

M






Please follow these installation and adjustment instructions carefully. Failure to comply with these instructions or misuse of this equipment will void your warranty coverage.

The instructions cover software version 1.00.



Equipment installation, connection and adjustment by qualified personnel only!

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1 Performance of the digital and analogue outputs during the operating and error modes	
2 Menu structure of the FC01-LQ (operator dialogue)	

The Flow Meter FC01-LQ is designed to detect flow speed, flow volume and medium temperature of water (other liquids upon request).

These quantities are made available to the user as analogue electrical signals, physically isolated, as _____ or _____ and may be monitored by means of a _____.

As r _____ or _____ the digital signals enable the user to integrate the FC01-LQ into a control and monitoring system.

The transistor outputs enable the user to additionally process _____, _____ and _____ in the control system.

The Flow Meter FC01-LQ may be used with calorimetric monitoring heads type CS \underline{x} (CSP, CSF).

The calorimetric measuring procedure is based on the physics of heat dissipation.

A body with a temperature higher than its surroundings supplies a medium flowing past that body with energy in the form of heat. The amount energy supplied is a function of temperature difference $\Delta\vartheta$ and mass flow.

The thermal measuring method CTD (Constant-Temperature-Difference) is based on following principle:

The temperature difference $\Delta\vartheta$ between the two sensors is kept constant and the mass flow is determined by measuring the calorific power.

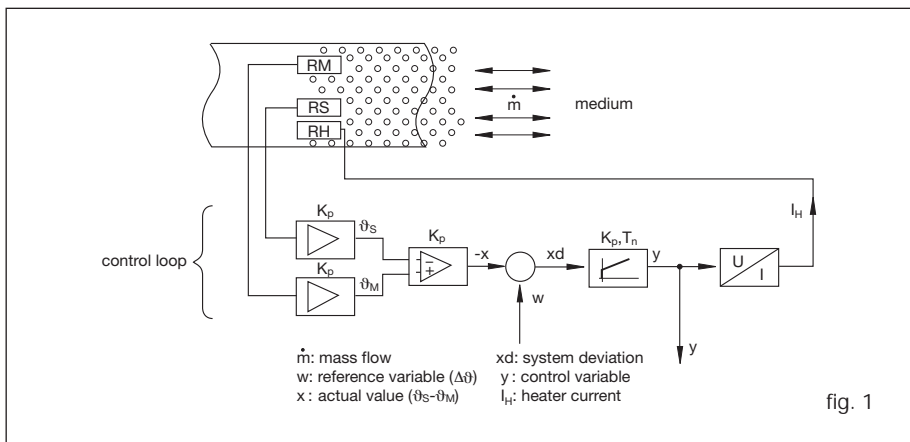
Fig. 1 is a schematic diagram of a CTD method based sensor.

Two temperature-sensitive resistors (sensor elements RS and RM) are immersed in the medium. Sensor RM assumes the temperature of the medium ϑ_M whilst heater resistor RH heats element RS to temperature ϑ_S . As a function of the medium, the temperature differential $\Delta\vartheta = \vartheta_S - \vartheta_M$ is preselected as a reference variable by the CTD control and is kept constant. The required heater current I_H is a function of mass flow so that the control variable of the control can be used for evaluation.

Major benefits of this method are:

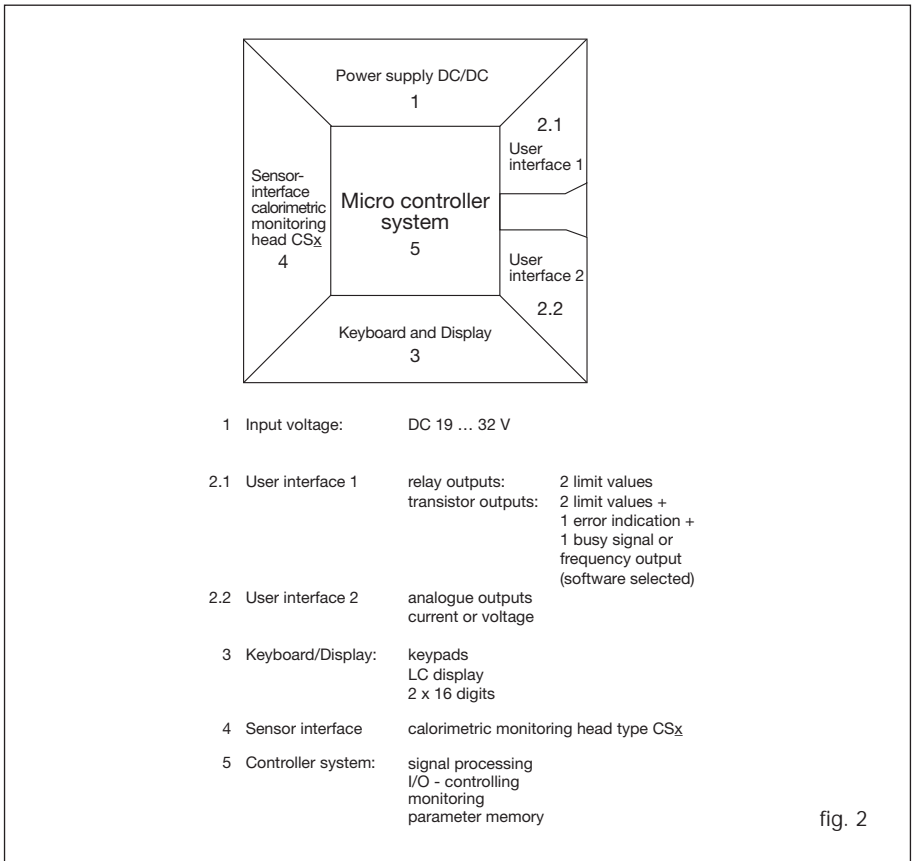
- Fast response, particularly to sudden flow standstill.
- Medium temperature measurement, providing optimum temperature compensation.
- Increased safety because the sensor cannot be overheated during flow standstill.

The flow rate is determined by mass flow.



The system comprises the following hardware functional modules:

- 1 Input voltage DC supply (terminal XV)
- 2 User interfaces: 2.1 signal outputs 2-way or 4-way signal outputs (terminal XAH)
2.2 analogue outputs 1 and 2 (terminal XAO)
- 3 Keyboard and display: keypads
liquid crystal display
- 4 Sensor interfaces: calorimetric monitoring head type CS_x (terminal XSK)
- 5 Micro controller system: signal processing and monitoring



There is no electrical isolation between monitoring head and central electronic unit.

Connection of the monitoring heads is by means of precut cable links.

Cables and user interface connections are shown in para. 2.3.2 and circuit diagram 2.3.2.1/ 2.3.2.2.

System configuration and parameter setting are by means of the keyboard if need to be changed. (paras. 5 and 6)

This mainly applies to monitoring head selection, signal outputs (switch point setting) and analogue outputs (zero point setting and scaling).

(optional) 1. - Relays outputs (2 limit values)
 , relay change over contact
 The channels may be assigned in menu "CONFIGURATION", either individually or in pairs, to the physical quantities of temperature or flow. The switch on and off values can be set as desired in menu "PARAMETERS" (yet within the measuring range) for each contact.

Please see para. 8.4.1 for electrical connection.

2. - Transistor outputs (2 setpoints + 2 status outputs or 2 setpoints + 1 status output + frequency output)
 , transistor output - collector/emitter (NPN) freely connectable

Channel 1: common error signal

Channel 2: busy signal or frequency output

Channels 3 and 4: Both channels may be assigned individually or in pairs to the physical quantities of temperature or flow. The switch on or off values of each transistor output can be set as desired.

Please see para. 8.4.2 for electrical connection.

(optional) : , current or voltage output
 Please see the ordering number to find out whether it is a current or voltage output.

Output quantities: 0/1 - 5 V FS (option V1)

0/2 - 10 V FS (option V2)

0/4 - 20 mA FS (option C1)

These FS (full scale) output quantities apply to both channels (flow and temperature) as standard.

20% zero elevation and FS value can be programmed. (See para. 5.11)

Shield connections are ungrounded.



DC 24 V supply

Internal switch mode power supply with physical isolation of the primary and secondary side.



A PTC resistor provides protection from overcurrent. The element automatically resets upon removal of the disturbance or after disconnection of the supply voltage of the FC01-LQ for approx. 1 s (e.g. remove terminal XV).

Please see para. 8.2.1 for technical characteristics.

These are general directions for the application of calorimetric measuring heads which from application to application should be reviewed by the user in accordance with individual requirements.

The standard monitoring head material is stainless steel 1.4571/AISI 316 Ti, an austenitic, acid-resisting stainless steel that is commonly used throughout industry. Manufacturers claim it also withstands oxidizing organic and anorganic acids, and partly even reductive media.

The resistance of this stainless steel should however be verified by the user, particularly when it is used in medium mixtures that may from time to time be exchanged with cleansing agents. Its chemical resistance also depends on temperature, flow rate and concentration of the medium.

Stainless steels owe their resistance to rust mainly to their alloy combination with chromium, the formation of chromic oxide on the steel surface resulting in a passive state. Contamination, deposits on the surface, or foreign rust may however neutralize the passivity. Therefore care should be taken to keep the surfaces clean.

Stainless steel heads must not get in contact with steel parts other than stainless steel or with chemically dissimilar metals, as this would cause electrolytic corrosion.

Hastelloy 2.6410 is a material with a chemical resistance generally exceeding that of stainless steel and copper-based alloys. They are particularly suitable for alkaline media (pH > 7). They should however be examined for suitability for each specific application using resistance tables and pragmatical values.

general industry and installation

insertion-type for sensor adapter and ball valve

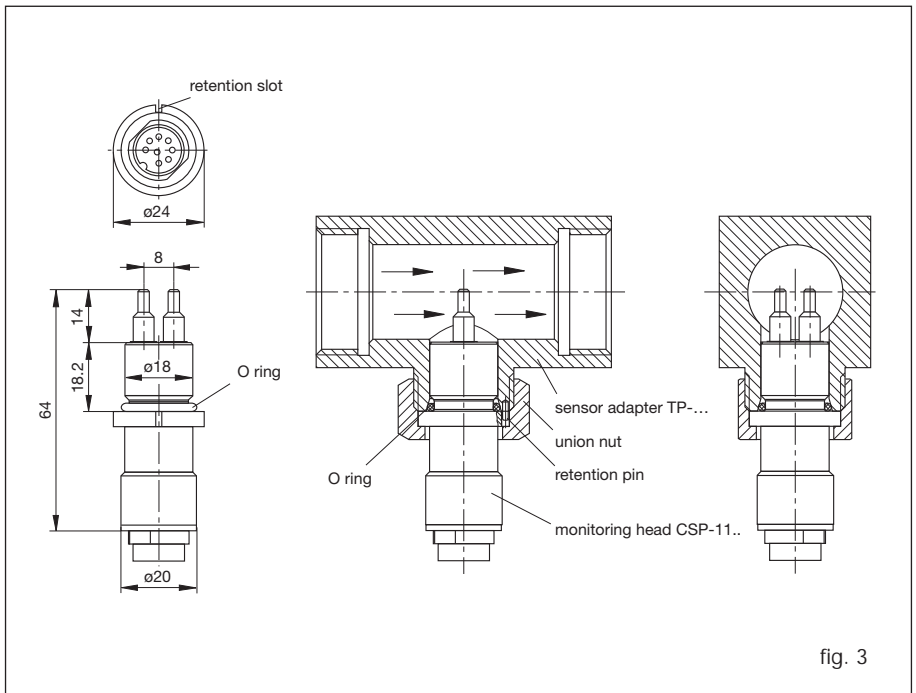
sensor adapter TP-.. (fig. 4)

ball valve BV-.. (fig. 5)

M

stainless steel 1.4571/AISI 316 Ti, electropolished

O ring viton



The sensor adapter TP-... is available in 6 pipe diameters from 1/2" to 2".
 Sensor adapter is available as screw-in (fig. 4 top) or welding type (fig. 4 bottom).

M

- brass or
- stainless steel 1.4571/AISI 316 Ti

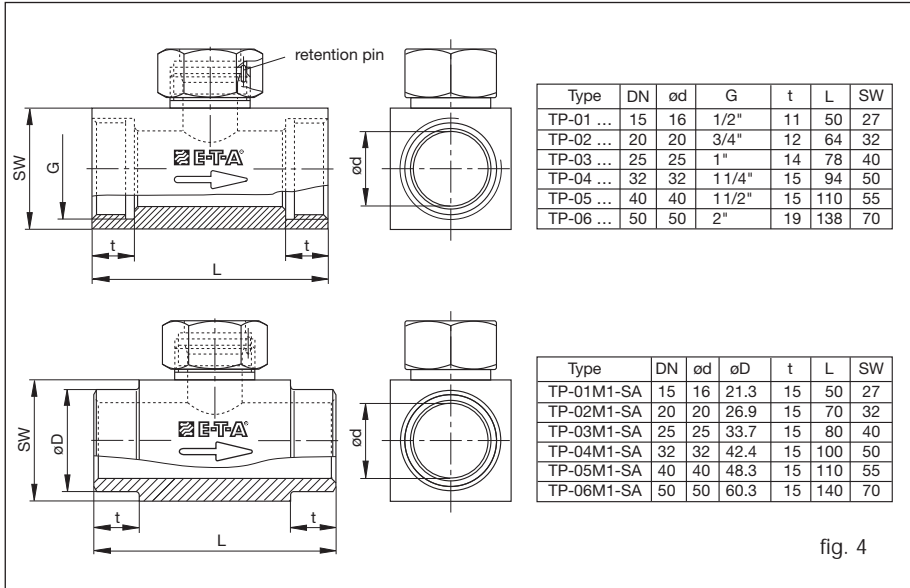


fig. 4

M

⚠ The monitoring head should only be installed or removed when the pipes are unpressurised.
 To ensure the safety label is clearly visible, it should be affixed on to or close to the measuring point.

- Insert the monitoring head with the O ring into the sensor adapter and tighten the union nut (observe correct retention).

The retention pin ensures correct alignment of the monitoring head after the union nut has been tightened.

Correct immersion depth of the monitoring head is ensured by the stop provided.

