



TRICOR®

Remote Display TRD 8001





Manual-Version

TRD_8001_CLASSIC_M_EN_190215_E004

SW-Version

This manual is valid for

Main SW: Mv3.40 and higher

Display SW: Dv3.40 and higher

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1. General Information

1.1. Features

The TRD 8001 is a remote display for the TRICOR CLASSIC Mass Flow Meter.

It can be used for units with TCE 8000 electronics as a second display or for units with the TCE 6000 electronics as temporary display for setup or as permanent display.

1.2. Safety

1.2.1. General Safety

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

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

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

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

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

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

1.2.2. Special Requirements for Ex Installations

Installation and operation in potentially hazardous areas (Zone 0 and Zone 1) is not permitted. For installation and operation in ATEX zone 2, please read the instructions in chapter 3.3.

1.2.3. Warnings in this Manual

NOTE:

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

WARNING!

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



1.3. Ordering Codes and Accessories

1.3.1. Ordering Code

Ordering Code	Description
TRD 8001	Remote display for TRICOR CLASSIC Mass Flow Meter
TRD 8001-Ex	TRD 8001 for hazardous areas, zone 2 (ATEX II 3G Ex nA IIC T4)

1.3.2. Accessories

Ordering Code	Description
Contact KEM	Connecting Cable TRD ⇔ TCE 8000 electronics
217012	Connecting Cable TRD ⇔ TCE 6000 electronics, 2 meters
217011	Connecting Cable TRD ⇔ TCE 6000 electronics, 5 meters

2. Getting Started

2.1. Unpacking

Verify that you have received the following items:

- TRD 8001
- Instruction manual
- Connecting cable to the TRICOR CLASSIC Mass Flow Meter (when ordered)

2.2. Operating Elements

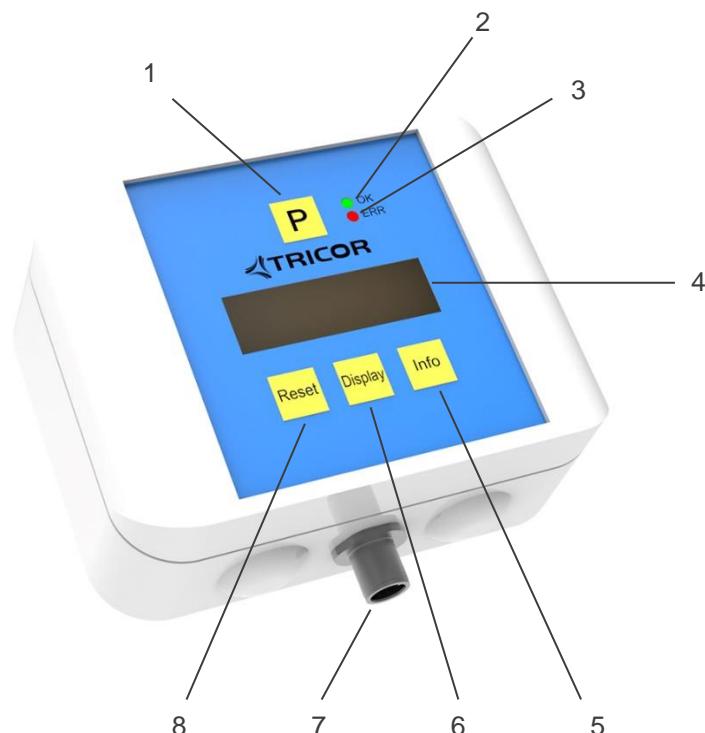


Fig. 1: Operating Elements of TRD 8001

- 1 = Pushbutton "P", activates/selects the different menus and confirms the settings
- 2 = LED "OK", flashes green when there is no error
- 3 = LED "ERR", flashes red when an error occurs
- 4 = Display
- 5 = Pushbutton "Info", normal: selects the status menu, SETUP: softkey
- 6 = Pushbutton "Display", normal: toggles the display, SETUP: softkey
- 7 = I/O connector
- 8 = Pushbutton "Reset", normal: resets the batch counter, SETUP: softkey



2.3. Pin Assignments

The I/O connector is an M12 connector, B coded, male.

I/O connector pin assignment

1	+ 24 V	Positive supply
2	-RS485	RS485 negative line
3	GND	Supply ground
4	+RS485	RS485 positive line
5	n.c.	

Tab. 1: I/O connector pin assignment

2.4. Quick Start

WARNING!

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

In case the TRD 8001 has to be used with a TCE 6000, just connect it via the standard cable available from KEM.

If the TRD 8001 is to be used with a TCE 8000, connect the cable available from KEM in the TCE 8000 according to the TRICOR CLASSIC instruction manual.

2.4.1. First Operation

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

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

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

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

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

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

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

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

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

2.4.2. CONTROL Menu

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

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

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

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

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

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

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

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

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

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

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



3. Installation

3.1. Mechanical Installation

The TRD 8001 can be used as a handheld display for fast setting or check at an TCE 6000 electronics or as wall mounted display.

For wall mount provide 2 or 4 fixing points according to the drawing in chapter 7.3.2.

Flip up the side covers of the housing, fix the housing with suitable screws to the wall and reclose the side covers.

NOTE

It is not necessary to open the housing for mounting the TRD 8001.

3.2. Electrical installation

The TRD 8001 can be connected to or disconnected from the TRICOR CLASSIC electronics at any time via the M12 connector at the TRD 8001, without switching off the power supply and without disturbing the operation of the TRICOR CLASSIC Mass Flow Meter.

3.2.1. Connecting to a TCE 8000

Switch off the power supply for the TCM and prepare the TCE 8000 for installing the cables (see TRICOR CLASSIC instruction manual).

Connect the cable to the TCE 8000 according to Tab. 2.

If possible use end sleeves for the individual wires.

Terminal M12 conn	Signal	Color	Terminal TCE 8000
1	+24 V	Yellow	50
2	-RS485	Green	21
3	GND	Grey	8 or 20 or 51
4	+RS485	Pink	22
5	n. c.		
PE	Protective ground		

Tab. 2: Connections TCE 8***

3.2.2. Connecting to a TCE 6000

Connect the male connector of the cable to the connector "RS485" of the TCE 6000.

Connect the female connector of the cable to the TRD 8001.

3.3. Ex Installation

WARNING!

In hazardous locations all installations must only be carried out by qualified personnel!

Switch off all power supplies before installing or uninstalling the unit in hazardous locations!

The TRD 8001 is available for hazardous areas, zone 2 (II 3G Ex nA IIC T4).

The TRD 8001 can as well be used as a secondary display outside the hazardous area for a TRICOR CLASSIC Mass Flow Meter with TCE 8000 electronics located inside the hazardous area.

WARNING!

Never install any TRD 8001 in zone 0 or 1!



4. Manual Operation

4.1. Power On Sequence and Principles of Manual Control

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

CORIOLIS

TRICOR

TRD 8001

SENSOR TYPE

TCM 028K

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

SW MAIN

Rev.: V3.40

This indicates the SW version of the main processor.

SW DISPLAY

Rev.: V3.40

This indicates the SW version of the display processor.

READY

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

*** WARNING ***

NO ACTUAL RAM BACKUP

SEE MANUAL

OK

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

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

For further information refer to chapter 4.5.9.

Now the TRD 8001 switches to the measuring mode, displaying the default screen:



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

In manual control the TRD is menu driven and provides two operational modes, the "Measuring Mode" and the "Control Mode".

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

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

In the control menu all necessary settings can be made.

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

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

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

For the description of the control menu see chapter 4.5.

4.2. Setup Guidelines

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

The different possibilities for optimizing the settings are described below.

