Operating Instructions

for

Differential Flow Computer

Model: ZFC

We don’t accept warranty and liability claims neither upon this publication nor in case of improper treatment of the described products.

The document may contain technical inaccuracies and typographical errors. The content will be revised on a regular basis. These changes will be implemented in later versions. The described products can be improved and changed at any time without prior notice.

1. Contents

Manufactured and sold by:

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Hardwareversion : 03.01.xx
Softwareversion : 03.01.xx

2. Note

Please read these operating instructions before unpacking and putting the unit into operation. Follow the instructions precisely as described herein.
The instruction manuals on our website www.kobold.com are always for currently manufactured version of our products. Due to technical changes, the instruction manuals available online may not always correspond to the product version you have purchased. If you need an instruction manual that corresponds to the purchased product version, you can request it from us free of charge by email (info.de@kobold.com) in PDF format, specifying the relevant invoice number and serial number. If you wish, the operating instructions can also be sent to you by post in paper form against an applicable postage fee.

The devices are only to be used, maintained and serviced by persons familiar with these operating instructions and in accordance with local regulations applying to Health & Safety and prevention of accidents.

When used in machines, the measuring unit should be used only when the machines fulfil the EC-machine guidelines.

as per PED 2014/68/EU

In acc. with Article 4 Paragraph (3), "Sound Engineering Practice", of the PED 2014/68/EU no CE mark.

3. Instrument Inspection

Instruments are inspected before shipping and sent out in perfect condition.
Should damage to a device be visible, we recommend a thorough inspection of the delivery packaging. In case of damage, please inform your parcel service / forwarding agent immediately, since they are responsible for damages during transit.

Scope of delivery:
The standard delivery includes:
- Differential Flow Computer model: ZFC

4. Regulation Use

Any use of the Differential Flow Computer, model: ZFC, which exceeds the manufacturer’s specification, may invalidate its warranty. Therefore, any resulting damage is not the responsibility of the manufacturer. The user assumes all risk for such usage.

5. Operating Principle

5.1 Functions and features

The flow computer, model ZFC is a microprocessor driven instrument for the calculation of differential flow measurement applications using flow equations for liquids. This product has been designed with a focus on:

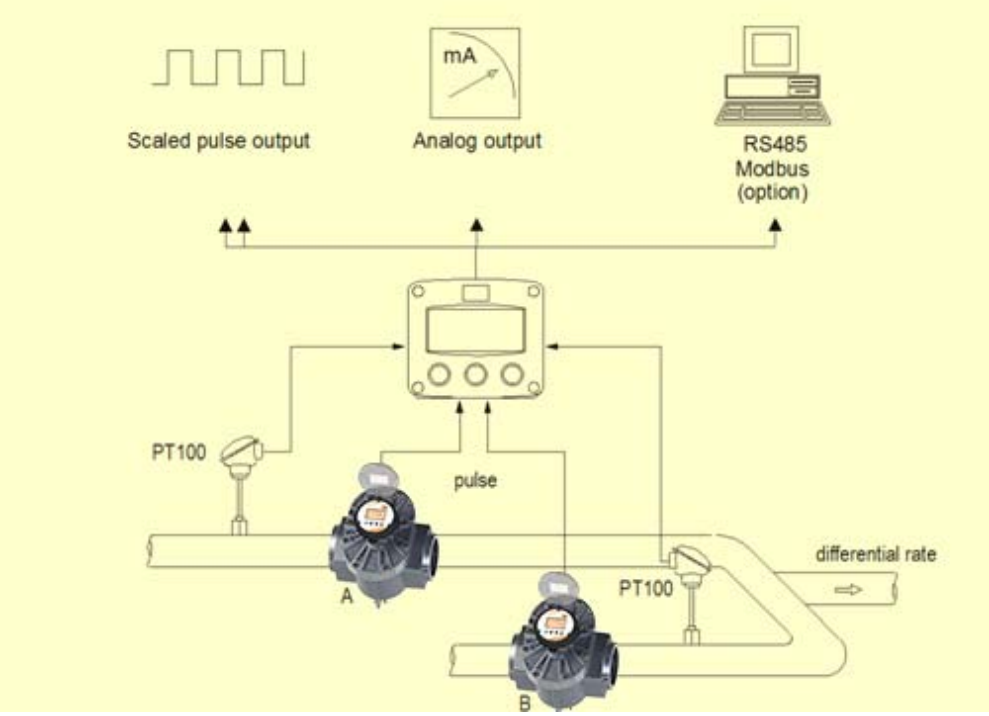
- two multi-purpose pulse inputs;
- several mounting possibilities with aluminum or GRP enclosures for harsh industrial surroundings;
- ability to process all types of flowmeter signals;
- transmitting possibilities with analog / pulse and communication outputs.

Flowmeter and temperature input

This manual describes the unit with a pulse input from the flowmeter. The ZFC has also a PT100 temperature input. Other versions are available to process (0)4-20 mA signals. Two flowmeters with a passive or active pulse, Namur or sine wave (coil) signal output can be connected to the ZFC. To power the sensor, several options are available.

Standard output

- Pulse output to transmit a pulse that represents a totalized quantity as programmed.
- Linear 4-20 mA analog output to represent the actual calculated differential flow rate as programmed. The 4-20 mA signal limits can be tuned.



Typical application

Configuration
The ZFC is designed for use in many types of applications. For that reason, a setup menu is available to program the ZFC according to your specific requirements.

The setup includes several important features, such as K-Factors, engineering units, signal selection, etc. All settings are stored in a non- volatile memory and therefore kept in the event of a power failure.

Display information
The unit has a LCD with (optional) backlight to show the process information, status and alarm messages. The display refresh rate is programmed in the setup menu.

At a key press, the display refresh rate will switch to FAST for 30 seconds. When 'OFF' is selected, the display goes off after 30 seconds after the last key press. The display temporarily comes on after a key press.

A backup of the total and accumulated total in EEPROM memory is made every minute.

Backlight
A backlight is available as an option. The brightness can be tuned as desired.

Options
The following options are available: active (0)4-20 mA analog output, full Modbus communication RS485, mechanical relay or active output, power- and sensor-supply options, extended measurement range for PT100, wall-mount and weather-proof enclosures and LED backlight.

6. Operation

- This device may only be operated by persons who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Take careful notice of the "Safety rules, instructions and precautionary measures" in the front of this manual.

This chapter describes the daily use of the ZFC. This instruction is meant for users / operators.

6.1 Control panel

The control panel has three keys. The available keys are:

Control panel

Functions of the keys

This key is used to program and save new values or settings.
The PROG/ENTER key is also used to gain access to the setup menu (read chapter 7).

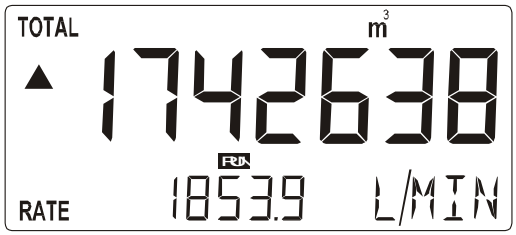
This key is used to select the accumulated total and temperature.
The SELECT/▲ key is also used to increase a value after the PROG/ENTER key has been pressed (read chapter 7).

This key is used to reset the total.
The CLEAR/▶ key is also used to select a digit or an option after the PROG/ENTER key has been pressed (read chapter 7).

6.2 Operator Information and functions

In general, the ZFC operates in the operator mode. The shown information depends on the settings which are made in the setup menu.

The signal from the connected sensor is processed by the ZFC in the background, independent from the selected display refresh rate.



Process information (typical)

For the Operator, the following functions are available:

- **Display calculated differential flow rate and calculated differential total**
  This is the main display information of the ZFC. After the selection of any other information, it will always return to this main display automatically. Total is shown on the upper line of the display and flow rate on the bottom line. When selected in the setup menu, the display shows the flow rate only. If you press the select key, the total shows momentarily.

  When "-------" is shown, then the flow rate value is too high to be shown. The arrows ⇕ indicate the increase/decrease of the flow rate trend. If the consumption is very low, it might be that a stable low flow rate and total is shown; this is due to the settings of the ZFC.
- **Clear total**
  The value for total can be reset. To do so, press the CLEAR/▸ key twice. When the key is pressed once, the text "PUSH CLEAR" is shown. To avoid a reset at this stage, press another key other than the CLEAR/▸ key or wait for 20 seconds. A reset of the total does not influence the accumulated total.

  Type IB: When a Normally Closed (NC) contact is used, the local clear total function is disabled and a clear total is only possible with the external reset command.
- **Display calculated differential accumulated total**
  When the SELECT/▲ key is pressed, total and accumulated total are shown. The accumulated total cannot be reset. The value will count up to 99,999,999,999. The unit and number of decimals are shown according to the settings for the total.
- **Display line temperature and calculated flow rate INLET / OUTLET**
  When the SELECT/▲ key is pressed twice, the actual INLET / OUTLET temperature is shown at the top line of the display. At the bottom line, the calculated INLET / OUTLET flow rate is shown together with the engineering units for flow rate and temperature
- **Range error**
  As soon as the input value is out of the calibrated PT100 measurement range, the alarm indicator shows. When the SELECT/▲ key is pressed a few times, the alarm code is shown in the alarm display. This alarm is also activated at a wire break or faulty sensor.
  (standard range -100°C - +200°C or extended range, type ZV: -200° - +800°C).

Note !

Alarm
When the alarm indicator is shown, refer to chapter 9: Problem Solving.

7. Configuration

This and the following chapters are exclusively meant for electricians and non-operators. In these, an extensive description of all software settings and hardware connections are provided.

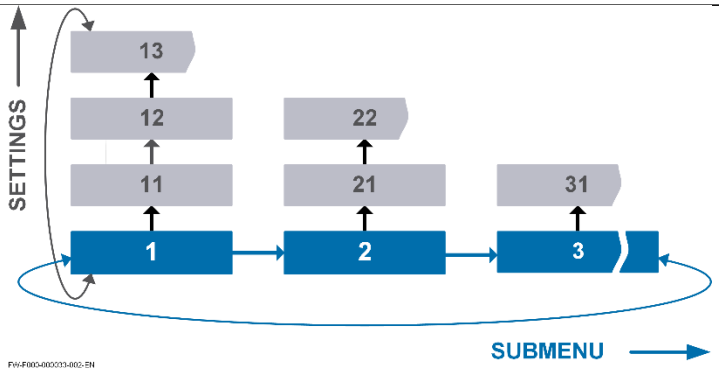
- Mounting, electrical installation, start-up and maintenance of this device may only be carried out by trained persons authorized by the operator of the facility. Persons must read and understand this manual before carrying out its instructions.
- This device may only be operated by persons who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Make sure, the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has been opened (danger from electrical shock). The housing may only be opened by trained persons authorized by the operator of the facility.
- Take careful notice of the "Safety rules, instructions and precautionary measures" in the front of this manual.

The SETUP menu is used to program the ZFC

The SETUP menu is accessible at all times while the ZFC remains fully operational. Be aware that in this case any change to the settings may have an influence on the operation.

It is possible to prevent access to the SETUP menu with a password. A password may be required to enter the SETUP menu. Without this password, access to SETUP is denied.

7.1 How to program the ZFC



The setup menu has different submenus. Each submenu has an unique number which is shown in front of the menu name.

Each setting has an unique two-digit number which is shown in front of the setting. The first digit refers to the submenu and the second digit refers to the setting.