Sealing of the monitoring head in the sensor adapter is by means of the O ring provided (fig. 3).

- Screw the sensor adapter into the pipe, using hemp or teflon tape for sealing.

The ball valve of Postberg GmbH at D-63485 Bruchköbel is available in 4 nominal diameters from 1" to 2". The ball valve ensures the sensors are fully immersed in the medium.

The monitoring head may also be replaced in pressurised pipe systems on duty.

- Please see the applicable drawing of Postberg GmbH for mounting instructions and dimensions, if necessary.

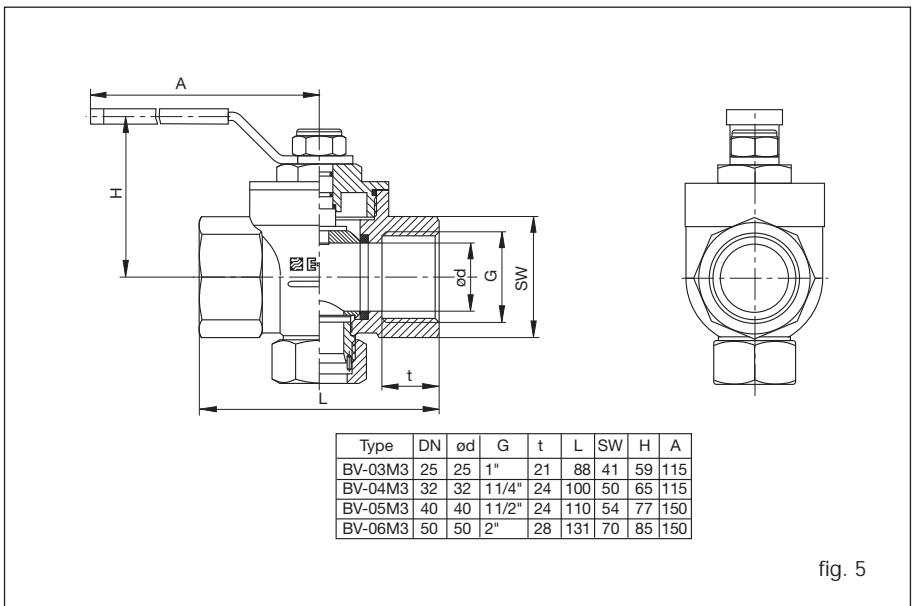


fig. 5

M

pipelines with nominal pipe diameters > DN50

M liquids
smooth shank, 18 mm dia., immersion depth adjustable within the PG16 cable gland (accessory) or mounting in the stainless steel cutting ring gland

- M**
- M1 sensor and shank stainless steel 1.4571 /AISI 316 Ti (sensor)
 - M7 sensor stainless steel 1.4571 /AISI 316 Ti, shank aluminium

Accessories:

- cable gland PG16 nickel-plated brass (see fig. 7)
- threaded installation bush stainless steel 316 (cutting ring) (see fig. 7)

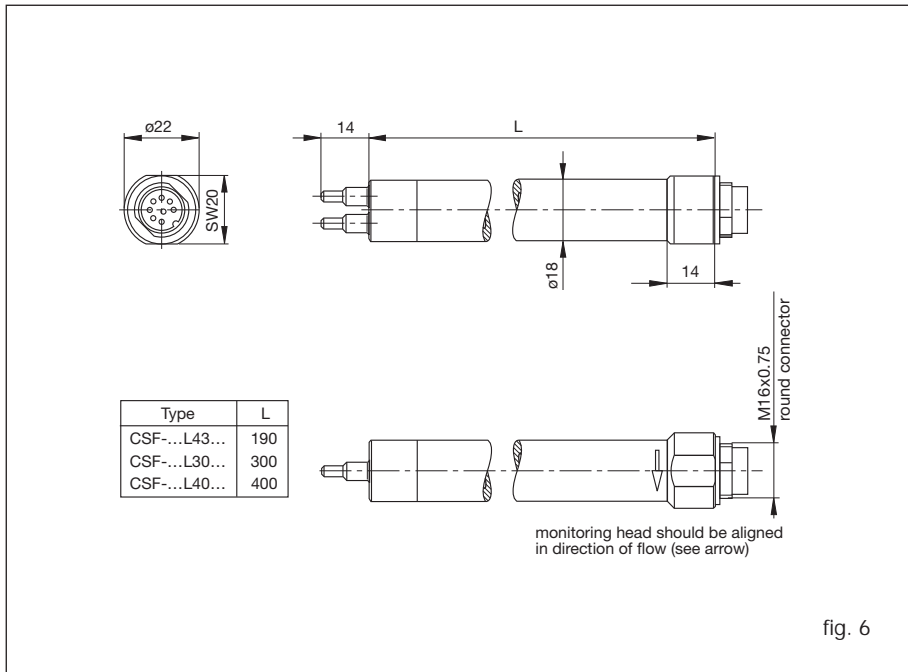
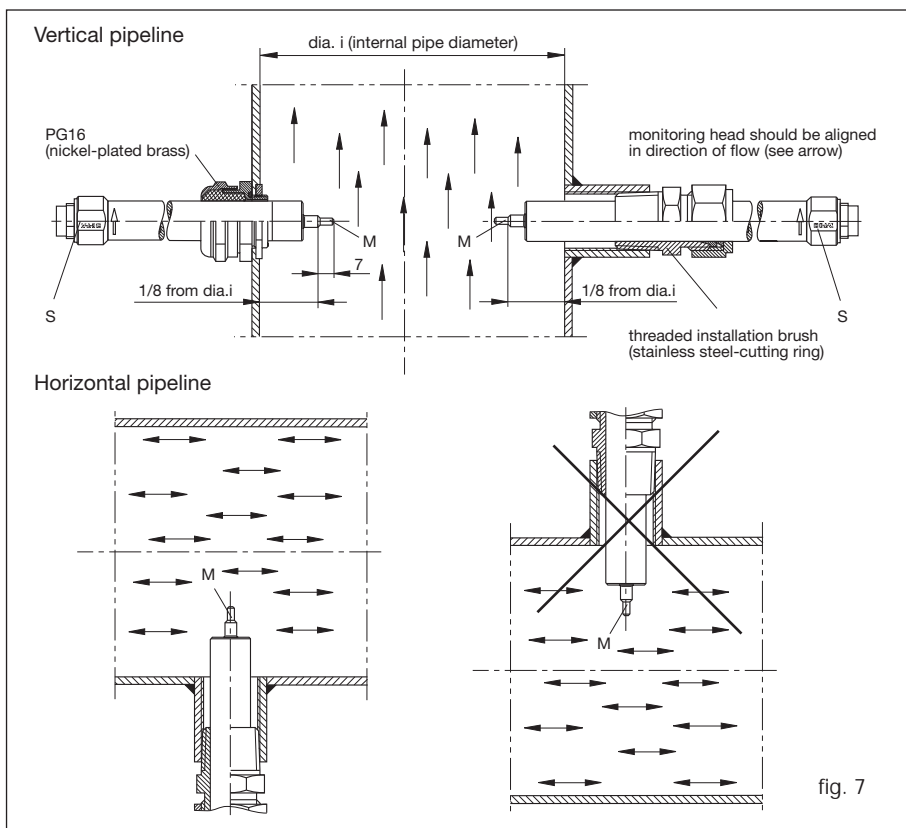


fig. 6

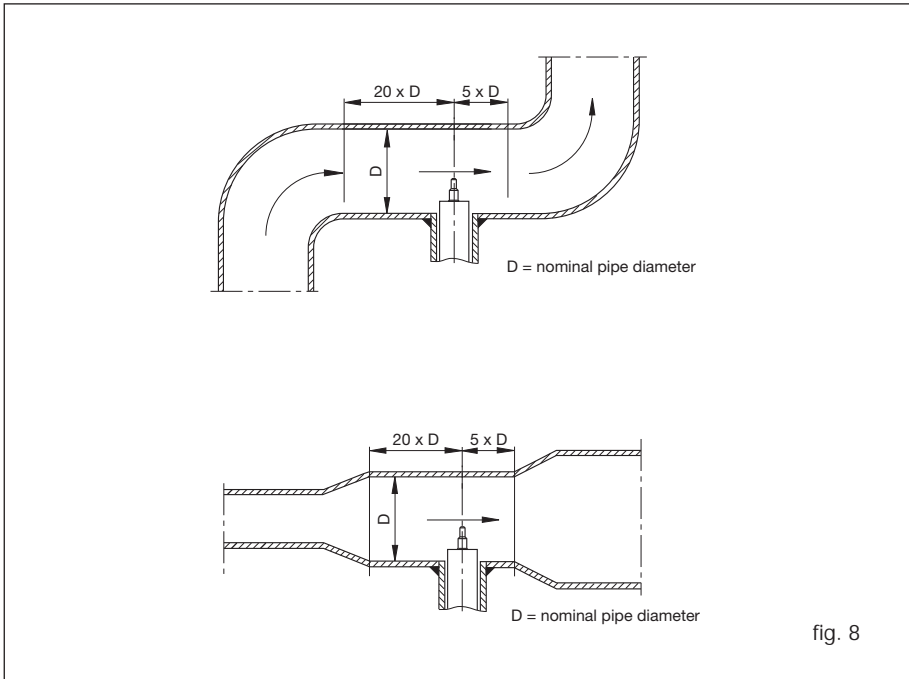
M

! The two sensors (M) should be screwed into the pipeline far enough to ensure that they are aligned side by side directly across the direction of flow. The sensors are correctly positioned when the wrench flats (S) are aligned parallel with the pipeline.

- In the case of vertical pipelines the monitoring head should be installed where the flow is rising, if possible.
- For horizontal pipelines the monitoring head should be mounted on the underside of the line (suspended).



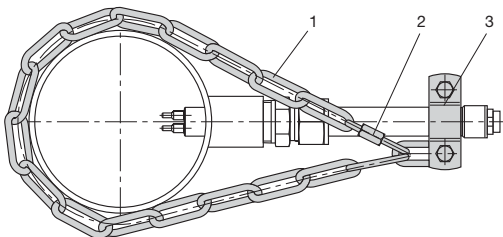
- The monitoring head should be installed only in a straight section of piping. There should be a distance of at least 20 pipe diameters before the monitoring head, and 5 pipe diameters after the monitoring head before or after bends and changes in pipe diameter, to avoid any effects of turbulence.



- When installing the monitoring head, please observe that the arrow corresponds to the flow direction.
- Fit monitoring head with locking set as follows (fig. 9):
 - Fix first link of chain (1) into the clip (3) (tightening torque 10 Nm).
 - Put chain catch (2) into link and fasten with the tight chain.



Locking set 01



- 1 chain 4 x 32 DIN 5685 (approx. 1 m)
- 2 catch for chain NG 5
- 3 clip with screws and nuts DN15 to DIN 11850 (tightening torque 10 Nm)

fig. 9

Cable Do + Ka type xx

(depends on FC01-LQ version and sensor-type used - see figs. 15 and 16)

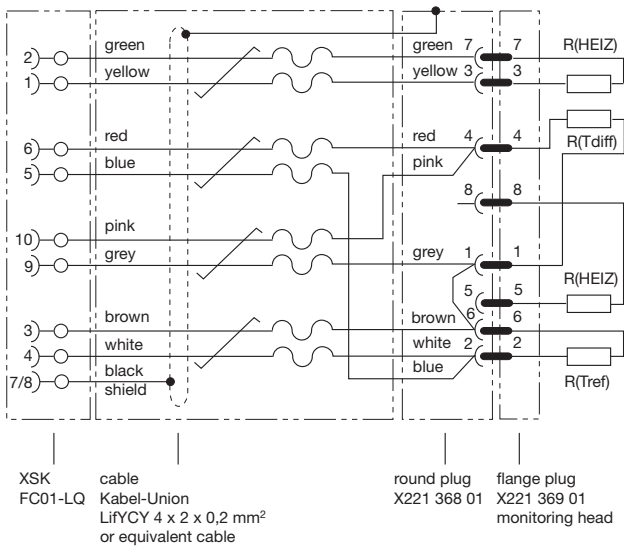


fig. 10

M

- The electronic housing is mounted on a symmetric rail to EN 50022.
- For thermal reasons, the modules should be spaced by at least 10 mm.
- Removal is by releasing the spring catch.

