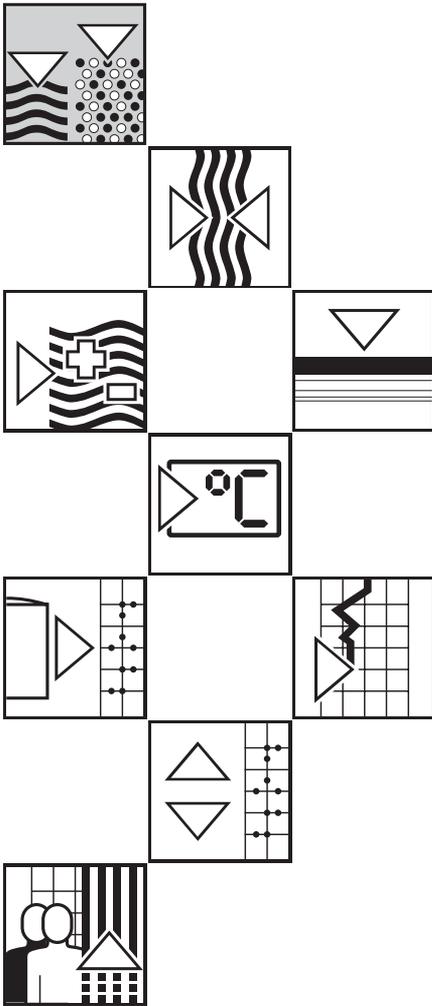


Electronic insert **FEC 12 with HART Protocol Level Measurement**

Operating Instructions



Endress + Hauser

The Power of Know How



Short Instructions

The short instructions are intended for trained personnel who have read and understood the operating instructions in this manual. They allow a quick standard calibration of the electronic insert using its own operating elements. A detailed description of calibration and operation is given in Sections 3 - 5.

Abb. 1
Short instructions for calibrating the FEC 12 electronic insert using its own operating elements

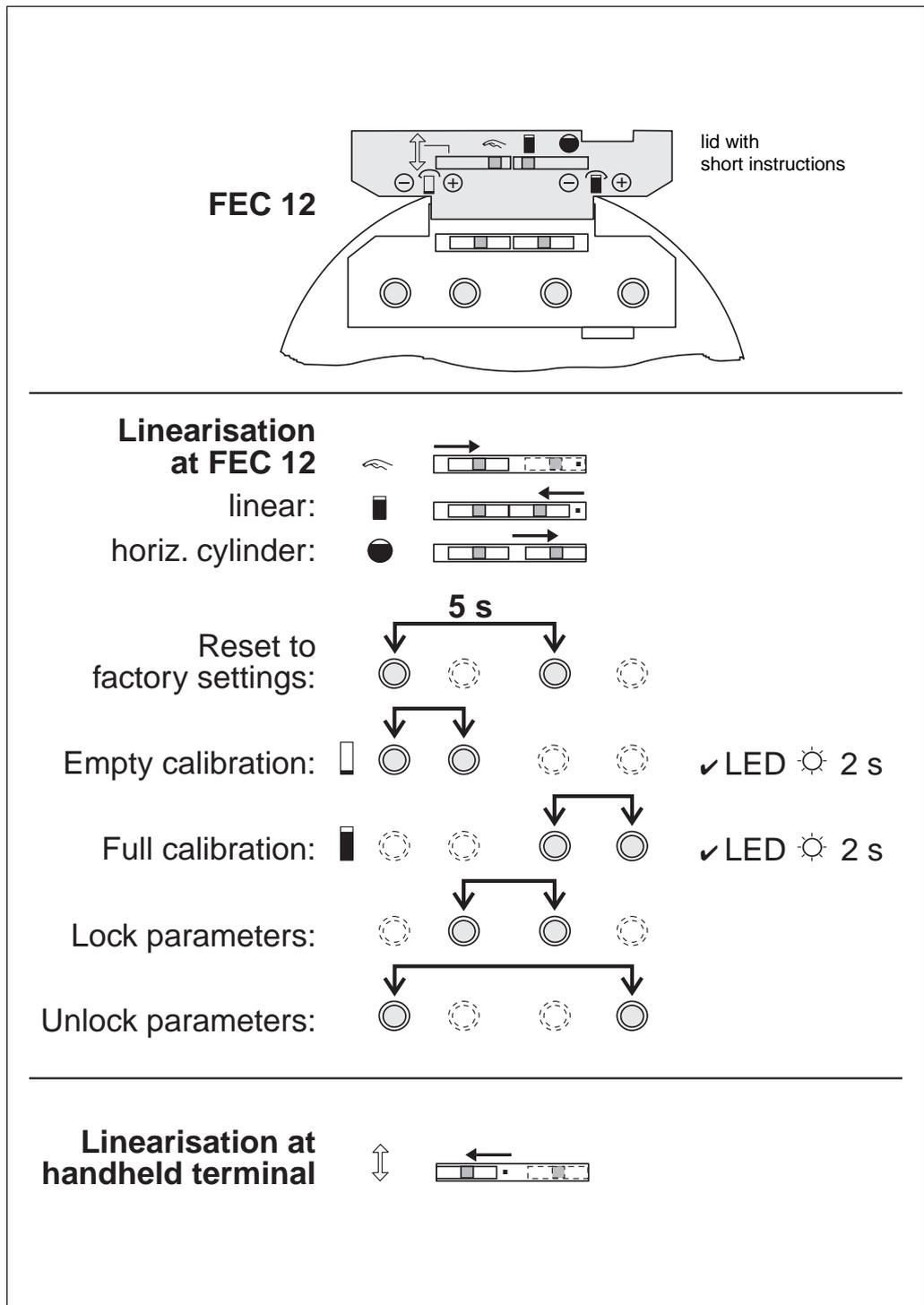


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In addition to these operating instructions, the following documentation is also available on the use of the FEC 12 electronic insert:

- Technical Information TI 242F/00/e: Multicap Probes DC ... E
- Technical Information TI 243F/00/e: Multicap Probes DC ... A
- Technical Information TI 240F/00/e: Multicap Probes DC ... T
- Operating instructions for the HART handheld terminal DXR 275

**Supplementary
documentation**

Notes on Safety

Approved usage

The electronic insert FEC 12 may be used for level measurement in connection with capacitive Multicap probes only. It has been designed to operate safely in accordance with current technical and safety standards and must be installed by qualified personnel according to the instructions in this manual.