Note that sometimes the name of the setting is shown on the upper line of the display.

How to enter the setup menu

When the setup menu is protected by a password, the ZFC asks for a password to access the setup menu. When in the operator mode, press and hold the PROG/ENTER key for 7 seconds to access the setup menu.

How to navigate in the setup menu

The setup menu has different submenus to program the ZFC. For navigation, the submenus and the settings are identified with numbers (for the submenu: e.g. 1; for the setting: e.g. 12.). The CLEAR/► key and the PROG/ENTER key are used for navigation. The explanation assumes that you are in the submenu TOTAL.

	Action	Result	Remark
	Press the CLEAR/► key to select the next submenu	• **The submenu FLOW RATE is displayed.**	
	Press again to go to the next submenu.	• **The submenu DISPLAY is displayed.**	
	Momentarily, press the PROG/ENTER key to select the previous submenu.	• **The submenu FLOW RATE is displayed.**	**The PROG/ENTER key is used as a ◄ key.**
	Press again to go to the previous submenu.	• **The submenu TOTAL is displayed.**	**The PROG/ENTER key is used as a ◄ key.**

The SELECT/▲ key and the CLEAR/► key are used for navigation.
The explanation assumes that you are in the submenu TOTAL. When you are:

- in the first setting and you navigate to the previous setting, the ZFC goes back to the related main menu.
- in the last setting and you navigate to the next setting, the ZFC goes to the related main menu.

Action		Result	Remark
1	Press the SELECT/▲ key to select the first setting.	• The setting UNIT shows.	-
2	Press the SELECT/▲ key again to go to the next setting.	• The setting DECIMALS shows.	-
3	Press the CLEAR/► key to select the previous setting.	• The setting UNIT shows.	-
4	Press the CLEAR/►key again to go to the previous setting.	• The submenu TOTAL shows	This is normal behavior because the setting UNIT is the first setting of the submenu TOTAL.

How to make a setting

Changes are only saved if you press the PROG/ENTER key.

The explanation assumes that you are in the submenu TOTAL and the setting UNIT. If you do not want to save the change, wait for approximately 20 seconds or press and hold the PROG/ENTER key for approximately 3 seconds.

Action		Result	Remark
1	Momentarily, press the PROG/ENTER key.	• The PROG indicator blinks. • The engineering unit L shows.	To access the setting.
2	Press the SELECT/▲ key to select the next engineering unit.	• The PROG indicator blinks. • The engineering unit m^3 shows.	If you wait too long, the program mode goes off and changes are not saved, this is normal behavior.
3	Press the SELECT/▲ key to select the next engineering unit.	• The PROG indicator blinks. • The engineering unit US GAL shows.	-
4	Press the CLEAR/► key to select the previous engineering unit	• The PROG indicator blinks. • The engineering unit m^3 shows.	-
5	To confirm the changes: Momentarily, press the PROG/ENTER key.	• The PROG indicator goes off. • The change is saved. • The engineering unit m^3 shows.	If you do not press the PROG/ENTER key to confirm, your selection is not saved.
	To discard the changes: Press and hold the PROG/ENTER key for approximately 3 seconds.	• The PROG indicator goes off. • The change is discarded. • The engineering unit L shows.	-

7.1.1 SETUP MENU - SETTINGS

1	**TOTAL-A**		
	11	unit	L; m3; kg; lb; GAL; USGAL; bbl; no unit
	12	decimals	0000000; 111111.1; 22222.22; 3333.333
	13	K-factor	0.000010 - 9999999
	14	decimals K-factor	0 - 6
2	**FLOW RATE-A**		
	21	unit	mL; L; m3; mg; g; kg; ton; gal; bbl; lb; cf; rev; - - - - (no unit); scf; nm3; nL; p
	22	time	/sec; /min; /hour; /day
	23	decimals	0000000; 111111.1; 22222.22; 3333.333
	24	K-factor	0.000010 - 9999999
	25	decimals K-factor	0 - 6
	26	filter	0 - 99
	27	period	0.1 - 99.9 seconds
3	**TOTAL-B**		
	31	K-factor:	0.000010 - 9999999
	32	decimals K-factor	0 - 6
4	**FLOW RATE-B**		
	41	K-factor	0.000010 - 9999999
	42	decimals K-FACTOR	0 - 6
5	**DISPLAY**		
	51	function	total; rate
	52	light	0% (off); 20%; 40%; 60%;- 80%; 100% (full brightness)
	53	measurement	bi-direct; not negative; threshold; stationary
	54	stationary flow rate	0000.000 - 9999999
	55	stationary total	0000.000 - 9999.999
6	**POWER MANAGEMENT**		
	61	LCD new	fast; 1 sec; 3 sec; 15 sec; 30 sec; off
7	**FLOWMETER**		
	71	signal A	npn; npn-lp; reed; reed-lp; pnp; pnp-lp; namur; coil-hi; coil-lo; 8-1 DC; 12 DC; 24 DC
	72	signal B	npn; npn-lp; reed; reed-lp; pnp; pnp-lp; namur; coil-hi; coil-lo; 8-1 DC; 12 DC; 24 DC
8	**TEMPERATURE A/B**		
	81	display	°C; °F; K
	82	no. of wires	2; 3
	83	filter	01 - 99
9	**FORMULA**		
	91	equations type	EL (fixed)
	92	thermal expansion coefficient	0.000000 - 9.999999 (*10-3/K)
	93	normal temperature	0.00 - 99,999.99 K

A	**ANALOG**		
	A1	output	disable; enable
	A2	rate-min	000.000 - 999999
	A3	rate-max	000.000 - 999999
	A4	cut-off	0.0 - 9.9%
	A5	tune-min	0 - 9999
	A6	tune-max	0 - 9999
	A7	filter	01 - 99
B	**P ULSE**		
	B1	mode	signed; not negative; separated
	B2	width	0.001 – 9
	B3	decimals	0000000; 111111.1; 22222.22; 3333.333
	B4	amount	0.001 – 9999999
C	**COMMUNICATION**		
	C1	speed	1200; 2400; 4800; 9600
	C2	address	1 - 247
	C3	mode	bus-rtu; bus-asc; off
D	**OTHERS**		
	D1	model	ZFC
	D2	software version	nn:nn:nn
	D3	serial no.	nnnnnnn
	D4	password	0000 - 9999
	D5	tag-nr	0000000 - 9999999

7.1.2 EXPLANATION OF SETUP-MENU 1 - TOTAL-A

1	TOTAL-A	
11	unit 	This setting is used to select the engineering unit for the indication of the total (A and B), the accumulated total (A and B), and the pulse output. ***When you change the engineering unit, you must recalculate and reprogram the K-factor for the (accumulated) total. When you recalculate and reprogram the K-Factor, the history for (accumulated) total is not correct anymore, because the (accumulated) total is not recalculated. For future reference, best practice is to make a note of the accumulated total before you program the recalculated K-Factor.***
12	decimals	This setting is used to set the amount of digits behind the decimal point for the (accumulated) total indication (A and B).
13	K-factor 	This setting is used to set the K-Factor for the total (A). With the K-Factor, the flowmeter pulse signals are converted to a quantity. The K-Factor is based on the number of pulses generated by the flowmeter per selected engineering unit, for example per m^3. A more accurate K-Factor (more decimals, as set in decimals K-Factor) allows for a more accurate operation of the system. Example 1: Calculating the K-Factor. The flowmeter generates 2.4813 pulses per liter and the selected unit is m^3. A cubic meter consists of 1000 liter which gives 2.4813 pulses*1000 liter=2481.3 pulses per m^3. So, the K-Factor is 2481.3. Enter for the Flowmeter K-Factor: 24813 and for the flowmeter K-Factor decimals: 1. Example 2: Calculating the K-Factor. The flowmeter generates 6.5231 pulses per gallon and the selected engineering unit is gallons. So, the K-Factor is 6.5231. Enter for the Flowmeter K-Factor: 65231 and for the Flowmeter K-Factor decimals: 4. ***When you recalculate and reprogram a new K-Factor, the history for (accumulated) total is not correct anymore, because the (accumulated) total is not recalculated. For future reference, best practice is to make a note of the accumulated total before you program the recalculated K-Factor.***
14	decimals K-factor	This setting is used to set the amount of digits behind the decimal point for the K-Factor (A).

7.1.3 EXPLANATION OF SETUP-MENU 2 - FLOW RATE-A

The settings for total and flow rate are entirely separate. In this way, different engineering units can be used for each e.g. cubic meters for total and liters for flow rate.

<table>
<tr><td>2</td><td colspan="5">FLOW RATE-A</td></tr>
<tr><td>21</td><td>unit
 
</td><td colspan="4">This setting is used to select the engineering unit for the indication of the flow rate (A and B).
Alteration of the engineering unit will have consequences for operator and setup values, they will not be automatically recalculated to the value of the new selected unit. The K-Factor has to be adapted as well; the calculation is not done automatically.</td></tr>
<tr><td>22</td><td>time
 
</td><td colspan="4">This setting is used to set the time unit for the flow rate calculation (A and B). Note that the flow rate is given in engineering unit/time unit, e.g. liters/minute (l/min).
When you change this setting, also recalculate and change the settings for the analog rate-min and analog rate-max.</td></tr>
<tr><td>23</td><td>decimals</td><td colspan="4">This setting is used to set the amount of digits behind the decimal point for the flow rate indication (A and B).</td></tr>
<tr><td>24</td><td>K-factor</td><td colspan="4">This setting is used to set the K-Factor for the flow rate (A). With the K-Factor, the flowmeter pulse signals are converted to a quantity. The K-Factor is based on the number of pulses generated by the flowmeter per selected engineering unit, for example per m^3. A more accurate K-Factor (more decimals, as set in decimals K-Factor) allows for a more accurate operation of the system.</td></tr>
<tr><td>25</td><td>decimals K-factor</td><td colspan="4">This setting is used to set the amount of digits behind the decimal point for the K-Factor (A).</td></tr>
<tr><td rowspan="12">26</td><td>filter</td><td colspan="4">This setting is used to stabilize the output signal. With the help of this digital filter a more stable but less actual representation of the flow rate can be obtained.
The filter principal is based on three input values: the filter level (01-99), the last calculated flow rate and the last average value. The higher the filter level, the longer the response time on a value change will be.</td></tr>
<tr><td>filter value</td><td colspan="4">RESPONSE TIME ON STEP CHANGE OF ANALOG VALUE. TIME IN SECONDS</td></tr>
<tr><td>influence</td><td>50%</td><td>75%</td><td>90%</td><td>99%</td></tr>
<tr><td>01</td><td>filter disabled</td><td>filter disabled</td><td>filter disabled</td><td>filter disabled</td></tr>
<tr><td>02</td><td>1.1 sec</td><td>0.2 sec</td><td>0.4 sec</td><td>0.7 sec</td></tr>
<tr><td>03</td><td>1.2 sec</td><td>0.4 sec</td><td>0.6 sec</td><td>1.2 sec</td></tr>
<tr><td>05</td><td>0.4 sec</td><td>0.7 sec</td><td>1.1 sec</td><td>2.1 sec</td></tr>
<tr><td>10</td><td>0.7 sec</td><td>1.4 sec</td><td>2.2 sec</td><td>4.4 sec</td></tr>
<tr><td>20</td><td>1.4 sec</td><td>2.8 sec</td><td>4.5 sec</td><td>9.0 sec</td></tr>
<tr><td>30</td><td>2.1 sec</td><td>4.0 sec</td><td>7.0 sec</td><td>14 sec</td></tr>
<tr><td>50</td><td>3.5 sec</td><td>7.0 sec</td><td>11 sec</td><td>23 sec</td></tr>
<tr><td>75</td><td>5.2 sec</td><td>10 sec</td><td>17 sec</td><td>34 sec</td></tr>
<tr><td>99</td><td>6.9 sec</td><td>14 sec</td><td>23 sec</td><td>45 sec</td></tr>
<tr><td>27</td><td>period
 
</td><td colspan="4">This setting is used to calculate the flow rate by counting the number of pulses within a certain time, for example 1 second. The longer the time the more accurate the flow rate will be.
• This setting does influence the update time for the analog output directly. If the output response is too slow, decrease the number of pulses.
• The shorter the update time, the higher the power consumption of the unit will be.</td></tr>
</table>

7.1.4 EXPLANATION OF SETUP-MENU 3 - TOTAL-B

The engineering units are the same as used in SETUP-menu 1 - Total-A.

