and confirm with “P” or skip with “EXIT”.

The standard TCE electronics provides two analog 4 … 20 mA outputs, I1 and I2. If the option “PRESSURE COMPENSATION“ is installed, only the output I2 is available.

The display shows

Use the keys “UP” and “DOWN” to select the desired output value and confirm with “P” or skip with “EXIT”.

The display shows



The indicated engineering unit depends on the selected output value and the display setup.

To input a negative sign (e.g. for -20 °C), move the cursor to the first digit. When the figures are incremented by pushing “UP”, the “9” is followed by the minus sign “-“, before the “0” appears.

Use the keys “RIGHT” and “UP” to select the desired value for 4 mA and confirm with “P” or skip with “EXIT”.

The display shows

Use the keys “RIGHT” and “UP” to select the desired value for 20 mA and confirm with “P” or skip with “EXIT”. The display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.8.4. CONTROL IN Menu

In the submenu “CTRL IN” the control input can be configured. The control input has three operating modes:

EXT. ZERO:
If an “ACTIVE” level is applied to the input, the TCE 8000 starts the zero offset adjustment procedure.

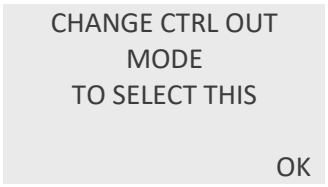
RESET BATCH:
If an “ACTIVE” level is applied to the input, the batch counter is reset to 0.
This mode must be selected, if the control output is to be used as a “BATCH-LIMIT” and/or if one of the analog outputs is to be used as batch output.

OFF:
The input is deactivated. Changes of the level applied to the input have no effect. This is the default.
The “ACTIVE” level is freely selectable. Since the standard version of TCE has an internal pull-down resistor built in, the default is “ACTIVE HIGH”.

HOLD:
If an “ACTIVE” level is applied to the input, the batch and grand totals stop counting.

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

If “EXT. ZERO” or OFF is selected and one of the outputs is set to batch output, the display shows



Confirm with “OK” and configure the output correspondingly if required.

The display shows

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.8.5. ANALOG IN Menu

In the submenu “mA-IN I1” the 4 … 20 mA input can be configured. This menu is only visible with the option “PRESSURE COMPENSATION“.

The value for 4 mA as well as the value for 20 mA can be freely selected to adapt the input to any passive 4 … 20 mA pressure sensor.

Use the keys “UP” and “DOWN” to select “OFF” or “PRESSURE” and confirm with “P” or skip with “EXIT”.

If “OFF” is selected, neither a pressure value is shown nor a pressure compensation using a measured pressure value is possible.

If “PRESSURE” was selected the display shows

VALUE AT 4mA
0.00 MPA
RIGHT UP EXIT

The indicated engineering unit depends on the selected output value and the display setup.

Use the keys “RIGHT” and “UP” to select the desired value for 4 mA and confirm with “P” or skip with “EXIT”.

The display shows

VALUE AT 20mA
10.00 MPA
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired value for 20 mA and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.8.6. INTERFACE Menu

In the submenu “INTERFACE” the interface can be configured.

Depending on the configuration one or more of the following interfaces can be selected:

RS485
HART®
Foundation Fieldbus®

IN/OUTPUTS MENU
INTERFACE
UP DOWN EXIT

P ➔

SET INTERFACE MODE
RS485
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

RS485

Data transmission is carried out via RS485 interface with the „Modbus RTU“ protocol.

SET INTERFACE MODUS
RS485
UP DOWN EXIT

P ➔

SELECT BAUD RATE
57600
MODBUS
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the baud rate and confirm with “P” or skip with “EXIT”.

The display shows

SELECT BYTE ORDER
3-2-1-0
RIGHT UP EXIT

Use the keys “UP” and “DOWN” to select the byte order for floating point numbers as it is valid with your system and confirm with “P” or skip with “EXIT”.

The display shows

ADDITIONAL TIME DELAY
00800. µs
RIGHT UP EXIT

If the device is installed within bigger bus and controlling systems, it might be helpful to slow down additionally the response of the TCE 8000 in order to avoid any communication errors.

Use the keys “RIGHT” and “UP” to select the additional time delay and confirm with “P” or skip with “EXIT”.

The display shows

SET UNIT ADDRESS
001
RIGHT UP EXIT

The following addresses cannot be set:

Address	**Function**
0	reserved for broadband communication (messages to all connected units)
248-255	reserved for special Modbus purpose

Use the keys “RIGHT” and “UP” to select the desired unit address and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

HART®

For the HART® interface special local settings are not available. All configurations are done directly via the interface.

The HART® interface is just activated and the display returns to the SETUP IN/OUTPUTS menu.

Foundation Fieldbus®

For the Foundation Fieldbus® interface special local settings are not available. All configurations are done directly via the interface.

The Foundation Fieldbus® interface is just activated and the display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.9. SETUP - DATA CONFIGURATION Menu

In the submenu “SETUP - DATA CONFIG” the current settings can be stored to the backup memory and the stored settings can be recalled

SETUP MENU **DATA CONFIG** UP DOWN EXIT	P ➔	DATA CONFIG MENU **SAVE DATA** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.9.1. SAVE DATA Menu

In the submenu “SAVE DATA” the current settings can be stored in the backup memory.

At each power on the TCE 8000 compares the content of the setup memory and the backup memory. If the data in those two memories are different, the TCE 8000 gives out a warning. To avoid this warning, it is recommended to make a backup as soon as the new settings are proven to be okay.

DATA CONFIG MENU **SAVE DATA** UP DOWN EXIT	P ➔	READY TO SAVE DATA START EXIT

Start the backup process with “START” or skip with “EXIT”.

If “START” is pressed, the display shows for some seconds

MEMORY ACCESS

After that for about two seconds

READY

The display returns to the “SETUP - DATA CONFIG” menu.

4.5.9.2. RECALL DATA Menu

In the submenu “RECALL DATA” the old settings are reloaded from the backup memory.

Reloading the old settings is recommended, if after bigger changes in the setup the TCM does not work properly any more.

NOTE:

Backup data overwritten with “SAVE DATA” cannot be restored!

DATA CONFIG MENU **RECALL DATA** UP DOWN EXIT	P ➔	RECALL BACKUP DATA? START EXIT

Start the recall process with “START” or skip with “EXIT”.

If “START” is pressed, the display shows for some seconds

MEMORY ACCESS

After that for about two seconds

READY

The display returns to the “SETUP - DATA CONFIG” menu.

4.5.10. SETUP - RESET TOTAL Menu

In the submenu “SETUP - RESET TOTAL” the “TOTAL” counters can be reset to zero

SETUP MENU **RESET TOTAL** UP DOWN EXIT	P ➔	WARNING ALL TOTAL VALUES WILL BE RESET!! START EXIT

Reset the “TOTAL“ with “START” or skip with “EXIT”.

NOTE:

All TOTAL values (“GRAND TOTAL”, “BATCH TOTAL” and “FAIL. TOTAL”) are reset!

The display returns to the “SETUP - RESET TOTAL” menu.

4.5.11. SETUP - CLEAR LOGS Menu

In the submenu SETUP - CLEAR LOGS all logged events can be acknowledged (deleted).

SETUP MENU **CLEAR LOGS** UP DOWN EXIT	P ➔	WARNING ALL LOGGED VALUES WILL BE CLEARED!! START EXIT

Acknowledge all logged events with „START” or skip with „EXIT” ab.

NOTE:

Acknowledged Log entries cannot be recovered.

Das Display kehrt zum Menü CLEAR LOGS zurück.

4.5.12. I/O-TEST Menu

In the “I/O-TEST” menu all inputs and outputs can be tested.

Select in the main menu

MAIN MENU		
	I/O-TEST	
UP	DOWN	EXIT

Press “P”. The display shows

ENTER CODE		
	2206	
LEFT	UP	EXIT

Change the indicated number with “LEFT” and “UP” to “2207“ and confirm with “P”.

If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows

I/O-TEST MENU		
	FREQ OUT	
UP	DOWN	EXIT

The following submenus are available:

FREQ OUT	A freely settable frequency can be applied to the output
CTRL OUT	The output level can be set
mA-OUT	A freely settable current can be applied to the output
CTRL IN	The level currently applied to the input is indicated
mA-IN	The current input current is indicated (Only with option “PRESSURE COMPENSATION“)

When the “I/O-TEST” menu is left, all outputs return to normal operation.

4.5.12.1. I/O-TEST - FREQUENCY OUT Menu

In the submenu “FREQ OUT” a freely settable frequency, between 1 Hz and 9,999 Hz, can be applied to the output.

I/O-TEST MENU		
	FREQ OUT	
UP	DOWN	EXIT

P ➔

ENTER FREQUENCY (Hz)		
	9.000	
RIGHT	UP	EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

If “P” was pressed the frequency is applied to the output and the display shows

CHANGE VALUE?		
	YES	EXIT

Press “YES” to enter a new value or “EXIT” to leave the menu.

If “EXIT” is pressed, the display returns to the “SETUP - I/O-TEST” menu.

4.5.12.2. I/O-TEST - CONTROL OUT Menu

In the submenu “CTRL OUT” a low or high level can be applied to the output.

I/O-TEST MENU		
CTRL OUT		
UP	DOWN	EXIT

P ➔

SELECT OUTPUT LEVEL !		
HIGH	LOW	EXIT

Use the keys “HIGH” and “LOW” to set the output value or leave the menu with “EXIT”.

If “EXIT” is pressed, the display returns to the “SETUP - I/O-TEST” menu.

4.5.12.3. I/O-TEST - ANALOG OUT Menu

In the submenu “mA-OUT” a freely settable current, between 2 mA and 22 mA, can be applied to the output.

I/O-TEST MENU		
mA-OUT		
UP	DOWN	EXIT

P ➔

ANALOG OUT TEST		
mA-OUT I1		
UP	DOWN	EXIT

Use the keys “UP” and “DOWN” to select the desired output and confirm with “P” or skip with “EXIT”.

The display shows

ENTER CURRENT 1 (mA)		
00.0		
RIGHT	UP	EXIT

Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

If “P” was pressed the current is applied to the output and the display shows

CHANGE VALUE?	
YES	EXIT

Press “YES” to enter a new value or “EXIT” to leave the menu.

If “EXIT” is pressed, the display returns to the “SETUP - I/O-TEST” menu.

4.5.12.4. I/O-TEST - CONTROL IN Menu

In the submenu “CTRL IN” the display shows the level currently applied to the control input.

The display shows the actual level at the input. It is automatically updated when the level at the input has changed.

After evaluating the input, press “EXIT” to return to the “SETUP - I/O-TEST” menu.

4.5.12.5. I/O-TEST - ANALOG IN Menu (optional)

The submenu “mA-IN” is only selectable with the option “PRESSURE COMPENSATION“.

In the submenu “mA-IN” the display shows the current applied to the control input.

After evaluating the input, press “EXIT” to return to the “SETUP - I/O-TEST” menu.

4.5.13. SERVICE Menu

The “SERVICE” menu is used to calibrate the meter, to set a user password and to recall the original factory settings.

For a description of the menu, please refer to chapter 6.

5. Remote Operation

As a standard, the TCE 8000 is equipped with RS485 and HART® interfaces. Foundation Fieldbus® is also available as an option.

Please read chapter 4 before installing a remote control, for getting a description of the functionality.

5.1. Serial RS485 Interface

5.1.1. Electrical Connection of RS485 Interface

Prepare the TCE 8000 and the cable as described in chapter 3.3.

Connect the signal RS485A or RS485+ (both names are used in the literature) to terminal 22 and RS485- or RS485B to terminal 21.

Terminal 20 is the ground reference pin for the interface and is connected to GND (terminal 8) with the non-Ex versions and connected to PE (terminal 52) with the Ex versions.

NOTE:

The operating range of the data terminals (21 and 22) is -7 V to +12 V referred to the reference pin (20). Voltages outside that range could damage the TCE 8000.

5.1.2. Usage of the TRICOR Configurator

The control software TRICOR Configurator as well as the corresponding manual is provided for download at the “Download” area of the TRICOR webpage (www.tricorflow.com/manuals/).

Using the TRICOR Configurator a remote operation with TRICOR CLASSIC meters is possible, without the need of knowledge about the Modbus protocol.

The usage of the converter CON.USB.RS-ISO is recommended for the connection between the TCE electronics and a personal computer (via USB interface).

5.1.3. RS485-Interface-Protocol

For communication via RS485 the Modbus RTU protocol is used.

