KROHNE

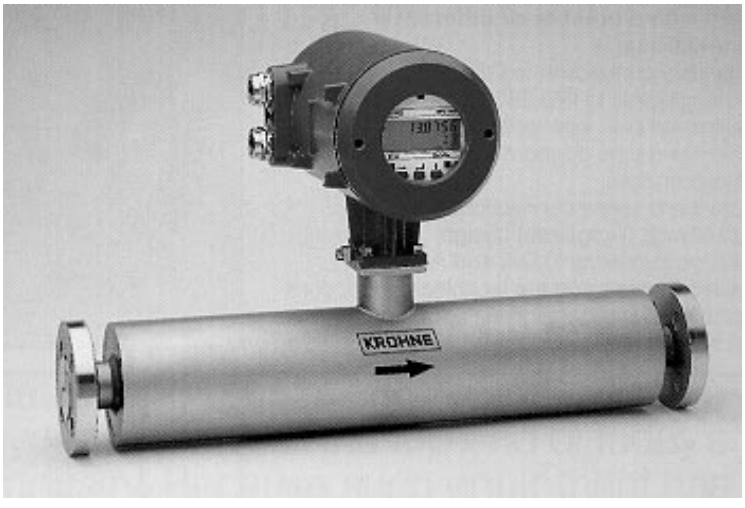
02/98

CORIMASS G+ Class

Single straight tube mass flow meter

Installation and Operating Instructions

MFM 4085 K/F



How to use these installation and operating instructions

For easy reference these Instructions are divided into four parts.

Only Part A (page 3) is needed for installation and initial start-up.

All CORIMASS mass flowmeters of the G-Series are factory set to your order specifications.

Part A Install flowmeter in the pipeline (Sect. 1), connect up (Sect. 2) and power the flowmeter (Sect. 3).

The system is operational

Part B Operator control and functions of the MFC 085 Signal Converter.

Part C Service and functional checks.

Part D Technical data, dimensions and measuring principle.

Product liability and warranty

The CORIMASS mass flowmeter MFM 4085 is designed for the direct measurement of mass flow rate, product density and product temperature, and also indirectly enables measurement of parameters such as total mass, concentration of dissolved substances and the volume flow.

For **use in hazardous areas**, special codes and regulations are applicable which are specified in the special "Ex installation and operating instructions" (supplied only with hazardous-duty equipment).

Responsibility as to suitability and intended use of our instruments rests solely with the purchaser.

Improper installation and operation of the flowmeters may lead to **loss of warranty**.

In addition, the **"general conditions of sale"** forming the basis of the purchase agreement are applicable.

If you need to return CORIMASS flowmeters to KROHNE, please complete the form on the **last page** of this manual and return it with the meter to be repaired. **Krohne regrets that it cannot repair or check your flowmeter unless accompanied by this completed form**.

CE / EMC Standards / Approvals

- The Corimass MFM 4085 with the MFC 085 signal converter meet the requirements of **the EU-EMC Directives** and bear the **CE symbol**.
- The Corimass MFM 4085 K -Ex are approved as hazardous duty equipment to the harmonised European Standards and to Factory Mutual (FM). Further details are given in the "Ex" supplementary instructions provided only with hazardous-duty equipment.

CE

Technical data subject to change without notice

Contents

Part A Installation and Start-up

1. Installation in the pipeline

1.1 General principles

The MFM 4085 K/F CORIMASS mass flow meter provides high accuracy and excellent repeatability. Narrow band pass digital filtering, and the mathematically modelled internal primary head design provides exceptional immunity to external vibratory disturbances from nearby process equipment. The accuracy of the flow meter is not affected by velocity profile. The straight single tube means there is a very low risk of cavitation, and no air can be trapped inside the meter. No back pressure is required at the outlet of the meter. As with all Coriolis mass flow meters, the CORIMASS is an active device with its own energy source. A good installation is essential for the high measurement accuracy.

The following installation guidelines are practical to implement, particularly if planned before the CORIMASS is first installed. For further dimensions or connections, please refer to Section D, Technical Data.

1.2 Installation Guidelines

1.2.1 Mounting location

For the G+ no special mounting requirements are necessary. However, good general engineering practices for the installation of flow meters should still be observed.

- The meter can be installed horizontally, in an upward sloping pipeline or vertically. For best results, a vertical installation with flow in an upward direction is recommended.

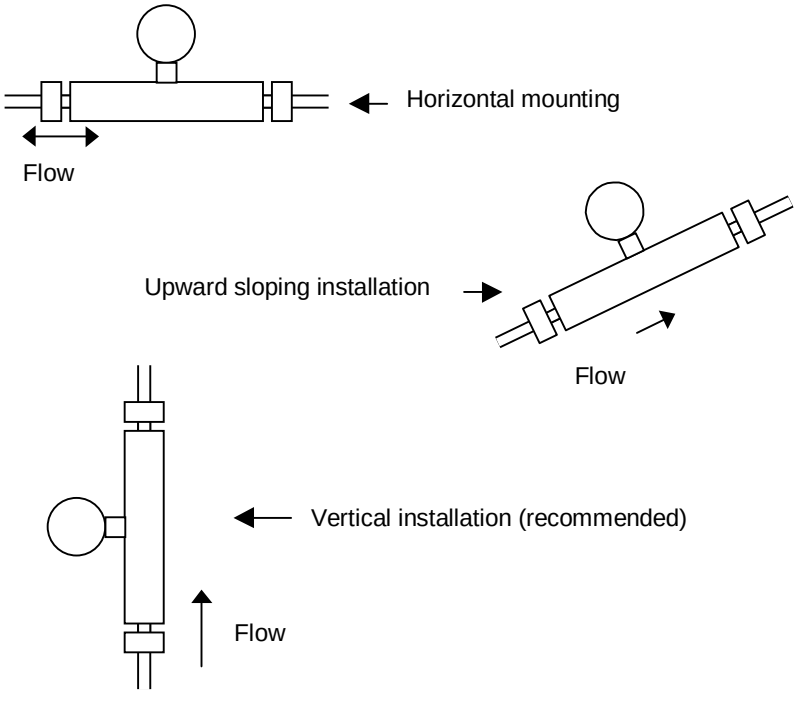


Figure 1

1.2.2 Connecting pipes

- Avoid mounting the meter with long vertical drops after the meter. This could cause siphoning and cause measurement errors.

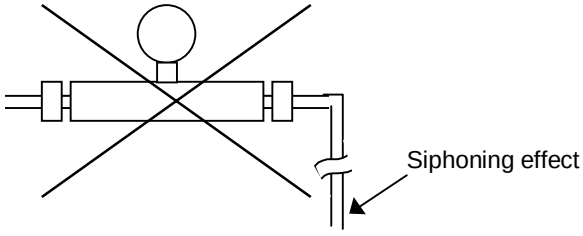


Figure 2. Avoid long vertical drops

- Install meter at least 4 × L downstream of pumps. (where L = length of the meter)

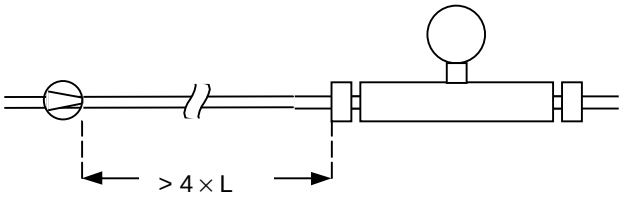


Figure 3

- Avoid mounting the meter at the highest point in the pipeline. Air or gas can accumulate here and cause faulty measurements.

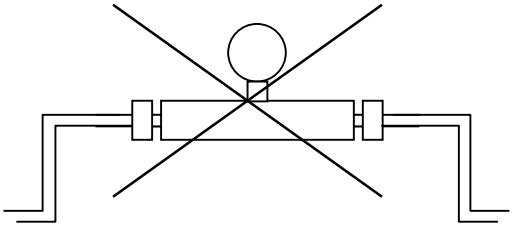


Figure 4

- The use of reducers at the flanges is allowed. Extreme pipe size reductions should be avoided due to possibility of cavitation and gassing. One size up from smallest available flange size is acceptable.

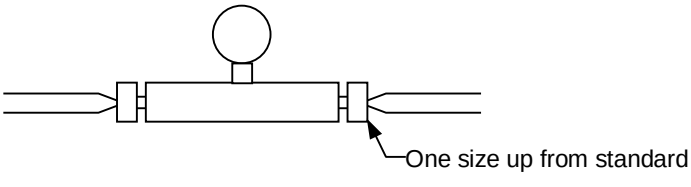


Figure 5

- The use of flexible hoses is allowed. For best results the meter should be supported by two spool pieces and the hoses connected to these spool pieces. For low flow rates (less than 10%) secondary clamps may be required.

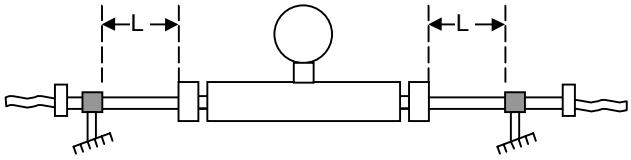


Figure 6

Note: See table on next page for information on supports for distances, L.

- To enable a good zero to be done, it is recommended that a shut-off valve be installed downstream of the flow meter.

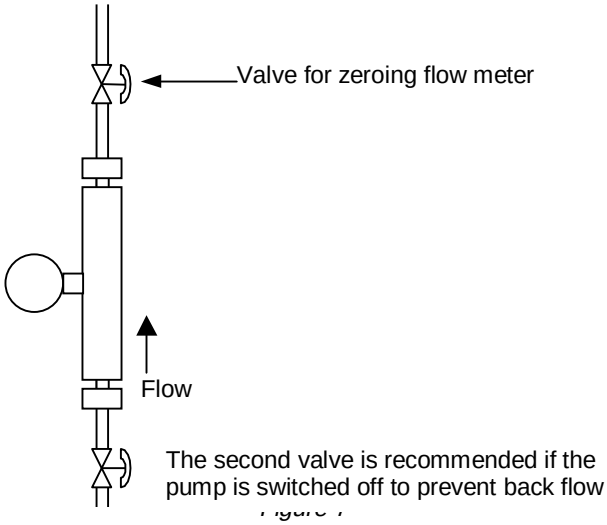


Figure 7

- Installing in a bypass

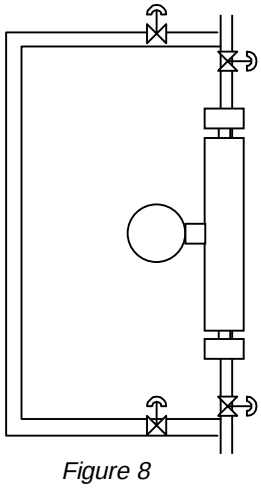


Figure 8

- Should it become necessary to support the pipework, the following guidelines should be followed. Do not clamp the meter body or the process pipework closer than distance L, as shown in the table below. Due to the weight of the 800 to 3000 G, the pipework should be supported. Please note minimum support distances as per table.

Meter Size	L (cm)	L (inch)
10 G+	21	8,8
100 G+	35	13,8
300 G+	48	18,9
800 G+	48	18,9
1500 G+	48 (DN 50) 70 (DN 80)	18,9 (2"N.B.) 27,6 (3"N.B.)
3000 G+	48 (DN 80) 60 (DN 100)	18,9 (2"N.B.) 23,7 (3"N.B.)

- Connecting pipes may have bends between the meter and supports

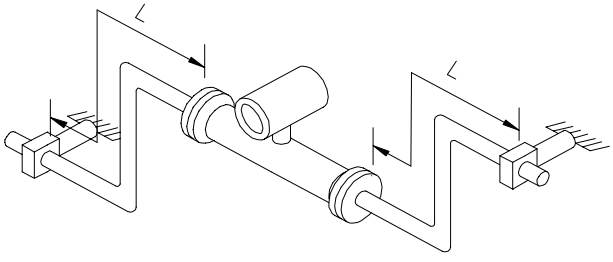


Figure 9

- Fit valves, sensors, sight glasses, etc. outside the supports if possible.

1.2.3 Mounting fixtures

- The connecting pipework must be in a stress free condition.
- The meter should fit between the connecting pipe with perhaps 2 - 3 mm ($^1/_8$ inch) to spare. It should not be necessary to force the pipes apart to fit meter. Flanges should be correctly aligned.
- Tighten flange bolts evenly.
- Do not fit rigid electrical conduit to the converter housing.
- Do not fit supports or any fixtures to any part of the meter or connecting pipework between meter and supports.

1.2.4 Installation factor

The installation factor feature is unique to the G-Series. This factor (found in menu 2.7.4) is a dimensionless number between 0 and 999 which is an indication of how well the instrument is installed and whether the product contained gas bubbles. This is a function of the amount of energy required to excite the measuring tube to its natural resonant frequency. The auto zero value (menu 1.1.1 or 3.1.1) should be as low as possible, typically less than 1% for normal installations and less than 2% for extreme conditions.

The following values are a guideline to a good installation:
With the meter filled with water, the values should be less than the figure indicated.

Meter Size	Installation factor Non Ex	• Installation factor Ex
10 G +	20	200
100 G +	10	150
300 G +	20	400
800 G +	20	300
1500 G +	30	300
3000 G +	40	400

- The higher installation factor for Ex instruments is due to the power limiting of the Zener barriers in the Exciter circuit, and does not mean bad installation.
- Product with higher density or entrained gas will exhibit higher installation factors.

Use the following procedure to check the installation factor. Warm up the electronics for at least 30 minutes. Flush the meter with water or product to ensure that all trapped air has been removed.

Key	Display Line 2	Display Line 2
→	Fct. (1).0	OPERATOR
↑	Fct. (2).0	TEST
→	Fct. 2.(1)	TEST DISP:
6 × ↑	Fct. 2.(7).0	TEST: TRANSD:
→	Fct. 2.7.(1)	SENSOR A
3 × ↑	Fct. 2.7.(4)	INSTAL:FACT:
→	Fct. xxx	LEVEL
	Display of installation factor	
3 × ↵	Fct. 2.7.(4)	INSTAL:FACT
↵	Display	

Note: Terms in brackets are flashing on the display.

1.2.5 Standard flange sizes

The following is a list of flanges for the meters, which are supplied as standard.

10 G+	DN 10 PN 40 / ½" ANSI 150
100 G+	DN 15 PN 40 / ¾" ANSI 150
300 G+	DN 25 PN 40 / 1" ANSI 150
800 G+	DN 40 PN 40 / 1½" ANSI 150
1500 G+	DN 50 PN 40 / 2" ANSI 150
3000 G+	DN 80 PN 40 / 3" ANSI 150

1.2.6 Cross talk

Multiple instruments of the same size installed in the same structure may cause a problem with cross talk between the operating frequencies of the instruments.

If this type of installation is envisaged, please contact your nearest Krohne office or representative for assistance.

Instruments of different sizes are normally not a problem. As a guide the following table of frequencies are provided for information (+/- 5 Hz) :

	10 G+	100 G+	300 G+	800 G+	1500 G+	3000 G+
Frequency in air (Hz)	230	223	253	250	290	295
Frequency in Water (Hz)	224	203	219	194	205	210

1.2.7 Inner Pipe diameters of the G-Series

Inner Diameter	10 G+	100 G+	300 G+	800 G+	1500 G+	3000 G+
[mm]	4.93	14.46	23.58	37.60	47.96	68
[inch]	0.19	0.57	0.93	1.48	1.89	2.68
Tube thickness [mm]	0.71	0.71	0.91	1.20	1.42	2.00

1.2.8 Sanitary Connections

The installation guidelines are the same for sanitary connections as for flanges up to the 300 G.

The 800 G, 1500 and 3000 G has a different requirement due to the weight of the meter. The standard sanitary connectors are not capable of carrying the weight of the meter. As a safety precaution Krohne has decided to ship the 800 G to 3000 G with extended spool pieces with the customer-requested sanitary connectors on the ends.

The installation length is thus increased with this extra set of spool pieces. This has the advantage of having the correct length and outside diameter of the pipe to enable secure clamping and a vastly improved installation. Supports must be used on the extra spool piece close to the sanitary connection.

All G+ meters with sanitary connections have stainless steel adaptor, which screw on each end of the meter using seals between the adaptor and the meter. The standard seal material is PTFE on 10 G+ and 100 G+, and Viton for all other sizes. Other materials are available on request. It is important that the adaptors are properly tightened to ensure crevice free seal (see table on the next page for correct torque tightening valves.

METER SIZE	SIZE & TYPE Seal is modelled on:	STD. MATERIAL	TYP. TORQUE Nm	KFTC part/drawing	ALTERN. MAT.	TYP. TORQUE Nm
10 G	½" Tri-clamp	PTFE	18	3.85055.00.00	None	
100 G	¾" Tri-clamp	PTFE	16	3.85155.00.00	Nitrile+ Silicone+ EPDM+ Viton+	8 • • 8
300 G	1" IDF/ISS	Viton	8	5.85065.00.00	Nitrile EPDM PTFE	9 • 11.5
800 G	DN40 DIN11851	Viton	27.5	5.85117.00.00	Nitrile EPDM Silicone	• 24 •
1500 G	2" IDF/ISS	Viton	24	5.85162.00.00	Nitrile EPDM PTFE	26 • 39.5

Installation lengths for sanitary connections - please contact Krohne for further details as installation lengths depend on customer requirements.

- Typical Torque on request.

1.3 External Heating and Insulation

When installing the G+ Meter in heated and insulated pipelines, it is not generally necessary or desirable to heat or insulate the case of the meter. This is because the central measuring tube is not thermally coupled to the case, except at the extreme ends. It is then only necessary to insulate the flanges as shown in the attached drawings. However, it is permissible to insulate the case of G+ Meters and special units with heating jackets are available.

The following notes will act as a guide for use of the G+ Meter with different types of heating and insulation systems. Please note that freezing of the product within the meter cannot damage the meter.

1.3.1 Insulation

It is recommended that the pipework and insulation material be installed as in figure 10. The insulation can be Rubber, Foam, Glass Fibre or any other process suitable material. It should, however, be firmly fixed with no components such as straps or covers that can vibrate.

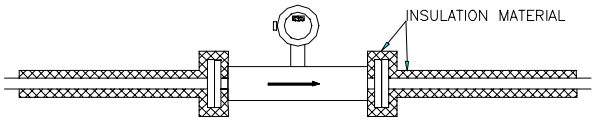


Figure 10
Insulation Principle

Notes:

1. Insulation Material: Rubber, Foam, Glass Fibre, or any other process suitable material.
2. Insulation must be firmly fixed to the pipework.

If especially desired by the customer, it is permissible to insulate the meter itself. If this is required, then the following guidelines should be followed.

The insulation must be firmly fixed to the meter with no components such as straps or covers that can vibrate (figure 11). DO NOT insulate converter (figure 12).

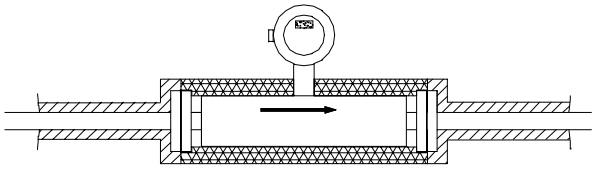


Figure 11

Important Note:

When insulating Ex meters, insulation must **not** rise above the square plate that connects the sensor and converter (figure 12).

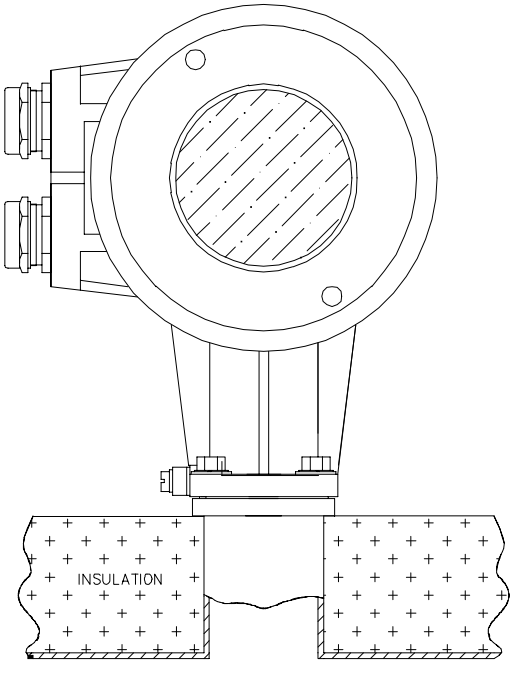


Figure 12

In addition, any heat tracing used (electrical or fluid) must **not** exceed 130°C for titanium meters (optional 150°C). For zirconium meters maximum temperature is 100°C. The Ex temperature classes are also different, see table below.

Ex Temperature Classes for Insulated/Heated Meters

Process Temperature	Temperature Class
65°C	T5
100°C	T4
130°C	T3
Optional 150°C	T3-T1

If remote meters are insulated (see figure 13), it is imperative that the insulation does not rise above the square plate mentioned above and a thermal insulation adapter must be purchased from Krohne and fitted as shown.

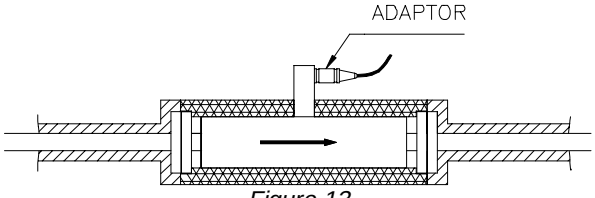


Figure 13

1.3.2 Electrical Trace Heating

The use of electrical heating tape is illustrated in figures 14,15,16 and 17. The use of self-limiting tape is ideal, but other types of electrical heating may be used. Any thermostat should be fitted to the adjacent pipework, if this is done it should be firmly fixed with no loose wires or connections that could vibrate. If only pipework and flanges are insulated, two turns of heating tape should be tightly applied to the flanges and covered in insulation as shown. All heating tapes should be tightly fixed with no areas that could vibrate. Between the flanges the heating tape should be secured to the converter neck, **but** insulated from it (figure 16) or run back to the first clamp and then in a loop to the opposite clamp (figure 17). Krohne can supply a list of electrical heating tape suppliers, if required. If the meter case is insulated then heating tape may be applied tightly under the insulation. It is recommended that the heating tape be applied axially and continuously taped down (figure 15).

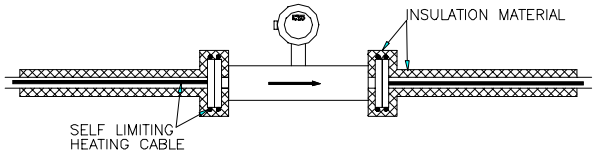


Figure 14

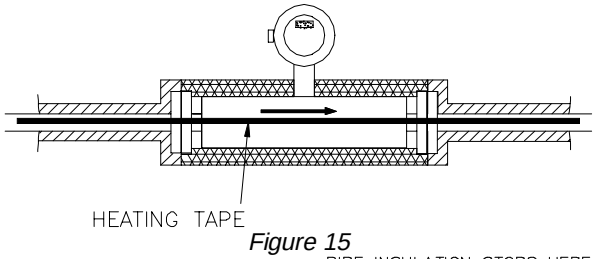


Figure 15

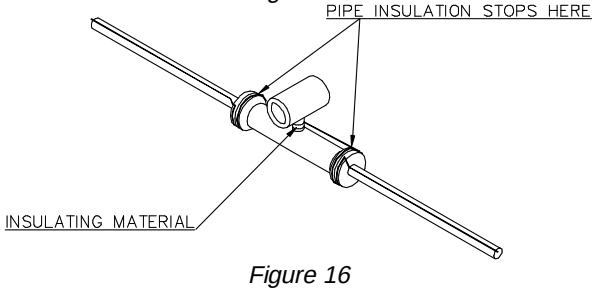


Figure 16

The converter must not be insulated or heated. For Ex meters refer to 'important note' in 'Insulation' section above.
In all cases, the installation factor should be monitored and maintained within the normal levels.

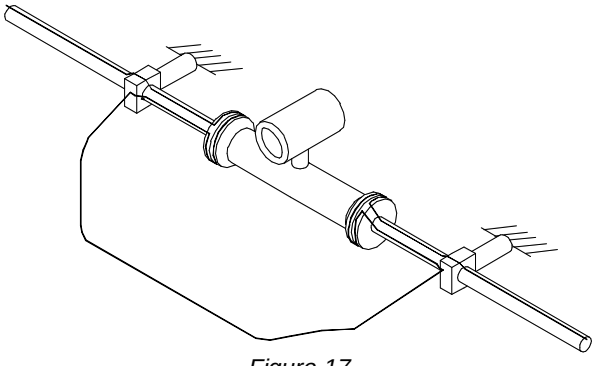


Figure 17

1.3.3 Hot Fluid or Steam Heating

Where pipelines are jacketed with concentric pipes, carrying a hot fluid such as water or steam, follow the following recommendations.
The jacket should be of as small a diameter as possible and the wall thickness should be as thin as possible (figure 18).

A radial gap between the process pipe and the inside of the jacket of 5-6mm is suitable.

The minimum clamping distance is increased (figure 18). The first clamp should be moved further away from the meter.

It is an advantage to avoid process pipework of a large diameter compared to the meter bore.

Krohne can provide further guidelines and dimensions of suitable pipes and jackets.

The jacket must be completely filled with no air pockets present.

Any clamps or supports must be applied at a distance greater than L.

Meter Size	L
10G+	10D
100G+	10D
300G+	10D
800G+	8D
1500G+	8D
3000G+	5D

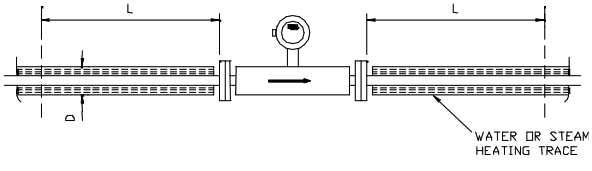


Figure18

Also available are special jacketed meters as shown in figure 19. These are also Ex approved. Remote jacketed meter must be fitted with an insulation adaptor shown in fig. 13.

Meter Size	L
10G+	10D
100G+	10D
300G+	10D
800G+	8D
1500G+	8D

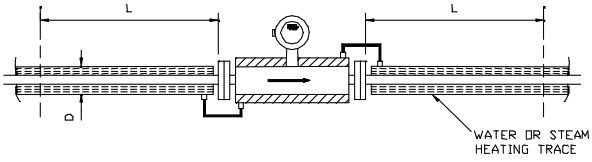


Figure 19

In all cases, the installation factor should be monitored and maintained within normal levels.

1.3.4 Heating Up From Cold

The proceeding insulation and heating instructions also apply in this case, together with the following notes:

The low thermal coupling between the Titanium tube and the flanges means that maintaining a G+ Meter at a desired temperature is straight forward as already described, however, heating from cold an uninsulated meter can be a lengthy process, particularly if the customer's product could be damaged by high rates of heat input at the flanges. The areas at each end of the meter can be heated from 20°C to 60°C in about 2 hours, but the centre of the meter can take 5 hours to reach this temperature particularly if the product has solidified. It is possible to speed this up if the meter is mounted vertically and a reduction of about an hour is possible, if the case is insulated. If the case is also heated, heating times are further cut.

The above comments assume that there is no flow through the meter. If there is flow through the meter then the desired temperature can be reached within a few minutes.

Another important fact to note, is that it is rarely necessary to fully melt all the product which has solidified in the meter, as it has been demonstrated that any 'plug' of product can be pushed through the meter by pumping pressures of less than 1 bar. Any 'plug' would be rapidly melted in the joining pipework. This fact is an important benefit of the single straight tube design and is not true of bent tube meters, or meters with flow dividers and multiple tubes.

Temperature Note

Most work in this subject has considered product temperature up to 80°C, if higher temperatures are required by the customer the proceeding guidelines still apply, but heat up from cold times will be extended.