The manufacturer accepts no responsibility for any damage arising from incorrect use, installation or operation of the equipment. Changes or modifications to the equipment not expressly approved in the operating instructions or by the bodies responsible for compliance may make the user's authority to use the equipment null and void. Damaged instruments which may be a safety hazard must not be operated and are to be marked as defective.

Use in hazardous areas

When used in explosion hazardous areas, the equipment must be installed in accordance with local regulations as well as with the technical and safety requirements on the measuring point as specified in the accompanying certificate.

Installation, commissioning and operation

Installation, electrical connection, commissioning, operation and maintenance may be carried out by trained and authorised personnel only. The operating instructions must have read and understand before the equipment is installed: instructions are to be followed exactly.

Safety Conventions

In order to highlight safety-relevant procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.



Note!

Note!

A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.



Caution!

Caution!

A caution indicates actions or procedures which, if not performed correctly, may lead to personal injury or incorrect function of the instrument.



Warning!

Warning!

A warning indicates actions or procedures which, if not performed correctly, may lead to personal injury, a safety hazard or destruction of the instrument.

1 Introduction

1.1 Application

The FEC 12 electronic insert is a transmitter for capacitive level measurement. It converts changes in capacitance resulting from changes in level into a capacitance-proportional impressed current. In vessels with a uniform cross section, the level or quantity (volume) can be thus displayed as a percentage of full level or, if a handheld terminal is used, in technical units. A pre-stored linearisation program also allows volumes to be measured in horizontal cylinders.

The FEC 12 electronic insert is installed in the housing of the Multicap probe. It can be used for applications in explosion hazardous areas.

Versions with corresponding features

Two versions of the FEC 12 electronic insert are available:

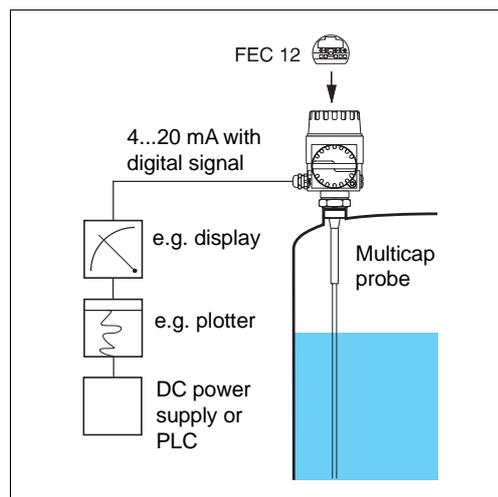
- With HART protocol to be used with the Universal HART Communicator (described in these operating instructions) and
- With INTENSOR protocol to be used with the Commulog VU 260 Z (see operating instructions BA 149F/00/e).

The version with the INTENSOR protocol can also be used for communication with the Silometer FMX 770.

- Analogue output signal: standard 4...20 mA current.
- Easy on-site settings: Settings "empty calibration" (= 4 mA) and "full calibration" (= 20 mA) using pushbuttons on the electronic insert.
- Operates with a linear characteristic as well as with a stored linearisation curve for horizontal cylinders.
- The adjustable integration time ensures stable measured values even with agitated materials.

1.2 Measuring System

The measuring system consists of a capacitive Multicap level probe and an FEC 12 electronic insert. A DC power supply is also required. The two-wire power cable is also used for signal transmission, and delivers a 4...20 mA signal with a superimposed bidirectional digital signal conforming to the HART protocol. The superimposed signal has no influence on the follow-up instrumentation.



*Fig. 2
Measuring system:
the electronic insert is used in a
Multicap probe for capacitive
measurement.*

1.3 Operating Principle

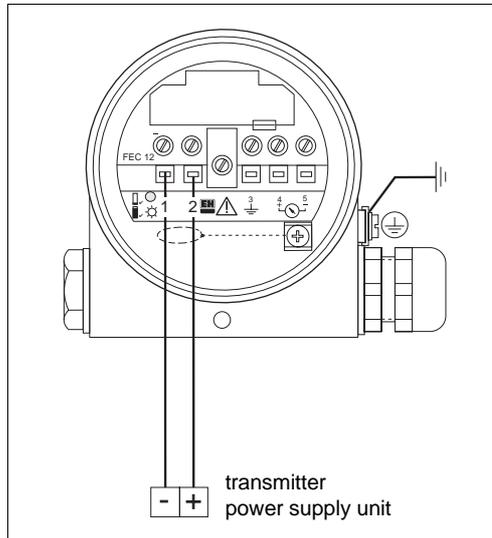
Capacitive measurement functions as follows: the probe and vessel wall form a capacitor. Depending on the level, the space between these "capacitor plates" is filled either with air (empty vessel) or an unspecified quantity of material. The initial capacitance for the empty vessel is low but increases proportionally to the amount of material covering the probe.

2 Installation

This section describes the electrical connection of the electronic insert. See Section 6 for instructions on replacing the electronic insert.

2.1 Electrical Connection

Fig. 3
Connecting the
FEC 12 electronic insert to the
power supply



Insert the power cable through the cable entry on the probe housing. Unscreened or general purpose multi-core cable can be used as the connecting cable. If strong electromagnetic interference occurs due to, e.g. machinery or radios, then screened cable, grounded at the probe end, should be used. Connect the screening to the ground terminal on the probe housing.

The power cable is connected to Terminals 1 - and 2 + of the electronic insert. The electronic insert has built-in polarity protection. The black ground wire in the probe is always connected to Terminal 3.



Warning!

Warning!

- When using the probe in explosion-hazardous areas, ensure that the type and routing of the intrinsically safe power and signal line is in accordance with the certificate and local regulations.
- See the certificate of conformity for maximum permissible values for capacitance and inductance.