A detailed description of the Modbus frame structure and the implemented registers and addresses can be found at the “Download” area of the TRICOR webpage (www.tricorflow.com/manuals/).

5.2. HART®

5.2.1. Electrical Connection for HART®

For the HART® communication the current output CURRENT 2 (I2) is used.

Connect the analog output CURRENT 2 as described in chapter 3.3.8 and connect a HART® communicator or a HART® Handheld Terminal in series to the analog output of the TCE.

Refer to the manual of your HART® communicator, respectively of the HART® Handheld Terminal, for the proper connection.

5.2.2. Device Description File for HART® Interface Protocol

For getting the newest DD file for the HART® Interface, please contact your TRICOR representative.

5.3. Foundation Fieldbus®

5.3.1. Electrical Connection for Foundation Fieldbus®

Prepare the TCE 8000 and the cable as described in chapter 3.3.4 or 3.3.5.

Connect the signal FF+ (positive rail of the bus) to terminal 32 and FF- (negative rail of the bus) to terminal 31.

5.3.2. Device Description File for Foundation Fieldbus® Interface Protocol

For getting the newest DD file for the Foundation Fieldbus® Interface, please contact TRICOR representative.

6. Service and Maintenance

6.1. Maintenance

The TRICOR CLASSIC Mass Flow Meters do not require regular maintenance.

In case of abrasive or sedimenting media however, it is recommended to return the measuring system to the manufacturer after 8,000 hours of operation for re-calibration and pressure test. This interval may be shorter when the medium is extremely abrasive or sedimenting. For best performance we recommend checking the calibration every 5 years, in harsh environments even more frequently.

If for the specific application an obligatory calibration is required, refer to the corresponding national regulations for the necessary calibration intervals.

6.2. Trouble Shooting

In case the TRICOR Mass Flow Meter does not work properly, first check the following items:

No display, no LED lighting
All cables properly connected?
➔ Connect the missing cables
Power supply switched on?
➔ Switch on the power supply
Display positioned properly (compact and wall mount only)?
➔ Remove the display and reset it properly
Internal fuse of the TCE blown?
➔ For checking and changing the fuses refer to chapter 6.3.
Output frequency too high or unstable
Most probably EMC problems
Shield and ground properly connected?
➔ Connect shield properly. If necessary, try additional means of grounding and shielding
Unstable flow reading with (theoretically) stable flow
Gas bubbles or solid particles in the medium?
➔ Mount the meter with the correct orientation
Strong external vibrations?
➔ Decouple the meter from the vibration source
Flow or pressure slugs in the medium?
➔ Decouple the meter hydraulically
No frequency or current output with operating display
Output correctly wired?
➔ Correct the wiring (see chapter 2.3)
Output correctly configured?
➔ Correct the configuration (see chapter 4.5.8)
Wrong flow direction (flow in the display is negative)?
➔ Change flow direction (see chapter 4.5.6.6)
Pressure display shows "PRESS ERROR"
Input correctly wired?
➔ Correct the wiring (see chapter 2.3)
Sensor working normally?
➔ Check with external digital Ampere meter. If required, replace the sensor
No pressure compensation
Compensation enabled?
➔ Enable compensation (see chapter 4.5.6.9)
Sensor working normally?
➔ Check with external digital Ampere meter. If required, replace the sensor

6.3. Maintenance and Repair Work

WARNING!

Impermissible repair of explosion protected devices
Risk of explosion in hazardous areas

Repair must be carried out by persons authorised by the manufacturer..

WARNING!

Maintenance during continued operation in a hazardous area
There is a risk of explosion when carrying out repairs and maintenance on the device in a hazardous area.
Isolate the device from power. - or -

Ensure that the atmosphere is explosion-free (hot work permit).

WARNING!

Impermissible accessories and spare parts
Risk of explosion in areas subject to explosion hazard.
Only use original accessories or original spare parts.

Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

WARNING!

Humid environment
Risk of electric shock.
Avoid working on the device when it is energized.
If working on an energized device is necessary, ensure that the environment is dry.

Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

CAUTION!

Hot parts in the device
Temperatures that can burn unprotected skin may be present for some time after the device has been switched off.

Observe the waiting time specified in “Technical Data” (see chapter 7.4) before starting with maintenance work.

WARNING!

Enclosure open
Risk of explosion in hazardous areas as a result of hot components and/or charged capacitors inside the device.
To open the device in a hazardous area:

1. Isolate the device from power.
2. Observe the wait time specified in “Technical Data” (see chapter 7.4) before opening the device.
3. Visually inspect sensor inlet and outlet.

Exception: Devices exclusively having the type of protection "Intrinsic safety Ex i" may be opened in an energized state in hazardous areas.

CAUTION!

Hazardous voltage at open device
Risk of electric shock when the enclosure is opened or enclosure parts are removed.
Before you open the enclosure or remove enclosure parts, de-energize the device.

If maintenance measures in an energized state are necessary, observe the particular precautionary measures.
Have maintenance work carried out by qualified personnel.

WARNING!

Hot, toxic or corrosive process media
Risk of injury during maintenance work.
When working on the process connection, hot, toxic or corrosive process media could be released.
As long as the device is under pressure, do not loosen process connections and do not remove any parts that are pressurized.

Before opening or removing the device ensure that process media cannot be released.

WARNING!

Improper connection after maintenance
Risk of explosion in areas subject to explosion hazard.
Connect the device correctly after maintenance.

Close the device after maintenance work.

The device is maintenance-free. However, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

NOTE:

Repairs and service may only be carried out by persons authorised by the manufacturer.

NOTE:

The manufacturer defines flow sensors as non-repairable products.

Maintenance information parameters

The basic maintenance information parameters are:

- Current Date and Time
- Operating Time Total
- Operating Time
- Configuration Counter
- Transmitter Hardware Revision
- HMI Hardware Revision
- Sensor Hardware Revision

6.3.1. Changing the fuse with the TCE 8***-wall mounted-**** and compact version

The power supply inputs of the TCE 8000 contain fuses. With the non-Ex versions the fuses can easily be replaced by qualified personnel.

Switch off the power supply.

Open the safety screw at the display cover of the unit with the provided Allen key.

Remove the display cover of the TCE by turning it counter clockwise.

Pull out the display

Remove the 3 screws in the PCB and pull it out carefully.

Below the ribbon cable connector you find the following fuse in the fuse holder:

Littelfuse NANO 2 375mA slow blow, ordering code 0452.375

NOTE:

For your own safety replace the fuse only by the same type and rating.

Replace the fuse and reclose the unit.

6.3.2. Changing the fuse with the TCE 8***-S-****

Switch off the power supply.

Remove the 4 screws in the back panel and pull out the back panel carefully.

Below the ribbon cable connector you find the following fuse in the fuse holder:

Littelfuse NANO 2 375mA slow blow, ordering code 0452.375

NOTE:

For your own safety replace the fuse only by the same type and rating.

Replace the fuse and reclose the unit.

6.3.3. Changing the fuses with the Ex versions

With the Ex versions the fuses are part of the safety barriers and must only be exchanged by KEM/AWL or by personnel authorized by KEM/AWL.

In case one of the fuses has blown, contact KEM/AWL or your nearest dealer.

WARNING!

The Ex versions of the TCE 8000 series contain several internal fuses for protecting the intrinsically safe TCM against too high voltage and power. Those fuses are critical parts and must not be exchanged except by KEM/AWL or by service personnel authorized by KEM/AWL. If the fuses are replaced by third persons, the Ex certification for the TCM will be void!

6.4. Calibration

In the “SERVICE” menu all measurements of the TCE 8000 can be calibrated.

Press “P” for about three seconds

The display shows

MAIN MENU
ZERO OFFSET
UP DOWN EXIT

Use the key “UP” or “DOWN” to select

MAIN MENU
SERVICE
UP DOWN EXIT

Press “P”. The display shows

ENTER CODE
2206
LEFT UP EXIT

Change the indicated number with “LEFT” and “UP” to “2208” and confirm with “P”.

If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows

SERVICE MENU
CALIBRATION
UP DOWN EXIT

Press “P”. The display shows

CALIBRATION MENU
METER VAR.
UP DOWN EXIT

The following submenus are available:

TEMP CALIB.	Calibrating the temperature measurement
AIR CALIB.	Calibrating the density measurement at low density (air)
WATER CALIB.	Calibrating the density measurement at high density (water)
METER VAR.	Calibrating the flow measurement

6.4.1. Temperature Calibration

For calibrating the temperature reading of the TCE 8000, the medium temperature must be well known.

Before starting the calibration, make sure that the temperature reading has been stable for several minutes, to make sure that the medium temperature and the temperature of the temperature sensor are the same.

CALIBRATION MENU **TEMP CALIB.** UP DOWN EXIT	P ➔	SET TEMP IN °C **25.0** RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to set the actual medium temperature and confirm with “P” or skip with “EXIT”.

The display returns to the “SERVICE - CALIBRATION” menu.

6.4.2. Air Density Calibration

The low end calibration of the density measurement is normally done with empty tubes (filled with air).

In the automatic mode the unit performs an automatic calibration, assuming that the tubes are filled with normal air.

In the manual mode the three parameters temperature, tube frequency and reference density can be altered individually. This is necessary if the air calibration is performed with a gas with a density different than air. In that case make first the automatic calibration and then override in the manual calibration the density value by the density of the medium used for calibration.

Before starting an automatic calibration, make sure that the TCM is completely empty as any drop of a liquid inside will spoil the calibration result.

CALIBRATION MENU **AIR CALIB.** UP DOWN EXIT	P ➔	AIR CALIBRATION MENU **AUTOMATIC** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

AUTOMATIC mode:

AIR CALIBRATION MENU **AUTOMATIC** UP DOWN EXIT	P ➔	WARNING TUBES HAVE TO BE FILLED WITH AIR! OK

Confirm with “OK”. The display shows:

DO YOU WANT TO PROCEED CALIBRATION? YES EXIT

Start the calibration with “YES” or skip with “EXIT”.

If “YES” was pressed, the display shows:

AIR TEMP:	23.0°C
FREQUENCY:	141.4 HZ
DENSITY:	1.4 G/L
	OK

Confirm with “OK”. The display returns to the “AIR CALIBRATION“ menu.

MANUAL mode:

AIR CALIBRATION MENU			P ➔	ENTER AIR TEMP:		
	MANUAL				**23.0 °C**	
UP	DOWN	EXIT		RIGHT	UP	EXIT

Use the keys “RIGHT” and “UP” to set the reference temperature and confirm with “P” or skip with “EXIT”. The display shows:

ENTER AIR FREQ:		
	141.52 Hz	
RIGHT	UP	EXIT

This value must only be entered, if you have the data from a calibration sheet of the TCM. Skip with “EXIT”. The display shows

ENTER AIR DENSITY:		
	1.407 G/L	
RIGHT	UP	EXIT

Use the keys “RIGHT” and “UP” to set the reference density and confirm with “P” or skip with “EXIT”.

The display returns to the “AIR CALIBRATION” menu.

6.4.3. Water Density Calibration

The high end calibration of the density measurement is normally done tubes filled with water. Butanol or other liquids with well-known density can be used as well.

In the automatic mode the unit performs an automatic calibration, assuming that the tubes are filled with water.

In the manual mode the three parameters temperature, tube frequency and reference density can be altered individually. This is necessary if the water calibration is performed with a liquid with a density different than water. In that case make first the automatic calibration and then override in the manual calibration the density value by the density of the medium used for calibration.

Before starting an automatic calibration, make sure that the TCM is completely filled with the reference medium. Any pollution (air bubbles, solid particles or rests of other liquids) will spoil the calibration result.

CALIBRATION MENU **WATER CALIB.** UP DOWN EXIT	P ➔	WATER CALIBRATION MENU **AUTOMATIC** UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

AUTOMATIC mode:

WATER CALIBRATION MENU **AUTOMATIC** UP DOWN EXIT	P ➔	WARNING TUBES HAVE TO BE FILLED WITH WATER! OK

Confirm with “OK”. The display shows:

DO YOU WANT TO
PROCEED CALIBRATION?

YES EXIT

Start the calibration with “YES” or skip with “EXIT”

If “YES” was pressed, the display shows:

WATER TEMP:	23.0°C
FREQUENCY:	131.2 HZ
DENSITY:	998.0G/L
	OK

Confirm with “OK”. The display returns to the “WATER CALIBRATION” menu.

MANUAL mode:

WATER CALIBRATION MENU **AUTOMATIC** UP DOWN EXIT	P ➔	ENTER WATER TEMP: **23.0 °C** RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to set the reference temperature and confirm with “P” or skip with “EXIT”.