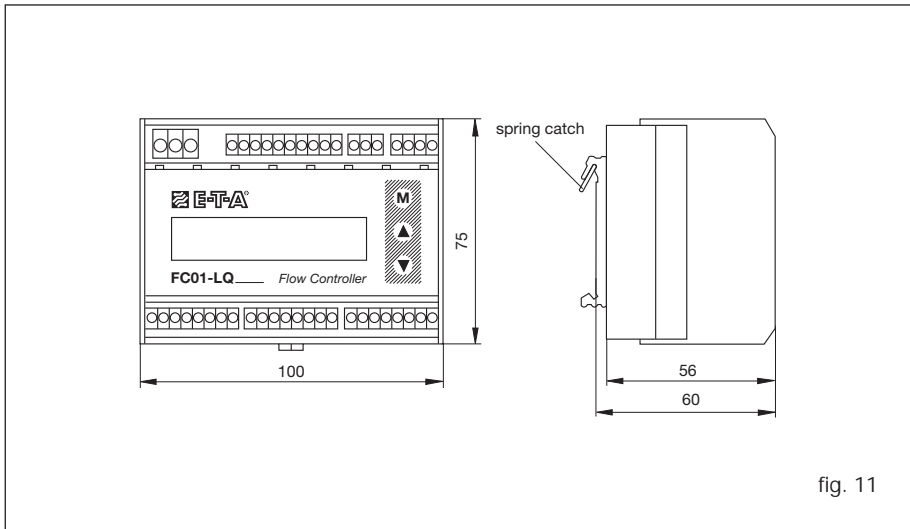
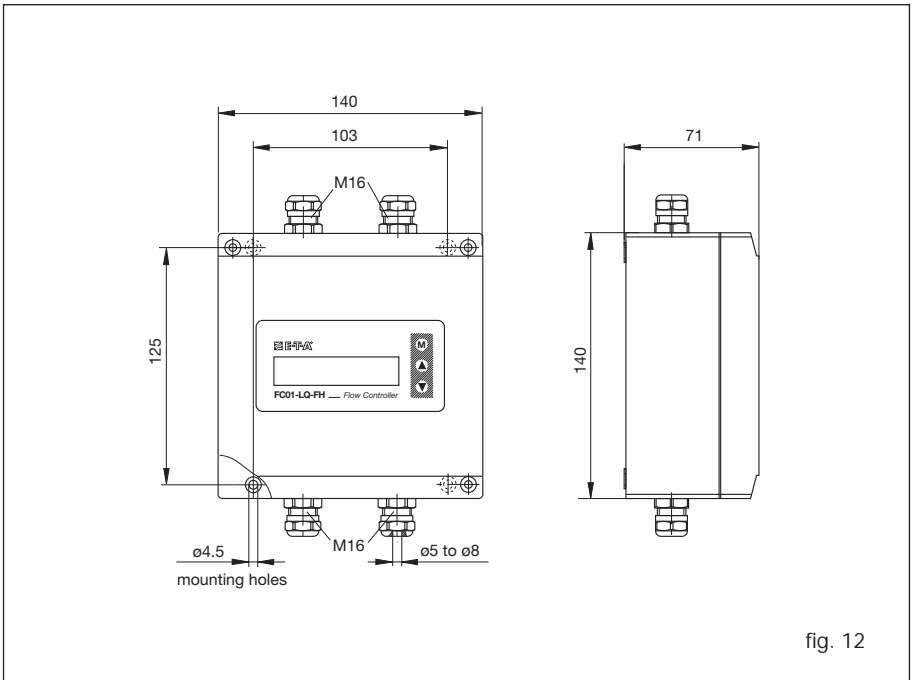
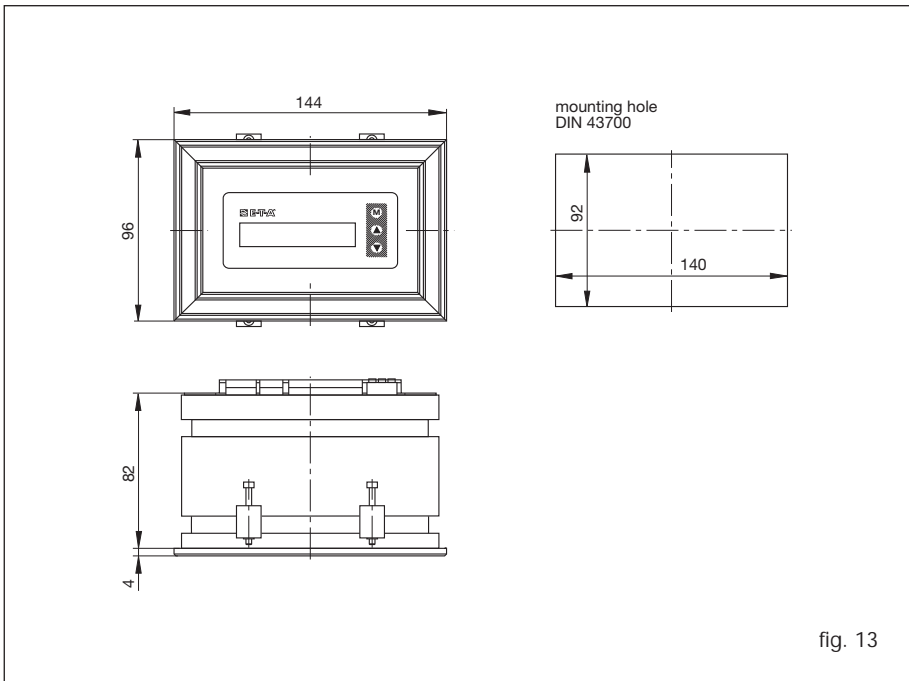


fig. 11

- Remove the cover of the housing.
- Install the housing in place using the 4 self-taping screws M4 (see fig. 12).
- Replace the cover and tighten the retaining screws.



- Insert housing in the front of mounting hole and fix with 4 screws (see fig. 13) from the rear.



Valid for all plug-in screw terminal strips:

Cable size:	0.14 mm ² to 1.5 mm ² , single or stranded conductor
Stripping length:	6.5 mm
Clamping screw:	M2 (nickel-plated brass)
Contact material:	pre-tinned tin bronze

Connection by 3 pole connector; max. 1.5 mm²; 3 x 0.75 mm² cable recommended

Pin No.	Signal name	Function
1	SGND	general reference ground/shield ground
2	+U _v	positive pole of supply voltage
3	-U _v	negative pole of supply voltage

Connection by 3 pole connector; factory-wired

Bridge 2-3 inserted = keyboard blocked

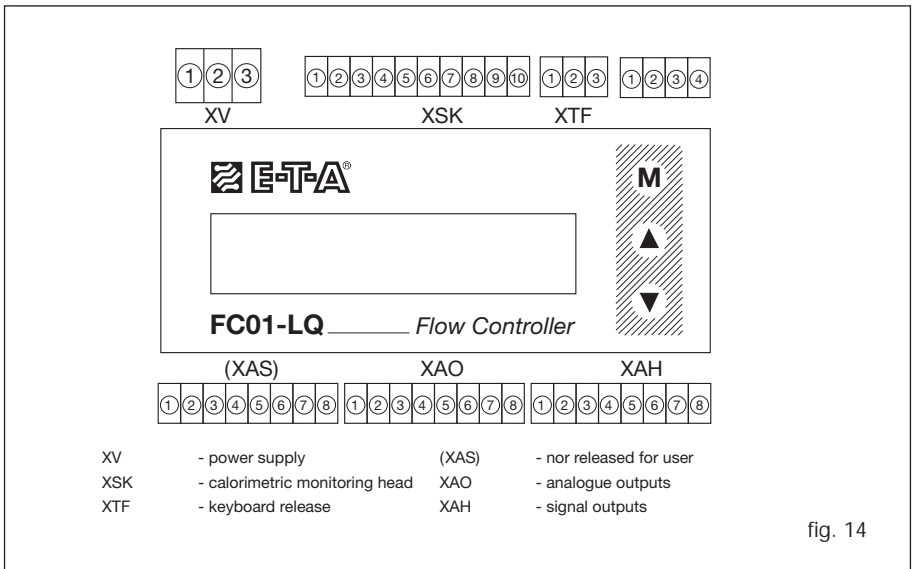


fig. 14

Connection by 8 pole connector; max. 1.5 mm²; LiYCY 2 x 0.25 mm² cable recommended for each analogue output

(option: V1, V2, C1)

Pin No.	Signal name	Function
1	NC	none
2	[ANAO1 ANA1GND SGNDA1	analogue output 1 - flow
3		reference potential for analogue output 1
4		shield ground for analogue output 1 (ungrounded) *
5	[SGNDA2 ANAO2 ANA2GND	shield ground for analogue output 2 (ungrounded) *
6		analogue output 2 - temperature
7		reference potential for analogue output 2
8	NC	none

*

Connection by 8 pole connector; max. 1.5 mm²; LiYCY 3 x 0.38 mm² cable recommended for each signal output

Pin No.	Signal name	Function
1	[SGNDL1 LIM1 LIM1COM	shield ground 1
2		non-inverted signal output 1 (N/O)
3		common change over input 1
4	[/LIM1	inverted signal output 1 (N/C)
5	[SGNDL2 LIM2 LIM2COM	shield ground 2
6		non-inverted signal output 2 (N/O)
7		common change over input 2
8	[/LIM2	inverted signal output 2 (N/C)

Connection by 8 pole connector; max. 1.5 mm²; LiYCY 4 x 2 x 0.2 mm² cable recommended

Pin No.	Signal name	Function
1	[/ERROR E /ERROR C	summarized error indication - emitter terminal
2		summarized error indication - collector terminal
3	[/BUSY/PULSE E /BUSY/PULSE C	availability signal or frequency output - emitter terminal
4		availability signal or frequency output - collector terminal

5]	— [LIM2 E	limit value 2 - emitter terminal
6]		LIM2 C	limit value 2 - collector terminal
7]	— [LIM1 E	limit value 1 - emitter terminal
8]		LIM1 C	limit value 1 - collector terminal

Pre-sized connecting cable Do+Ka type 15 or Do+Ka type 18 with plug-in screw terminal strip (see 2.2.3).

Only for connection of cable shield (not released for user)

Pin No.	Signal name	Function
3	SGND	/shield ground

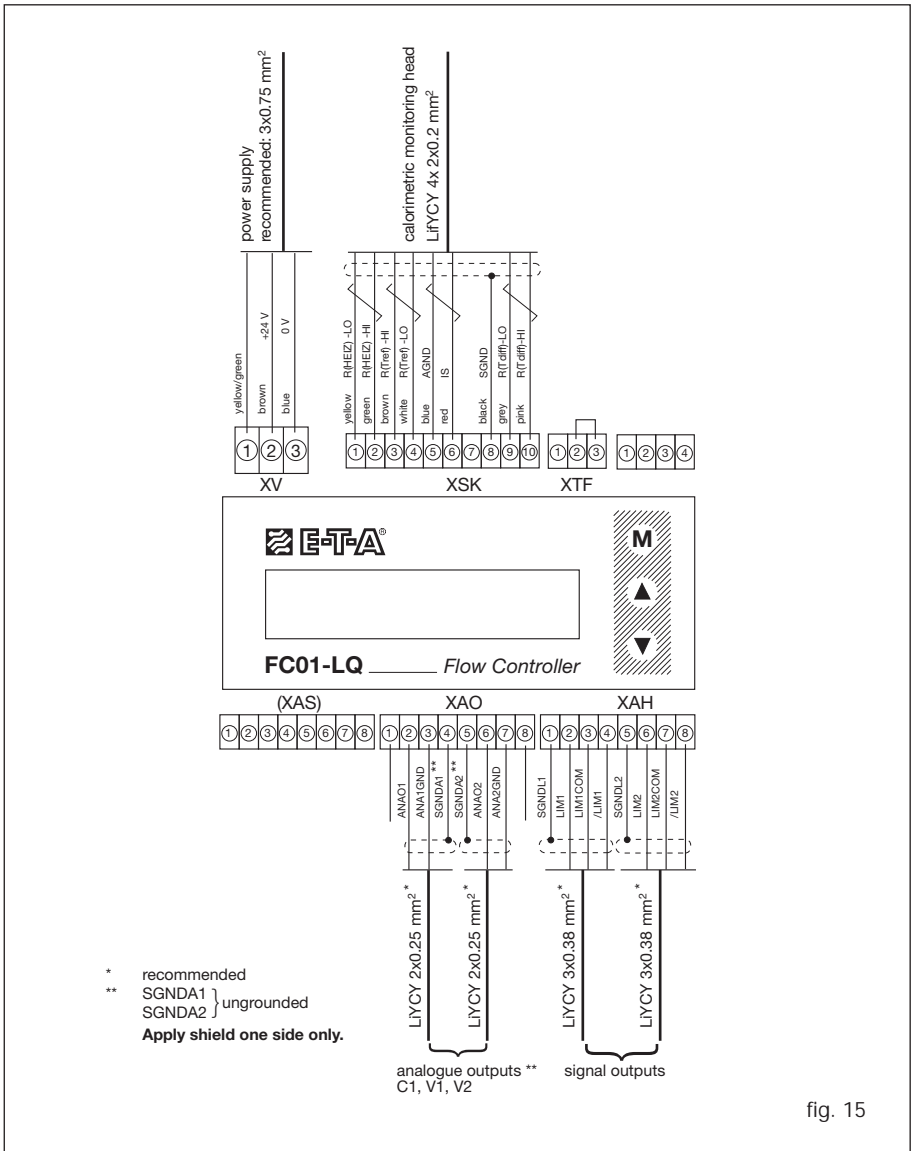


fig. 15

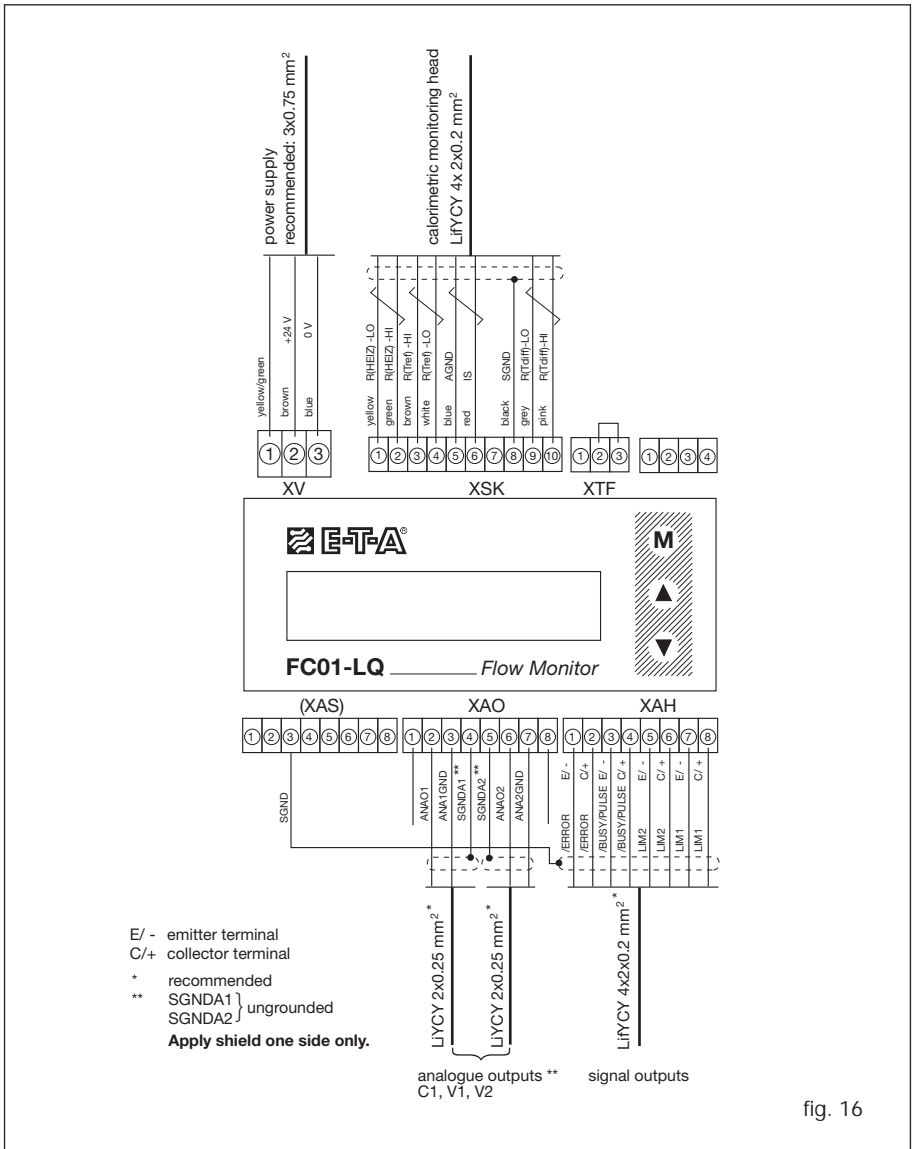


fig. 16

The quantity-dependent pulse may be selected in the menu item "DISPLAY SELECT". A square pulse signal is available for driving a counter or a primary control at the plug /BUSY E/- and /BUSY C/+ (pins 3 and 4) (see fig. 16 - circuit diagram FC01-LQ - transistor outputs).