4.2.1. Meter Mode

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

For avoiding strange effects with the total values when changing the engineering units, the TRD 8001 can be set up as a Mass Flow Meter, a Volume Flow Meter, a Gas Flow Meter or a Net Oil Computer.

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



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

4.2.2. Offset Adjustment

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

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

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

4.2.3. Flow Filter

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

The filters in the TRD 8001 are set by means of the time constant t . The time constant is the time the output needs, after a jump from a value x to 0, to go to $x/e = x/2.72$. A higher time constant means more stable reading, but also a slower reaction to changing flows.

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

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

A linear filter as it is realized in the TRD 8001 electronics just delays the flow reading and consequently the “TOTAL” value. Independent of the slope (fast or slow) of the rising and falling flow, the error of the internally calculated TOTAL and at the frequency output are canceled out, if the flow rises from zero (or any other value) and later goes back to the starting value. For getting a correct “TOTAL” via the display or the frequency output, it is just necessary to wait long enough after the flow is switched off.

For best results the TRD 8001 electronics provides two filters.

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

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

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

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

4.2.4. CUT OFF

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

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

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

For setting “CUT OFF” please refer to chapter 4.5.6.3.

4.2.5. STEP RESPONSE

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

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

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

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

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

For setting “STEP RESPONSE” refer to chapter 4.5.6.4.

4.2.6. Interaction of the Parameters

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

FLOW FILTER and CUT OFF

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

NOTE:

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



FLOW FILTER and STEP RESPONSE

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

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

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

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

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

WARNING!

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

4.3. Measuring Mode

4.3.1. Function of the Pushbuttons

In the measuring mode all pushbuttons have a fixed function:

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

4.3.2. Display Selection

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

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

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

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

4.3.3. Display Resolution

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

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

Example:

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

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

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

If the display shows “DISPLAY OVERFLOW”, change the engineering units. If any “TOTAL” display shows “DISPLAY OVERFLOW”, you can also reset the “TOTAL” values. (see chapter 4.5.10).

4.3.4. Resetting the Batch (TOTAL-) Value

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

For changing the setting, please refer to chapter 4.5.6.5.

4.3.5. Event Logging

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

There are three event classes:

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



4.3.5.1. Event codes

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

Error (ERR codes)

Event Code	Message on display	Meaning
ERR: ON	ERR: OFF	
0	96	INITIALIZATION FAILED
1	97	AMP. SENSOR A
2	98	AMP. SENSOR B
3	99	MEAS. DELAY OVER 250
5	101	UNST. DRIVER CURRENT
6	102	PT1000 OUT OF RANGE
7	103	TUBE FREQ. TOO LOW
8	104	TUBE FREQ. TOO HIGH
9	105	DRIVER CURRENT LOW
10	106	DRIVER CURRENT HIGH
17	113	MASS FLOW TOO HIGH
18	114	MASS FLOW TOO LOW
19	115	TEMPERATURE TOO HIGH
20	116	TEMPERATURE TOO LOW
21	117	DENSITY TOO HIGH
22	118	DENSITY TOO LOW
23	119	PRESSURE TOO HIGH
24	120	PRESSURE TOO LOW

Tab. 3: List of errors (ERR Codes)



Warnings (WARN Codes)

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

Tab. 4: List of warnings (WARN Codes)

Information (INFO Codes)

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

Tab. 5: List of information (INFO Codes)



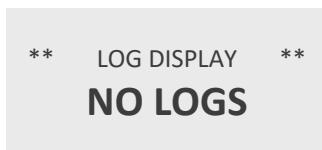
4.3.5.2. Info and event log menu

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

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

Display of log entries

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



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

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

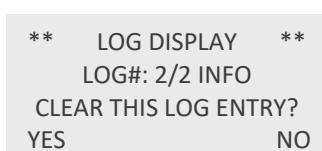


Here the most recently recorded (most current) is an INFO event that is the second of a total of two existing log entries. It was recorded approximately 4.8 seconds after powering up the TRD and provides the information that initialisation of the TRD was completed successfully at that time (“INITIALIZATION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

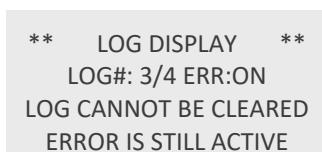
Resetting (erasing) event logs

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

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



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



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

Navigating between log entries

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

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

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

Info menu

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

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

Tab. 6: List of service parameters

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

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

Tab. 7: List of TCM device info

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



4.3.6. Totalizer

On the display the following three totalizer can be shown:

- Batch Total
- Grand Total
- Failure Total

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

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

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

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

4.4. Offset Adjustment

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

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

Proceed as follows:

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

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

NOTE:

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

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

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

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

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

To configure the input, please refer to chapter 4.5.8.4.

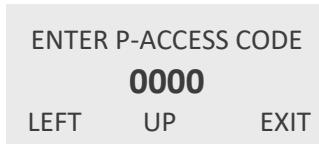
4.5. Control Mode

In the control mode the TRD 8001 can be adapted to the individual application. As unintentional changes of the settings might cause problems, some submenus are password protected. Additionally, using the "SERVICE" menu, a global access code can be set that locks the TRICOR CLASSIC Coriolis Mass Flow Meter completely.

To enter the control mode proceed as follows:

Press "P" for about three seconds

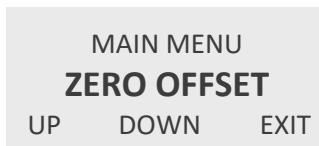
If a global access code is set the display shows



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

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

When the correct code is entered the display shows



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

Select the desired submenu and confirm with "P".

4.5.1. Function of the Pushbuttons

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

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



4.5.2. Submenus in the Main Menu

In the Main Menu the following submenus are addressable:

ZERO OFFSET:

Performing the automatic offset adjustment procedure.

This submenu is password protected.

DISPLAY:

Presetting the display.

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

SETUP:

Adjusting the TRD 8001 and configuring the inputs and outputs.

This submenu is password protected.

I/O-TEST:

Setting the outputs to defined values and displaying the actual status of the control inputs for testing the electrical connections.

This submenu is password protected.

SERVICE:

Calibrating the TRD 8001 with connected TCM.

This submenu is password protected.

FACTORY:

Service settings for TRD 8001 with connected TCM.

This submenu is password protected.

4.5.3. ZERO OFFSET Menu

Select in the main menu



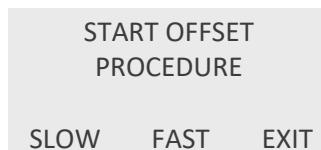
Press "P". The display shows



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

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

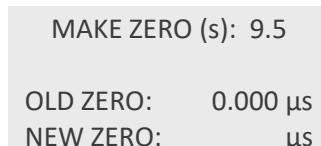
When the correct code is entered the display shows



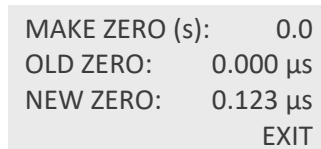
Press "SLOW" or "FAST" to start the procedure or skip with "EXIT".

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

The display shows



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



Press "EXIT" to return to the measuring mode.



4.5.4. DISPLAY Menu

Select in the main menu



Press "P". The display shows



The following submenus are available:

MASS TOTAL:

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

MASS FLOW:

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

VOL. TOTAL:

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

VOL. FLOW:

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

DENSITY:

Setting the density units and the density decimal point.

TEMPERATURE:

Setting the temperature units and the temperature decimal point.

PRESSURE:

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

DISP MODE:

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

4.5.4.1. DISPLAY - MASS TOTAL Menu

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



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

The following submenus are available:

TOTAL UNITS:

Setting the “TOTAL” units.

TOTAL DP:

Setting the “TOTAL” decimal point.