The display shows:

ENTER WATER FREQ:
131.27 Hz
RIGHT UP EXIT

This value must only be entered, if you have the data from a calibration sheet of the TCM. Skip with “EXIT”.

The display shows

ENTER WATER DENSITY:
998.03 G/L
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to set the reference density and confirm with “P” or skip with “EXIT”.

The display returns to the “WATER CALIBRATION” menu.

6.4.4. Flow Calibration

Mount the TCM in the test stand or mount a reference meter in series to the TCM to be calibrated. The accuracy of the test stand or reference meter must be better than 0.1 % of reading over the calibration range.

For best results with the zero offset calibration, a valve each in front and behind the TCM is recommended.

NOTE:

All mounting guidelines (see chapter 3) must be observed!
Any erroneous reading due to bad mounting will lead to a wrong calibration!

Operate the meter for at least 15 minutes for making sure that it has reached the final operating temperature. If the medium temperature differs much from the initial meter or ambient temperature, a longer warm up period might be recommended.

Close the valves and make the zero offset adjustment (see chapter 4.3.5 and 4.5.3).

If the calibration of the TCM shall be checked without adjusting the reading, just compare the TCM reading with the reading of the reference meter at the desired flow rates.

If the TCM shall be adjusted according to the test results, make a test run (or better several tests runs) at about 50 % of the TCM full scale flow.

Read the current TCM meter variable:

CALIBRATION MENU		SET METER VAR
METER VAR.	P ➔	**196.0**
UP DOWN EXIT		RIGHT UP EXIT

Calculate the new meter variable as:

$$METER\_VAR_{new} = METER\_VAR_{old} * \frac{Reference\ Reading}{TCE\ 8000\ Reading}$$

If you made several test runs, use the average meter variable.

Use the keys “RIGHT” and “UP” to set the calculated meter variable and confirm with “P” or skip with “EXIT”.

The display returns to the “SERVICE - CALIBRATION” menu.

6.4.5. Recalibration

KEM Küppers Elektromechanik GmbH and AW-Lake Company offers to recalibrate the sensor in Germany or the USA. The following calibration types are offered as standard according to configuration:

- Standard calibration
- Customer specified calibration
- Calibrations according DIN EN ISO/IEC 17025:2005
- Density calibration
- Witness calibration

6.5. Cleaning

Cleaning the enclosure

- Clean the outside of the enclosure with the inscriptions and the display window using a cloth moistened with water or a mild detergent.
- Do not use any aggressive cleansing agents or solvents, e.g. acetone. Plastic parts or the painted surface could be damaged. The inscriptions could become unreadable.

6.6. Service

Apart from the fuses the TCE 8000 does not contain any user serviceable parts.

In case of malfunction, please contact your nearest dealer or directly KEM Küppers Elektromechanik GmbH.

For the addresses see back of the manual.

Service information is information about the condition of the device used for diagnostics and service purposes.

The basic service information parameters are:

- Driver Current
- Pickup 1 Amplitude
- Pickup 2 Amplitude
- Sensor Frequency
- Frame Temperature
- Process Media Temperature
- Zero Point Adjustment Auto/Manual
- Zero Point Offset Value
- Manual Zero Point
- Zero Point Standard Deviation

6.7. Global Device Password

In order to protect the TRICOR CLASSIC Mass Flow Meter from unauthorized access, a user-specific password can be set. It protects the access to all configuration menus. The password can be set either through the local display as described below or through the Modbus interface (see TRICOR CLASSIC Modbus RTU manual).

NOTE:

If the global access code gets lost, the meter must be returned to KEM/AWL for resetting it. Resetting the code onsite is not possible!

Press “P” for about three seconds. The display shows

MAIN MENU
ZERO OFFSET
UP DOWN EXIT

Use the key “UP” or “DOWN” to select

MAIN MENU
SERVICE
UP DOWN EXIT

Press “P”. The display shows

ENTER CODE
2206
LEFT UP EXIT

Change the indicated number with “LEFT” and “UP” to “2208” and confirm with “P”.

If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows

SERVICE MENU
CALIBRATION
UP DOWN EXIT

Use the key “UP” or “DOWN” to select ACCESS CODE and confirm with “P” or skip with “EXIT”

SERVICE MENU
ACCESS CODE
UP DOWN EXIT

P ➔

SET P-ACCESS CODE
0001
LEFT UP EXIT

Change the indicated number with “LEFT” and “UP” to the desired code number and confirm with “P”.

The display shows

OLD P-CODE: 0
NEW P-CODE: ****
OK CANCEL

Confirm with “OK” or skip with “CANCEL”.

Write down the access code.

The display returns to the “SERVICE - ACCESS CODE” menu.

6.8. Reloading Factory Settings

In case the TCM has been completely misadjusted for any reason, the TCM can be reset to the original settings ex works.

Press “P” for about three seconds. The display shows

MAIN MENU
ZERO OFFSET
UP DOWN EXIT

Use the key “UP” or “DOWN” to select

MAIN MENU
SERVICE
UP DOWN EXIT

Press “P”. The display shows

ENTER CODE
2206
LEFT UP EXIT

Change the indicated number with “LEFT” and “UP” to “2208” and confirm with “P”.

If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows

SERVICE MENU
CALIBRATION
UP DOWN EXIT

Use the key “UP” or “DOWN” to select RECALL FACT and confirm with “P” or skip with “EXIT”.

The display shows

SERVICE MENU
RECALL FACT
UP DOWN EXIT

P ➔

RECALL FACTORY SETTINGS?
START EXIT

Start the recall process with “START” or skip with “EXIT”.

If “START” is pressed, the display shows for some seconds

MEMORY ACCESS

After that for about two seconds

READY

The display returns to the “RECALL FACTORY” menu.

7. Listings

7.1. Warranty

For warranty refer to the general terms and conditions of KEM Küppers Elektromechanik GmbH, which can be found on the corresponding website (www.kem-kueppers.com), respectively for the Americas those of AW Lake Company (www.aw-lake.com).

7.2. Compliances

Category	Standards or description	
EU Declaration of Conformity - EMC	Meets intent of Directive 2014/30/EU for Electromagnetic Compatibility. Compliance is given to the following specifications as listed in the Official Journal of the European Union:	
	EN 61326/2006	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A radiated and Conducted Emissions[16] and Immunity[16].
	IEC 61000-4-2/2009	Electrostatic Discharge Immunity (Performance criterion B)
	IEC 61000-4-3/2011	Radiated RF Electromagnetic Field Immunity (Performance criterion B)
	IEC 61000-4-4/A1-2013	Electrical Fast Transient/Burst Immunity (Performance criterion B)
	IEC 61000-4-5/2015[17]	Power Line Surge Immunity (Performance criterion B)
	IEC 61000-4-6/2014	Conducted RF Immunity (Performance criterion B)
	IEC 61000-4-11/2005[17]	Voltage Dips and Interruptions Immunity (Performance criterion B)
Australia/New Zealand Declaration of Conformity-EMC	Complies with the EMC Emission standard[16]	
	AS/NZS 2064	
FCC EMC Compliance	Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B[16].	

[16] Compliance demonstrated using high-quality shielded interface cables.
[17] Applies only to units with AC mains supply instead of or additional to the SELV supply.

Category	Standards or description	
EU Declaration of Conformity – Low Voltage	Compliance is given to the following specification as listed in the Official Journal of the European Union: Low Voltage Directive 2014/35/EU	
	EN 61010-1/2010	Safety requirements for electrical equipment for measurement control and laboratory use.
Designed to meet the following US standards	UL 61010-1/2012	Standard for electrical measuring and test equipment.
Designed to meet the following Canadian standards	CAN/CSA C22.2 no. 61010-1-4/2008	Safety requirements for electrical equipment for measurement, control, and laboratory use.
International standards	IEC61010-1/2010	Safety requirements for electrical equipment for measurement, control, and laboratory use.
Equipment Type	Test and measuring	
Safety Class	Class 1 (as defined in IEC 61010-1, Annex H) – grounded product	

7.3. Approvals and Certifications

	TCM 0325, 0650, 1550, 3100, 5500 and 7900	TCM 028K, 065K and 230K
ATEX Zone 1	Compact version: II 2G Ex db ia IIC T4 Gb Remote version[19]: Sensor: II 1G Ex ia IIC T4…T2 Ga Transm.: II 2(1)G Ex db [ia Ga] IIC T4 Gb	Compact version: II 2G Ex db ia IIB T4 Gb Remote version[19]: Sensor: II 1G Ex ia IIB T4…T2 Ga Transm.: II 2(1)G Ex db [ia Ga] IIB T4 Gb
ATEX Zone 2	All versions: II 3G Ex nA IIC T4	All Versions: II 3G Ex nA IIB T4
IECEx	Compact version: Ex db ia IIC T4 Gb Remote version[19]: Sensor: Ex ia IIC T4…T2 Ga Transm.: Ex db [ia Ga] IIC T4 Gb	Compact version: Ex db ia IIB T4 Gb Remote version[19]: Sensor: Ex ia IIB T4…T2 Ga Transm.: Ex db [ia Ga] IIB T4 Gb
cCSAus[18]	Compact version: Cl. 1, Div. 1, Group A-D: T4 (US, Can) Ex db ia IIC T4 Gb (Can) Remote version[19]: Sensor: Cl. 1, Div. 1, Group A-D: T4...T2 (US, Can) Ex ia IIC T4...T2 Ga (Can) Transm.: Cl. 1, Div. 1, Group A-D: T4 (US, Can) Ex db [ia Ga] IIC T4 Gb (Can)	Compact version: Cl. 1, Div. 1, Group C, D: T4 (US, Can) Ex db ia IIB T4 Gb (Can) Remote version[19]: Sensor: Cl. 1, Div. 1, Group C, D: T4...T2 (US, Can) Ex ia IIB T4...T2 Ga (Can) Transm.: Cl. 1, Div. 1, Group C, D: T4 (US, Can) Ex db [ia Ga] IIB T4 Gb (Can)
EAC (TR-CU)	Compact version: 1Ex d ia IIC T4 Gb X Remote version[19]: Sensor: 0Ex ia IIC T4...T2 Ga X Transm.: 1Ex d [ia Ga] IIC T4 Gb X	Compact version: 1Ex d ia IIB T4 Gb X Remote version[19]: Sensor: 0Ex ia IIB T4...T2 Ga X Transm.: 1Ex d [ia Ga] IIB T4 Gb X
KGS (Korean)	Compact version: Ex d [ia] IIC T4 Remote version[19]: Sensor: Ex ia IIC T4 Transm.: Ex d [ia] IIC T4	Compact version: Ex d [ia] IIB T4 Remote version[19]: Sensor: Ex ia IIB T4 Transm.: Ex d [ia] IIB T4

[18] For cCSAus the electronic is only available in aluminum housing.
[19] Only wall mounting, not panel mounting.