Signal ground shall be connected to pin 3 (BUSY E/-) and the driving load to pin 4 (BUSY C/+).

The pulse length is 50 ms ($\pm 1\%$) continuously.

Select cable size $\leq 1.5 \text{ mm}^2$ to make the connections.

The shield cables can be connected to connector , pin 3.

(fig. 17)

If the frequency output of the FC01-LQ is connected to an electronic counter, computer or PLC, the load current should not exceed 10 mA so as to ensure low level is 0.8 V. The max. admissible voltage level of 48 V is irrelevant in this connection.

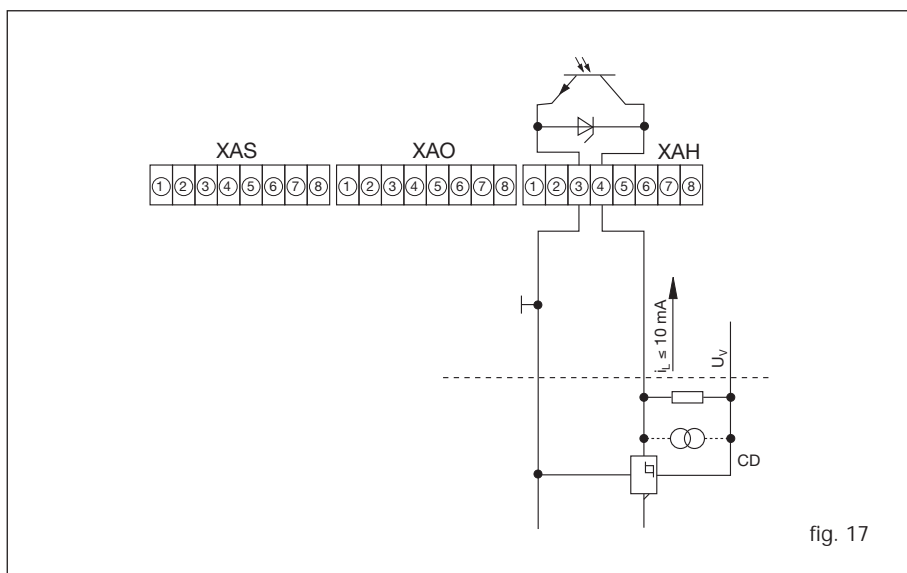


fig. 17

(fig. 18)

The FC01-LQ driver output comprises an integral safety circuit which when isolating the counter operating coil will limit overvoltages caused by inductance and convert the energy stored.

The counter should be able of processing a counting frequency of \geq , as the pulse length is 50 ms ($\pm 0.1\%$) continuously.

It should therefore be ensured that the counter can be increased by one during the time available.

If a separate relief network is preferred to the integral network, care should be taken when processing the max. frequency of 10 Hz to ensure the energy stored in the operating coil has dissipated by the time the counter output is reset. The time to do this should be below 40 ms, making due consideration to switching times and pulse variations.

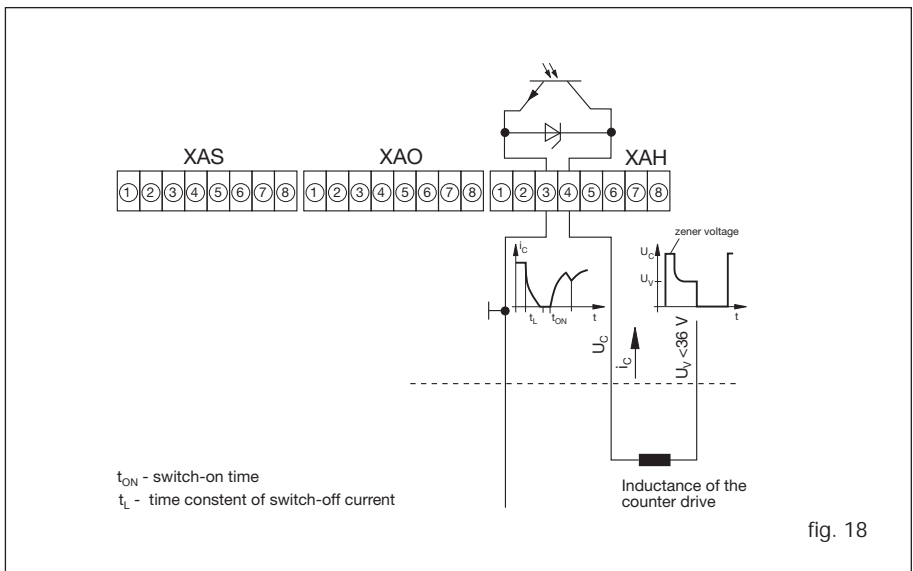
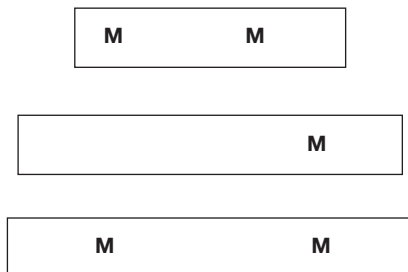


fig. 18

- As there will be a reset pulse available at the output in the moment the supply voltage of the FC01-LQ is applied, make sure that the counter is switched on delayed or set to zero after it has been switched on

Clear menu-driven control, via keyboard and display, enables easy definition of parameters and configuration. This provides high system flexibility, making the FC01-LQ the optimum solution for a wide variety of measuring, monitoring and display tasks.

All functions are distributed on the three following menu levels:



See Appendix 2 listing all functions available.



Setting and configuration is by means of three front keypads (M) MODE, (▲) UP and (▼) DOWN. It is also required for setting the unit to simultaneously press (▲) UP and (▼) DOWN = (▲ + ▼).

⚠ The FC01-LQ can only be set or operated when connector XTF (keyboard release) is removed!

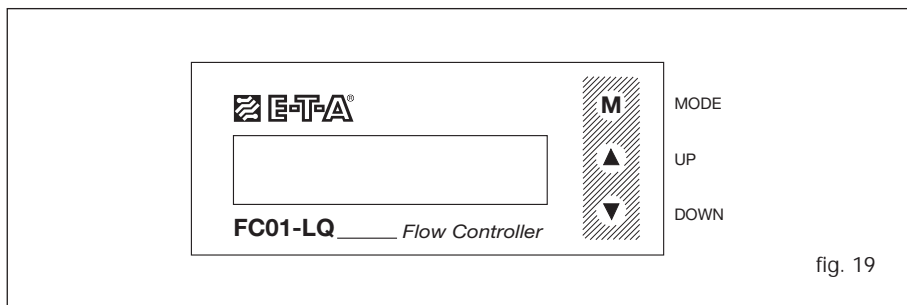









fig. 19



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The next menu option is selected by pressing  MODE (forward paging).

Pressing  MODE after the last menu option will cause skipping to the first option of the menu.

Simultaneously pressing  UP and  DOWN =  calls the selected menu option, or causes skipping to the selected submenu.

Some menu options require numerical values to be entered. After selecting the appropriate menu option, the value indicated can be changed by pressing  UP or  DOWN.




Each time  UP or  DOWN are pressed, the value indicated will be increased and reduced respectively, by one numeral skip.

The longer  UP or  DOWN are pressed, the faster the increase or reduction.

Pressing  MODE transfers the set value or the selected menu option to a volatile memory.

A permanent transfer of settings and values is only effected when quitting the menu, after a plausibility check of all entries.

Afterwards the data are still available even after switching the FC01-LQ repeatedly on and off.

Selected data such as MIN, MAX values, totalized quantity or LAST ERROR can be deleted or reset by simultaneously pressing  UP and  DOWN = .



After configuration and parameter selection re-connect plug (keyboard release) to protect the system against unauthorised access!

Upon power application will be shown on the display for approx. 1 sec., with the being indicated in the second line.

During this period, the integral controller will conduct test routines (see para. 7.1, Test and diagnosis).

If during the test no error was found, the display will indicate . The FC01-LQ will then be in the heating up period required for the measuring procedure.

M

Upon completion of the heating up period and availability of the first measured value, the display will change to measuring cycle, and the user interfaces such as analogue outputs or limit switches will be up-dated.

- It is not possible to configure or select parameters of the system during the measuring operations!

All options of the main menu may be addressed without affecting the measuring and monitoring function.

Menu option values

PEAK VALUE MIN

PEAK VALUE MAX

LAST ERROR

TOTALISATOR

may be deleted simultaneously operating the  UP and  DOWN =  switches without affecting the measuring operations.

Theoretically established measuring values will be used when the measuring range of calorimetric monitoring heads is exceeded (0.05 ... 3 m/s for water). The FM-LQ 1 can thus be operated beyond the measuring values defined (up to 4 m/s for water).

This feature will not affect the accuracy specified for the measuring ranges defined whilst no accuracy information can be given for conditions where the measuring ranges are exceeded.

Analogue output, limit switches etc. can be set beyond the measuring range. When per cent display is selected, the defined measuring range will correspond to 0 ... 100% (>100% when the defined range is exceeded).

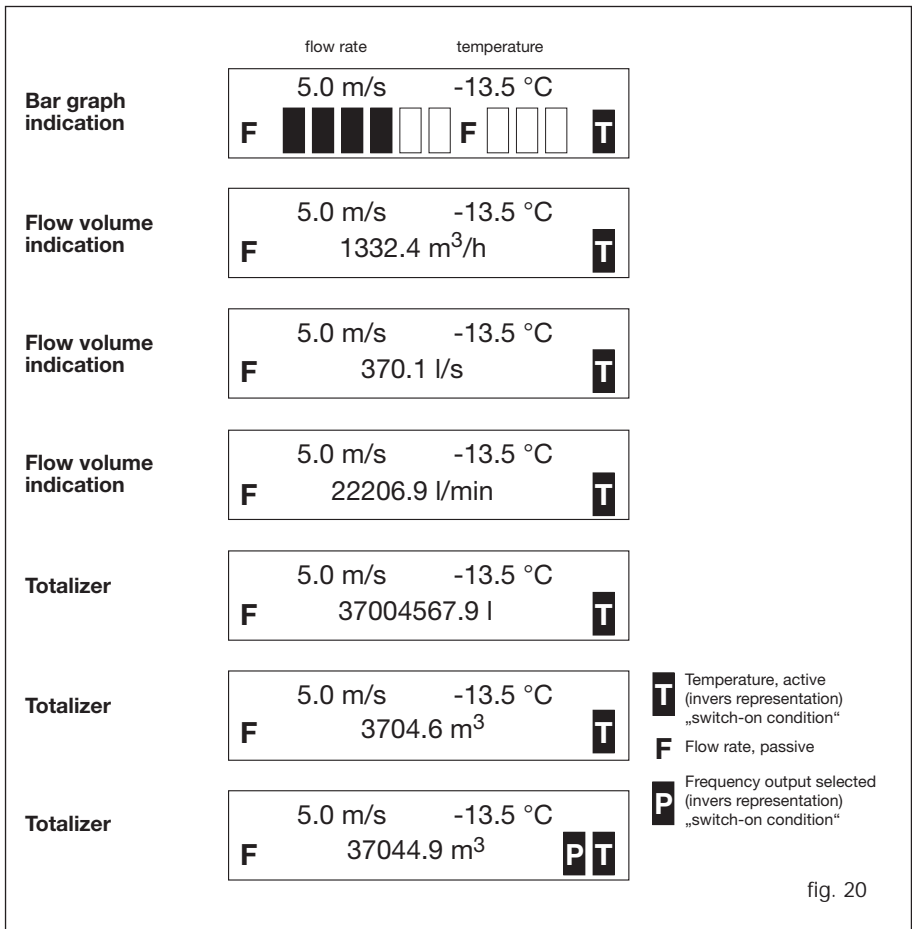
The following operating data may be retrieved in the main menu during the measuring cycle: (see para. 4.2.1).

M

Flow rate and medium temperature are indicated by the units selected in the upper line of the LC display.

The lower line of the display will optionally show the switching condition of the limit switches and an analogue bar with a 10-segment resolution, or the flow volume/time unit pertinent to the indicated flow rate or the totalized flow volume (totalizer function).

The analogue bar has different meanings, depending on its configuration (see para. 5.7 - menu option BARGRAPH).



The limit switches are identified according to their physical assignment, i.e. by F for flow rate and T for medium temperature, at the first or last place of the second line on the display.

If and are shown reversed, the limit switch is in the switch-on condition.