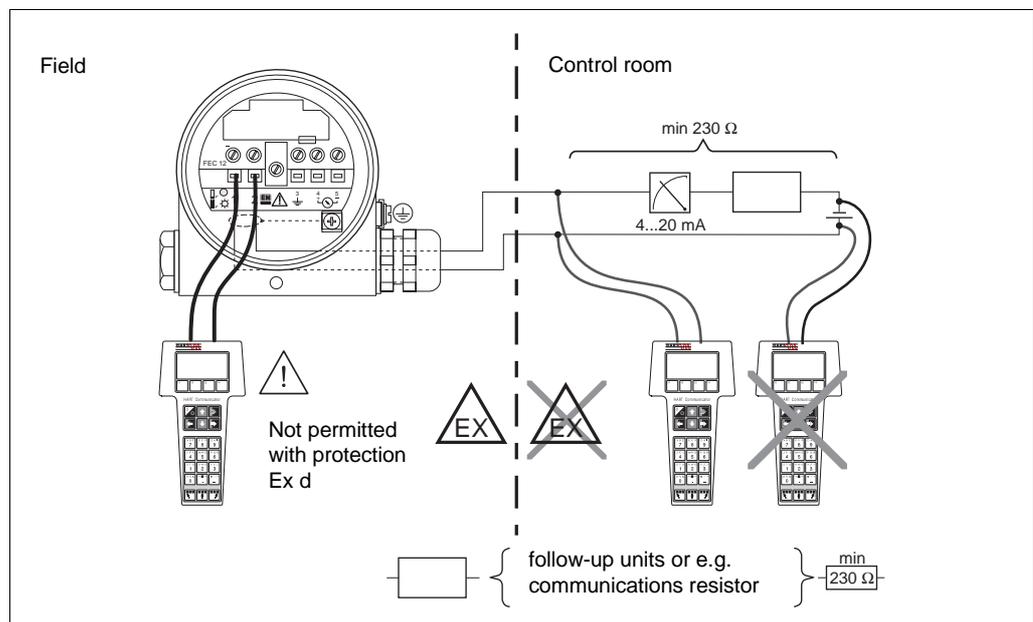


Note!

Note!

After connection, ensure that the cover is screwed down securely and that the cable gland of the probe housing is screwed tight.

Fig. 4
Connecting the handheld terminal
to the load or power cable



A load should be connected into the power cable when connecting a handheld terminal. The handheld terminal can now be connected at any point along the power cable for communication with the electronic insert. The size of the load is given in the following table.

Load for handheld terminal

FEC 12 electronic insert	Load resistance minimum	Load resistance maximum ($U_B=30V$)
Version HART	230 Ω	720 Ω
Without communication	0 Ω	720 Ω

Maximum cable length: 1000 m.

Maximum capacitance for screened cabling: 100 nF.

2.2 Technical Data

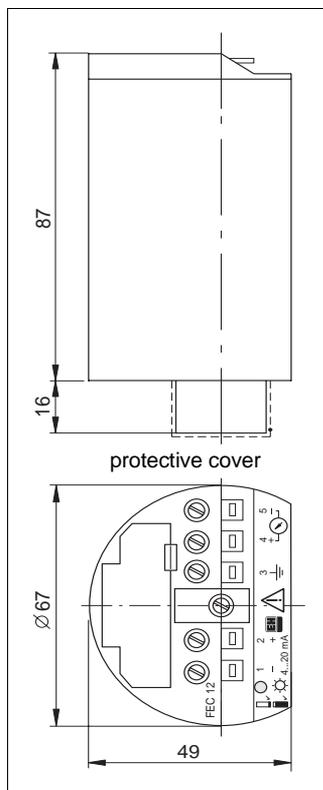


Fig. 5
Construction and dimensions of the FEC 12 electronic insert

Weight : approx. 170 g
Housing: plastic, potted electronics,
Colour: light grey RAL 7035, protection to DIN 40050: IP 20

Interlock diode with jumper: 13.0 V ... 30 V,
With Interlock diode: 13.8 V ... 30 V
for Ex d with Zener diode module: 13.8 V ... 30 V
Permissible superimposed AC voltage (50 Hz ... 400 Hz): 100 mV_{pp}
Without communication: 3 % of power supply voltage,
No understepping of minimum voltage!
Integrated polarity protection
Current consumption 3.8 ... 22 mA

Load for HART: 230 ... 720 Ω ,
Without communication: 0 ... 720 Ω

Initial capacitance ('offset') for empty vessel
(probe free): 0 pF ... 350 pF
Change in capacitance ('span') for full vessel
(probe covered): 10 pF ... 2000 pF
Total capacitance resulting from initial capacitance plus
change in capacitance: maximum 2000 pF

Output signal: superimposed direct current
for initial capacitance: 4 mA
for total capacitance: 20 mA
Resolution: 14 μ A
Alarm signal for error indication (can be switched off):
22 mA \pm 0.1 mA, to NAMUR

Adjustable time constant: 0 ... 40 s
Factory set: 1 s

Output current from power supply voltage:
smaller than 0.05 % / V of full scale value at 24 V
Output current from load:
smaller than 0.1 % / 100 Ω of full scale value at 24 V

Type of signal: quasi-sine curve superposed on measuring current
without DC component

With Interlock diode: for ammeter

According to DIN 40040, HOE, condensation not permitted
Permitted ambient temperature:
Nominal operating range: 0 ... +70 $^{\circ}$ C
Limiting operating range: -20 ... +80 $^{\circ}$ C
Storage temperature: -40 ... +85 $^{\circ}$ C
Protection against electrostatic build-up: up to 15 kV
RFI immunity (depending on type of housing): up to 10 V/m
Electromagnetic Compatibility:
Interference Emission to EN 61326; Electrical Equipment Class B
Interference Immunity to EN 61326; Annex A (Industrial) and
NAMUR Recommendation EMC (NE 21)

