kajaani

kajaaniMCAi™

Installation, operating & service manual
W4610201 V2.5 EN
- for software version 2.5–>

metso
automation

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Caution / Warning

During installation, maintenance and service operations, remember that the sample line may contain hot sample or water – be careful!

Always check that the incoming voltage & frequency are correct before making any electric connections. Wrong connection may damage the equipment!
The applicable electrical safety regulations must be closely followed in all installation work!

Before any welding works in the vicinity of the devices, make sure that operating voltage is not connected!

1. Introduction

1.A. The kajaaniMCA*i* Consistency Analyzer

The kajaaniMCA*i* is an in-line consistency analyzer based on microwave technology. The kajaaniMCA*i* measures pulp consistency based on the propagation velocity of microwaves. Due to this measurement principle, the analyzer can be used on a very large conductivity and temperature range. In addition, the measurement is independent of pulp type and flow rate.

The kajaaniMCA*i* is available in two different sensor types: MCA*i* -F & MCAi-FS (Fork type), and MCA*i* -FT (Flow Through type). The sensor is always delivered with a Display Unit which can be used to perform the most important operations (e.g. sampling). The portable Communicator terminal, with additional functions, is available as option.

Fig. 1.1. Construction of the kajaaniMCAi-FT.

1.B. Measurement Principle

Microwaves are a form of electromagnetic radiation. Their propagation velocity is dependent on the medium in which they travel. The propagation velocity is calculated using the following formula:

$$\boxed{v = c / e_r}$$

where c = velocity of light in vacuum;
ε_r = dielectric constant of the medium.

Microwaves travel considerably more slowly in water than in wood fibers. Thus the quantity of wood fibers – i.e. consistency – can be determined by measuring the propagation time of microwaves through the pulp stock. Kajaani MCA*i* measures the propagation time of microwaves between the transmitter antenna and the receiver antenna. This measurement method has several advantages: it is independent of pulp type and pulp flow rate, and only requires single-point calibration.

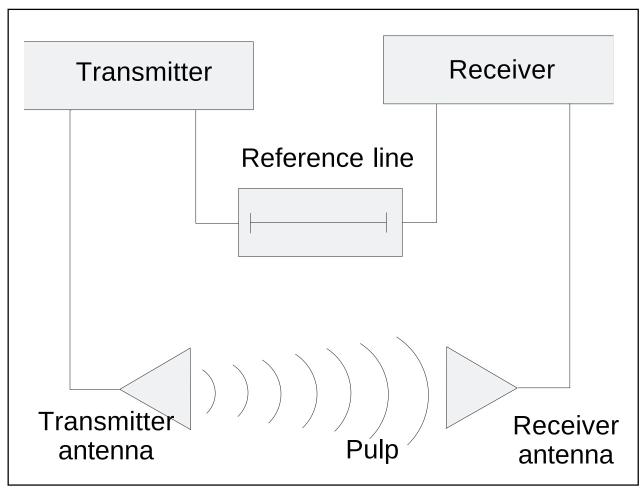


Fig. 1.2. Measurement principle of the kajaaniMCAi.

2. Construction

The kajaaniMCA*i* consists of the sensor unit and Display Unit. Two sensor types are available: the flow-through MCA*i* -FT and the fork-type MCA*i* -F. The sensor type to be used is chosen according to the diameter of the process pipe.

2.A. MCA*i* -F & MCA*i* -FS

In the MCA*i*-F and MCA*i*-FS sensors, the probe-type antennas are installed on a fork-shaped sensor body that is inserted into the process pipeline. In the MCA*i*-FS the antennas are closer to each other than in the MCA*i*-F model. Otherwise the sensors are identical.

Measurement data is transmitted between the signal antennas and sensor electronics through antenna cables installed inside the sensor body. A Pt-100 sensor is also installed inside the sensor body to measure temperature in the process.

Standard material for the sensor body is AISI 316L; Titanium or Hastelloy are available as options. The antennas are made of glazed ceramic and titanium.

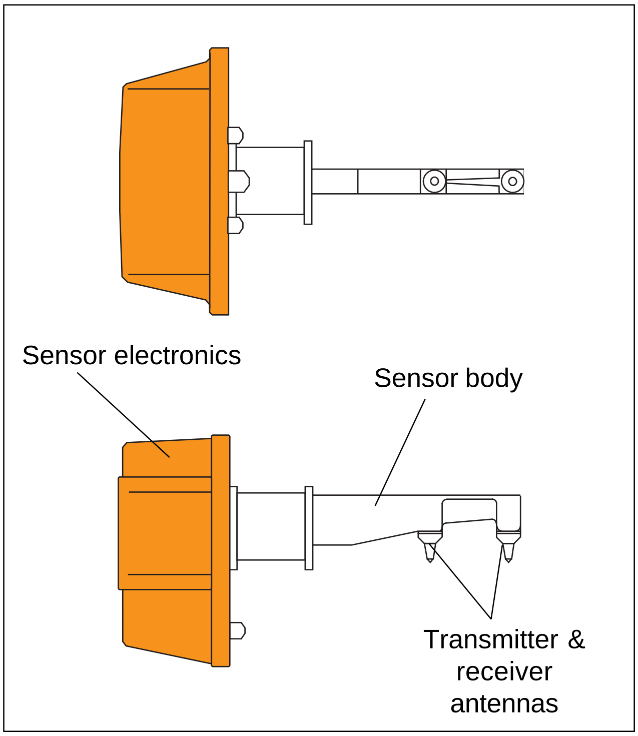


Fig. 2.1. MCAi-F sensor.

2.B. MCA*i* -FT

The body of the flow-through sensor consists of a pipe section which, when installed, forms part of the process pipeline. Models FT 150 and 200 are without flanges, while models FT 100, 250 and 300 are provided with fixed flanges. The transmitter and receiver antennas are installed on the opposite sides of the pipe, so that the measurement takes place across the pulp flowing through the pipe.

The Pt-100 temperature sensor is installed in a coupling (diam. 1cm) which is inserted about 2cm into the pipe, at an angle with regard to the direction of the flow.

Standard material for the sensor body is AISI 316L. The antennas are made of glazed ceramic and titanium.

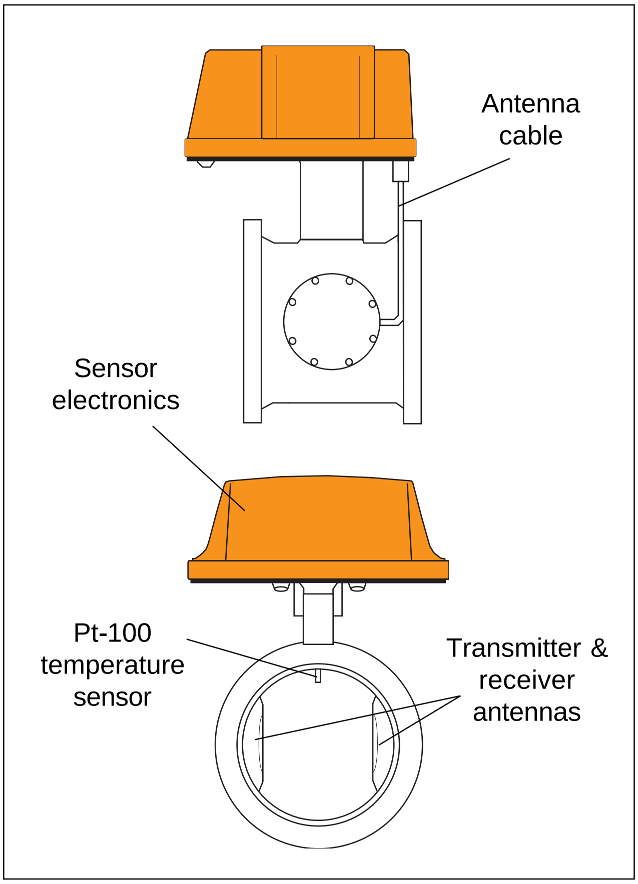


Fig. 2.2. MCAi-FT sensor.

2.C. Sensor Electronics

Both sensor types use similar sensor electronics, with three units mounted on top of each other: the Microwave Module, Main Board, and Processor Board. In addition, a MIMO Control Board is mounted on top of the Microwave Module and forms part of it. These units are enclosed in a metal housing to eliminate electric interference (EMC-shielding).

Electric connections are made on the Field Connection Board as shown in Fig. 3.7, and also the Pt-100 sensor is connected to this board. Reset and Abort buttons are located on one side of the Field Connection Board; these buttons are needed to reset and clear the sensor's memories. Terminals for the Microwave Module's transmitter and receiver are located on the other side of the board. The microwave cables to the antennas are connected to these terminals.

2.C.1. Reset-Abort procedure

NOTE: This will erase all stored configurations from the memory and initialize the device with system defaults!

1. Press the RESET switch and keep it down.
2. Also press the ABORT switch, and keep both switches down for about 3 seconds.
3. Release the RESET switch.
4. Release the ABORT switch.

Reset-Abort is now complete, and the sensor's memory has been initialized with program defaults.

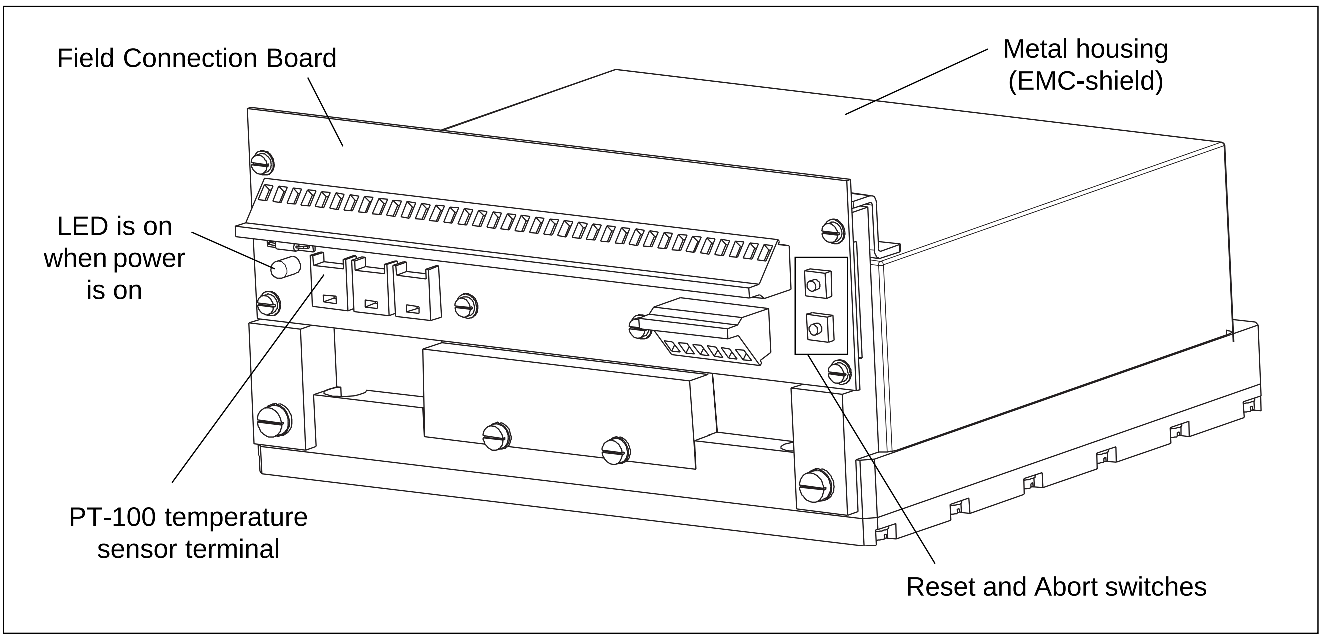


Fig. 2.3. Sensor's Electronics Unit.

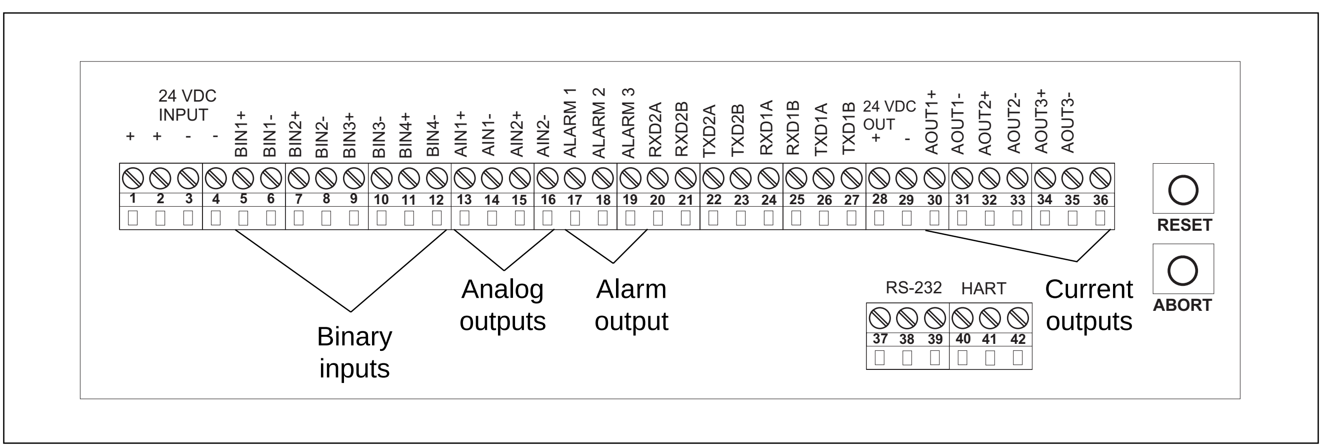


Fig. 2.4. Field Connection Board.

2.D. MCA*i* Display Unit + Shield

The MCA*i* Display Unit is used as a fixed display, alongside a Communicator-i or HART communicator. The required information is selected on the 8-digit display using four function keys for operation. One function key is also used for taking samples.