7.4. Technical Data

7.4.1. TCM Transducer – Technical Data for Liquids

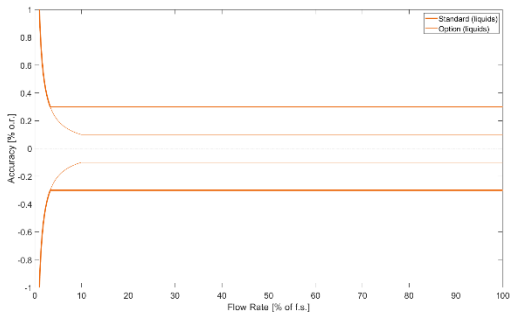
	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
Max. Flow Rate (kg/h)	325	650	1,550	3,100	5,500	7,900	28,000	65,000	230,000
Max. Flow Rate (lb/min)	12	24	57	114	202	290	1,029	2,388	8,450
Basic Accuracy (Mass Flow)	±0.3 % of flow rate (option: up to 0.1 % of flow rate)								±0.3 % (±0.15 %)
Basic Accuracy (Volume Flow)	±0.3 % of flow rate (option: up to 0.15 % of flow rate)								±0.3 % (±0.2 %)
Repeatability	±0.05 % of flow rate								
Zero Stability	±0.01 % of full scale								±0.015 %
Density Range	up to 2,500 kg/m³ [2.5 g/cm³] (higher ranges on request)								
Density Accuracy	±1.0 kg/m³ [±0.001 g/cm³]								
Density Repeatability	±0.5 kg/m³, ±0.0005 g/cm³								
Process Temperature Range	±1 °C ±0.5 % of reading [±1.8 °F ±0.5 % of reading]								
Temperature Repeatability	±0.2 °C [±0.36 °F]								
Process and Ambient									
Process Connections	female thread ½“ adaptors for flanges, dairy and tri-clamp				flanges EN1092, ANSI B16.5, DIN2512 treaded tri-clamp				
Max. Pressure Standard	200 bar [2,900 psi] option: up to 345 bar [5,000 psi] (not forASME)					100 bar [1,450 psi]			
Pressure Drop at max. Flow	for detail information please contact us								
Process Temperature (non Ex)	-40 °C ... +100 °C [-40 °F ... +212 °F] (standard) -40 °C ... +150 °C [-40 °F ... +302 °F] (option) -60 °C ... +200 °C [-76 °F ... +392 °F] (option)								
Process Temperature (Ex)	meter mount	-40 °C ... +70 °C [-40 °F ... +158 °F] (T4)							n/a
	remote version	-40 °C ... +70 °C [-40 °F ... +158 °F] (T4) -40 °C ... +135 °C [-40 °F ... +275 °F] (T3) -60 °C ... +200 °C [-76 °F ... +392 °F] (T2)							
Ambient Temperature	-40 °C ... +70 °C [-40 °F ... +158 °F]								
Storage Temperature	-40 °C ... +100 °C [-40 °F ... +212 °F]								
Electr. Connections Remote	screw type terminals								
Electr. Connections Meter Mount	none (internally connected to the electronics)								
Ingress Protection	IP65 (IP66/IP67 on request)								
General									
Tube Arrangement	2 serial	2 parallel	2 serial	2 parallel	2 parallel	2 parallel	2 parallel	2 parallel	2 parallel
Tube Inner Diameter	4 mm	4 mm	8 mm	8 mm	7 mm	9 mm	16 mm	28 mm	43 mm
Tube Material	1.4404 [AISI 316L]								
Housing Material	1.4404 [AISI 316L]								
Dimensions	see dimensional drawings chapter 7.4.7								

Calibration for Liquids and Gases: The TRICOR CLASSIC flowmeters are always factory calibrated with water.
Calibration Conditions: Water: 20 °C ... 25 °C [68 °F ... 77 °F], ambient temperature: 20 °C ... 25 °C [68 °F ... 77 °F].
All specifications are based on above mentioned calibration reference conditions, a flow calibration protocol is attached to each instrument.
Stated accuracy combines the effects of repeatability, linearity and hysteresis.
Typical flow dynamics based on max. flow rate is 100:1.

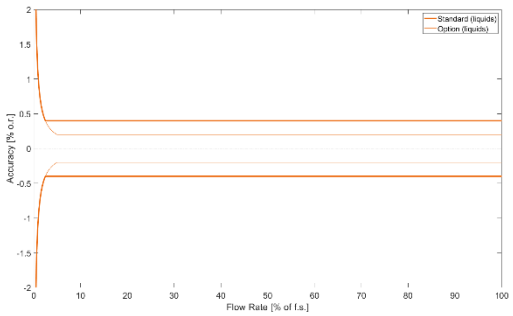
7.4.2. Accuracy for Liquids

7.4.2.1. TCM 0325 to TCM 065K

Mass Flow

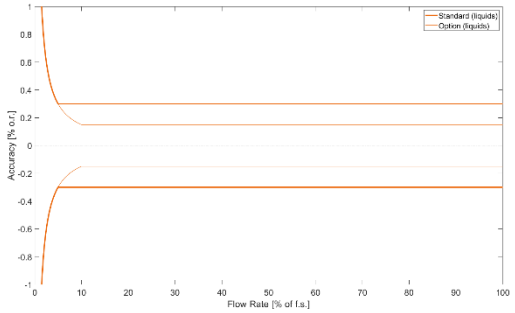


Volume Flow

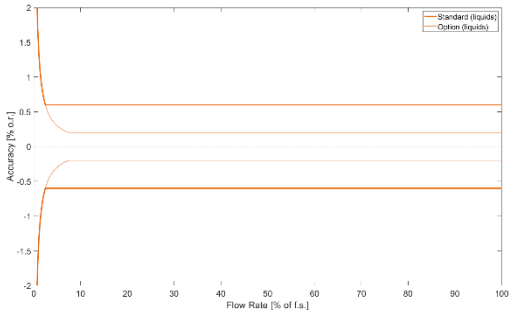


7.4.2.2. TCM 230K

Mass Flow



Volume Flow



Flow Rate of full Scale	Accuracy
$\geq \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$	± Basic Accuracy
$< \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$	$\pm \frac{\text{Zero Point}}{\text{Measured Value}} * 100$

7.4.3. TCM Transducer – Technical Data for Gases

	TCM 0325	TCM 0650	TCM 1550	TCM 3100	TCM 5500	TCM 7900	TCM 028K	TCM 065K	TCM 230K
Nom. Flow Rate (kg/h)[20) 22)]	78	177	333	740	910	1,430	5,100	15,650	48,900
Nom. Flow Rate (lb/min)[20) 22)]	3	7	12	27	34	53	188	575	1,797
Nom. Flow Rate (Nm^3/h)[20) 21)]	109	247	464	1,031	1,268	1,993	7,109	21,813	68,157
Nom. Flow Rate (SCFM)[20) 21)]	64	146	273	607	747	1,173	4,184	12,838	40,115
Basic Accuracy	±1 % of flow rate (option: up to ±0.5 % of flow rate)								
Repeatability	±0,25 % of flow rate								
Zero Stability in kg/h [lb/min]	0.0325 [0.0012]	0.065 [0.0024]	0.155 [0.0057]	0.31 [0.0114]	0.55 [0.020]	0.79 [0.029]	2.8 [0.103]	6.5 [0.239]	23 [0.845]
Density Measuring Range	see comment[20)]								
Density Accuracy	±1.0 kg/m^3 [±0.001 g/cm^3]								
Density Repeatability	±0.5 kg/m^3 [±0.0005 g/cm^3]								
Process Temperature Range	±1 °C ±0.5 % of reading [±1.8 °F ±0.5 % of reading]								
Temperature Repeatability	±0.2 °C [±0.36 °F]								
Process and Ambient									
Process Connections	female thread ½ " adaptors for flanges, dairy and tri-clamp				flanges EN1092, ANSI B16.5, DIN2512 treaded tri-clamp				
Max. Pressure Standard	200 bar [2,900 psi] option: up to 345 bar [5,000 psi] (not for ASME)					100 bar [1,450 psi]			
Pressure Drop at Max. Flow	for detail information please contact us								
Process Temperature (non Ex)	-40 °C ... +100 °C [-40 °F ... +212 °F] (standard) -40 °C ... +150 °C [-40 °F ... +302 °F] (option) -60 °C ... +200 °C [-76 °F ... +392 °F] (option)								
Process Temperature (Ex)	meter mount	-40 °C ... +70 °C [-40 °F ... +158° F] (T4)							n/a
	remote version	-40 °C ... +70 °C [-40 °F ... +158 °F] (T4) -40 °C ... +135 °C [-40 °F ... +275 °F] (T3) -60 °C ... +200 °C [-76 °F ... +392 °F] (T2)							
Ambient Temperature	-40 °C ... +70 °C [-40 °F ... +158 °F]								
Storage Temperature	-40 °C ... +100 °C [-40 °F ... +212 °F]								
Electr. Connections Remote	screw type terminals								
Electr. Connections Meter Mount	none (internally connected to the electronics)								
Ingress Protection	IP65 (IP66/IP67 on request)								
General									
Tube Arrangement	2 serial	2 parallel	2 serial	2 parallel	2 parallel	2 parallel	2 parallel	2 parallel	2 parallel
Tube Inner Diameter	4 mm	4 mm	8 mm	8 mm	7 mm	9 mm	16 mm	28 mm	43 mm
Tube Material	1.4404 [AISI 316L]								
Housing Material	1.4404 [AISI 316L]								
Dimensions	see chapter 7.4.7								

Max. allowed flow velocity (Ma 0.5).
For gas applications, flow rate and pressure drop for individual sensor sizes are dependent on operating temperature, pressure and fluid composition. Therefore, when selecting a sensor for any particular gas application, please use the the TSP (TRICOR Sizing Program) or contact us.

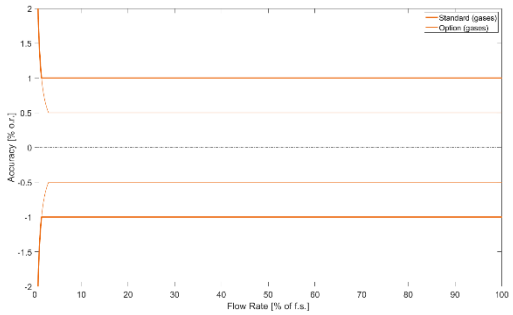
[20)] Nominal flow rates that produce approximately 3 bar [43 psi] pressure drop for natural gas at 50 bar [725 psi] operational pressure.

[21)] Normal reference conditions (Nm^3/h) are 1,013 bar und 0 °C. Standard (SCFM) reference conditions are 14.7 psi und 60 °F.

[22)] Flow rate and density range depend on the gas density and the pressure range.

7.4.4. Accuracy for Gases

Mass Flow



Flow Rate of full Scale	Accuracy
$\geq \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$	± Basic Accuracy
$< \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$	$\pm \frac{\text{Zero Point}}{\text{Measured Value}} * 100$

7.4.5. Technical Data TCE 8000/8100 Transmitter

General	
Supply Voltage	24 V DC or 100 … 240 V AC (version dependent)
Power Consumption	max. 4 W (DC version) max. 11 W (AC version)
Environmental Conditions	• Transient over voltages up to the levels of overvoltage category II • Temporary over voltages occurring on mains supply only • Mains AC supply voltage fluctuations up to ±10 % of the nominal voltage • Humidity 80% to temperatures up to 31 °C [88 °F] decreasing linearly to 50% rH at 40 °C [104 °F]; max 80% rH, non-condensing. • Installation category II; • Pollution degree 2 • Indoor use and Outdoor use possible • Altitude up to 2,000 m
Reverse Polarity Protection	yes
Galvanic Isolation	2,500 V AC
Display	back-lit LCD screen, 132 x 32 dot
Programming	via front keyboard or Windows-based TRICOR configurator program (Modbus)
Interfaces	RS485 (Modbus RTU), Option HART®, Foundation Fieldbus® other options on request
Cable Glands	Suitable for Ø 7 - 13 mm cables Material: Brass/Ni plated (option: Stainless steel 1.4404 [AISI 316]) Thread: 2 x ½" NPT or 2 x M20 x 1.5
Housing: Wall-mounted	
Dimensions	see chapter 7.4.7
Electrical Connections	cage clamp terminals
Sensor Cable Glands	Barrier cable gland: applied by manufacturer (thread: ½" NPT)
Housing Material	Aluminum diecast (option: 1.4404 [AISI 316L])
Protection class	IP65 (IP66/IP67 on request)
Weight:	with aluminum diecast housing: 3.8 kg [8.3 lb] with 3 m cable with 1.4404 [AISI 316L] housing: 6.15 kg [13.56 lb]
Temperature	ambient: -40 °C ... +70 °C [-40 °F ... +158 °F] storage and transport: -40 °C ... +80 °C [-40 °F ... +176 °F]
Housing: Panel-mounted (only TCE 8000)	
Dimensions	see chapter 7.4.7
Electrical Connections	cage clamp terminals
Housing Material	Noryl
Protection Class	front: IP50, rear: IP30
Weight	0.4 kg [0.88 lb]
Temperature	ambient: ±0 °C ... +60 °C [32 °F ... +140 °F] storage and transport: -20 °C ... +70 °C [-4 °F ... +158 °F]
Analog Outputs	
Current Outputs (2x)	4 ... 20 mA passive, two-wire, isolated
Resolution	14 bit
Linearity	±0.05 % of full scale
Temperature Drift	0.05 % per 10 K
Load	< 620 Ω (at 24 V supply)
Output Value	programmable: flow, total, density, temperature
Pulse Output	
Frequency Range	0.5 - 10,000 Hz (in TOTAL mode: 0 - 100 Hz)
Output Signal	active push pull output for flow rate

Status In- and Output	
Status Output	push pull programmable (in FREQUENCY mode: 0.5 - 10,000 Hz)
Control Input	programmable
Analog Input (option)	
Input Type	4 … 20 mA active for two-wire passive pressure sensor
Resolution	12 bit
Linearity	±0.05 % of full scale
Temperature Drift	0.05 % per 10 K
Supply Voltage	> 20 V (at 20 mA sensor current)

7.4.6. Technical Data TCE/TCM Cable

	Standard cable	High temperature cable
General		
Outer Diameter	8.70 mm ±0.2 mm	6,9 mm ±0,2 mm
Sheath	PVC	FEP
Colour	grey (RAL7032)	black
Labeling	UL (white)	—
RoHS	yes	yes
Resistance		
Flammability	flame-retardant (IEC 60332-1-2)	flame-retardant
Hydrolysis Resistance	hydrolysis resistance	—
Oil Resistance	oil resistance	oil resistance
Laying		
Range of Temperatures	moved: -50 °C to +70 °C [-58 °F to +158 °F] fixed: -40 °C to +80 °C [-40 °F to +176 °F]	-65 °C up to +180 °C [-85 °F up to +356 °F]
Bending Radius	moved: 85 mm (10xD) fixed: 42.5 mm (5xD)	moved: 71 mm (10xD) fixed: 35.5 mm (5xD)

7.4.7. Torque requirements

Description	Torque
Cable gland to housing	10 Nm
Enclosure lids	10 Nm
Wall bracket screws	10 Nm

7.4.8. PED (European Directive for pressure equipment)

The pressure equipment directive RL 2014/68/EU applies to the alignment of the statutory orders of the European member states for pressure equipment. Such equipment in the sense of the directive includes vessels, pipelines and accessories with a maximum allowable pressure of more than 0.5 bar above atmospheric. Coriolis Mass Flow Meters are considered as piping.