3	TOTAL-B	
31	K-factor	This setting is used to set the K-Factor for the total (B). With the K-Factor, the flowmeter pulse signals are converted to a quantity. The K-Factor is based on the number of pulses generated by the flowmeter per selected engineering unit, for example per m^3. A more accurate K-Factor (more decimals, as set in decimals K-Factor) allows for a more accurate operation of the system.
32	decimals K-factor	This setting is used to set the amount of digits behind the decimal point for the (accumulated) total indication (B).

7.1.5 EXPLANATION OF SETUP-MENU 4 - FLOW RATE-B

The engineering units are the same as used in SETUP-menu 2 - Flow rate-A.

4	FLOW RATE-B	
41	K-factor	This setting is used to set the K-Factor for the flow rate (B). With the K-Factor, the flowmeter pulse signals are converted to a quantity. The K-Factor is based on the number of pulses generated by the flowmeter per selected engineering unit, for example per m^3. A more accurate K-Factor (more decimals, as set in decimals K-Factor) allows for a more accurate operation of the system.
42	decimals K-factor	This setting is used to set the amount of digits behind the decimal point for the K-Factor (B).

7.1.6 EXPLANATION OF SETUP-MENU 5 - DISPLAY

5	DISPLAY	
51	function	This setting can be set to display total or rate. • *When 'total' is selected, simultaneously, total is shown with the large digits and flow rate with the smaller digits. When SELECT is pressed, the accumulated total is shown temporarily.* • *When 'rate' is selected, only flow rate will be shown with the large digits together with its measuring unit. When SELECT is pressed, the total and the accumulated total are shown temporarily.*
52	light	The backlight brightness can be adjusted from 0% (off) to 100% (full brightness) in steps of 20%. When the ZFC is only loop powered, the backlight is disabled. An external power supply is required to supply the backlight.
53	measurement	To solve undesired display readings during low or even negative consumption situations, four different measurement methods have been implemented. Note that the selection does influence the analog output value (ref. flow rate) as well.
	bi-directional	Shown flow rate: positive and negative. Shown total: increases or decreases.
	not negative	Shown flow rate: only positive or zero. Shown total: increases or decreases.
	threshold	Shown flow rate: as soon as the flow rate is lower than SETUP 54 or negative, zero flow rate is shown. Shown total: as soon as the flow rate is lower than SETUP 54 or negative, totalization will stop.
	stationary	Shown flow rate: as soon as the flow rate is lower than SETUP 54 or negative, the stationary flow rate (SETUP 54) is shown. Shown total: as soon as the flow rate is lower as SETUP 54 or negative, stationary totalization (SETUP 55) will be activated. However, if the value of
54	stationary flow rate threshold stationary Note !	Enter here the flow rate according SETUP 53: threshold or stationary. The time and measuring units are according to flow rate SETUP 21 and 22. Flow rate zero is shown as soon as the flow rate will be lower as this setting. As soon as the flow rate is lower as this setting, this flow rate is shown. *If the flowmeters do not generate pulses, the flow rate shows zero.*
55	stationary total Note !	Enter here a flow rate per hour according to SETUP 53 – 'stationary'. The measuring unit is according to TOTAL (A and B) - SETUP 11. This flow rate is converted to a total which will be used as long as the flow rate is lower as SETUP 54. • If the flowmeters do not generate pulses, the totalization will stop. • This function is disabled if value zero has been entered.

7.1.7 EXPLANATION OF SETUP-MENU 6 - POWER MANAGEMENT

When used with the internal battery option (type PB/PC), the user can expect reliable measurement over a long period of time. The ZFC has several smart power management functions to extend the battery life time significantly. Two of these functions can be set.

6	POWER MANAGEMENT	
61	lcd new	The calculation of the display-information influences the power consumption significantly. When the application does not require a fast display refresh rate, it is strongly advised to select a slow refresh rate. Please understand that NO information will be lost; every pulse will be counted and the output signals will be generated in the normal way. At a key press, the display refresh rate will switch to FAST for 30 seconds. When 'OFF' is selected, the display goes off after 30 seconds after the last key press. The display temporarily comes on after a key press. Example battery life-time with a coil pick-up: • 1kHz pulse and FAST update: about 2 years; • 1kHz pulse and 1 sec update: about 5 years.
62	battery mode	The ZFC has two modes: operational or shelf. After "shelf" has been selected, the ZFC can be stored for several years; it will not process the sensor signal; the display is switched off but all settings and totals are stored. In this mode, power consumption is extremely low. To wake up the ZFC again, press the SELECT/▲ key two times.

7.1.8 EXPLANATION OF SETUP-MENU 7 - FLOWMETER

The ZFC is able to handle several types of input signal. The pickup / signal is selected with:

- SETUP 71 (Input A), Read also chapter 8
- SETUP 72 (Input B), Read also chapter 8.

Note ! *The selection "active pulse" offers a detection level of 50% of the supply voltage.*

7	FLOWMETER				
71/72	SIGNAL				
	TYPE OF SIGNAL	EXPLANATION	RESISTANCE	FREQ. / mV	REMARK
	NPN	NPN input	100 kΩ pull-up	max. 6 kHz.	(open collector)
	NPN-LP	NPN with low pass filter	100 kΩ pull-up	max. 1.2 kHz.	(open collector) less sensitive
	REED	Reed-switch input	1 MΩ pull-up	max. 600 Hz.	
	REED-LP	Reed-with low pass filter	1 MΩ pull-up	max. 120 Hz.	Less sensitive
	PNP	PNP input	100 kΩ pull-down	max. 6 kHz.	
	PNP-LP	PNP with low pass filter	100 kΩ pull-down	max. 1.2 kHz.	Less sensitive
	NAMUR	NAMUR input	820 Ω pull-down	max. 4 kHz.	External power required
	COIL-HI	High sensitive coil input	-	min. 20 mV_{pp}	Sensitive for interference!
	COIL-LO			min. 80 mV_{pp}	
	8-1 DC			max. 10 kHz.	
	12 DC	Active pulse input detection level 12V DC	4 kΩ	max. 10 kHz.	External power required
	24 DC	Active pulse input detection level 12V DC	3 kΩ	max. 10 kHz.	External power required

7.1.9 EXPLANATION OF SETUP-MENU 8 - TEMPERATURE A/B

8	TEMPERATURE A/B				
81	display	This setting is used to program the temperature unit which is shown to the operator. This setting does not influence the actual calculations.			
82	no. of wires	This setting is used to program the number of wires for the PT100 sensors.			
83	filter	The analog output signal of a sensor represents the actual temperature. This signal is measured several times a second. The value measured is a "snap-shot" of the real temperature as it will be fluctuating. With the help of this digital filter a stable and accurate reading can be obtained while the filter level can be set to a desired value. The filter principal is based on three input values: the filter level (01-99), the last measured analog value and the last average value. The higher the filter level, the longer the response time on a value change will be..			
	filter value	Response time on step change of analog value. (Time in seconds).			
	influence	50%	75%	90%	99%
	10	1.8 sec	3.5 sec	5.6 sec	11 sec
	20	3.5 sec	7.0 sec	11 sec	23 sec
	30	5.3 sec	10 sec	17 sec	34 sec
	50	8.8 sec	17 sec	29 sec	57 sec
	75	13 sec	26 sec	43 sec	86 sec
	99	17 sec	34 sec	57 sec	114 sec

7.1.10 EXPLANATION OF SETUP-MENU 9 - FORMULA

9	FORMULA	
91	equations type	This setting shows the formula. The type EL stands for Equations Liquid - flow computer for corrected liquid volume The formula used: $Q_{normal} = Q * (1 + \alpha (T_{normal} - T))$ where: Q_{normal} : calculated volume at reference conditions Q : measured volume α : thermal expansion coefficient T_{normal} : reference temperature T : measured temperature
92	thermal expansion coefficient	Enter here the thermal expansion coefficient α for the liquid used. The value to be entered has to be multiplied with 1000. The decimal position is fixed but cannot be shown: x,xxxxxx. With the default value of 0.000000 the volume correction is disabled. Examples: Calculation of the thermal expansion coefficient α for water is 0.00031 per K. Enter: 0310000. α for petrol is 0.00110 per K. Enter: 1100000.
93	normal temperature	Enter here the reference temperature T_{normal} in degrees Kelvin (K). In most applications, the volume has to be calculated at 15°C which is 288,15 K.

7.1.11 EXPLANATION OF SETUP-MENU A - ANALOG OUTPUT

A linear 4-20 mA signal (option AB: 0-20 mA or option AU: 0-10 V) output signal is generated that represents the flow rate. The settings for the flow rate influence the analog output directly. The relationship between the flow rate and the analog output is set with the following settings.

A	ANALOG OUTPUT	
A1	output  	If the analog output is not used, select disable to minimize the power consumption. *Option 4T: When a power supply is available but the output is disabled, a 3.5mA signal will be generated.*
A2	rate-min	Enter here the flow rate at which the output should generate the minimum signal 4mA - in most applications at zero flow. The number of decimals shown depends upon setup 23. The engineering units/time (e.g. L/min) is dependent upon setup 21 and 22.
A3	rate-max	Enter here the flow rate at which the output should generate the maximum signal (20 mA) - in most applications at maximum flow. The number of decimals shown depends upon setup 23. The engineering units/time (e.g. L/min) is dependent upon setup 21 and 22.
A4	cut-off	To ignore leakage of the flow for example, a low flow cut-off can be set as a percentage of the full range of 16 mA, 20 mA. When the flow is less than the required rate, the current will be the minimum signal 4 mA.
		Example: Calculate the cut-off. Rate-min: 0L/min [4mA], Rate-max: 100 L/min [16mA], Cut-off: 2% Required rate [L/min]: (rate-max - rate-min)*cut-off: (100-0)*2%=2.0L/min Output [mA]: rate-min + (rate-max*cut-off): 4+(16*2%)=4.32mA
A5	tune-min   	The 4mA value can be tuned precisely with this setting. The initial minimum analog output value is 4mA. However, this value might differ slightly due to ambient influences such as temperature for example. Before tuning the signal, make sure that the analog signal is idle (not used) for any application! After pressing PROG, the current will be about 4mA. The current can be increased / decreased with the arrow keys and is directly active. Press ENTER to store the new value. *If required, you can program the analog output 'up-side-down'. The* 4mA *represents the maximum flow rate and the 20mA represents the minimum flow rate.*