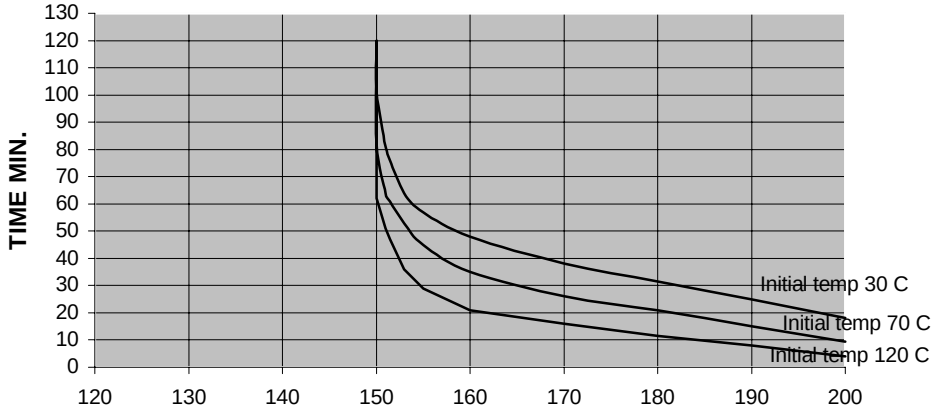
The G+ Meters have maximum operating temperatures, as follows:

Zirconium Tubes 100°C
Titanium Tubes 130°C
Titanium Tubes (to special order) 150°C

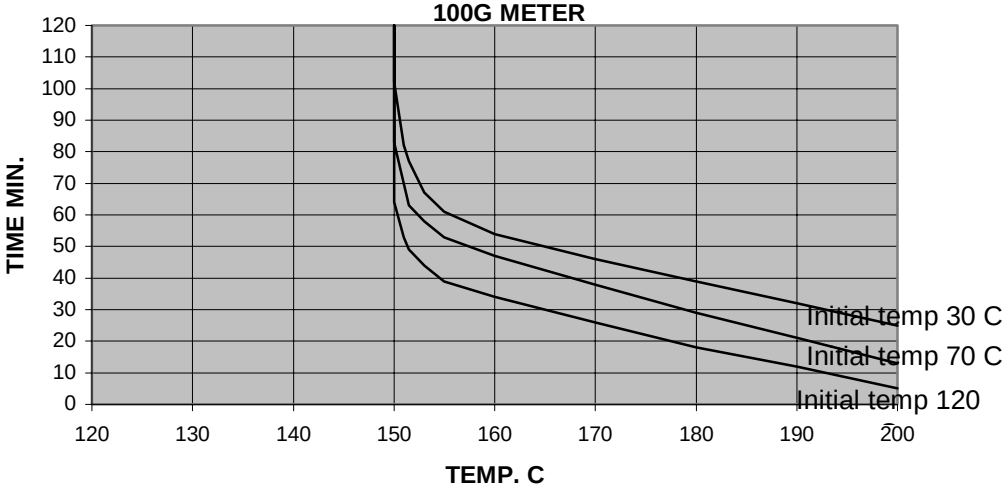
On Titanium tube meters, it is, however, possible to exceed 150°C up to an absolute maximum of 200°C, for short periods. The time is limited by the initial temperature and final temperature. To assess the time allowable, refer to figures 11,12 and 13, which cover the 10G+, 100G+ and 300G+ meters. For the 800G+ and 1500G+ refer to Krohne Ltd.

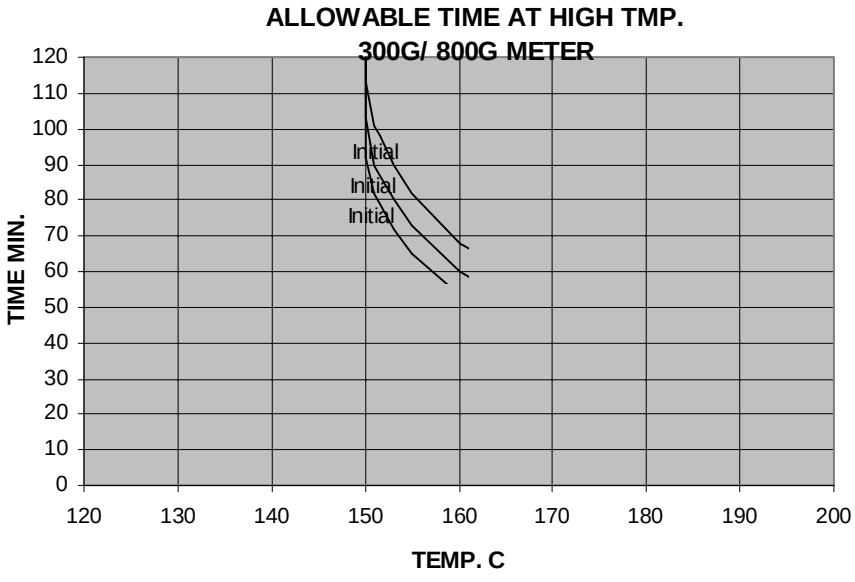
This does not apply to the 3000G+. These meters must not exceed 130°C. Zirconium tube meters must never exceed 100°C.

ALLOWABLE TIME AT HIGH TEMP .
10 G METER



ALLOWABLE TIME AT HIGH TEMP.
100G METER





2. Electrical installation

2.1 Location and connecting cables

Location

Do not expose the compact flow meter to direct sunlight. Install a sunshade if necessary.

Connecting cables

To conform to protection category requirements, observe the following recommendations:

– Fit blanking plug PG 16 and apply sealant to unused cable entries.
– Do not kink cables directly at cable entries.
– Provide water drip point (U bend in cable).
– Do not connect rigid conduit to cable entries.
– If cables are a tight fit, enlarge inside diameter of cable gland by removing the appropriate ring(s) from the seal.

2.2 Connection to power

Please ensure that the information about power given on the data plate corresponds to the locally available mains voltage.

– Note information given on the instrument data plate (voltage, frequency)!

– **Electrical connection in conformity with IEC 364** or equivalent national standard. Special regulations apply to installation in **hazardous areas**. Please refer to separate "Ex" installation instructions.

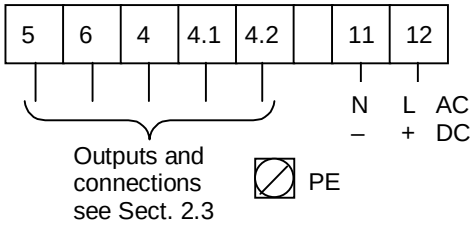
– The **PE protective ground conductor must** be connected to the separate U-clamp terminal in the terminal box of the signal converter.

– Do not cross or loop the **cables in the terminal box** of the signal converter. Use separate (PG or NPT) cable glands for power and output cables.

– Ensure that the **screw thread of the round cover** on the terminal box is well greased at all times.

NOTE: The grease used must be non-corrosive to aluminium; typically it must be resin- and acid-free.

– Protect **sealing ring** from damage.



Power and signal connections for MFC 085 K

2.3 Inputs and outputs

The table below shows the input/output connection for the converter. The exact configuration depends on which optional output modules were fitted in the factory.

Table of input/output connections

Trm. No.	Option 1 (Current, pulse, status output and control input)	Option 2* (2 current,NGI status output)
5	Common (-)	Common (-)
6	Current output (+)	Current output 1 (+)
4	Control input	Control input.
4.1	Pulse output	Current output 2 (+)
4.2	Status output (active)	Status output (passive)

* The inputs/outputs share a common signal ground that is galvanically isolated from ground (PE).

For the standard converter, the pulse output is passive and requires an external voltage source for operation. In addition, the signal may need protection from external electrical interference. The use of screened cables and a filter capacitor next to any counter is recommended. (Fig. a)

It is possible to connect the pulse output without using an external voltage supply. However to do this the function of the alarm output must be sacrificed. (Fig. b).
If the alarm output is used to power the pulse signal then the following settings **must** be made in the menus.

(i) Fct. 3.5.1 ALARM FUNCTION must be set to OFF

(ii) Fct. 3.5.2 ALARM ACTIVE LEVEL must be set to ACTIVE LOW.

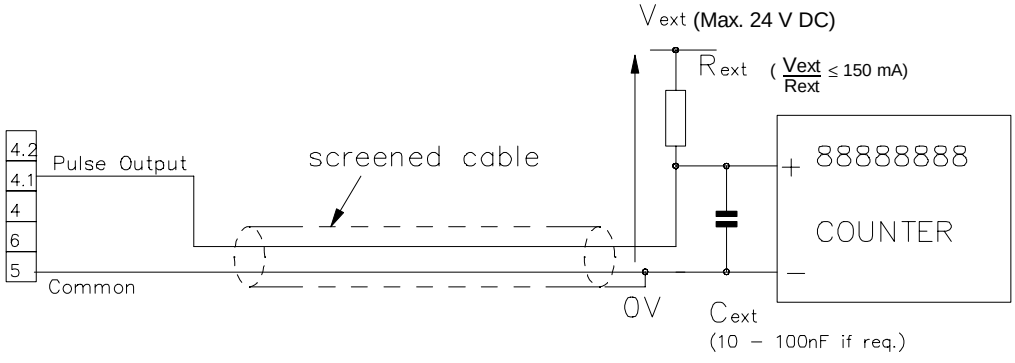


Fig. a Preferred connections to an external counter with separate power supply (Example). For correct wiring see table of Input/ output connections

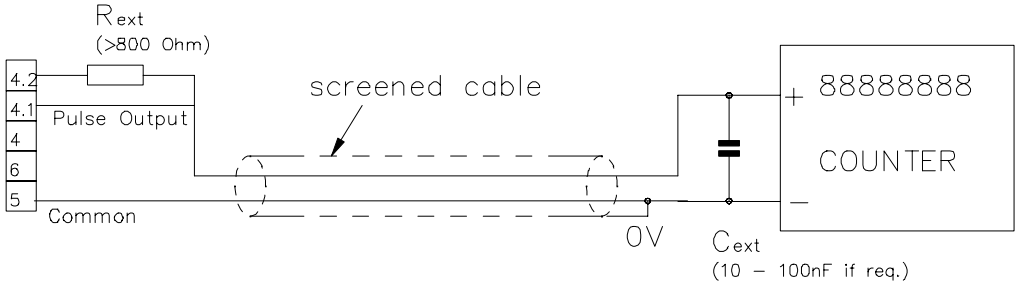


Fig. b Connection without external voltage source (Example). For correct wiring see table of Input/ output connection

Additional input/output options

Trm. No.	Option 4* (Current and RS485)	Option 5* (Current and Modbus)	Option 6 (1 Current, 1 Dual phase pulse output and control input)	Option C (2 current, pulse and control input)	Option D (3 current and pulse)	Option E (3 current and control input)	Option F (3 current and status output)
5	Common (-)	Common (-)	Common (-)	Common (-)	Common (-)	Common (-)	Common (-)
6	Current output 1 (+)	Current output 1 (+)	Current output 1 (+)	Current output (+)	Current output 1 (+)	Current output 1 (+)	Current output 1 (+)
4	TX/RX	TX/RX	Control Input	Current output 2 (+)	Current output 2 (+)	Current output 2 (+)	Current output 2 (+)
4.1	TX/RX	TX/RX	Pulse Output A	Control Input	Current output 3 (+)	Current output 3 (+)	Current output 3 (+)
4.2	+5V	+5V	Pulse Output B	Pulse Output	Pulse output	Control Input	status output (passive)

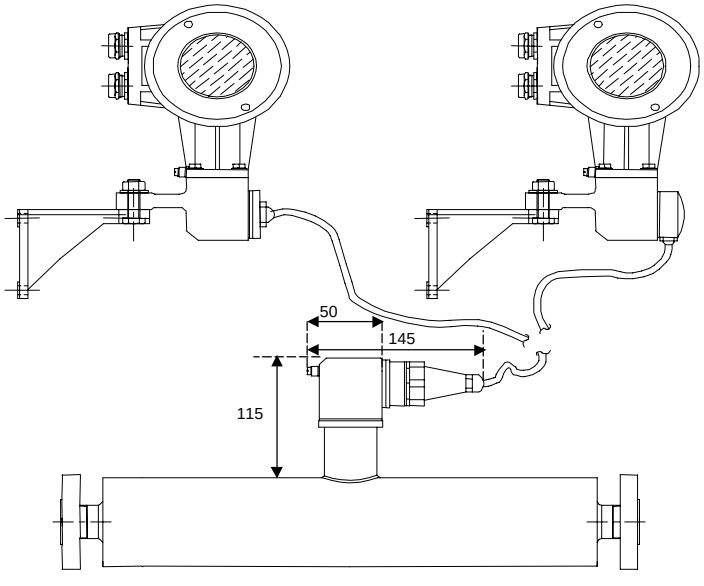
The pulse out alarm outputs where selected are passive.

* Refer to separate RS 485 or Modbus manual

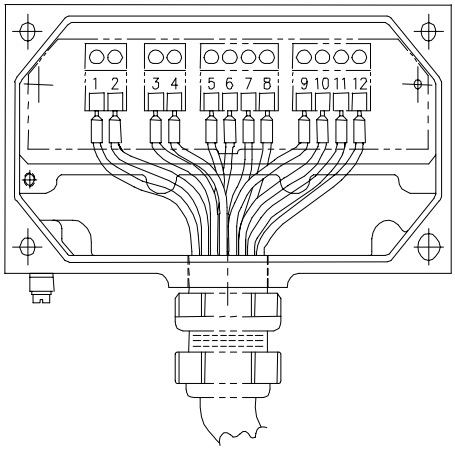
2.4 Connection of remote meters

The G meter can be supplied as remote meter with 5 m cable. Under no circumstances should the cable be cut shorter or joined to increase its length. The meter is calibrated with this 5m length. Any changes will influence the performance of the meter.

There are two different configurations of remote meter, on the first version the cable is fixed at the converter end and the second has a terminal junction box at the converter end.



The connection on the transducer end is done for both versions over a special connector. On the fixed version the connection on the converter side is fixed. The second option uses a junction box for the connection. Wiring is done according to the following figure. PG 16 or ¾" NPT adaptor are available with the junction box version to put the cable into flexible conduit.



TERMINAL No	COLOUR	SIGNAL
1	WHITE	DRIVE –
2	BLACK	DRIVE +
3	YELLOW	SCREEN
4	YELLOW	SCREEN
5	BLACK	–
6	RED	STRAIN
7	BLACK	TEMP/STRAIN
8	BLUE	TEMP
9	ORANGE	SENS B –
10	BLACK	SENS B +
11	GREEN	SENS A –
12	BLACK	SENS A +

3. Start-up

3.1 Factory Set Parameters

The mass flow meter leaves the factory ready to be used. All process data has been programmed according to the customer order. See factory programming sheet delivered with the flow meter.

When no process details were supplied at the time of order, the mass flow meter is programmed to a standard default set of values and functions.

The current and pulse outputs treat all flows as positive. The actual flow and quantity is thereby measured independent of the flow direction. The indicator will indicate a " – " or " + " in front of the flow rate.

These factory-set settings for current and pulse may cause an error under the following conditions: When the pump is stopped and a reverse flow is present, which is larger than the low flow cut-off or when totalizing should be indicated for both flow directions.

To avoid these possible problems:

a) Set flow mode (Fct. 3.1.8) to either flow > 0 or Flow < 0, so that reverse flows are ignored.
or
b) Increase Low Flow cut-off (Fct. 3.1.7) so that small reverse flows are ignored.
or
c) Set the alarm output (Fct. 3.5.1) to DIRECTION so that external equipment can differentiate between positive and negative flows.

3.2 Initial Start-up

- Please check that the power supply corresponds to the information supplied on the data plate.
- Switch on the power supply.
- On switch-on, the signal converter first carries out a self-test. The following sequence is displayed:

  TEST

  10 G **GX.XX**
  Primary Head Software Version

  STARTUP

  Mass flow will be displayed following a brief settling phase for the primary head.

  A minimum warm-up time of 30 minutes is recommended to ensure stable measurement operation.

- For stable and accurate mass flow results the following should be checked:
  a) The quality of the mechanical installation. See Sect. 1.2.2.
  b) A good zero point calibration should be done. See Sect. 3.4. Further information regarding zero point calibration can be found in Sect. 5.

3.3 Installation factor

The extensive self-diagnosis functions of the MFM 4085 also include a so-called installation factor. This factor indicates whether the flow meter has been correctly installed in the pipeline and whether the mounting supports have been fitted at defined points. For that reason, the installation factor must without fail be checked during the initial start-up phase. The installation factor can be checked by way of the keystroke combination as in Sect. 1.2.3.

If correctly installed, the value of the installation factor when the primary head is full of water should be as per table in section 1.2.3. If the figure is higher, the specified accuracy of the flow meter cannot be guaranteed. Please check the installation again on the basis of the installation information (Sect. 1.2). If necessary adjust clamping with the meter displaying the installation factor to obtain optimum performance.

3.4 Zero point adjustment

After installation adjust the zero point. To do this, the primary head must be completely filled with the liquid product **without gas or air inclusions**. This is best obtained by allowing the liquid product to flow through the primary head for approx. 2 minutes at a throughput rate of greater than 50% of rated flow. Subsequently ensure that flow comes to a complete stop in the primary head (see fig 10, Section 1.2) for setting the zero without interruption to product flow, use a bypass set-up as shown in fig. 11 (Section 1.2). For best results the zero adjustment should be performed with the front cover in place. To activate the calibration, use the bar magnet provided to operate the magnetic sensors on the display.

Now initiate zero adjustment by way of the following keystroke combination:

Start from measuring mode

Key	Display line 1	line 2
→	Fct. (1).0	OPERATOR
2x→	Fct. 1.1.(1)	ZERO SET
→		(MEASURE.VAL.)
↵		CALIB. (NO)
↑		CALIB. (YES)
↵	X.X	PERCENT
		ACCEPT (YES)
↵	Fct. 1.1.(1)	ZERO SET
3x↵		ACCEPT (YES)
↵		Display

Under certain conditions, it may not be possible to adjust the zero point:

– If the medium is in motion. Shut-off valves not tightly closed.
– If there are gaseous inclusions in the primary head. Flush the primary head and repeat the calibration.
– If resonant oscillations of the piping are interfering with the primary head. Check the clamping of the instrument.
– If there are active warning(s) in the status message list. (See section 4.6)

In such cases, the zero point adjustment procedure is automatically aborted and the following message is displayed for a short time:

ZERO.ERROR

Then the converter returns to the start of the function 1.1.1:

Fct. 1.1.1 ZERO SET

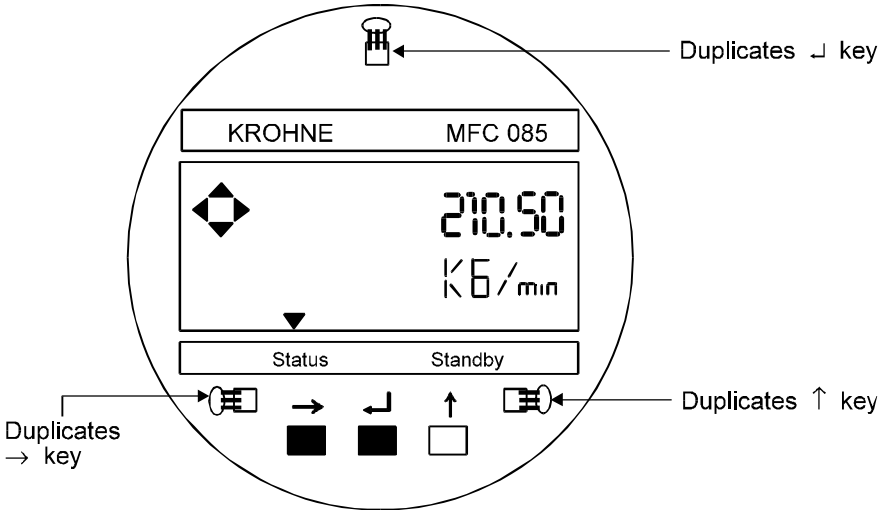
Further information on zero point adjustment is given in Section 5.

The CORIMASS MFM 4085 is ready to operate after zero has been adjusted.

All parameters have been factory-set in keeping with the data specified in your order. Detailed information for further setting of the signal converter will be found in Part B of the operating instructions.

3.5 Programming the converter with a bar magnet

- The converter can be programmed by means of the magnetic sensors mounted on the faceplate without removing the front lid.
- To do this, a bar magnet (standard supply) is used to activate the sensors by holding the magnet close to the glass window of the housing lid.
- These sensors then duplicate the functions of the push buttons.



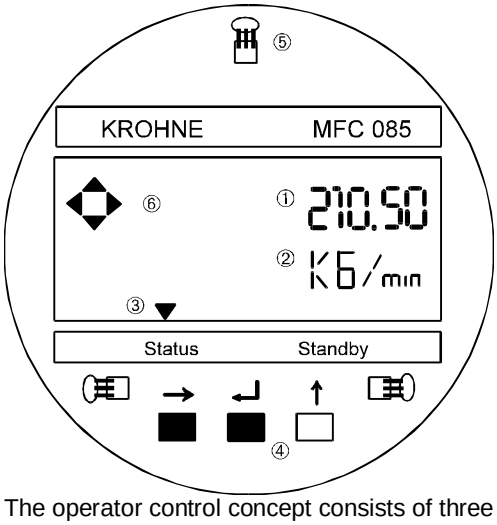
Part B MFC 085 Signal Converter

4. Operation of the Signal converter

4.1 Operating and check elements

The operating elements are accessible after removing the cover of the electronics section using the special wrench. The converter is also programmable with magnetic sensors and a bar magnet without removing the covers of the electronic housing.

Caution: Do not damage the screw thread and the gasket, never allow dirt to accumulate, and make sure they are well greased at all times.



① Display 1st (top) line
② Display 2nd (middle line
③ Display 3rd (bottom line: arrows (τ) to identify the state of the signal converter
– **Status** message indicator
– **Standby** mode
④ Keys for operator control of the signal converter.
⑤ Magnetic sensors to set the converter by means of a handheld bar magnet without opening the housing. Function of sensors same as keys ℘.
⑥ Compass field, signals actuation of a key.

The operator control concept consists of three levels (horizontal). See next page.

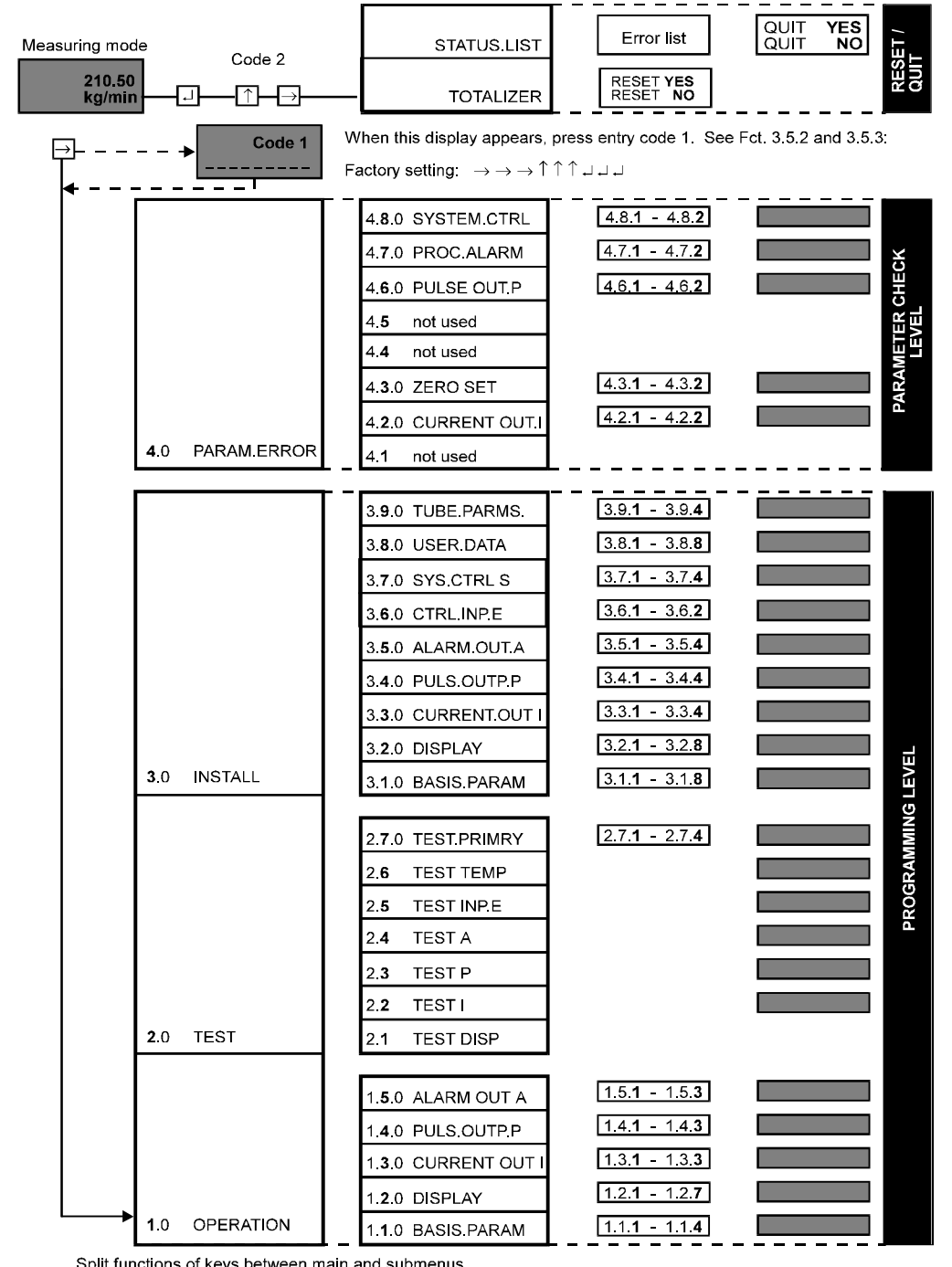
Setting level: This level is divided into three main menus:
Fct. 1.0 OPERATION: This menu contains only the most important parameters and functions of Menu 3 (install) to allow rapid changes to be made during the measurement mode.
Fct. 2.0 TEST: Test menu for checking the signal converter (displays, outputs, measuring range).
Fct. 3.0 INSTALL: All flow measurement- and flowmeter-specific parameters and functions can be set in this menu.

Parameter check level: **Fct. 4.0 PARAM.ERROR**: This level is not selectable.
After exiting from the "Setting level", the signal converter checks new data for plausibility. If an error is detected, the signal converter indicates PARAM.ERROR in Fct. 4.0. In this menu, all functions can be scanned and those changed that are not "plausible".

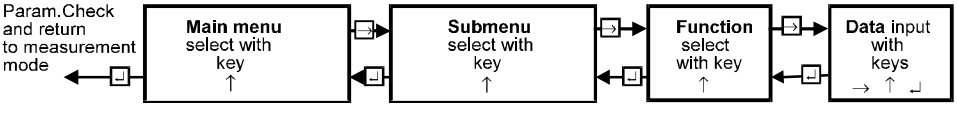
Reset/acknowledge level (Quit): This menu has two tasks and is selected via Entry Code 2 (↵ ↑ →)

1) Resetting of totalizer, provided that resetting is enabled under Fct. 3.8.5 ENABL.RESET, input YES.
2) Status message and acknowledgement (Quit) messages that have occurred since the last acknowledgement are indicated in a list. After elimination of the cause(s) and acknowledgement, these messages are deleted from the list.

4.2 Krohne Operating Concept



Split functions of keys between main and submenus.
The blinking part of the display (cursor) that may be changed is printed in bold.