TOTAL UNITS



The following units can be selected:

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

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

TOTAL DP



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

4.5.4.2. DISPLAY - MASS FLOW Menu

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



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

The following submenus are available:

FLOW UNITS:

Setting the flow units.

FLOW DP:

Setting the flow decimal point.

DISP FILTER:

Setting the display filter.



Manual Operation

FLOW UNITS



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

Time-Unit Description

S	second
MIN	minute
H	hour
D	day

Mass-Unit Description

G	gram
KG	kilogram
LB	pound
OZ	dry ounce
T	metric ton
ST	stone
MT	metric ton

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

FLOW DP



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

DISP FILTER



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

NOTE:

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

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

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

4.5.4.3. DISPLAY - VOL. TOTAL Menu

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



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

The following submenus are available:

TOTAL UNITS:

Setting the “TOTAL” units.

TOTAL DP:

Setting the “TOTAL” decimal point.

TOTAL UNITS



The following units can be selected:

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

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

TOTAL DP



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



4.5.4.4. DISPLAY - VOL. FLOW Menu

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



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

The following submenus are available:

FLOW UNITS:

Setting the flow units.

FLOW DP:

Setting the flow decimal point.

DISP FILTER:

Setting the display filter.

FLOW UNITS



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

Time-Unit Description

S	second
MIN	minute
H	hour
D	day

Volume-Unit Standard volume Description

(if gas measuring mode activated see chapter 4.5.6.1)

cm ³	Ncm ³	(Norm) Cubic Centimeter
LITER	NL	(Norm) Liter
GAL	SGAL	(Standard) US Gallon
BBL	STB	(Standard) US Barrel
LOZ	SLOZ	(Standard) Liquid Ounce
IGAL	SIGL	British (Standard) Gallon
IBBL	SIBL	British (Standard) Barrel
m ³	Nm ³	Cubic Meter
kM ³	kNm ³	(Norm) 1000 Cubic Meter
hL	hNL	(Norm) Hectoliter
kL	kNL	(Norm) Kiloliter
ML	MNL	(Norm) Megaliter
CF	SCF	Cubic Foot
MCF	MSCF	(Standard) 1,000 Cubic Feet

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

FLOW DP

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

DISP FILTER

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

NOTE:

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

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

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

4.5.4.5. DISPLAY - DENSITY Menu

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



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

The following submenus are available:

DENS UNITS:

Setting the density units.

DENS DP:

Setting the density decimal point.

DENS UNITS



Manual Operation

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

Unit	Description
G/cm ³	Gram per Cubic Centimeter
G/L	Gram per Liter
KG/m ³	Kilogram per Cubic Meter
KG/L	Kilogram per Liter
LB/FT ³	Pounds per Cubic Feet
LB/GAL	Pounds per Gallon
BRIX	Brix

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

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

DENS DP



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

4.5.4.6. DISPLAY - TEMPERATURE Menu

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



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

The following submenus are available:

TEMP UNITS:

Setting the temperature units.

TEMP DP:

Setting the temperature decimal point.

TEMP UNITS



The following units can be selected:

Unit	Description
°C	Centigrade
°F	Fahrenheit
KELVIN	Kelvin

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

TEMP DP



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

4.5.4.7. DISPLAY - PRESSURE Menu

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

NOTE:

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



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

The following submenus are available:

PRESS. UNITS:

Setting the pressure units.

PRESSURE DP:

Setting the pressure decimal point.

PRESS. UNITS





Manual Operation

The following units can be selected:

Unit	Description
KPA	kilopascal
MPA	megapascal or N/mm ²
PSI	pound per square inch
BAR	bar

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

PRESS DP



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

4.5.4.8. DISPLAY - DISPLAY MODE Menu

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



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

The following submenus are available:

DISPLAY 1:

Setting the content of display view 1.

DISPLAY 2:

Setting the content of display view 2.

BACKLIGHT:

Switching on and off the backlight.

TIME MODE:

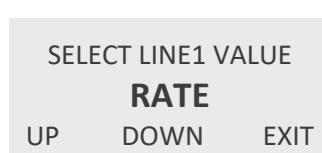
Setting fixed or alternating display.

DISPLAY 1



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

The display shows:

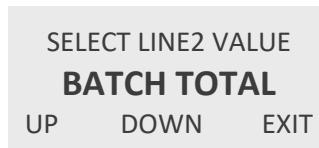


The following values can be selected:

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

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

If "DUAL LINE" was selected, the display shows



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

The TCM returns to the "DISPLAY MODE" menu.

DISPLAY 2

See DISPLAY 1

BACKLIGHT



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

TIME MODE



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

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

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



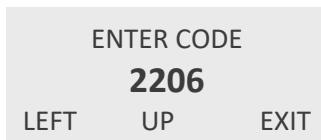
4.5.5. SETUP Menu

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

Select in the main menu



Press “P”. The display shows



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

When the correct code is entered the display shows



The following submenus are available:

PARAMETER:

METER MODE	Selection between Mass Flow Meter and Volume Flow Meter
CUT OFF	Setting the flow CUT OFF value
STEP RESP	Set Step Response (option)
RESET KEY	Enable/disable the key “Reset”
FLOW-DIREC	Setting up the TCM for reverse flow
K-FACTOR	Factor for fine scaling the metric variable of the meter
FAULT TIME	Setting the error response time
PRESS. COMP.	Enable/disable the “PRESSURE COMPENSATION” (option)
TOTAL COUNT	Setting up the mode of operation “TOTAL counter”
LANGUAGE	Selecting the display language

FILTER:

FLOW	Setting the flow filter time constant
DENS	Setting the density filter time constant

IN/OUTPUTS:

FREQ OUT	Configuring the frequency output
CTRL OUT	Configuring the control output
mA-OUT	Configuring the analog output (4 ... 20 mA)
CTRL IN	Configuring the control input
mA-IN I1	Configuring the analog input (option)
INTERFACE	Configuring the interface

DATA CONFIG:

SAVE DATA	Saving the actual settings as backup
RECALL DATA	Recalling the last settings from the backup

RESET TOTAL:

RESET TOTAL	Resets the TOTAL and the FAIL. TOTAL count to zero.
-------------	---

CLEAR LOGS:

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

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

4.5.6. SETUP - PARAMETER Menu

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



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

4.5.6.1. METER MODE Menu

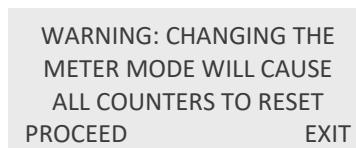
In the submenu “METER MODE” the meter mode (“MASS METER” for Mass Flow Meter, “VOLUME METER” for Volume Flow Meter, „REF.VOLUME“ for gas measuring mode under reference conditions or „NET OIL“ for Net Oil Computer) can be set.

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



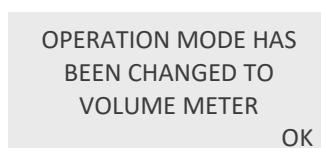
Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

If the meter mode is changed, the display shows:

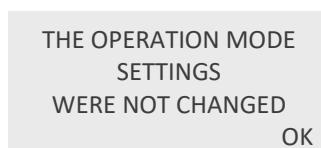


Confirm with “PROCEED” or skip with “EXIT”.

If “PROCEED” is pressed, the display shows:



If “EXIT” is pressed, the display shows:



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



4.5.6.2. Gas measuring mode (optional)



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

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



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

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

4.5.6.3. CUT OFF Menu

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

There are 2 different “CUT OFF” values:

FLOW:

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

DENSITY:

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

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



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

FLOW

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

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

NOTE:

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



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

The display returns to the “CUT OFF” menu.

DENSITY Liquid

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

The display returns to the “CUT OFF” menu.

DENSITY Gas

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

The display returns to the “CUT OFF” menu.