A	ANALOG OUTPUT	
A6	tune-max	The 20mA value can be tuned precisely with this setting. The initial maximum analog output value is 20mA. However, this value might differ slightly due to ambient influences such as temperature for example.  Before tuning the signal, make sure that the analog signal is idle (not used) for any application! After pressing PROG, the current will be about 20mA. The current can be increased / decreased with the arrow keys and is directly active. Press ENTER to store the new value.  *If required, you can program the analog output 'up-side-down'. The* 4mA or *represents the maximum flow rate and the 20mA represents the minimum flow rate.*
A7	filter	This setting is used to stabilize the output signal. With the help of this digital filter a more stable but less actual representation of the flow rate can be obtained. The filter principal is based on three input values: the filter level (01-99), the last calculated flow rate and the last average value. The higher the filter level, the longer the response time on a value change will be.

	filter value	RESPONSE TIME ON STEP CHANGE OF ANALOG VALUE. TIME IN SECONDS			
	influence	50%	75%	90%	99%
	01	filter disabled	filter disabled	filter disabled	filter disabled
	02	0.1 sec	0.2 sec	0.4 sec	0.7 sec
	03	0.2 sec	0.4 sec	0.6 sec	1.2 sec
	05	0.4 sec	0.7 sec	1.1 sec	2.1 sec
	10	0.7 sec	1.4 sec	2.2 sec	4.4 sec
	20	1.4 sec	2.8 sec	4.5 sec	9.0 sec
	30	2.1 sec	4.0 sec	7.0 sec	14 sec
	50	3.5 sec	7.0 sec	11 sec	23 sec
	75	5.2 sec	10 sec	17 sec	34 sec
	99	6.9 sec	14 sec	23 sec	45 sec

7.1.12 EXPLANATION OF SETUP-MENU B - PULSE

B	PULSE	
B1	mode	The unit has three scaled pulse output modes. This functionality drives two pulse outputs which, depending on the mode, can be used as follows:
	signed	On pulse output R1 a pulse will be send when the total has increased or decreased with the set quantity (SETUP B4). Pulse output R2 will send a 0 for increase or 1 for decrease.
	not negative	On pulse output R1 a pulse will be sent when the total has increased with the set quantity (SETUP B4). On pulse output R2 the sign of the flow rate will be send (positive=0, negative=1).
	separated	On pulse output R1 a pulse will be sent when the total has increased with the set quantity (SETUP B4). On pulse output R2 a pulse will be sent when the total has decreased with the set quantity (SETUP B4).

B	PULSE	
B2	width	The pulse width determines the time that the output will be active; in other words the pulse duration. Value “zero” will disable the pulse output. The pulse signal always has a 50% duty cycle, hence the minimum time between the pulses is equal to the pulse width setting. If the frequency should go out of range – when the flow rate increases for example – an internal buffer will be used to “store the missed pulses”: As soon as the flow rate slows down, the buffer will be “emptied”. It might be that pulses will be missed due to a buffer-overflow, so it is advised to program this setting within its range!
B3	decimals	This setting is used to set the amount of digits behind the decimal point for the amount.
B4	amount	A pulse will be generated every time a certain quantity is added to the total. Enter this quantity here while taking the decimals for pulse into account.

7.1.13 EXPLANATION OF SETUP-MENU C - COMMUNICATION (OPTION)

This product is designed for the connection to a communication network. Products with a communication option do not include cyber security functions. Kobold cannot take any responsibility for the cyber security, omissions or errors in the communication safety. To maintain a secure operation, automation and control, it is the sole responsibility of the owner to install and manage the appropriate safety measures to protect the network, the product and the communication against any kind of security breaches.

The functions described below deal with hardware that is not part of the standard delivery. Programming of these functions does not have any effect if this hardware has not been installed. Consult chapter 10 and the Modbus communication protocol description for a detailed explanation.

C	COMMUNICATION	
C1	speed	This setting is used to set the Baudrate.
C2	address	This setting is used to set the communication address for the ZFC.
C3	mode	This setting is used to set the Modbus transmission mode. Select OFF to disable the communication.

7.1.14 EXPLANATION OF SETUP-MENU D - OTHERS

For support and maintenance it is important to have information about the characteristics of the ZFC. Your supplier will ask for this information when support is required.

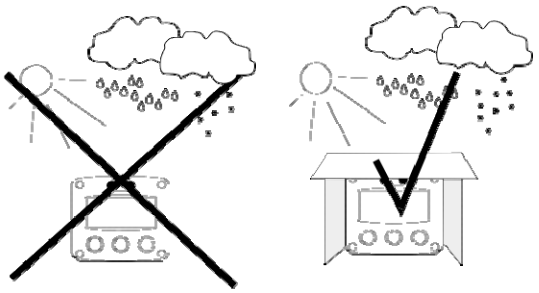
D	OTHERS	
D1	model	This setting shows the model name.
D2	software version	This setting shows the version number of the firmware (software).
D3	serial no.	This setting shows the serial number.
D4	password	This setting is used to set a password (pin code) to limit the access for the setup menu. Only persons who know the pin code can access the setup menu. The pin code 0000 disables the pin code to allow for access by any person.
D5	tag-nr	This setting is used to set a tag number for the ZFC.

8. Installation

8.1 General directions

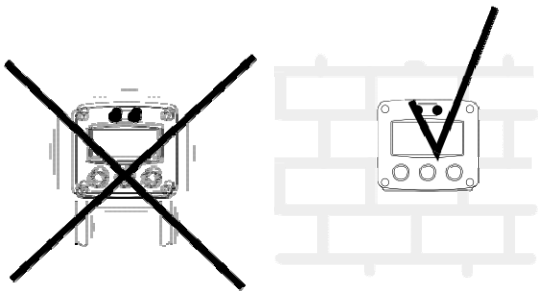
- Mounting, electrical installation, start-up and maintenance of this device may only be carried out by trained persons authorized by the operator of the facility. Persons must read and understand this manual before carrying out its instructions.
- This device may only be operated by persons who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Make sure, the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has been opened (danger from electrical shock). The housing may only be opened by trained persons authorized by the operator of the facility.
- Take careful notice of the "Safety rules, instructions and precautionary measures" at the front of this manual.

8.2 Installation / Surrounding conditions



Take the relevant IP classification of the enclosure into account (see identification plate). Even an enclosure rated for IP67 / TYPE 4(X) should NEVER be exposed to strongly varying (weather) conditions.

When panel-mounted, the front panel of the ZFC is rated for IP65/TYPE 4(X)!



When used in very cold surroundings or varying climatic conditions, inside the instrument case, take the necessary precautions against moisture.

Mount the ZFC onto a solid structure to avoid vibrations.

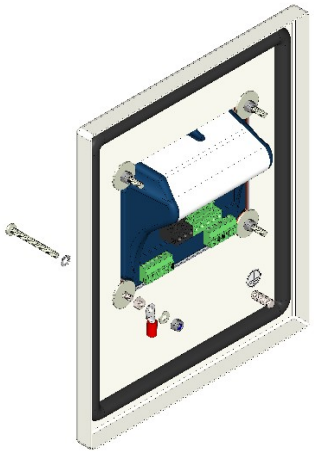
8.3 Installing the hardware

- Electro static discharge does inflict irreparable damage to electronics! Before installing or opening the ZFC, the installer has to discharge himself by touching a well-grounded object.
- This chapter shows general information regarding the electrical installation of the ZFC.

8.3.1 General installation guidelines

- In the ZFC, different types of bonding and earthing are used. The common (ground) is mostly used for termination of the wire shields.
- For V AC applications, the terminal 00 shall not be connected to avoid earth loops.
  For V DC applications, the terminal 00 shall be connected to the common.
- The wire screens (shield) are meant to prevent electromagnetic interference and shall be galvanic isolated, connected to the common ground terminals that belong to the specific sensor connection. The wire screens shall be terminated at one side to prevent wire loops. Inside of the Kobold unit, the different common ground terminals are connected to each other. It is advised, as illustrated, to terminate the wire screens in the vicinity of the sensor and to insulate the wire screen with a shrink tube at the Kobold unit side.
- Separate cable glands with effective IP67 / TYPE 4(X) seals for all wires.
- Unused cable entries: ensure that you fit IP67 / TYPE 4(X) plugs to maintain rating.
- An effective screened cable for the input signal, and grounding of its screen to the "⊥ " terminal or at the sensor itself, whichever is appropriate to the application.

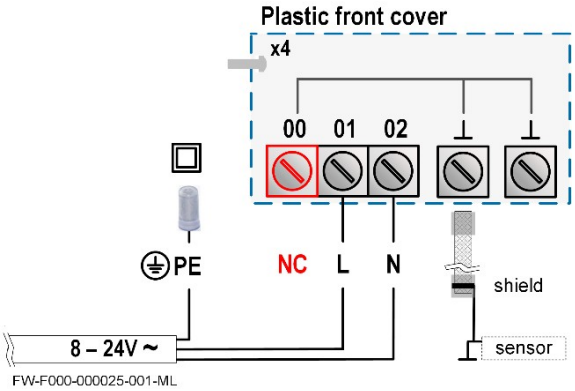
Field mounted



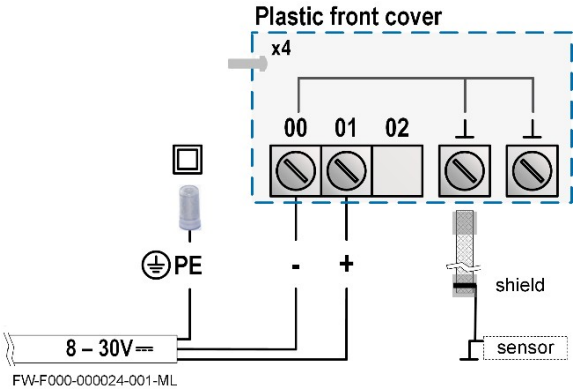
Panel mounted

8.3.2 Plastic (GRP) enclosure

The PE connection
The ZFC in a GRP enclosure meets the requirements of class 2 (double insulated). Therefore the incoming PE wire is terminated with an insulating end cap.