4.3 Key functions

Function of the keys	
Cursor	The location of the cursor on the display is indicated by flashing characters. This could be a single digit when entering number; numeric sign (+ or -) ; measure-ment units (g,kg,t etc.); or any other text field. Throughout this manual the location of the cursor, in programming examples, will be indicated by parentheses ( ) around the flashing characters.
↑	**Select** or **Up Key.** This key changes the field/digit under the cursor. - Digit: Increase value by 1 for each key press. (0 follows 9). - Dec. pt. Move decimal point. **0000(.)0000** changes to **00000(.)000** - Menu Increase menu number by 1. i.e. **Fct. 1.(1).0** changes to **Fct. 1.(2).0** When the menu number reaches its maximum the next ↑ changes the number to 1. i.e. **Fct 1.(5).0** changes to **Fct 1.(1).0** - Text Change text field. i.e. ”YES” to ”NO” or ”g” to ”kg” to ”t” etc. - Sign Toggle ”+” to ”-”
→	**Cursor** or **Right Key.** This key moves the cursor onto the next field to be edited. (usually the next on the right). - Number Move cursor from 12(3).50 to 123(.)50 to 123.(5)0 - Text Move to next field. i.e. **(kg)/min** to **kg/(min)** - Menu Move to next menu column: i.e. from **Fct 1.(2).0** to **Fct. 1.2.(1)** **or** if the cursor is already in the rightmost column: invoke that menu function. i.e. from **Fct. 1.2.(1)** press → to edit MASS FLOW format.
↵	**Accept** or **Enter Key.**
	-Within a function Accept changes (if any) and exit the function. -Menu Move cursor to the next column on the left. i.e. from **Fct. 1.2.(1)** back to **Fct. 1.(2).0** If the cursor is already in the leftmost column then ↵ exits the menus. See next box: ”To terminate” .
Note:	If numerical values are set that are outside the permissible input range, the display shows the min. or max. . acceptable value. After pressing the ↵ the number may be corrected.

4.3.1 How to enter programming mode

To start:		
	Display	Comments
→ Press	Fct. 1.0 Operation **or**	If this appears, see next box: ”Function of the keys ” .
	CodE 1 ---------	If this appears on the display, set the 9-keystroke **Entry CodE 1** . Factory setting: → → → ↵ ↵ ↵ ↑ ↑ ↑
1^{st}- 8^{th}place (key)	CodE 1 *******-	Each keystroke acknowledged by " ∗ " in display.
9^{th} place (key)	Fct. 1.0 Operation	If this appears, see box: ”Function of the keys ” below.
	CodE 1 (9 alpha characters)	A wrong Entry CodE 1 was keyed in. Press any key and set the correct 9-keystroke

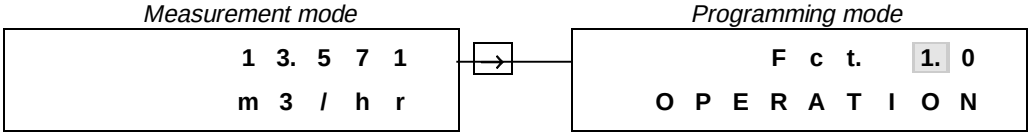
4.3.2 How to terminate Programming mode

To terminate:		
Press ↵ 1-3 times	Fct (1).0 OPERATOR	Press ↵ 1-3 times until the cursor is under the extreme left menu column. (Fct. 1.0 , 2.0 or 3.0)
↵	+ 12.345 kg/min **or**	If no changes have been made to the system’s configuration return directly to the measurement mode.
	(ACCEPT YES)	Changes have been detected. Press ↵ to accept these changes. **or**
↑	(ACCEPT NO)	Press ↵ to reject changes and return directly to measurement mode. **or**
↑	(GO BACK)	Press ↵ to return to the menus, Fct. 1.(0) to make further changes
↵	PARAM.CHECK	Assuming ACCEPT YES was selected, the system now checks the new setting for errors.
After 1-2 sec.	+ 12.345 kg/min	No errors detected. Return to measurement mode.
	Fct. (4).0 PARAM.ERROR	**or** Errors were detected. The sub-menus of 4.0 will guide the operator to those functions where problems have been identified.

Examples

The cursor (flashing part of display) has a grey background in the following examples:

To start programming



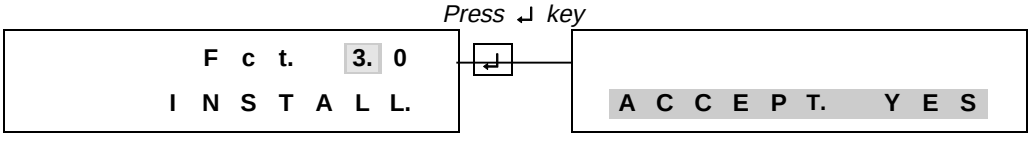
PLEASE NOTE: When "**yes**" is set under **Fct. 3.8.2 ENTRY CODE**, the following will appear in the display after pressing the → key:

CodE 1 - - - - - - - - -.

The 9-stroke entry code must now be entered.
Factory setting: → → → ↵ ↵ ↵ ↑ ↑ ↑.
Each keystroke is acknowledged by an " ∗ " in the display.

To terminate programming

Press ↵ key repeatedly until one of the following menus are displayed:
Fct. 1.0 OPERATION, Fct. 2.0 TEST or Fct. 3.0 INSTALL



To accept the new parameters
Press ↵ to confirm.
"PARAM.CHECK" will appear in the display.

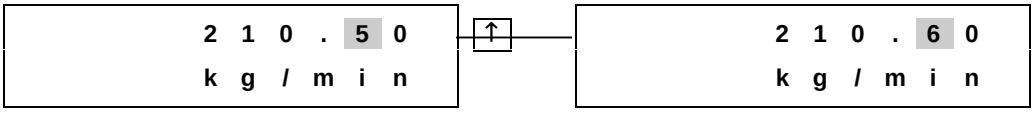
The measuring mode will continue after a few seconds with the new parameters, when no errors are detected.

When an error is detected the display will indicate "Fct. 4.0 PARAM.ERROR". The error parameters can be called up in this menu and corrected.

New parameters not to be accepted
When the new parameters are not to be accepted, the following keystrokes should be executed: Press ↑ key. The display will show "ACCEPT NO". When the ↵ key is then pressed, the instrument will return to the measurement mode using the old parameters.

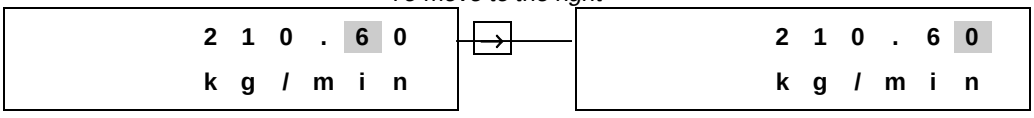
To change numeric values

Increase numeric value



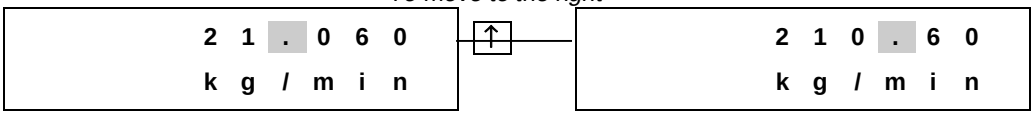
To move the cursor (flashing digit)

To move to the right



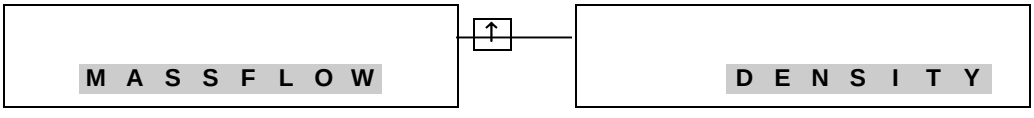
To move the decimal point

To move to the right



To change the text

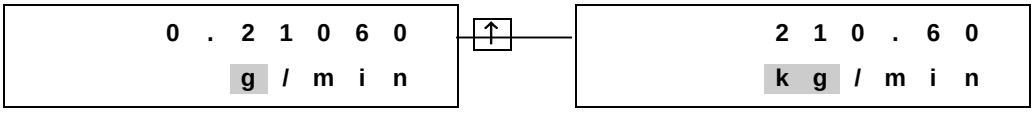
Select next text



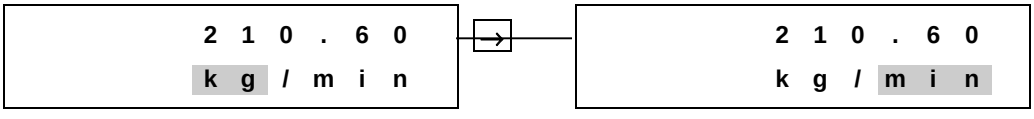
To change the units

Numeric values automatically converted

Select new unit

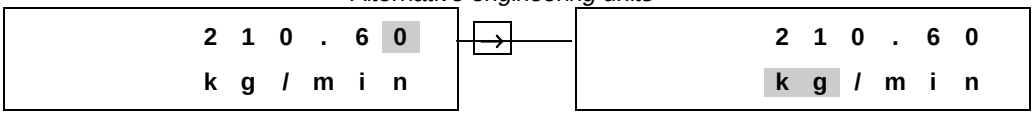


Alternative time unit

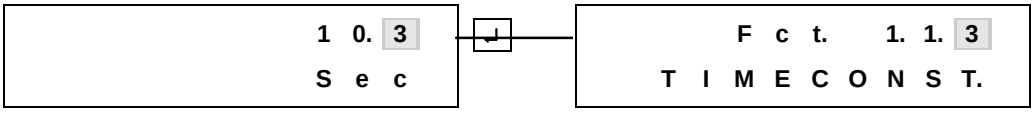


To change from numeric values back to text

Alternative engineering units



Return to function display



4.4 Table of programmable functions

Fct. No.	Text	Description and settings
1.0	**OPERATION**	**Main menu 1.0 Operation**
1.1.0	BASIS.PARAM	**Submenu 1.1.0 Base data**
1.1.1	ZERO SET	**Zero adjustment.** See Fct. 3.1.1
1.1.2	L.F. CUTOFF	**Low flow cutoff.** See Fct. 3.1.2
1.1.3	TIME CONST.	**Signal converter time constant.** See Fct. 3.1.3
1.1.4	STANDBY	**Switching between measuring operation and standby**. See Fct. 3.1.4
1.2.0	DISPLAY	**Submenu 1.2.0 Display**
1.2.1	CYCL.DISP	**Switching between steady display and cyclic display**
1.2.2	STATUS MSG	**Selects which status messages should be displayed**
1.2.3	MASS FLOW	**Unit for mass flow**. See Fct. 3.2.3
1.2.4	MASS TOTAL	**Unit for mass total.** See Fct. 3.2.4
1.2.5	DENSITY	**Unit for density.** see Fct. 3.2.5
1.2.6	TEMPERAT	**Unit for temperature.** see Fct. 3.2.6
1.2.7	VOLUME.FLOW	**Unit for volume flow.** See Fct. 3.2.7
1.2.8	VOLUME.TOTAL	**Unit for volume total.** See Fct. 3.2.8
1.2.9	CONC.MEAS	**Parameters for concentration measurement.** See separate concentration measurement instruction manual
1.2.10	CONC.MEAS	See 1.2.9
1.2.11	CONC.MEAS	See 1.2.9
1.3.0	CUR.OUTP. I	**Submenu 1.3.0 Current output I.**
1.3.1	FUNCTION I	**Function current output I.** see Fct. 3.3.1
1.3.2	MIN.VALUE*	**Minimum range for current output I** see Fct. 3.3.3
1.3.3	MAX.VALUE*	**Maximum range for current output I** see Fct. 3.3.4
1.4.0	PULS.OUTP. P	**Submenu 1.4.0 Pulse,** frequency output **P.** see Fct. 3.4.0
1.4.1	FUNCTION P	**Select. Parameter to be totalized**
1.4.2	PULSE/MASS *	**Select. Pulse per unit**
1.4.3	PULSE WIDTH *	**Select pulse width in milliseconds**
1.5.0	ALARM.OUT.A	**Submenu 1.5.0 Process alarm output A.** see Fct. 3.5.0
1.5.1	FUNCTION A	**Select alarm function.** See Fct. 3.5.1
1.5.2	ACTIV.LEVEL	**Select. active high or low.** See Fct. 3.5.2

* Exact display depends on selected function. See sub-menu 3.3.0

Fct. No.	Text	Description and settings
2.0	TEST	**Main Menu 2.0. Test functions**
2.1	TEST DISP.	**Carry out display test.** Start with the key → (Duration of test approx. 30 sec.). Stop test at any time with the ↵ key.
2.2	TEST I	**Test current output I** * SURE (NO). Use the ↑ key to select YES, then press ↵. * 0 mA will be output from the converter. Use the ↑ key to select test currents from the list below. 0 mA, 2 mA, 4 mA, 10 mA, 16mA, 20 mA, 22 mA. To exit test mode, press the ↵ key at any time.
2.3	TEST P	**Test frequency output P** * SURE (NO). Use the ↑ key to select YES ,then press ↵ key.
2.3.1	FREQUENCY	* LEVEL LOW 0 volt DC level will be output from the converter. Use the ↑ key to select test signals from the list below. * LEVEL HIGH (+ V volts dc) * 1 Hz * 100 Hz * 10 Hz *1000 Hz
2.3.2	TEST PULSE	* Test Pulse Use the ↑ key to select desired pulse width from the list below: * 0.4 mSec * 100.0 mSec * 1.0 mSec * 500.0 mSec * 10.0 mSec Then press ↵. The system now sends pulses of the required width. To stop the test press ↵ twice.
2.4	TEST A	**Test alarm output** * SURE (NO). Use the ↑ key to select YES, then press ↵ * LEVEL LOW. 0 Volts is output on the alarm terminal. Press the ↑ key to switch output to: * LEVEL HIGH . +24V dc is output on the alarm terminal. To exit test mode, press the ↵ key at any time.
2.5	TEST INP.E	**Test control input** The actual input level, HI or LO, and the selected functions are displayed see Fct. 3.6.1 End test by pressing the ↵ key.
2.6	TEST TEMP.	**Test temperature and strain gauge** Start with the → key. The temperature in °C is displayed. Use the ↑ key to display the temperature in °F. Use the ↑ key again to display strain. End the test by pressing ↵ key
2.7.0	TEST.PRIMRY.	**Sub menu 2.7.0 Test primary head values.**
2.7.1	SENSOR A	**Monitor the amplitudes of sensor A and B as percentage of their max. value. (80% is ideal)** Start test with the → key. End the test with the ↵ key.
2.7.2	SENSOR B	
2.7.3	FREQUENCY	**Monitor the primary head frequency.** Start test with the → key. End the test with the ↵ key.
2.7.4	INSTAL.FACT.	**Monitor the primary head's drive level.** Start test with the → key. End test with the ↵ key.

Fct. No.	Text	Description and settings
3.0	INSTALL.	**Main menu 3.0 Installation**
3.1.0	BASIS.PARAM	**Submenu 3.1.0 Base data**
3.1.1	ZERO SET	**Zero adjustment.** Use the ↑ key to select between MEASURE.VAL. and SET VALUE then press the ↵ key. * MEAS.VALUE (ensure "ZERO" flow in the pipeline) 1) Select: CALIB.YES or NO 2) If YES: Calibration (approx. 20 sec. duration) Display: Actual flow rate as percent of the maximum rated flow for the primary head. ($Q_{100\%}$) 3) Select: ACCEPT YES or NO * SET.VALUE Direct input of a zero flow offset. Units: As selected by Fct. 1.2.1 or 3.2.1
3.1.2	L.F. CUTOFF	**Low flow cutoff** Value: 0 to 10 percent of nominal flow
3.1.3	TIME CONST.	**Time constant for output of measured values** Range 0.5 ... 20 sec. (Option: 0,2 ... 20 sec.)
3.1.4	STANDBY	**Use the key ↑ to switch between three modes of operation**, then press ↵: * MEASURE * STANDBY (tube vibrating, Mass Flow set to zero) * STOP (tube drive stopped) Note: It is not possible to switch directly from STOP to STANDBY.
3.1.5	PRIMRY.TYPE	**Type of the primary head **** Using the ↑ key select the primary head type that is connected to the converter: * 10 G * 800 G *100 G *1500 G *300 G *3000 G Then press → key to select material field, then ↑ key to select: * T * T+ * Z * Z+ as per the data plate
3.1.6	CF5	**Primary head constant. **** Displays the primary head constant as stamped on the primary head's data plate. (Password protected)
3.1.7	FLOW DIR.	**Define direction of flow.** Select either FORWARD or BACKWARD
3.1.8	FLOW MODE	**Define whether bi-directional or uni-directional flow is expected.** Select either: * FLOW > 0 (Ignore negative flows) * FLOW < 0 (Ignore positive flows) * FLOW +/- (Allow positive and negative flows)

** These menus are protected by the Code 4 password, see Fct. 3.8.8

Fct. No.	Text	Description and settings
3.2.0	DISPLAY	**Submenu 3.2.0 DISPLAY**
3.2.1	CYCL. DISP.	**Cyclic display required?** Setting NO or YES. If YES is selected then in measurement mode the display will switch from Mass Flow to Density to Total to Temperature every 4 seconds.
3.2.2	STATUS MSG.	**Which status messages to be displayed ?** * NO MESSAGE (= no warning messages in main display, warning system ignores status of outputs) * PRIMRY.HEAD (= light warning messages in the main display, warning system ignores status of outputs) * OUTPUT (= output saturation/alarm status messages in the main display) * ALL MSG. (= all warning messages in the main display. System responds to output status)
3.2.3	MASS FLOW	**Units and format for mass flow display** * g, kg, t, oz, lb per s, min, h, d * Number of digits after the decimal point selectable.
3.2.4	MASS TOTAL	**Units and format for totaliser** * g, kg, t, oz, lb * Number of digits after the decimal point selectable.
3.2.5	DENSITY	**Units and format for density** * g, kg, t, per cm^3, dm^3, litre, m^3 or oz, lb per in^3 ,ft^3 , USgal, gallon or SG (Specific Gravity relative to water at 20°C) * Number of digits after the decimal point selectable.
3.2.6	TEMPERAT.	**Units for temperature** * °C or °F * Format fixed at 1 decimal place
3.2.7	VOLUME.FLOW	**Units and format for volume flow** * Select OFF (no volume flow display) or * cm^3, dm^3, litre, m^3 , in^3 ,ft^3 , USgal, or gallon per * s, min, hr, day * Number of digits after the decimal point selectable.
3.2.8	VOL.TOTAL	Units and format for totalizer cm^3, dm^3, liter, m^3, $inch^3$, ft^3, US gal, gallon.
3.2.9 to 3.2.11		Concentration menu when installed. Please refer to separate Concentration instruction manual

Fct. No.	Text	Description and settings
3.3.0	CUR.OUTP. I	**Submenu Current output I** For systems with 2 or more current outputs see Sect. 4.7
3.3.1	FUNCTION I	**Function current output I** * OFF (O/P current = 0 mA) * MASS FLOW (Mass flow in range MIN [Fct. 3.3.3] to MAX [Fct. 3.3.4] output as current in range [Fct 3.3.2] 0/4-20mA) * DENSITY (Density in range MIN [Fct. 3.3.3] to MAX [Fct. 3.3.4] output as current in range [Fct 3.3.2] 0/4-20 mA) * TEMPERATUR (Temperature in range MIN [Fct. 3.3.3] to MAX [Fct. 3.3.4] output as current in range [Fct 3.3.2] 0/4-20 mA) * VOL.FLOW (Volume flow in range MIN [Fct. 3.3.3] to MAX [Fct. 3.3.4] output as current in range [Fct 3.3.2] 0/4-20 mA) SOLUTE.FLOW CONC. BY MASS CONC.BY } Concentration measurement functions available if installed (see sep. instruction manual). * DIRECTION (Negative flow gives current of 0/4 mA, positive flow gives current of 20 mA)
3.3.2	RANGE I	**Range for current output I:** Select from the following by pressing ↑ key and then ↵ key * 0-20 mA * 4-20 mA * 0-20/22 mA (O/P = 22 mA when error detected) * 2/4-20 mA (O/P = 2 mA when error detected) * 3.5/4-20 mA (O/P = 3.5 mA when error detected)
3.3.3 or or or or or	MIN.VALUE MIN. FLOW, MIN. DENSITY MIN. TEMP. MIN V.FLOW MIN.CONC.	**Value of measured quantity** as set by Fct. 3.3.1 that corresponds to the minimum output current (0 or 4 mA as set by 3.3.2) Menu not available if Function 3.3.1 is set to OFF or DIRECTION
3.3.4 or or or or or	MAX.VALUE MAX. FLOW, MAX. DENSITY, MAX TEMP MAX V.FLOW MAX.CONC	**Value of measured quantity** as set by Fct. 3.3.1 that corresponds to an output current of 20 mA Menu not available if Function 3.3.1 is set to OFF or DIRECTION

Fct. No.	Text	Description and settings
3.4.0	PULS.OUTP. P	**Submenu 3.4.0 Frequency output P**
3.4.1	FUNCTION P	**Function frequency output P** * OFF (Output = 0V DC) * MASS FLOW (Frequency output 0 to MAX Freq. Hz = Mass Flow in range: MIN. FLOW to MAX FLOW as set in Fct. 3.4.3 and 3.4.4) * MASS TOTAL(1 pulse = fixed mass as set in Fct 3.4.2) * DENSITY (Frequency output 0 to MAX Freq. Hz = Density in range: MIN.DENSITY to MAX.DENSITY as set in Fct. 3.4.3 and 3.4.4) * TEMPERAT. (Frequency output 0 to MAX Freq. Hz = Temperature in range: MIN. TEMP to MAX. TEMP as set in Fct. 3.4.3 and 3.4.4) * VOLUME.FLOW(Frequency output 0 to MAX Freq. Hz = Volume flow in range: MIN. V.FLOW to MAX. V.FLOW as set in Fct. 3.4.3 and Fct. 3.4.4) * VOL.TOTAL(1 pulse = fixed volume as set in Fct 3.4.2) SOLUTE.FLOW SOLUTE.FLOW CONC.BY.MASS CON:BY:VOLUME } Concentration parameters if option installed. See separate instruction manual. * DIRECTION (Negative flow gives output of 0 volts DC, Positive flow gives output of +V volts DC)
3.4.2 or or	PULSE/MASS PULSE/VOL. PULSE/TIME	**Mass per pulse value** for function TOTAL MASS **Volume per pulse value** for function VOL. TOTAL **Maximum frequency value** for functions MASS FLOW, DENSITY, TEMPERATUR and VOLUME.FLOW or CONC.OPTIONS. Not accessible for functions OFF and DIRECTION.
3.4.3 or or or or or or	MIN.VALUE MIN. FLOW, MIN. DENSITY, MIN. TEMP. MIN. V.FLOW CONC.OPTIONS PULSE.WIDTH	**Value of measured quantity that corresponds to 0 Hz output** For functions MASS TOTAL, VOL.TOTAL OR SOL.TOTAL. Not accessible for functions OFF and DIRECTIONS
3.4.4 or or or or or or	Full Scale MAX. FLOW, MAX. DENSITY MAX TEMP. MAX V.FLOW CONC.OPTIONS	**Value of measured quantity that corresponds to Max. Frequency** Not accessible for functions OFF, DIRECTION, TOTAL MASS TOTAL, or VOL. TOTAL

Fct. No.	Text	Description and settings
3.5.0	ALARM.OUT.A	**Sub menu 3.5.0 Process alarm output**
3.5.1	FUNCTION A	**Function for alarm output P** * OFF (Output goes to its inactive state) * MASS FLOW (Alarm active if mass flow goes outside limits as set in Fcts. 3.5.3 and 3.5.4) * MASS TOTAL (Alarm active if totaliser goes outside limits as set in Fcts. 3.5.3 and 3.5.4) * DENSITY (Alarm active if density goes outside limits as set in Fcts. 3.5.3 and 3.5.4) * TEMPERAT. (Alarm active if temperature goes outside limits as set in Fcts. 3.5.3 and 3.5.4) * VOLUME.FLOW (Alarm active if volume flow go outside limits as set in Fcts. 3.5.3 and 3.5.4) * VOL.TOTAL (Alarm active ... Solute flow Conc. by mass Conc. by volume } Concentration option if installed. See separate instruction manual * I 1.SAT (Alarm active if value output on current output exceeds the range as set in Fct. 3.3.3 and 3.3.4) * P 1.SAT (Alarm active if value output on pulse output is either: > 1.3 x Max Limit as set in Fct 3.3.4 or < Min Limit as set in Fct 3.3.3 * ANY O/P.SAT (Alarm active if value output on either current or pulse output exceeds the selected ranges) * SEVERE ERR. (Output active if a severe error is detected) * ALL MSG. (Output active if any warnings occur) * DIRECTION (Output active for positive flows, inactive for negative flows)
3.5.2	ACTIV.LEVEL	**Select the desired voltage level for the active state** * ACTIVE.HIGH (24 V dc) * ACTIVE LOW (0 V dc)
3.5.3	MIN. LIMIT or	**Minimum allowable value for functions** TOTAL MASS, MASS FLOW, DENSITY, TEMPERATUR and VOLUME.FLOW Units: depend on function but will correspond to those set in Fcts. 3.2.1 to 3.2.5 Not accessible for all other functions
3.5.4	MAX. LIMIT. or	**Maximum allowable value for functions** MASS TOTAL, MASS FLOW, DENSITY, TEMPERATUR and VOLUME.FLOW Units: depend on function but will correspond to those set in Fcts. 3.2.1 and 3.2.5 Not accessible for all other functions

Fct. No.	Text	Description and settings
3.6.0	CTRL.INP.E	**Submenu 3.6.0 Control input**
3.6.1	FUNCTION E	**Function of the control input** * OFF (control input inactive) * STANDBY (When active converter switches to STANDBY) * ZERO SET (Zero calibration triggered on the transition from inactive to active on the control input) * RESET TOTAL (Totaliser reset to zero on the transition from inactive to active on the control input) * CLEAR. MSG. (Status warnings cleared on the transition from inactive to active on the control input)
3.6.2	ACTIV.LEVEL	**Set the desired voltage level for the input to be active** * ACTIVE LOW (0 to 2 V) * ACTIVE.HIGH (4 to 24 V)
3.7.0	SYS.CTRL S	**Submenu 3.7.0 System control**
3.7.1	FUNCTION S	**Function for system control** * OFF (System control inactive) * FLOW = OFF (Mass flow readings forced to zero, totaliser frozen) * FLOW = 0/RST. (Mass flow readings forced to zero, totaliser frozen while active but reset to zero as condition becomes inactive. Not available with Custody Transfer Protection) * OUTPUTS OFF (Forces all outputs to their OFF states)
3.7.2	REFERENCE	**Condition for triggering the above function** * DENSITY (Function is triggered if density goes outside Max or Min limits as set in Fcts 3.7.3 and 3.7.4) * TEMPERATUR (Function is triggered if temperature goes outside Max or Min limits as set in Fct 3.7.3 and 3.7.4) Function not available with Custody Transfer Protection.
3.7.3	MIN. LIMIT.	**Minimum allowable value of temperature or density selected in Fct. 3.7.2** Units: depend on function but will correspond to those set in Fct. 3.2.1 and 3.2.5 Function not available with Custody Transfer Protection.
3.7.4	MAX. LIMIT.	**Maximum allowable value of temperature or density selected in Fct. 3.7.2** Units: depend on function but will correspond to those set in Fct. 3.2.1 and 3.2.5 Function not available with Custody Transfer Protection.