Construction

Power Supply

Load

Capacitance Ranges

Analogue Output

Output damping

Accuracy

Communication Interface

Additional Signal Output

Environmental Conditions

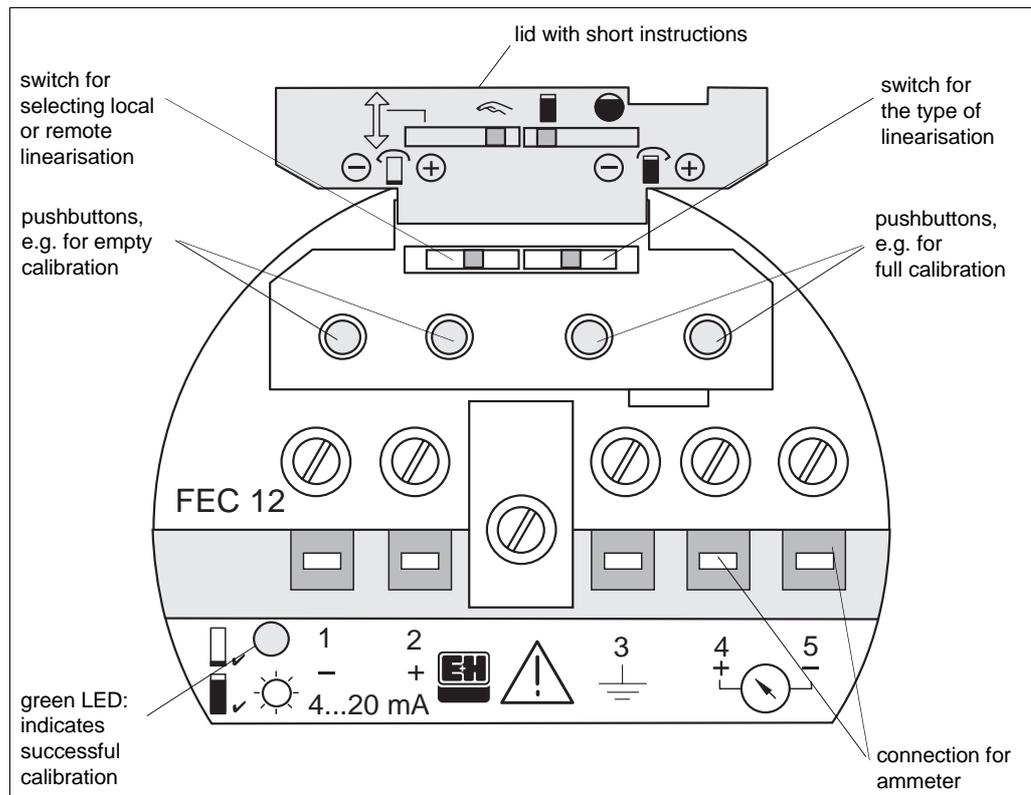
3 Operating Elements

This Section describes the operating elements of the electronic insert. It also describes the menu structure of the HART protocol used with the Universal HART Communicator DXR 275.

3.1 FEC 12 Electronic Insert

The operating elements of the electronic insert are protected by a cover. This can be raised by inserting a small screwdriver into a slit at the edge. The inside of the cover has symbols printed on it that serve as a quick operating manual.

Fig. 6
Operating elements on the
FEC 12 electronic insert



Switches

The lefthand switch selects whether the linearisation is to be carried out remotely with the handheld terminal or locally with the FEC 12 operating elements. If linearisation at the FEC 12 is required, then one of two stored linearisation modes in the electronic insert is activated (vertical vessel with linear characteristics or horizontal cylinder) at the righthand switch.

Pushbuttons

Calibration, locking and reset to factory-set values are carried out at the FEC 12 by using the four pushbuttons (see Section 4).

Basic Operation:

The pushbuttons marked with (+) increase current and those marked (-) decrease current. Punching the pushbuttons produces a step-wise change. The smallest resolution possible is 0.014 mA. If the pushbutton is pressed continuously, then the current also changes continuously until the pushbutton is released. The change begins slowly and gradually increases in speed and so quickly passes through a wide range. Just before reaching the value required, the pushbutton should be released and the procedure completed by punching the pushbutton for fine resolution. If the value required is overrun, then correct for it by pressing the pushbutton for the other direction.

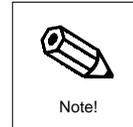
3.2 HART Communicator DXR 275

When the lefthand switch is set to remote linearisation (arrow symbol), the FEC 12 electronic insert can be calibrated using the HART Communicator handheld terminal. The terminal communicates with the electronic insert over the power/signal cable. The operating manual for the HART Communicator describes its operation. Some knowledge of operating the HART Communicator is assumed for the following section.

Note!

When calibrating the FEC 12 electronic insert, the following sections will assume the operating steps given below. They apply to all instructions and will, therefore, no longer be given in this manual:

- First step: Move from the "MATRIX GROUP SEL." menu to the next higher menu with the → arrow key.
- Last step: Return to the "Online" menu with F3 [HOME].



3.3 HART Menu Structure

All parameters of the FEC 12 can be addressed by the menu structure using the handheld terminal. The following diagram shows the menu structure of the HART protocol for the FEC 12 electronic insert. Each field in the menu structure can be selected using the arrow or numeric keys on the handheld terminal.

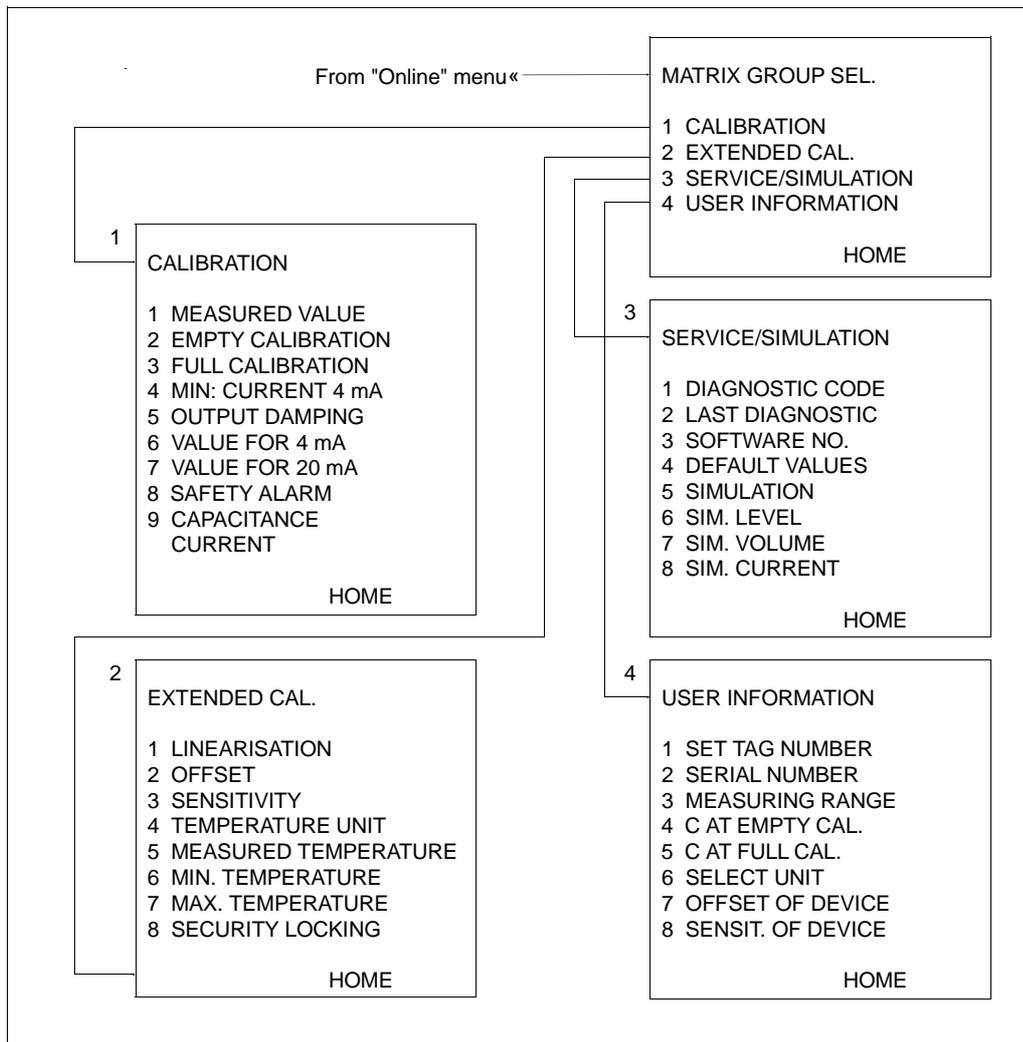


Fig. 7
Menu structure for the HART Communicator handheld terminal

4 Calibrating

This section deals with the basic settings necessary for the electronic insert to convert capacitance values into correct data on level or volume, which can then be shown on a display unit (e.g. meter or handheld terminal).

The electronic insert can carry out basic settings in two ways:

- On site at the electronic insert itself or
- On the handheld terminal.

The initial basic settings can also be carried out locally at the electronic insert and then later with the handheld terminal for, e.g. setting the type of linearisation (Note: the electronic insert must not be locked).



Note!

- After completing calibration the matrix should then be locked (see Section 5.1). After locking, all entries can be called up and displayed but no longer changed.
- The values entered can be written in the table below so that the identical values can again be entered if the electronic insert is replaced. A complete recalibration is not then required (see also Section 6).

4.1 Basic Calibration at the FEC 12 Electronic Insert

The following entries are required for basic calibration of the electronic insert:

- Type of linearisation
- Empty calibration
- Full calibration



Note!

- If an initial calibration is not to be carried out, but instead a recalibration of the system, then a reset the electronic insert first.
- This also applies when it is not clear if the electronic insert is calibrated with factory settings (see following section). Unwanted settings may result and lead to incorrect measured values.

Reset (recall of factory settings)

Press the pushbuttons for empty calibration (-) and for full calibration (-) simultaneously for approx. 5 s. This produces the following factory settings:

Significance	Factory settings	Entered values
Empty calibration [%]	0.0	
Full calibration [%]	100.0	
Min. current 4 mA	off	
Output damping [s]	1	
Value for 4 mA [%]	0.0	
Value for 20 mA [%]	100.0	
Safety alarm	max (110 %)	
Linearisation	linear	
Offset [pF]	349.90	
Sensitivity [pF/%]	16.49	
Set tag number	'-----'	
Select unit	%	

Two types of linearisation can be selected:

- Vessel characteristics as linear
- Vessel characteristics as a horizontal cylinder

Use the lefthand switch to select whether linearisation is to be carried out at the electronic insert or by the handheld terminal. If the switch is moved to the right, then linearisation is carried out at the electronic insert. The handheld terminal cannot now change the setting. If the switch is moved to the left, then linearisation must be carried out with the handheld terminal and the switch on the right remains inactive.

Select the type of linearisation for local calibration using the righthand switch. When it is moved to the left, then the level (output current) is proportional to volume, i.e. the cross-section of the vessel should be constant over its entire length. When it is moved to the right, then linearisation is set for a horizontal cylinder, and the measured value supplied corresponds directly to a percent of full volume.

With the vessel empty (0 %) both pushbuttons on the left (-) and (+) are pressed simultaneously in order to set the signal current to the 4 mA lower value. The green LED lights up to acknowledge that the setting has been accepted. Only when the green LED goes out is the correct current value of 4 mA shown on the ammeter.

With the vessel full (100 %) both pushbuttons on the right (-) and (+) are pressed simultaneously in order to set the signal current to the 20 mA upper value. The green LED lights up to acknowledge that the setting has been accepted. Only when the green LED goes out is the correct value of 20 mA shown on the ammeter.

In this case, the level of product in the vessel must be known as accurately as possible and should not be too high. A level which is too high reduces the accuracy of the zero point (corresponding to an empty vessel). An ammeter must be connected to the electronic insert at Terminals 4 - 5.

Assuming that the level is at 15 %, the current value corresponding to a 15% level must now be determined. The lower current value can be varied by pressing the two pushbuttons on the left. The following calculation is used:

- ① The lower current value (= empty vessel, 0 %) is 4 mA.
- ② The upper current value (= full vessel, 100 %) is 20 mA.
- ③ This gives a measuring range ('span') of 16 mA for a change from 0 to 100 % or a 0.16 mA increase in current for every 1 % rise in level.
- ④ For a 15 % level, this is 15 % x 0.16 mA/% or 2.4 mA. This must be added to the 4 mA to give the current value required:
 $2.4 \text{ mA} + 4 \text{ mA} = 6.4 \text{ mA}$
- ⑤ The value 6.4 mA (check with the ammeter) is set by pressing the two pushbuttons on the left. Pressing pushbutton (+) increases the current and pressing pushbutton (-) decreases the current.

Note!

- No indication is given on the green LED when using this procedure.
- If the operating status is unclear due to an incorrect setting, then all settings should be reset to factory-set values and the basic calibration carried out again.

Selecting linearisation

Empty calibration

Full calibration

Alternative procedure: calibration with the vessel almost empty



Alternative procedure: calibration with the vessel almost full

The level of the vessel must be known as accurately as possible and should be as high as possible. A level which is too low reduces the accuracy of the upper point (corresponding to a full vessel). An ammeter must be connected to the electronic insert at Terminals 4 - 5.

Assuming that the level is at 90 %, the current value corresponding to a 90 % level must now be determined. The upper current value can be varied by pressing the two pushbuttons on the right. The following calculation is used:

- ① The lower current value (= empty vessel, 0 %) is 4 mA.
- ② The upper current value (= full vessel, 100 %) is 20 mA.
- ③ This gives a measuring range ('span') of 16 mA for a change from 0 to 100 % or a 0.16 mA increase in current for every 1 % rise in level.
- ④ For a 90 % level this is 90 % x 0.16 mA/% or 14.4 mA. This must be added to the 4 mA to give the current value required:
 $14.4 \text{ mA} + 4 \text{ mA} = 18.4 \text{ mA}$
 (The upper current value can also be used and
 $10 \% \times 0.16 \text{ mA}/\% = 1.6 \text{ mA}$ is to be subtracted from 20 mA)
- ⑤ The value 18.4 mA (check with the ammeter) is set by pressing the two pushbuttons on the right. Pressing pushbutton (+) increases the current and pressing pushbutton (-) decreases the current.



Note!

- No indication is given on the green LED when using this variation.
- If the operating status is unclear due to an incorrect setting, then all settings should be reset to factory-set values and the basic calibration carried out again.

Locking the parameters

Press simultaneously the pushbutton for empty calibration (+) and the pushbutton for full calibration (-). The settings of the electronic insert can now be called up at any time using the handheld terminal but not changed. This condition is indicated in the handheld terminal by the appearance of the code 9999 in Menu Level 2 "EXTENDED CALIBRATION", Field 8 "SECURITY LOCKING" (see Section 5).

Unlocking the parameters

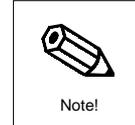
Press simultaneously the pushbutton for empty calibration (-) and the pushbutton for full calibration (+). All settings of the electronic insert can now be called up and changed using the handheld terminal. This condition is indicated in the handheld terminal by the appearance of the code 12 in Menu Level 2 "EXTENDED CALIBRATION", Field 8 "SECURITY LOCKING" (see Section 5).

4.2 Basic Settings using the HART Communicator DXR 275

The FEC 12 allows calibration in % only. A remote calibration from the handheld allows, e.g. technical units to be displayed. If a recalibration is to be carried out, then a reset should be done first. The parameters of the electronic insert must not be locked, see above!

Note!

When calibrating the FEC 12 electronic insert, the following sections will assume the operating steps given below. They apply to all instructions and will, therefore, no longer be given in this manual:



- First step: Move from the "MATRIX GROUP SEL." menu to the next higher menu with the → arrow key.
- Last step: Return to the "Online" menu with F3 [HOME].

Step	Entry	Cursor in display at	Significance
1	3	SERVICE/SIMULATION	
2	4	DEFAULT VALUES	
3	12	12	Code number for reset
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value to be transmitted

Reset (factory settings)

The factory settings given on reset are shown in the following table:

Menu field	Significance	Factory setting	Values entered
1; 2	EMPTY CALIBRATION [%]	0.0	
1; 3	FULL CALIBRATION [%]	100.0	
1; 4	MIN. CURRENT 4 mA	OFF	
1; 5	OUTPUT DAMPING [s]	1	
1; 6	VALUE FOR 4 mA [%]	0.0	
1; 7	VALUE FOR 20 mA [%]	100.0	
1; 8	SAFETY ALARM	MAX (110 %)	
2; 1	LINEARISATION	LINEAR	
2; 2	OFFSET [pF]	349.90	
2; 3	SENSITIVITY[pF/%]	16.49	
4; 1	SET TAG NUMBER	'-----'	
4; 6	SELECT UNIT	%	

Selecting linearisation

Two vessel characteristics are available: linear or horizontal cylinder

Note!

- The switch on the left on the FEC 12 electronic insert must be moved to the left so that linearisation can be carried out remotely with the handheld terminal.

Step	Entry	Cursor in display at	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	1	LINEARISATION e.g. LINEAR	Selecting linearisation Level is proportional to volume, i.e. the cross-section of the vessel remains constant over the entire distance
3		HORIZ. CYL.	Horizontal cylinder : the measured value directly corresponding to volume
4	F4 [ENTER]		Confirms entry, value to be transmitted

Empty and full calibration

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic calibration
2	2	EMPTY CALIBRATION	Empty calibration
3	0.0	0.0	Vessel is empty, a 4 mA signal is output at the entered level or volume
4	F4 [ENTER]		Confirms entry, value to be transmitted
5	3	FULL CALIBRATION	Full calibration
6	100.0	100.0	Vessel is full, a 20 mA signal is output at the entered level or volume
7	F4 [ENTER]		Confirms entry, value is transmitted

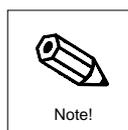
**Note!**

- You can also calibrate in technical units, see also 4 mA/20 mA value, p 13. In this case, if a horizontal cylinder is selected, the entries must be made in volume units!

4.3 Extended Calibration using the HART Communicator 275**4 mA threshold**

The factory settings allow a current range from 3.8 mA to 20 mA and larger. Since a current less than 4 mA could result in unwanted responses by process control systems, it is possible to set a threshold of 4 mA on the current output, below which it cannot fall.