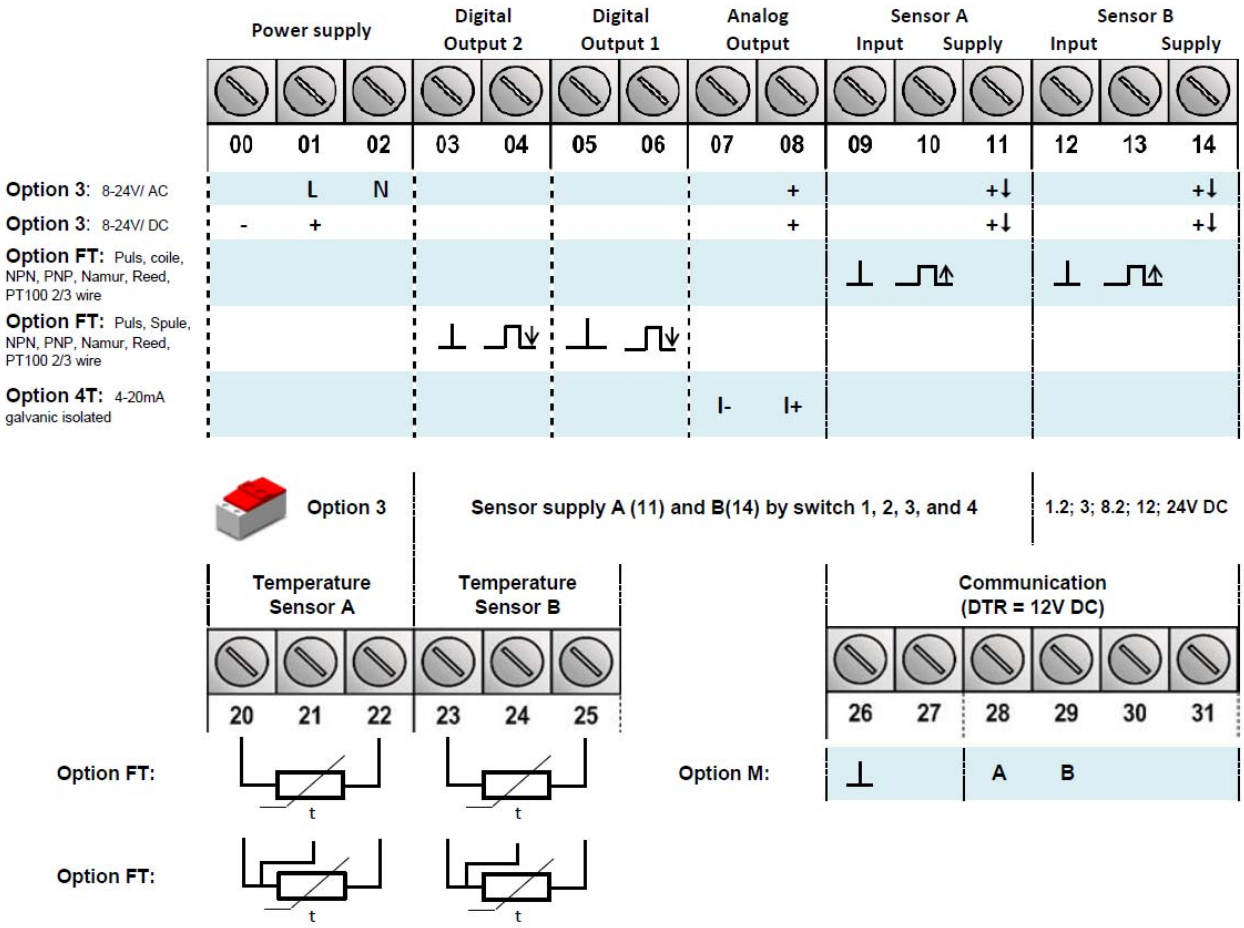


Type OR (8-24V AC)



Type (8-30V DC)

8.3.3 Terminal connectors



Overview of terminal connectors - Standard configuration and options

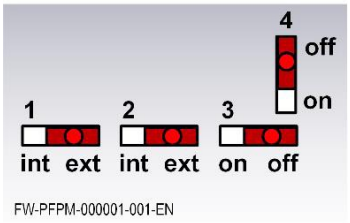
SENSOR SUPPLY

It is possible to supply the sensor with different voltages. You can set the voltage with the switches. Internal power is only applicable for low power sensors (Coil, Reed). External power is only available when the main external power supply is connected.
The sensor supply voltage is selectable: 1.2; 3; 8.2; 12 or 24V DC.

Set the sensor supply

1. Make the ZFC safe. If applicable, mind the battery power.
2. Open the ZFC and carefully remove the cable-connectors and the protective cover.
3. Find and set the switches and select the V_{out} as required.
4. Close the protective cover and install the cable connectors.
5. Close the ZFC.

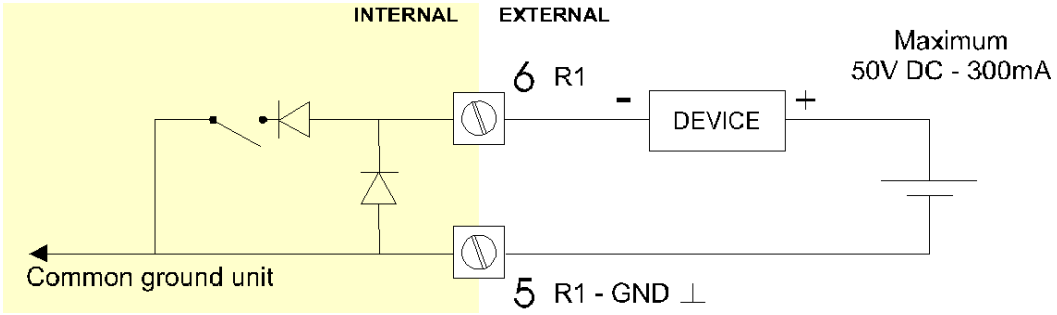
Risk of electrocution - High voltage!
Make sure, all the leads to the terminals are disconnected from the ZFC and NEVER connect the mains power supply to the unit when the protection cover has been removed!

Type 3	Power supply in: 8-24V AC / 10-30V DC				
 Switch location (typical)	Sensor A		V_{out} selection		Sensor supply out
	1	2	3	4	NOTE: Use an AC autotransformer (spartrafo) with galvanic isolation.
	int	-	off	off	Coil 1.2V DC; <1mA Reed 3V DC; <1mA
	ext	-	on on off	on off off	8.2V DC @8V_{in} AC / 10V_{in} DC 12V DC @10V_{in} AC / 14V_{in} DC 24V DC @18V_{in} AC / 26V_{in} DC

Sensor supply voltage - Switch setting

Terminal 05-06 (R1) / 03-04 (R2); scaled pulse output
SETUP 8 (read chapter 7) determines the pulse output function. The maximum pulse frequency of this output is 60 Hz. If a relay output option has been supplied, be sure that the output frequency does not exceed 5Hz or else the life-time of the relay will be reduced significantly.

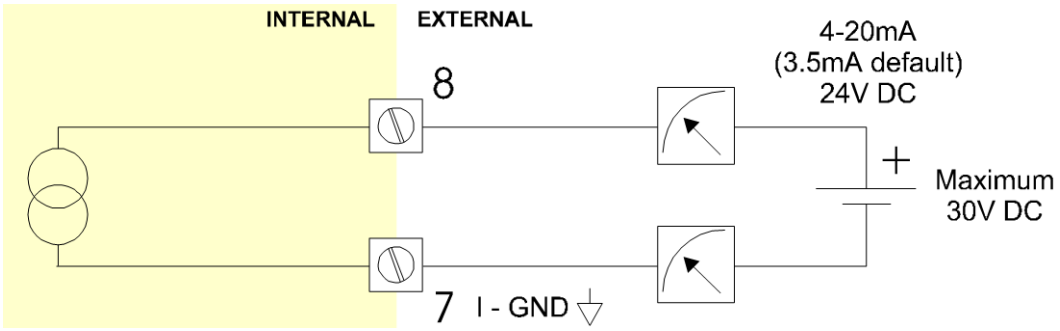
Type FT
A passive transistor output is available with this option. Max. driving capacity 300mA@50V DC.



Terminal connections - Pulse output (typical)

Terminal 07-08 analog output (SETUP A):
An analog output signal proportional to the differential flow rate is available as standard

Type 4T
An isolated 4-20mA signal proportional to the flow rate is available with this option. When the output is disabled, a 3.5mA signal will be generated on these terminals. Max. driving capacity 1000 Ohm @ 30VDC.

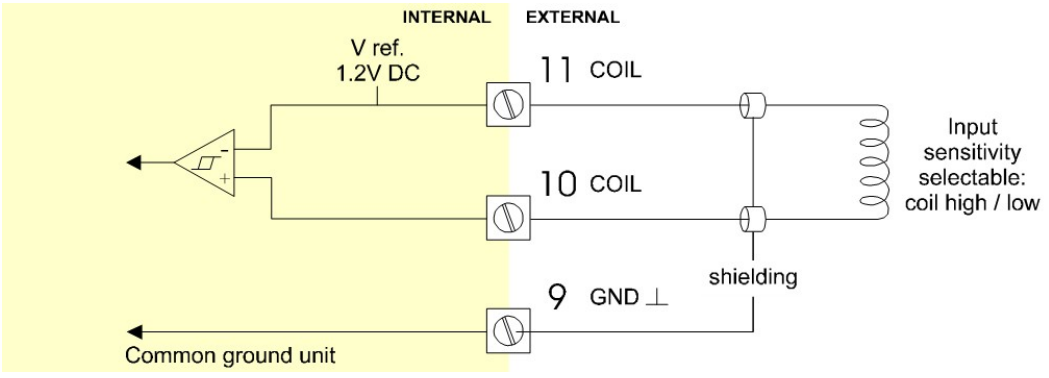


Terminal connections - Isolated 4-20mA analog output (typical)

Terminal 09-11; Terminal 12-14; Flowmeter input A and B:
Three basic types of flowmeter signals can be connected to the unit: pulse, active pulse or coil. The connections for flowmeter A (Terminal 09-11) and B (Terminal 12-14) are the same. The screen of the signal wire must be connected to the related common ground terminal (unless earthed at the sensor itself). The maximum input frequency is approximately 10 kHz (depending on the type of signal). The input signal type has to be selected in the flowmeter setup (read chapter 7).

Sine-wave signal (Coil):
The ZFC is suitable for use with flowmeters which have a coil output signal. Two sensitivity levels can be selected:

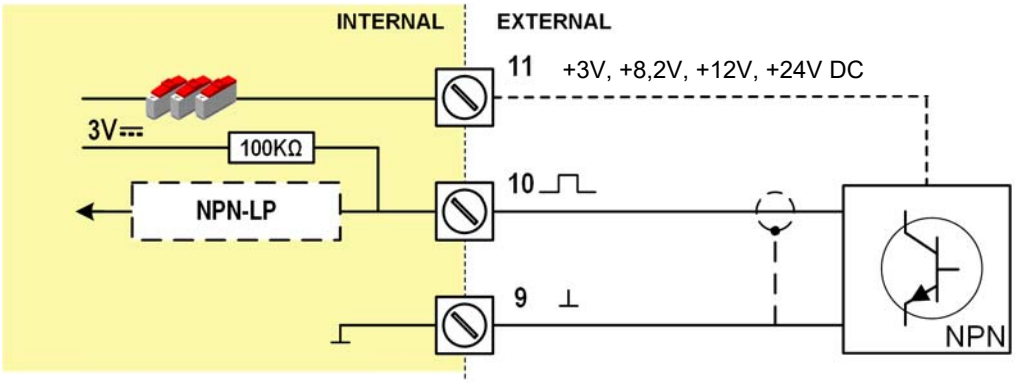
- COIL-LO: sensitivity from about 80 mVpp;
- COIL-HI: sensitivity from about 20 mVpp;



Terminal connections - Coil signal input (typical)

Pulse-signal NPN / NPN-LP:

The ZFC is suitable for use with flowmeters which have a NPN output signal. For reliable pulse detection, the pulse amplitude has to go below 1.2V. Signal setting NPN-LP employs a low-pass signal noise filter, which limits the maximum input frequency (read chapter 7).