Fct. No.	Text	Description and settings
3.8.0	USER DATA	**Submenu 3.8.0 User data**
3.8.1	LANGUAGE	**Language for display text** * GB/USA (= English) * F (= French) * D (= German)
3.8.2	ENTRY.CODE1	**Entry code for accessing menus required?** * NO (Entry to menus with the → key only) * YES(Entry with → key and 9-keystroke code see Fct 3.8.3)
3.8.3	CODE 1	**Set Code 1** (Fct. 3.8.2 must be set to YES otherwise this function is not available) * Factory setting: → → → ↵ ↵ ↵ ↑ ↑ ↑ * If a different code is required: press any 9-keystroke combination and then press the same key combination again. Each keystroke is acknowledged by "*". CODE WRONG (incorrect entry) appears if 1st and 2nd entries are not the same. Press ↵ then → keys and repeat the procedure.
3.8.4	LOCATION	**Tag name setting** (measuring point number) Required only for flow meters using the MIC 500 Hand Held Communicator (HHC), connected to current output).. Factory setting: "MFC 085" Characters assignable to each place: A...Z / 0...9 / + / - / * / = / // (> = blank character)
3.8.5	ENABL. RESET	**Allow totaliser reset from the RESET/ACKNOWLEDGE menu or with Control.Input E** Select : NO/YES
3.8.6	CSTDY CODE 3	**Custody transfer required?** The function is protected by the **CODE E** password. After pressing the → key enter a 9-keystroke password. If incorrect, 9 characters are displayed which can be decoded in the factory, otherwise select: * NO (No protection) * YES (Custody Transfer Protection required)
3.8.7	CODE 3	**CodE E setting** (9 characters). (If custody transfer is active then this function is unavailable) * Factory setting: ↵ → ↑ ↵ ↑ → ↵ → ↑ * If a different code is required, press any 9-keystroke combination and then press the same key combination again. Each keystroke is acknowledged by "*". **CODE WRONG** appears if 1st and 2nd entries are not the same. Press ↵ then → keys and repeat the procedure.
3.8.8	PARAM.CODE 4	Extra code ↵ ↑ to allow subsequent access to Menus: Fct. 3.1.5 Fct. 3.1.6 Fct. 3.9.3 Fct. 3.9.4

Fct. No.	Text	Description and settings
3.9.0	TUBE PARAMS	**Submenu 3.9.0 primary head specific parameters** Password protected, see Fct. 3.8.8
3.9.1	CF1	**Density coefficient 1** Input the value stamped on the primary head's data plate or perform on site calibration as described in Sect. 5.12.
3.9.2	CF2	**Density coefficient 2** Input the value stamped on the primary head's data plate or perform on site calibration as described in Sect. 5.12.
3.9.3	CF3	* **Reference strain** Displays the value stamped on the primary head's data plate.
3.9.4	CF4	* **Reference temperature** Displays the value stamped on the primary head's data plate.
3.9.5	CF5	***Primary head constant** Displays the value stamped on the primary head's data plate.
3.9.6	DSS CF6	**Density strain slope** Displays the value which is mentioned on the cal. Sheet
3.9.7	DTS CF 7	**Density temperature slope** Displays the value which is mentioned on the cal. Sheet
3.9.8	FSS CF8	**Slope strain** Displays the value which is mentioned on the cal. Sheet
3.9.9	FTS CF9	**Slope temperature** Displays the value which is mentioned on the cal. Sheet
3.9.10	D.REF.HIGH	**Density adjustment, High Point**
3.9.11	D.REF.LOW	**Density adjustment, Low Point**
3.10.0	CONC.MEAS	**Concentration measurement option when installed**
3.10.1	SOLUTE R20	See separate Concentration instruction manual
3.10.2	SOLUTE K1	See separate Concentration instruction manual
3.10.3	SOLUTE K2	See separate Concentration instruction manual
3.10.4	LIQUID	See separate Concentration instruction manual
3.10.5	LIQUIDR20	See separate Concentration instruction manual
3.10.6	LIQUID K1	See separate Concentration instruction manual
3.10.7	LIQUID K2	See separate Concentration instruction manual
3.11.0	SERIAL I/O	RS485 or Modbus option, if installed
3.11.1	PROTOCOL	See separate RS485 or Modbus instruction manual
3.11.2	ADDRESS	See separate RS485 or Modbus instruction manual
3.11.3	BAUDRATE	As per 3.11.1

* Only accessible if allowed through password in Fct. 3.8.8.

Fct. No.	Text	Description and settings
4.0	PARAM.ERROR	**Main Menu 4.0** Parameter error
4.1	Not Used	
4.2.0	CUR.OUTP.I	**Range settings incorrect** LOW SCALE ≥ FULL SCALE
4.2.1	LOW SCALE	**Low scale range for current output I** see Fct. 3.3.3
4.2.2	FULL SCALE	**Full scale range for current output I** see Fct. 3.3.4
4.3.0	ZERO	**Zero calibration incorrect.** **The measured zero offset must be less than ±10 %** **of the primary head's full scale flow rating.**
4.3.1	ZERO SET	**Zero calibration** see Fct. 3.1.7
4.3.2	PRIMRY.TYPE	Type of primary head see Fct. 3.1.5
4.4	Not Used	
4.5	Not Used	
4.6.0	PULS.OUTP. P	**Range setting incorrect** LOW SCALE ≥ FULL SCALE
4.6.1	LOW SCALE	**Low scale range for pulse output** see Fct. 3.4.3
4.6.2	FULL SCALE	**Full scale range for pulse output** see Fct. 3.4.4
4.7.0	PROC. ALARM	**Minimum and maximum limits incorrect** MIN.LIMIT > 96 % of MAX.LIMIT
4.7.1	MIN.LIMIT	**Minimum limit for range checking** see Fct. 3.5.3
4.7.2	MAX.LIMIT	**Maximum limit for range checking** see Fct. 3.5.4
4.8.0	SYS.CTRL.S	**Minimum and maximum limits incorrect** MIN.LIMIT > 96 % of MAX.LIMIT
4.8.1	MIN. LIMIT	**Minimum limit for condition checking** see Fct. 3.7.3
4.8.2	MAX. LIMIT	**Maximum limit for condition checking** see Fct. 3.7.4

4.5 Reset / Quit Menu - Totalizer reset and status indication acknowledgement

Totalizer reset

Button	Display	Description
	10.36 kg	Measurement mode
↵	**CodE 2** **––**	Enter access Code 2 for reset/quit menu: ↑ →
↑ →	**RESET.TOTAL**	Totalizer reset menu Only appears if "yes" programmed in Fct. 3.8.5. Reset enable No or Yes. If "no" is programmed "status light" only appears. See next section.
→	**RESET.YES**	If the reset function is enabled RESET **YES** will be shown, press ↵ to execute the function. To cancel the reset operation press ↑ to get RESET **NO** and then press ↵ If the reset function is disabled by menus Fct. 3.8.5 or 3.8.6 then BLOCKED is displayed. Press ↵ to continue
↵↵	0.00 kg	Assuming RESET YES was selected the totalisers will now be cleared.

View status message(s) and quit

Button	Display	Description
	0.36 **kg/min** **∇**	Measurement mode The presence of the ∇ marker above **Status** on the display indicates the presence of warning messages in the status list.
↵	**CodeE 2** **– –** **∇**	Enter access code for reset/quit menu: ↑ →
↑→	**RESET.TOTAL** **∇**	Totalizer reset menu.
↑	**STATUS.LIST** **∇**	View/Quit Status message menu
→	**≡ 1 Err ≡** **MASS FLOW** **∇**	This display shows that there is just 1 warning in the list, in this case MASS FLOW. The ≡ symbols indicate that this is a new error and not one that has been previously acknowledged. Use either the ↑ or → keys to view other messages in the list. Otherwise press ↵ to exit.
→	**≡ 1 Err ≡** **QUIT YES** **∇**	At the end of the message list the QUIT **YES** prompt is shown. Selecting YES will clear if possible messages in the list. To cancel the operation press ↑ to get QUIT **NO** and then press ↵
↵	**STATUS.LIST**	Assuming the conditions that caused the message have passed (i.e. mass flow is back within the meter's range) then the Status marker, ∇ will disappear.
↵	**0.36** **kg/min**	Assuming RESET YES was selected, the totalisers will now be cleared.

4.6 Status messages

ERROR MESSAGES	TYPE	COMMENT
SAMPLING	Severe	PLL out of range
SENSOR A	Severe	Sensor A voltage signal less than 5% of desired value
SENSOR B	Severe	Sensor B voltage signal less than 5% of desired value
RATIO A/B	Severe	One sensor signal much larger than the other
EEPROM	FATAL	Unable to save data in EEPROM. Hardware fault
SYSTEM	FATAL	Indicates software error, will always occur with WATCHDOG
WATCHDOG	Severe	Reset due to SYSTEM error or temporary power supply drop-off
NVRAM	Severe	NVRAM check sum error, previous data lost
DC A	Severe max.	DC voltage part of sensor A is larger than 20% of ADC
DC B	Severe max.	DC voltage part of sensor B is larger than 20% of ADC
NVRAM FULL	Light	NVRAM has exceeded its specified number of write cycles
MASS FLOW	Light	Mass flow rate > 2 $\times$ nominal flow *
ZERO ERROR	Light	Mass flow rate at zero adjust is larger than > 20% of nominal (100%) flow rate *
TEMPERATUR	Light	Temperature > outside operating range
STRAIN	Light	Strain out of operating range
I.SAT	Output	Current output saturated **
FREQ.SAT	Output	Frequency output saturated **
ALARM.OUT.A	Output	Process alarm limit check exceeded **
ROM DEF	Light	EEPROM check sum error, defaults loaded from ROM
TOTAL O/F	Light	Custody transfer only. Mass total has overflowed the display, i.e. it has gone from 99999999 $\rightarrow$ 00000000
TEMP.CUST	Light	Custody transfer only. Operating temperature has drifted by more than $\pm$30°C from the zero calibration temperature
POWER.FAIL	Light	Custody transfer only. There has been an interruption of power to the converter.

* Actual mass flow rate is too big or manual zero offset PUTIN.VAL in Fct. 1.1.1 was programmed incorrectly.

** Change output range to avoid saturation.

4.7 Menu variations for systems with other output options

Fct. No	OPTION 1	OPTION 2	OPTION 4	OPTION 5	OPTION 6	OPTION C	OPTION D	OPTION E	OPTION F
Fct. 1.3	CUR.OUTP.I	CUR.OUTP.I*	CUR.OUTP.I	CUR.OUTP.I	CUR.OUTP.I	CUR.OUTP.I*	CUR.OUTP.I*	CUR.OUTP.I*	CUR.OUTP.I*
Fct. 1.4	PULS.OUT.P	BLOCKED	BLOCKED	BLOCKED	PULS.OUT.P	PULS.OUT.P	PULS.OUT.P	BLOCKED	BLOCKED
Fct. 1.5	STATUS.OUT.A	STATUS.OUT.A	BLOCKED	BLOCKED	BLOCKED	BLOCKED	BLOCKED	BLOCKED	STATUS.OUT.A
Fct. 2.2	TEST I	TEST I*	TEST I	TEST I	TEST I	TEST I*	TEST I*	TEST I*	TEST I*
Fct. 2.3	TEST P	BLOCKED	BLOCKED	BLOCKED	TEST P	TEST P	TEST P	BLOCKED	BLOCKED
Fct. 2.4	TEST A	TEST A	BLOCKED	BLOCKED	BLOCKED	BLOCKED	BLOCKED	BLOCKED	TEST A
Fct. 2.5	TEST.INP.E	TEST.INP.E	BLOCKED	BLOCKED	BLOCKED	BLOCKED	BLOCKED	TEST.INP.E	BLOCKED
Fct. 3.3	CUR.OUTP.I	CUR.OUTP.I*	CUR.OUTP.I	CUR.OUTP.I	CUR.OUTP.I	CUR.OUTP.I*	CUR.OUTP.I*	CUR.OUTP.I*	CUR.OUTP.I*
Fct. 3.4	PULS.OUTP.P	BLOCKED	BLOCKED	BLOCKED	PULS.OUTP.P	PULS.OUTP.P	PULS.OUTP.P	BLOCKED	BLOCKED
Fct. 3.5	STATUS.OUT.A	STATUS.OUT.A	BLOCKED	BLOCKED	BLOCKED	BLOCKED	BLOCKED	BLOCKED	STATUS.OUT.A
Fct. 3.6	CTRL.INP.E	CTRL.INP.E	BLOCKED	BLOCKED	BLOCKED	CRTL.INP.E	BLOCKED	CTRL.INP.E	BLOCKED
Fct. 4.2	CUR.OUTP.I	CUR.OUTP.I*	CUR.OUTP.I	CUR.OUTP.I	CUR.OUTP.I	CUR.OUTP.I*	CUR.OUTP.I*	CUR.OUTP.I*	CUR.OUTP.I*
Fct. 4.6	PULS.OUTP.P	N/A	N/A	N/A	PULS.OUTP.P	PULS.OUTP.P	PULS.OUTP.P	N/A	N/A
Fct. 4.7	STATUS.OUT.A	STATUS.OUT.A	N/A	N/A	N/A	N/A	N/A	N/A	STATUS.OUT.A

* These menus access two or more current outputs.
Press → and a flashing ”1” appears.
i.e. Fct. 1.3.0
CUR.OUTP.I**1**

USE THE ↑ TO SELECT THE REQUIRED OUTPUT NUMBER THEN PRESS ↵ TO SELECT.

5 Description of Functions

5.1 Zero point adjustment

When operating the system for the first time, it is necessary to set the zero point of the instrument.

Once the zero point has been adjusted, the installation should not undergo any further modifications in order to maintain the quality of the measurement. This means that after system changes (such as the piping or changing the calibration factor), it is advisable to re-adjust the zero-point.

To achieve a successful zero calibration the primary head should be completely full of process fluid at normal operating pressures and temperatures. Ideally there should be no air inclusions in the fluid, particularly for horizontal installations, so it is recommended that the primary head be flushed with the process fluid at a high flow rate (>50%), for 2 minutes, prior to starting the adjustment. After flushing, flow in the primary head must be brought back to zero by tightly closing appropriate valves.

The zero off-set can either be measured automatically or entered manually using the display keys. If an automatic adjustment is to be made then the operator should trigger this, with the front cover still in place, using the bar magnet provided to operate the magnetic sensors on the display. This is to ensure that the zero adjustment is carried out with the mechanical installation **exactly** the same as for normal operation.

Begin from the measuring mode.

Key	Display line 1	line 2
→	9-key stroke entry code (if enabled)	
	Fct. (1).0 OPERATOR	
↑	Fct. (2).0 TEST	
↑	Fct. (3).0 INSTALL	
→	Fct. 3.(1) BASE DATA	
→	Fct. 3.1.(1) ZERO SET	
→	(MEAS.VALUE)	

NOTE:
The brackets around parts of the above text indicates the cursor position, these characters will be flashing on the display. Flashing values can now be changed with the ↑ key. Pressing the → key moves the cursor to the next ”field” which then starts to flash.

The operator can now choose either A) Automatic (recommended) or B) manual adjustment.

A) Automatic adjustment :

key	Display line 1	line 2
↵		CALIB. (NO)
↑		CALIB. (YES)
↵	X.X	PERCENT*
↵		ACCEPT (YES)
4x↵	Return to measuring mode	

* Display of actual flow rate % of maximum value, for a period of 20 seconds.

B) Manual adjustment :

Key	Display line 1	line 2
↑		SET.VALUE
↵	(0).000	kg/min
	Input zero value in the sequence : dimension, sign, numeric value. (see section 5.2).	
↵		
4x↵	Return to measuring mode.	

In all the following examples, a short notation is used for the setting of the signal converter. Pushing a key several times is indicated by the number of times without the intermediate display messages. Only the final display output is listed. If programming is possible in the different menus 1.0 or 3.0 the only change is in the function number (e.g. for zero adjustment 1.1.1. instead of 3.1.1.), the inputs for the programming of the functions are the same.

Under certain conditions, it may not be possible to adjust the zero point, for instance when :

– The medium is in motion, because the shut-off valves etc. are not functioning properly.
– There are still gaseous inclusions in the primary head because it was flushed insufficiently.
– Resonant vibration of the piping interferes with the primary head because of poor clamping.

In such cases the zero point adjustment will not be accepted. If the zero adjustment was started by the binary input, the converter will show the message :

ZERO.ERROR

This will appear in the display for a short time after the adjustment. The converter also reports the ZERO.ERROR in the status list.

If the zero calibration was started from the menus then Parameter Error 4.3 will be displayed when the operator tries to accept the new values.

Under certain circumstances, when the media consists of unevenly mixed components, it might be difficult to adjust the zero point. In such a case, the zero point adjustment procedure must be carried out under special conditions :

– Media which tend to vaporise or degas should be kept under higher pressure.
– Two-phase media consisting of a separable solid component (slurry): In such a case it might be advisable to fill the primary head with the carrier medium only.
– Other two-phase media .

If it is not possible to separate the solid or gaseous components, the operator can fill the measuring system with a substitute liquid (e.g. with water).

5.2 Low Flow Cutoff (Fct. 1.1.2 and 3.1.2)

If the FLOW MODE (Fct. 3.1.8) is set to FLOW +/- then at zero flow small signal fluctuations will average out to nothing and the totaliser will remain fixed. However, if "one-way flow" is selected, this averaging process will not work and the totaliser reading will increase slowly with time. To prevent this the Low Flow Cutoff should be set.

The Low Flow Cutoff is entered as a percentage of the rated flow of the primary head. The cutoff may be set in the range of 0.0 to 10.0% in steps of 0.1%.

Thus, for a 10G instrument with a low flow cutoff of 0.2%, any flows less than 0.02 kg/min are taken as 0 kg/min.

To set the Low Flow Cutoff to 1% :

Key.	Display line 1	line 2
→→→	Fct. 1.1.(1)	ZERO SET
↑	Fct. 1.1.(2)	L.F.CUTOFF
→	(0)0.0	PERCENT
→↑	(1).0	PERCENT
↵	Fct. 1.1.2	L.F. CUTOFF
4x↵		

5.3 Time constant

Measurements taken from the primary head require filtering in order to give stable readings in the presence of fluctuating flows. The degree of filtering also affects how quickly the reading responds to rapid changes in flow.

SHORT TIME CONSTANT:
FAST RESPONSE
FLUCTUATING READING

LONG TIME CONSTANT:
SLOW RESPONSE
STABLE READING

The figure below shows the typical response of the system for varying Time Constants and a sharp change in flow.

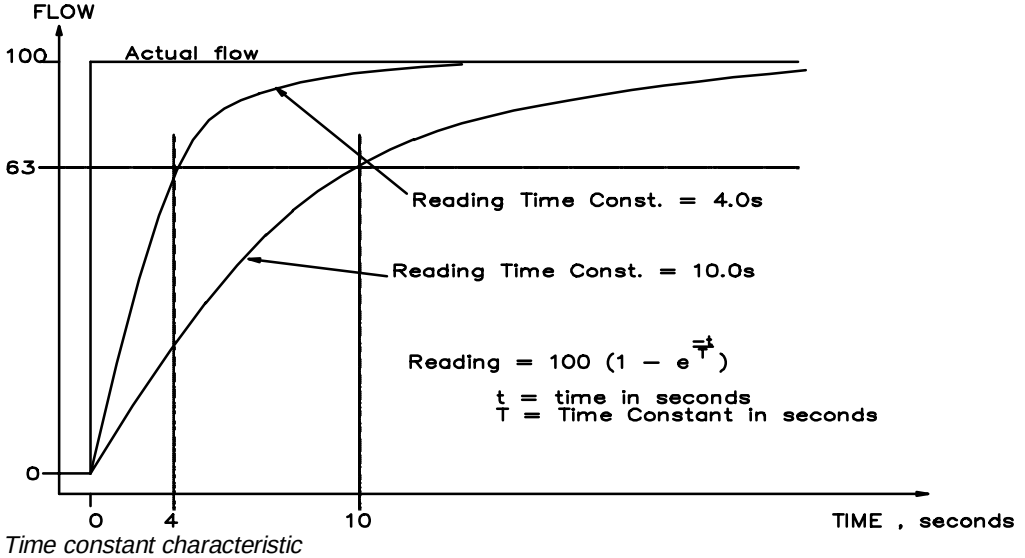
To set the Time Constant :

Begin from measuring mode.

Key	Display line 1	line 2
→→→	Fct. 1.1.(1)	ZERO SET
↑↑	Fct. 1.1.(3)	TIME. CONST.
→	(0)4.0	TIME C. S.
	Edit the time constant in seconds in range 0.5 to 20.	
↵	Fct. 1.1.(3)	TIME.CONST
4x↵		

This filtering only applies to mass and volume flow readings and any outputs that use them. The mass totaliser is independent of the time constant.

The standard range for the time constant is 0.5 to 20 seconds. For faster response times, a range of 0.2 to 20 seconds is available as a factory set option.



Time constant characteristic

5.4 Programming the display for measurement values (Fct. 1.2. and 3.2.)

The following measurement functions can be displayed :

Fct. 1.2.1	CYCL.DISP
Fct. 1.2.2	STATUS MSG.
Fct. 1.2.3	MASS FLOW
Fct. 1.2.4	MASS TOTAL
Fct. 1.2.5	DENSITY
Fct. 1.2.6	TEMPERAT.
Fct. 1.2.7	VOLUME.FLOW
Fct. 1.2.8	VOL.TOTAL

For systems with concentration software their specific extra displays will be added to the above list from Fct. 1.2.9 onwards.
The displayed measurement function can be changed in the measurement mode by pressing ↑ key.
The setting of the display output is demonstrated for the example of displaying the mass flow rate in kg/h.
Starting from the display of measurement values, the following programming steps are necessary.

Begin from measuring mode.

Key	Display line 1	line2
→	Fct. (1).0	OPERATOR
2x↑	Fct. (3).0.	INSTALL
→	Fct. 3.(1).0.	BASE DATA
↑	Fct. 3.(2).0.	DISPLAY
→↑↑	Fct. 3.2.(3).	MASS FLOW

After pressing → key the display shows :

0000.0000 (kg)/min

This display means that mass flow will be displayed in units of kg/min to an accuracy of 4 decimal places.
The brackets around 'kg' indicate the cursor position, these characters will be flashing on the display. The flashing value can now be changed with the ↑ key. By pressing the → key the cursor moves to 'min' which starts to flash.
This dimension may now also be changed by using the ↑ key. After pressing the → key again, the cursor moves to the output format of the numeric value which can then be edited.

To change the display to kg/h with 5 decimal places, follow the following procedure.

Key	Display line 1	line 2
	0000.0000	(kg)/min
→	0000.0000	kg/(min)
↑	0000.0000	kg/(h)
→	0000(.)0000	kg/h
↑	00000(.)000	kg/h
↑	000000(.)00	kg/h
↑	0000000(.)0	kg/h
↑	00000000(.)	kg/h
↑	0(.)0000000	kg/h
↑	00(.)000000	kg/h
↑	000(.)00000	kg/h
↵	Fct. 3.2.(3). MASS FLOW	

The setting of the display for TOTAL MASS or DENSITY is done the same way.

Temperature is displayed with a fixed position of one decimal place. However, the user can choose between °C and °F.

Begin from measuring mode

Key	Display line 1	line 2
→	Fct. (1).0	OPERATOR
→↑	Fct. 1.(2).0.	DISPLAY
5x↑	Fct. 1.2.(6).	TEMPERATUR
→		(°C)
↑		(°F)
↵	Fct. 1.2.(6).	TEMPERATUR

Volume flow is an optional display in the measurement mode. To turn on this display with units dm3/hr :

Key	Display line 1	line 2
↑	Fct. 1.2.(7)	VOL.FLOW.
→		(OFF)
↑	00000.000	(cm3)/S
↑	00000.000	(dm3)/S
→↑↑	00000.000	dm3/(hr)
→	00000(.)000	dm3/ hr
↑↑	0000000(.)0	dm3/hr
↵	Fct. 1.2.(7)	VOL.FLOW

For a list of available units for each display refer to Section 5, Technical data.

If a cyclic display of all measurement values is desired the following inputs have to be added to the previous steps :

Key	Display line 1	line 2
↵→	Fct. 1.2.(1).	CYCL. DISP.
→		(NO)
↑		(YES)
↵	Fct. 1.2.(1).	CYCL. DISP.
4x↵		

With the cyclic display enabled, the converter will switch displays in the measuring mode every 3 to 4 seconds as if the operator had pressed the ↑ key.

5.5 Programming Numeric Data

Various functions on the MFC 085 require numeric data to be entered by the operator. Numeric data is always entered in the following manner.

Using setting FULL SCALE of current output, Fct. 1.3.3 as an example:

Begin from the measuring mode:

Key	Display line 1	line 2
→	Fct. (1).0	OPERATOR
→↑↑	Fct. 1.(3).0	CUR.OUTP. I
→↑	Fct. 1.3.(2)	MIN. FLOW
	(assume function is set to MASS FLOW)	
↑	Fct. 1.3.(3)	MAX. FLOW
→	(0)*5.0000	kg/min
	Current setting of MAX.FLOW Units and accuracy are as set by the format Fct. 1.2.1	
↑	(1)5.0000	kg/min
→	1(5).0000	kg/min
5x↑	1(0).0000	kg/min
→	10(.)**0000	kg/min
	Decimal point may now be moved one digit to the right for each press of the ↑ key	
→↑	10.(1)000	kg/min
↵	Fct. 1.3.(3)	MAX FLOW
4x↵		

Return to measuring mode

* The flashing '0' to the left of the number to be edited allows extra digits to be added, as in this example. If no extra digits are required, pressing the → key will cause this leading zero to be blanked.

(0)5.0000 kg/min
→ (5).0000

** Some values do not allow the decimal point to be moved.

NOTE:
Some numerical values have fixed permissible limits. For example, Menu 3.1.2., L.F. CUT OFF only allows values in the range 0 to 10%. If, for example, the operator tries to enter a value of 15%, the converter responds as follows :

Key	Display line 1	line 2
	15.0	PERCENT
↵	10.0	MAX.VALUE

Press ↵ again to correct the number:

↵	(0)10.0	PERCENT

Re-edit the number or press ↵ again to accept this value.

5.6 Setting the current output (Fct. 1.3. and 3.3)

The current output can be programmed to the following measurement values :

- Mass Flow
- Density
- Temperature
- Volume Flow Rate
- Flow Direction

For the current output of the MFC 085, five ranges are available :

0 to 20 mA
4 to 20 mA
0 to 20 mA warning state: 22 mA
4 to 20 mA warning state: 2 mA
4 to 20 mA warning state; 3.5 mA

All output ranges will over range to 20.5 mA. The 4 - 20 mA ranges will under range to 3.8 mA. All functions except flow direction have a minimum and a maximum value. When the current output is set to one of these quantities, then the output range (4 to 20 or 0 to 20 mA) will correspond to the appropriate minimum and maximum (see figure on next page).

For example, to use the current output for density with the following parameters :

MIN DENSITY = 0.5g/cm^3
MAX DENSITY = 2.0g/cm^3
RANGE 4 to 20 mA

Density	Current	
0.5 g/cm^3	4 mA	(minimum)
1.0 g/cm^3	10 mA	
2.0 g/cm^3	20 mA	(maximum)

If the current output is used to indicate the direction of flow the output is as follows :

Flow	Current
pos.	20 mA
neg.	0 or 4 mA depending on range.

Where the current range has a warning state, the output will jump to this current level when the meter detects an abnormal condition. When the condition clears, the current output returns to normal automatically.