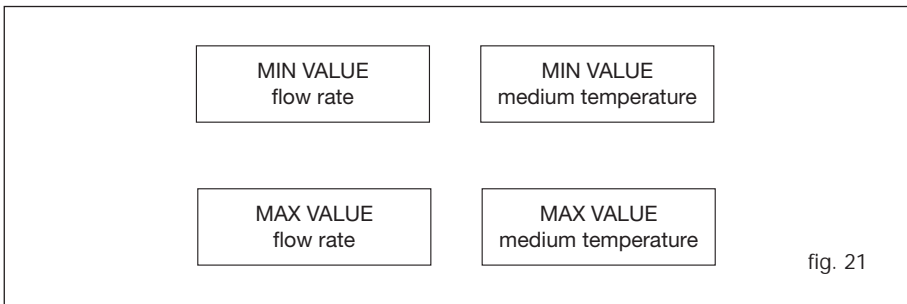
Limit switches lying within the analogue bar range are also represented at the appropriate place of the analogue bar (see para. 5.7).

The following figures show the display variants under menu option "Measured value(s)" (para. 5.6 - menu option DISPLAY SELECT and 5.9 - menu option FREQUENCY OUTPUT).

(menu option: **M** **M**)

The FC01-LQ comprises four specific measured-values memories.

They store the lowest and highest value of flow rate and medium temperature.



After switch-on or NOT-BUSY indication, the minimum and maximum values are deleted and will be continuously updated (non-return pointer principle).

The peak values may be retrived in the main menu and are deleted by simultaneously pressing

▲ UP and ▼ DOWN = ▲ + ▼ .

! Power failure or disconnection of the power supply will delete the contents of the four measured-values memories.

(menu option:)

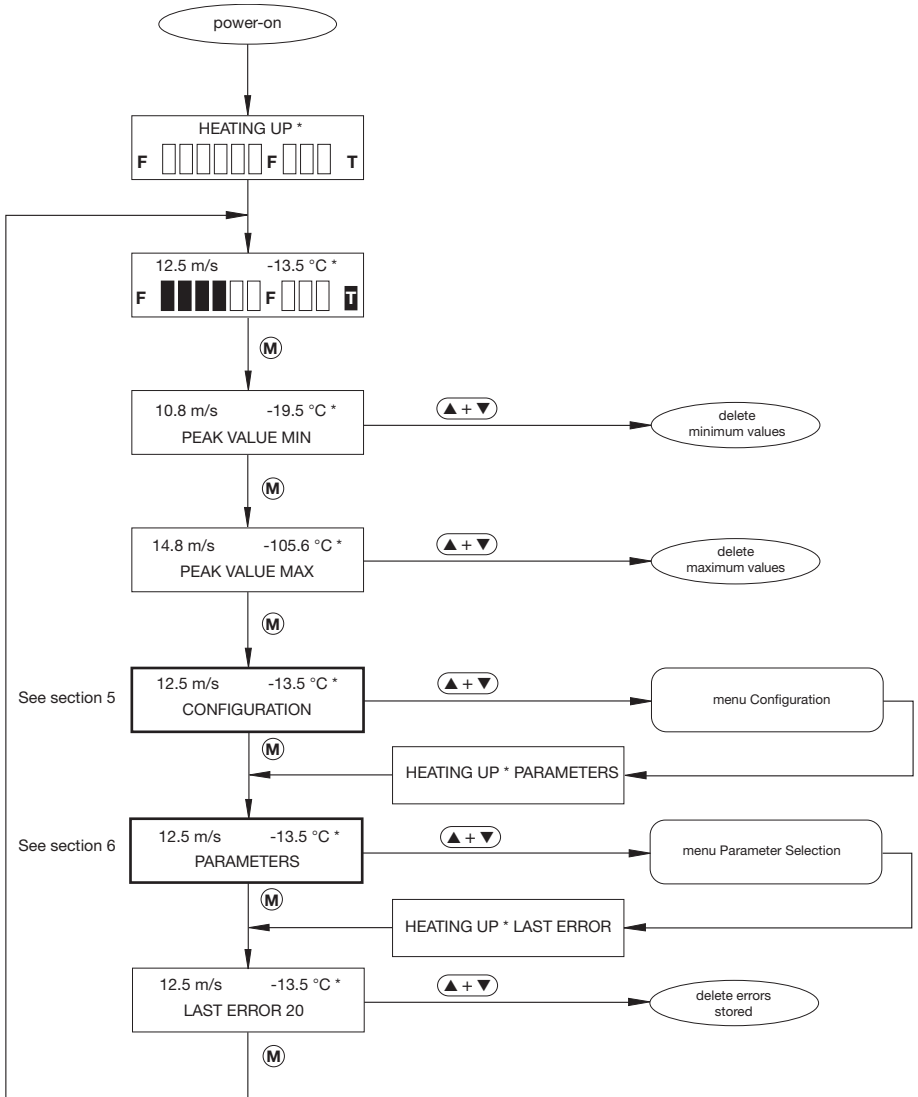
The last main menu option to be called is the error memory.

This error memory comprises the number of the last error (see section 7). It may be very helpful when commissioning the FC01-LQ.

Other than the peak value memories described above, the contents of this memory will be retained even upon power failure.

The user may purposely delete the error memory in the condition selected by simultaneously pressing ▲ UP and ▼ DOWN = ▲ + ▼ .

M



* not available with turbine-type sensor

(menu option:)


The CONFIGURATION menu serves to adjust the FC01-LQ to the application within the entire system. During system configuration, measuring operations are not possible (see appendix 1). Configuration possibilities are:

(menu option:)

This menu option comprises all monitoring heads that can be used with the FC01-LQ (issue 07.2003). The appropriate sensor can be selected from the following menu (for type designation see type label or CPI catalogue).

- TYPE CSP11WM1 (insertion head for water with sensor adapter TP-..)
- TYPE CSP11WM1BV (insertion head for water with ball valve BV-..)
- TYPE CSF11WM1 (monitoring head for water with adjustable immersion depth)
- TYPE S-No. xxx (custom designed monitoring head for special liquids)

The monitoring head programme is continuously extended - please enquire.

 Menu option SENSOR SELECT may influence data in the parameter selection menu (see para. 5.12, Quitting the configuration menu).


M (menu option:)

To operate the FC01-LQ with a calorimetric monitoring head, it is necessary to set sensor-specific characteristics.

These characteristics are specified by the sensor code which together with the monitoring head type number is marked on the monitoring head housing.

Enter the following characteristics when selecting a : The setting is menu driven:

- | | |
|------------------------|------------------------|
| 1. SENSOR CODE C value | characteristics range: |
| 2. SENSOR CODE T value | characteristics range: |

 Take care to repeat these settings after replacing the monitoring head or electronic control unit FC01-LQ, as the accuracy of measurements is determined by the sensor code.

Enter the following characteristics when selecting a :

- | | |
|------------------------|------------------------|
| 1. SENSOR CODE C value | characteristics range: |
| 2. SENSOR CODE value | characteristics range: |

The nominal diameter of the ball valve is selected in menu option BV SIZE SELECT.

Available sizes are:

- DN25 (1 in), DN32 (1 1/4 in), DN40 (1 1/2 in) und DN50 (2 in).

Enter the following characteristics when selecting a :

- 1. SENSOR CODE C value characteristics range:
- 2. SENSOR CODE T value characteristics range:

The internal diameter of the sensor adapter is selected in menu option TYPE SELECT.

Available sizes are:

- TP01 (1/2 in)
- TP02 (3/4 in)
- TP03 (1 in)
- TP04 (1 1/4 in)
- TP05 (1 1/2 in)
- TP06 (2 in)


(menu option: **M**)

The FC01-LQ comprises two limit switches (LS1 and LS2) which are assigned to the physical quantity/quantities to be monitored in submenu LIMIT SWITCHES.

The following combinations are available:

- LS1 F and LS2 F
 limit switch 1 flow rate
 limit switch 2 flow rate
- LS1 T and LS2 T
 limit switch 1 medium temperature
 limit switch 2 medium temperature
- LS1 F and LS2 T
 limit switch 1 flow rate
 limit switch 2 medium temperature
- LS1 T and LS2 F
 limit switch 1 medium temperature
 limit switch 2 flow rate

Mode of operation, limit value and hysteresis of the limit switches are set in menu PARAMETER SELECTION.

 Menu option LIMIT SWITCHES may influence data in the parameter selection menu (see para. 5.12, Quitting the configuration menu).

(menu option:)

At these point (1st line top left) the requested unit for the flow velocity will be set.

This menu option is used to set the desired flow rate unit:

- METRE/SEC [m/s]
- FEET/SEC [FPS]
- PERCENT [%]
- BLANK [no unit]

Any further entries relating to flow rate (e.g. limit value, analogue output etc.), refer to that unit.

Standard percent is displayed when BLANK (no unit) is selected.

When the flow rate unit is changed, all configuration and parameter data relating flow rate will automatically be converted!

M

(menu option: **M**)

This submenu is used to select the medium temperature unit (1st line top left).

Options are:

- GRAD CELSIUS [°C]
- GRAD FAHRENHEIT [°F]
- KELVIN [K]

All other entries relating to the medium temperature (limit value, analogue output, etc.) refer to the unit selected there. When the temperature unit is changed, all configuration and parameter data relating to medium temperature will automatically be converted.

(menu option:)




The FC01-LQ enables the user to define the 2nd line of the display 2 in certain points.

When the first line of the LC display in the main menu indicates the flow rate in the unit selected as well as the medium temperature in °C, °F or K, it is possible to select the second line from the following menu options (see para. 5.14).

- BARGRAPH :
- LITRE/SECOND [l/s]
- LITRE [l]
- LITRE/MINUTE [l/min]
- METRE³ [m³]
- METRE³ / HOUR [m³/h]
- GALLONS° [° = US-GALLONS]
- GALLONS°/MINUTE

Where totalizer function has been selected, the totalizer will start at zero counting in the unit selected (litre, m³ or gallons).

When the display changes from m³ to litre or gallons, or from litre or gallons to m³, the value already counted will be converted.

The content of the totalizer is deleted by simultaneously pressing  UP and  DOWN = , or when the max. display value (99999999.9 l, m³ or gallons) is reached.

In both cases the totalizer will restart from zero.



The content of the totalizer is deleted in the event of power failure or disconnection of the power supply!

Skipping to the submenu BARGRAPH or PIPE SIZE is effected depending on the selected menu option.

(menu option:)

This menu option allows the user to set the bar graph as desired. The following settings should be made:

- FLOW / TEMP = (bar graph assignment: flow rate/medium temperature)
- ZERO = (initial value of the bar graph)
- FS = (final value of the bar graph)

Independent of its assignment, the bar graph has a constant resolution of 10 segments.

When entering the initial or final value, the user should observe reasonable resolution!

The bar graph also comprises the representation of the limit switch(es) as far as they can be indicated in the bar range selected.

The representation of the limit switches in the bar graph depends on the switch-on value of the limit switch.

For representation details see para. 4.2.1 (Operating data).

Limit switch assignment:	LS1 F and LS2 T
Switch-on value LS2:	23 °C
Switch-off value LS2:	29 °C
Analogue bar graph assignment:	medium temperature
Initial value - analogue bar graph:	20 °C
Final value - analogue bar graph:	30 °C
Instantaneous temperature value:	25 °C

resulting in the analogue bar graph display shown below:

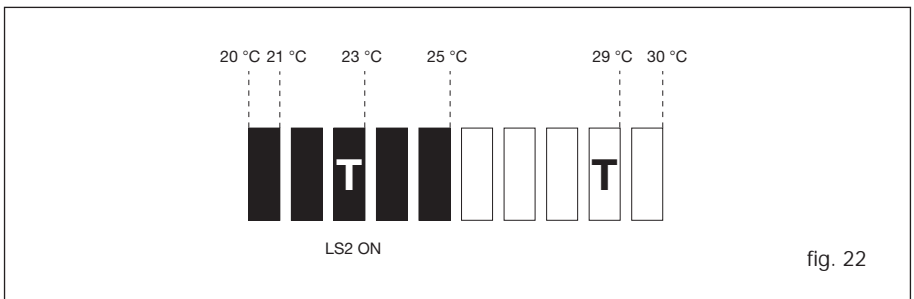


fig. 22

(menu option:)

If flow volume/time unit display has been selected, it is necessary to indicate the pipe diameter to calculate mass flow.

This is provided by selecting the pipe diameter in menu option PIPE SIZE comprising pipe diameters from mm.

(menu option:)

The totalizer function of the FC01-LQ has been expanded by the output of . The function can only be displayed by version (transistor outputs).

The proportional quantity pulses have been determined as follow:

Example: 1 pulse / 10.0 [litre]

The frequency output will supply 1 pulse per 10 litres (totalized quantity).




When the quantity-proportional pulses are assigned, the frequency of the frequency output must not exceed 10 Hz. The limits that can be displayed are determined by the flow velocity range and the pipe diameter.

Potential setting range of the frequency output: 1 pulse per 0.1 ... 999.9 [litre], [m³], [gallons]

The max. frequency being exceeded will not cause the measurement to stop but will rather cause the error output to signal error 60 on the display. This error is included in priority group III. If a combination of priority III errors occurs simultaneously, they are indicated or stored in the error memory observing the following sequence:

Error No. 20, 30, 60, 40, 41.

When the measurement is stopped (as caused by priority II error and calling the configuration or parameter selection menus), the pulses for the quantity already counted will be available. Thereafter the output of pulses will be stopped, with the frequency output becoming high-resistive until the measurement is restarted.

The content of the totalizer may be deleted by simultaneously pressing  UP and  DOWN =  in the main menu.

As the frequency output refers to the content of the totalizer, although its operation is not dependent on the content of the totalizer, a totalized quantity that is smaller than that set per pulse will not be lost.

This means that only the content of the totalizer is deleted.

(menu option:)

This menu option allows adjustment of the flow rate analogue output specifically to the requirement of the entire system.

Options are:

- OFFSET = 0%/20% FS (0/4 ... 20 mA, 0/1 ... 5 V, 0/2 ... 10 V)
- ZERO = (0(20) % corresponds to a flow rate of _ [m/s] [%] [FPS])
- FS = (100% corresponds to a flow rate of _ [m/s] [%] [FPS])

When entering the initial or final value, the user should observe a reasonable resolution!

With a flow volume/time unit selected in menu DISPLAY SELECT and when setting the initial and end values, the pertinent flow volumes will also be indicated.

(menu option: **M**)

In conformance with the configuration "Flow rate analogue output" it is possible to adjust the medium temperature analogue output to the requirements of the entire system.