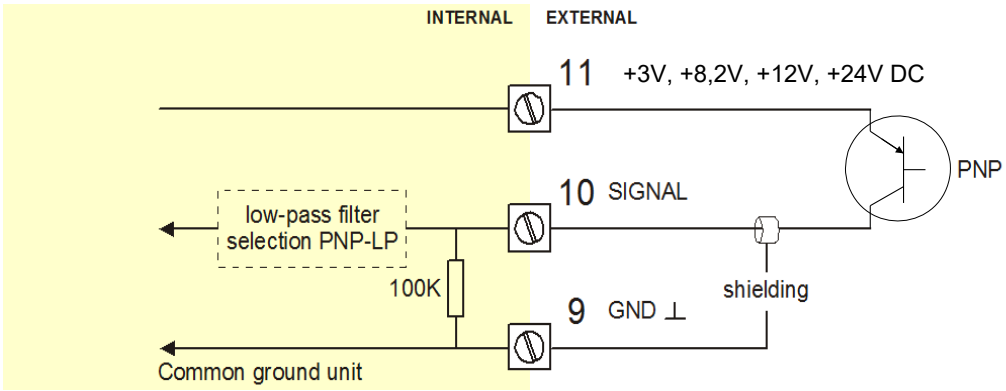


Terminal connections - NPN signal input (typical)

Pulse-signal PNP / PNP-LP:

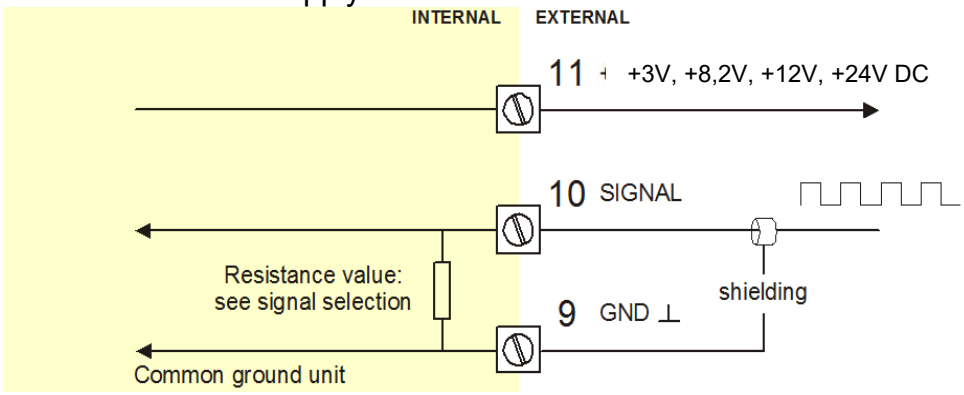
The ZFC is suitable for use with flowmeters which have a PNP output signal. 3 V is offered on terminal 11 which has to be switched by the sensor to terminal 10 (SIGNAL). For a reliable pulse detection, the pulse amplitude has to go above 1.2 V. Signal setting PNP-LP employs a low-pass signal noise filter, which limits the maximum input frequency (read chapter 7).

A sensor supply voltage of 8.2, 12 or 24 V DC can be provided with external power supply. For a signal detection level of 50% of the supply voltage: please refer to "active signals".



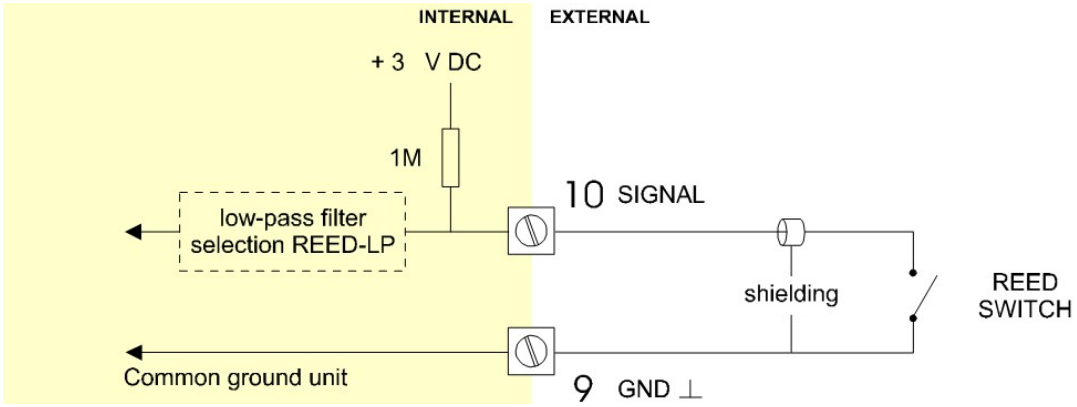
Terminal connections - PNP signal input (typical)

Active signal 8.2V, 12V and 24V:
If a sensor gives an active signal (read chapter 3). The detection levels are 50% of the selected supply voltage; approx. 4V (8-1 DC) or 6V (12 DC) or 12V (24 DC). Active signal selection may well be desired in case of power supply type 3 is available for sensor supply.



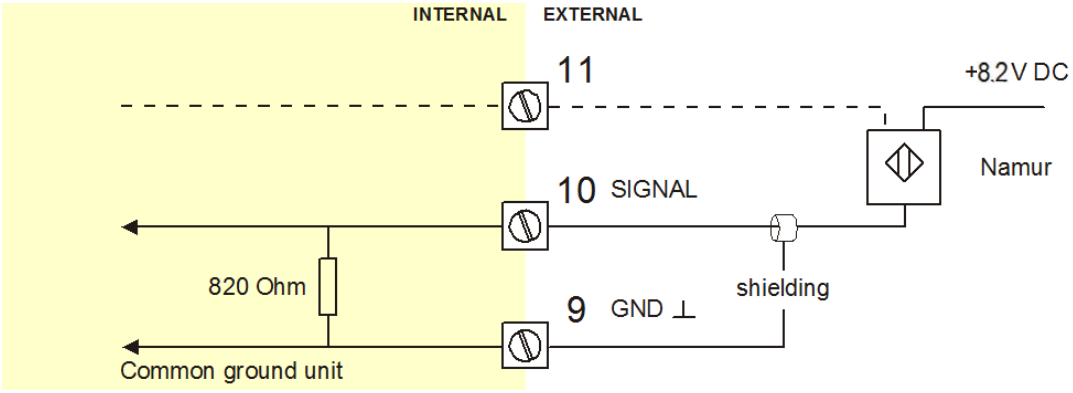
Terminal connections - Active signal input (typical)

Reed-switch:
The ZFC is suitable for use with flowmeters which have a reed-switch. To avoid pulse bounce from the reed-switch, it is advised to select REED LP - low-pass filter (read chapter 7).



Terminal connections - Reed-switch signal input (typical)

NAMUR-signal:
The ZFC is suitable for flowmeters with an NAMUR signal. With external power supply the 8.2V for the sensor (terminal 11) can be realized.



Terminal connections - NAMUR signal input (typical)

Terminal 20-22 and 23-25; Temperature inputs FT - PT100
Two types of PT100 elements can be connected: 2- or 3-wire. The temp coefficient for the RTD is 0.00385 ohms/ohms/°C. The Ro is 100 ohms at 0.0°C.
The temperature of the inlet flow will be measured with sensor A - terminal 20-22.

The temperature of the outlet flow will be measured with sensor B - terminal 23-25.

Terminal 26-31: type M - communication RS485
For connections, refer to figure: Overview of terminal connectors - Standard configuration and options

Please connect the DTR (or the RTS) signal of the interface to this terminal and set it active (+12 V). If no active signal is available, it is possible to connect a separate supply between terminals 26 and 27 with a voltage between 8 V and 24 V.

Terminal 00 - 01: type 3 backlight (option):
If the unit is supplied with a power supply:

- Corresponding to the AC or DC power supply, the connections must be occupied, the backlight is integrated.
- The backlight intensity is set in the setup menu: Display

9. Problem solving

In this chapter, several problems are included that can occur when the ZFC-EL is going to be installed or while it is in operation.

Flowmeter does not generate pulses:
Check:

- Signal selection;
- Pulse amplitude;
- Flowmeter, wiring and connection of terminal connectors;
- Power supply of flowmeter.

Flowmeter generates "too many pulses":
Check:

- Settings for total and Flow rate;
- Type of signal selected with actual signal generated;
- Sensitivity of coil input;
- Proper grounding of the ZFC;
- Use screened wire for flowmeter signals and connect screen to terminal 9. (unless connected at sensor).

Analog output does not function properly:
Check:

- is the analog output enabled?
- are the flow-levels programmed correctly?
- connection of the external power-supply according to the specification.

Flow rate displays "0 / zero" while there is flow (total is counting): Check:

- SETUP 22 / 25 and 41-42: are the K-factor and time unit correct?
- SETUP 26 / 27: The unit has to count the number of pulses according to SETUP 26 within the time according to SETUP 27. Make sure that 27 is set to 10.0 seconds for example: the result is the unit has at least 10 seconds time to measure the number of pulses according to SETUP 26.

The password is unknown:

- If the password is not 1234, there is only one possibility left: call your supplier.

ALARM
When the alarm flag starts to blink an internal alarm condition has occurred. Press the "select button" several times to display the error code. When multiple errors arise at the same time, their error codes are added and their sum is shown. The digital [d] codes are:

Not recoverable by the end user:

[d] 0 = no error;

[d] 1 = display error;

[d] 2 = data-storage error;

[d] 3 = error 1 + error 2 simultaneously;

[d] 4 =: initialization error.

[d] 8 =: Analog input error;

[d] 16 =: PT100 ADC error**.**

Recoverable by the end user:

[d] 32 =: Correction calculation factor (A) error;

[d] 64 =: Correction calculation factor (B) error;

[d] 128 =: Temperature Pressure Compensation (TPC A) calculation error;

[d] 256 =: Temperature Pressure Compensation (TPC B) calculation error;

[d] 512 =: PT100 sensor 1 out of range error;

[d] 1024 =: PT100 sensor 2 out of range error.

For a not recoverable error, keep the error code at hand and contact your supplier.

10. Communication

General

The product is fitted with the Modbus communication protocol and can be equipped with various physical interfaces like RS485 (please see device datasheet for available options). The tables below show the various variables that can be accessed through the communication.

Currently, the function codes supported are:

- function code 3 “Read Holding Registers” (4x references);
- function code 16 “Preset Multiple Registers” (4x references).

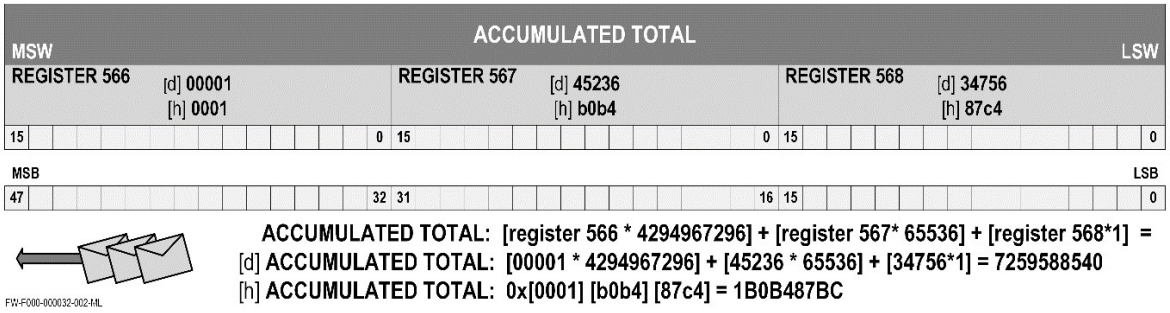
The table below shows the Modbus PDU addresses in a decimal format, followed by its hexadecimal representation (0x0000). When the PLC address range is required (4x references are typically used by PLCs), please add a value of 40001 to the Modbus PDU address. E.g. reading the serial number of the product with PLC-based addressing means: 165 + 40001 = register 40166.

The variables that consist of a multiple register must always read/write in 1 single action!