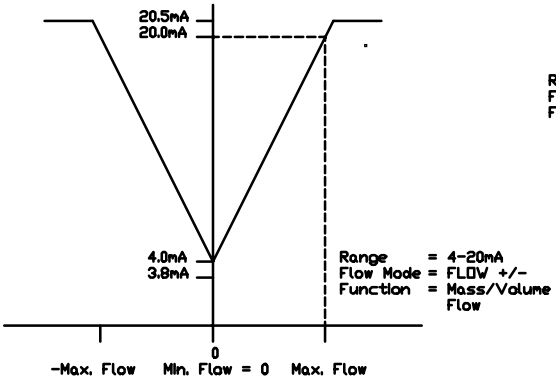
To program the density example above:

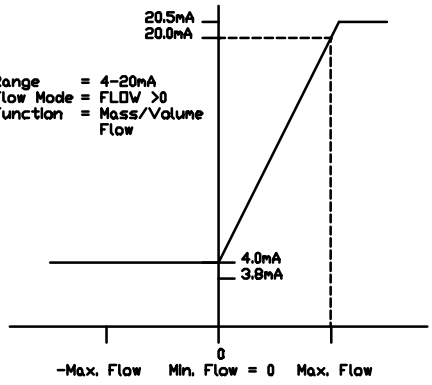
Begin from measuring mode

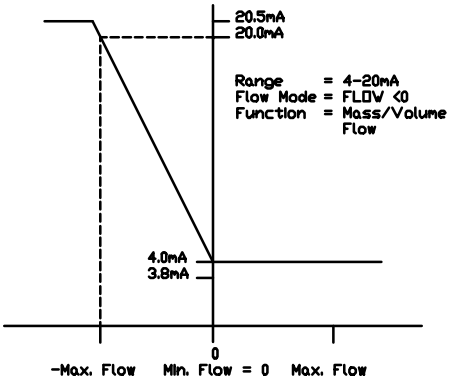
Key	Display line 1	line 2
→	Fct. (1).0	OPERATOR
2x↑	Fct. (3).0	INSTALL
→↑↑	Fct. 3.(3).0.	CUR.OUTP.I
→	Fct. 3.3.(1).	FUNCTION I
→		(TEMPERATUR)
↑		(VOLUME.FLOW)
:		(OFF)
:		(MASS FLOW)
↑		(DENSITY)
↵	Fct. 3.3.(1).	FUNCTION 1
↑	Fct. 3.3.(2).	MIN.DENSITY
→	Input of min. value.	
↵	Fct. 3.3.(2).	MIN.DENSITY
→	Fct. 3.3.(3).	MAX.DENSITY
→	Input of max. value.	
↵	Fct. 3.3.(3).	MAX.DENSITY
↑	Fct. 3.3.(4).	RANGE I
→		(0-20/22mA)
↑		(2/4-20mA)
↑		(3.5/4-20mA)
↑		(0-20mA)
↑		(4-20mA)
↵	Fct. 3.3.(4).	RANGE I
4x↵		

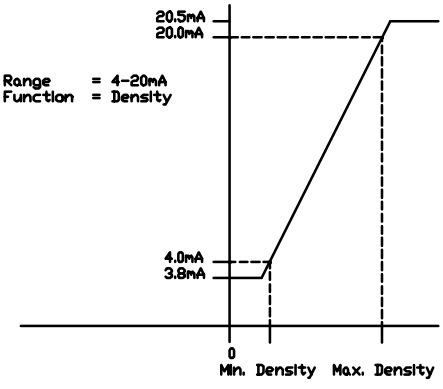
If during operation the density measured falls outside the set maximum and minimum limits, the output is said to be saturated. This may cause problems with external instrumentation. Saturation may be indicated to the customer using either the process alarm (section 5.7) or the status warnings (section 5.12.).

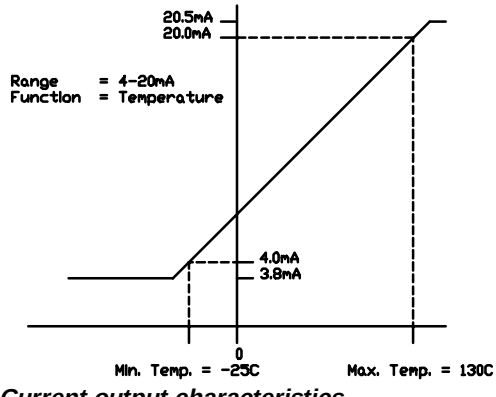
If the output function is set to OFF or to DIRECTION then sub-menus Fct. 3.3.3 and Fct. 3.3.4 are not available.

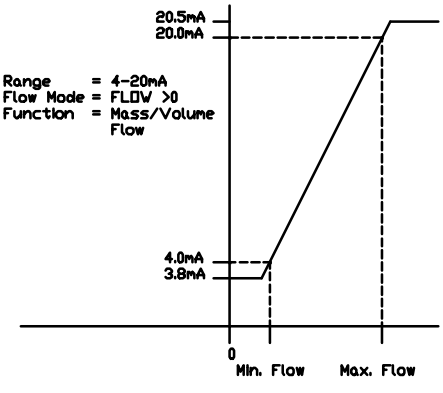












Current output characteristics

5.7 Setting the frequency/pulse output (Fct. 3.4. and 1.4)

The frequency/pulse output allows the transfer of one of the following measurement values :

VALUE	OUTPUT TYPE
Mass Total	Pulse
Mass Flow Rate	Frequency
Density	Frequency
Temperature	Frequency
Volume Total	Pulse
Volume Flow Rate	Frequency
Flow Direction	Binary 0 or V+

For systems with the Concentration option, the following functions are also available:

VALUE	OUTPUT TYPE
Concentration by mass / Brix	Frequency
Concentration by volume	Frequency
Solute flow / Brix rate	Frequency
Solute Total	Pulse

The exact programming of this output depends on the measurement value selected.

Pulse Outputs:
When the pulse output (Fct. 1.4.1 or 3.4.1) is set to either MASS TOTAL, VOL.TOTAL OR SOL.TOTAL (Concentration systems only) then the following sub menus are available:

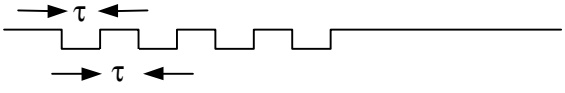
Fct. 3.4.1	FUNCTION P
Fct. 3.4.2	PULSE/MASS
(or	PULSE/VOL.)
Fct. 3.4.3	PULSE.WIDTH

For these functions the output sends out a series of pulses where each pulse represents a fixed mass or volume. So, for example, to set the converter for 1 pulse equal to 20g, proceed as follows :

Begin from measuring mode

Key	Display line 1	line 2
→↑↑	Fct. (3).0.	INSTALL.
→↑↑↑	Fct. 3.(4).0.	PULS.OUTP. P
→	Fct. 3.4.(1).	FUNCTION P
→		(OFF)
↑		(MASS FLOW)
:		(TOTAL MASS)
:		(DENSITY)
:		(TEMPERAT)
:		(VOLUME.FLOW)
:		(VOL. TOTAL)
↑		(DIRECTION)
↵	Fct. 3.4.(1).	FUNCTION P
↑	Fct. 3.4.(2).	PULSE/MASS
→	1.000	1 P. = (KG)
	Current setting 1kg per pulse	
4x↑	1.000	1 P. = (g)
→	(0)1.000	1 P. = g
↑↑	(2)1.000	1 P. = g
→9x↑	2(0).000	1 P. = g
↵	Fct. 3.4.(2).	PULSE/MASS

Menu Fct. 3.4.3 can now be used to set the minimum pulse width, τ , in the range 0.4 to 500 ms.



In this way the operator can be sure that the pulses produced by the impulse output will never be shorter than the specified width.

When setting the pulse width, τ, and the mass (or volume) per pulse, Q, the operator should take into account the maximum flow rate, $Flow_{max}$, he expects through the meter, such that:

$$Flow_{max} < \frac{Q}{2\tau}$$

where:

$Flow_{max}$ is in units g/s (or cm^3/s)
Q is in units of g (or cm^3)
τ is in units of seconds

If $Flow_{max}$ exceeds the above, limit saturation will occur and pulses will be lost and any external counter connected will under-read. It is possible to generate warnings of saturation in one of two ways:

I. Set the Alarm output, Fct. 3.5.1 to either **P1 SAT** or **ANY OP.SAT**. If the pulse output saturates now the Alarm output will signal a warning.
II. Set the **STATUS MSG**. function Fct. 1.2.2 to either **OUTPUT** or **ALL MSGS**. If the pulse output becomes saturated now the **Status** arrow on the display will be lit and the display will start to flash.

To program the pulse width to 10 ms

	Fct. 3.4.(2)	PULSE/MASS
↑	Fct. 3.4.(3)	PULSE.WIDTH
→	(0)0.4	mSec
↑	(1)0.4	mSec
→ →	10.(4)	mSec
6 × ↑	10.0	mSec
↵	Fct. 3.4.(3)	PULSE.WIDTH
4 × ↵		

Having programmed this, one pulse will be sent from the output for every 20g of process fluid going through the primary head.

NOTE:
The pulse output ignores the sign, positive or negative of the flow. To ensure reliable operation, the system should be set for one-way flow with suitable low flow cutoff.

Frequency:
For these values the frequency output sends out a continuous square wave with a frequency representing the corresponding measured value. As with the current output, the frequency output is scaled to match the maximum and minimum settings for these values. The range of the frequency output may also be set by Fct. 1.4.2. or Fct. 3.4.2..

Example 1 :

Measured value	=	mass flow
Max flow	=	5 kg/min
Min flow	=	0
Max frequency	=	500 Hz

Flow	Frequency
0 kg/min	0 Hz
1 kg/min	100 Hz
5 kg/min	500 Hz
6.5 kg/min	650 Hz (1.3xMax Flow)
>6.5 kg/min	650 Hz

Example 2 :

Measured value = temperature
Max temperature = 75°C
Min temperature = -25°C
Max frequency = 1000 Hz

Temperature	Frequency
< - 25°C	0 Hz
0°C	250 Hz
20°C	450 Hz
75°C	1000 Hz
> 95°C	1300 Hz

To set up example 1, proceed as follows :

Begin from measuring mode.

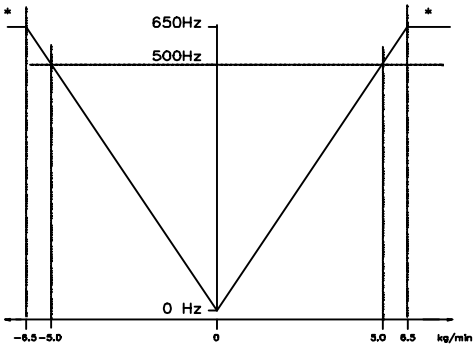
Key	Display line	line 2
→↑↑	Fct. (3).0.	INSTALL.
→↑↑↑	Fct. 3.(4).0.	PULS.OUTP. P
→	Fct. 3.4.(1).	FUNCTION P
→		(TOTAL MASS)
↑		(MASS FLOW)
↵	Fct. 3.4.(1).	FUNCTION P
↑	Fct. 3.4.(2).	PULSE/TIME
→	(0)1000	MAX Hz
	Current max. frequency 1000 Hz.	
→9x↑	(0)000	MAX Hz
→	0(0)00	MAX Hz
5x↑	0(5)00	MAX Hz
↵	Fct. 3.4.(2).	PULSE/TIME
↑	Fct. 3.4.(3).	MIN. FLOW
→	Input min. flow of 0 kg/min	
↵↑	Fct. 3.4.(4).	MAX. FLOW
→	Input max. flow of 5 kg/min	
↵	Fct. 3.4.(4).	MAX. FLOW
4x↵		

The frequency output will allow flows to be registered up to 1.3 times the maximum value. (Note : for mass flow and volume flow, all flows are assumed positive).
The absolute maximum output frequency is 1300 Hz so the Max. Value allowed for Fct. 3.4.2. is 1000 Hz allowing for the 1.3 x over-range.

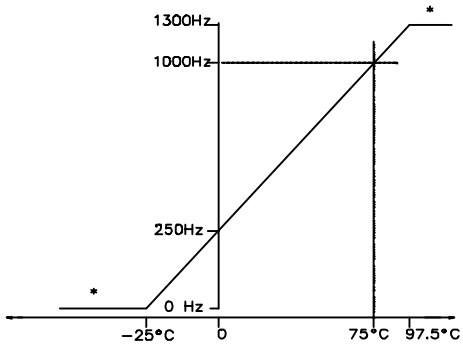
NOTE:
The frequency output has a duty cycle of 50% for a frequency range > 1Hz. For a frequency range < 1Hz, the duty cycle is not 50%.

Binary output:
If the frequency output is set to signal the flow direction, Fct. 3.4.2. is suppressed and the output is as follows :

Flow	Direction
pos.	+ V
neg.	0 Volts



Max Freq. = 500Hz
Flow Mode = FLOW +/-
Function = Mass Flow
Max Flow = 5kg/min
Min. Flow = 0kg/min



Max Freq. = 1000Hz
Function = Temperature
Max. Temp = 75°C
Min. Temp = -25°C

* = Saturation

Frequency output characteristic of example 1 and 2

5.8 Setting the process alarm output (Status)

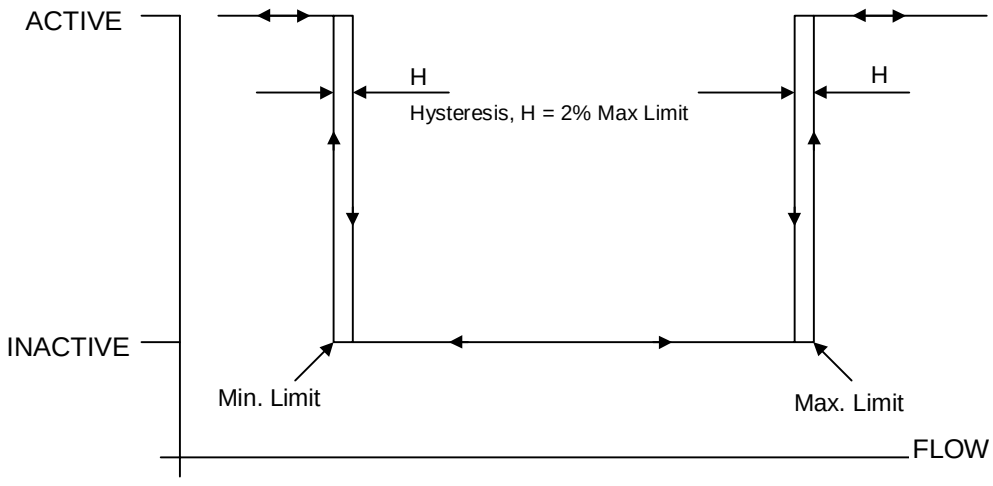
The process alarm output is a two state signal (active or inactive) that can be used to indicate a variety of meter and process states , see Table below:

For all functions it is possible to define whether the output is to be active high, 24 Volts or active low, 0 Volts (Fct. 3.5.2). The first five functions check measured values against user-defined limits. While the value is within these limits the Process Alarm output is inactive. If the value exceeds the limits then the output becomes active. To prevent multiple switching of the output when the measured value is just on the limits, hysteresis is built in. Refer to figure below; as mass flow increases past the maximum limit the output switches to active. However, as flow then decreases the output will not switch to inactive until it becomes less than MAX - H where H = 2% of upper limit.

Process alarm functions

Function	Inactive	Active
Mass total	Total in range	Total out of range
Mass flow	Mass flow in range	Mass flow out of range
Density	Density in range	Density out of range
Temperature	Temp. in range	Temperature out of range
Volume flow	Volume flow in range	Volume flow out of range
Concentration by mass *	Concentration in range	Concentration out of range
Concentration by volume *	Concentration in range	Concentration out of range
Solute Mass Flow Rate*	Solute flow rate in range	Solute flow rate out of range
Current outputs I 1,2 3	Specified current output OK	Current output saturated
Frequency output	Frequency output OK	Output saturated
Any Output	All outputs OK	At least one output saturated
All status messages	No converter errors	At least one error detected
Severe errors	No serious converter faults	Major converter fault;measurement stops
Flow direction	neg. flow (-ve)	pos. flow (+ve)

. If concentration option installed.



Process alarm characteristics

For example, a process requires that the process fluid temperature stays within the range 30 to 40°C and the low level signal is required to indicate that the temperature has gone out of range. Begin from measuring mode

Key	Display line 1	line 2
→↑↑	Fct. (3).0.	INSTALL
→4x↑	Fct. 3.(5).0.	ALARM.OUT.A
→	Fct. 3.5.(1).	FUNCTION A
→		(OFF)
↑		(MASS FLOW)
:		(MASS TOTAL)
:		(DENSITY)
↑		(TEMPERATURE)
↵	Fct. 3.5.(1).	FUNCTION A
↑	Fct. 3.5.(2).	ACTIV.LEVEL
→		(ACTIVE.HIGH)
↑		(ACTIVE LOW)
↵	Fct. 3.5.(2).	ACTIV.LEVEL
↑	Fct. 3.5.(3).	MIN. LIMIT
→	Input minimum temperature	
↵	Fct. 3.5.(3).	MIN. LIMIT
↑	Fct. 3.5.(4).	MAX. LIMIT
→	Input maximum temperature	
↵	Fct. 3.5.(4).	MAX. LIMIT
4x↵		

Return to measuring mode.

NOTE:

For functions other than range checking Fct. 3.5.3. and 3.5.4. are not accessible.

5.9 Setting the control input (Binary)

The MFC 085 has an input connection which allows certain meter functions to be controlled remotely. These functions are:

- Reset totaliser
- Standby
- Acknowledge status message
- Start zero calibration

The function will be triggered when the input becomes active. For standby the converter will be held in standby for as long as the input is active. The other functions are triggered on the transition of the input from inactive to active. The active level of the input may be defined using Fct. 3.6.2. as active high (4 - 24 volts) or active low (0 - 2 volts).

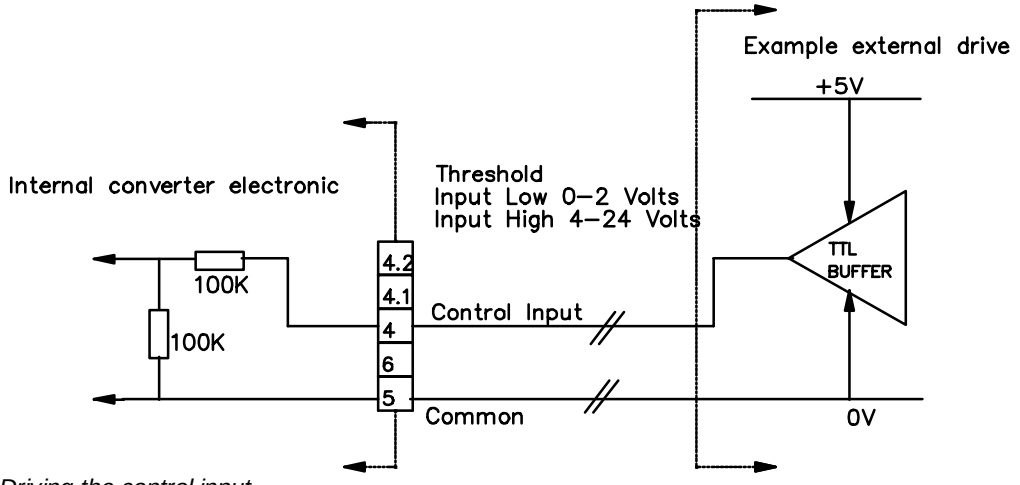
NOTE:
Internal resistors attached to the control input pull it low, 0V, when the input is not driven. (see figure below)

Example:

Using a TTL signal to reset the totaliser when the signal goes from high (+5V) to low (0V).

Begin from measuring mode

Key	Display line 1	line 2
→↑↑	Fct. (3).0	INSTALL
→5x↑	Fct. 3.6.0	CTRL.INP.E
→	Fct. 3.6.(1)	FUNCTION E
→		(OFF)
↑		(STANDBY)
:		(ZERO SET)
↑		(RESET MASS)
↵	Fct. 3.6.(1)	FUNCTION E
↑	Fct. 3.6.(2)	ACTIV.LEVEL
→		(ACTIVE.HIGH)
↑		(ACTIVE. LOW)
↵	Fct. 3.6.(2)	ACTIV.LEVEL
4x↵		



Driving the control input

5.10 Setting the system control

Some applications for the MFM 4085 may require measurement to be suspended at particular times, such as during steam cleaning. The system control functions allow the converter to automatically detect user-defined conditions and then to act accordingly.

Selectable conditions (Fct. 3.7.2.) are :

Density out of range
Temperature out of range

The ranges for these conditions are set by Fct. 3.7.3. and 3.7.4. (These range checks are subject to hysteresis in the same way as the process alarm, see Sect. 5.7).

When such a condition is met, the converter takes one of the following actions :

1. Flow reading forced to zero, totaliser stopped, any output registering flow will go to zero.

2. Flow reading forced to zero as above, but totaliser is cleared to zero when measurement restarts.

3. Disable outputs. All outputs, current, frequency and alarm are forced to their zero/inactive state.

Example:
A process has to be steam cleaned regularly. The user has the pulse output set to total mass, but he does not want pulses sent to his instrumentation during cleaning. However, he still requires a temperature reading from the current output. The nominal density of his process fluid is 1.2g/cm3.

Begin from measuring mode

Key	Display line 1	line 2
→↑↑	Fct. (3).0.	INSTALL
→6x↑	Fct. 3.(7).0.	SYS.CTRL.S
→	Fct. 3.7.(1).	FUNCTION S
→		(OFF)
↑		(FLOW OFF)
↵	Fct. 3.7.(1).	FUNCTION S
↑	Fct. 3.7.(2).	REFERENCE
→		(TEMPERATUR)
↑		(DENSITY)
↵	Fct. 3.7.(2).	REFERENCE
↑	Fct. 3.7.(3).	MIN. LIMIT
→	Input minimum density of 0.5g/cm3	
↵	Fct. 3.7.(3).	MIN. LIMIT
↑	Fct. 3.7.(4).	MAX. LIMIT
→	Input maximum density of 5.0g/cm3. This value is set high as only low fluid density are of interest in this case.	
NOTE :	The max. value in this case will set a hysteresis of 0.1g/cm3	
↵	Fct. 3.7.(4).	MAX. LIMIT
4x↵		

As the line is drained and prior to steam cleaning, density reading will fall below 0.5g/cm3. When this happens the converter will read zero flow and no more pulses will be sent from the pulse output. The current output registering temperature will function as normal. When the line is refilled and density exceeds 0.6g/cm3, measurement will restart.

When this function becomes active then the standby indicator on the display becomes lit. All displays for mass flow, density, temperature etc. work as normal. However, if functions 1 or 2 above are selected then the mass flow (and hence volume flow) will be zero and will be displayed as shown below.

0.0000
STANDBY.

5.11 Standby function (Fct. 1.1.4. and 3.1.4.)

The instrument may be switched to a 'STANDBY' state. Once in this state, all outputs go to their off state and the mass totaliser is frozen. The main display will have the STANDBY indicator set and will display either the frozen totaliser or just STANDBY.

Begin from measuring mode

Key	Display line 1	line 2
		STANDBY
↑	3.456	kg Frozen Totalizer
↑		STANDBY

Whilst in this state the measuring tube still vibrates and the measurements can come back on line in an instant.

There is an additional standby state, 'STOP', in this case the drive to the primary head is disabled and vibrations cease. However, when leaving STOP the converter has to return to STARTUP before measurements can resume.

The instrument can be switched to STANDBY either by the keys on the display or by the control input signal (see section 5.9). STOP can only be set by the keys.

To set STANDBY or STOP :

Begin from measuring mode

Key	Display line 1	line 2
→	Fct. (1).0.	OPERATOR
→→	Fct. 1.1.(1).	ZERO SET
3x↑	Fct. 1.1.(4).	STANDBY
→		(MEASURE)
↑		(STANDBY)
↑		(STOP)
	Use the ↑ key to select the desired mode.	
↵	Fct. 1.1.(4)	STANDBY

If STANDBY or STOP was selected the instrument goes immediately into that state.

To return to measurement, go back to Fct. 1.1.4. and select MEASURE.

NOTE:
It is not possible to change mode directly from STOP to STANDBY, as the converter must first be switched to MEASURE to restart the primary head vibrations.

In addition to these 'standby' modes the SYSTEM CONTROL function provides a fully automated way of switching to similar modes using either the density or temperature of the process fluid as a control (see section 5.10).

5.12 Density adjustment for maximum measuring accuracy

G-Series Coriolis Mass Flow meters are factory calibrated for density prior to shipment. This calibration is based on measurements made with air and water under reference conditions. The results of this calibration are stored in the calibration factors CF1 and CF2 in menus Fct. 3.9.1 and 3.9.2. However for applications that require maximum accuracy an on-site density calibration will be required.
To calibrate density measurements two points are required. For convenience these are often taken to be: i) air (meter empty), and ii) water or the normal process fluid. However if the application only has a limited density range of interest then best results will be obtained if the calibration points are taken at each end of that range. Similarly if the application normally operates at a particular temperature then the calibrations should be done at that temperature.

Setting the Low Calibration Point
(It does not normally matter which order the calibration points are measured in but it is usually more convenient if the Low density point is done first particularly if air is used. However if one of the density points is to be water then this should be treated as the **High** point).

Ensure that the meter is properly installed and is operating correctly.
If air is used the meter must be dry inside with no droplets of liquid. If necessary blow through with clean compressed air to dry. If a fluid is used circulate the fluid at a high flow rate for a few minutes to ensure that no air bubbles remain inside the meter.
Adjust flow rate to the typical rate for the application. (50% of rated flow is ideal). If operating at temperatures other than ambient maintain these conditions for about 20 minutes so that the meter can stabilise. (G+ meters 100G and bigger need only be left 5 minutes but 20 minutes is optimum).
On the menus go to menu 3.9.11 D. REF. LOW and proceed as follows:

Key	Line 1	Line 2	Notes:
	Fct. 3.9.(11)	D. REF. LOW	
→		(MEAS. VALUE)	
↵		CALIB. (NO)	Use the ↑ key to select CALIB YES or press ↵ to abort
↑		CALIB. (YES)	Press ↵ to start the calibration. The meter will now log the current temperature, frequency and strain values. If for some reason this is not possible BLOCKED will be displayed and the operation aborted.
↵		(AIR)	Use the ↑ key to select whether this calibration point was AIR, or OTHER fluid. If AIR is selected then pressing ↵ completes the operation.
↑		(OTHER)	
↵	0.0000	(g) / cm3	Enter the fluids density and units in the normal way and then press ↵. The value entered here must be the density of the fluid at the operating temperature. If the exact density of the product is not known at this time, enter an approximate value (taking a sample from the line if required), an exact value may be entered later.
↑→	0.0000	kg / (cm3)	
↑↑↑	0.0000	kg / (m3)	
→→	(0).0000	kg / m3	
↑x5	(5).0000	kg / m3	
→↑↑	500(.)00	kg / m3	
↵	Fct. 3.9.(11)	D. REF. LOW	
↵x4			Exit the menus and save the changes.

Setting the High Calibration Point
Ensure that the meter is properly installed and is operating correctly.
Circulate the high density fluid at a high flow rate for a few minutes to ensure that no air bubbles remain inside the meter.
Adjust flow rate to the typical rate for the application. (50% of rated flow is ideal). If operating at temperatures other than ambient maintain these conditions for about 20 minutes so that the meter can stabilise. (G+ meters 100G and bigger need only be left 5 minutes but 20 minutes is optimum).
On the menus go to menu 3.9.10 D. REF. HIGH and repeat the procedure as for the LOW density point. (note WATER and not AIR will be the option for the density type in this case.)

Note : If on leaving functions 3.9.10 or 3.9.11 the CALIB. ERR message is displayed this means that the meter was unable to calculate realistic values for CF1 and CF2. Press ↵ to continue.
This error may be caused by a number of factors. Please check the following:
Check initial values of CF1 and CF2, these should be the same or similar to the values printed on the data plate. If these are vastly different re-enter the values from the data plate and repeat the calibrations.
Check CF3 and CF4 are as printed on the data plate.
Ensure that both calibration points were carried out with different density fluids and that the correct densities were entered on the display.

Reviewing the Calibration settings.
After successfully calibrating the density it is recommended that the new data is recorded on the table below. CF1 and CF2 can be found from menus Fct. 3.9.1 and 3.9.2.

Density Calibration Data

Serial Number	Date	Primary Type		
Fct. 3.9.1 CF1				
Fct. 3.9.2 CF2				
Fct. 3.9.3 CF3				
Fct. 3.9.4 CF4				
	Frequency	Temperature	Strain	Density
Fct. 3.9.10 D. REF. HIGH	Hz	°C/°F	Ω	
Fct. 3.9.11 D. REF. LOW	Hz	°C/°F	Ω	

CF1 to CF4 can be found from menus Fct. 3.9.1 to 3.9.4 To find the remaining data proceed as follows.