A detailed risk analysis of the flowmeter has been performed in accordance with the RL 2014/68/EU. All risks are assessed to be "none" provided that the procedures and standards referenced in these operating instructions are observed.

7.4.8.1. Division of media (liquid/gaseous) into the fluid groups

The classification of fluids on the basis of the new European Hazardous Substances Regulation is regulated in Article 13 of RL 2014/68/EU.

Fluids are gases, liquids and vapours as pure phase as well as their mixtures. Fluids can also contain a suspension of solids. According to the Pressure Equipment Directive, the fluid group is determined by the medium flowing or being in the component later. The directive distinguishes between two fluid groups:

Group 1 fluids

 **Explosive** R phrases: for example: 2, 3 (1, 4, 5, 6, 9, 16, 18, 19, 44)	 **Very toxic** R phrases: for example: 26, 27, 28, 39 (32)
 **Extremely flammable** R phrases: for example: 12 (17)	 **Toxic** R phrases: for example: 23, 24, 25 (29, 31)
 **Highly flammable** R phrases: for example: 11, 15, 17 (10, 30)	 **Oxidizing** R phrases: for example: 7, 8, 9 (14, 15, 19)
 **Flammable** R phrases: for example: 11 (10)	

Tab. 8: Fluids group 1 according to RL 2014/68/EU

Group 2 fluids

All fluids not belonging to Group 1.

Also applies to fluids which are for example dangerous to the environment, corrosive, dangerous to health, irritant or carcinogenic (if not highly toxic).

7.4.8.2. Conformity assessment

Flowmeters of categories I to III comply with the safety requirements of the directive. They are affixed with the CE mark and an EC declaration of conformity is provided.

The flowmeters are subjected to the conformity assessment procedure - Module A2.

Flowmeters according to Article 3 Paragraph 3 are designed and manufactured in accordance with sound engineering practice in Germanyk. PED conformity reference is not affixed to the CE mark.

7.4.8.3. Diagrams

- Gases of fluid group 1
- Pipelines according to Article 3 Number 1.3 Letter a) First dash
- Exception: unstable gases belonging to Categories I and II must be included in Category III.

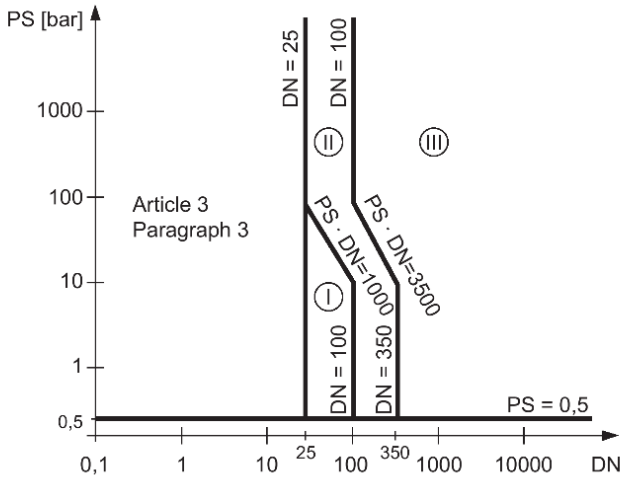


Fig. 25: Diagram 1 for gases of fluid group 1

- Gases of fluid group 2
- Pipelines according to Article 3 Number 1.3 Letter a) Second dash
- Exception: liquids at temperatures > 350 ° C belonging to Category II must be included in Category III.

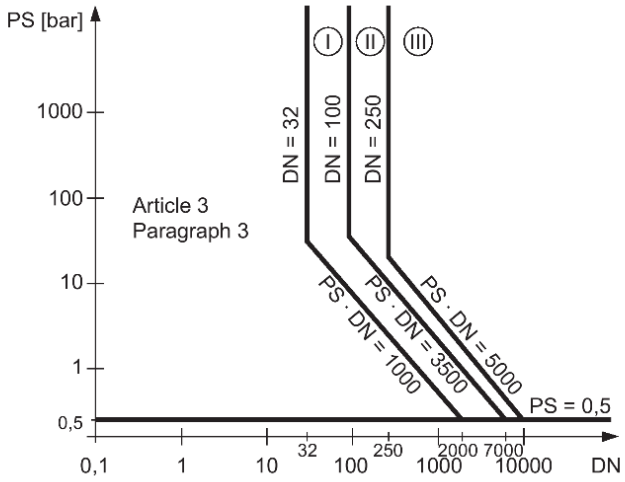


Fig. 26: Diagram 1 for gases of fluid group 2

- Liquids of fluid group 1
- Pipelines according to Article 3 Number 1.3 Letter b) First dash

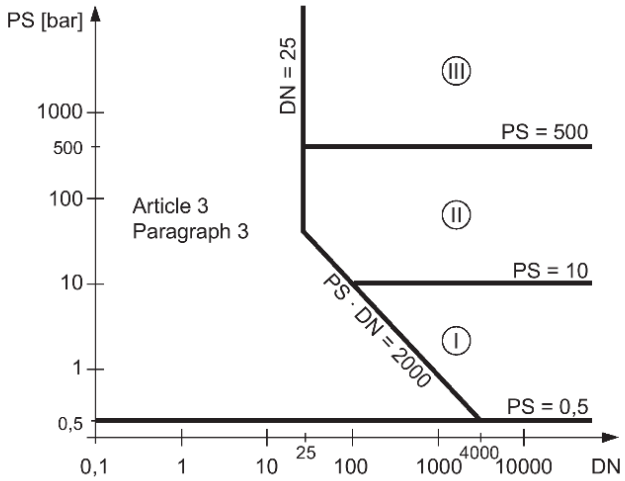


Fig. 27: Diagram 2 for gases of fluid group 1

- Liquids of fluid group 2
- Pipelines according to Article 3 Number 1.3 Letter b) Second dash

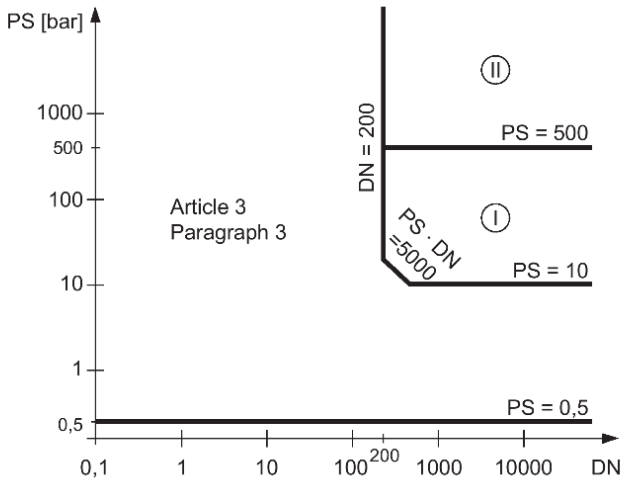


Fig. 28: Diagram 2 for gases of fluid group 2

7.4.9. Pressure – temperature ratings

Pressure – temperature ratings are determined by process connection material and applicable standards. The tables below detail the allowed maximum process pressure for sensor variants with stainless steel and Hastelloy measuring tubes.

With two major exceptions, the pressure rating of the flow sensors is independent of the process medium temperature. Design rules for flange connections in both the EN1092-1 and ASME B16.5 standards dictate pressure derating with increasing temperature. The charts below show the effect of process medium temperature on the pressure ratings for the flanges within the product program.

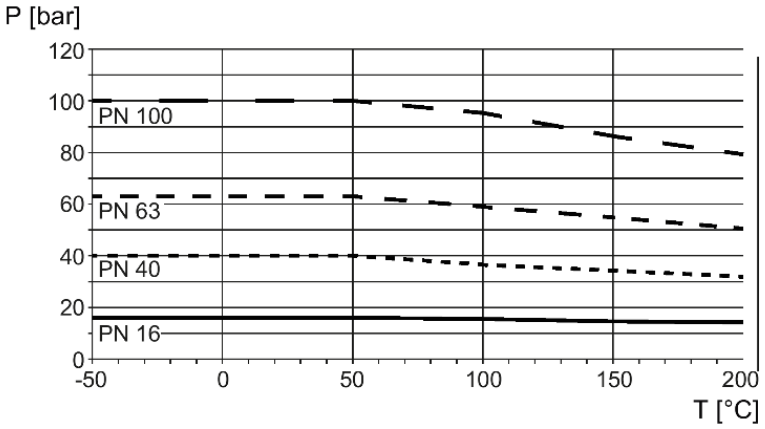


Fig. 29: Metric flange ratings, EN 1092-1 (previously DIN 2628, DIN2629, DIN 2635, DIN 2636, DIN 2637, DIN 2638) (P: Process pressure; T: Process temperature)

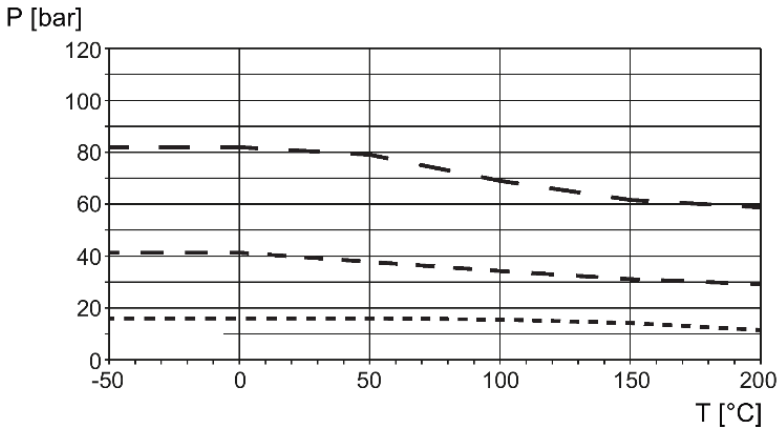


Fig. 30: ANSI flange ratings, ASME B16.5 (P: Process pressure; T: Process temperature)

PN	Temperature TS (°C [°F])					
	-50 [-58]	0 [+32]	+50 [+122]	+100 [+212]	+150 [+302]	+180 [+356]
16 bar [232 psi]	16.0 bar [232.1 psi]	16.0 bar [232.1 psi]	16.0 bar [232.1 psi]	15.2 bar [220.5 psi]	13.7 bar [198.7 psi]	13.1 bar [190.0 psi]
40 bar [580 psi]	40.0 bar [580.2 psi]	40.0 bar [580.2 psi]	40.0 bar [580.2 psi]	37.9 bar [549.7 psi]	34.5 bar [500.4 psi]	32.9 bar [477.2 psi]
63 bar [915 psi]	63.0 bar [913.7 psi]	63.0 bar [913.7 psi]	63.0 bar [913.7 psi]	59.7 bar [865.9 psi]	54.3 bar [787.6 psi]	51.8 bar [751.3 psi]
100 bar [1,450 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	94.8 bar [1,375.0 psi]	86.1 bar [1,248.8 psi]	82.1 bar [1,190.8 psi]

Tab. 9: Pressure - temperature rating according to EN1092-1 (other process connections on request)