4.5.6.4. STEP RESPONSE Menu

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

NOTE:

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

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

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



Manual Operation

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

NOTE:

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



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

The display returns to the “SETUP - PARAMETER” menu

4.5.6.5. RESET KEY Menu

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

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



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

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

4.5.6.6. FLOW DIRECTION Menu

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

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

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



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

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

4.5.6.7. K-FACTOR Menu

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

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



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

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

4.5.6.8. FAULT TIME Menu

In the submenu “FAULT TIME” the reaction time of the TRD 8001 in case of an error can be defined.

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

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



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

The display shows



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

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

4.5.6.9. PRESSURE COMPENSATION Menu

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

NOTE:

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



Manual Operation

The following modes are possible:

OFF:

No pressure compensation.

mA-IN I1:

The pressure measured via the analog 4 ... 20 mA input is used for the compensation.

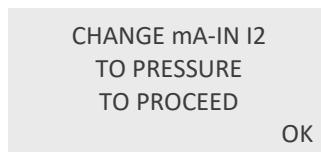
MANUAL:

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



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

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



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

If "MANUAL" is selected, the display shows



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

The display returns to the "PRESS. COMP.". menu.

4.5.6.10. TOTAL COUNT Menu

In the submenu "TOTAL COUNT" the "TOTAL" counter can be configured.

The following operating modes are available:

DEFAULT:

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

FORWARD:

The "TOTAL" count includes only flow in positive direction. With negative flow the TOTAL value does not change.

BACKWARD:

The "TOTAL" count includes only flow in negative direction. With positive flow the TOTAL value does not change.



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

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

4.5.6.11. LANGUAGE Menu

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

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



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

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

4.5.7. SETUP - FILTER Menu

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



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

4.5.7.1. FLOW FILTER Menu

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

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

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

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



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

The display returns to the "SETUP - FILTER" menu.

4.5.7.2. DENSITY FILTER Menu

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

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

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

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



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

The display returns to the "SETUP - FILTER" menu.

4.5.8. SETUP - IN/OUTPUTS Menu

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



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

4.5.8.1. FREQUENCY OUT Menu

In the submenu "FREQ OUT" the frequency output can be configured.

The frequency output has two operating modes:

FREQUENCY:

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

TOTAL COUNT:

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

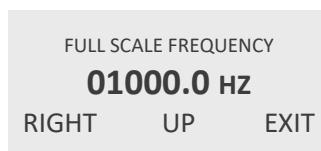


Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

FREQUENCY

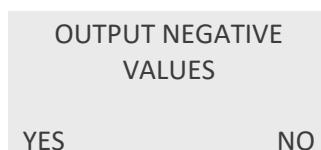
Use the keys “RIGHT” and “UP” to select the desired full scale value and confirm with “P” or skip with “EXIT”.

The display shows

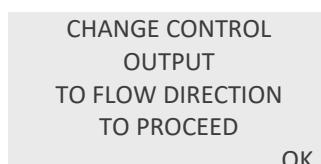


Use the keys “RIGHT” and “UP” to select the desired frequency and confirm with “P” or skip with “EXIT”.

The display shows



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



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



TOTAL COUNT



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

4.5.8.2. CONTROL OUT Menu

In the submenu "CTRL OUT" the control output can be configured.

The control output has four operating modes:

FAULT:

In case of an error the control output goes to the active state.

"ACTIVE HIGH" means the output is low in normal operation, high in case of a fault.

For setting the on and off delay time, please refer to chapter 4.5.6.8.

FLOW DIR:

The flow direction is indicated. "ACTIVE HIGH" means the output is high if a positive flow is measured.

BATCH:

In the batch mode the TRD 8001 operates as a batch counter. If the preset batch value is reached, the control output goes to the active state. With an active signal at the control input the batch counter can be reset to zero. For this mode the control input must be configured as "RESET BATCH". "ACTIVE HIGH" means the output goes to "HIGH" when the preset batch value is reached.

FLOW LIMIT:

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

NOTE:

For negative flow limits the relation is: -99 is greater than -100.

"ACTIVE HIGH" means the output goes to "HIGH" when the preset limit value is reached.

OFF:

The output is deactivated. "ACTIVE HIGH" means the output is permanently at high.

FREQUENCY:

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

DENS. LIMIT:

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

PHASE SHIFT:

Prerequisite: the FREQ-OUT has been programmed for TOTAL COUNT. As soon as "TOTAL" has increased by the chosen amount, another pulse is generated on FREQ OUT. To have a frequency ratio of 50 % on the output, the state of the output changes respectively after half the amount. A pulse offset by 90° is also generated on CTRL OUT after each pulse on FREQ-OUT.

The maximum output frequency in this operating mode is about 50 Hz.

FAULT

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

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

FLOW DIR

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

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

BATCH

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

The display shows



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

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

FLOW LIMIT

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

The display shows



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



Manual Operation

The display shows

```
SELECT ACTIVE STATE
ACTIVE HIGH
UP     DOWN     EXIT
```

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

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

OFF

```
CTRL OUT MENU
OFF
UP     DOWN     EXIT
```

P →

```
SELECT ACTIVE STATE
ACTIVE HIGH
UP     DOWN     EXIT
```

Confirm with “P” or skip with “EXIT”.

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

FREQUENCY

```
FREQ OUT MENU
FREQUENCY
UP     DOWN     EXIT
```

P →

```
FULL SCALE FLOW
8000.0 G/s
RIGHT    UP     EXIT
```

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

The display shows

```
FULL SCALE FREQUENCY
01000.0 Hz
RIGHT    UP     EXIT
```

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

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

4.5.8.3. ANALOG-OUT Menu

In the submenu “mA-OUT” the 4 ... 20 mA outputs can be configured.

Each analog output can show one of the following parameters:

FLOW:

The output current is proportional to the flow.

DENSITY:

The output current is proportional to the density.

TEMP:

The output current is proportional to the temperature.

BATCH COUNT:

The output current is proportional to the current batch value.

This mode is only possible, if the control input is configured as “RESET BATCH”

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



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

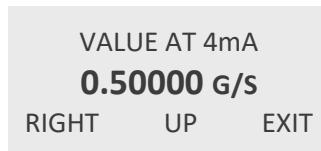
The standard TRD electronics provides two analog 4 ... 20 mA outputs, I1 and I2. If the option "PRESSURE COMPENSATION" is installed, only the output I2 is available.

The display shows



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

The display shows

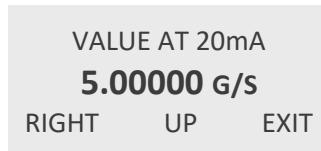


The indicated engineering unit depends on the selected output value and the display setup.

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

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

The display shows



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

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

4.5.8.4. CONTROL IN Menu

In the submenu "CTRL IN" the control input can be configured.

The control input has three operating modes:

EXT. ZERO:

If an "ACTIVE" level is applied to the input, the TRD 8001 starts the zero offset adjustment procedure.

RESET BATCH:

If an "ACTIVE" level is applied to the input, the batch counter is reset to 0.

This mode must be selected, if the control output is to be used as a "BATCH-LIMIT" and/or if one of the analog outputs is to be used as batch output.



Manual Operation

OFF:

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

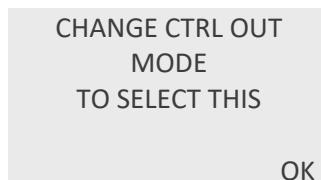
HOLD:

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



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

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



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

The display shows



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

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

4.5.8.5. ANALOG IN Menu

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

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



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

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

If "PRESSURE" was selected the display shows

VALUE AT 4mA		
0.00 MPA		
RIGHT	UP	EXIT

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

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

The display shows

VALUE AT 20mA		
10.00 MPA		
RIGHT	UP	EXIT

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

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

4.5.8.6. INTERFACE Menu

In the submenu "INTERFACE" the interface can be configured.