Key	Line 1	Line 2	Notes:
	Fct. 3.9.(10)	D. REF. HIGH	
→		(MEAS. VALUE)	
↑		(SET VALUE)	
↵	210.1234	HZ	Record this frequency value.
↵	22.1	°C	Record this temperature value.
↵	467.05	STRAIN	Record this strain value.
↵			If WATER (or AIR for menu 3.9.6)
	or	(WATER)	was selected then this will be
	1200.1		displayed here. If a fluid other than air
		(kg) / min	or water was selected then the density input by the customer will be displayed. If required these values can be edited here. Note if the value is edited CF1 and CF2 will be adjusted.
↵	Fct. 3.9.(10)	D. REF. HIGH	
↑	Fct. 3.9.(11)	D. REF. LOW	Repeat for the LOW calibration point.

When reviewing the calibration data the frequency, temperature and strain values cannot normally be edited. If a replacement converter is being fitted then it may be necessary to copy the calibration points into the new set of electronics. (CF1 to CF5 must be copied in all cases). Frequency , temperature and strain data can be edited if the operator first enters the PARAM.CODE.4 password in menu 3.3.8 (see section 5.14.4).

Density of water as a function of temperature

Temperature in		Density in	
°C	°F	kg/m^3	lb/ft^3
0	32	999.8396	62.41999
0.5	32.9	999.8712	62.42197
1	33.8	999.8986	62.42367
1.5	34.7	999.9213	62.42509
2	35.6	999.9399	62.42625
2.5	36.5	999.9542	62.42714
3	37.4	999.9642	62.42777
3.5	38.3	999.9701	62.42814
4	39.2	999.9720	62.42825
4.5	40.1	999.9699	62.42812
5	41	999.9638	62.42774
5.5	41.9	999.9540	62.42713
6	42.8	999.9402	62.42627
6.5	43.7	999.9227	62.42517
7	44.6	999.9016	62.42386
7.5	45.5	999.8766	62.42230
8	46.4	999.8482	62.42053
8.5	47.3	999.8162	62.4185
9	48.2	999.7808	62.41632
9.5	49.1	999.7419	62.41389
10	50	999.6997	62.41125
10.5	50.9	999.6541	62.40840
11	51.8	999.6051	62.40535
11.5	52.7	999.5529	62.40209
12	53.6	999.4975	62.39863
12.5	54.5	999.4389	62.39497
13	55.4	999.3772	62.39112
13.5	56.3	999.3124	62.38708
14	57.2	999.2446	62.38284
14.5	58.1	999.1736	62.37841
15	59	999.0998	62.37380
15.5	59.9	999.0229	62.36901
16	60.8	998.9432	62.36403
16.5	61.7	998.8607	62.35887
17	62.6	998.7752	62.35354
17.5	63.5	998.6870	62.34803
18	64.4	998.5960	62.34235
18.5	65.3	998.5022	62.33650
19	66.2	998.4058	62.33047
19.5	67.1	998.3066	62.32428
20	68	998.2048	62.31793
20.5	68.9	998.1004	62.31141
21	69.8	997.9934	62.30473
21.5	70.7	997.8838	62.29788
22	71.6	997.7716	62.29088
22.5	72.5	997.6569	62.28372
23	73.4	997.5398	62.27641
23.5	74.3	997.4201	62.26894
24	75.2	997.2981	62.26132
24.5	76.1	997.1736	62.25355
25	77	997.0468	62.24563
25.5	77.9	996.9176	62.23757
26	78.8	996.7861	62.22936
26.5	79.7	996.6521	62.22099
27	80.6	996.5159	62.21249
27.5	81.5	996.3774	62.20384
28	82.4	996.2368	62.19507
28.5	83.3	996.0939	62.18614
29	84.2	995.9487	62.17708
29.5	85.1	995.8013	62.16788
30	86	995.6518	62.15855
30.5	86.9	995.5001	62.14907
31	87.8	995.3462	62.13947
31.5	88.7	995.1903	62.12973
32	89.6	995.0322	62.11986
32.5	90.5	994.8721	62.10987
33	91.4	994.7100	62.09975
33.5	92.3	994.5458	62.08950
34	93.2	994.3796	62.07912
34.5	94.1	994.2113	62.06861
35	95	994.0411	62.05799
35.5	95.9	993.8689	62.04724
36	98.6	993.6948	62.03637
36.5	97.7	993.5187	62.02537
37	98.6	993.3406	62.01426
37.5	99.5	993.1606	62.00302
38	100.4	992.9789	61.99168
38.5	101.3	992.7951	61.98020
39	102.2	992.6096	61.96862
39.5	103.1	992.4221	61.95692
40	104	992.2329	61.94510
40.5	104.9	992.0418	61.93317
41	105.8	991.8489	61.92113
41.5	106.7	991.6543	61.90898
42	107.6	991.4578	61.89672
42.5	108.5	991.2597	61.88434
43	109.4	991.0597	61.87186
43.5	110.3	990.8581	61.85927
44	111.2	990.6546	61.84657
44.5	112.1	990.4494	61.83376
45	113	990.2427	61.82085
45.5	113.9	990.0341	61.80783
46	114.8	989.8239	61.79471
46.5	115.7	989.6121	61.78149
47	116.6	989.3986	61.76816
47.5	117.5	989.1835	61.75473
48	118.4	988.9668	61.74120
48.5	119.3	988.7484	61.72756
49	120.2	988.5285	61.71384
49.5	121.1	988.3069	61.70000

Temperature in		Density in	
°C	°F	kg/m^3	lb/ft^3
50	122	988.0839	61.68608
50.5	122.9	987.8592	61.67205
51	123.8	987.6329	61.65793
51.5	124.7	987.4051	61.64371
52	125.6	987.1758	61.62939
52.5	126.5	986.9450	61.61498
53	127.4	986.7127	61.60048
53.5	128.3	986.4788	61.58588
54	129.2	986.2435	61.57118
54.5	130.1	986.0066	61.55640
55	131	985.7684	61.54153
55.5	131.9	985.5287	61.52656
56	132.8	985.2876	61.51150
56.5	133.7	985.0450	61.49636
57	134.6	984.8009	61.48112
57.5	135.5	984.5555	61.46580
58	136.4	984.3086	61.45039
58.5	137.3	984.0604	61.43489
59	138.2	983.8108	61.41931
59.5	139.1	983.5597	61.40364
60	140	983.3072	61.38787
60.5	140.9	983.0535	61.37203
61	141.8	982.7984	61.35611
61.5	142.7	982.5419	61.34009
62	143.6	982.2841	61.32400
62.5	144.5	982.0250	61.30783
63	145.4	981.7646	61.29157
63.5	146.3	981.5029	61.27523
64	147.2	981.2399	61.25881
64.5	148.1	980.9756	61.24231
65	149	980.7099	61.22573

Temperature in		Density in	
°C	°F	kg/m^3	lb/ft^3
65.5	149.9	980.4432	61.20907
66	150.8	980.1751	61.19233
66.5	151.7	979.9057	61.17552
67	152.6	979.6351	61.15862
67.5	153.5	979.3632	61.14165
68	154.4	979.0901	61.12460
68.5	155.3	978.8159	61.10748
69	156.2	978.5404	61.09028
69.5	157.1	978.2636	61.07300
70	158	977.9858	61.05566
70.5	158.9	977.7068	61.03823
71	159.8	977.4264	61.02074
71.5	160.7	977.1450	61.00316
72	161.6	976.8624	60.98552
72.5	162.5	976.5786	60.96781
73	163.4	976.2937	60.95002
73.5	164.3	976.0076	60.93216
74	165.2	975.7204	60.91423
74.5	166.1	975.4321	60.89623
75	167	975.1428	60.87816
75.5	167.9	974.8522	60.86003
76	168.8	974.5606	60.84182
76.5	169.7	974.2679	60.82355
77	170.6	973.9741	60.80520
77.5	171.5	973.6792	60.78680
78	172.4	973.3832	60.76832
78.5	173.3	973.0862	60.74977
79	174.2	972.7881	60.73116
79.5	175.1	972.4890	60.71249
80	176	972.1880	60.69375

5.13 Specific Gravity

From Software version G2.0 onwards the operator has the option of displaying density as A SPECIFIC GRAVITY.

$$\text{Spec. Grav.} = \frac{\text{Density of Process Fluid}}{\text{Density of Water at } 20^\circ\text{C}}$$

To set the display for Specific Gravity go to menu Fct. 1.2.5:

	Fct. 1.2.(5).	DENSITY
→	0000.0000	(g) / cm^3
Press the ↑ key repeatedly until the display shows		
↑	0000.0000	(lb) / cm^3
↑	0000.0000	(S.G.)
↵	Fct. 1.2.(5).	DENSITY

5.13.1 Referred Density (Option)

Referred density is a factory-installed option which expands the type of density outputs available to three different variations - "actual" (normal density output), "fixed", and "referred". Any one of these three options can be selected in Fct. 1.2.5 or Fct. 3.2.5 - the "DENSITY" function of the "DISPLAY" submenu. Program "actual" if the "Referred" or "Fixed" Options are not desired.

Referred density corrects the actual density value to a standardised density value based on a reference temperature. The reference temperature and the slope are programmable. The sign of the slope coefficient (α) is always positive based on the assumption that increasing temperature decreases the actual density measured. The referred density equation is as follows:

$$\rho_r = \rho_a + \alpha (t_a - t_r)$$

where "ρ" is the density and "t" the temperature. Subscripts "r" and "a" indicate "referred" or "reference" and "actual" respectively.

Note that the above equation is linear. Referred density accuracy is determined by how precise a fit a linear function is to the actual temperature-density relationship of the process over the range of operating temperatures. Also note that the coefficient, α , depends on the temperature units selected, °F or °C, as well as the density units selected. The units of α are the change in density per degree change in temperature.

Key strokes for the "referred density" option shown below - start from the measuring mode:

Key	Display line 1	Display line 2	Step #
→	Fct.(1).0	OPERATOR	1. enter programming mode
2×↑	Fct.(3).0	INSTALL	
→	Fct.3.(1).0	BASIS.PARAM	
↑	Fct.3.(2).0	DISPLAY	
→	Fct.3.2.(1)	CYCL.DISP.	
4×↑	Fct.3.2.(5)	DENSITY	
→		ACTUAL	
↑		FIXED	
↑		REFERRED	
↵	0.0000000	(g)/cm^3	2. set mass units in this step (or S.G.)
→	0.0000000	g/(cm^3)	3. set volume units in this step
→	0(.)0000000	g/cm^3	1. set decimal point location in this step
↵	+ 20.0	REF.TEMP (°C)	2. set ref. temp. -°F or °C, sign & value
↵	(0).000000	SLOPE/°C	6. set slope (α) of temp. coefficient
↵	Fct.3.2.(5)	DENSITY	7. enter inputs
4×↵			8. return to measuring mode

5.13.2 Fixed Density (Option):

The "Fixed Density" Option permits setting a fixed, specific density value for the purpose of calculating volumetric flowrate and/or volumetric total from mass flow. This is useful when dealing with pure liquids or liquids with a known, fixed composition when it is desired to know the volumetric flow referenced to a specific (fixed) density at a specific temperature.

It is programmed by selecting ”FIXED” rather than ”REFERRED” and programming the fixed density value in that step (step #4) of the program shown in 6.13.2 where the decimal point is adjusted for ”Referred Density”. After setting the fixed density value, press 4x ↵ to return to the measuring mode. ”Actual Density” is programmed in similar fashion except the density value is not entered as with ”Fixed Density”.

5.14 User data

5.14.1 Programming the display language

The converter can display its messages and prompts in one of three languages, German, English or French. The language may be changed using Menu 3.8.1..
Example: Setting for German language

Begin from measuring mode.

Key	Display line 1	line 2	
→	Fct. (1).0	OPERATOR	
↑↑	Fct. (3).0	INSTALL	
→7x↑	Fct. 3.(8).0	USER DATA	
→	Fct. 3.8.(1)	LANGUAGE	
→		(GB/USA)	
↑		(F)	French
↑		(D)	German
↵	Fct. 3.8.(1)	SPRACHE	
		German selected	
↵	Fct. 3.(8).0	USER DATEN	
↵↵↵			

5.14.2 Password protection of menus

As mentioned in Section 4.2, access to the menus can be protected by a password. This password protection is enabled by Menu 3.8.2. and the password itself can be altered by Menu 3.8.3.. To enable password protection and to change the password from its factory setting, proceed as follows (Note: the password must be enabled in Fct. 3.8.2. before it can be changed in Fct. 3.8.3.).

Begin from measuring mode

Key	Display line 1	line 2
→	Fct. (1).0	OPERATOR
→→	Fct. (3).0	INSTALL
→7x↑	Fct. 3.(8).0	USER DATA
→↑	Fct. 3.8.(2)	ENTRY.CODE.1
→		(NO)
↑		(YES)
↵	Fct. 3.8.(2)	ENTRY.CODE.1.
↑	Fct. 3.8.(3)	CODE 1
→	CodE 1	- - - - - - - - -
any key x9	CodE 1	* * * * * * * * *
	Enter new password	
	CodE 1	- - - - - - - - -
	Enter the new password again	

If the new password was entered the same both times it will be accepted, otherwise "CODE WRONG" will be displayed.

NOTE:
The default value of the password protection code when leaving the factory is: → → → ↵ ↵ ↵ ↑ ↑ ↑

5.14.3 Custody transfer protection code

The converter can be set for measurement with or without the custody transfer protection enabled.

When using custody transfer protection, any additional provisions of the local calibration authority must be adhered to and the entire instrument must be approved by that authority.

The custody transfer protection can naturally also be used without official approval. The calibration protection in the converter affects only the total summating counter. All settings which alter the measured value of mass flow can no longer be altered when the calibration protection is active.

The following cannot be altered :

- Primary head type and CF 1 to 5
- Low flow cut-off
- Custody transfer password
- Mass total display units and format.
- Flow direction
- Flow mode (Set to FLOW > 0 only)
- Standby
- Control input function. (Only acknowledge messages still allowed)
- System control. (Conditions and limits that trigger the system control function are locked. 0 FLOW+RST function not allowed).
- Mass totaliser can no longer be reset. When the totaliser rolls over from 99999999 to 00000000 a status message will be set.

When custody transfer protection is enabled a warning message will be generated on any interruption of the mains supply, or if the process fluid temperature varies by more than ±30°C from the temperature that the zero calibration was performed at.
To enable or disable the custody transfer protection, use menu Fct. 3.8.6. CSTDY CODE.

Begin from measuring mode.

Key	Display line 1	line 2
→	Fct. (1).0	OPERATOR
2x↑	Fct. (3).0	INSTALL.
→	Fct. 3.(1).0	BASE DATA
7x↑	Fct. 3.(8).0	USER DATA
→	Fct. 3.8.(1)	LANGUAGE
5x↑	Fct. 3.8.(6)	CSTDY CODE
→		CodE 3
	Input 9-keystroke Entry-Code	
		CODE (NO)
↑		CODE (YES)
4x↵		

The default value of the custody transfer protection code when leaving the factory is

↵→↑↵↑→↵→↑

This password may be changed using Menu 3.8.7.. However, this can only be done if custody transfer protection is disabled first, as described above.

Begin from measuring mode.

Key	Display	
	line 1	line 2
→	Fct. (1).0	OPERATOR
2x↑	Fct. (3).0	INSTALL.
→	Fct. 3.(1).0	BASE PARAM.
7x↑	Fct. 3.(8).0	USER DATA
→	Fct. 3.8.(1)	LANGUAGE
6x↑	Fct. 3.8.(7)	CODE 3
→	CodeE 3	- - - - - - - -
	Enter new custody transfer password two times.	
	Fct. 3.8.(7)	CODE 3
4x↵		

If the two entered passwords are different the message "CODE WRONG" is displayed.

The message has to be acknowledged with the ↵ key and input must be repeated with Fct. 3.8.7.. Then the protection state 'active' or 'inactive' can be chosen with Fct.3.8.6..

NOTE:
If the input of the custody transfer password is wrong, a 9-character code is displayed. With this character code the manufacturer can decode the password in cases where the password is lost.

It is also possible to protect just the mass totaliser. Menu 3.8.5. ENABL.RESET determines whether the operator can clear the mass total from the ACKNOWLEDGE/RESET MENU.

Begin from measuring mode.

Key	Display	
	line 1	line 2
→	Fct. (1).0	OPERATOR
2x↑	Fct. (3).0	INSTALL
→7x↑	Fct. 3.(8).0	USER DATA
→4x↑	Fct. 3.8.(5)	ENABL.RESET
→		(YES)
↑		(NO)
↵	Fct. 3.8.(5)	ENABL.RESET
4x↵	+110.25	kg
	Mass Total Display	
↵	CodE 2	- -
↑→		RESET MASS
→		BLOCKED
	Totaliser Reset is disabled	
↵↵		

5.14.4 Primary head type and tube parameters (CF1 - 5)

The primary head type and tube parameters are factory set and should not normally be changed by the customer. They are only normally needed if the converter has to be replaced in the field. In this case, the new converter must be programmed with the correct primary head type, and parameters, CF1 to CF5, must be entered as printed on the data plate.
In order to prevent accidental changes to key parameters CF3 and CF5 and the Primary head type, an additional level of password protection is included. The operator may freely look at these parameters as "READ ONLY" but he may only be able to change it when he has first entered the correct PARAM.CODE 4 password.

	Fct. (1).0	OPERATION
↑↑	Fct. (3).0	INSTALL
→↑ × 7	Fct. 3.(8).0	USER DATA
→↑ × 7	Fct. 3.8.(8)	PARAM.CODE.4
↑	CodE 4	– –
↵↑		OK
↵	Fct. 3.8.(8)	PARAM.CODE.4

The operator may now edit, (if required), CF3, CF4, CF5 as well as PRIMRY.TYPE. Having made the changes the operator should save them and return to the main displays. Once back in the main displays any subsequent attempts to edit these parameters will be blocked until the PARAM.CODE.4 password is re-entered.

To edit these parameters:

Key	Display line 1	line 2
	Fct. 3.8.(8)	PARAM.CODE.4
↵↵	Fct. (3).0	INSTALL
→→4x↑	Fct. 3.1.(5)	PRIMRY.TYPE
→		(10G) T
↑		(100G) T
↑		(300G) T
→		(300G) T
↑		(300G) T+
	Select the correct size and type (T, T+, Z, Z+) as printed on the data plate.	
↵	Fct. 3.1.(5)	PRIMRY.TYPE
↑	Fct. 3.1.(6)	CF5
→	(0)16.000	CF5
	Enter CF5 as printed on the data plate.	
↵	Fct. 3.1.(6)	CF5
↵	Fct. 3.1.0.	INSTALL
8x↑	Fct. 3.9.0.	TUBE PARAM
→	Fct. 3.9.1.	CF1
	Enter CF1 to CF4 (Fct. 3.9.1. to 3.9.4.) as printed on the data plate.	
4x↵		

5.14.5 Location

It is possible to program each unit with an individual identification number. This is especially useful if the 'SMART' option is being used. To set the location number :

Begin from measuring mode

Key	Display line 1	line 2
→↑↑	Fct. (3).0	INSTALL
→7x↑	Fct. 3.(8).0	USER DATA
→↑↑↑	Fct. 3.8.(4)	LOCATION
→		(M)FC 085 Factory Setting

Use the ↑ key to change the character under the cursor. The sequence is :
A to Z, 0 to 9, +, -, *, /, =, SPACE.

Use the → key to move the cursor to the next character.

Press ↵ key when completed.

Part C Special options, Functional checks, Service and Order numbers

6. Special Options

6.1 Use in hazardous areas

MFM 4085 K/F - Ex Coriolis massflow meters are approved for use in hazardous areas as electrical equipment in conformance with the harmonised European Standards and Factory Mutual (FM). Conformity between the temperature classes and the temperature of the process fluid, meter size and material of the measuring tube is defined in the test certificate. The Test Certificate, certificate of conformity and wiring instructions are included in the Installation and Operating instructions for Ex equipment.

This is a separate manual to the standard Installation and Operating manual and is only supplied when an instrument for use in a hazardous area is ordered. If you have an "Ex" instrument, please ensure that you have this manual and read it carefully before using the massflow meter.

6.2 Converter with non-standard output options

The flowmeter may be supplied with one or more of the output options as mentioned in Part B, Section 4.7. These are factory fitted options and changes should not be attempted by unqualified personnel. Most of these options are hi-pot-tested to comply with the requirements of Ex and CE and if field exchanged these requirements may be violated. * Krohne will also not accept responsibility or honour the warranty if this is done. If you need an option change, please contact your nearest office for advice.

*All options are not compatible in certain configurations with older versions of software.

6.3 Concentration measurement

The Corimass G-Series may be fitted with a concentration measurement option. This option enables the meter to measure sugar concentration in °Brix or °Baumé, concentration by mass or volume.

The fluid may be a liquid / liquid or a liquid / solid suspension mixture. If the meter has been fitted with this option a separate Concentration manual will be supplied with the meter.
If you have any queries, please contact your local Krohne office for further assistance.

6.4 Converter with Hart communication option

The instrument menu can be accessed and programmed remotely via the 4 - 20 mA output. The following options are available:

a) H.H.C Hand-Held Communicator with Hart communications protocol.
b) MS DOS PC via an RS 232 adaptor and CONFIG software

Detailed instructions are supplied when these options are purchased. Refer to the section with the Order numbers for ordering details or contact Krohne.

6.5 Converter with RS 485 or Modbus Communication option

When this option is fitted only one analog 4 - 20 mA output is fitted as well.

Detailed description of the Krohne RS 485 or Modbus protocol is available on request or when the meter is ordered a copy is included in the instruction package.

6.6 Custody Transfer option

The G-Series has been approved for custody transfer applications in Germany. If you have a custody transfer application, please check with your local authorities in the weights and measures department for local requirements.

Krohne will gladly assist in obtaining a local approval.

7. Functional checks

7.1 Test functions

Menu 2.0. contains a number of test functions. These allow the current, frequency and alarm outputs to be driven at a number of fixed test levels, so that the communication between the converter and the customer's equipment can be verified. In addition, other functions allow various measured parameters from the primary head to be viewed directly for trouble shooting purposes.

7.1.1 Testing the display

This function sends a test sequence to the LCD display which causes each element of the display to be lit in sequence. If any segments fail to light, this indicates that the display is faulty and should be replaced.

Begin from measuring mode.

Key	Display line 1	line 2
→↑	Fct. (2).0	TEST
→	Fct. 2.(1)	TEST DISP.
→	Display blanks then starts its test sequence	

The test may be terminated at any time by pressing the ↵ key, otherwise the display returns automatically when the sequence is complete.

7.1.2 Testing current output

This function allows a number of fixed current levels from 0 to 22 mA to be driven from the current output. This function interrupts the normal operation of the output, so the operator will be asked if he is sure before the test commences.

Key	Display line 1	line 2
	Fct. 2.(1)	TEST DISP.
↑	Fct. 2.(2)	TEST I
→		SURE (NO)
↑		SURE (YES)
↵		(0 mA)
		0 mA is output
↑		(2 mA)
↑		(4 mA)
↑		(10 mA)
↑		(16 mA)
↑		(20 mA)
↑		(22 mA)
↑		(0 mA)

Press the ↵ key at any time to stop the test and return the output to normal operation.

Systems with two or more current outputs

From software G2.00 onwards programming of any current output will be by menus Fct. 1.3.0 and Fct. 3.3.0 (testing will be by menu Fct. 2.2) regardless of how many current outputs are fitted. When programming (or testing) a system with two current outputs the operator must first select the desired output number.

	Fct. 3.(3).0	CUR.OUT.I
→	Fct. 3.3.0	CUR.OUT.I(1)
↑	Fct. 3.3.0	CUR.OUT.I(2)
	Use the ↑ key to select the desired output number	
↵	Fct. 3.3.(1)	FUNCTION I
	Program the selected output as normal	

7.1.3 Testing pulse output

This function allows the frequency/pulse output to be tested. The frequency output has an open collector transistor drive which requires a pull-up resistor to an external DC power supply. (Sect. 2.3). When this output is connected to the customer's instrumentation, reliable operation can only be ensured if the customer takes proper care to ensure the connection is properly screened against external electrical interference. Therefore, it is important that this output connection should be thoroughly tested before being put into use.

To test the frequency, connect a frequency meter to the pulse output terminals and proceed as follows:

Key	Display line 1	line 2
	Fct. 2.(2)	TEST I
↑	Fct. 2.(3)	TEST P
→		SURE (NO)
↑		SURE (YES)
↵↵	Fct. 2.3.(1)	FREQUENCY
→		(LEVEL LOW)
		0V on the output
↑		(LEVEL HIGH)
		+V on the output
↑		1 Hz
		A frequency meter connected to the output will show 1Hz.
↑		10 Hz
↑		100 Hz
↑		1000 Hz
		After testing the 1000 Hz signal connect a counter to the output.
↵	Fct.2.3.(1)	FREQUENCY

To test the pulse output, connect an external counter to the output terminals. When testing the pulse output, the operator has the choice of the following pulse widths: 0.4 ms, 1.0 ms, 10.0 ms, 100.0 ms and 500 ms. The operator should choose the pulse width that best matches the performance of his external pulse counter.

Connect a pulse counter to the impulse output and proceed as follows:

	Fct. 2.(3).0	TEST P
→		SURE (NO)
↑		SURE (YES)
↵	Fct. 2.3.(1)	FREQUENCY
↑	Fct. 2.3.(2)	TEST PULSE
→		(0.4 mSec)
	Use the ↑ to select the desired pulse width	
↑		(1.0 mSec)
↑		(10.0 mSec)
↑		(100.0 mSec)
	Having selected the pulse width zero the external counter and then press ↵	
↵	625	100.0 mSec

The meter now issues a stream of pulses with the set width. The running total of pulses sent is shown on the display. The test stops when either 100,000 pulses have been sent or the operator presses the ↵ key.

If the counter reads a smaller number than the actual number of pulses sent, or the frequency meter under reads, then this indicates that a weak signal is reaching the frequency meter/pulse counter. In this case try the following suggestions:-

(i) Decrease the external pull-up resistor
(ii) Decrease/remove the filter capacitor.
(iii) Decrease the cable length between the converter and the counter.
(iv) Add external buffers to boost the signal.

If the pulse counter reads a larger number than the converter, or if the frequency meter reading is high or unstable, then this indicates the presence of external interference. Try one or more of the following:-

(i) Add/increase the size of the filter capacitor. (10 - 100nF)
(ii) Use high quality screened cable.
(iii) Keep cable lengths as short as possible, avoiding high power equipment/switchgear and any cabling connected to them.
(iv) Use external buffers.

7.1.4 Testing alarm output

This is a simple function that allows the alarm output to be tested at both its high and low states.

Key	Display line 1	line 2
	Fct. 2.(3)	TEST P
↑	Fct. 2.(4)	TEST A
→		SURE (NO)
↑		SURE (YES)
↵		(LEVEL LOW)
		0V on the output
↑		(LEVEL HIGH)
		+24V on the output
↵	Fct. 2.(4)	TEST A

7.1.5 Testing control input

Menu 2.5 allows the state of the control input signal to be tested.

Key	Display line 1	line 2
	Fct. 2.(4)	TEST A
↑	Fct. 2.(5)	TEST INP.E
→	HI	RESET MASS

Line 1 of the display shows the current state of the input. HI = 4 - 24 Volts, LO = 0 - 2 Volts. Line 2 shows the currently selected function of the input. As the voltage on the input changes so the display will change from HI to LO accordingly. However, whilst using the test function no action will be taken in response to the input (i.e. the total will not be reset).
NOTE: If the input is disconnected it will read LO.