Refer to the illustration:

For this example, it is assumed that the variable accumulated total has 3 registers (words) with address 566, 567 and 568. When a transmission is done, register 566, which acts as the MSW, arrives first with bit 15 which is the MSB of the lowest addressed word, but is also the MSB (bit 47) of the complete variable that represents the Accumulated total.

Although most Modbus Masters will support variables that span 2 registers, variables spanning more registers sometimes require you to manually calculate the resulting value.



For additional information regarding using your Modbus device, please read the'General Modbus Communication Protocol' on homepage www.modbus.org .

Runtime variables

PDU ADDRESS	REGISTER	VARIABLE RUN TIME	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 1596 [h] 0x63C	41597	temperature corrected differential flow rate	2	r	uint32	0…9999999 Representation: unit, time, decimals depending on variables 48, 49, 50
[d] 566 [h] 0x236	40567	temperature corrected differential total	3	r*	uint48	0…9999999999 Representation: unit, decimals depending on variables 32, 33
[d] 560 [h] 0x230	40561	temperature corrected differential accumulated total	3	r	uint48	0…99999999999999 Representation: unit, decimals depending on variables 32, 33
[d] 572 [h] 0x23C	40573	Flow rate-A	2	r	uint32	0…9999999 Representation: unit, time, decimals depending on variables 48, 49, 50
[d] 588 [h] 0x24C	40589	Flow rate-B	2	r	uint32	0…9999999 Representation: unit, time, decimals depending on variables 48, 49, 50
[d] 212 [h] 0x0D4	40213	Temperature-A	1	r	uint16	0…9999999
[d] 218 [h] 0x0DA	40219	Temperature-B	1	r	uint16	0…9999999

PDU ADDRESS	REGISTER	VARIABLE RUN TIME	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 516 [h] 0x204	40517	error status (bitfield)	1	r	uint16	[d] 1: Display error [d] 2: data-storage error [d] 4: initialization error [d] 8: Analog input error [d] 16: PT100 ADC error [d] 32: Correction calculation factor (A) error [d] 64: Correction calculation factor (B) error [d] 128: TPC A calculation error [d] 256: TPC B calculation error [d] 512: PT100 sensor1 out of range error [d] 1024: PT100 sensor2 out of range error

Reading differential flow rate, total or accumulated total

The returned values are given including the decimals and represent the actual value. The given value may differ from the value that is shown on the display – this is due to the fact that the display is limited in the number of digits and may have a slower update rate set.

For example, when two decimals are selected for total and total has a value of 123456.78 the display will show 23456.78 while communication will read a “total” of 12345678 and a “total decimals” of 2.

*** Clearing total**

It is possible to clear the total counter by means of writing a value of 0 to all the 3 registers of total/flow rate in a single write action. Writing any other value will result in the reply of an error message because the registers of total/flow rate are during operation read-only.

Setup variables

PDU ADDRESS	REGISTER	VARIABLE TOTAL A	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 32 [h] 0x020	40033	unit (A and B)	1	r/w	uint16	0: none 3: kg 6: usgal 1: L 4: lb 7: bbl 2: m3 5: gal
[d] 33 [h] 0x021	40034	decimals (A and B)	1	r/w	uint16	0…3
[d] 34 [h] 0x022	40035	K-factor	2	r/w	uint32	1...9999999 Representation: 0.000010…9999999 depending on variable 54: decimals K-factor.
[d] 37 [h] 0x025	40038	decimals K-factor	1	r/w	uint16	0…6

PDU ADDRESS	REGISTER	VARIABLE FLOW RATE A	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 48 [h] 0x030	40049	unit(A and B)	1	r/w	uint16	0: mL 6: ton 12: none 1: L 7: gal 13: scf 2: m3 8: bbl 14:NM3 3: mg 9: lb 15: NL 4: g 10: cf 16: P 5: kg 11: rev
[d] 49 [h] 0x031	40050	time unit (A and B)	1	r/w	uint16	0: sec 2: hour 1: min 3: day
[d] 50 [h] 0x032	40051	decimals (A and B)	1	r/w	uint16	0…3
[d] 51 [h] 0x033	40052	K-factor	2	r/w	uint32	1...9999999 Representation: 0.000010…9999999 depending on variable 54: decimals K-factor.
[d] 54 [h] 0x036	40055	decimals K-factor	1	r/w	uint16	0…6
[d] 62 [h] 0x03E	40063	filter	1	r/w	uint16	1...99
[d] 71 [h] 0x047	40072	period	1	r/w	uint16	1...999 Representation: 0.1 – 99.9 sec

PDU ADDRESS	REGISTER	VARIABLE TOTAL B	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 40 [h] 0x028	40041	K-factor	2	r/w	uint32	1...9999999 Representation: 0.000010…9999999 depending on variable 43: decimals K-factor.
[d] 43 [h] 0x02b	40044	decimals K-factor	1	r/w	uint16	0…6

PDU ADDRESS	REGISTER	VARIABLE FLOW RATE B	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 227 [h] 0x0E3	40228	K-factor	2	r/w	uint32	1...9999999 Representation: 0.000010…9999999 depending on variable 230 decimals K-factor
[d] 230 [h] 0x0E6	40231	decimals K-factor	1	r/w	uint16	0…6

PDU ADDRESS	REGISTER	VARIABLE DISPLAY	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 64 [h] 0x040	40065	function	1	r/w	uint16	0: total 1: flow rate
[d] 67 [h] 0x043	40068	backlight brightness	1	r/w	uint16	0: off 2: 40% 4: 80% 1: 20% 3: 60% 5: 100%
[d] 73 [h] 0x049	40074	measurement	1	r/w	uint16	0: bi-direct 2: threshold 1: not negative 3: stationary
[d] 77 [h] 0x04D	40078	stationary flow rate	2	r/w	uint32	0...9999999 Representation: 0.000000…9999999
[d] 44 [h] 0x02C	40045	stationary total	2	r/w	uint32	0...9999999 Representation: 0.000000…9999999

PDU ADDRESS	REGISTER	VARIABLE POWER MANAGEMENT	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 80 [h] 0x050	40081	LCD update time	1	r/w	uint16	0=fast 2=3sec 4=30sec 1=1sec 3=15sec 5=off
[d] 81 [h] 0x051	40082	power mode	1	r/w	uint16	0=operational 1=shelf

PDU ADDRESS	REGISTER	VARIABLE FLOWMETER	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS		
[d] 96 [h] 0x060	40097	flowmeter signal A	1	r/w	uint16	0: npn 1: npn lp 2: reed 3: reed lp	4: pnp 5: pnp lp 6: namur 7: coil-hi	8: coil-lo 9: act. 8.1V 10: act. 12V 11: act. 24V
[d] 97 [h] 0x061	40098	flowmeter signal B	1	r/w	uint16	0: npn 1: npn lp 2: reed 3: reed lp	4: pnp 5: pnp lp 6: namur 7: coil-hi	8: coil-lo 9: act. 8.1V 10: act. 12V 11: act. 24V

PDU ADDRESS	REGISTER	VARIABLE TEMPERATURE A/B	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS		
[d] 209 [h] 0x0D1	40210	display	1	r/w	uint16	0: °C	1: °F	2: K
[d] 208 [h] 0x0D0	40209	number of wires	1	r/w	uint16	0: 2	1: 3	
[d] 199 [h] 0x0C7	40200	filter	1	r/w	uint16	0…99		

PDU ADDRESS	REGISTER	VARIABLE FORMULA	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 74 [h] 0x04A	40075	thermal expansion coefficient	1	r/w	uint32	0…9999999 ($*10^{-9}$)
[d] 537 [h] 0x219	40538	normal temperature	1	r/w	uint16	0.00…99,999.99; step: 0.01 K; Representation: temperature unit depending on variable 528

PDU ADDRESS	REGISTER	VARIABLE ANALOG OUTPUT	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 112 [h] 0x070	40113	analog output	1	r/w	uint16	0: disable 1: enable
[d] 113 [h] 0x071	40114	rate-min	2	r/w	uint32	0…9999999 Representation: unit, time, decimals depending on variables 48, 49, 50
[d] 116 [h] 0x074	40117	rate-max	2	r/w	uint32	0…9999999 Representation: unit, time, decimals depending on variables 48, 49, 50
[d] 119 [h] 0x077	40120	cut off	1	r/w	uint16	0...99 Representation: 0.0 – 9.9%
[d] 120 [h] 0x078	40121	tune-min	1	r/w	uint16	0...9999
[d] 122 [h] 0x07A	40123	tune-max	1	r/w	uInt16	0...9999
[d] 99 [h] 0x063	40100	filter	1	r/w	uint16	1...99

PDU ADDRESS	REGISTER	VARIABLE PULSE	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 135 [h] 0x087	40136	mode	1	r/w	uint16	0: not negative 1: separated 2: signed
[d] 128 [h] 0x080	40129	pulse width	1	r/w	uint16	0…9999, (0=disabled) Representation: 0.000 – 9.999 sec
[d] 133 [h] 0x085	40134	decimals	1	r/w	uint16	0…3
[d] 130 [h] 0x082	40131	amount	2	r/w	uint32	1...9999999 Representation: 0.001…9999999 depending on variables 133

PDU ADDRESS	REGISTER	VARIABLE COMMUNICATION	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 144 [h] 0x090	40145	speed (baud rate)	1	r/w	uint16	0: 1200 2: 4800 1: 2400 3: 9600
[d] 145 [h] 0x091	40146	Modbus address	1	r/w	uint16	1…247
[d] 146 [h] 0x092	40147	Modbus mode	1	r/w	uint16	0=ASCII 1=RTU 2=OFF

PDU ADDRESS	REGISTER	VARIABLE OTHERS	NO. REGISTERS	R/W	TYPE	VALUE / REMARKS
[d] 173 [h] 0x0AD	40174	model number	1	r	uint16	0…9999
[d] 160 [h] 0x0A0	40161	model suffix	1	r	char	Representation: ASCII character
[d] 162 [h] 0x0A2	40163	firmware version	2	r	uint32	0…999999 Representation: nn:nn:nn
[d] 165 [h] 0x0A5	40166	serial no	2	r	uint32	0…9999999 Representation: nnnnnnn
[d] 168 [h] 0x0A8	40169	password	1	r	uint16	0…9999
[d] 170 [h] 0x0AA	40171	tag-nr	2	r/w	uint32	0...9999999 Representation: nnnnnnn

11. List of configuration settings

LIST OF CONFIGURATION SETTINGS			
SETTING	DEFAULT	DATE:	DATE:
1 TOTAL-A		Enter your settings here	
11 unit	L		
12 decimals	0000000		
13 K-factor	0000001		
14 decimals K-factor	0		
2 FLOW RATE- A			
21 unit	L		
22 time unit	/min		
23 decimals	0000000		
24 K-factor	0000001		
25 decimals K-factor	0		
26 filter	1		
27 period	1.0 sec.		
3 TOTAL-B			
31 K-factor	0000001		
32 decimals K-factor	0		
4 FLOW RATE- B			
41 K-factor	0000001		
42 decimals K-factor	0		
5 DISPLAY			
51 function	total		
52 light	100%		
53 measurement	bi-directional		
54 stationary flow rate	0 L/ min		
55 stationary total	0 L/hr		
6 POWER MANAGEMENT			
61 LCD-new	1 sec.		
62 battery mode	operate		
7 FLOWMETER			
71 signal A	coil-lo		
72 signal B	coil-lo		
8 TEMPERATURE A/B			
81 display unit	°C		
82 no. of wires	3		
83 filter	0		
9 FORMULA			
91 type	EL		
92 thermal exp. coefficient	0.000000		
93 normal temperature	288.15 K		

LIST OF CONFIGURATION SETTINGS			
SETTING	DEFAULT	DATE:	DATE:
A ANALOG OUTPUT			
A1 output	disabled		
A2 rate-min	0000000		
A3 rate-max	9,999,999		
A4 cut-off	0.0		
A5 tune-min	0160		
A6 tune-max	6656		
A7 filter	1		
B PULSE			
B1 mode	signed		
B2 width	0 (off)		
B3 decimals	0		
B4 amount	1.000		
C COMMUNICATION			
C1 speed	9600		
C2 address	1		
C3 mode	BUS-RTU		
D OTHERS			
D1 model	ZFC		
D2 software version			
D3 serial no.			
D4 password	0000		
D5 tag-nr	0000000		

12. Maintenance

12.1 General directions

- Mounting, electrical installation, start-up and maintenance of this device may only be carried out by trained persons authorized by the operator of the facility. Persons must read and understand this manual before carrying out its instructions.
- This device may only be operated by persons who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Make sure, the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has been opened (danger from electrical shock). The housing may only be opened by trained persons authorized by the operator of the facility.
- Take careful notice of the "Safety rules, instructions and precautionary measures" in the front of this manual.