IN/OUTPUTS MENU	P →	SET INTERFACE MODE
INTERFACE		RS485
UP DOWN EXIT		UP DOWN EXIT

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

RS485

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

SET INTERFACE MODUS	P →	SELECT BAUD RATE
RS485		19200
UP DOWN EXIT		UP DOWN EXIT

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

The display shows

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

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



Manual Operation

The display shows

```
ADDITIONAL TIME DELAY
00800. µs
RIGHT    UP    EXIT
```

If the device is installed within bigger bus and controlling systems, it might be helpful to slow down additionally the response of the TRD 8001 in order to avoid any communication errors.

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

The display shows

```
SET UNIT ADDRESS
001
RIGHT    UP    EXIT
```

The following addresses cannot be set:

Address	Function
---------	----------

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

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

The display returns to the "SETUP IN/OUTPUTS" menu.

4.5.9. SETUP - DATA CONFIGURATION Menu

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

```
SETUP MENU
DATA CONFIG
UP    DOWN    EXIT
P →
DATA CONFIG MENU
SAVE DATA
UP    DOWN    EXIT
```

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

4.5.9.1. SAVE DATA Menu

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

At each power on the TRD 8001 compares the content of the setup memory and the backup memory. If the data in those two memories are different, the TRD 8001 gives out a warning. To avoid this warning, it is recommended to make a backup as soon as the new settings are proven to be okay.

```
DATA CONFIG MENU
SAVE DATA
UP    DOWN    EXIT
P →
READY TO SAVE DATA
START    EXIT
```

Start the backup process with "START" or skip with "EXIT".

If "START" is pressed, the display shows for some seconds

**MEMORY
ACCESS**

After that for about two seconds

READY

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

4.5.9.2. RECALL DATA Menu

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

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

NOTE:

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

DATA CONFIG MENU
RECALL DATA
UP DOWN EXIT

P →

RECALL BACKUP DATA?
START EXIT

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

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

**MEMORY
ACCESS**

After that for about two seconds

READY

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



4.5.10. SETUP - RESET TOTAL Menu

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



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

NOTE:

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

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

4.5.11. SETUP - CLEAR LOGS Menu

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



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

NOTE:

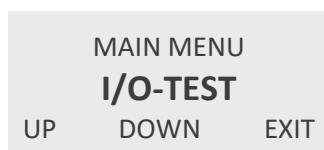
Acknowledged Log entries cannot be recovered.

Das Display kehrt zum Menü CLEAR LOGS zurück.

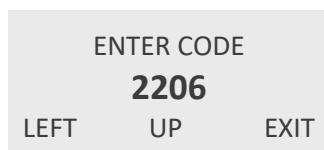
4.5.12. I/O-TEST Menu

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

Select in the main menu



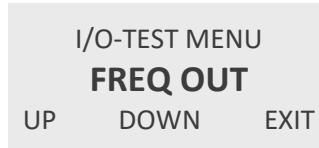
Press “P”. The display shows



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

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

When the correct code is entered the display shows



The following submenus are available:

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

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

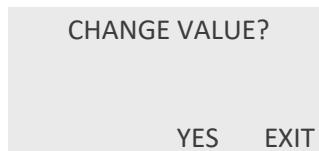
4.5.12.1. I/O-TEST - FREQUENCY OUT Menu

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



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

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



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

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

4.5.12.2. I/O-TEST - CONTROL OUT Menu

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



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

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



Manual Operation

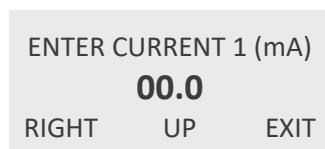
4.5.12.3. I/O-TEST - ANALOG OUT Menu

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



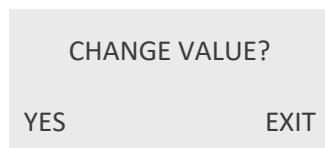
Use the keys “UP” and “DOWN” to select the desired output and confirm with “P” or skip with “EXIT”.

The display shows



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

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



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

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

4.5.12.4. I/O-TEST - CTRL IN Menu

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



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

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

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

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

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



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

4.5.13. SERVICE Menu

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

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



5. Remote Operation

The TRD 8001 does not have an interface for remote operation.

As the TRD 8001 uses the RS485 interface of the TCE 8000 electronics, it cannot be used, if any of the interfaces of the TCE 8000 is used for remote control.

With the TCE 6000 it is possible to connect the TRD 8001 to the RS485 interface of the TCE 6000 and to use simultaneously the USB interface of the TCE 6000.

6. Service and Maintenance

6.1. Maintenance

The remote display TRD 8001 does not require regular maintenance.

For any maintenance of the TRICOR CLASSIC Mass Flow Meter refer to the corresponding manual (www.tricorflow.com/manuals/).

6.2. Trouble Shooting

In case the TRD 8001 does not work properly, first check the following items:

No display, no LED lighting

All cables properly connected?

→ Connect the missing cables

Power supply switched on?

→ Switch on the power supply

For all other possible faults refer to the TRICOR CLASSIC instruction manual (www.tricorflow.com/manuals/).

6.3. Maintenance and Repair Work

WARNING!

Impermissible repair of explosion protected devices

Risk of explosion in hazardous areas

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

WARNING!

Maintenance during continued operation in a hazardous area

There is a risk of explosion when carrying out repairs and maintenance on the device in a hazardous area.

Isolate the device from power. - or -

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

WARNING!

Impermissible accessories and spare parts

Risk of explosion in areas subject to explosion hazard.

Only use original accessories or original spare parts.

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



WARNING!

Humid environment

Risk of electric shock.

Avoid working on the device when it is energized.

If working on an energized device is necessary, ensure that the environment is dry.

Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

CAUTION!

Hot parts in the device

Temperatures that can burn unprotected skin may be present for some time after the device has been switched off.

Observe the waiting time specified in "Technical Data" (see chapter 7.3) before starting with maintenance work.

WARNING!

Enclosure open

Risk of explosion in hazardous areas as a result of hot components and/or charged capacitors inside the device.

To open the device in a hazardous area:

1. Isolate the device from power.
2. Observe the wait time specified in "Technical Data" (see chapter 7.3) before opening the device.
3. Visually inspect sensor inlet and outlet.

Exception: Devices exclusively having the type of protection "Intrinsic safety Ex i" may be opened in an energized state in hazardous areas.

CAUTION!

Hazardous voltage at open device

Risk of electric shock when the enclosure is opened or enclosure parts are removed.

Before you open the enclosure or remove enclosure parts, de-energize the device.

If maintenance measures in an energized state are necessary, observe the particular precautionary measures. Have maintenance work carried out by qualified personnel.

WARNING!

Improper connection after maintenance

Risk of explosion in areas subject to explosion hazard.

Connect the device correctly after maintenance.

Close the device after maintenance work.

NOTE:

Repairs and service may only be carried out by persons authorised by the manufacturer.

NOTE:

The manufacturer defines flow sensors as non-repairable products.

Maintenance information parameters



The basic maintenance information parameters are:

- Current Date and Time
- Operating Time Total
- Operating Time
- Configuration Counter
- Transmitter Hardware Revision
- HMI Hardware Revision
- Sensor Hardware Revision

6.4. Changing the Fuses

The TRD 8001 does not contain fuses.

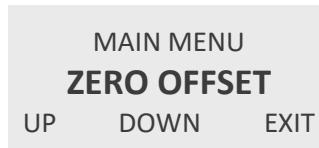
For the fuses in the TRICOR CLASSIC Mass Flow Meter refer to the corresponding TRICOR CLASSIC manual (www.tricorflow.com/manuals/).