7.1.6 Viewing temperature and strain

Menu 2.6 allows the current temperature and strain gauge readings to be monitored. These figures are used internally by software for flow and density compensation.

Key	Display line 1	line 2
	Fct. 2.(5)	TEST INP.E
↑	Fct. 2.(6)	TEST TEMP.
→	20.0	°C
	Current temperature °C	
↑	68.0	°F
	Current temperature °F	
↑	465.05	STRAIN
	Resistance of the Strain Gauge in Ohms.	
↵	Fct. 2.(7)	TEST TEMP.

7.1.7 Viewing primary head signal conditions

Menu 2.7 allows four measured parameters from the primary head to be displayed.

Sensor A, Sensor B (Fct. 2.7.1 and 2.7.2)
These give the normalised sensor signal levels from the primary head. In normal operation these are controlled so that they both read about 80 - 82%.

If the sensors read less than this it indicates that the vibrations of the primary head are being impeded. This could be due to a poor installation or a large quantity of air in the process fluid.

Frequency (menu 2.7.3)
This function displays the current resonant frequency of the primary head. This value is primarily used to calculate the density of the process fluid.

Installation factor (menu 2.7.4)
This factor is a measure of the quality of the primary head's installation. This figure shows roughly how much energy is required to sustain the oscillations in the primary head. Generally, the lower the installation factor the better the installation, any reading less than 20 for 10 to 800 G, 30 for 1500 G, 40 for 3000 G is acceptable (See Section 1.2.4 for Ex Installation factors - which are higher.). In addition, if the process fluid has a large gas content this will have the effect of damping out primary head oscillation, which will in turn cause the installation factor to increase.

8. Service and Troubleshooting

8.1 Threads and "O" Ring of the converter housing lid

The screw threads and gaskets of both housing covers should be well greased at all times. Always check for signs of damage and never allow dust to accumulate. Defective gaskets and lids should be replaced immediately to maintain the integrity of the protection category.

The grease used must be non-corrosive to aluminium and should be acid- and resin-free.

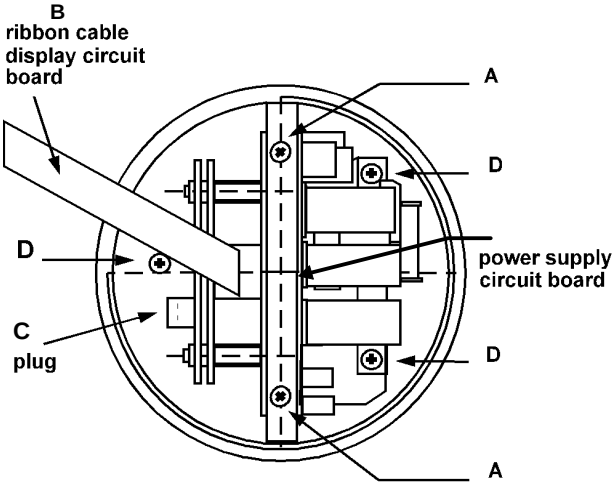
8.2 Replacing the converter electronics

Always switch off power before commencing work!
For Ex version allow 30 minutes to cool before opening housing.

1. Use the special wrench to remove the cover from the terminal compartment.
2. Disconnect all cables from the terminals in the rear terminal compartment.:

MFC 085 : term. 5/6/4/4.1/4.2/11/12

3. Use the special wrench to remove the cover from the electronic compartment.
4. Undo screws A and fold display board to side.
5. Remove plug C (10-pin, signal cable).
6. Undo screws D using a screwdriver for recessed-head screws and carefully remove the complete electronics.
7. On the electronics, check the supply voltage and fuse F9, and change / replace if necessary, see Sect. 8.3.
8. Reassemble in reverse order (points 6 to 1).
9. Primary head specific parameters, as printed on the data plate, must now be entered on to the new converter. (see section 7.1).
10. Subsequently be sure to check the zero and store the new zero value.



A. Screws that hold the display PCB in place.

B. Ribbon cable connecting display PCB to converter electronics.

C. 10-pin sensor connector.

D. Screws that hold the converter electronics in place.

Important: Ensure that the screw thread of the covers on the electronics and terminal compartments are well greased at all times. The grease used must be non-corrosive to aluminium and should be acid- and resin-free.

8.3 Change of operating voltage and power fuse F9

Always switch off power source before commencing work!

Remove electronics as described in Section 8.2.

8.3.1 Replacement of power fuse F9

The mains fuse F9 of the converter, sits on the power supply board beside the transformer, as shown below.
The fuse will not blow, unless there was either a connection error or a fault in the converter itself.
The table below shows the right fuse for the different voltages the converter could be set to. Do not use any other than the specified type.

For position of fuses, see power supply board layout diagram.

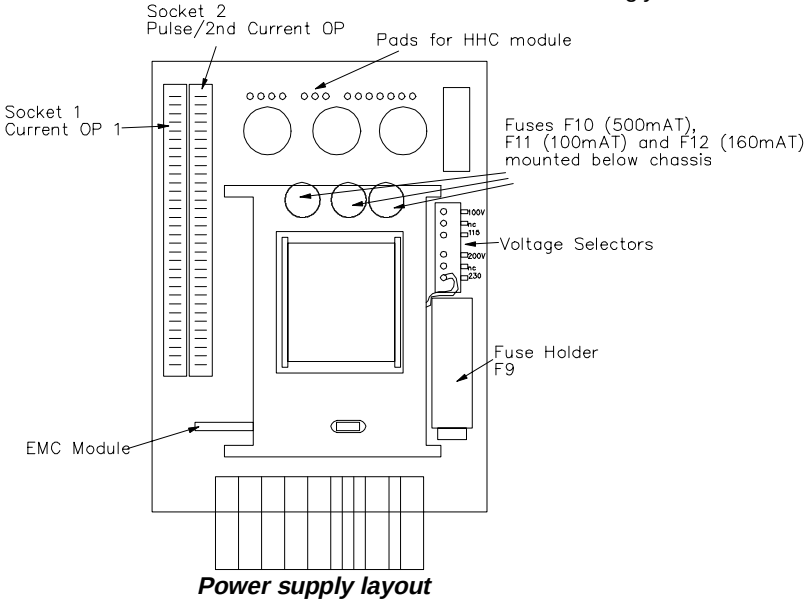
Voltage	Fuse F9
200,230/240 VAC	160 mA T
100,115/120 VAC	315 mA T
42,48 VAC	800 mA T
21,24 VAC	1.6 A T

The fuses should be in anti-surge type with a breaking capacity of 1500 A at 250 V AC.
For part numbers, see table under section 9, Order numbers.

8.3.2 Changing the operating voltage

1. Insert voltage select cable into the correct position on the power supply circuit board, to obtain desired voltage.
2. If necessary, change fuse F9 to suit the new voltage. (See fuse table for values of F9)

IMPORTANT
If the operating voltage has been altered from the factory setting, ensure that the primary head's data plate and the label on the F9 fuse holder are amended accordingly.



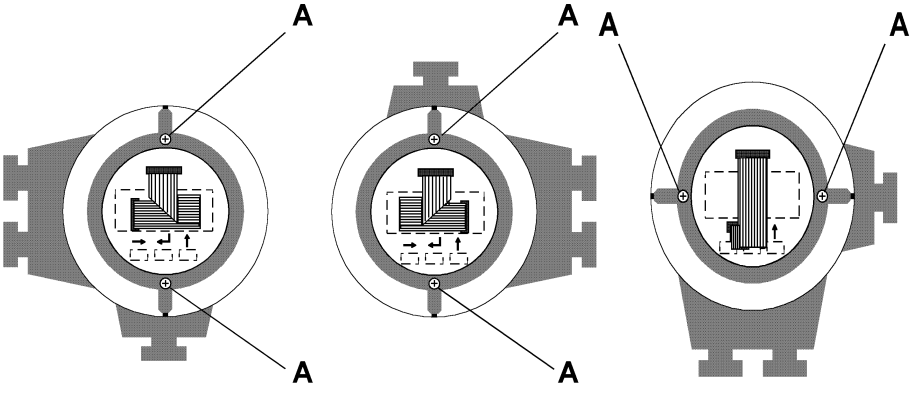
Power supply layout

8.4 Turning the display circuit board

To ensure horizontal positioning of the display irrespective of the location of the MFM 4085 K compact flow meter, the display circuit board can be turned through 90° or 180°.

1. **Switch off the power supply!**
2. Unscrew the cover from the electronics compartment using the special wrench.
3. Remove screw A from the display board.
4. Turn display board into desired position.
5. Fold the ribbon cable as shown in the following drawings. Please follow directions scrupulously so as to avoid damage to electronic components and printed boards! For the version on the right the screws A must be repositioned on the display board.
6. Carefully screw down the display board.

Directions for folding the ribbon cable on the display circuit board:



8.5 Turning the signal converter housing

To facilitate access to connecting, indicating and operating elements on MFM 4085 K compact flow meters that are installed in locations that are hard to get at, the signal converter housing can be turned through 90°.

1. The connection wires between primary head and signal converter housing are extremely short and can break easily.
2. **Switch off the power source!**
3. Clamp the flow meter firmly by the primary head housing.
4. Secure the converter housing against slipping and tilting.
5. Loosen slightly but **do not remove** the 4 bolts connecting the two housings.
6. Carefully turn the converter housing clockwise or anti-clockwise a maximum of 90°, but do not lift the housing. If the gasket should stick, do not attempt to lever it off.
7. To conform to the requirements of protection category IP 67, keep connecting faces clean and tighten the 4 fixing bolts uniformly.

Any faults resulting from failure to follow these instructions scrupulously shall not be covered by our warranty!

WARNING: Ex/Hazardous duty versions may not be turned. Please order correct position at time of placing order or consult Krohne.

8.6 Troubleshooting

Operational errors may be caused by:

– The process medium
– The installation
– The measuring system

Most frequently, errors occur in the measuring system when it is installed and switched on for the first time. They are normally due to incorrect installation of the primary head.

When the measuring system is switched on and the converter's self-test has been carried out (Display message 'TEST') the message 'STARTUP' is displayed. During this time, the converter tries to activate the primary head. Usually, the desired value for the oscillation amplitude is reached after a few seconds and the converter starts displaying mass flow. However, if the display is flashing, the system cannot enter the measuring mode. The problem is signalled by the arrow to 'Status' on the front plate.

First of all, it is advisable to inspect the installation to determine if it was installed in compliance with the installation instructions. If this is the case, then the following steps should be taken for localising the fault :

If the primary head is not installed in a vertical position, increase the flush period and flow rate in order to remove air bubbles and solid materials from the primary head.
If the primary head starts to oscillate, but the measured values are erratic or the primary head keeps returning to STARTUP, then the possible cause of the trouble could be:

1. Poor installation causing an excessively high installation factor.
2. Bad zero calibration.

Monitor the primary head's INSTAL.FACT using Fct. 2.7.4. If the reading is high, (see Section 1.2.3) then this indicates either poor meter clamping or excessive gas in the process fluid. For horizontally installed systems, flush the meter at a high flow rate to remove any air bubbles that may have collected. Shut off the flow and recheck the drive level. If the drive reading is still high, check that the meter has been installed and clamped correctly. In a poor installation, drive power is wasted in transmitting vibrations to the attached pipe work, and this greatly degrades meter performance. As a general guide, the clamping should be adjusted as described in the installation manual.

Sympathetic vibrations, which are transmitted to the primary head via the floor or the pipe system, can lead to an unstable zero point. This can cause the mass totalizer to ”creep” with time, even when the flow is shut off.

Another reason for an increase in the display of the flow rate is due to calibrating the zero point with a non-zero flow rate. In this case, make sure that the shutoff valves are completely closed and then re-calibrate the zero point.

Problems occurring during the measuring process

During operation the system is continually checking itself and its measured values against various conditions. If one or more of these conditions are broken, then the system indicates that a problem has occurred and various messages are stored in an internal message list. Whenever a new problem is found the display starts to flash and the status arrow is lit, drawing the operator's attention to the problem. The display will continue to flash indefinitely until the operator acknowledges the warnings.

The operator may inspect the message list at any time, using the RESET/ACKNOWLEDGE menu. As the operator goes through the list, if a message is marked with '≡' characters, this indicates a new warning that the operator had not previously acknowledged. At the end of the list the operator is asked to acknowledge the warnings with 'QUIT (YES)' prompt. If the operator selects YES by pressing the ↵ key, the system will attempt to remove the warnings from the list. If the source of a problem is still present (say mass flow is too high for example) the warning can not be removed from the list. When the operator returns to the measurement mode the display will have stopped flashing showing that all the problems detected so far have been acknowledged. However, the status arrow will only be extinguished if there are no longer any messages present in the list. It is also possible to indicate in the main display if so desired (see section 5.12).

In summary

The display flashes if the meter has detected problems that have not been acknowledged by the operator.
The status arrow is shown until all warnings have been acknowledged and cleared.
– The warning message shown in the display, if cause is still present.
– A warning is contained in the message list if :
The cause of the problem is still present.
The cause of the problem is no longer present, but the warning has not yet been acknowledged.
– A message shows three bars "≡" as long as it has not been acknowledged.

A complete list of warning messages and their causes are given on the following page.

Status messages

ERROR MESSAGES	TYPE	COMMENT
SAMPLING	Severe	PLL out of range
SENSOR A	Severe	Sensor A voltage signal less than 5% of desired value
SENSOR B	Severe	Sensor B voltage signal less than 5% of desired value
RATIO A/B	Severe	One sensor signal much larger than the other
EEPROM	FATAL	Unable to save data in EEPROM. Hardware fault.
SYSTEM	FATAL	Indicates software error, will always occur with WATCHDOG
WATCHDOG	Severe	Reset due to SYSTEM error or temporary power supply drop-off
NVRAM	Severe	NVRAM check sum error, previous data lost
DC A	Severe	DC voltage part of sensor A is larger than 20% of ADC max
DC B	Severe	DC voltage part of sensor B is larger than 20% of ADC max
NVRAM FULL	Light	NVRAM has exceeded its specified number of write cycles
MASS FLOW	Light	Mass flow rate > 2 nominal flow *
ZERO ERROR	Light	Mass flow rate at zero adjust is larger than > 20% of nominal (100%) flow rate *
TEMPERATUR	Light	Temperature > outside operating range
STRAIN	Light	Strain out of operating range
CURRENT.SAT	Output	Current output saturated **
FREQ.SAT	Output	Frequency output saturated **
ALARM.OUT.A	Output	Process alarm limit check exceeded **
ROM DEF	Light	EEPROM check sum error, defaults loaded from ROM
TOTAL O/F	Light	Custody transfer only. Mass total has overflowed the display, i.e. it has gone from 99999999 to 00000000
TEMP.CUST	Light	Custody transfer only. Operating temperature has drifted by more than ±30°C from the zero calibration temperature
POWER.FAIL	Light	Custody transfer only. There has been an interruption of power to the converter.

* Actual mass flow rate is too big or manual zero offset PUTIN.VAL in Fct. 1.1.1 was programmed incorrectly.

** Change output range to avoid saturation.

8.7 Fault finding

Most of the common faults and symptoms experienced with the flowmeter can be resolved with the help of the following table.

To simplify the use of the table, the faults and symptoms are grouped together:

GROUPS
- D Display, inputs and outputs
- I Current output
- P Pulse output
- A Alarm output (Status)
- E Control input (Binary)
- OP Measurement mode and commissioning
- ST Commissioning and Start-up of the flowmeter

Please check the following table of hints and advice before calling your KROHNE Service Department.

Group	Fault / Symptom	Cause	Remedy
Group D			
D1	No display or outputs	Power not switched on	Switch on power
		Power supply fuse F9 blown	Replace fuse as per Section 8.3.1
		Fuses F10, and/or F12 blown	Replace converter as per Sect. 8.2 or call Krohne service.
D2	Fluctuating display and outputs	Time constant too small	Increase time constant as per Section 5.3.
D3	Mass flow display incorrect	The wrong values for parameters CF3 - CF5 programmed. (These are stamped on the data plate)	Check and correct according to Sections 5.12 and 5.14.4
		Zero calibration	Re-do zero, check manual offset
		Primary sensor faulty	Check as per Section 8.8
D4	Density display and outputs not correct	Parameters CF 1-4 incorrect	Check the correct according to 5.12 - 5.14:
		Excitation frequency of primary sensor not correct when filled with water (see section 1.2.5)	Check for air in meter. Call Krohne.
		Primary sensor faulty	Check as per Section 8.8
Group I			
I1	Connected instrument displays 0 or negative values	Connection polarity wrong	Correct as per Sect. 2.3
		Connected instrument faulty or current output faulty	Check output with a mA meter. I Test OK Check cabling and connected instrument and replace if necessary. I Test faulty Current output faulty. Replace converter or call Krohne service.
Group	**Fault / Symptom**	**Cause**	**Remedy**

		Current output switched off.	Switch on as per Fct. 3.3.1
I2	Wrong display on connected instrument	Current programming not correct.	Correct the programming as per Fct. 3.3.1 - 3.3.4
I3	Fluctuating display on connected instrument	Time constant too small	Increase the time constant as per Fct. 3.1.3
Group P			
P1	Connected totalizer not counting	Connection / polarity not correct.	Check and correct as per Section 2.3
		Totalizer or external supply voltage faulty.	Check output with totalizer: Test OK Check cabling and totalizer. Check external voltage supply Test faulty Pulse output faulty. Replace converter or call Krohne Service.
		Alarm output is used as external voltage supply, a possible electrical short-circuit or alarm/pulse output faulty.	Check connections as per Section 2.3. Voltage between terminals 5 and 4.2 approx. 24 V. Correct short circuit if present. If still faulty the alarm or pulse output is faulty. Re-place converter or call Krohne Service.
		Pulse output is switched off	Switch on as per Fct. 3.4.1
P2	Fluctuating pulse rate	Time constant too small	Increase time constant as per Fct. 3.1.3
P3	Pulse rate too high or too low	Programming of pulse output incorrect.	Correct programming as per Fct. 3.4.1 - 3.4.4
		External induced noise due to low quality cable or unscreened cable.	Check cabling and replace with screened cable. See Section 2.3
Group A			
A1	Alarm output not functioning	Connection / polarity incorrect.	Correct as per Sect. 2.3
		Alarm output or external instrument faulty	Program alarm output to "direction" as per Fct. 3.5.1. Set flow direction to negative and check alarm output. Test OK Check external instrument and if necessary replace. Test faulty Alarm output faulty. Replace converter or call Krohne Service.
		Alarm output switched off	Switch on as per Fct. 3.5.1
A2	Incorrect voltage level at output terminals (Hi/Lo)	Incorrectly programmed in Fct. 3.5.2	Correct as follows: Hi = 24 V Lo = 0 V

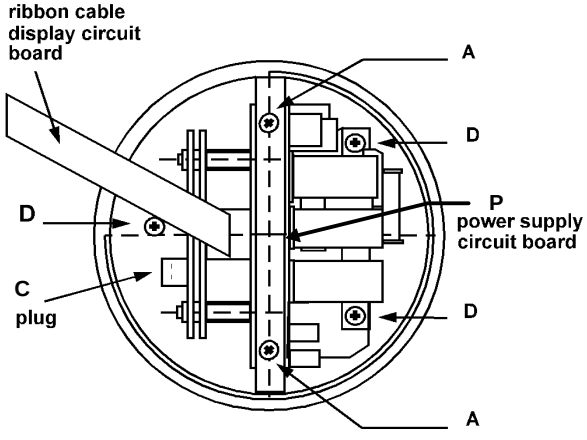
Group	Fault / Symptom	Cause	Remedy
Group E			
E1	Control input does not function	Connection / polarity incorrect.	Correct as per Sect. 2.3
		Programming incorrect	Correct the programming as per Fct. 3.6.1 - 3.6.2. Test as per Fct. 2.15. If test is faulty, the output is faulty. Replace converter or call Krohne Service.
		Control input switched off.	Switch on as per Fct. 3.6.1
Group ST			
ST1	Display keeps returning to ”test”. (during start-up)	Poor/intermittant power. Supply to meter.	Check incoming supply
		Hardware failure	Replace converter or call Krohne Service.
ST2	Display returns to ”Start up” and the status arrow is illuminated.	Possible poor mechanical installation.	Check install factor and correct installation as per Section. 1
			Check the status list in reset/quit menu as per Section 4.5 and acknow-ledge the error message.
		Primary Sensor faulty	Check as per Sect. 8.8
		Fuse F11 blown. (negative analog voltage).	Call Krohne Service.
ST3	Display returns to Start-up and the primary sensor is noisy.	Sensor cannot vibrate freely due to poor mechanical installation.	Correct installation as per Section 1 and try again.
Group OP			
OP1	Installation factor larger than value given in Sect. 1.2.3	Mechanical installation not correct or air bubbles in process fluid. External influences due to pumps, motors, etc.	Check installation and correct if necessary (see Section 1). Flush process pipe work to get rid of air.
OP2	Display indicates a flow-rate during zero setting. Valves closed.	Valves not shut tight or air in process fluid.	Check valves for tight shut-off. Flush lines with high velocity.
		Zero calibration not OK	Check that flow is zero and pipe is full without air bubbles. Do automatic calibration as per Section 5.1 and ensure that a ”0” is programmed in the zero set function.

8.8 Checking the Primary Head

Remember! Always switch the power off before opening the converter housing.

Required tools and test equipment
- Phillips screwdriver
- Multimeter
- Special wrench to unscrew converter housing lids

8.8.1 Compact Meter



A. Screws that hold the display PCB in place.

B. Ribbon cable connecting display PCB to converter electronics.

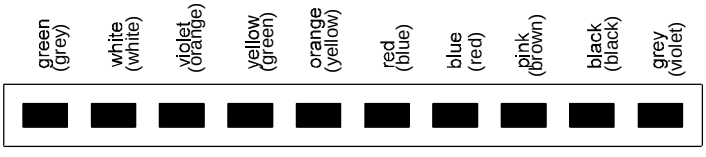
C. 10-pin sensor connector.

D. Screws that hold the converter electronics in place.

P. Power supply circuit board

Preliminary preparation
- Remove front lid of electronic housing
- Unscrew the two screws ”A” that hold down the display PCB and fold the ribbon cable and PCB carefully to one side.
- Unplug blue primary connector ”C” from amplifier board

10-Pin Sensor Connector ”C” (Connector between primary and converter)

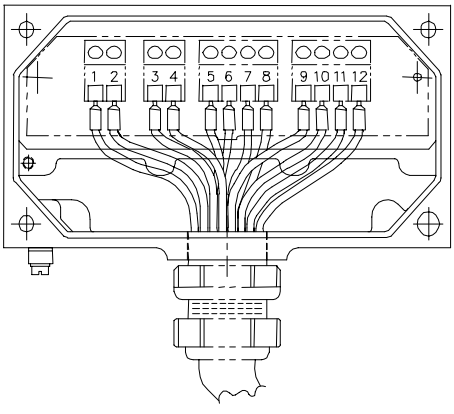


Colours in parenthesis are valid for Ex-converters

Testing the resistance values of the sensors and exciter		Typical values	Assessment of measured values
1	**Measuring tube driver**: Measure between grey and black	30 - 50 ohm	
2	**To check sensor A and B**: Measure between: green and violet (Sensor A) white and yellow (Sensor B)	50 - 130 ohm	**Measurements outside typical values:** Primary faulty Replace or call Krohne service.
3	**To check the temperature sensor (RTD)**: Measure between blue and red.	500 - 550 ohm (ambient temperature dependent)	**Measurements inside typical values:** Sensor OK
4	**To check the strain gauge**: Measure between orange and red.	400 - 600 ohm	

8.8.2 Remote Meter

The G meter can be supplied as remote meter with 5 m cable. Under no circumstances should the cable cut be shorter or joined to increase its length. The meter is calibrated with this 5m cable length. Any changes will influence the performance of the meter.
There are two different configurations of remote meter, on the first version the cable is cast on the converter end and the second has a terminal junction box at the converter end. On the junction box version, the measurements can be done at the terminals. On the cast version, measurements can be done on the blue primary connector (see section 8.8.1).



TERMINAL No	COLOUR	SIGNAL
1	WHITE	DRIVE –
2	BLACK	DRIVE +
3	YELLOW	SCREEN
4	YELLOW	SCREEN
5	BLACK	–
6	RED	STRAIN
7	BLACK	TEMP/STRAIN
8	BLUE	TEMP
9	ORANGE	SENS B –
10	BLACK	SENS B +
11	GREEN	SENS A –
12	BLACK	SENS A +

Testing the resistance values of the sensors and exciter		Typical values	Assesment of measured values
1	**Measuring tube driver**: Measure between white and black	30 - 50 ohm	
2	**To check sensor A and B**: Measure between: green and black (Sensor A) orange and black (Sensor B)	50 - 50 ohm	**Measurements outside typical values:** Primary faulty Replace or call Krohne service.
3	**To check the temperature sensor (RTD)**: Measure between blue and black	500 - 550 ohm (ambient temperature dependant)	**Measurements inside typical values:** Sensor OK
4	**To check the strain gauge**: Measure between black and red.	400 - 600 ohm	

8.9 Status Warnings

The MFC 085 can detect a number of anomalous conditions during operation. These are classed into four groups as follows :

LIGHT
These include :
– Mass flow >2x primary head rating.
– Temperature outside operating range
– Mass total overflow.
Typically these indicate a problem with the use of the instrument, not the instrument itself.

OUTPUT
These warnings occur where the converter is trying to drive a signal on either the current or frequency output which is outside the selected range. For example: Max flow = 10kg/min but actual flow is 15kg/min. If the current output was set for mass flow then it would saturate at 20mA (10kg/min) plus over-range. Saturation of the outputs in this way may or may not be a problem for the operator, so it is optional as to whether a warning is set or not in this case. (If required, the process alarm could be used to indicate independently the saturation of the outputs). In addition, if the Process Alarm is used to detect that a measured value is out of range then this also generates an output warning.

SEVERE
These include any fault that causes the primary head to stop vibrating. This may be due to large quantities of air in the process fluid or to poor clamping of the instrument. Severe errors may also be due to a hardware fault. The instrument will restart as soon as the fault clears.

FATAL
Fatal errors indicate a major fault with the converter. In this case the converter stops completely and then tries to restart as if it had just been switched on. Normally such errors will require repair by service personnel.

Viewing and acknowledging warning messages
Whenever a warning occurs the display will start to flash and the status arrow on the display will be set. The flashing display enables the operator to see from a distance that a problem has occurred. The operator can now inspect the list as follows:
Begin from measuring mode.

Key	Display line 1	line 2
↵	CodE 2	- -
↑	CodE	* -
→		RESET MASS
↑		MSG. LIST
→	≡2 Err≡	MASS FLOW
	(Flow > 2 x Nominal tube flow)	
	The "≡" symbols indicate that this warning has not previously been acknowledged.	
→	2 Err	I1 SAT
	(Current output saturated)	
↵		QUIT (YES)
↵		MSG. LIST

If the operator selects "QUIT YES" the status arrow will disappear if the causes of the warning have themselves cleared. However, if for example the mass flow is still too large, then the arrow will remain. On returning to the measurement, however, the display will have stopped flashing. This shows that the warnings have been acknowledged by the operator even if it was not possible to clear them. In this event, the flow rate should be reduced and "QUIT YES" selected again.

The user can control the level of warnings from Fct.1.2.2. This menu also allows the warning to be viewed directly from within the measurement mode if desired.

The operator can choose from:

NO MESSAGE
No warnings will be displayed in the main displays. Output saturation warnings ignored. Light warnings do not cause display to flash.

PRIMARY HEAD
Light warnings registered in main display. Output warnings ignored.

OUTPUT
Only output warnings in main display.

ALL MESG.
All warning messages displayed.

NOTE:
Only if "OUTPUT" or "ALL MESGS." are selected above will saturation of the outputs trigger a converter warning (display flashing etc.), otherwise these conditions are completely ignored.