Class/Group	Temperature TS (°C [°F])					
	-50 [-58]	0 [+32]	+50 [+122]	+100 [+212]	+150 [+302]	+180 [+356]
150 / 2.2	19.0 bar [275.6 psi]	19.0 bar [275.6 psi]	18.4 bar [226.9 psi]	16.2 bar [235.0 psi]	14.8 bar [214.7 psi]	13.7 bar [198.7 psi]
300 / 2.2	49.6 bar [719.4 psi]	49.6 bar [719.4 psi]	48.1 bar [697.6 psi]	42.2 bar [612.1 psi]	38.5 bar [558.4 psi]	35.7 bar [517.8 psi]
600 / 2.2	99.3 bar [1,440.2 psi]	99.3 bar [1,440.2 psi]	96.2 bar [1,395.3 psi]	84.4 bar [1,224.1 psi]	77.0 bar [1,116.8 psi]	71.3 bar [1,034.1 psi]
900 / 2.2	110.0 bar [1,595.4 psi]	110.0 bar [1,595.4 psi]	110.0 bar [1,595.4 psi]	110.0 bar [1,595.4 psi]	110.0 bar [1,595.4 psi]	107.0 bar [1,595.4 psi]

Tab. 10: Pressure - temperature rating according to ASME B16.5 (other process connections on request)

PN	Temperature TS (°C [°F])					
	-50 [-58]	0 [+32]	+50 [+122]	+120 [+248]	+150 [+302]	+200 [+392]
10 K	14.0 bar [203.1 psi]	14.0 bar [203.1 psi]	14.0 bar [203.1 psi]	14.0 bar [203.1 psi]	13.4 bar [194.4 psi]	12.4 bar [179.8 psi]
20 K	34.0 bar [493.1 psi]	34.0 bar [493.1 psi]	34.0 bar [493.1 psi]	34.0 bar [493.1 psi]	33.1 bar [480.1 psi]	31.6 bar [458.3 psi]
40 K	68.0 bar [986.3 psi]	68.0 bar [986.3 psi]	68.0 bar [986.3 psi]	68.0 bar [986.3 psi]	66.2 bar [960.1 psi]	63.2 bar [916.6 psi]
63 K	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	99.0 bar [1,435.9 psi]

Tab. 11: Pressure - temperature rating according to JIS

PN/DN	Temperature TS (°C [°F])				
	-50 [-58]	0 [+32]	+50 [+122]	+100 [+212]	+140 [+284]
10 bar [145 psi] / 85-219.1	10.0 bar [145.0 psi]	10.0 bar [145.0 psi]	10.0 bar [145.0 psi]	10.0 bar [145.0 psi]	10.0 bar [145.0 psi]
16 bar [232 psi] / 48.3-76.2	16.0 bar [232.1 psi]	16.0 bar [232.1 psi]	16.0 bar [232.1 psi]	16.0 bar [232.1 psi]	16.0 bar [232.1 psi]
25 bar [363 psi] / 6.35-42.4	25.0 bar [362.6 psi]	25.0 bar [362.6 psi]	25.0 bar [362.6 psi]	25.0 bar [362.6 psi]	25.0 bar [362.6 psi]

Tab. 12: Pressure - temperature rating according to DIN 32676 & ISO 2852

PN	Temperature TS (°C [°F])					
	-50 [-58]	0 [+32]	+50 [+122]	+100 [+212]	+150 [+302]	+200 [+392]
100 bar [1450 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]	100.0 bar [1,450.4 psi]

Tab. 13: Pressure - temperature rating according to Swagelok SS-12-VCO-3 socket weld with SS-12-VCO-4 nut

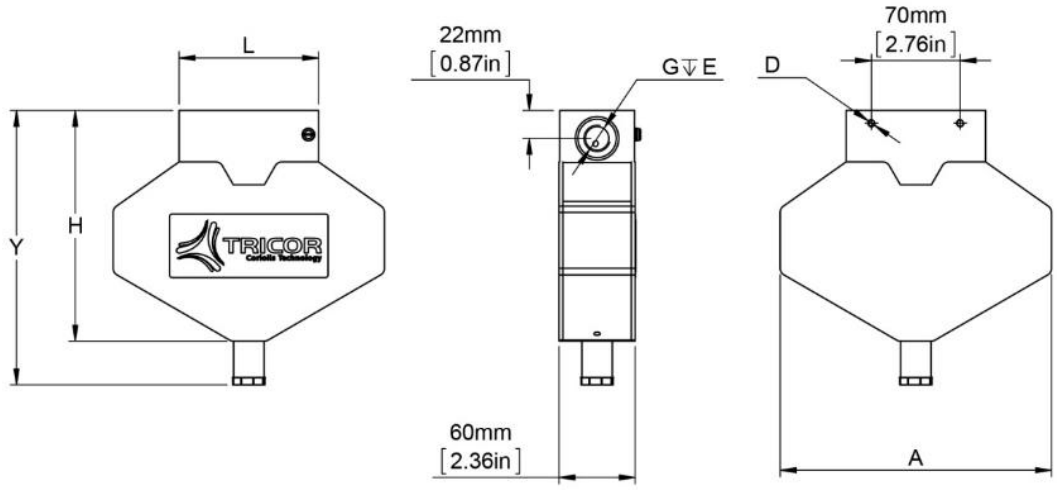
NOTE

Test pressure

Maximum allowable test pressure (MATP) for the flowmeter and process connection is 1.5 times the nominal pressure up to 150 bar (2,176 psi).

7.4.10. Dimensional Drawings

Dimensional Drawing Sensors TCM 0325 to TCM 0650



Sensor Type	A	D	E	G[23)]	H	L[24)]	Y
TCM 0325	214 mm [8.43 in]	M6 ↧ 10	21 mm [0.83 in]	G ½“	182 mm [7.17 in]	110 mm [4.33 in]	216 mm [8.50 in]
TCM 0650	214 mm [8.43 in]	M6 ↧ 10	21 mm [0.83 in]	G ½“	182 mm [7.17 in]	110 mm [4.33 in]	216 mm [8.50 in]

*Fig. 31: Dimensions TCM 0325-**-****-**** through TCM 0650-**-****-****

Dimensional Drawing Sensor TCMH 0450

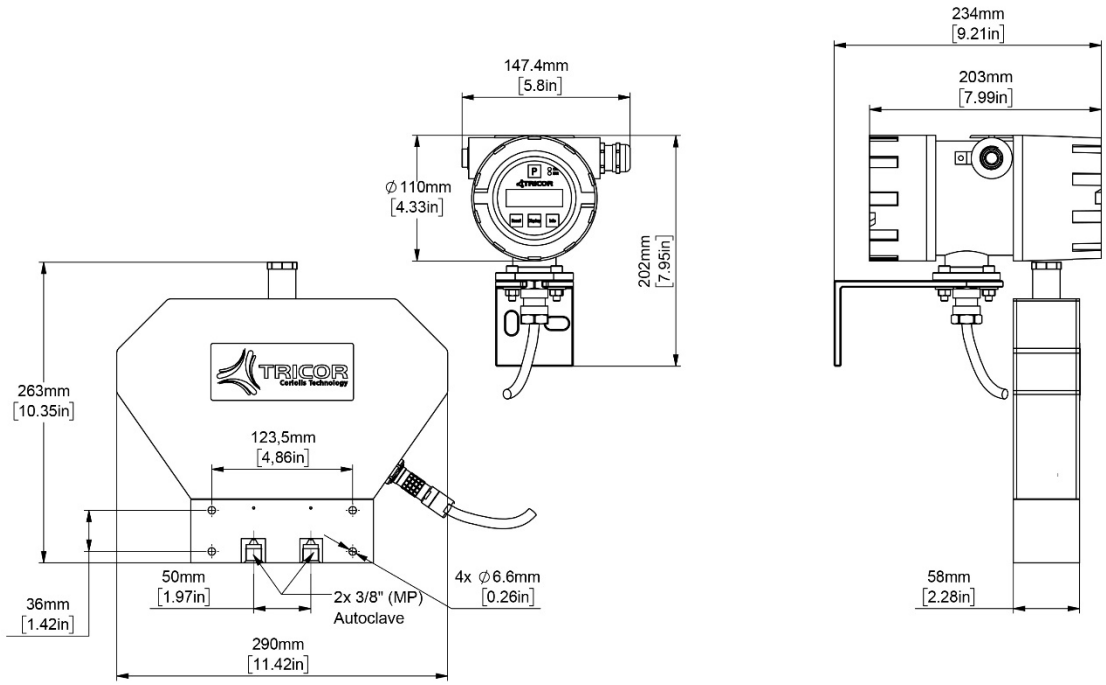


Fig. 32: Meter Dimensions TCMH 0450, Ex/Ex1

[23)] Other connections on request.
[24)] Further lengths on request.

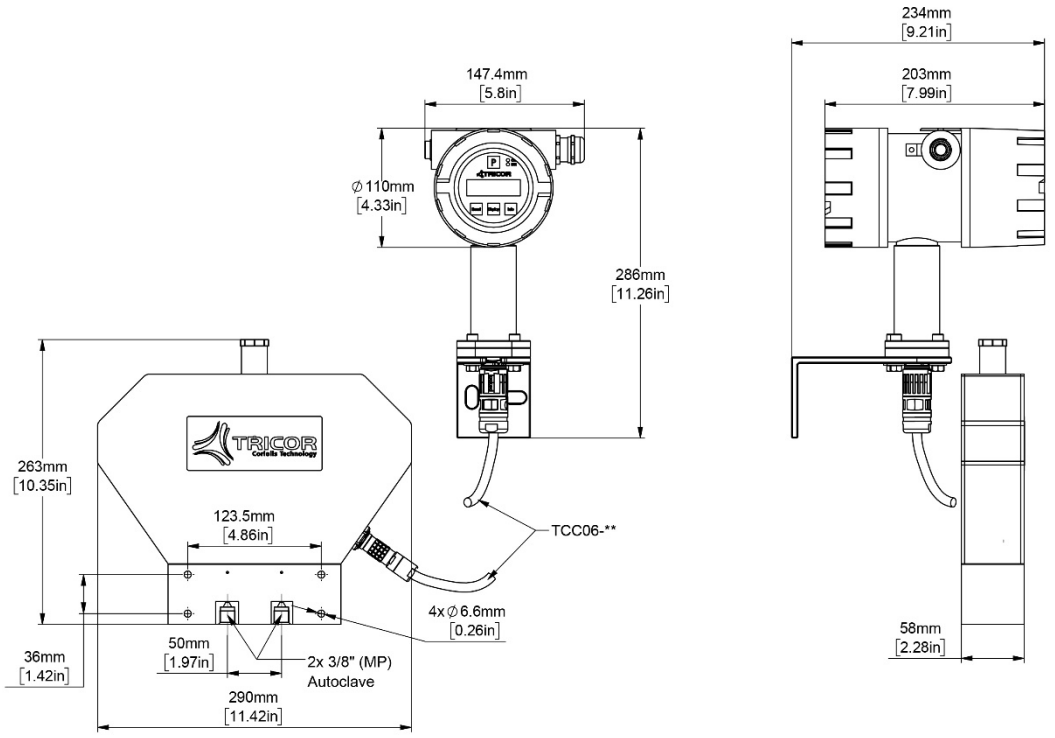
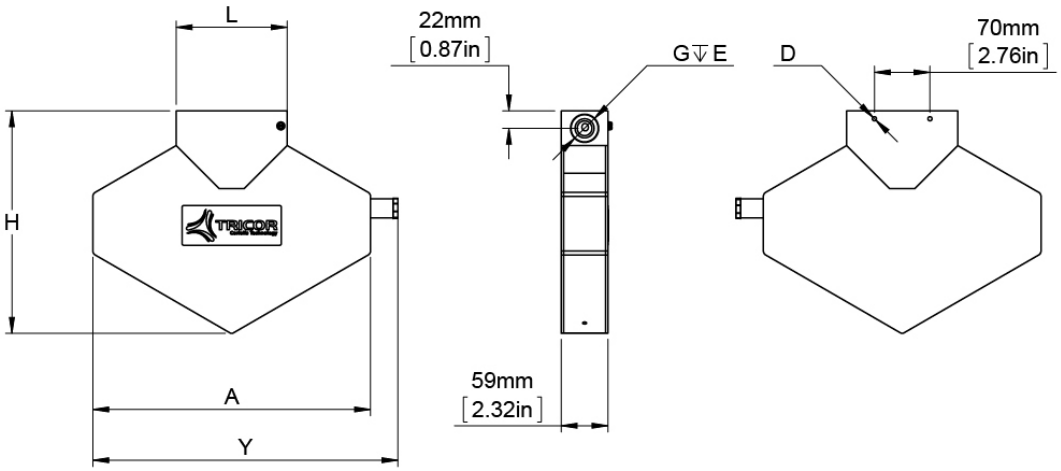


Fig. 33: Meter Dimensions TCMH 0450, Ex3

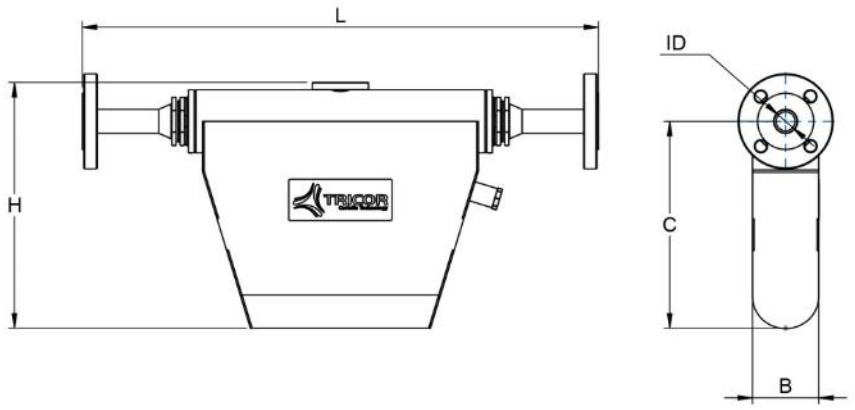
Dimensional Drawing Sensors TCM 1550 to TCM 3100



Sensor Type	A	D	E	G[25)]	H	L[26)]	Y
TCM 1550	350 mm [13.78 in]	M6 ↧ 10	18 mm [0.71 in]	G ½“	280 mm [11.02 in]	140 mm [5.51 in]	384 mm [15.12 in]
TCM 3100	350 mm [13.78 in]	M6 ↧ 10	18 mm [0.71 in]	G ½“	280 mm [11.02 in]	140 mm [5.51 in]	384 mm [15.12 in]

*Fig. 34: Dimensions TCM 1550-**-****-**** through TCM 3100-**-****-****

Dimensional Drawing Sensors TCM 5500 to TCM 065K



Sensor Type	B	C	H	L[26]	I.D.	Connection[25]
TCM 5500, 7900	61 mm [2.40 in]	204 mm [8.03 in]	260 mm [10.24 in]	460 mm [18.11 in]	Ø 13 mm [Ø 0.51 in]	on request
TCM 028K	80 mm [3.15 in]	253 mm [9.96 in]	315 mm [12.40 in]	625 mm [24.61 in]	Ø 23 mm [Ø 0.91 in]	on request
TCM 065K	151 mm [5.94 in]	387 mm [15.24 in]	480 mm [18.90 in]	830 mm [32.68 in]	Ø 40 mm [Ø 1.57 in]	on request

*Fig. 35: Dimensions TCM 5500-**-****-**** through TCM 065K-**-****-****

Dimensional Drawing Sensors TCM 230K

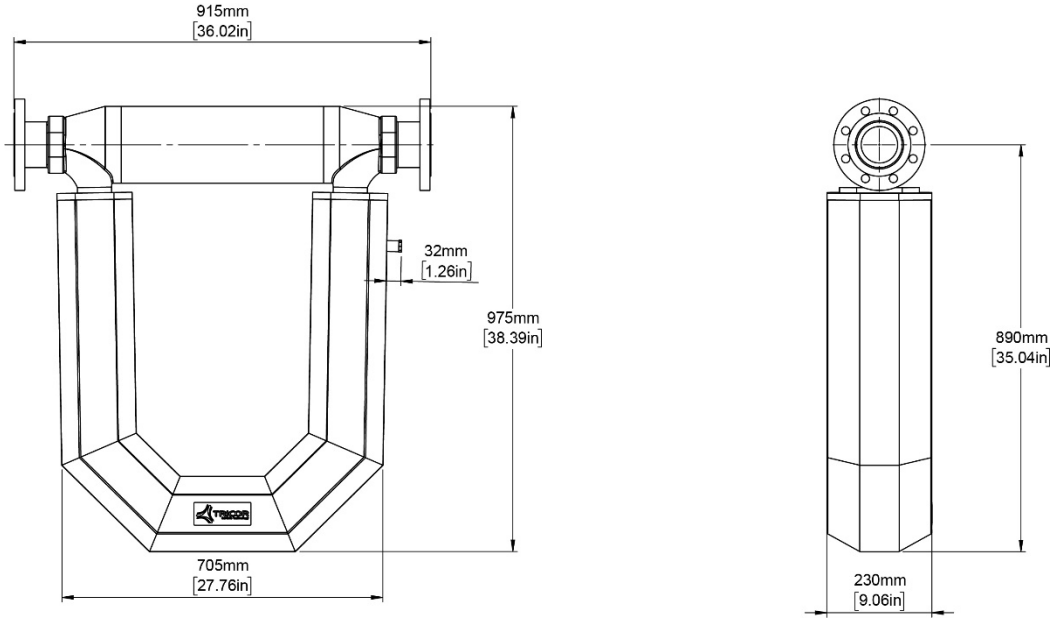


*Fig. 36: Dimensions TCM 230K-**-****-****

[25] Other connections on request.
[26] Further lengths on request.

Dimensional Drawing Meter-Mount Transmitter TCE 8000/8100

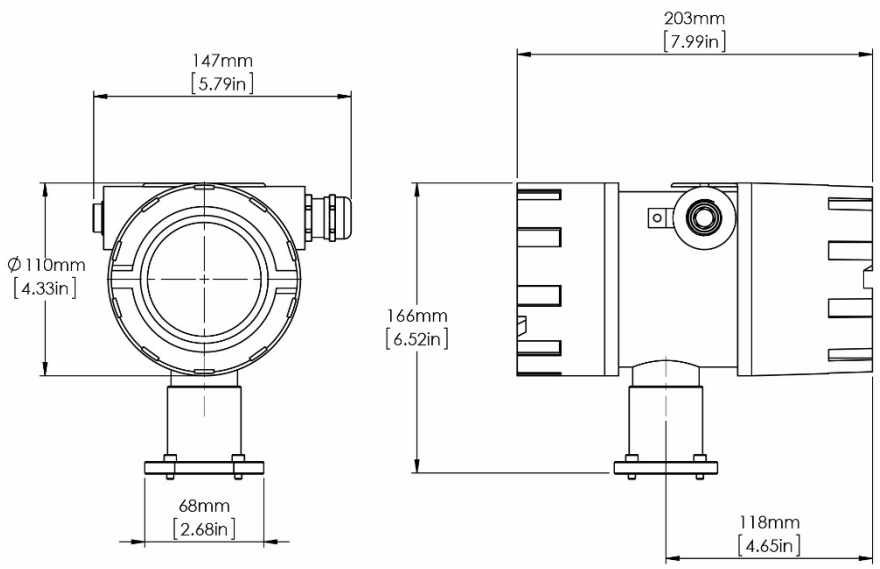


Fig. 37: Dimensions compact transmitter TCE 8000/8100

Dimensional Drawing Wall-Mount Transmitter TCE 8000/8100 (not for hazardous area)

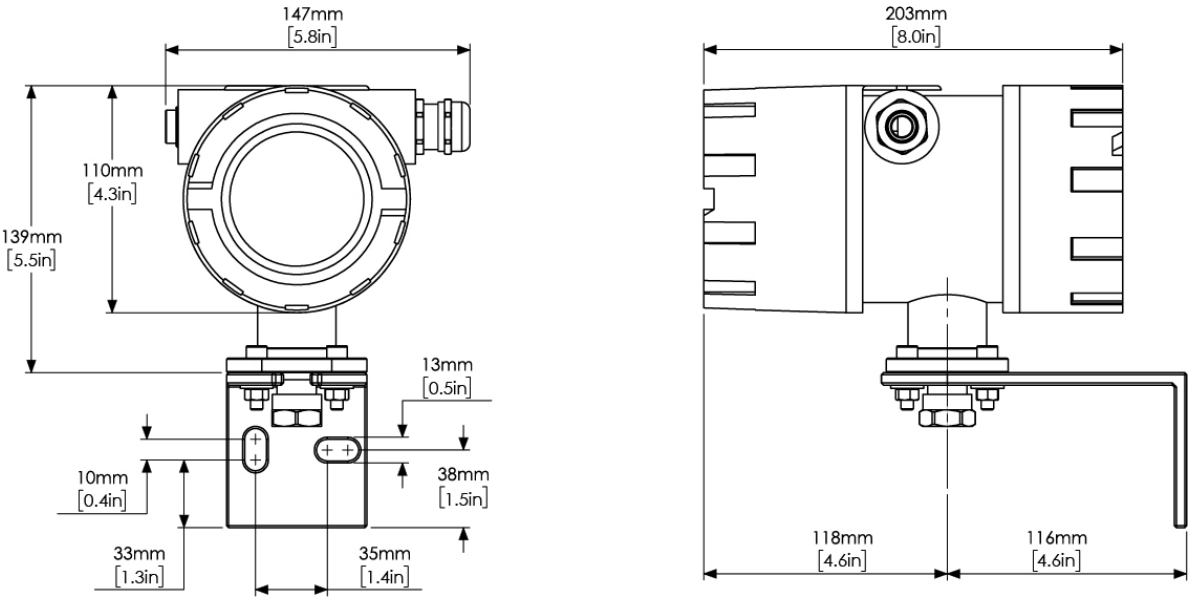


Fig. 38: Dimensions Wall-Mount Transmitter TCE 8000/8100 (not for hazardous area)

Dimensional Drawing Wall-Mount Transmitter TCE 8000/8100 (for hazardous area)

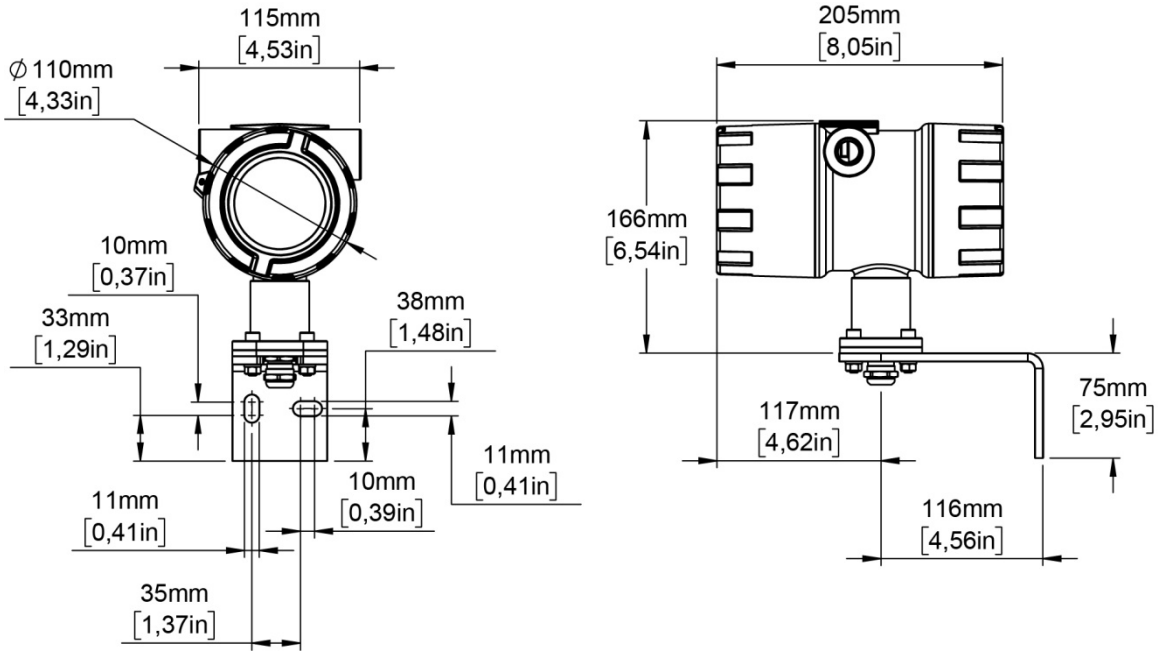


Fig. 39: Dimensions Wall-Mount Transmitter TCE 8000/8100 (for hazardous area)