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic calibration
2	4	MIN. CURRENT 4 mA ON	Current output at minimum 4 mA Threshold is at 4.0 mA
3		OFF	Current range begins at 3.8 mA
4	F4 [ENTER]		Confirms entry, value is transmitted

**Note!**

- At factory setting the 4 mA threshold is switched off

The output damping is set in the factory at 1 s and affects the speed at which the current output responds to a change in level. When there is a sudden jump from empty to full in the vessel, after 1 s the current display reaches 63% or 14.08 mA of the set point (1*output damping). After 5 s (5*output damping) it reaches 99 % or 19.84 mA. If a larger output damping is set, then these display times are correspondingly longer.

Output damping

The output damping can be selected between the range 0 and 40 s. For liquids, the turbulence can cause the display to be unstable. Increasing the output damping with the handheld terminal cancels this effect.

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic setting
2	5	OUTPUT DAMPING	Setting the output damping
		1 s	(Factory setting 1 s)
3	e.g. 2	2	Sets the output damping to 2 s
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value is transmitted

If another value instead of 0 (= empty vessel) is to be displayed, then the value can be entered here. The units are changed from % in the "SELECT UNIT" menu.

Value for 4 mA

Step	Entry	Cursor in display at	Significance
1	1	CALIBRATION	Basic setting
2	6	VALUE FOR 4 mA	Value for 4 mA
3	e.g. 20.0	20.0	Value is displayed if the current value is 4 mA
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value is transmitted

If another value instead of 100 (= full vessel) is to be displayed, then the value can be entered here. The units are changed from % in the "SELECT UNIT" menu (see below).

Value for 20 mA

Step	Entry	Cursor in Display at	Significance
1	1	CALIBRATION	Basic setting
2	7	VALUE FOR 20 mA	Value for 20 mA
3	e.g. 80.0	80.0	Value is displayed, if the current value is 20 mA
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value is transmitted

Instead of giving the results in %, the following units may be selected:

Selecting units

Level:	cm	dm	m	inch	ft			
Volume:	l	hl	cm3	dm3	m3	ft3	us_gal	i_gal
Weight:	ton	kg	t	lb.				

Step	Entry	Cursor in display at	Significance
1	4	USER INFORMATION	User information
2	6	SELECT UNIT	Select units
		%	Factory setting
3	↓ e.g. 10x	m3	Volume display in m3
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value to be transmitted

5 Entries for the Measuring Point

5.1 Locking/Unlocking Parameters

Locking

The parameters can be locked from the handheld terminal by entering a code number between 1 and 11 or between 13 and 9998: all settings in the electronic insert are protected from being altered. If the code number 9999 is shown in the display, then locking has been activated at the electronic insert by pushbutton.

Step	Entry	Cursor in Display at	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	8	SECURITY LOCKING	Locking
		12	No locking activated
3	e.g. 35	35	Selected code number for locking
4	F4 [ENTER]		Confirms entry, value is transmitted

With the exception of "SECURITY LOCKING" all fields can be viewed but not changed..

Unlocking

Locking can be again cancelled by entering the code number 12. This does not apply if the locking was activated at the electronic insert. This is indicated by the code number 9999 in the menu field.

Step	Entry	Cursor in Display at	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	8	SECURITY LOCKING	Locking
	e.g. 35	35	Selected code number for locking
3	12	12	Code number for unlocking
4	F4 [ENTER]		Confirms entry, value to be transmitted

5.2 Tag Number

A measuring point number ("SET TAG NUMBER") can be assigned to the electronic insert by using the handheld terminal. This consists of 8 ASCII characters. This measuring point tag serves to identify different electronic inserts connected to the same power line as every electronic insert has to have its own unique tag number.

Step	Entry	Cursor in Display at	Significance
1	4	USER INFORMATION	User information
2	1	SET TAG NUMBER	Locking
3	e.g. LIC10	LIC10	Enter up to 8 characters
4	F4 [ENTER]		Confirms entry, value is transmitted

6 Diagnosis and Troubleshooting

6.1 Alarms

The following response is set in the factory:

If the FEC 12 detects a fault, then the current output is set to 22 mA (=110 %) to enable process control systems to, e.g. assume a response.

Output on alarm

If no alarm indication is to be given on an alarm, then "CONTINUE" can be set. In this case the FEC 12 continues to measure although the measured value is possibly incorrect.

Alarm indication

Step	Entry	Cursor in Display to	Significance
1	1	CALIBRATION	Basic setting
2	8	SAFETY ALARM MAX (110%)	Output on alarm Output jumps to 22 mA (=110 %), factory set
3	↓	CONTINUE	Continue measuring, no alarm indication
4	F4 [ENTER]		Confirms entry
5	F2 [SEND]		Value to be transmitted

6.2 Simulation

Simulation enables the current value coming from the electronic insert to be simulated. It can be used for checking the correct processing of probe signals, e.g. in a process control system. Simulation may also be necessary for tracing faults. No change in level is required to produce a different current value. The various types of simulation

- Level (LEVEL)
- Volume (VOLUME)
- Current (CURRENT)

are independent from one another and therefore none affects the others.

Note!

- If simulation is activated, Warning E 613 is displayed to indicate this.
- The full simulation range is only available with a free probe, only a limited range is possible with a covered probe.
- On completion, switch off simulation again in order to continue normal measurement.



Activate simulation as follows:

Simulation

Step	Entry	Cursor in Display at	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	5	SIMULATION OFF	Simulation Simulation switched off
3	↓	ON	Simulation switched on
4	F4 [ENTER]		Confirms entry, value to be transmitted

Simulation for level

Enter the level value to be simulated. The appropriate current is given by the electronic insert.

Step	Entry	Cursor in Display at	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	6	SIM. LEVEL e.g. 77.06	Simulation for level Actual measured value is displayed
3	e.g. 35.00	35.00	Level to be simulated is entered
4	F4 [ENTER]		Confirms entry, value to be transmitted

Simulation for volume

Enter the volume value to be simulated. The appropriate current is given by the electronic insert.