If this facility is enabled then the operator may view the warnings as follows :
Begin from measuring mode

Key	Display line 1	line 2
	(23.124	kg/min)
	whole display flashing	
↑	(≡2 Err≡	Mass Flow)
	error not yet acknowledged	
↑	(0.98	g/cm3)
↑	(2 Err	I1 SAT)
↑	(1244.344	kg)
↑	(≡2 Err≡	Mass Flow)
↑	(20.4	°C)

To set up the converter to display errors in the measuring mode:

Begin from measuring mode

Key	Display line 1	line 2
→	Fct. (1).0.	OPERATOR
→↑	Fct. 1.(2).0.	DISPLAY
→↑	Fct. 1.2.(2)	STATUS MSG.
→		(NO MESSAGE)
↑		(PRIMRY.HEAD)
↑		(OUTPUT.)
↑		(ALL MESGS.)
↵	Fct. 1.2.(2)	STATUS MSG
4x↵		

If the current output is set to a range with a warning state (e.g. 0 - 20/22mA) then the output will jump to that state when any anomalous condition occurs.

9. Order numbers

Standard Converters			Order Number
100 - 240 V AC	HART	CE	2.10710100
21 - 48 V AC	HART	CE	2.10710340
24 V DC	HART	CE	2.10725100
100 - 240 V AC	Multi I/O HART	CE	2.11239020
21 - 48 V AC	Multi I/O HART	CE	2.11239040
24 V DC	Multi I/O HART	CE	2.11239060

Ex Converters			Order Number
100 - 240 V AC	HART	CE	2.10724100
21 - 48 V AC	HART	CE	2.10724340
24 V DC	HART	CE	2.10726100
100 - 240 V AC	Multi I/O HART	CE	2.11239080
21 - 48 V AC	Multi I/O HART	CE	2.11239100
24 V DC	Multi I/O HART	CE	2.11239120

Power Supply - Fuse F9		
Value	Order number	Fuse type
160 mA T	5.07379.00	5 × 20 mm G-Fuse Switching capacity 1500 A
315 mA T	5.05804.00	
800 mA T	5.08085.00	
1.6 A T	5.07823.00	
1.25 A T	5.09080.00	TR 5, switching capacity 35 A

Fuse		Value
F 10	+5 V Analog voltage	500 mA T
F 11	Negative Analog voltage	100 mA T
F 12	Input /output functions	160 mA T

These fuses F10, F11 & 12 are soldered into the power supply and are essential to ensure the system complies with the European Union's low voltage directive. Any attempt to replace these fuses will invalidate the waranty and should not be attempted by the customer. These fuses will only blow in the event of:

- Customer abuse, i.e. removing the display with the power still on or incorrect use of outputs.
- Hardware fault

Spares and accessories		Order number
1.	Special spanner for lid	3.07421.01
2.	Lid "O"ring seal	
3.	RS 232 Adaptor and Config. Software	2.10209.00
4.	Magnet	2.07053.00

Part D Technical Data, Measurement principle and Block diagram

10. Technical Data

10.1 Measuring ranges and error limits

CORIMASS MFM 4085 K&KM	10 G	100 G	300 G	800 G	1500 G	3000 G
Measuring ranges (*see "Reference conditions" below)						
Nominal flow rate	10 kg/min 600 kg/h 22 lb/min	100 kg/min 6000 kg/h 220 lb/min	300 kg/min 18000 kg/h 660 lb/min	800 kg/min 48000 kg/h 1760 lb/min	1500 kg/min 90000 kg/h 3300 lb/min	3000 kg/min 180000 kg/h 6600 lb/min
Useable range	20 kg/min 1200 kg/h 44 lb/min	200 kg/min 12000 kg/h 440 lb/min	600 kg/min 36000 kg/h 1320 lb/min	1600kg/min 96000 kg/h 3520 lb/min	3000 kg/min 180000 kg/h 6600 lb/min	6000 kg/min 360000 kg/h 13200 lb/min
Min. flow rate	0.25 kg/min 15 kg/h 0.55 lb/min	2 kg/min 120 kg/h 4.4 lb/min	5 kg/min 300 kg/h 11 lb/min	15 kg/min 900 kg/h 33 lb/min	25 kg/min 1500 kg/h 55 lb/min	50 kg/min 3000 kg/h 110 lb/min
Measuring accuracy / error limits	(See reference conditions below)					
Mass flow	better than ± (0.15% of MV + Cz)					
Density						
(range 0.5 - 2 g/cm^3 or 30-125 lb/ft^3, field calib.)	± 0.009 g/cm^3	± 0.003 g/cm^3	±0.002 g/cm^3	±0.002 g/cm^3	±0.002 g/cm^3	±0.002 g/cm^3
	± 0.56 lb/ft^3	± 0.19 lb/ft^3	0.13 lb/ft^3	0.13 lb/ft^3	0.13 lb/ft^3	0.13 lb/ft^3
Temperature (within temperature range)	≤ 1°C/1.8°F	≤ 1°C/1.8°F	≤ 1°C/1.8°F	≤ 1°C/1.8°F	≤ 1°C/1.8°F	≤ 1°C/1.8°F
Zero stability	±0.0005kg/min	± 0.005 kg/min	±0.015 kg/min	± 0.04 kg/min	±0.075kg/min	±0.150 kg/min
	± 0.0011lb/min	± 0.011 lb/min	± 0.033 lb/min	± 0.088 lb/min	±0.163 lb/min	±0.326 lb/min
Repeatability	better than ± (0.04% of MV + Cz)					
	MV = measured value					
	$Cz\,[\,\%\,] = \left\{ \frac{\text{zero stability} \times 100\%}{\text{mass flow}} \right\}$					

*Reference conditions	(pulse output)
Liquid	Water at 20°C / 68°F
Ambient temperature	20°C / 68°F
Operating pressure	2 bar / 29 psig

10.2 Primary head

CORIMASS MFM 4085 K and KM			10 G	100 G	300 G	800 G	1500 G	3000 G
Connections								
Flange	DIN 2635	PN 40	DN 10/15	DN 15/25	DN 25/40	DN 40/50	DN 50/80	DN 50/100
	ANSI B 16.5	150 lb	½"	¾",1	1",1 ½"	1½",2"	2",3"	3",4"
Sanitary	Tri-Clamp		½"	¾"	1½"	2"	2"	on request
Process parameters								
Temperature			-25°C to Tmax **or** -13°F to Tmax, See Table below					for Tmax

Material Type				
Size	T *	T+ **	Z	Z+
10 G	130°C	130°C	100°C	100°C
100 G	130°C	130°C	100°C	100°C
300 G	130°C	130°C	100°C	100°C
800 G	130°C	130°C	100°C	100°C
1500 G	130°C	130°C	100°C	100°C
3000 G	130°C	130°C	-	-

*Temperature of 150°Con request

Density	0.5 – 2 g/cm^3 **or** 30 to 125 lb/ft^3
Nominal pressure	≤ 63 bar **or** ≤ 910 psig, dependent on connection
Pressure drop	0.9 | 0.5 | 0.7 | 0.5 | 0.7 | 0.3
Ambient temperature (complete flow	
in operation Standard	– 30 to + 60°C **or** – 20 to + 140°F
Hazardous-duty	– 20 to + 55°C **or** – 4 to + 131°F
in storage	– 50 to + 85°C **or** – 58 to + 185°F
Secondary containment housing	63 bar / 910 psig, standard
Protection category IEC 529/EN 60 529	IP 67, equivalent to NEMA 6 (complete flow meter)
Hazardous-duty version (complete f/meter)	
European Standard	EEx de or d [ib] IIC T6 ... T3, PTB-No. Ex-94.C.2054 X, Ex-97.D.2194 X and Ex-97.D.2195 X
Factory Mutual (FM)	Class I, Div 1 and Div 2
Materials	
Wetted parts	titanium alloy, grade 9, ASTM B 338-91 / Zirconium
Secondary containment housing	stainless steel 1.4301/1.4306 (AISI 304/304L) 3000 G: Powder coated steel ASTM 106 B
Flanges	stainless steel 1.4301/1.4306, 1.4401/1.4404 (AISI 304'304L or 316/316L)
Special versions	Steam/ liquid heating, heating medium temp. max.150°C/ 302°F, max. 5 bar/72 psig food approved version 3A or EHEDG

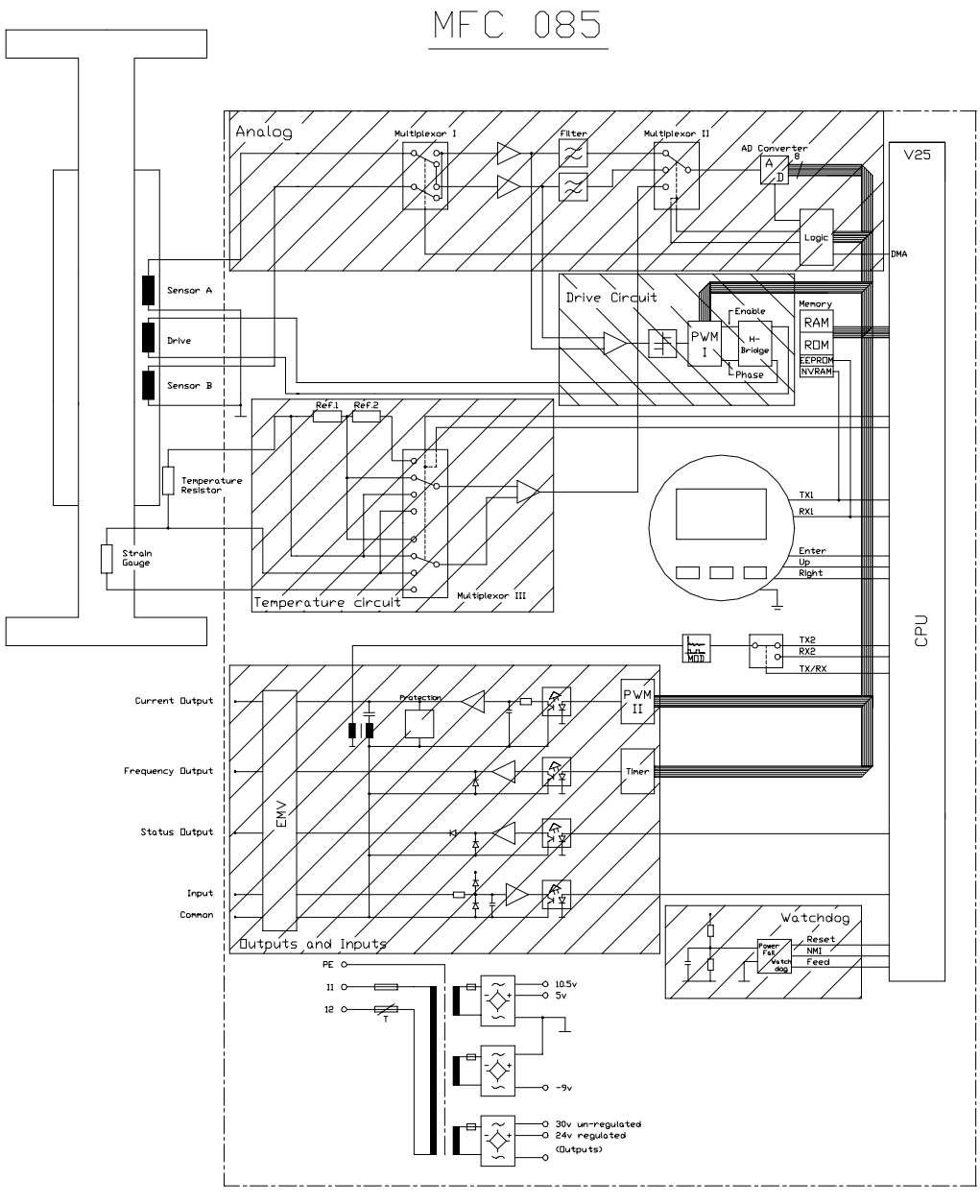
10.3 MFC 085 Signal Converter

Measured quantities and units	
Mass flowrate	g, kg, t, oz, lb **per** second, minute, hour, day
Total mass (or total volume)	g, kg, t, oz, lb (or cm^3, dm^3, m^3, liter, in^3, ft^3, imp. or US gallons)
	g, kg, t **per** cm^3, dm^3, m^3, liter **or** oz, lb **per** in^3, ft^3, imp. or US gall
Density	specific gravity, referred density, fixed density
Volumetric flowrate	cm^3, dm^3, liter, m^3, in^3, ft^3, imp. or US gall **per** sec, min, hour, day
Temperature	°C or °F
Option	sugar concentration in °Brix or Baumé, mass or volume concentration, caustic soda concentrate
Programmable functions	display format, physical units, current, pulse and status outputs, low-flow cutoff, time constant, primary constant, lower/upper range limits, forward/reverse measurement, standby, zero and reset of total mass
Current output	For input/output Connections, see table below.
Function	– All operating data adjustable – galvanically isolated only from mains, CPU, etc. not from other outputs
Current	0 - 20 mA or 4 - 20 mA
Load	≤ 500 ohms
Linearity	≤ 0.2% of measured value in range of 2 - 20 mA ≤ 0.02% of full scale deflection in range of 0 - 2 mA
Pulse output	If fitted see “inputs and outputs / versions” above
Function	– all operating data adjustable – open collector – galvanically isolated only from mains, CPU, etc. not from other outputs
Pulse rate	up to 1300 Hz
Amplitude	max. 24 V
Load rating	≤ 150 mA
External voltage	≤ 24 V DC
Status output	If fitted – all operating data adjustable – galvanically isolated only from mains, CPU, etc. not from other outputs
Function	status, limit value, direction identification
Voltage	max. 24 V, also suitable as voltage source for the pulse output
Load rating	short-circuit-proof. Voltage limiting initiated at > 20 mA.
Control input	If fitted
Function	– programmable for totalizer reset, zero point, status acknowledgement or changeover standby ←→ measuring mode – galvanically isolated via optocoupler – active “high” or “low”
Control signals	high: 4 - 24 V low: 0 - 2 V input current: 0.2 mA

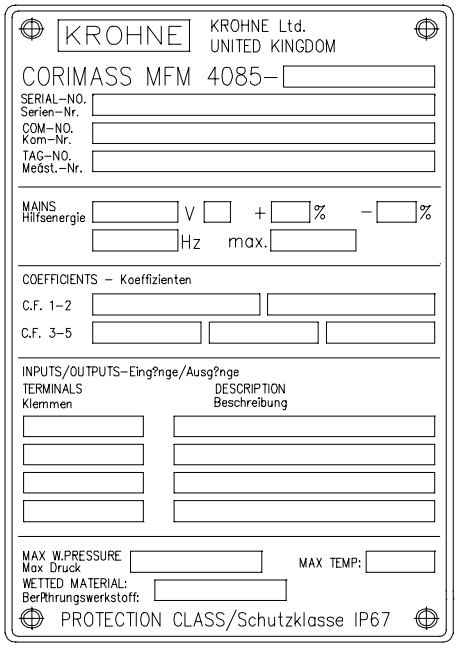
	OPTION 1 STD	OPTION 2 2 CRNT	OPTION 4 1 Current & RS485	OPTION 5 1 Current & Modbus	OPTION 6 1 Current input,Dual phase pulse	OPTION C 3 CRNT & PULSE	OPTION D 3 CRNT & I CONTR INPUT	OPTION E 3 CRNT & CONTR INPUT	OPTION F 3 CRNT & STATUS
Current Outputs	1	2	1	1	1	3	3	3	1
Pulse Outputs	1	0	0	0	1	1	0	0	0
Status Outputs	1	1 (passive)	0	0	0	0	0	1 (passive)	0
Binary Inputs	1	1	0	0	1	0	1	0	0
TERMINALS :-									
4.2	Alarm	Alarm	+5V	+5V	Pulse B	Pulse	Input	Alarm	+5V
4.1	Pulse	Current 2	TX / RX	TX / RX	Pulse A	Current 3	Current 3	Current 3	TX / RX
4	Input	Input	TX /RX	TX /RX	Input	Current 2	Current 2	Current 2	TX /RX
6	Current	Current 1	Current 1	Current 1	Current 1	Current 1	Current 1	Current 1	Current 1
5	Common	Common	Common	Common	Common	Common	Common	Common	Common

Low-flow cut-off		0 - 10% of nominal full-scale range
Time constant for flow		0.5 - 20 seconds (optionally: 0.2 - 20 seconds)
Power supply		
Standard		230 V AC ± 10% 200 V AC ± 10% 115 V AC ± 10% 100 V AC ± 10% 48 - 63 Hz
Special versions		21, 24, 42, 48 V AC, +10/-15%, 48 - 63 Hz 24 V DC, ± 30%
Power consumption		AC : 18 VA DC : 10 W
Operator control / interfaces		
Keypad		3 keys → ↵ ↑
Local display	Type	3-line, illuminated LCD display 1st (top) line: 8 character, 7 segments for numerals and signs 2nd (middle) line: 10-character, 14 segments for texts 3rd (bottom) line: 6 markers ▼ for status identification
	Function	actual measured value, forward, reverse or sum totalizer (7 characters), each can be set for continuous or cyclic display, and status output
	Meas quantities. and units	see page 89 “Measured quantities and units”
	Plain text language	English, German French
Magnetic sensors MP		same function as the 3 keys, operation by means of hand-held bar magnet without opening the housing
Communications options		
RS 232 adaptor and Config. Software		Operating via a MSDos PC. For further information see Product Guide 6 “Communications techniques”.
HART-System		Via handheld communicator. For further information see Product Guide 6 “Communications techniques”.
RS 485/ Modbus Serial communications		For detailed protocol information please contact Krohne
Housing material		die-cast aluminium with polyurethane finish

10.4 Block diagram of Converter MFC 085



10.5 Instrument data plate (Std.)

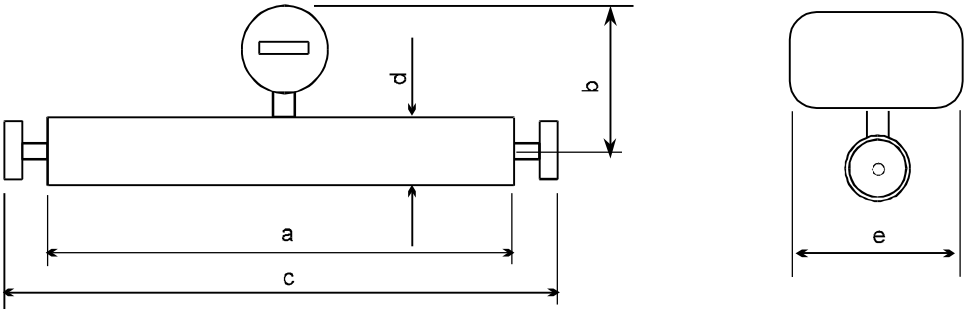


10.6 Dimensions and weights

Dimensions In mm and (inch)	**MFM 4085 K Compact Unit**					
	10 G	**100 G**	**300 G**	**800 G**	**1500 G**	**3000 G**
a	415 (16.34)	565 (22.24)	744 (29.29)	988 (38.90)	1115(43.90)	1400(55.12)
b	242 (9.55)	249 (9.80)	249 (9.80)	269 (10.60)	283 (11.14)	335 (13.19)
c (with flanges)	490 (19.29)	656 (25.83)	843 (33.19)	1110(43.70)	1242(48.90)	1630(64.17)
c (with different connections)	On request					
d	90 (3.54)	102 (4.02)	102 (4.02)	142 (5.59)	170 (6.69)	274 (10.79)
e	208 (8.19)	208 (8.19)	208 (8.19)	208 (8.19)	208 (8.19)	208 (8.19)
Weight in kg & (lb)	12.1 (26.7)	17.6 (38.8)	26.5 (58.4)	59.0 (130)	101 (223)	190 (419)

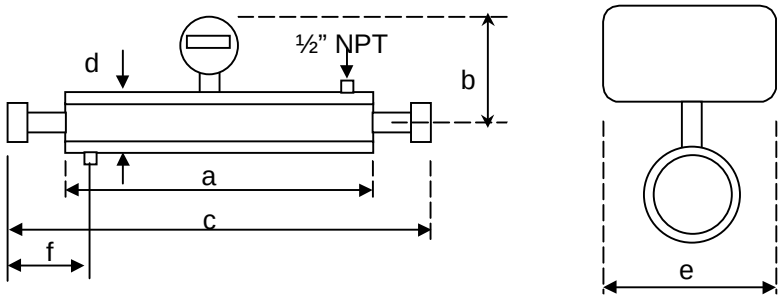
For hazardous-duty version, dimensions e + 30 mm or e + 1.18" and dimension b + 18 mm or b + 0.71"

- 800 G with 1 ½"ANSI 600 lb flanges, dimensions c + 8 mm or c + 0.32"
- 1500 G with ANSI 600 lb flanges, dimensions c + 8 mm or c + 0.32"



Meters with Heating Jackets

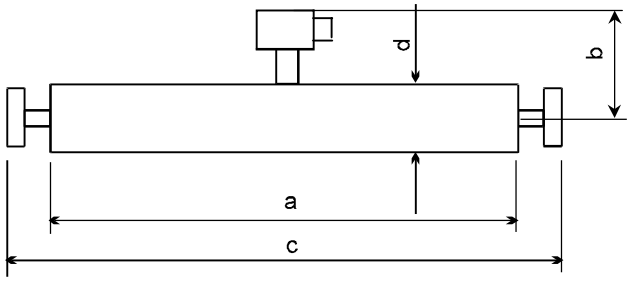
Dimensions In mm and (inch)	MFM 4085 K Compact Unit					
	10 G	**100 G**	**300 G**	**800 G**	**1500 G**	**3000 G**
d	102 (4.02)	115 (4.53)	115 (4.53)	156 (6.14)	206 (8.11)	In prep
f	67 (2.7)	76 (3.0)	80 (3.1)	91 (3.6)	94 (3.7)	In prep
Weight in kg & (lbs) and Empty Jacket	14.3 (31.5)	20.9 (46.1)	30.9 (68.1)	66 (146)	112 (247)	In prep



Dimensions In mm and (inch)	MFS 4000 F Standard					
	10 G	**100 G**	**300 G**	**800 G**	**1500 G**	**3000 G**
a	415 (16.34)	565 (22.24)	744 (29.29)	988 (38.90)	1115(43.90)	1400(55.12)
b	159 (6.25)	166 (6.54)	166 (6.54)	186 (7.32)	200 (7.87)	252 (9.92)
c (with flanges)	490 (19.29)	656 (25.83)	843 (33.19)	1110(43.70)	1242(48.90)	1630(64.17)
c (with different connections)	On request					
d	90 (3.54)	102 (4.02)	102 (4.02)	142 (5.59)	170 (6.69)	274 (10.79)
e	208 (8.19)	208 (8.19)	208 (8.19)	208 (8.19)	208 (8.19)	208 (8.19)
Weight in kg & (lb)	9.9 (21.8)	15.4 (34.0)	24.3 (53.6)	57 (126)	99 (218)	188 (414)

For hazardous-duty version, dimensions e + 30 mm or e + 1.18" and dimension b + 18 mm or b + 0.71"

- 800 G with 1 ½"ANSI 600 lb flanges, dimensions c + 8 mm or c + 0.32"
- 1500 G with ANSI 600 lb flanges, dimensions c + 8 mm or c + 0.32"

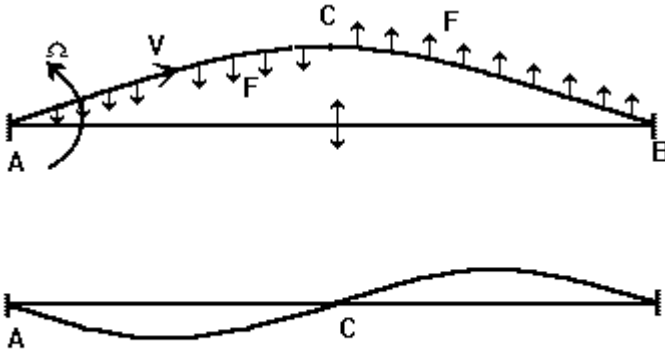


Dimensions In mm and (inch)	MFS 4000 F with heating option					
	10 G	**100 G**	**300 G**	**800 G**	**1500 G**	**3000 G**
d	102 (4.0)	114.3 (4.5)	114.3 (4.5)	156 (6.14)	206 (8.11)	In prep
f	67 (2.7)	76 (3.0)	80 (3.1)	91 (3.6)	94 (3.7)	In prep
Weight in kg & (lbs) and Empty Jacket	12.1 (26.7)	18.7 (41.2)	28.7 (63.9)	65 (143)	110 (243)	In prep

11. Measuring Principle

Coriolis forces occur in oscillating systems when a mass moves towards or away from an axis of oscillation. This is illustrated by way of a simple example.

A measuring tube oscillates about the neutral axis A-B. The fluid particles in the liquid product flow through the measuring tube at velocity 'v'.



Between points A and C these fluid particles are accelerated from a lower to a higher rotational velocity. The mass of these accelerated particles generates Coriolis force F_C opposing the direction of rotation.

Between points C and B the fluid particles are decelerated which sets up Coriolis forces in the direction of rotation. These Coriolis forces (Fc) which act upon the two halves of the tube with opposite direction, are directly proportional to the mass flow.

The Coriolis distortion is extremely small and superposed on the fundamental component of the measuring tube. The total motion of the measuring tube is picked up by inductive sensors.

A measured value that refers directly to the mass flowrate of the liquid flowing through the measuring tube is generated by appropriate signal processing.

12. Software History

Release Date	Hardware	Firmware	Installation/ Operating Manual
3/94 to 7/97	MFM 4085 K	Up to G 2.20	7.02194.31 (GB) 7.02194.71 (USA)
7/97 to 10/97	MFM 4085 K+F	U 2.21 to U 2.27	7.02194.31 (GB) 7.02194.71 (USA) plus G+ Addendum
10/97	MFM 4085 K+F	G 3.00	7.02194.31 (GB) 7.02194.71 (USA) plus G+ Addendum
11/97	MFM 4085 K+F	G 3.01	7.02194.31 (GB) 7.02194.71 (USA) plus G+ Addendum

If you need to return flow meters for testing or repair to KROHNE

Your CORIMASS mass flow meter

– has been wet calibrated in an accurate flow meter test rig.

If installed and operated in accordance with these operating instructions, your flow meter will rarely present any problems.
Should you nevertheless need to return a CORIMASS flow meter for checkout or repair, please pay strict attention to the following points:

Due to statutory regulations concerning protection of the environment and the health and safety of our personnel, Krohne may only handle, test and repair returned flow meters that have been in contact with liquids if it is possible to do so without risk to personnel and environment. This means that Krohne can only service your flow meter if it is accompanied by a certificate in line with the following model confirming that the flow meter is safe to handle.

If the flow meter has been operated with toxic, caustic, flammable or water-endangering liquids, you are kindly requested

– to check and ensure, if necessary by rinsing or neutralising, that all cavities in the flow meter are free from such dangerous substances. (Directions on how you can find out whether the primary head has to be opened and then flushed out or neutralised are obtainable from Krohne on request.)
– to enclose a certificate with the flow meter confirming that the flow meter is safe to handle and stating the liquid used.

Krohne regret that they cannot service your flow meter unless accompanied by such a certificate.

SPECIMEN certificate

Company: ..... Address: .....

Department: ..... Name: .....

Tel. no.: .....

The enclosed Coriolis mass flow meter

CORIMASS, Type: ..... Krohne order no. or series no.: .....

has been operated with the following liquid:

.....

Because this liquid is water-endangering */toxic */caustic */flammable * we have:

– checked that all cavities in the flow meter are free from such substances*
– flushed out and neutralised all cavities in the flow meter *

(*delete if not applicable)

We confirm that there is no risk to man or environment through any residual liquid contained in this flow meter.

Date: ..... Signature: .....

Company stamp: