

**Manual**

**F4 calculator**

<b>1</b>	<b>GENERAL</b>	<b>4</b>			
1.1	Installation	4			
1.2	Principle of energy measurement	5			
1.2.1	Alternative naming	5			
1.2.2	Medium	5			
1.2.3	Operating conditions	6			
1.2.3.1	Normal operating conditions for battery supplied calculators	6			
1.2.3.2	Limitations mains supplied	6			
1.3	Calculator specifics	7			
1.3.1	Monthly values	7			
1.3.2	Account days	7			
1.3.3	Pulse counter register 1 and 2	8			
1.3.4	Placing of flow sensor	8			
1.3.5	M-Bus	8			
1.3.6	Communication address	8			
1.3.7	Power cut	8			
<b>2</b>	<b>BUTTONS AND JUMPERS</b>	<b>9</b>			
2.1	Push button	9			
2.2	Service button	9			
2.3	Test button	9			
2.4	Save data button	9			
2.5	Jumpers 2/4-Wire method for temperature sensors	10			
2.6	ON/OFF jumper battery powered calculators <u>ONLY</u>	10			
2.7	Slot jumpers Signal/Power redirecting	10			
2.8	Power ON/OFF	10			
<b>3</b>	<b>DISPLAY</b>	<b>11</b>			
3.1	Back-light	11			
3.2	Display test	11			
3.3	Display modes	12			
3.3.1	Transport mode	12			
3.3.2	Initial mode ( INIT mode)	12			
3.3.3	Service Mode	13			
3.3.3.1	Service/INIT mode sequence	13			
3.3.4	Test mode (programming mode)	14			
3.3.5	Normal mode ( operating mode )	15			
3.3.5.1	Display sequence normal mode	16			
3.3.5.2	Display seq. normal mode 2	17			
3.3.5.3	Display sequence normal mode (summary)	17			
3.3.5.4	Display sequence normal mode schematics	18			
3.4	Error codes	19			
<b>4</b>	<b>SEALS, CALCULATOR PROTECTION</b>	<b>20</b>			
4.1	Volume check	20			
4.2	Neutral seals	20			
<b>5</b>	<b>CONNECTING THE CALCULATOR / HANDLING</b>	<b>21</b>			
5.1	Circuit board F4	21			
5.2	Connection terminals	22			
5.2.1	Sensors and M-Bus connection	22			
5.2.1.1	EN1434 terminal table	22			
5.2.2	Pulse input connection	23			
5.2.3	Pulse output connection	23			
5.2.4	Connection 3V/12V	23			
5.2.5	Save data	24			
5.2.6	Alarm output connection	24			
5.2.7	Option board connection	24			
5.2.8	Potential free output	24			
5.3	Battery and mains connection	25			
5.4	Calculator connection	25			
5.5	Mains connection and backup battery	25			
5.6	Option board handling	26			
5.6.1	Option board installation procedure	26			
5.6.1.1	Installing several option boards at the same time	26			
5.6.2	DIP-Switch setting of option board	27			
5.6.3	Installing additional option boards when one or several option boards is/are installed	27			
5.6.4	Configure the option board	27			
5.6.5	Reconfigure option boards	27			
5.6.6	Uninstall, removal of option boards or reconfiguring option boards	27			
5.7	Cable fittings	28			
5.8	Mounting	28			
5.9	Zero sequence current	29			
5.9.1	Description of zero sequence current	29			

<b>6</b>	<b>CALCULATION</b>	<b>30</b>	<b>8.10</b>	<b>Data output interfaces</b>	<b>36</b>
<b>6.1</b>	<b>Calculation of flow</b>	<b>30</b>	<b>8.11</b>	<b>Pulse outputs</b>	<b>37</b>
6.1.1	Momentary flow	30	<b>8.12</b>	<b>Pulse inputs</b>	<b>37</b>
<b>6.2</b>	<b>Calculation of power</b>	<b>31</b>	<b>8.13</b>	<b>Alarm output</b>	<b>37</b>
<b>6.3</b>	<b>Temperature measurement and 4-wire measurement</b>	<b>31</b>	<b>APPENDIX</b>		<b>38</b>
<b>6.4</b>	<b>Storing values</b>	<b>31</b>			
<b>7</b>	<b>TESTING, PROGRAMMING &amp; SERVICE</b>	<b>32</b>			
<b>7.1</b>	<b>Programming the calculator</b>	<b>32</b>			
<b>7.2</b>	<b>Display test</b>	<b>32</b>			
<b>7.3</b>	<b>Installation test</b>	<b>32</b>			
<b>7.4</b>	<b>Service</b>	<b>33</b>			
7.4.0	Time	33			
7.4.1	Date	33			
7.4.2	Pulse value	33			
7.4.4	Account days	33			
7.4.6	Communication address (primary address)	33			
7.4.7	Resetting stored error time	33			
7.4.8	Placement of flow sensor placing	33			
7.4.9	Recommended date for battery replacement	33			
7.4.A	Return to normal mode	33			
7.4.10	Clarifications on format	33			
<b>7.5</b>	<b>Verifying the calculator</b>	<b>34</b>			
<b>8</b>	<b>TECHNICAL DATA</b>	<b>35</b>			
<b>8.1</b>	<b>Data output table</b>	<b>35</b>			
<b>8.2</b>	<b>Power supply</b>	<b>36</b>			
<b>8.3</b>	<b>Temperature sensors</b>	<b>36</b>			
<b>8.4</b>	<b>Flow sensors</b>	<b>36</b>			
<b>8.5</b>	<b>Temperature ranges</b>	<b>36</b>			
<b>8.6</b>	<b>Ambient temperature &amp; Temperature class</b>	<b>36</b>			
<b>8.7</b>	<b>Flow sensor placing</b>	<b>36</b>			
<b>8.8</b>	<b>Maximum values for power</b>	<b>36</b>			
<b>8.9</b>	<b>Dynamic behaviour</b>	<b>36</b>			

# 1 General

## 1.1 Installation

The calculator is delivered set in “Transport mode”, but depending on delivery options the calculator can be delivered in other “display modes”, e.g. “Transport mode”, see display modes for more information. Follow this procedure to install the calculator:

1. Setting of calculator, see “Service, setting meter” for more information.
2. Install option boards, see “Install option boards” for more information.
3. To mount the calculator, see “Mounting”.
4. Connecting the calculator, see “Connections”.
5. Check Seal, see “Seals”.
6. Display and function test, see “Display and function tests”.
7. Set the calculator into normal mode, see “Different display modes” for more information.
8. Function test, see “Tests”

## 1.2 Principle of energy measurement

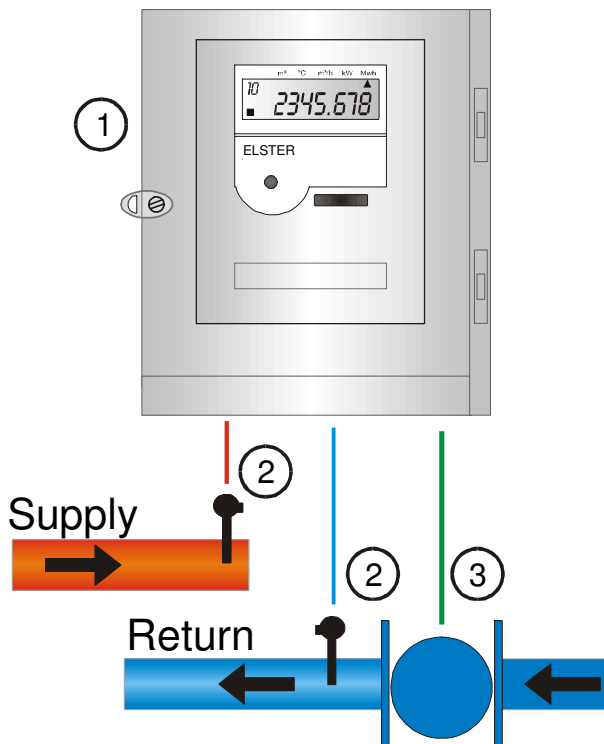


Fig. 1.1, Principle of energy measurement

**Energy measurement** consists of:

1. Calculator
2. Two paired temperature sensors, resistance thermometers, PT100 or PT500
3. Flow sensor, that emits pulses

The calculator calculates energy by measuring temperature difference at each flow pulse emitted by the flow sensor, or at the sum of several pulses.

Data stored in calculator can be read on the display or through an external communication. M-Bus is the standard communication protocol. Other communication protocols are available on option boards.

### 1.2.1 Alternative naming

The nomenclature for the energy industries are not unified, different words are used to explain the same things. The words recommended are underlined.

Calculator, Heat meter or meter

**Flow sensor:**

Supply, forward, hot and high.  
Return, cold, low

### 1.2.2 Medium

The F4 calculator algorithm is only for measuring energy in water.

When using water mixtures another algorithm is required then the calculator MF4, a calculator for mixtures is required.

### 1.2.3 Operating conditions

All electronics have limitations like response time, in memory capacity and so on. In order for the battery consumption and for trouble free usage of the calculator following limitations apply for the F4, see below.

#### 1.2.3.1 Normal operating conditions for battery supplied calculators

The usage of the calculator is different. In order for the battery life expectancy to be valid, following definition of normal operating condition, limits where one can use the calculator:

**M-Bus telegram reading** (all protocols) maximum once per day. High frequency usage of M-Bus reading reduces battery life.

**Only one option board** can be installed in the calculator. When more boards are required and installed the battery life expectancy will be reduced. E.g. one option board 10 years, two option boards 6 years. **Note:** Not every option board can be used in a battery supplied calculator, see the option board documentation for more information.

**Flow sensor pulses emitted** at the average rate of maximum 1,5 p/min and with the maximum temperature difference at 50 degrees K. The average shall be based on the whole lifetime of the battery. The calculator shall also have standard decimal setting, see standard decimal setting Appendix, A1.

**Configuration** by using the “FlexServ program” wrongly can seriously reduce battery life expectancy on the calculator. Use factory settings when possible, the settings in which the calculator was delivered from factory.

Calculator must be set in **normal mode** (sequence “10” on display) when using the calculator for measuring, see also 3.3.5 normal mode. Service-/Init-/Test-mode reduces battery lifetime expectancy when the calculator is set in these modes for longer periods of time.

#### 1.2.3.2 Limitations mains supplied

The M-Bus reading frequency must not exceed once every 20 min. When the reading frequency exceed this interval the calculator must be equipped with “galvanic separation board” (FCR2-M1A, for slot A).

## 1.3 Calculator specifics

The calculator also stores additional data, besides recorded and calculated values. The calculator specifics are explained below.

### 1.3.1 Monthly values

The calculator has up to 37 monthly registers. In these registers monthly values are stored at the end of each month. The monthly value is a snapshot of values at the end of the month. The values are:

- When values are stored
- Accumulated energy
- Volume, according to flow sensor
- Volume, according to energy calculation
- Energy
- Accumulated volume from pulse 1
- Accumulated volume from pulse 2
- Possible error code, at the time of storage

When the maximum number of monthly values is reached normally 37 values, the calculator replaces the “oldest” value with a new.

The monthly values can be read in the display and over the M-Bus the calculator. The order of presentation is the “newest” value first and then the previously stored value will be presented and so on.

The number of monthly values can be changed by using the “FlexServ version 2”. **Note:** Only by authorized personnel from ELSTER.

See also 3.3.5.1 table 3.2 for more information on sequence 40.

### 1.3.2 Account days

Some utility companies prefer to read all their meters at the same time twice a year, at two predicated days (specific dates) also called account days.

The F4 has the possibility to store two account days. The user can specify when these dates are using service mode or the “FlexServ program”. Values stored in the account days register are the same set of values as for monthly register, see monthly values 1.3.1. Account day is default set to:

Account day 1: 1 January (0101)  
Account day 2: 1 July (0701)

The values for the account day will be stored at the day shift. E.g. Calculator will store the account day values at 00:00, 1:st of January and at 00:00, 1:st of July each year.

The “newest” value will be presented first and then the previously stored value and so on. The “old” account day values will be replaced when “new ones” are to be stored. See also 3.3.5.1 table 3.2 for more information on sequence 30.

Account days can only be changed by the “FlexServ program version 2”. **Note:** Only by authorized personnel from ELSTER.

### 1.3.3 Pulse counter register 1 and 2

The calculator has two (2) pulse inputs that acts as volume accumulators in [m<sup>3</sup>]. To set the volume accumulators to pulse counters the pulse weight in calculator must be set to:

**1000 [l/p], 0 decimals**

**Example:** 1000 [l/p], 0 decimals - 1 m<sup>3</sup> per pulse (One pulse one increment of display). See also 3.3.5.1 table 3.2 for more information on sequence 13 and 14.

### 1.3.4 Placing of flow sensor

The calculator uses different algorithms to calculate the energy depending on which pipe (hot or cold) the flow sensor is placed. Always set the flow sensor placing correctly in the calculator.

**Recommended** flow sensor placing is in the return (cold) pipes, see also fig 1.1, 1.2 principle of energy measurement, as this side normally is the “cooler side” for the flow sensor.

The flow sensor placing can be set in the “service mode”, see Service 7.4 or by using the “FlexServ program” version 2 or higher.

See also 3.3.5.1 and table 3.2 for more information on sequence 64, flow sensor placing.

### 1.3.5 M-Bus

The F2/3/4 calculator is equipped with M-Bus communication. The M-Bus in the calculator is according to M-Bus standard and the recommendation according to M-Bus user group.

**Battery powered** calculators are sensitive and may not be connected into loops with more than 250 M-Bus nodes with maximum one M-Bus read once a day, otherwise the battery life expectancy in the calculator will be affected.

**Extreme M-Bus communication**, when the calculator is flooded by the M-Bus, the calculator will prioritize the M-Bus over the display. This flooding will result in strange calculator display behaviour.

Flooding of the M-Bus communication will not affect the calculator readings.

### 1.3.6 Communication address

The calculator has two (2) communication addresses in M-Bus.

**Primary address**, this is a value from 1-250. The primary address can be changed in the “service mode”, see also service 7.4 or by using the “FlexServ program” version 2 or higher.

When two or more meters within a M-Bus loop use the same primary address a communication collision will occur. The primary address must be unique for each calculator in the M-Bus loop.

**“Secondary address”**, is normally set to F4 serial number (S/N).

When two or more calculators in an M-Bus loop use the same primary address a communication collision will occur. This is why secondary addressing is recommended when no calculator has the same secondary address from factory.

In most M-Bus reading programs the user can choose to address the calculator by the primary or secondary address. The transfer and communication speed for the calculator will not be affected by choosing the primary or the secondary addressing in M-Bus.

### 1.3.7 Power cut

#### Mains powered

When the mains power is cut the calculator will run following sequence:

1. Automatically switch over to the backup battery.
2. Store calculator data to an EEPROM.
3. Generate an error code “0000080” on display sequence 15. See also Error Codes, 3.4 (Only when selected in the calculator programming).

The F4 calculator has a backup battery (both mains and battery driven calculators). This battery will supply the calculator with power when main power is cut. The backup battery will last up to 10 years at normal usage of calculator, maximum one M-Bus reading per day and normal energy values.

**When power fails**, the calculator stores all data to the EEPROM at dayshift. When power is cut from both mains and backup battery and the calculator loses all recorded data in temporary memory, there are two (2) cases:

1. All data stored after dayshift will be lost, see also storing values, 6.4
2. All data stored after the save by short circuit the “Save data button” will be lost, see also 2.4 Save data button. Only when the “save data button” is short circuit after a dayshift.

## 2 Buttons and jumpers

### 2.1 Push button

The calculator is equipped with a “Push button”. With the “Push button” the user can toggle between different values on the display at the display sequence the calculator is in at the moment. The user can also use the button to in enter different display sequences by holding the button until the calculator shift sequence. There are two ways to use the “Push button”,

1. **Push**, e.g. press (and release) to toggle between different values in the display sequence, see “Display” for more information.
2. **Hold**, e.g. hold Push button and hold it pressed until the display changes display sequence, see “Display” for more information.



Fig 2.1, Push button

Push button

### 2.2 Service button

The service button is used in combination with holding the “Push button” to enter service mode, see also “Service mode 3.3.3”.

**Tool:** Screwdriver or any other suitable dull object.

To enter (or exit) **service mode**, hold the service button (carefully) pressed using a small screwdriver and then hold the “Push button” pressed a few seconds (5s), then release the “Push button” and then release the screwdriver. The display sequence changes to “01” (or back to “10”). For more information, see “Display 3” for more information.

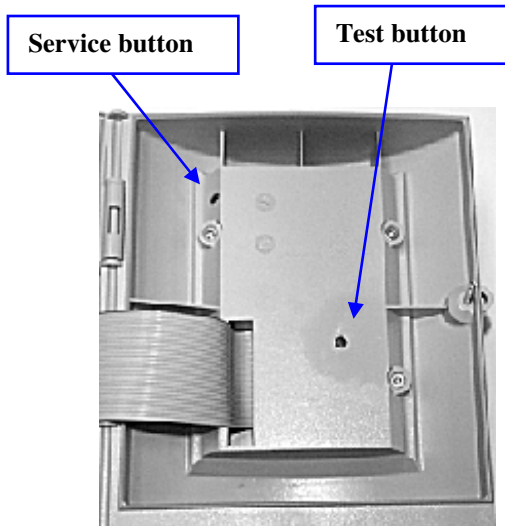


Fig 2.2, Location of service and test buttons

### 2.3 Test button

This button is used in combination with holding the “Push button” to set calculator into test mode.

**Tool:** Test key

(Rubber key with a leading top)

Enter test mode, hold test button using “Test key” and then hold the “Push button” pressed in for approximately five (5) seconds then release the “Push button” and then release the rubber key. A flash will appear on the display to indicate the test mode.



Fig 2.3, Test key

Exit test mode, by using the same procedure as entering the “test mode”, see above, the flash will disappear after exiting the test mode.

**Note:** only to be used by authorized personnel

### 2.4 Save data button

The save data button is used when saving data is necessary, when changing batteries or when installing option boards.

When the “Save data button” is short circuited, the calculator makes readings and saves all data from temporary memory to the calculator EEPROM.

**Note:** Data from option boards will not be saved.

**Tool:** Test key

(Rubber key with a leading top to short circuit buttons.)

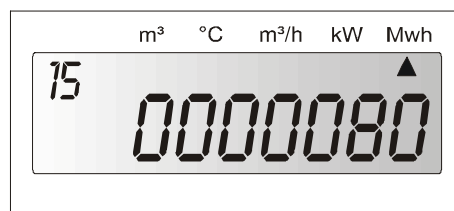
To save, use the “Test key” and short circuit the “Save data button” the calculator will store all temporary data to the EEPROM.



Fig 2.4, Save data button

Check “save data” procedure:

The calculator will display an error code when data is properly saved. Prior to “save” change the display sequence to number 15. Then short circuit the “Save data button” using a “Test key”, the code “0000080” will be displayed and confirm data storage, see also Error codes 3.4.



2.3b, Error code displayed when data is saved.

## 2.5 Jumpers 2/4-Wire method for temperature sensors

The F4 is by default configured for 2-wire measuring method connection for temperature sensors. The calculator allows 4-wire measuring method, by removal of jumpers, see fig 2.5.

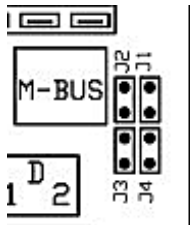


Fig 2.5, 2/4-Wire jumpers

**4-wire connection,**  
remove jumpers J1, J2, J3 and J4.

**2-wire connection,** place jumpers J1, J2, J3 and J4.

**Note:** the jumpers must be placed

according to fig 2.5.

**Note:** Wrongly placed jumpers can damage the calculator.

## 2.6 ON/OFF jumper battery powered calculators ONLY

Some F4 is equipped with an ON/OFF jumper this jumper should be used for **battery powered calculators only**.

**Note:** When cutting the power to the calculator, e.g. setting calculator “Power OFF” remove the “K2” then “K3”. See also Power ON/OFF 2.8 below.

**Note:** ON/OFF jumper only applicable on calculators powered with batteries. To cut power from mains supplied calculator see fig 5.1, Circuit board 5.1 and Power ON/OFF.

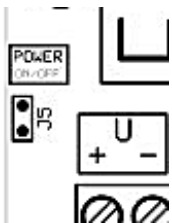


Fig. 2.6, ON/OFF jumper, OFF, no jumper

**Power off,** no jumper  
**Power on,** jumper on

**To cut power from mains supplied calculator** see fig. 5.1, Circuit board 5.1 or 2.8 Power ON/OFF.

**WARNING:** The ON/OFF jumper will not set a mains powered calculator into “power OFF” mode. When installing option boards in a “mains powered” calculator this operation (ON/OFF jumper) will only damage the option board and the calculator.

## 2.7 Slot jumpers Signal/Power redirecting

On the slots “C” and “D” there are jumpers for redirecting power and bus signals. When these are removed without placing a correct option board in to the slot, the signals from the calculator can be disturbed and the calculator’s pulse output and alarm output can be disabled depending on which jumper that is wrongly removed.

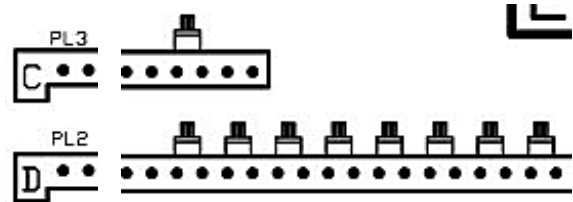


Fig 2.7, Slot jumpers on slot C and slot D

## 2.8 Power ON/OFF

For power off cut the power to the calculator by removing the 4-pole connector “K2” and then “K3”. Recommended procedure:

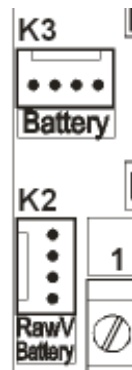


Fig. 2.7, Power off

### Power OFF:

1. Save data, short circuit “Save data button” (avoid losing any data).
2. Remove K2 (main)
3. Remove K3 (backup)

### Power ON:

1. Connect K3 (backup)
2. Connect K2 (main)

### 3 Display

The F2/3/4 calculators are equipped with a LCD (Liquid crystal display). The units on display label and decimal placing is different depending on calculator configuration. See also clarification of display fig. 3.1:

1. Display sequence, in this case “10”, default position, (the position the calculator returns to after 60 seconds of “push-button” inactivity). The digit “1” displays the sequence and the “0” displays the order in the sequence. The digits together form the display sequence “10”, see also fig. 3.1b (below).
  2. Sensor pulse indicator square, indicates a flow pulse emitted from flow sensor. The square can also indicate that an error has been detected. At error (reverts to normal); the square will appear as long as the calculator do not receive a pulse, and disappear when receiving a pulse. At High frequency (2Hz or more); The square will appear steadily and disappear on error.
  3. Value, max. seven (7) digits
  4. Value unit indicator arrow, the triangle points on the correct unit on the display label for the unit. (Only when the calculator is correctly set).
  5. Different units on display label, depends on ordering configuration of calculator.
  6. Decimal placing.
- Note:** the digits after the decimalplacing “blinks” only in sequence “10” in accordance with EN1434, according to the standard the decimals on the display must be clearly marked.

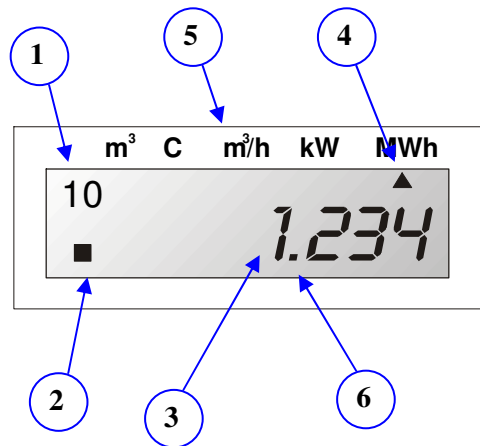


Fig 3.1, Display, m³, C...

#### 3.1 Back-light

The calculator display can be equipped with a “back-light” function. The “back-light” will light up the display each time the “Push button” is pressed, and will be turned off one minute after “Push button” inactivity.

In the display modes Service/INIT/Test mode the light will light steadily. Avoid setting a calculator equipped with “back-light” in these modes for longer periods (10min.). Do not set the calculator into these modes during transport otherwise the backup battery life span will seriously be reduced.

During transport and temporarily storage of the calculator the “Transport mode” mode is to prefer, in this mode the “back-light” is off. See display modes, 3.3 for information about display modes.

**Note:** The “back-light” function consumes more energy than a calculator without “back-light” function. Battery powered calculators (powered with only batteries) should not be equipped with the “back-light” function.

#### 3.2 Display test

In accordance with EN1434 all calculators must have display test. For F2/3/4 the display test is on sequence 12.

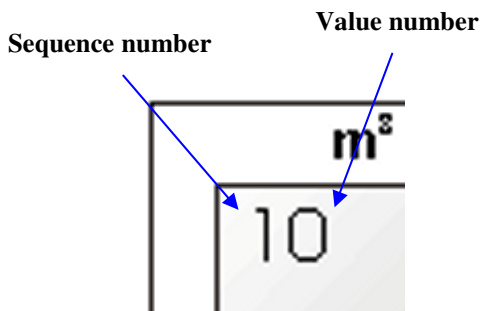


Fig 3.1b, sequence number, value number together form display sequence.

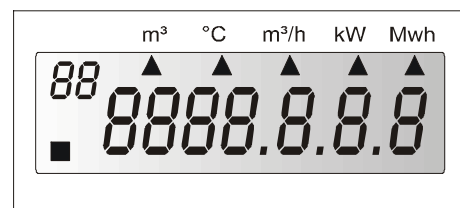


Fig. 3.2, Display test

### 3.3 Display modes

The calculator can be set in different display modes depending on what data that shall be accessed in the calculator. To enter the different modes the seals must be broken and a recommended tool should be used, see below. The calculator is normally delivered in “Transport mode”. Depending on programming the calculator can be delivered in other display modes as well.

The sequences in the different display modes can vary depending on different programming of the calculator. The display modes are:

1. Transport mode
2. Initiation-mode (INIT-mode) programming by using “Push button”, see service mode.
3. Service mode, programming by only using the “Push button”
4. Test mode (test and programming mode), by using the “service program” version 2 or higher the calculator can be programmed.
5. Normal mode, operating mode, working mode.

**Note:** Avoid setting the calculator into “service/initial mode” or “testing mode” for longer time periods (1 hour) otherwise the battery life length expectancy will be effected.

#### 3.3.1 Transport mode

The calculator normally is delivered in transport mode. In transport mode the calculator “sleeps”, no measurements and no communication from or to the calculator will be performed. In transport mode only the system clock and (if any) option board will be supported with minimum power requirements. The calculator’s “operating time” (display sequence 50) will be in a stand still.

**To exit “Transport mode”,** hold “Push button” pressed (approximately 5 seconds) until the “no” sign disappears. The display sequence changes to “00” or “10” depending on calculator settings. In most settings the calculator enters the INIT-mode. The INIT-mode is indicated by display sequence “00” see also initiation mode 3.3.2 for further information.

Using the “service program” version 2.0 or higher the calculator can be set in “Transport mode”, only to be used by authorized personnel.

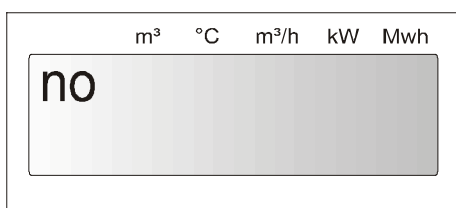


Fig. 3.3, Sequence transport mode

#### 3.3.2 Initial mode ( INIT mode)

The calculator enters the INIT mode after exiting the transport mode (this can vary depending on setting of the calculator). The INIT mode is indicated by display sequence “00”, see also fig 3.5 above. In the INIT mode some calculators setting can be altered using the “Push button” prior to an installation without braking any calculator seals. See Service/INIT mode display sequence 3.3.3.1.

The calculator’s INIT mode can be identical to its service mode. In some calculators a few sequences are missing compared to the service mode depending on calculator setting. For service/INIT mode sequence, service mode sequence 3.3.3.1.

In INIT-mode the value digit to be changed will blink and the display sequence will indicate unit for the value, see service mode 3.3.3 for more information.

**To change value digit,** push “Push button” until correct value is acquired, see fig 3.5 below.

**To change digit “to be changed”,** hold “Push button” until the next value digit starts to blink, see fig 3.5.

**To exit INIT mode** without braking any seals when in INIT mode:

1. Hold “Push button” until display sequence “0A” appears.
2. Release the “Push button”
3. Press “Push button” once to change the value digit to “1” (exit INIT mode).
4. Hold “Push button” to exit the INIT mode, the display sequence should read “10”, normal mode.

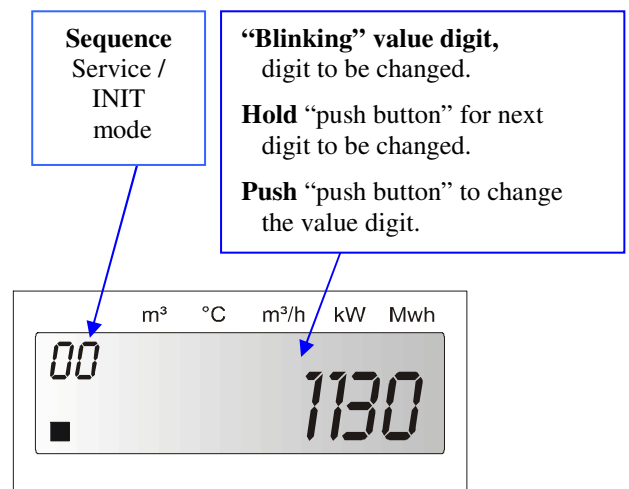


Fig. 3.5, Sequence service or INIT mode

### 3.3.3 Service Mode

In service mode the settings of the calculator can be altered using the “Push button”. The service mode is indicated by “00” (or “0x”) in the display sequence. See also service 7.4 for more information on each service sequence and INIT mode 3.3.2 for initial mode.

**To enter “service mode”,** hold the “Service button” pressed with and screwdriver (or another dull object) at the same time hold “Push button” pressed in 1-2 seconds. Then release the “Push button” and the display sequence will change to service mode, display sequence “00” (also remove the screwdriver), see also service buttons 2.2.

**To exit “service mode”,** the same procedure as when entering the service mode, see above.

**To change value digit,** push “Push button” until correct value digit is acquired.

**To change value digit “to be changed”,** hold “Push button” pressed until required value digit starts to blink. **Note:** The changed value digit is changed, only when the next value digit is selected and starts to blink. E.g. do not exit service mode when the changed value digit is still blinking. Ensure that the change has been carried out by the calculator, by first reaching the next service sequence (example from “01” to “02”) before exiting the service mode.

**To enter next sequence,** hold the “Push button” until next service sequence appears on display, see also fig. 3.1b.

**To exit Service mode** in service sequence “0A”:

1. Hold “Push button” until display sequence “0A” appears.
2. Release the “Push button”
3. Press “Push button” once to change the value digit to “1” (exit INIT mode).
4. Hold “Push button” to exit the INIT mode, the display sequence should read “10”, normal mode.

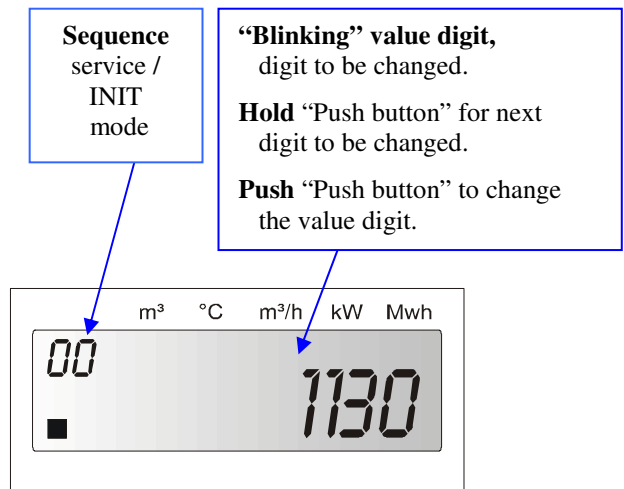


Fig. 3.5, Sequence service or INIT mode

#### 3.3.3.1 Service/INIT mode sequence

Sequence	Description, format
00	Time, HHMM
01	Date, YYMMDD
02	Pulse value, 0000-9999 e.g. 2.5l/p is displayed with 2500
03	Pulse value decimal places, 0-4
04	Account days 1, MMDD
05	Account days 2, MMDD
06	Primary communication address set with three (3) digits, e.g. “5” is set to “0005”
07	Resetting stored error time, 0 = Reset stored error time (default) 1 = Do not reset error time
08	Flow sensor placing, 0 = installed at low temp. (default) 1 = installed at high temperature
09	Replacement of battery date, YYMMDD Do not change without consulting ELSTER
0A	Exit service sequence, 1 = Exit 0 = Return to sequence “00”

Table 3.1, Service display sequence,

HH-Hour, mm-Minutes,

YY-Years, MM-months, DD-Days.

See, “Testing..., Service” for additional information

**Note:** Values in the service mode may only be altered by trained professionals.

**Note:** The display sequences in service mode may vary depending on calculator configuration.

**Warning:** Altering the values in the service mode can seriously effect on the calculator performance and can result in wrong measuring.

### 3.3.4 Test mode (programming mode)

In the test mode all the calculator parameters can be configured, with the “service program” version 2.0 or higher. Tests can also be performed on the calculator, see verifying the calculator 7.5. A flash on the display will indicate this mode, see fig 3.6.

The calculator also activates the optical interface and emits high frequent pulses corresponding to the energy increment. See Service 7.4 for more information. The M-Bus and the display response in this mode will be slower and in some cases disturbed.

**Setting calculator into test mode** by using the “test key”, a rubber key with an electric leading head. Hold the “test key” pressed to short circuit the “test button” (at the same time), hold the “Push button” pressed (approximately 1-2 seconds), and then release the “Push button”. The display will show a “flash” indicating “test mode”, (remove the “test key”), see also fig 3.6 (below).

**Exit test mode**, the same procedure as to “set the calculator into test mode”, see above. The “flash” will disappear from the display upon exit.

**Energy consumption** will be higher in “Test mode” than in calculator normal operating mode. Avoid setting the calculator into “Test mode” for longer period than (>1h) or the battery/backup battery life length will be seriously reduced.

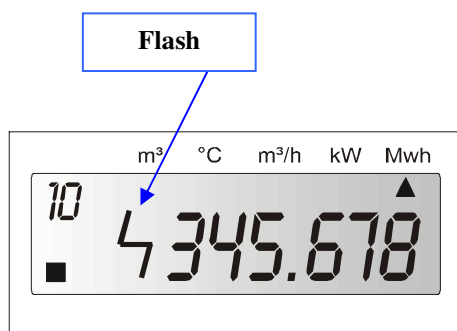


Fig 3.6, Display in test mode, “flash” in display

**Only Service program version 2.00** (00-10-09) or later versions may be used to program F4. With the service program the calculator can be programmed (configured). This program is backward compatible e.g. F3/2 can be programmed with the service program version 2.00 or higher. See also the Service program manual for further information.

In the service program:

**Read type**, the calculator programming is read into the service program.

**Change mode**, the display mode is changed.

**Change type** will erase all previously stored calculator readout data.

**Note 1:** Avoid to set the calculator into “Service/Initial mode” or “Testing mode” for longer time periods (1 hour), when battery life length will be affected.

**Note 2:** Calculators delivered with energy unit “BTU” and flow unit “USG/min” has fixed decimal setting.

**Warning 1:** Changing the programming using the service program version 2.0 or higher can seriously affect the calculator behaviour, such as parameters as battery life length can be seriously reduced and measuring will be affected. Do not use the service program without proper education or consulting ELSTER.

**Warning 2:** When programming the F4 only use Service program version 2.0 or higher, otherwise the calculator will be seriously damaged!

**Warning 3:** When programming the F4 only use Service program version 2.0 or higher, otherwise the calculator will be seriously damaged!

### 3.3.5 Normal mode ( operating mode )

Normal mode is the calculator's operating mode. In this mode the calculator accumulates energy, calculates and makes measurements. The calculator can also communicate by using M-Bus or SIOX protocols (SIOX only with an extra option board).

#### Display sequences

The first digit from left is the sequence number, see also fig. 3.1b below. This number announces in which sequence currently is on display (1 to F).

The second digit from left is the value number and announces which value is displayed in the specific sequence. The value numbers loop within each sequence (there are a few exceptions).

See also, display sequence schematics 3.3.5.4 and display sequence normal mode 3.3.5.1.

#### Enter next sequence

Hold the "Push button" to enter next sequence, release when correct display sequence is reached. Repeat this procedure to enter next sequence. When exiting the last display sequence F0 the display will return to the first display sequence 10.

On exiting the display sequence 30 and 40 the calculator will return to display sequence 10.

#### Read values

Press "Push button" to toggle to the next display value. After the last value in the specific sequence the first value in this sequence will be displayed and so on.

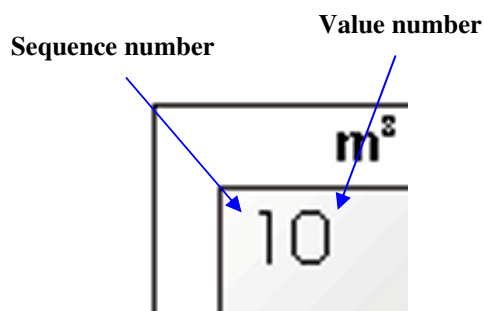


Fig 3.1b, Sequence number and value number together form display sequence.

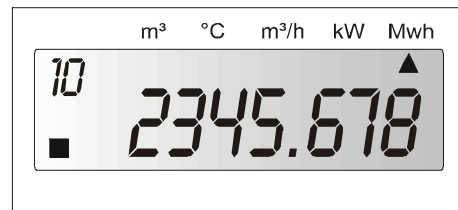


Fig 3.7, Display sequence "10" in normal (seq. 10 default sequence position).

#### Default position

When calculator is set in normal mode the display will return to the default sequence position after 60s, (the return time can be altered by using the "Service program 2.0" or higher).

#### Blinking digits

In accordance with EN1434 the digits after the decimal places blink.

#### Unit arrow

An arrow will indicate the correct unit for the value, the display labels varies depending on calculator.

**Example**, calculator delivered with different display labelling depending on kWh, MWh, GJ or MBTU to be outputted by the calculator.

**Note:** When calculator is reprogrammed the "service program" version 2.0 or higher the label is not "automatically" changed.

### 3.3.5.1 Display sequence normal mode

Seq	Description
10	Accumulated energy (Default position)
11	Accumulated volume according to flow sensor <sup>1</sup>
12	Display test, see fig.3.2
13	Accumulated volume for pulse input 1, [m <sup>3</sup> ]
14	Accumulated volume for pulse input 2, [m <sup>3</sup> ]
15	Error code, see Error code
16	Error time, [Minutes]
20	Momentary power
21	Momentary flow
22	High temperature, 0 decimals
23	Low temperature, 0 decimals
24	Temperature difference, 1 decimals
30	Account days <sup>2</sup> , when values are stored, [YYMMDD]
31	Account days <sup>2</sup> , Accumulated energy
32	Account days <sup>2</sup> , Accumulated volume according to flow sensor.
33	Account days <sup>2</sup> , Accumulated volume according to energy calculation
34	Account days <sup>2</sup> , Accumulated volume pulse input 1, [m <sup>3</sup> ]
35	Account days <sup>2</sup> , Accumulated volume pulse input 2, [m <sup>3</sup> ]
36	Possible error code, at time of storage of account days
37	Possible accumulated error time, at the time of storage account days, [Minutes]
3x	Following account days registers (loop back)
40	Monthly registers <sup>3</sup> , date when values are stored, [YYMMDD]
41	Monthly registers <sup>3</sup> , Accumulated energy
42	Monthly registers <sup>3</sup> , Accumulated volume according to flow sensor
43	Monthly registers <sup>3</sup> , Accumulated volume according to energy calculation
44	Monthly registers <sup>3</sup> , Accumulated volume pulse input 1, [m <sup>3</sup> ]
45	Monthly registers <sup>3</sup> , Accumulated volume pulse input 2, [m <sup>3</sup> ]
46	Possible error code, at time of storage of monthly register
47	Possible accumulated error time, at the time of storage, [Minutes]
4x	Following monthly registers (loop back)
50	Operating time, [Hours]
51	Relevant date, [YYMMDD]
52	Relevant time, [HH.MM]
53	Recommended date for battery replacement, [YYMMDD]
60	Communication address, Primary address
A0	Communication address, Secondary address (normally same as meter S/N)
bx	Meter S/N <sup>5</sup>
63	Pulse value [l/p]
64	Placing of flow sensor, [H/L], L = Low
70	Accumulated volume corresponding to accumulated energy
71	Last remote read accumulated energy
72	Time since latest remote read accumulated energy, [Hours]
73	Accumulated error time, [Minutes]
74	Previous error code
75	Time for previous error code, [Minutes]

Table 3.2, Display sequence 10 – 70, normal mode

### 3.3.5.2 Display seq. normal mode 2

90	ID Option card A
91	Status option card A
92	ID Option card B
93	Status option card B
94	ID Option card C
95	Status option card C
96	ID Option card D
97	Status option card D
98	ID Option card E
99	Status option card E
9A	ID Option card F <sup>4</sup>
9b	Status option card F <sup>4</sup>
A0	Sequence option card A
b0	Sequence option card B
C0	Sequence option card C
d0	Sequence option card D
E0	Sequence option card E
F0	Sequence option card F <sup>4</sup>

Table 3.2b, Display sequence normal mode

- 1 F2/F3/F4 have two registers for accumulated volume. Value 11, is incremented at the rate of arrived flow pulses. The other register, value 70 is incremented in conjunction with energy calculation.
- 2 In order to change to the next account day, keep pushing the button until the date starts to increment, then release the button. After the display 37, see table above, the next account day will display. **Note:** If one hold the "Push button" again the display reverts to default position (seq. 10).
- 3 To change to another month keep pushing the button until the date starts to increment. Release at the requisite month. After display 47, see above, the next stored date will be displayed. **Note:** If one hold the "Push button" again the display reverts to default position ( seq. 10).
- 4 This sequence's slot is only available in the F2, but will also be displayed in the F4. The F4 has maximum 5 slots.
- 5 The second digit form left in the sequence "bx" (e.g. x) will marke the most significant digit in the calculator serialnumber. Example: Calculator serialnumber is "0000 0015" the sequence will display "b0", and if the seraialnumber is "8000 0015" the sequece will display "b8".

For more information on the sequences:

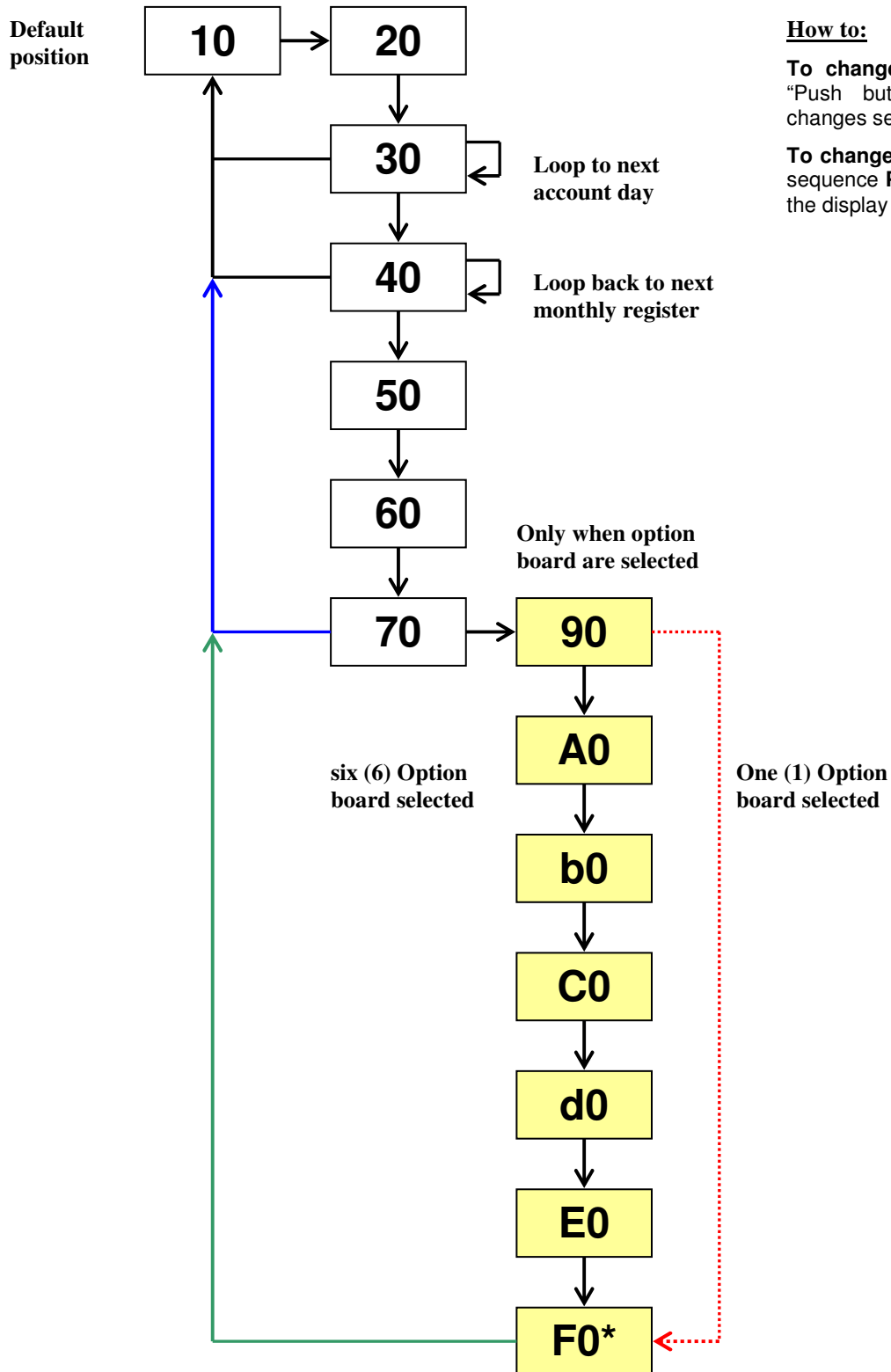
See also for further information, 0 calculator specifics.

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### 3.3.5.3 Display sequence normal mode (summary)

- 10 - Readout values 1 (Power, flow)
- 20 - Readout values 2 (Temperature, momentary values)
- 30 - Account days values
- 40 - Monthly registers
- 50 - Date registers
- 60 - Communication, settings
- 70 - Volume check, error listings
- 90 - Option board status
- A0 -F0 Option board sequences

### 3.3.5.4 Display sequence normal mode schematics



**How to:**

**To change sequence** HOLD the “Push button” until the display changes sequence.

**To change values** within a specific sequence PUSH “Push button” until the display changes value.

Fig 3.8, Display schematics for “normal mode”

\* Only in F2. No such option board slot in F4 but will be displayed in the display sequence.

### 3.4 Error codes

Sometimes an error code will appear in display sequence 15, 37, 47, 74 and on M-Bus. The error code message can be interpreted using the table below. The error codes consist of three (3) hexadecimal (Hex) digits, e.g. 0 – 15. Each digit can have up to 4 different error codes in combination. The correct error code can be acquired by combining the digits, see also example below. The digits shall be read from the right to the left.

**Example:** 0000005 = 1 + 4 = error 1 and error 4, low temperature sensor disconnected and high temperature sensors disconnected.

Display	1	Low temp. sensor disconnected
<b>digit 1</b>	2	Low temp. sensor short circuit
first	4	High temp. sensor disconnected
( from	8	High temp. sensor short circuit
right )		
Display	1	Internal bus collision has occurred within
<b>digit 2</b>		24 hours.
second	2	I <sup>2</sup> C error ( internal bus error )
( from	4	Low flow
right )	8	Alarm input, low voltage*
Display	1	Battery expire
<b>digit 3</b>	2	Oscillator error
third	4	Pulse input too long
( from	8	Not in use
right)		

Table 3.3, Error code numbers

A good help to is use the table below to find out which error the calculator displays

**Example:** 00000045

First digit 5 from right = Error code 4 + Error code 1 = Temperature sensors (low+high) disconnected  
 Second digit 4 from right = Error code 4 = Low Flow Error

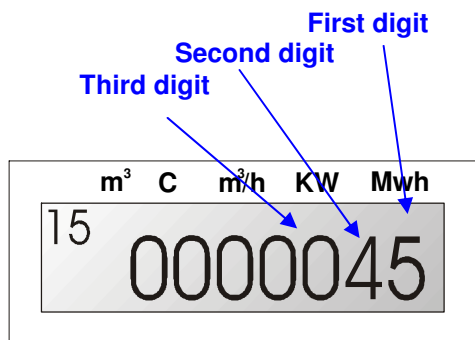


Fig 3.10, error at display sequence “15”  
 first digit “5”, second digit “4”

No.		Error number (s)
Hex.	Dec.	
0	0	0
1	1	1
2	2	2
3	3	1 + 2
4	4	4
5	5	4 + 1
6	6	4 + 2
7	7	4 + 2 + 1
8	8	8
9	9	8 + 1
A	10	8 + 2
B	11	8 + 2 + 1
C	12	8 + 4
D	13	8 + 4 + 1
E	14	8 + 4 + 2
F	15	8 + 4 + 2 + 1

Table 3.3b, Error hex decoding key

\* “0000080”, can vary depending on setting in the calculator.

1. No voltage (**default value**), the calculator will show this error code when there is no power supplied from the mains.
  2. External alarm set, alarm from an external device.
- This error code will also appear when the “Save data button” is short circuited, see also 2.4, Save data button.

## 4 Seals, calculator protection

The F2/3/4 are tampering protected with seals. To enter the calculator or to enter “Test mode”, “Service mode” or to enter the electronics inside the calculator several seals need to be broken, see placement of the seals below:

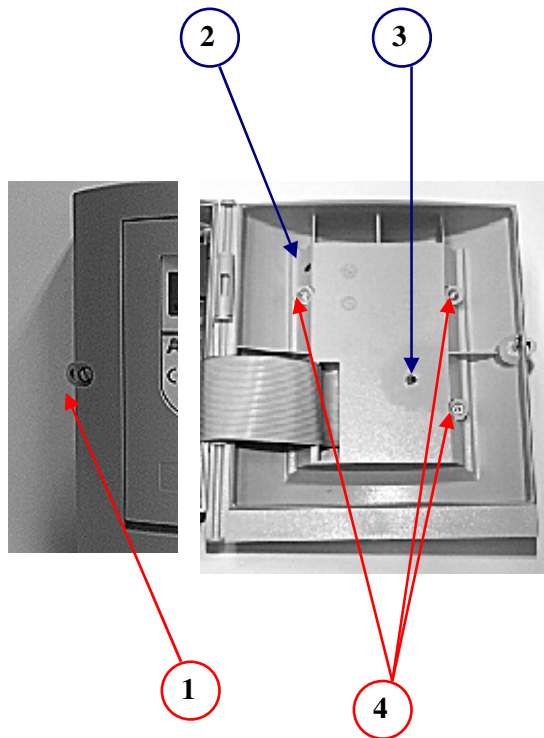


Fig 4.1, Placement of seals F3/F4

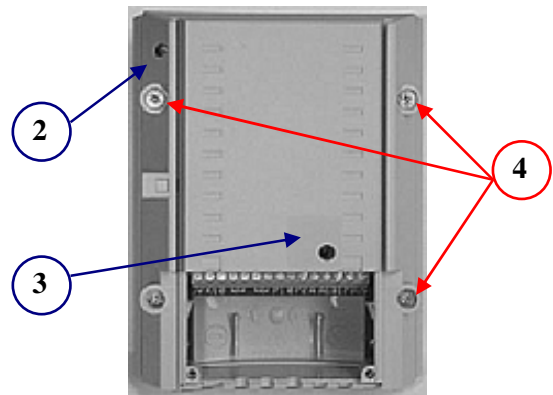


Fig 4.1, F2 Placement of seals

### Seals

1. Installation seal, installation and tampering protection.
2. Service seal, to protect the calculator entering the service mode.
3. Test seal, to protect the calculator entering and program the calculator.
4. Factory seal, the electronics protection

### 4.1 Volume check

The F2/3/4 have an extra volume check, e.g. the calculator has two different accumulated volume registers:

- Volume accumulated from flow sensor (Display sequence 11)
- Volume accumulated from energy calculation, e.g. calculated from increment register. (Display sequence 70)

This function prevents tampering of flow pulses programmed in meter and acts as an extra check. Normally there is a small difference between these two registers.

### 4.2 Neutral seals

With every delivery of the F2/3/4 four neutral seals are included. These neutral seals can be used after installation.



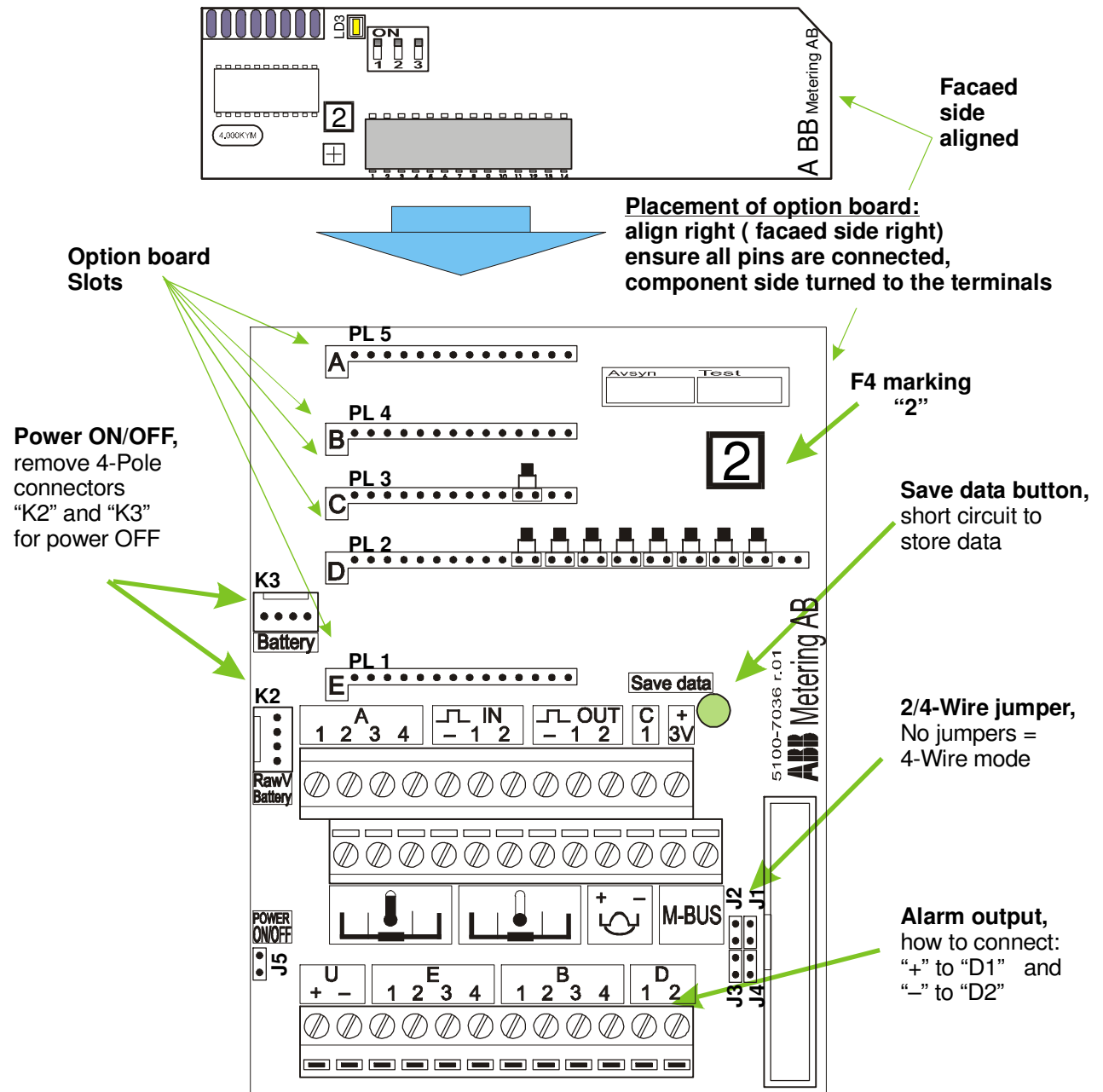
Fig 4.2, Neutral seals can be used after an installation.

# 5 Connecting the calculator / handling

The figure below shows the main circuit board of F4. The “2” indicates main circuit board for F4.

**Note:** Only option boards marked with “2” may be installed in calculator F4.

## 5.1 Circuit board F4



## 5.2 Connection terminals

### 5.2.1 Sensors and M-Bus connection

The connections of temperature sensors are shown in figure 5.2 and table 5.1, numbering in accordance to EN1434.

**Warning;** Do not connect the M-Bus to the wrong terminal or the calculator can be seriously damaged when the power from the M-Bus loop enters through the wrong terminals.

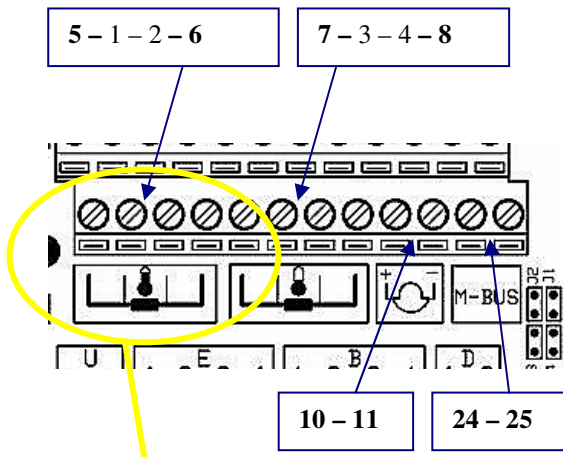


Fig 5.2, Terminal numbering according to EN1434, (numbering from left to right).

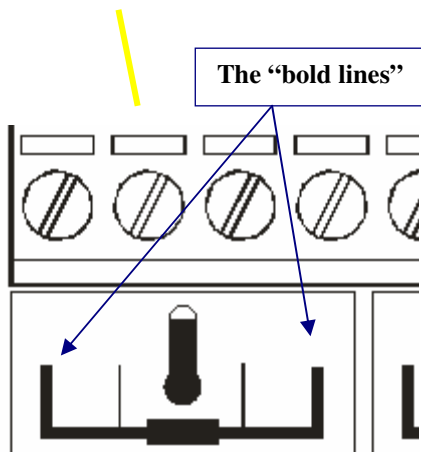


Fig 5.2c, when using the 2-wire method, the wires are to be connected to terminals marked with the "bold lines".

#### 5.2.1.1 EN1434 terminal table

See fig. 5.2 and 5.2b, Potential free output 5.2.8 and Mains 5.5

Terminal no.	Signal description
1	High temp. sensor*
2	High temp. sensor*
3	Low temp. sensor*
4	Low temp. sensor*
5	High temp. sensor
6	High temp. sensor
7	Low temp. sensor
8	Low temp. sensor
10	Flow sensor signal input (+)
11	Flow sensor signal input (-)
16	Pulse 1 output (+)
17	Pulse 1 output (-)
18	Pulse 2 output (+)
19	Pulse 2 output (-)
24	M-Bus interface**
25	M-Bus interface**
26	Earth symbol
27	N (neutral)
28	L (line)

Table 5.1, terminal connection according to EN1434

\* Connected only when 4-Wire method

\*\* Not sensitive to polarity

When the 2-Wire method is to be used connect the terminals 5,6,7 and 8.

## 5.2.2 Pulse input connection

The calculator can accumulate pulses from other meters, such as electricity meters, cold and warm water meters and gas meters. Pulse input shall be connected to the terminal marked IN and the outputs from the other device shall be of the type "Open Collector". The input is of the type "TDL" and can supply a pulse output with 3V – max. 20mA.

**Pulse input 1**, connect

"+" to "IN 1",  
 "-“ to "IN -"

**Pulse input 2**, connect

"+" to "IN 2",  
 "-“ to "IN -"



Fig 5.10, pulse input

### Specification pulse input:

Min pulse duration 250ms, Voltage: 3V. The pulse registers accumulates the pulses, see also pulse counter 1.3.3.