6.5. Calibration

In the “SERVICE” menu all measurements of the TRD 8001 can be calibrated.

Press “P” for about three seconds

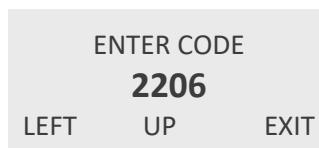
The display shows



Use the key “UP” or “DOWN” to select



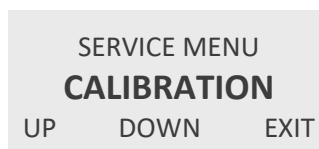
Press “P”. The display shows



Change the indicated number with “LEFT” and “UP” to “2208” and confirm with “P”.

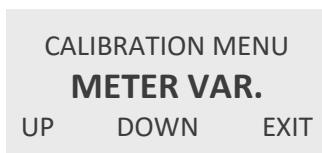
If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows





Press “P”. The display shows



The following submenus are available:

TEMP CALIB.	Calibrating the temperature measurement
AIR CALIB.	Calibrating the density measurement at low density (air)
WATER CALIB.	Calibrating the density measurement at high density (water)
METER VAR.	Calibrating the flow measurement

6.5.1. Temperature Calibration

For calibrating the temperature reading of the TRD 8001, the medium temperature must be well known.

Before starting the calibration, make sure that the temperature reading has been stable for several minutes, to make sure that the medium temperature and the temperature of the temperature sensor are the same.



Use the keys “RIGHT” and “UP” to set the actual medium temperature and confirm with “P” or skip with “EXIT”.

The display returns to the “SERVICE - CALIBRATION” menu.

6.5.2. Air Density Calibration

The low end calibration of the density measurement is normally done with empty tubes (filled with air).

In the automatic mode the unit performs an automatic calibration, assuming that the tubes are filled with normal air.

In the manual mode the three parameters temperature, tube frequency and reference density can be altered individually. This is necessary if the air calibration is performed with a gas with a density different than air. In that case make first the automatic calibration and then override in the manual calibration the density value by the density of the medium used for calibration.

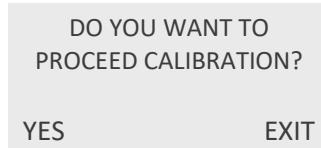
Before starting an automatic calibration, make sure that the TCM is completely empty as any drop of a liquid inside will spoil the calibration result.



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

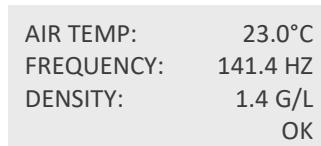
**AUTOMATIC mode:**

Confirm with “OK”. The display shows:



Start the calibration with “YES” or skip with “EXIT”.

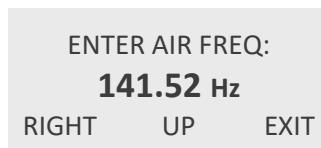
If “YES” was pressed, the display shows:



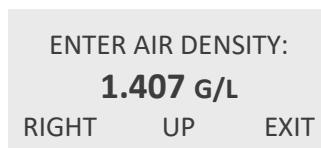
Confirm with “OK”. The display returns to the “AIR CALIBRATION” menu.

MANUAL mode:

Use the keys “RIGHT” and “UP” to set the reference temperature and confirm with “P” or skip with “EXIT”. The display shows:



This value must only be entered, if you have the data from a calibration sheet of the TCM. Skip with “EXIT”. The display shows



Use the keys “RIGHT” and “UP” to set the reference density and confirm with “P” or skip with “EXIT”.

The display returns to the “AIR CALIBRATION” menu.



6.5.3. Water Density Calibration

The high end calibration of the density measurement is normally done tubes filled with water. Butanol or other liquids with well-known density can be used as well.

In the automatic mode the unit performs an automatic calibration, assuming that the tubes are filled with water.

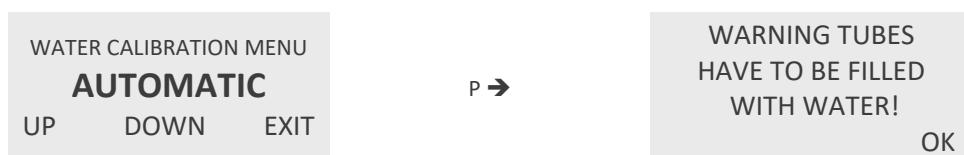
In the manual mode the three parameters temperature, tube frequency and reference density can be altered individually. This is necessary if the water calibration is performed with a liquid with a density different than water. In that case make first the automatic calibration and then override in the manual calibration the density value by the density of the medium used for calibration.

Before starting an automatic calibration, make sure that the TCM is completely filled with the reference medium. Any pollution (air bubbles, solid particles or rests of other liquids) will spoil the calibration result.

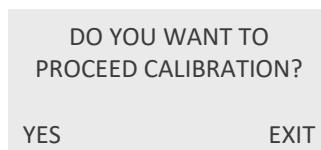


Use the keys "UP" and "DOWN" to select the desired mode and confirm with "P" or skip with "EXIT".

AUTOMATIC mode:

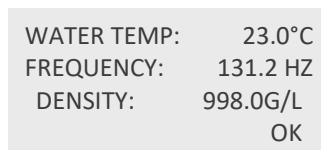


Confirm with "OK". The display shows:



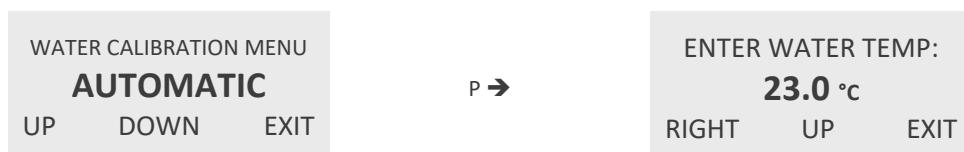
Start the calibration with "YES" or skip with "EXIT"

If "YES" was pressed, the display shows:



Confirm with "OK". The display returns to the "WATER CALIBRATION" menu.

MANUAL mode:





Use the keys “RIGHT” and “UP” to set the reference temperature and confirm with “P” or skip with “EXIT”.

The display shows:

ENTER WATER FREQ:
131.27 Hz
RIGHT UP EXIT

This value must only be entered, if you have the data from a calibration sheet of the TCM. Skip with “EXIT”.

The display shows

ENTER WATER DENSITY:
998.03 G/L
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to set the reference density and confirm with “P” or skip with “EXIT”.

The display returns to the “WATER CALIBRATION” menu.

6.5.4. Flow Calibration

Mount the TCM in the test stand or mount a reference meter in series to the TCM to be calibrated. The accuracy of the test stand or reference meter must be better than 0.1 % of reading over the calibration range.

For best results with the zero offset calibration, a valve each in front and behind the TCM is recommended.

NOTE:

All mounting guidelines (see chapter 3) must be observed!

Any erroneous reading due to bad mounting will lead to a wrong calibration!

Operate the meter for at least 15 minutes for making sure that it has reached the final operating temperature. If the medium temperature differs much from the initial meter or ambient temperature, a longer warm up period might be recommended.

Close the valves and make the zero offset adjustment (see chapter 4.4 and 4.5.3).

If the calibration of the TCM shall be checked without adjusting the reading, just compare the TCM reading with the reading of the reference meter at the desired flow rates.

If the TCM shall be adjusted according to the test results, make a test run (or better several tests runs) at about 50 % of the TCM full scale flow.

Read the current TCM meter variable:

<p>CALIBRATION MENU METER VAR. UP DOWN EXIT</p>	P →	<p>SET METER VAR 196.0 RIGHT UP EXIT</p>
--	------------	---



Calculate the new meter variable as:

$$METER_VAR_{new} = METER_VAR_{old} * \frac{\text{Reference Reading}}{\text{TRD 8001 Reading}}$$

If you made several test runs, use the average meter variable.

Use the keys “RIGHT” and “UP” to set the calculated meter variable and confirm with “P” or skip with “EXIT”.

The display returns to the “SERVICE - CALIBRATION” menu.

6.6. Service

The TRD 8001 does not contain any user serviceable parts.

In case of malfunction, please contact your nearest dealer or directly KEM Küppers Elektromechanik GmbH.

For the addresses see back of the manual.

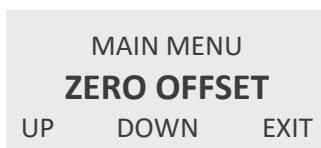
6.7. Global Device Password

In order to protect the TRICOR CLASSIC Mass Flow Meter from unauthorized access, a user-specific password can be set. It protects the access to all configuration menus. The password can be set either through the local display as described below or through the Modbus interface (see TRICOR CLASSIC Modbus RTU manual).

NOTE:

If the global access code gets lost, the meter must be returned to KEM/AWL for resetting it. Resetting the code onsite is not possible!

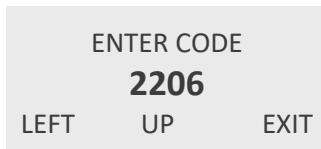
Press “P” for about three seconds. The display shows



Use the key “UP” or “DOWN” to select



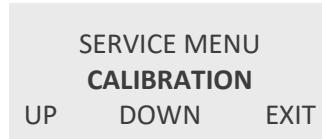
Press “P”. The display shows



Change the indicated number with “LEFT” and “UP” to “2208” and confirm with “P”.

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

When the correct code is entered the display shows

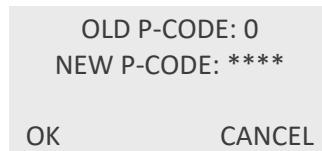


Use the key "UP" or "DOWN" to select ACCESS CODE and confirm with "P" or skip with "EXIT"



Change the indicated number with "LEFT" and "UP" to the desired code number and confirm with "P".

The display shows



Confirm with "OK" or skip with "CANCEL".

Write down the access code.

The display returns to the "SERVICE - ACCESS CODE" menu.

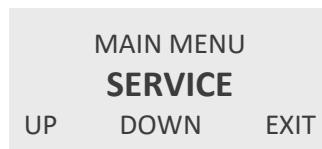
6.8. Reloading Factory Settings

In case the TCM has been completely misadjusted for any reason, the TCM can be reset to the original settings ex works.

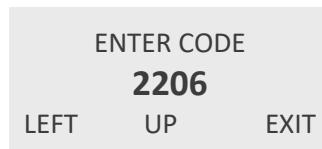
Press "P" for about three seconds. The display shows



Use the key "UP" or "DOWN" to select



Press "P". The display shows



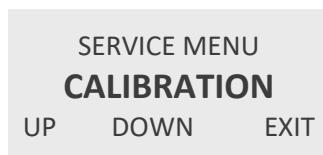
Change the indicated number with "LEFT" and "UP" to "2208" and confirm with "P".

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



Service and Maintenance

When the correct code is entered the display shows



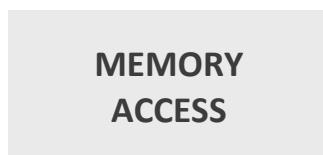
Use the key “UP” or “DOWN” to select RECALL FACT and confirm with “P” or skip with “EXIT”.

The display shows



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

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



After that for about two seconds



The display returns to the “RECALL FACTORY” menu.

7. Listings

7.1. Warranty

For warranty refer to the general terms and conditions of KEM Küppers Elektromechanik GmbH, which can be found on the corresponding website (www.kem-kueppers.com), respectively for the Americas those of AW Lake Company (www.aw-lake.com).

7.2. Certifications and Compliances

Category	Standards or description	
EU Declaration of Conformity – EMC	Meets intent of Directive 2014/30/EU for Electromagnetic Compatibility. Compliance is given to the following specifications as listed in the Official Journal of the European Union:	
	EN 61326/2006	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A radiated and Conducted Emissions ¹⁾ and Immunity ¹⁾ .
	IEC 61000-4-2/2009	Electrostatic Discharge Immunity (Performance criterion B)
	IEC 61000-4-3/2011	Radiated RF Electromagnetic Field Immunity (Performance criterion B)
	IEC 61000-4-4/A1-2013	Electrical Fast Transient/Burst Immunity (Performance criterion B)
	IEC 61000-4-5/2015 ²⁾	Power Line Surge Immunity (Performance criterion B)
	IEC 61000-4-6/2014	Conducted RF Immunity (Performance criterion B)
	IEC 61000-4-11/2005 ²⁾	Voltage Dips and Interruptions Immunity (Performance criterion B)
Australia/New Zealand Declaration of Conformity- EMC	Complies with the EMC Emission standard ¹⁶⁾	
	AS/NZS 2064	
FCC EMC Compliance	Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B ¹⁾ .	

¹⁾ Compliance demonstrated using high-quality shielded interface cables.

²⁾ Applies only to units with AC mains supply instead of or additional to the SELV supply.



Category	Standards or description	
EU Declaration of Conformity – Low Voltage	Compliance is given to the following specification as listed in the Official Journal of the European Union: Low Voltage Directive 2014/35/EU	
	EN 61010-1/2010	Safety requirements for electrical equipment for measurement control and laboratory use.
Designed to meet the following US standards	UL 61010-1/2012	Standard for electrical measuring and test equipment.
Designed to meet the following Canadian standards	CAN/CSA C22.2 no. 61010-1-4/2008	Safety requirements for electrical equipment for measurement, control, and laboratory use.
International standards	IEC61010-1/2010	Safety requirements for electrical equipment for measurement, control, and laboratory use.
Equipment Type	Test and measuring	
Safety Class	Class 1 (as defined in IEC 61010-1, Annex H) – grounded product	
ATEX	II 3G Ex nA IIC T2...T4 Gc	Option

7.3. Technical Data

7.3.1. TRD 8001 Remote Display

Display	back-lit LCD screen, 132 x 32 dot
Supply Voltage	via interface
Programming	via front keyboard
Interface to TCE	RS485
EMC	according to EN 61000-6-4 and 61000-6-2
Dimensions	90 x 120 x 50 mm (h x w x d)
Electrical Connections	connectors M12, B coded
Housing Material	ABS-FR (plastic, flame retardant)
Protection Class	IP64
Weight	0.4 kg [0.88 lb]
Temperature	operation: 0 °C ... +60 °C [32 °F ... +140 °F] storage and transport: -20 °C ... +80 °C [-4°F ... +176°F]
Wall Mount	hidden screws