Options are:

- OFFSET = 0%/20% FS (0/4 ... 20 mA, 0/1 ... 5 V, 0/2 ... 10 V)
- ZERO = (0(20) % corresponds to a medium temperature of ... [°C] [°F] [K])
- FS = (100% corresponds to a medium temperature of ... [°C] [°F] [K])

When entering the initial or final value, the user should observe a reasonable resolution!

Upon configuration of the analogue outputs, the menu may be quitted or re-set to the start (SENSOR SELECT).

To quit the configuration menu, the controller will check the data entered for plausibility.



"CONFIG. OK!" is indicated when the data are found correct. The menu may than be quitted by pressing **M** MODE.


Errors found during the plausibility check are indicated in the following sequence of priority.

Priority of entry errors in the CONFIGURATION menu:

- ERR. A-OUT FLOW OUT OF RANGE
(flow analogue output outside measuring range)
- ERR. A-OUT FLOW ZERO ≥ FS
(initial value ≥ final value with flow analogue output)
- ERR. A-OUT TEMP OUT OF RANGE
(temperature analogue output outside measuring range)
- ERR. A-OUT TEMP ZERO ≥ FS
(initial value ≥ final value with temperature analogue output)

- ERR. BARGRAPH OUT OF RANGE
(bar value outside measuring range)
- ERR. BARGRAPH ZERO ≥ FS
(bar initial value ≥ bar final value)

The menu can only be quitted after correction of the error(s). To do this, return to the beginning of the configuration menu by pressing  UP or  DOWN and select the menu option with the incorrect entry for correction.

 If during the configuration data are affected which are accessible in the parameter selection menu, (which may be the case for the options Sensor Selection, Medium Selection and Limit Switch Assignment), the option "PARAMETERS" in the main menu will be flashing.

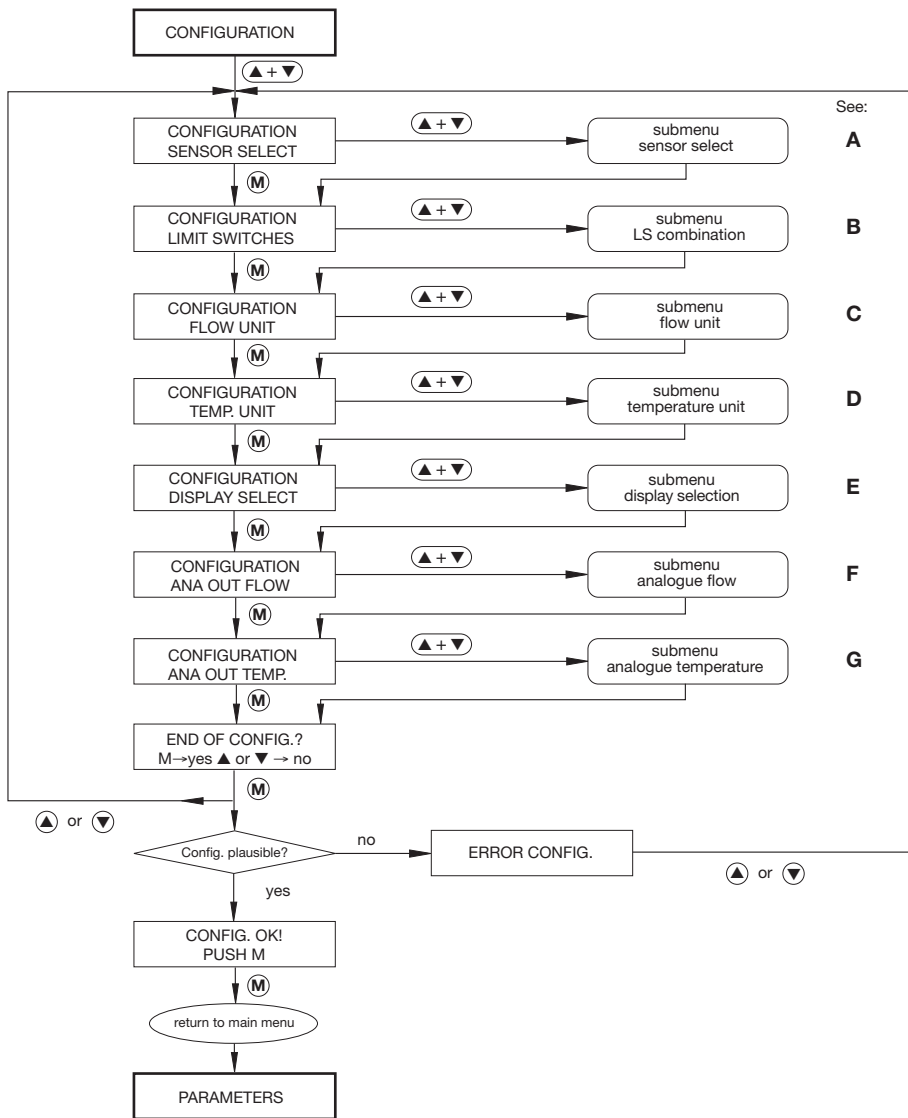
In this event it is imperative to branch into parameter selection menu to set the data in conformance with the desired application.

: Changing the limit switch assignment from → → to
→ →

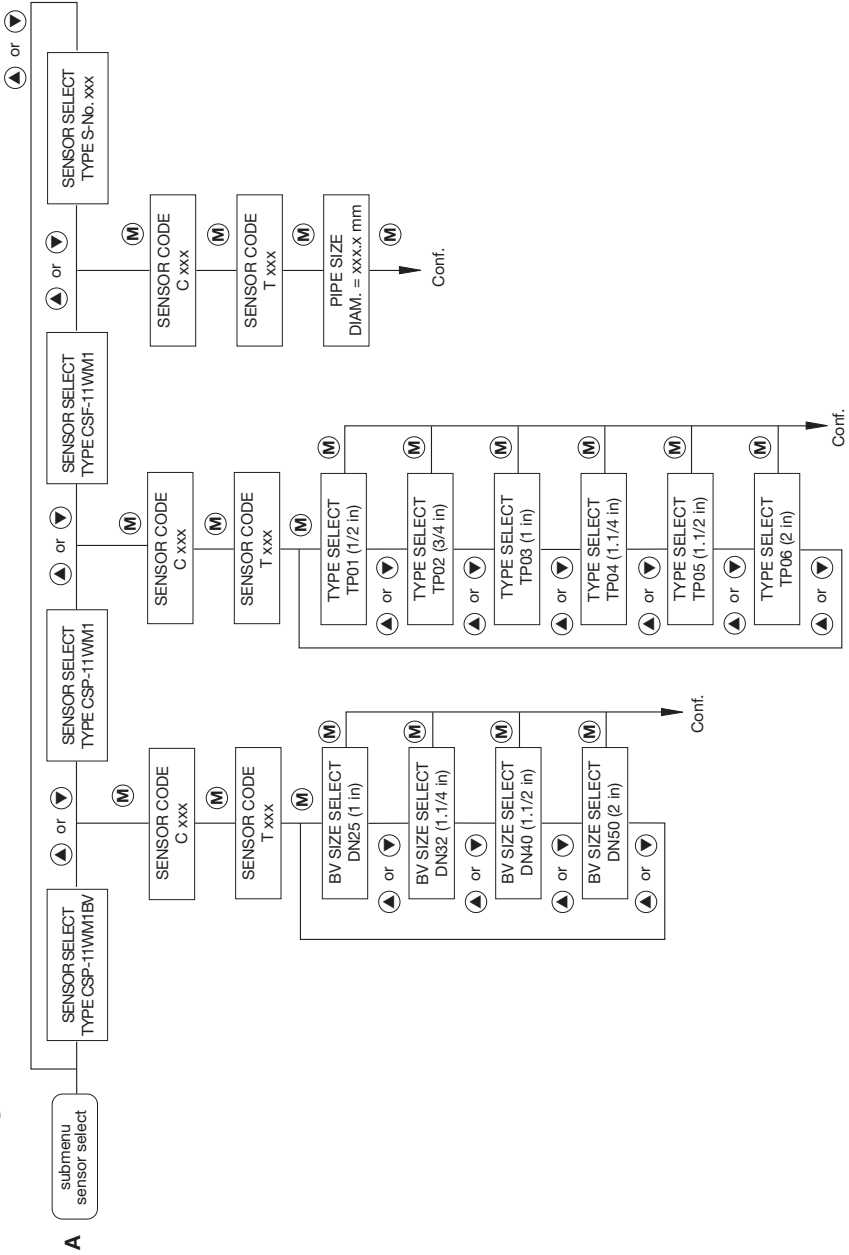
Effects on parameter data: = 0.00
= end of measuring range (depending on the medium selected)

Reason: Changing the physical assignment of limit switch 2 will adjust its switch-on and switch-off values to the new assignment (flow rate).

An overview of the configuration menu and a summary of the measuring ranges and menus available for the sensor type selected are shown on the following pages.

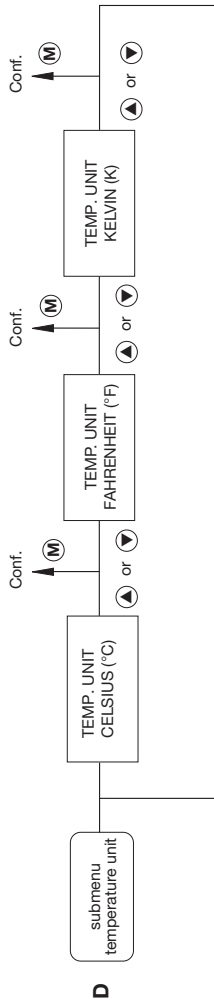
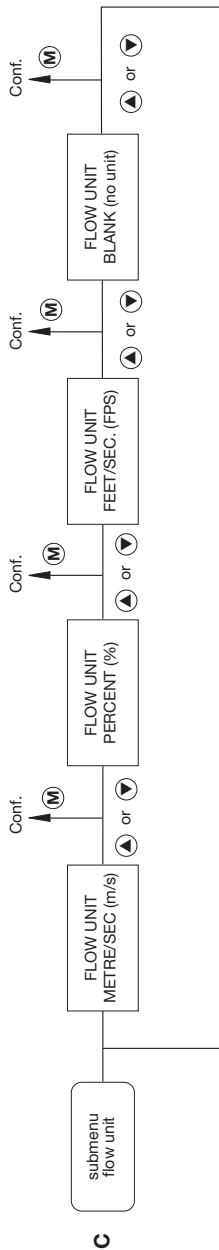
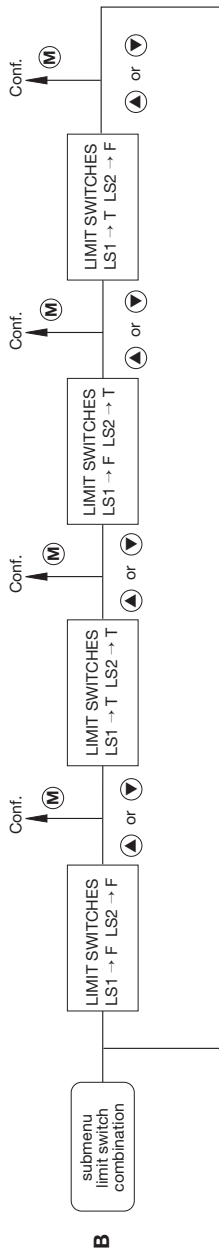


5.14 Configuration submenus



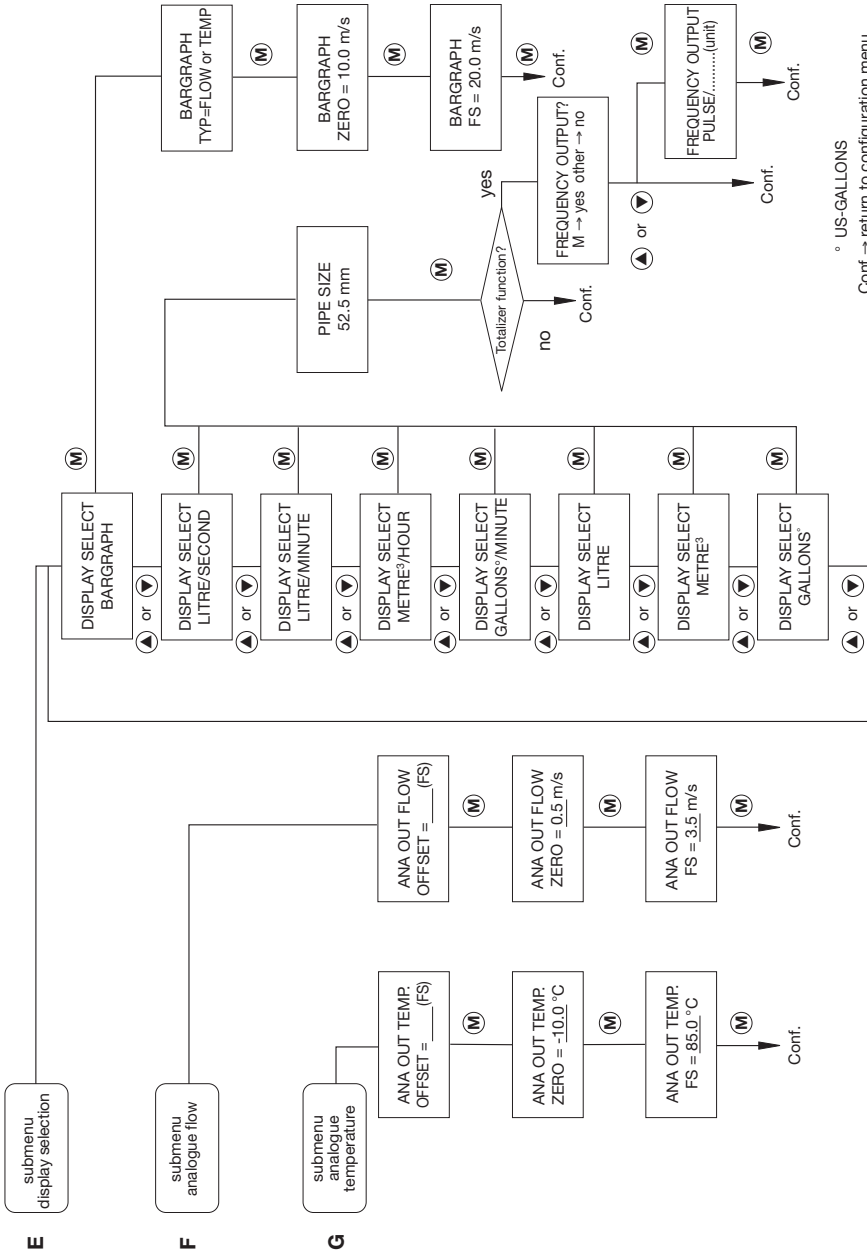
Conf. → return to configuration menu

Configuration submenus (cont'd)



Conf. → return to configuration menu

Configuration submenus (cont'd)



* US-GALLONS
 Conf. → return to configuration menu

(menu option: **M**)

After configuration of the FC01-LQ in conformance with its application (configuration menu), it is possible to set parameters (e.g. limit values).