**Note:** The jumpers on slot C and D must be correctly set according to the marking on circuit board otherwise the output will not work.

## 5.2.3 Pulse output connection

Pulse output is generated from terminal marked "OUT". The pulse outputs are of the type "Open Collector". See also table 5.1 and fig 5.2B.

The pulse weight follows the display, which are connected to the pulse output. The display label indicates the unit and number of digits indicates the resolution of the pulse. At each increment of the last digit on the display a pulse will be emitted. Example: Display "MWh" with "3 digits" (15.415 MWh). There will be a pulse at every 0.001 MWh (1 kWh).

**Pulse output 1**, connect

"+" to "OUT 1" and  
 "-“ to "OUT -"

**Pulse output 2**, connect

"+" to "OUT 2" and  
 "-“ to "OUT -"



Fig 5.11, Pulse output

**Specification** of the pulse outputs max.30V, max.20mA and pulse duration 250ms.

**Note:** The jumpers on slot D must be correctly set according to the marking on main circuit board otherwise the output will not work.

## 5.2.4 Connection 3V/12V

The calculator can supply an external device with 3V/12V, with 20mA in total, see fig 5.12. The 12V connection exists only in mains powered calculators

**3V**, connect "+" to "+3V" and "-“ to "IN -"

**12V**, connect "+" to "U +" and "-“ to "IN -"

**Note:** The calculator can supply the current **max.20mA** to other devices.

**Note:** Only mains powered meters may supply an external device.

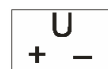


Fig 5.12, Marking of the terminals to be connected

## 5.2.5 Save data

By short short-circuiting the “Save data” button using the plastic “Test key” the calculator will store the measured values to an EEPROM. This is necessary when installing option boards to avoid losing calculator data. See Save data button 2.4.

## 5.2.6 Alarm output connection

The F4 calculator is equipped with one alarm output. The alarm emits one pulse every hour as long as an alarm exists in the calculator. The alarm output can be configured in the Service Program version 2 for F4 and depending on configuration of calculator this function can be disabled.

The alarm output shall be connected to the terminal marked D. The alarm output is of the type “Open collector”.

**Alarm, connect**  
“+” to “D1” and  
“GND” to “D2”

**Specification:** max 30V, max 20mA,  
Pulse duration 250ms.

**Note:** The jumpers on slot D must be correctly set according to the marks on circuit board otherwise the alarm output will not work.

## 5.2.7 Option board connection

The terminals marked A, B, C, D and E are connection for the option boards, please see option board documentation for additional information. See also Circuit board 5.1.

## 5.2.8 Potential free output

With an option board the F3/4 can be equipped with a potential free output (galvanic insulated output), for more information see relay option board documentation.

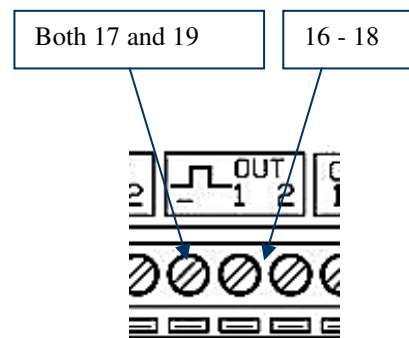


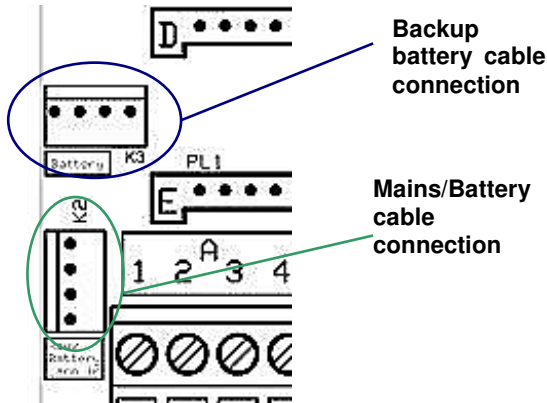
Fig 5.2b, numbering of terminal according to EN1434, (numbering form left to right).  
(Note: “OUT –“ has numbers 17 and 19)

### 5.3 Battery and mains connection

There are two wires connecting the main circuit board to the power supply boards, Battery “K3” and Mains “K2”, for connection, see fig. 5.3

Power off, remove first “K2” connector then “K3” connector.

Power on, connect first “K3” then “K2” connector.



Figs 5.3, Battery/Mains power supply and backup battery connection

### 5.4 Calculator connection

The main circuit board is connected to the calculator via the connection “K1”, see fig 5.4.

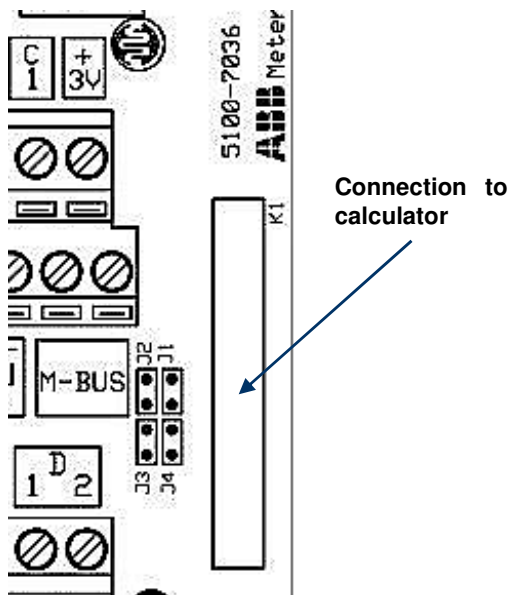


Fig 5.4, Calculator connection

### 5.5 Mains connection and backup battery

The F4 are normally delivered with mains, and backup battery. (Only applies to mains version of F4). The backup battery prevents data loss during mains power failure.

Connection of main supply:  
line to terminal marked “L”  
neutral to terminal marked “N” and  
ground to the terminal marked with “ground symbol”, see also below.

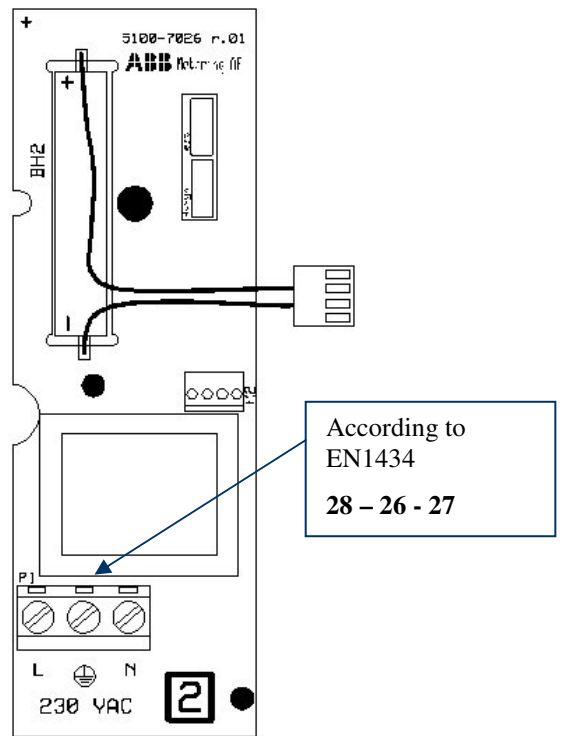


Fig 5.8, connection board mains supply, with backup battery

## 5.6 Option board handling

Extended functions can be added to the F4 calculator by installing option boards.

**Note:** Only calculators with mains power supply may be equipped with option boards. Check option board documentation for exceptions.

**Note:** Only option boards with the mark “2” may be used with the F4. See fig. 5.5.

**Note:** Only one (1) option board may be installed at the same time, in order for the calculator to recognize and install the option board in calculator memory.

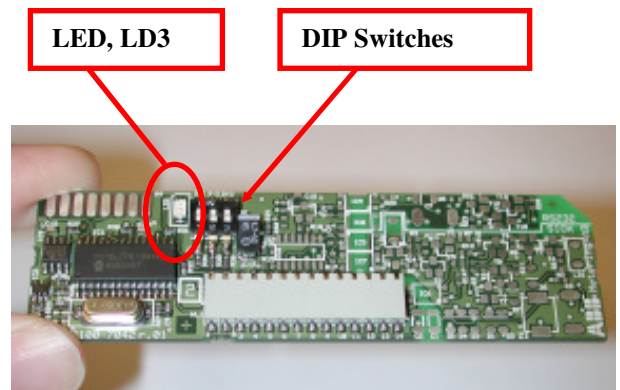
### 5.6.1 Option board installation procedure

Fig 5.9 for picture on option board component side.

1. Check option board for marking “2” and which card slots can be used for the option board and check correct jumper setting on option board, see table 5.5 DIP-Switch settings 5.6.2.
2. Save data, using “test key” to short circuit the “Save data” button.
3. Disconnect the flow sensor by removal of one flow sensor cable connected to the terminals.
4. Cut power to main circuit board by removing 4-pole connectors first “K2“ (mains) and then “K3” (backup) connectors.
5. Remove jumpers on the slot (only when required). When uncertain check with option board documentation.
6. Check dipswitch settings on option board.
7. Insert the option board into the calculator carefully (**Note:** only one option board at the time). The component side shall be turned to the terminals of the calculator. Align the option board (faced side) to the right inside the connection box. Do not bend any terminal pins and ensure that all pins are connected to the terminals.

**2**

*Fig 5.5, Only option boards mark with the “2” may be installed in the F4 calculator.*



*Fig. 5.9, Option board, Component side*

8. Turn power ON, by connecting 4-pole connectors first “K3” and then “K2”.
9. Check installation LED “LD3” blinks and then turns off, this indicates proper installation of option board into calculators memory.
10. Connect flow sensor.

Follow the steps 3-9 for installation of additional option boards. Note; only one (1) option board may be installed at the time.

**Note:** The option board may only be installed in assigned slots, please consult option board documentation for information.

**Note:** Option board affects battery life expectancy please check with option board documentation or ELSTER when using a calculator only powered by batteries.

#### 5.6.1.1 Installing several option boards at the same time

Only one option board may be installed in the calculator F4 at the same time otherwise the installation will fail.

To install several “option boards” at the same time, see also 5.6:

1. Install the first option board and follow 5.6.1 the steps 1-9 there.
2. For additional option boards repeat steps 3-9.
3. Finish by connecting the flow sensor (step 10)

## 5.6.2 DIP-Switch setting of option board

Slot	BY 1	BY 2	BY 3
A	On		
B		On	
C	On	On	
D			On
E	On		On
F			
Service	(On)	On	On

Table 5.5, DIP-Switch setting of option board for card slots, On – “ON”, “ – “OFF”, (On) – insignificant

Not all option boards can be combined and most of the option boards must be installed in certain slots. For further information check option board documentation for information.

## 5.6.3 Installing additional option boards when one or several option boards is/are installed

Only one option board may be installed at the same time. To install a option board into a calculator that already have option board(s) installed follow “Option board installation process” 5.6.1 the steps 1–9, and repeat the steps 3-9 for additional boards. End the installation with step 10.

**Note:** Ensure that the LED “LD3” is turned off in powered calculator before installing next option board.

## 5.6.4 Configure the option board

The option boards can be configured with F4-adaptkit (FT-4-adapt-kk). Prior to placing the option board inside the calculator, see also documentation, service adapter and option board documentation.

**Note:** When configuring already installed option board in the calculator all option boards installed in the calculator must be removed. The calculator must be “uninstalled” with uninstall option board. Then the option boards can be reinstalled in the calculator.

## 5.6.5 Reconfigure option boards

Always when option boards are reconfigured, the option boards must be uninstalled. Follow the procedure “uninstall, removal...” 5.6.6. The option board may not be reconfigured when installed in the calculator.