Dimensional Drawing Meter-Mount Transmitter TCE 8000/8100 with blind cover

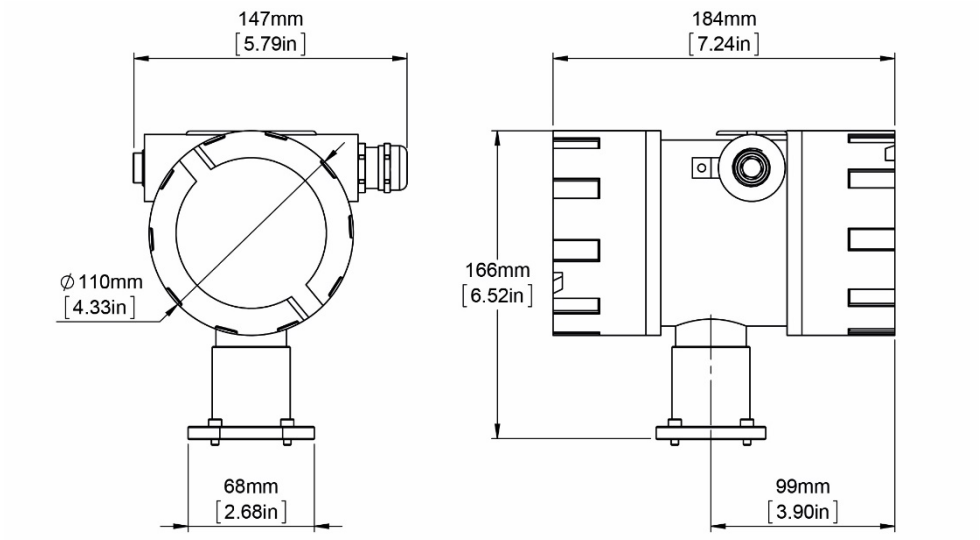


Fig. 40: Dimensions Meter-Mount Transmitter TCE 8000/8100 with blind cover

Dimensional Drawing Meter-Mount Transmitter TCE 8000/8100 High Temperature (not for hazardous area)

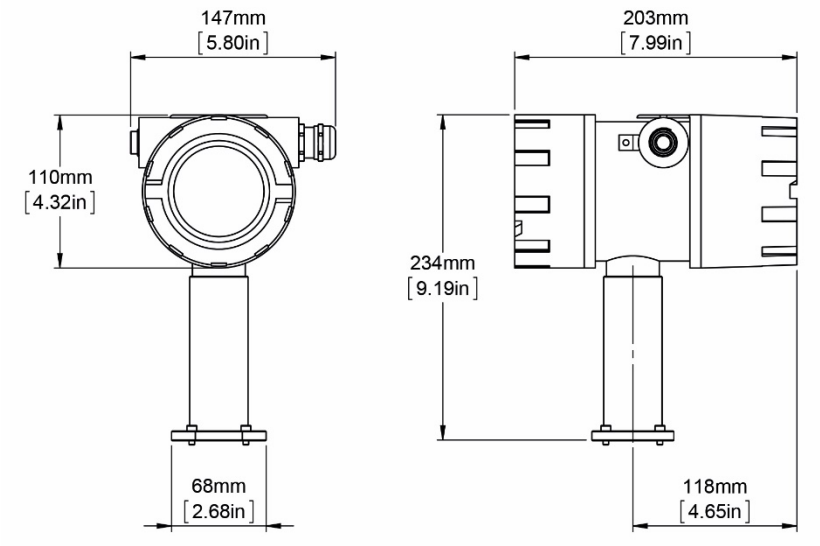


Fig. 41: Dimensions Meter-Mount Transmitter TCE 8000/8100 High Temperature

Dimensional Drawing High Temperature Connection Head

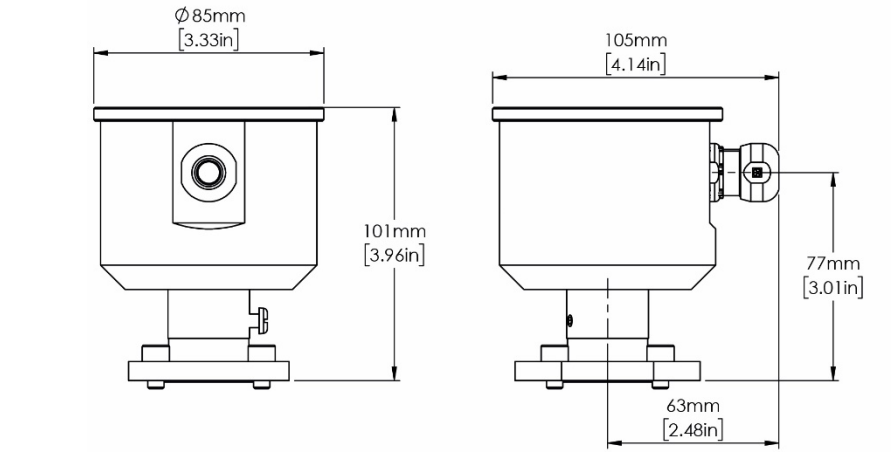


Fig. 42: Dimensions Connection head

Dimensional Drawing remote panel-mounted housings

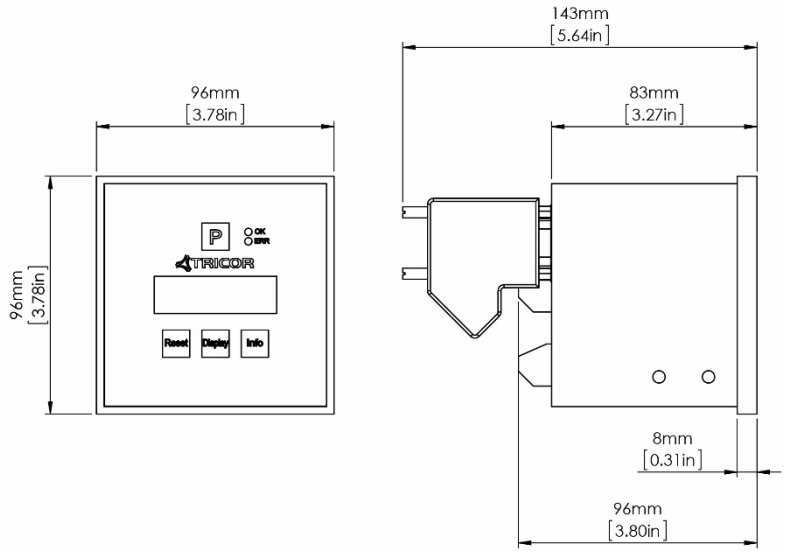


*Fig. 43: Dimensions TCE 8***-S-*****

The required cutout for the panel is 92 mm +0.8/-0 mm x 92 mm +0.8/-0 mm.

The maximum thickness of the panel is 2 mm.

7.5. WEEE and RoHS

The TRICOR CLASSIC Mass Flow Meter described herein is not subject to the WEEE directive and the corresponding national laws. At the end of life forward the TCM to a specialized recycling company and do not dispose it off as domestic waste.

The TCM described herein fully complies with the RoHS directive.

7.6. Menu Structure

7.6.1. Main Menu

In the following table only the menus and parameters of the first two levels of the HMI menu structure are listed.

Level 1		Level 2		Mehr Informationen
No.	Name	No.	Name	
1	ZERO OFFSET			ZERO OFFSET Menu (Page 66)
2	DISPLAY	2.1	MASS TOTAL	DISPLAY - MASS TOTAL Menu (Page 67)
		2.2	MASS FLOW	DISPLAY - MASS FLOW Menu (Page 68)
		2.3	VOL. TOTAL	DISPLAY - VOL. TOTAL Menu (Page 70)
		2.4	VOL. FLOW	DISPLAY - VOL. FLOW Menu (Page 71)
		2.5	DENSITY	DISPLAY - DENSITY Menu (Page 72)
		2.6	TEMPERATURE	DISPLAY - TEMPERATURE Menu (Page 73)
		2.7	PRESSURE	DISPLAY - PRESSURE Menu (Page 74)
		2.8	DISP MODE	DISPLAY - DISPLAY MODE Menu (Page 75)
3	SETUP	3.1	PARAMETER	SETUP - PARAMETER Menu (Page 78)
		3.2	FILTER	SETUP - FILTER Menu (Page 84)
		3.3	IN/OUTPUTS	SETUP - IN/OUTPUTS Menu (Page 85)
		3.4	DATA CONFIG	SETUP - DATA CONFIGURATION Menu (Page 94)
		3.5	RESET TOTAL	SETUP - RESET TOTAL Menu (Page 95)
		3.7	CLEAR LOGS	SETUP - CLEAR LOGS Menu (Page 95)
4	I/O-TEST	4.1	FREQ OUT	I/O-TEST - FREQUENCY OUT Menu (Page 96)
		4.2	CTRL OUT	I/O-TEST - CONTROL OUT Menu (Page 97)
		4.3	mA-OUT	I/O-TEST - ANALOG OUT Menu (Page 97)
		4.4	CTRL IN	I/O-TEST - CONTROL IN Menu (Page 98)
5	SERVICE	5.1	CALIBRATION	Calibration (Page 105)
		5.2	ACCESS CODE	Global Device Password (Page 110)
		5.3	RECALL FACT.	Reloading Factory Settings (Page 112)

Tab. 14: Main menu

7.6.2. Menu Item „DISPLAY“

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
2.1	MASS TOTAL	2.1.1	TOTAL UNITS		
		2.1.2	TOTAL DP		
2.2	MASS FLOW	2.2.1	FLOW UNITS		
		2.2.2	FLOW DP		
		2.2.3	DISP FILTER		
2.3	VOL. TOTAL	2.3.1	TOTAL UNITS		
		2.3.2	TOTAL DP		
2.4	VOL. FLOW	2.4.1	FLOW UNITS		
		2.4.2	FLOW DP		
		2.4.3	DISP FILTER		
2.5	DENSITY	2.5.1	TOTAL UNITS		
		2.5.2	TOTAL DP		
2.6	TEMPERATURE	2.6.1	TEMP UNITS		
		2.6.2	TEMP DP		
2.7	PRESSURE	2.7.1	PRESS.UNITS		
		2.7.2	PRESSURE DP		
2.8	DISP MODE	2.8.1	DISPLAY 1	2.8.1.1	SINGLE LINE
				2.8.1.2	DUAL LINE
		2.8.2	DISPLAY 1	2.8.2.1	SINGLE LINE
				2.8.2.2	DUAL LINE
		2.8.3	BACKLIGHT	2.8.3.1	ON
				2.8.3.2	OFF
		2.8.4	TIME MODE	2.8.4.1	FIXED
				2.8.4.2	ALTERNATE

Tab. 15: Menu items “DISPLAY”

7.6.3. Menu Item „SETUP“

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
3.1	PARAMETER	3.1.1	METER MODE		
		3.1.2	CUT OFF		
		3.1.3	STEP RESP.		
		3.1.4	RESET KEY		
		3.1.5	FLOW-DIREC		
		3.1.6	K-FACTOR		
		3.1.7	FAULT TIME		
		3.1.8	PRESS.COMP.		
		3.1.9	TOTAL COUNT		
3.2	FILTER	3.2.1	FLOW		
		3.2.2	DENSITY		
3.3	IN/OUTPUTS	3.3.1	FREQ OUT		
		3.3.2	CTRL OUT		
		3.3.3	mA-OUT		

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
		3.3.4	CTRL IN		
		3.3.5	CTRL IN 2		
		3.3.6	mA-IN I1		
		3.3.7	INTERFACE		
		3.3.8	FAULT MODE		
3.4	DATA CONFIG	3.4.1	SAVE DATA		
		3.4.2	RECALL DATA		
3.5	RESET TOTAL				
3.6	CLEAR LOGS				

Tab. 16: Menu items "SETUP"

7.6.4. Menu Item „I/O-TEST"

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
4.1	FREQ OUT				
4.2	CTRL OUT				
4.3	mA-OUT	4.3.1	mA-OUT I1		
		4.3.2	mA-OUT I2		
		4.3.3	FAULT MODE		
4.4	CTRL IN				

Tab. 17: Menu items "I/O-TEST"

7.6.5. Menu Item „SERVICE"

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
5.1	CALIBRATION	5.1.1	METER VAR.		
		5.1.2	TEMP CALIB.		
		5.1.3	AIR CALIB.	4.1.3.1	AUTOMATIC
				4.1.3.2	MANUAL
		5.1.4	WATER CALIB.	4.1.4.1	AUTOMATIC
				4.1.4.2	MANUAL
		5.1.5	PCZ MODE	4.1.5.1	OFF
				4.1.5.2	ON
5.2	ACCESS CODE				
5.3	RECALL FACT.				

Tab. 18: Menu items "SERVICE"

7.7. List of Figures

7.8. List of Tables

Contact

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