During parameter setting, measuring operations are not possible (see Appendix 1).

The following parameters may be set in the Parameter selection menu:

M (menu option: **M** **M**)

The measuring time may be set between 1 and 30 sec., referring both to flow rate and medium temperature.

The effect of the measuring time may be compared to that of a filter; it is used to determine the average of the last measured values (measuring time 100 ms) after each measurement.

The set measuring time does not influence the measuring rate and display up-date.

(menu option:)

(menu option:)

Depending on the configuration (see configuration menu) limit value 1 may be set either for flow rate or medium temperature.

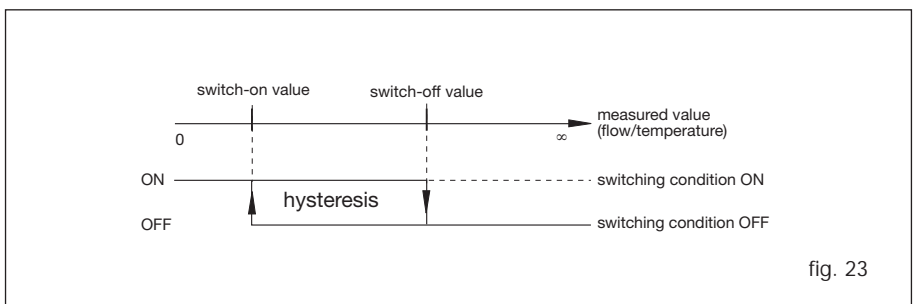
The limit value may be set over the entire measuring range and is always related to the display value.

Limit switch up-date is by measuring rate, independent of the set measuring time.

The hysteresis is determined by entering different switch-on and switch-off values. Its magnitude should be reasonably adjusted to current operating conditions.

A specific definition of the operation (closed-current or open-circuit principle) may be dropped by separately entering the switch-on and switch-off value of the limit switch, because the definition is deducted from the switch-on and switch-off value..

: Switch-on value lower than switch-off value



FC01-LQ with relay outputs (option R2):

- LIM1 - LIM1COM = closed
/LIM1 - LIM1COM = open

FC01-LQ with transistor outputs (option T4):

- LIM1E - LIM1C = switched

: Switch-on value higher than switch-off value

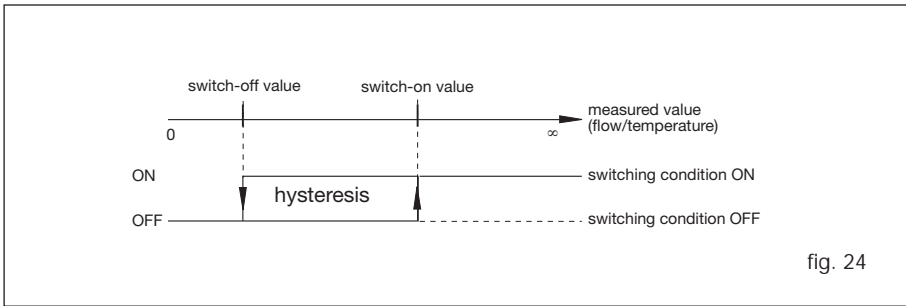


fig. 24

as described in example 1 (fig. 23)

With limit switch 1 set for flow rate and a flow volume/time unit selected in menu DISPLAY SELECT, and when setting the switch-on and switch-off value, the pertinent flow volumes will also be indicated.

(menu option:)
(menu option:)

See limit switch 1!

(menu option:)

The scaling factor influences flow rate indication.

The factor, which may be set between 0.01 and 9.99, allows flow rate indication changes (increasing or reducing the measured value in the display).

For example, the scaling factor may be used to indicate the average flow rate in the pipeline rather than that available at the sensor.

Before the parameter selection menu can be quitted, the controller will conduct a plausibility check of the data entered.

“PARAMETERS OK!” is indicated when the data are found to be correct. The menu may then be quitted by pressing **(M)** MODE.

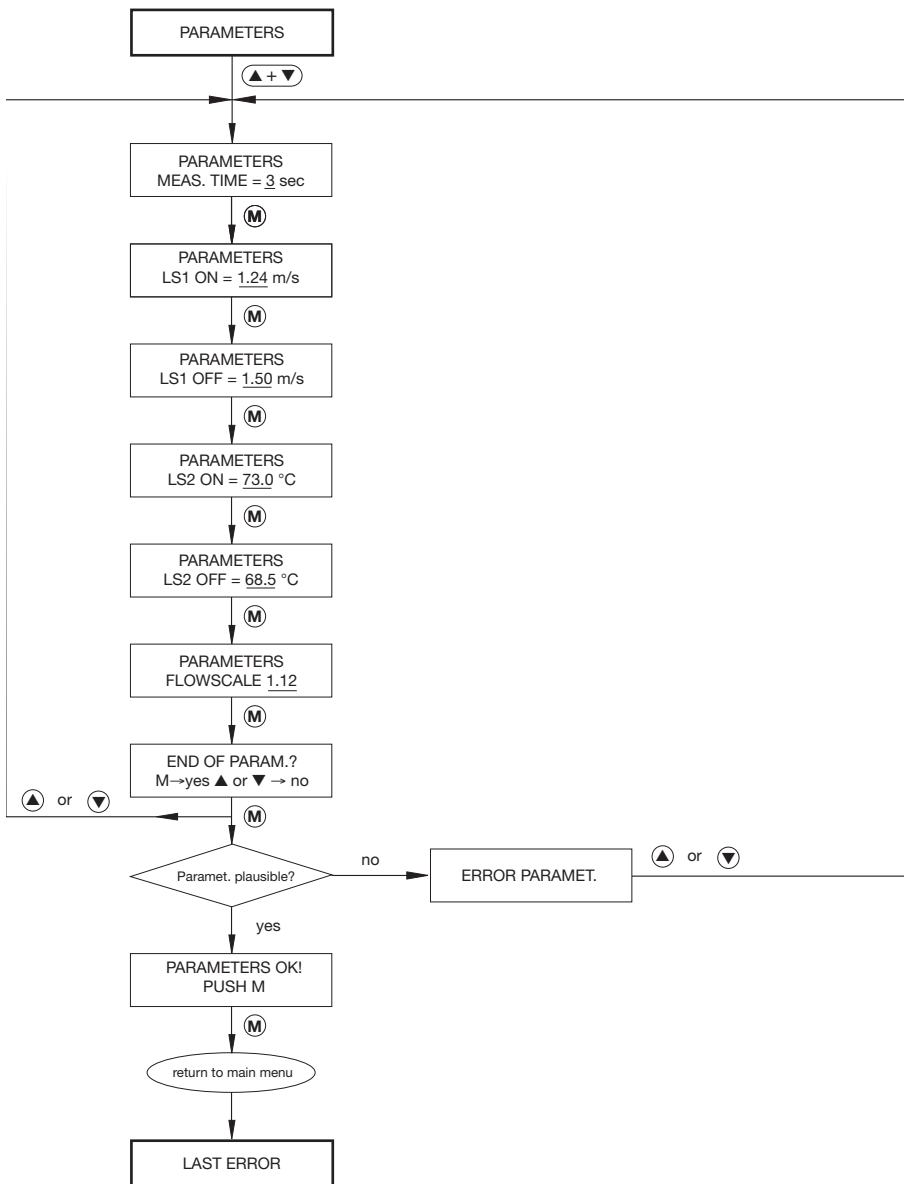
Errors found during the plausibility check are indicated in the following sequence of priority.

Priority of entry errors in the PARAMETER SELECTION menu:

- ERROR LS1 OUT OF RANGE
 switch-on and/or switch-off value for limit switch 1 outside measuring range
- ERROR LS2 OUT OF RANGE
 switch-on and/or switch-off value for limit switch 2 outside measuring range
- ERROR LS1 ON = OFF
 switch-on value for limit switch 1 equals switch-off value for limit switch 1
- ERROR LS2 ON = OFF
 switch-on value for limit switch 2 equals switch-off value for limit switch 2

The menu can only be quitted after correction of the error(s). To do this, return to the beginning of the parameter selection menu by pressing **(▲)** UP or **(▼)** DOWN and select the menu option with the incorrect entry for correction.

An overview of the parameter selection menu is shown on the following page.



The FC01-LQ is provided with extensive test and diagnosis functions which may be classified as follows:

Priority group I comprises the switch-on test routines (FC01-LQ self-test) which are carried out when the system is switched on.

Their implementation is indicated.

Errors No. 1 to 5 do not allow system operation.

The test routines may be repeated by pressing any of the switches.

If even after several trials the switch-on test cannot be conducted without error indication, the system should be returned to the supplier for rectification, indicating the error number.

Priority I errors cannot be rectified by the user!

These test functions are continuously carried out during operation. The occurrence of errors No. 10 and 21 will cause measurements to stop, indicating the error and monitoring the source of the error. Upon rectification of the error, the system will automatically return to measuring operation.

These test routines are also continuously carried out during operation.

Other than the above priority groups, errors No. 20, 30, 60, 40 and 41 will not cause measurements to stop; the error output will indicate and the number of the error will be shown on the display.

Independent of the priority group, all errors found are indicated with their relevant number.

In order to facilitate operation, the last error is stored in a non-volatile memory. The stored error may be retrieved and deleted in the main menu.

If a combination of errors occurs simultaneously, they are indicated or stored in the error memory observing the following sequence.

Error	Cause	Rectification
No. 1	No system parameter available	Return to supplier.
No. 2	Incorrect test sum of parameter memory	Return to supplier.
No. 3	Incorrect test sum of program memory	Return to supplier.
No. 4	Incorrect test sum of data memory	Return to supplier.
No. 5	Internal controller error	Return to supplier.

Error	Cause	Rectification
No. 10	Sensor not connected; or cable between FC01-LQ and sensor defective; or defective sensor	Check cable or replace sensor.
No. 21	Sensor selected (configuration) differs from sensor connected Medium temperature too high	Correct sensor selection in configuration menu

Error	Cause	Rectification
No. 20	Medium temperature too low	
No. 30	Over limits of flow rate	
No. 60	Assignment of quantity per pulse too low *	
No. 40	Controller error (oscillator-watchdog) Admissible EMC levels may have been exceeded	
No. 41	Controller error (watchdog timer) Admissible EMC levels may have been exceeded	

* Error No. 60 can only occur with version FC01-U1T4.

M

	rail-mounted	surface mounted	front panel mounted
Storage temperature:	-20 ... +70 °C	-20 ... +70 °C	-20 ... +70 °C
Ambient temperature: *	+10 ... +50 °C **	+10 ... +50 °C	+10 ... +50 °C
Degree of protection:	IP20	IP65	IP65

* Only if the modules are spaced by at least 10 mm.

** The max. ambient temperature of +40 °C applies to all systems fitted with current output C1.

Pin selection:	Signal name	Pin XV
	shield	1
	+U _V	2
	-U _V	3

Supply voltage: U_{VN} = DC 24 V *

Input voltage range: U_V = DC 19 V to DC 32 V
(ripple incl.)

Admissible ripple: max. 20 % U_V

Rated current consumption: I_{Vnk} = 170 mA with zero flow

I_{Vnk} = 200 mA with max. flow (end of measuring range)

Power consumption may be up to 300 mA ± 10 % when analogue output C1 is fitted.

* DC 12 V possible if the FC01-LQ is used option C1 (analogue outputs).

M

Inrush current:	$I_p = \text{typ. } 3 \text{ A (} 20 \mu\text{s)}$
Switch-off current:	$I_{\text{kip}} = \text{typ. } 0.75 \text{ A}$
Rated power consumption:	$P_n = 4.1 \text{ W}$ with zero flow, voltage outputs $P_n = 4.8 \text{ W}$ max. flow (end of measuring range), voltage outputs
Insulation voltage:	supply input - central electronic unit $\geq \text{DC } 500 \text{ V}$

Signal name	Pin XAO
NC	1
analogue output 1 - flow rate	2
reference ground 1	3
shield 1 *	4
shield 2 *	5
analogue output 2 - temperature	6
reference ground 2	7
NC	8
NC - not used	

Analogue output 1 - ANA OUT FLOW (flow output)

Analogue output 2 - ANA OUT TEMP. (temperature output)

*

The output is reverse polarity protected.