**Note:** Always “uninstall” the option board and then install the option boards again after reconfiguration.

## 5.6.6 Uninstall, removal of option boards or reconfiguring option boards

To uninstall, reconfigure one or several option boards, all option boards in calculator must be removed and the “uninstall procedure” executed by the “uninstall option board”. When the calculator is reprogrammed all option board must be “uninstalled”. Following procedure to uninstall option boards from calculator memory:

1. Save data, avoid losing any data, short circuit the “save data button” using the “Test key”.
2. Remove the flow sensor connected to the terminal. Remove one wire connecting the flow sensor to the terminal.
3. Cut the power to the main circuit board by removing the 4-pole connectors, first “K2” and then “K3”.
4. Remove all option boards placed inside calculator.
5. Place the “Uninstall option board” in “**slot A**” carefully do not bend any terminal pins. Ensure that the component side of the option board is turned against the terminals of the F4 align the right side (faced side) of the option board inside the calculator. Check that all pins are connected to option board terminal.
6. Turn power ON by connecting 4-pole connector “K3” (backup).
7. Check that “LD3” diode blinks (very fast) and then lit steadily. The “uninstall procedure” has been executed and calculator memory has been cleared from option board information.
8. Power off remove 4-pole connector “K3”.
9. Remove the uninstall board from calculator.
10. The install “old” or “new” option boards, see 5.6.1 “option board installation procedure”.

### 5.7 Cable fittings

The F3/4 are equipped with cable glands see fig. 5.6, below.

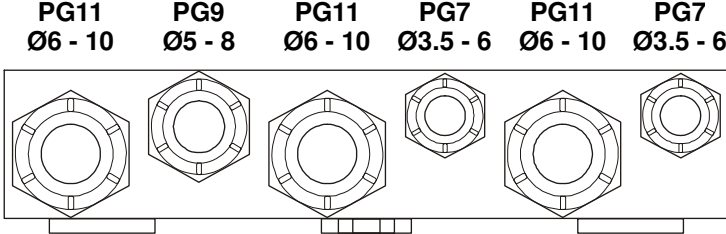


Fig 5.6, Cable fittings F3/4

### 5.8 Mounting

The F3/4 is constructed for wall mounting, see below fig 5.7. The plastic plugs must be placed after mounting.

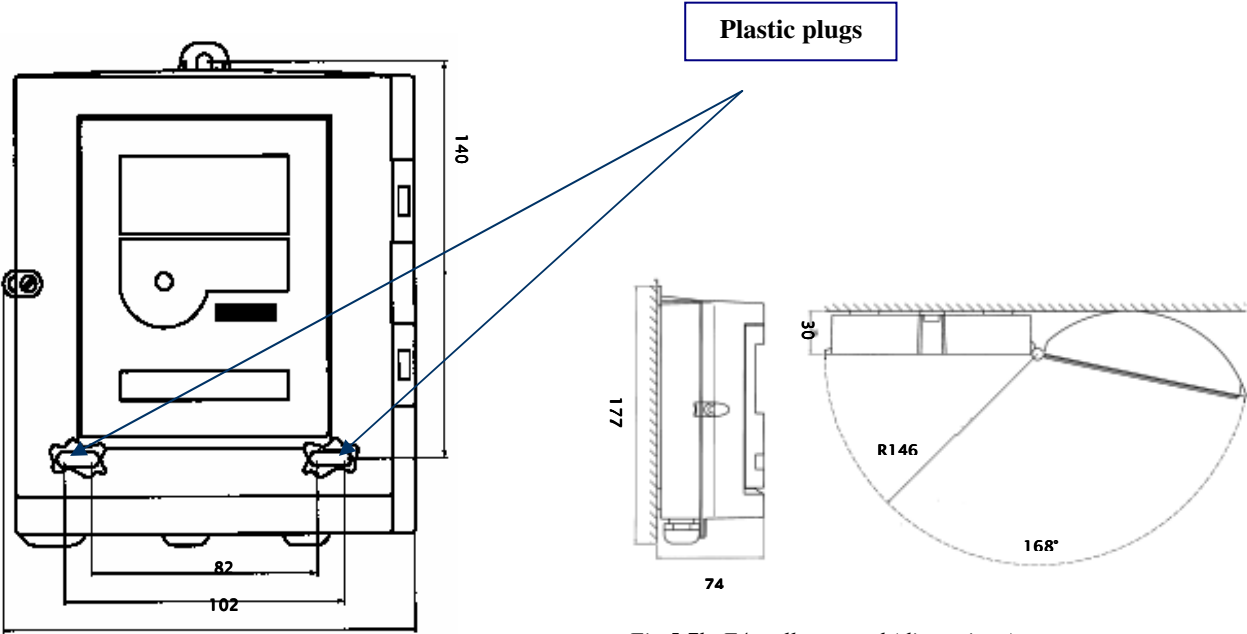


Fig 5.7, F4 front view (dimensions)

Fig 5.7b, F4 wall mounted (dimensions)

## 5.9 Zero sequence current

When connecting the calculator to input or outputs one need to be aware of the possibility of “Zero sequence current” can cause problems in the input/output systems, such as no signals, error readings, parity errors and in worst case damaged circuits in the system.

### 5.9.1 Description of zero sequence current

The phenomena are common in electrical circuits that are not galvanic separated and devices are connected to ground. The two different grounds have a often a small potential difference and a current will appear between the two grounds, the current uses the non galvanic separated I/O and the wires to travel through the calculator causing problems. The zero sequence current in these systems can be considerable.

In fig 5.20 and fig 5.21 to illuminate the problem we use the flow sensor as a grounded object 1 and the calculators M-Bus as grounded object 2. Of course the problem can exist between pulse input, pulse output, alarm input or input/output through option board that are not galvanic separated (e.g. analogue input board).

**Note:** The majority of the flow sensors are galvanic separated. Please contact your agent for further information.

U2500 is an example on a flow sensor that is not galvanic separated.

#### Solution:

1. Avoid connecting to two “grounds” to calculator.
2. Galvanic-isolate the circuits, in F4 using option boards.

#### Products:

- FCRC-41C1 Option board to galvanic separate pulse inputs, outputs and alarm outputs. Placed on “slot A” in F4.
- FCR2-41B Option board to galvanic separate the M-Bus loop. Placed on “slot B” in F4 calculator.

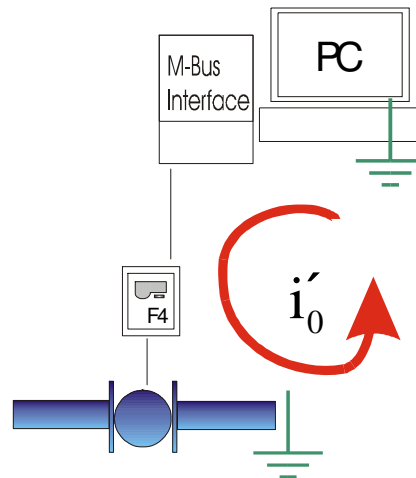


Fig 5.20, Zero sequence current between the M-Bus loop connected to ground through the PC and the grounded flow sensor. The current  $i'_0$  run through the system and causes disturbance.

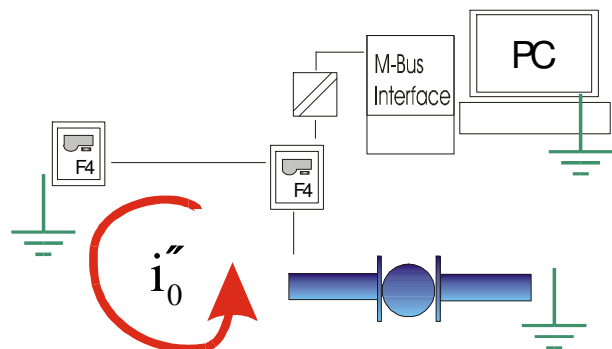


Fig 5.21, Example the M-Bus interface is galvanic separates the PC and the M-Bus loop. The zero sequence current appears between the M-Bus loop connected to ground through the grounded flow sensor and another grounded calculator in the loop. The current  $i''_0$  runs through the system and causes disturbance.

## 6 Calculation

F4 calculator is in accordance with EN1434:1997, part 1 and 2, measuring and calculating energy.

The calculator fulfils the requirements for environmental class C, in accordance with EN1434:1997 part 4

The calculator saves energy in order for the battery life length to be as long as possible. This is why the calculator measures and calculates in a specific order.

### 6.1 Calculation of flow

At each sensor pulse\* the calculator checks the time counter against the calculators set "average power and flow", then the calculator updates it's record. If the time counter, with the resolution 1/128s, is shorter than the average time\*\* the number of pulses will be stored for next calculation

The calculation depends on the timing between the pulses following cases:

- <5s calculation of the of the sum of the pulses received in 5s.
- >5s calculation at every pulse
- <60s calculation even if no pulse are received.

The flow calculation can also be initialized by M-Bus, OPTO-interface or "Save data" request

\* Only when the flow pulses are emitted with lower frequency than every 5 seconds.

\*\* Default average time set to 5 seconds. Using "Service program" version 2.0 or higher this time can be altered.

#### 6.1.1 Momentary flow

The momentary flow is calculated at the end of an averaging period of 4 seconds, normally set in the calculator. The flow pulses registered at the period are used to calculate the momentary flow. The averaging period for momentary flow can be changed using the "Service program" version 2.0 or higher.

The flow calculation is based on how many pulses are received during the averaging period 4s and flow of the previous periods. There are two cases with following simplified formula applicable:

1. Normal condition 
$$F = k \cdot \frac{N}{t}$$

2. Shut off 
$$F_- = k \cdot \frac{N_0}{t_0 + t_-}$$

F	Flow
k	constant, varies depending on pulse setting (e.g. x [l/p]), decimal setting and energy units in calculator.
N	number of pulses during the averaging period
t	Time during pulses has been collected
t <sub>0</sub>	time during when the pulses have been accumulated
t <sub>-</sub>	time since the last pulse has been accumulated

When the calculator receives only a few pulses in each averaging period the momentary flow in the display will vary with each period.

## 6.2 Calculation of power

The calculated flow, see above is used by the meter to calculate the power and this value is added to the previously stored power values. The power is calculated at each flow pulse or at the maximum time for measurement (normally 60s is set in calculator).

## 6.3 Temperature measurement and 4-wire measurement

The measuring of the temperature sensors is done at each flow pulse or at the maximum time for measurement (normally 60s is set in calculator).

If 4-wire connection is used, the calculator measures both the cable resistance and the temperature sensor resistance. The calculator corrects the temperature measurement with the consideration of the cable resistance.

**Note:** This is only done if 4-wire connection is set and used in calculator

## 6.4 Storing values

The calculator stores the measured values at each dayshift (at 00:00 each day) or when “Save data” button is short circuit. See also 1.3.7 Power cut.

**Power off** at error or when disconnecting the “K2” and “K3” 4-pole connectors in calculator. Depending on circumstances there will be two cases:

1. The calculator will lose values and reset the time back for maximum 60 seconds, normally in “very short power off” (less than 1min.).
2. The calculator will lose all measured values in the temporary memory. When power is back on to meter the meter will read the EEPROM values stored at day change and reset the internal clock to “00:00”

The “very short power off” can vary depending on ambient temperature, connected input/output from 0 to several minutes.

## 7 Testing, programming & service

To ensure the functions in the F3/F4 test can be performed.

### 7.1 Programming the calculator

The calculator parameters can be configured by entering the calculator “Service mode” or “INIT mode”, see Service 7.4.

The calculator can also be set into “test mode”, see 3.3.4, in “test mode” even more calculator parameters can be configured. The “service program” 2.0 or higher can be used to program the calculator. When the calculator is “reprogrammed” all the stored calculator data (measured and calculated) will be erased from the calculator. Avoid losing any data by making a read and record the calculator data before “reprogramming” a calculator.

**Warning;** only “service program” version 2.0 or higher may be used to program the calculator otherwise the calculator may be permanently damaged. Only to be used by trained professionals.

**Note:** All option boards installed in the calculator must be reinstalled, see 5.6 Option board handling for more information. Depending on how much is changed the option boards must be reconfigured as well.

### 7.2 Display test

By selecting display sequence “12” the LCD display can be tested.

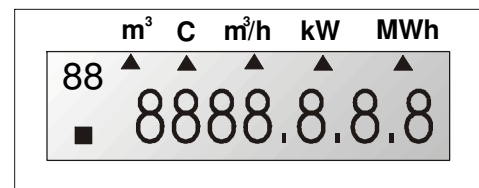


Fig. 3.2, Display test

### 7.3 Installation test

When installing the calculator it is necessary to verify calculator functions and the installation. Recommended procedure:

1. Wait for a flow sensor pulse, check for “sensor “indicator square” on calculator display, see also displays 3. Once the pulse is emitted check the temperature values display sequence “22” and “23” are correct.
2. Check that the real time clock is working properly and time is set correctly.