7.3.2. Dimensional Drawing

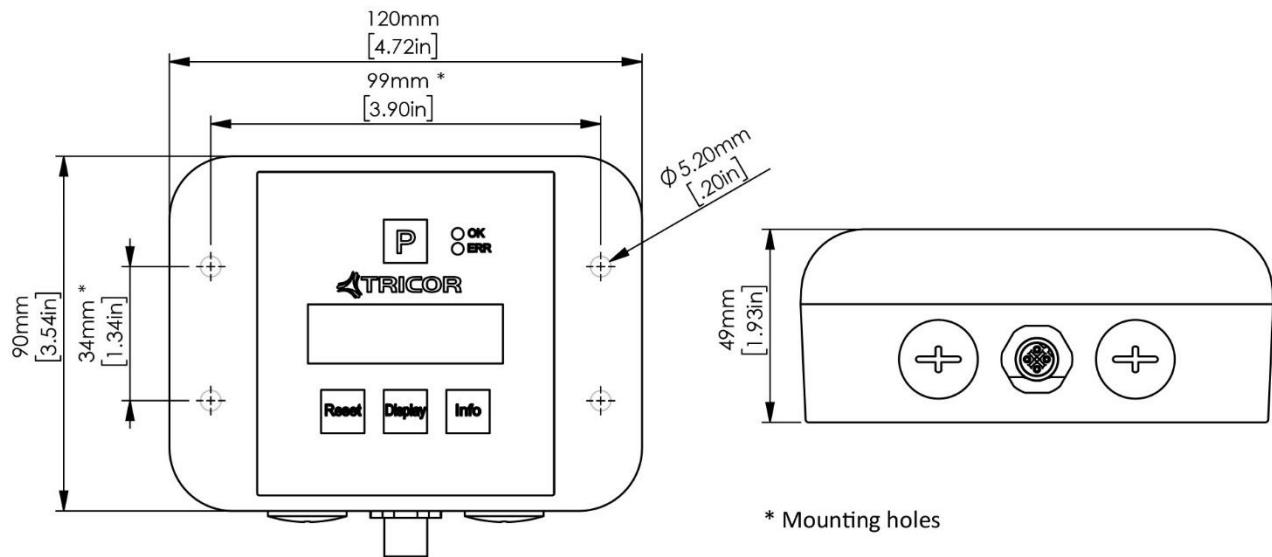


Fig. 2: Dimensions TRD 8001

7.4. WEEE and RoHS

The TRICOR CLASSIC Mass Flow Meter described herein is not subject to the WEEE directive and the corresponding national laws. At the end of life forward the TCM to a specialized recycling company and do not dispose it off as domestic waste.

The TCM described herein fully complies with the RoHS directive.



7.5. Menu Structure

7.5.1. Main Menu

In the following table only the menus and parameters of the first two levels of the HMI menu structure are listed.

Level 1		Level 2		Mehr Informationen
No.	Name	No.	Name	
1	ZERO OFFSET			ZERO OFFSET Menu (Page 25)
2	DISPLAY	2.1	MASS TOTAL	DISPLAY - MASS TOTAL Menu (Page 26)
		2.2	MASS FLOW	DISPLAY - MASS FLOW Menu (Page 27)
		2.3	VOL. TOTAL	DISPLAY - VOL. TOTAL Menu (Page 29)
		2.4	VOL. FLOW	DISPLAY - VOL. FLOW Menu (Page 30)
		2.5	DENSITY	DISPLAY - DENSITY Menu (Page 31)
		2.6	TEMPERATURE	DISPLAY - TEMPERATURE Menu (Page 32)
		2.7	PRESSURE	DISPLAY - PRESSURE Menu (Page 33)
		2.8	DISP MODE	DISPLAY - DISPLAY MODE Menu (Page 34)
3	SETUP	3.1	PARAMETER	SETUP - PARAMETER Menu (Page 37)
		3.2	FILTER	SETUP - FILTER Menu (Page 43)
		3.3	IN/OUTPUTS	SETUP - IN/OUTPUTS Menu (Page 44)
		3.4	DATA CONFIG	SETUP - DATA CONFIGURATION Menu (Page 52)
		3.5	RESET TOTAL	SETUP - RESET TOTAL Menu (Page 54)
		3.7	CLEAR LOGS	SETUP - CLEAR LOGS Menu (Page 54)
4	I/O-TEST	4.1	FREQ OUT	I/O-TEST - FREQUENCY OUT Menu (Page 55)
		4.2	CTRL OUT	I/O-TEST - CONTROL OUT Menu (Page 55)
		4.3	mA-OUT	I/O-TEST - ANALOG OUT Menu (Page 56)
		4.4	CTRL IN	I/O-TEST - CTRL IN Menu (Page 56)
5	SERVICE	5.1	CALIBRATION	Calibration (Page 61)
		5.2	ACCESS CODE	Global Device Password (Page 66)
		5.3	RECALL FACT.	Reloading Factory Settings (Page 67)

Tab. 8: Main menu

7.5.2. Menu Item „DISPLAY“

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
2.1	MASS TOTAL	2.1.1	TOTAL UNITS		
		2.1.2	TOTAL DP		
2.2	MASS FLOW	2.2.1	FLOW UNITS		
		2.2.2	FLOW DP		
		2.2.3	DISP FILTER		
2.3	VOL. TOTAL	2.3.1	TOTAL UNITS		
		2.3.2	TOTAL DP		
2.4	VOL. FLOW	2.4.1	FLOW UNITS		
		2.4.2	FLOW DP		
		2.4.3	DISP FILTER		
2.5	DENSITY	2.5.1	TOTAL UNITS		
		2.5.2	TOTAL DP		
2.6	TEMPERATURE	2.6.1	TEMP UNITS		
		2.6.2	TEMP DP		
2.7	PRESSURE	2.7.1	PRESS.UNITS		
		2.7.2	PRESSURE DP		
2.8	DISP MODE	2.8.1	DISPLAY 1	2.8.1.1	SINGLE LINE
				2.8.1.2	DUAL LINE
		2.8.2	DISPLAY 1	2.8.2.1	SINGLE LINE
				2.8.2.2	DUAL LINE
		2.8.3	BACKLIGHT	2.8.3.1	ON
				2.8.3.2	OFF
		2.8.4	TIME MODE	2.8.4.1	FIXED
				2.8.4.2	ALTERNATE

Tab. 9: Menu items “DISPLAY”

7.5.3. Menu Item „SETUP“

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
3.1	PARAMETER	3.1.1	METER MODE		
		3.1.2	CUT OFF		
		3.1.3	STEP RESP.		
		3.1.4	RESET KEY		
		3.1.5	FLOW-DIREC		
		3.1.6	K-FACTOR		
		3.1.7	FAULT TIME		
		3.1.8	PRESS.COMP.		
		3.1.9	TOTAL COUNT		
3.2	FILTER	3.2.1	FLOW		
		3.2.2	DENSITY		
3.3	IN/OUTPUTS	3.3.1	FREQ OUT		
		3.3.2	CTRL OUT		
		3.3.3	mA-OUT		



Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
3.4	DATA CONFIG	3.3.4	CTRL IN		
		3.3.5	CTRL IN 2		
		3.3.6	mA-IN I1		
		3.3.7	INTERFACE		
		3.3.8	FAULT MODE		
	DATA CONFIG	3.4.1	SAVE DATA		
		3.4.2	RECALL DATA		
3.5	RESET TOTAL				
3.6	CLEAR LOGS				

Tab. 10: Menu items "SETUP"

7.5.4. Menu Item „I/O-TEST“

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
4.1	FREQ OUT				
4.2	CTRL OUT				
4.3	mA-OUT	4.3.1	mA-OUT I1		
		4.3.2	mA-OUT I2		
		4.3.3	FAULT MODE		
4.4	CTRL IN				

Tab. 11: Menu items "I/O-TEST"

7.5.5. Menu Item „SERVICE“

Level 2		Level 3		Level 4	
No.	Name	No.	Name	No.	Name
5.1	CALIBRATION	5.1.1	METER VAR.		
		5.1.2	TEMP CALIB.		
		5.1.3	AIR CALIB.	4.1.3.1	AUTOMATIC
				4.1.3.2	MANUAL
		5.1.4	WATER CALIB.	4.1.4.1	AUTOMATIC
				4.1.4.2	MANUAL
		5.1.5	PCZ MODE	4.1.5.1	OFF
				4.1.5.2	ON
5.2	ACCESS CODE				
5.3	RECALL FACT.				

Tab. 12: Menu items "SERVICE"

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