Insulation voltage:	analogue output - analogue output DC 500 V analogue output - central electronic unit DC 500 V
---------------------	--

M

Signal voltage range:	$U_S = 0 \text{ V (1 V) to } 5 \text{ V } \pm 2\% \text{ FS}$
Max. signal ripple:	$dU_S = 5\% \text{ FS}$
Min. admissible load resistance:	$R_I = 1 \text{ k}\Omega$
Max. admissible load capacity:	$C_I = 1 \text{ nF}$
Max. admissible load inductance:	$L_I = 100 \text{ nH}$
Short circuit proof:	yes (XAO - between all terminals)

Signal voltage range:	$U_S = 0 \text{ V (2 V) to } 10 \text{ V } \pm 2\% \text{ FS}$
Max. signal ripple:	$dU_S = 5\% \text{ FS}$
Min. admissible load resistance:	$R_I = 1 \text{ k}\Omega$
Max. admissible load capacity:	$C_I = 1 \text{ nF}$
Max. admissible load inductance:	$L_I = 100 \text{ nH}$
Short circuit proof:	yes (XAO - between all terminals)

Signal current range:	$I_S = 0 \text{ mA (4 mA) to } 20 \text{ mA } \pm 2\% \text{ FS}$
Max. signal ripple:	$dI_S = 5\% \text{ FS}$
Min. admissible load resistance:	$R_I = 0\Omega$
Max. admissible load resistance:	$R_I = 250\Omega$

(DC or AC)

Pin selection:	Signal name	Pin XAH
	Limit Switch 1 / shield	1
	Limit Switch 1 / N/O	2
	Limit Switch 1 / common	3
	Limit Switch 1 / N/C	4
	Limit Switch 2 / Schirm	5
	Limit Switch 2 / N/O	6
	Limit Switch 2 / common	7
	Limit Switch 2 / N/C	8

Max. admissible switching capacity: 50 W
 Max. admissible switching current: 1 A
 Max. admissible continuous current: 1 A
 Max. admissible switching voltage: 50 V
 Contact life at 1 A: 3×10^5 cycles

Max. admissible switching capacity: 125 VA
 Max. admissible switching current: 1.25 A
 Max. admissible continuous current: 1.25 A
 Max. admissible switching voltage: 100 V
 Contact life $\cos \phi = 0.5$: 2.4×10^5 cycles
 Insulation voltage: signal contact - central electronic unit DC 500 V
 signal contact - signal contact DC 500 V

(DC)

Pin selection:	Signal name	Pin XAH	Polarity
	/ ERROR emitter	1	-
	/ ERROR collector	2	+
	/ BUSY / PULSE emitter	3	-
	/ BUSY / PULSE collector	4	+
	Limit Switch 2 emitter	5	-
	Limit Switch 2 collector	6	+
	Limit Switch 1 emitter	7	-
	Limit Switch 1 collector	8	+

Low level - active: $U_{ce} < 0.8 \text{ V}$ at $I_c < 10 \text{ mA}$
 $U_{ce} < 1 \text{ V}$ at $I_c < 100 \text{ mA}$

High level - passive: $U_{ce} < 48 \text{ V}$
 $U_{ce \text{ max}} = 60 \text{ V}$
 max. leakage current $\leq 25 \mu\text{A}$

Reverse polarity protection: yes

Short circuit protection: yes

Max. admissible switching capacity: 1.5 W
Max. admissible switching current: 150 mA
Max. admissible switching voltage: 36 V

(DC voltage - without external safety circuit)

Max. admissible switching capacity: 1.5 VA
Max. admissible switching current: 40 mA
Max. admissible switching voltage: 36 V

Max. admissible switching capacity: 1.5 VA
Max. admissible switching current: 1.5 A
Max. admissible switching voltage: 36 V

Insulation voltage: signal contact - central electronic unit DC 500 V
signal contact - signal contact DC 500 V

M

Measuring is possible up to the flow rates indicated in the display range. However, the indicated accuracy is no longer guaranteed.

M

Flow rate measurement:

Sensor adapter type	Measuring range in m ³ /h	Display range in m ³ /h
TP01	0.02 ... 2.2	2.9
TP02	0.04 ... 3.4	4.5
TP03	0.05 ... 5.3	7.1
TP04	0.1 ... 8.7	11.6
TP05	0.14 ... 13.6	18.1
TP06	0.2 ... 21.2	28.3

M

Flow measurement ranges:

The flow measurement range is determined by the inner pipe diameter (see table). It can be calculated with the following equation:

Q [m³/h] - flow quantity

V_N [m/h] - average standard velocity

A_R [m²] - inner pipe cross-section

M

Inner pipe diameter D in mm	Measuring range in m ³ /h	Display range in m ³ /h
50	21	28
80	55	70
100	85	110
150	190	250
200	340	450
250	530	700
350	1040	1380
500	2120	2830

Setting range for internal pipe diameter: 50.0 mm ... 999.9 mm

Measuring range: 0.05 ... 3 m/s

Display range: 0 ... 4 m/s

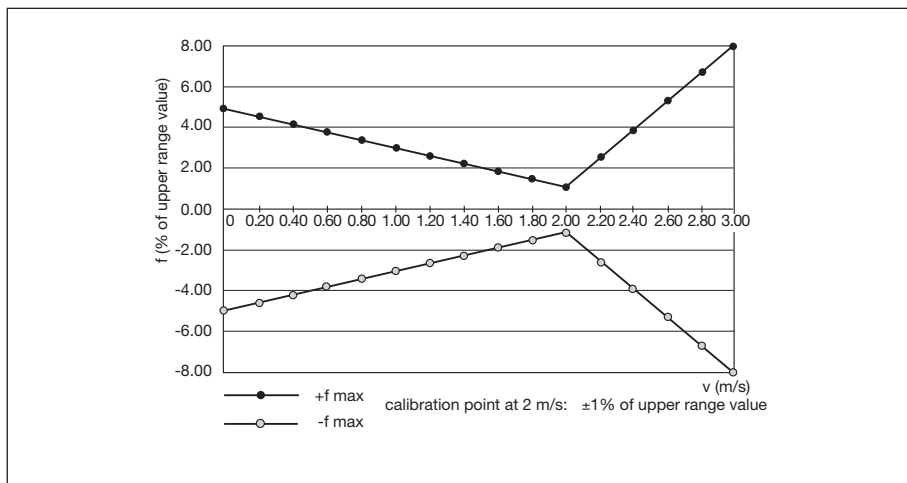
Response delay: 2.5 s

Repeatability: 1% MW **

(5% MBE to 100% MBE)

Accuracy: ±1% MBE * at 2 m/s

see failure ddiagram)



Measuring range: -40 °C ... +130 °C
Accuracy: $\pm 1\%$ MB ***

Temperature drift: 0.1%/K/MBE *
Heating up period until full accuracy is reached: 15 min.

- * MBE - of final value
- ** MW - measured value
- *** MB - measuring range

Terminal	Mnemonics	Data
XSK1	R(HEIZ)-LO	Function: terminal for negative pole of heater element Drain output of heating current control Max. sink current: $I_{\text{sink}} = 88 \text{ mA}$ Dielectric strength: $-0.5 \text{ V} \dots +20 \text{ V DC}$
XSK2	R(HEIZ)-HI	Function: terminal for positive pole of heater element Hi-potential of heater source Output voltage range (load dependent) $U_a = 21 \text{ V} \dots 24 \text{ V DC}$ Max. current output: $I_{\text{max}} = 100 \text{ mA}$ Not short-circuit proof
XSK3	R(Tref)-HI	Function: terminal for positive RTD * pole for medium temperature measurement Input resistance: $> 1 \text{ G}\Omega$ Dielectric strength: $-17 \text{ V} \dots +30 \text{ V DC}$
XSK4	R(Tref)-LO	Function: terminal for negative RTD * pole for medium temperature measurement Input resistance: $> 1 \text{ G}\Omega$ Dielectric strength: $-17 \text{ V} \dots +30 \text{ V DC}$
XSK5	AGND	Function: analogue ground Reference potential of excitation current source for RTD * operation
XSK6	IS	Function: output of excitation current source for RTD * operation Excitation current: $1 \text{ mA} \pm 1\%$ Admissible load range: $R_{\text{load}} = 0 \dots 2 \text{ k}\Omega$ Dielectric strength: $\pm 15 \text{ V DC}$
XSK7 XSK8	SGND	Function: shield ground Terminals for sensor cable shielding
XSK9	R(Tdiff)-LO	Function: terminal for negative pole of the heated RTD * Input resistance: $> 1 \text{ G}\Omega$ Dielectric strength: $-17 \text{ V} \dots +30 \text{ V DC}$
XSK10	R(Tdiff)-HI	Function: terminal for positive pole of the heated RTD * Input resistance: $> 1 \text{ G}\Omega$ Dielectric strength: $-17 \text{ V} \dots +30 \text{ V DC}$

* RTD = resistive temperature device

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No.	Accessory	Ordering configuration
1	surface mounted housing	FC01-LQ-FH
2	front mounted housing	FC01-LQ-ST
3	connecting cable for calorimetric monitoring head cable type LifYCY 4 x 2 x 0.2 mm ² - Typ 15/ -10 °C ... +80 °C highly flexible/paired - Typ 18/ -60 °C ... +200 °C non-halogenous/highly flexible/paired	Do+Ka
4	calorimetric monitoring heads	CSP / CSF
5	sensor adapter (screw-in or welding type)	TP
6	ball valve	BV
7	locking set 01 (for monitoring head CSF-11)	0Z122Z00024

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Appendix 1 - Performance of the digital and analogue outputs during the operating and error modes

Duty-/ Error status	LIMIT SWITCH 1	LIMIT SWITCH 2	NO ERROR	NOT BUSY and FREQUENCY OUTPUT	ANA OUT FLOW	ANA OUT TEMP.
Start-up (reset)	ON	ON	ON	ON	MAX	MAX
Start-up test active	OFF	OFF	OFF	OFF	MIN	MIN
Error No. 1	OFF	OFF	OFF	OFF	MIN	MIN
Error No. 2	OFF	OFF	OFF	OFF	MIN	MIN
Error No. 3	OFF	OFF	OFF	OFF	MIN	MIN
Error No. 4	OFF	OFF	OFF	OFF	MIN	MIN
Error No. 5	OFF	OFF	OFF	OFF	MIN	MIN
Heating period active	OFF	OFF	ON	OFF	MIN	MIN
Normal duty	X	X	ON	ON	X	X
Configuration active	OFF	OFF	ON	OFF	MIN	MIN
Parameter selection active	OFF	OFF	ON	OFF	MIN	MIN
Error No. 10	OFF	OFF	OFF	OFF	MIN	MIN
Error No. 20	X	X	OFF	ON	X	X
Error No. 21	OFF	OFF	OFF	OFF	MIN	MIN
Error No. 30	X	X	OFF	ON	X	X
Error No. 60 *	X	X	OFF	FA	X	X
Error No. 40	X	X	Y	ON	X	X
Error No. 41	X	X	Y	ON	X	X

X = standard performance

Y = OFF pulse

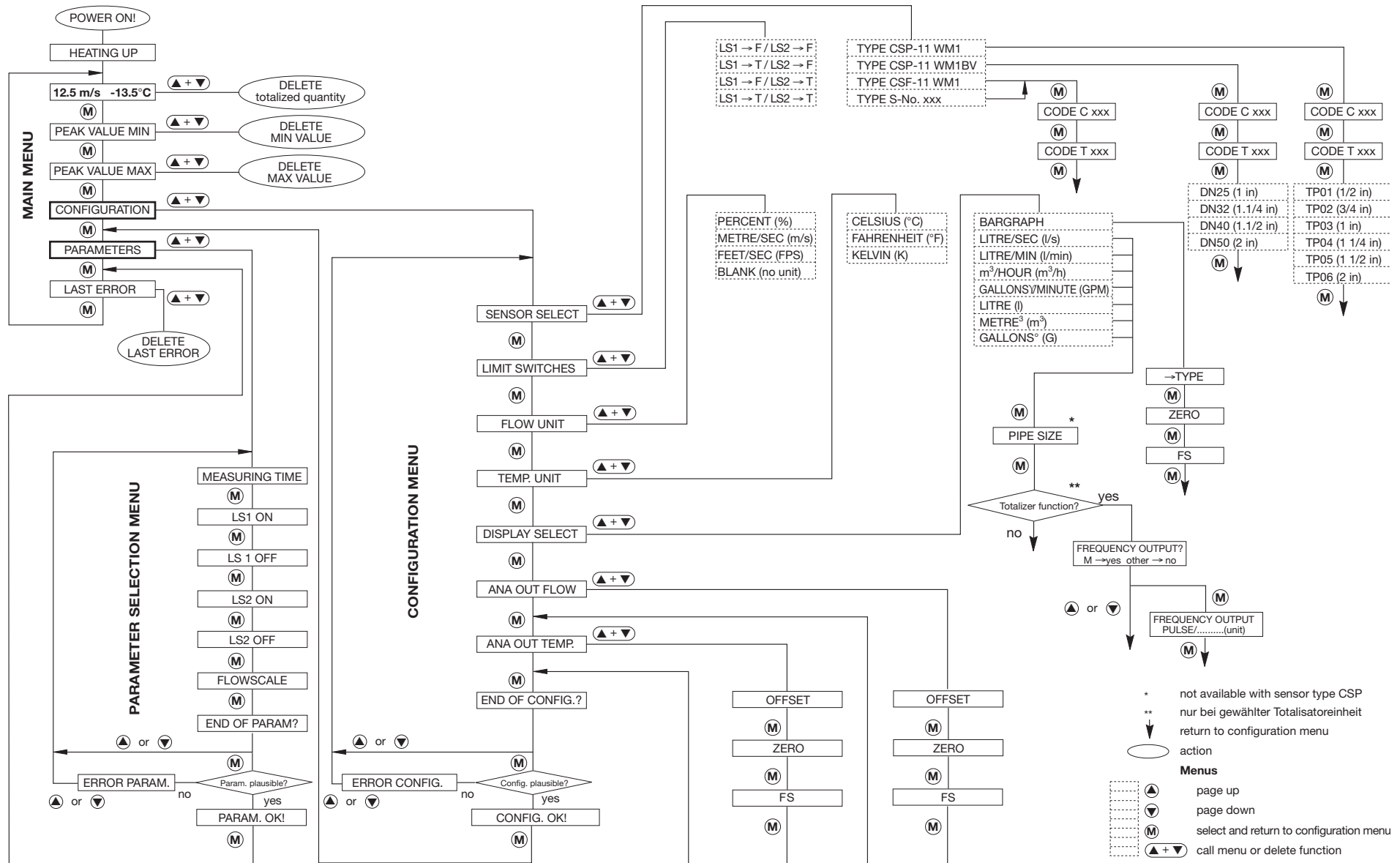
FA = frequency output 10 Hz

* When frequency output has been selected.

Note: The occurrence of error No. 40/41 will always cause an internal reset.

Status of the outputs prior to the error status described → see start-up (reset)

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