Step	Entry	Cursor in Display to	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	7	SIM. VOLUME e.g. 77.06	Simulation of volume Actual measured value is displayed
3	e.g. 5.00	5.00	Volume to be simulated is entered
4	F4 [ENTER]		Confirms entry, value to be transmitted

Simulation for current

Enter directly the current value to be simulated.

Step	Entry	Cursor in Display at	Significance
1	3	SERVICE/SIMULATION	Service/Simulation
2	7	SIM. CURRENT e.g. 17.02	Simulation of current output Actual measured value is displayed
3	e.g. 8.00	8.00	Current to be simulated is entered
4	F4 [ENTER]		Confirms entry, value to be transmitted

**Note!**

The values entered during simulation are stored until simulation is again switched off.

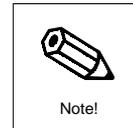
6.3 Description of Fault Responses, Error Messages

Error code	Significance
103	Initialisation activated
106	Check sum error This appears during the download, and remains if the download is not completed correctly. A new and successful download or reset deletes the error message.
116	Error in download format
204	Measuring capacitance too large (larger than 2000 pF)
613	Simulation switched on
615	The actual calibration at 4 mA produces an initial capacitance larger than 350 pF. It cannot be altered further. A reset deletes the error message.
616	The actual calibration at 20 mA produces a total capacitance larger than 2000 pF. It cannot be altered further. A reset deletes the error message.
617	The actual calibration produces a difference in capacitance ('span') of less than 10 pF between initial and total capacitance. It cannot be altered further. A reset deletes the error message.
618	Process-specific sensitivity too large
620	The current lies outside the permitted range (4.0 ... 20 mA or 3.8 ... 20 mA). It has no relationship to the measured value.

6.4 Replacing the FEC 12 Electronic Insert

Note!

If you want to transmit the settings of the old electronic insert into a new electronic insert, then please note the following section.



- Disconnect the power supply cable from the old electronic insert
- Loosen the central mounting screw
- Remove the electronic insert

Removal

- Plug in the new electronic insert
- Screw down the central mounting screw securely
- Connect the power cable to the electronic insert

Insertion

6.5 Transmitting Basic Settings

The recalibration procedure can be dispensed when replacing an electronic insert. Call up the setting for offset and sensitivity using the handheld terminal, replace the electronic insert, and then enter both settings in the new electronic insert.

The offset value indicates zero point calibration and is given as the capacitance value (initial capacitance). The value for sensitivity is the difference between the initial and total capacitance ('span') divided by 100.

Calling up offset and sensitivity

Calling up offset and sensitivity (cont.)

Step	Entry	Cursor in Display to	Significance
1	2	EXTENDED CALIBRATION	Extended calibration
2	2	OFFSET e.g. 63.43	Offset of electronic insert Record value for offset
3	F3 [ESC]	OFFSET	
4	3	SENSITIVITY e.g. 2.02	Sensitivity of electronic insert Record value for sensitivity
5	F3 [ESC]	SENSITIVITY	

Entering offset and sensitivity

Step	Entry	Cursor in Display to	Significance
1	2	EXTEND. CALIBRATION	Extended calibration
2	2	OFFSET	Offset
	63.43	63.43	Enter recorded value for offset
3	F4 [ENTER]	OFFSET	Confirms entry
4	3	SENSITIVITY	Sensitivity
	2.02	2.02	Enter recorded value for sensitivity
5	F4 [ENTER]	SENSITIVITY	Confirms entry
6	F2 [SEND]		Value to be transmitted

All settings can be transmitted from one electronic insert to another. Please see following section.

6.6 Transmitting All Settings

All settings stored in an electronic insert can be transmitted to another electronic insert using the HART Communicator handheld terminal. The procedure begins with an upload with the data from the old FEC 12 to the handheld terminal. Once the upload has been completed, a download is made and all data are transmitted from the handheld terminal to the new FEC 12.

Upload (loading data into the handheld terminal)

Step	Entry	Display	Significance
0		MATRIX GROUP SEL.	
1	←	Online	Higher menu level
2	3	Transfer Device to Memory	Data transfer Upload: Loading data into the memory of the handheld terminal
3	1	Looking for a device Save data from device to configuration memory	Looking for an electronic insert Ready for receiving data
4	F3 [SAVE]	Overwrite existing configuration memory	Prompts confirmation
5	F1 [YES]	Device to Memory	Data of the electronic insert now in memory of handheld terminal

Data loaded into the HART Communicator

1 Set Tag Number	6 Value for 4 mA	11 Temperature Unit
2 Select Unit	7 Value for 20 mA	12 Descriptor
3 Output Damping	8 Linearisation	13 Message
4 Safety Alarm	9 Offset	14 Date
5 Min Current 4 mA	10 Sensitivity	15 Poll addr

You must first move to the "Offline Configure" menu before carrying out a download.

Download

Step	Entry	Display	Significance
0		MATRIX GROUP SEL.	
1	←	Online	
2	1	Offline	
3	1	Offline Configure	
4	1	New Device or	
	2	Last Device	

The data you wish to be transmit to another electronic insert can be collected in this menu.

- 1 New Device → This option enables a new electronic insert to be calibrated.
- 2 Last Device → This option enables variables to be edited and changed after an upload.

There are four function keys within this menu:

- HELP (F1) - Online help. Help describes the variable shown in the display
- SEND (F2) - Marks the variable in the display for the download and then marks the next variable.
- EDIT (F3) - The variable can be edited and is marked for download once RETURN (F4) is pressed.
- SKIP (F4) - The variable is skipped (not marked for download). The next variable is then marked.

The "Offline" menu is displayed after the last variable. The parameters are now stored in the HART Communicator and are ready for a download into an electronic insert. After marking has been carried out, downloads can be carried out without first marking the variables again.

Step	Entry	Display	Significance
0		MATRIX GROUP SEL.	
1	←	Online	Main menu level
2	3	Transfer	Data transfer
		Device to Memory	
3	2	Memory to Device	Download: Loading data into electronic insert
		Looking for a device	Looking for a device
		Download data from configuration memory to device	Ready for data transmission
4	F3 [SEND]	Sending data to device	Data now stored in electronic insert

**Download
(loading data into the electronic insert)**

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