The ZFC does not require special maintenance unless it is used in low-temperature applications or surroundings with high humidity (above 90% annual mean). It is the user's responsibility to take all precautions to dehumidify the internal atmosphere of the ZFC in such a way that no condensation will occur, e.g. to put a dose of desiccant (drying agent) inside the enclosure just before closing it.
Furthermore, it is required to replace the desiccant periodically as advised by its supplier.

Check periodically:

- The condition of the enclosure, cable glands and front panel.
- The input/output wiring for reliability and aging symptoms.
- The process accuracy. As a result of wear and tear, re-calibration of the flowmeter might be necessary. Do not forget to re-enter any subsequent K-Factor alterations.
- Clean window and enclosure only with a lint-free cleaning cloth made damp with a mild soap solution. Do not use any aggressive solvents as these might damage the coating.

12.2 Instructions for repair

This product cannot be repaired by the user and must be replaced with an equivalent certified product. Repairs are only allowed to be carried out by the manufacturer or his authorized agent.

13. Technical Data

Display	
Type	High intensity reflective numeric and alphanumeric LCD, UV-resistant.
Dimensions	90 x 40mm (3.5”x 1.6”)
Digits	Seven 17mm (0.67") and eleven 8mm (0.31"). Various symbols and measuring units.
Refresh rate	User definable: 8 times/sec - 30 secs.
Type ZFC	LCD with LED backlight. Good readings in full sunlight and darkness. Power requirements: 12-24V DC + 10% or type PD, PF, PM. Power consumption max. 1 Watt. Only available for safe area applications.

Enclosures	
General	Die-cast aluminum or GRP (Glassfibre Reinforced Polyamide) enclosure with Polycarbonate window, silicone gaskets. UV stabilized and flame retardant material.
Control Keys	Three industrial micro-switch keys. UV-resistant silicone keypad.
Field/wall-mount enclosures	Dimensions: 130 x 120 x 75mm (5.10” x 4.72” x 2.95”) – LxHxD.
Classification	IP67 / TYPE 4(X)
GRP enclosures	
Type K	Drilling: 6x 12mm (0.47”).

Operating temperature	
Operational	-40 – +80 °C (-40 – +178 °F)
Relative Luftfeuchtigkeit	90 %, no condensation allowed.

Power requirements	
Type 3	8-24V AC / 8-30V DC; Power consumption max. 5 Watt.

Sensor excitation	
Type 3	1.2; 3; 8.2; 12; 24V DC - max. 50mA@24V DC

Terminal connections	
Type 3	Removable plug-in terminal strip. Wire max. 1.5mm^2 and 2.5mm^2

Data protection	
Type	EEPROM backup of all settings. Backup of running totals every minute. Data retention at least 10 years.
Password	Configuration settings can be Password protected.

Inputs

Flowmeter	
Type FT	npn; npn-lp; reed; reed-lp; pnp; pnp-lp; namur; coil-hi; coil-lo; 8-1 DC; 12 DC; 24 DC
Frequency	Minimum 0 Hz – maximum 7 kHz for total and flow rate. Maximum frequency depends on signal type and internal low-pass filter. E.g. Reed switch with low-pass filter: max. frequency 120 Hz.
K-Factor	0.000010 - 9999999 with variable decimal position.
Low-pass filter	npn-lp; reed-lp; pnp-lp

Temperature	
Type FT	2 or 3 wire PT100.
Standard range	-100 to +200 °C (-148 to 392 °F) – accuracy: 0.1 °C (0.18 °F).
Extended range (ZV)	-200 to +800°C (-328 to 1832°F) – accuracy: 0.5 °C (0.9°F).
Update time	Four times a second.
Note !	The linearity is internally compensated.

Ausgänge

Analog output	
Function	transmitting differential flow rate
Accuracy	10 Bit. Error < 0,05 % – update 10 times a second. Software function to calibrate the 4.00 mA and 20.00 mA levels preciously within setup.
Load	max. 1 kΩ
Type 4T	Passive galvanically isolated 4-20 mA output

Switch outputs	
Function	One pulse output – transmitting accumulated total.
Pulse output	Max. frequency 500 Hz. Pulse length user definable between 0.001 up to 9.999 seconds.
Typ FT	Passive transistor output – not isolated. Load max. 50 V DC – 300 mA.

Communication (option)	
Protocol	bus-rtu; bus-asc
Speed	1200; 2400; 4800; 9600
Adressing	1–247
Type M	RS485 2-wire

Operational

Operator functions	
Shown functions	• Compensated differential total and/or compensated differential flow rate. • Compensated differential total and compensated differential accumulated total. • Inlet temperature and compensated flow rate. • Outlet temperature and compensated flow rate. • Compensated differential total can be reset to zero by pressing the CLEAR-key twice.

Total	
Digits	7 digits
Unit	l; m^3; kg; lb; GAL; USGAL; bbl; no unit
Decimals	0000000; 111111,1; 22222,22; 3333,333
Note !	Total can be reset to zero.

Accumulated total	
Digits	11 digits
Unit/decimals	According to selection for total.

Flow rate	
Digits	7 digits
Units	ml; l; m^3; mg; g; kg; ton; gal; bbl; lb; cf; rev; - - - - (no unit); scf; nm^3; nl; p
Decimals	0000000; 111111,1; 22222,22; 3333,333
Time units	/sec; /min; /hour; /day

Flow temperature	
Digits	6 digits
Units	°C; °F; K
Decimals	1
Normal temperature	Default: 273.15 K – any temperature can be set.

Flow equations	
Typ EL	Equations liquid – flow computer for corrected liquid volume.
Formel	Qnormal = Q * (1 + α (Tnormal – T)) where: α = thermal expansion coefficient.

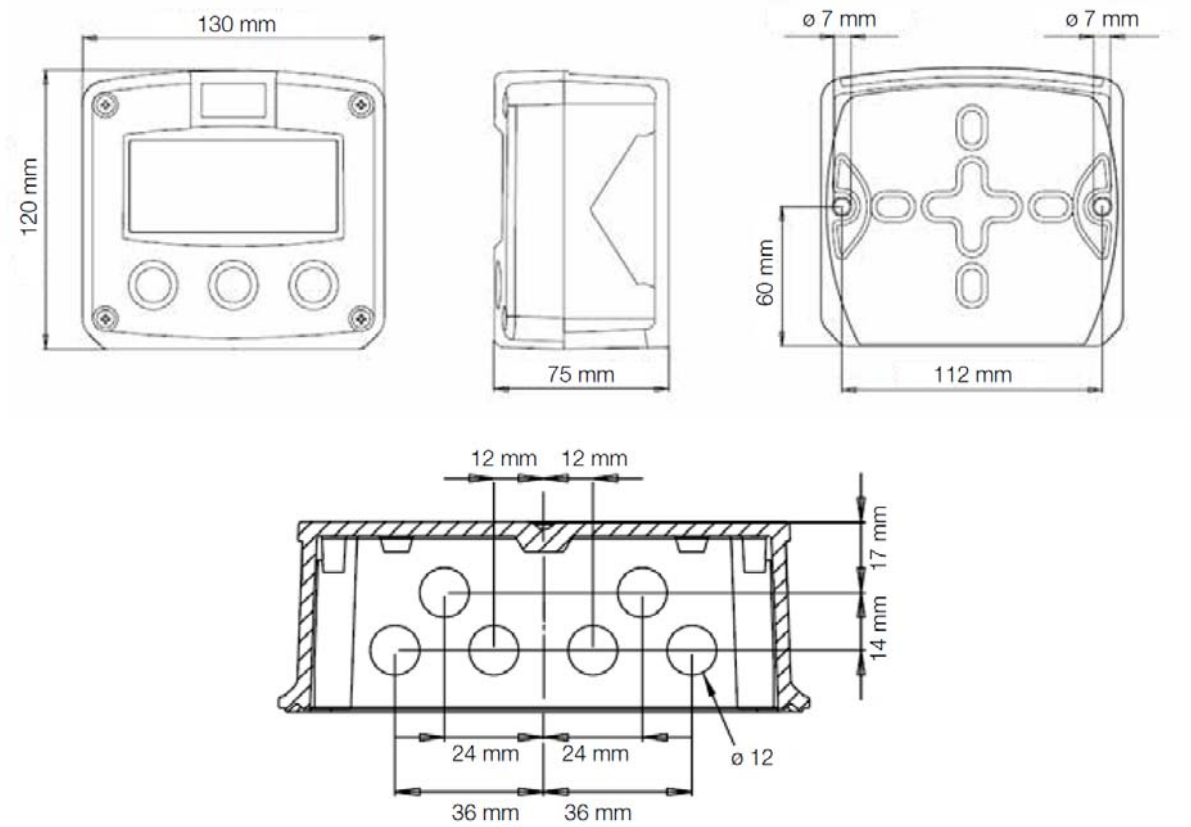
14. Order Codes

Example: **ZFC-K FT 4T 0 3 0 0**

Model	Enclosure	Input	Output	Communi-cation	Power supply	ATEX	Special version
ZFC-...	**K** = wall mounting enclosure, glass fiber reinforced, plastic, IP67	**FT** = Pulse: coil, NPN, PNP, Namur, reed, 1 x Pt100, 2/3 wires	**4T** = 4-20 mA, galv. separated, 2 x passive transistor	**0** = without **M** = RS 485 Modbus RTU, 2 wires	**3** = 8-24 $V_{AC/DC}$ incl. sensor supply	**0** = without	**0** = without **Y** = special (specify in clear text)

15. Dimensions

Housing dimensions ZFC



16. EU Declaration of Conformance

We, KOBOLD Messring GmbH, Hofheim-Ts, Germany, declare under our sole responsibility that the product:

Differential Flow Computer **Model: ZFC**

to which this declaration relates is in conformity with the standards noted below:

EN 61000-6-2:2005
Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

EN 61000-6-3:2007/A1:2011
Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments

EN 61326-1:2013
Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

EN 50581:2012 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Also, the following EC guidelines are fulfilled:

2014/35/EU **Low Voltage Directive**
2014/30/EU **EMC Directive**
2011/65/EU **RoHS** (category 9)

Hofheim, 05 Dec. 2018

H. Peters
General Manager

M. Wenzel
Proxy Holder