## 7.4 Service

When calculator is in for service there can be a necessity to change the calculator configuration. These parameters can be changed in the “Service mode”, see below for detailed information. The “Service program” version 2.0 can be used to change even more parameters in the calculator. Recommended procedure to enter “service mode”:

1. Brake the seals, set calculator in “Service mode”, see also “Service mode” 3.3.3.
2. Make the changes, see below for explanation and see also service mode display sequence 3.3.3.1.
3. Exit service mode when changes are done, the same procedure as when entering the “service mode”.
4. Replace the broken seals.

Sequence service mode, see also table 3.1, 3.3.3.1

### 7.4.0 Time

In the display sequence, ”00” the time can be changed with the time format “HHMM”\*.

#### 7.4.1 Date

The date can be changed in the display sequence, ”01”, the format is “YYMMDD”\*.

#### 7.4.2 Pulse value

The weight of pulse values can be changed in display sequence,

- ”02”, pulse value and
- “03”, decimal setting for pulse value.

The pulse value is always displayed with four (4) digits, in service sequence, value number “02”. The decimal setting in service sequence, value number “03”.

**Example:** “02” displays 2500 and “03” displays 3.  
Pulse value: 2.5 l/p

#### 7.4.4 Account days

To change the two account days, (two extra monthly registers) this can be done in the display sequence:

- ”04”, Account day 1
- “05”, Account day 2.

The format is ”MMDD”\*. If the account days is set to ”0000”, the calculator will not store any values in account days.

### 7.4.6 Communication address (primary address)

The primary communication address can be changed in display sequence “06”. The communication address can be set with three (3) digits, with the value 0-250.

**Example,** address 5 on display: 0005

### 7.4.7 Resetting stored error time

To reset the stored error time set calculator to display sequence “07” and by changing the value to “0” the calculator will reset the error time.

**Note:** Set value to “1” if the error time shall remain the same.

### 7.4.8 Placement of flow sensor placing

In display sequence “08” the flow sensor placement can be changed with the following format 1 or 0 where;

- 0 = Flow sensor installed in low (return, cold) pipe
- 1 = Flow sensor installed in high (forward, hot) pipe

### 7.4.9 Recommended date for battery replacement

In display sequence ”09” battery replacement date can be altered, format “YYMMDD”\*

#### 7.4.A Return to normal mode

In display sequence ”0A” the user can exit the “service mode” and return to normal mode (operating mode) without using the “service button”. Setting the value to

- “1” = exit “service mode”
- “0” = next service mode sequence

#### 7.4.10 Clarifications on format

- \* YY = Years with two digits
- MM = Months with two digits
- DD = Days with two digits
- HH = Hours with two digits
- MM = Minutes with two digits

**Example:** Account days, format “MMDD”,  
Display shows, “1201”.  
December (12) the first (01).

## 7.5 Verifying the calculator

Verification of the calculator's measurement accuracy is undertaken in the test mode, where the energy value/flow sensor pulse is issued via the HF-output at the service adapter. For each flow sensor pulse, measurement takes place on the temperature sensors and a pulse burst corresponding to the measured energy of the meter is issued.

To test (verify) the measurement accuracy of the calculator by means help of HF-pulses proceed as follows:

1. While short circuiting the test button with "Test key", see fig. 2.2, hold the "Push button", until the display mode changes.
2. The calculator now enters test mode. This is indicated by a special symbol being displayed.
3. Connect fixed resistance for simulation of Pt100 via terminal block units Nos. 5-6 (flow) and 7-8 (return).
4. Connect a pulse generator via terminal block unit Nos. 10-11 (connection 11 is ground) in order to simulate flow sensor pulses. Note: Voltage level is max. 3V.
5. Connect an OPTO-head/interface with HF-pulse interface at the front.
6. Simulate a flow sensor pulse after which the meter issues an (approximately) 20 kHz pulse burst corresponding to  $100 \cdot k \cdot dt$  pulses via the HF-output. "k" is the energy factor. (kWh/°C/m<sup>3</sup>) and dt is the difference between simulated flow and return temperatures.  
**Example:**  $R_f=138.50\Omega$  (100.00°C),  $R_r=127.07\Omega$  (70.00°C) =>  $dt=30.00^\circ\text{C}$ ,  $k=1.141$  gives  $100 \cdot 1.141 \cdot 30 = 3423$  pulses.
7. The next flow sensor pulse can be sent immediately after the HF-pulse burst from the meter has been dispatched.

To leave test mode proceed as follows:

1. While the short circuit the test button hold the "Display Button", see fig.2.2.
2. The calculator now enters *operation mode*.

To verify (test) the measurement accuracy of the meter with the help of the display, first set up connections in accordance with points 3 and 4 above for testing by means of HF-pulses. Testing is undertaken in the meter's operation mode. Proceed as follows:

1. Supply flow sensor pulses until the energy display is incremented one step.
2. Supply flow sensor pulses with a maximum frequency of 12 Hz until the display has been stepped appropriate numbers of steps.
3. Errors in testing decrease with the number of steps made during the test. If the meter is programmed for 1.0 liter/pulse and resolution for display of energy is 0.001MWh, this means that 10 steps on the display correspond to 288.85 pulses from the flow sensor with selected temperatures in accordance with the above. The testing error is maximum + - 1 pulse, which, in the example, corresponds to 0.35%.

## 8 Technical data

### 8.1 Data output table

The following data are accessible via the data output:

Data	M-Bus		SIOX	
	acc. EN 60870-5	Manu- factures Specific	820	Ext- ended
Flow sensor placing	X		X	X
Program version	X		X <sup>5</sup>	X
Manufacturer	X			
Communication address	X		X	X
Meter number	X			X
Error code (limited)	X		X	X
Accumulated energy	X		X	X
Accumulated, volume 1 <sup>1</sup>	X		X	X
Accumulated, volume 2 <sup>2</sup>	X			X
Flow temperature (high)	X		X	X
Return temperature (low)	X		X	X
Temperature difference	X		X	X
"Operation time" (operation time, error time)	X			X
Momentary flow	X		X	X
Momentary power	X		X	X
Time and date	X			X
Pulse register for pulse input 1	X			X <sup>7</sup>
Pulse register for pulse input 2	X			X <sup>7</sup>
Monthly values <sup>3</sup> data storage	X			X
Monthly values <sup>3</sup> accumulated energy	X			X
Monthly values <sup>3</sup> accumulated volume 1 <sup>1</sup>	X			X
Monthly values <sup>3</sup> accumulated volume 2 <sup>2</sup>	X			X
Account days, same as monthly values, see above	X			X
High resolution energy		X	X	X
High resolution volume 1 <sup>1</sup>		X	X	X
High resolution volume 2 <sup>2</sup>		X		X
Relevant error code		X		X
Accumulated time for relevant error		X		X
Previous error code		X	X <sup>6</sup>	X <sup>6</sup>
Previous accumulated time for relevant error		X		
Manufacturing number		X		
Pulse value		X		
Latest read energy via communication		X		
Time [h] since latest reading		X		
Recommended date for battery replacement				X
Error codes and accumulated error times during storage (see monthly registers and account days above)				X

Table 8.1, Data output

1. As per flow sensor.
2. Corresponding to energy registers.
3. 37 registers.
4. -
5. For being compatible towards existing system, the version number is fictitiously set to four.
6. Total error time.
7. The option board can be configured to display pulse value units.

## 8.2 Power supply

Battery	3.6V - 2.750Ah or 3.6V - 2x 2.750Ah Operation time max. 10 years
Mains	230V±10%, 45-65Hz, battery 2.750 Ah as a spare

Table 8.2, Power supply

Voltage drop, if voltage drop occurs during operation the meter goes to working on it's a spare battery.

## 8.3 Temperature sensors

Approved and matching pares type PT100 or PT500 are to be used.

Maximum sensor current (RMS): 4µA for PT100

Cable area [mm <sup>2</sup> ]	Maximum cable length for PT100 sensors [m]
0.22	2.5
0.50	5.0
0.75	7.5
1.50	15.0

Table 8.3, Cable areas for PT100

## 8.4 Flow sensors

Flow sensors with pulse output.

Frequency Max. [Hz]	12 Hz
Pulse Value [l/p]	0.0001-9999
Pulse Length Min. [ms]	40
Voltage Max. [V]	3
Cable length Max. [m]	15

Table 8.4, Flow sensor specifics

## 8.5 Temperature ranges

Temperature range	0 - 190°C
Temperature difference	2 - 120K

Table 8.5, Temperature ranges

## 8.6 Ambient temperature & Temperature class

F2/3/4 comply with the prerequisites for Environmental Class C according to EN1434.

Ambient temperature Storage/Transport	-20°C to +70°C
Ambient temperature Operation	+5°C to +55°C

Table 8.6, Ambient temperature ranges.

## 8.7 Flow sensor placing

F2/3/4 can be configured for flow sensor placed in hot or cold pipe (supply or return pipe). This is marked H = hot or L = Low in the display.

## 8.8 Maximum values for power

The values below are valid for energy unit [MWh] and standard decimal setting.

Pulse values [l/p]	Maximum power [ MW ]
1.0	3.3
10.0	33.0
100.0	330.0
2.5	3.3
25.0	33.0
250.0	330.0

Table 8.8, max. power pulse values

## 8.9 Dynamic behaviour

Measurements are undertaken for each flow sensor pulse, provided the time between the pulses is five (5) seconds or longer. If the time between pulses is less than five seconds, measurement takes place each five seconds. When the period between the flow sensor pulses exceeds 60 seconds, a measurement takes place every 60th second. For this measurement only the temperature is updated.

## 8.10 Data output interfaces

M-Bus acc. to EN1434-3	OPTO-interface (EN60870-5) and bus connection (terminal)
SIOX	Option Board, bus connection (terminal)
LonWorks	External interface

Table 8.10, Data output interfaces

## 8.11 Pulse outputs

F3/4 are equipped with two pulse outputs as standard of the type "Open collector" for energy (Pulse output 1) and volume (Pulse output 2). The pulse outputs can be galvanic separated from the calculator by installing an option board, "FCRC-41D1".

**Pulse output 1**, energy, one (1) pulse per display update in the energy register (seq. "10").

**Pulse output 2**, flow, one (1) pulse per display update in the flow register (seq. "11").

Pulse duration	[ms]	250
Voltage	[V]	3 - 30
Max. current	[mA]	20

Table 8.11, Pulse output data

## 8.12 Pulse inputs

F3/4 are equipped with two pulse inputs as standard. The pulse inputs can be used for measuring of other meter with pulse outputs, such as cold- and hot water meters, gas, electricity meters and other meters.

The pulse inputs are constructed as volume registers. These registers accumulate the pulses into two volume registers with the value [m<sup>3</sup>].

Frequency	[Hz]	12
Min. Pulse duration	[ms]	40
Max. Voltage	[V]	3

Table 8.12, Pulse input data

## 8.13 Alarm output

The F4 is equipped with one alarm output as standard of the type "Open collector". The alarm output sends a pulse every hour as long as an error code exists. The pulse duration 250ms for pulse and alarm output can be altered using the "Service program" version 2 or higher in 125ms steps.

Alarm frequency when an error exists	Once every hour
Pulse length [ms]	250

# Appendix

## A1 Decimal setting for F2/3/4

Pulse value [l/p]	MWh	GJ	m <sup>3</sup>	KWh	MBTU	kW	m <sup>3</sup> /h
1.0	0.001	0.001	0.001	0.1	0.001	0.01	0.001
10	0.01	0.01	0.01	1	0.01	0.1	0.01
100	0.1	0.1	0.1	-	0.1	1	0.1
1000	1	1	1	-	1	1	1
2.5	0.001	0.01	0.01	0.1	0.01	0.01	0.001
25	0.01	0.1	0.1	1	0.1	0.1	0.01
250	0.1	1	1	-	1	1	0.1
2500	1	1	1	-	1	1	1

Table A1, The options marked “-“ should not be used. For the pulse inputs the decimal setting follow the same table setting as for the volume register [m<sup>3</sup>].

## Decimal settings for F2/3/4 pulse inputs

Pulse value [l/p]	m <sup>3</sup>
1.0	0.001
10	0.01
100	0.1
1000	1
2.5	0.01
25	0.1
250	1
2500	1

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