The MCA*i* Display Unit uses mains voltage (90... 260 VAC) connected to its terminal (Fig. 2.6). A transformer inside the Display Unit transforms the supply voltage to 24VDC (18–36VDC) operating voltage for the sensor's electronics. The Display Unit has connectors for the Communicator-i and HART® communicator, a Cs current output, and an RS-232 connection for a PC. The RS-232 bus can be used for updating the MCAi software version and for reading data from the MCAi to a PC. These terminals are shown in Fig. 2.6.

NOTE: Signal connections are illustrated in Fig. 3.7!

Fig. 2.5. Display Unit + shield.

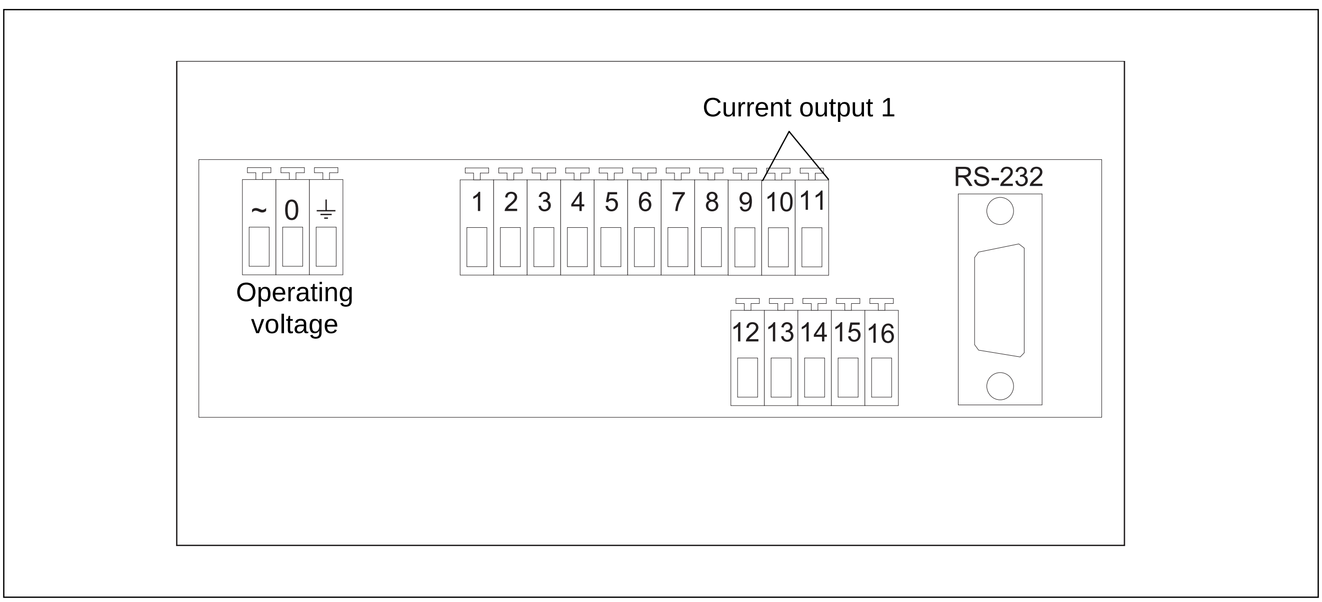


Fig. 2.6. Terminals of Display Unit.

3. Installation

NOTE: Before installing the process coupling / sensor, make sure that the process pipeline is not pressurized and installation will be safe!

3.A. General Principles

The sensor type is selected according to the diameter of the process pipeline at the installation point.

The flow-through models are FT 100/4", FT 150/6", FT 200/8", FT 250/10" and FT 300/12". The fork-type sensors MCA*i*-F and MCA*i*-FS can be installed to pipelines with a diameter of 250 mm / 10" or larger.

When choosing the installation point, pay attention to the following:

- The MCA*i*-F or MCA*i*-FS should not be installed in locations where the pulp may contain pieces of string or other such objects that may get entangled around the sensor body.
- Never install the sensor on the suction side of a pump, or to a tower.
- There should be a long enough straight, free pipe section before and after any changes in the pipe profile: 4 times pipe diameter before the sensor, and 2 times pipe diameter after the sensor.
- No other devices must be inserted into the process pipe in the installation point of an MCA*i* -F or MCA*i*-FS sensor, nor 1m before it.
- Choose the installation point so that the sensor can be inserted into the process coupling without damaging the antennas (Fig. 3.1) – about 60cm (2 ft) of free space is needed for installation!
- Also make sure that the Display Unit can be installed – the length of the sensor cable is 10m (33 ft).
- Do not install the sensor too far from a pump – max. distance between pump and sensor is 12 m (39 ft).

Also pay attention to the following specifications:

- process temperature 0–100°C (32–212°F);
- conductivity in accordance with the sensor specifications (see App. 1 of this manual);
- process pressure at least 1.5 bar (21.8 psi) to eliminate air bubbles;
- pressure resistance of the sensor: MCA*i* FT 16 bar (232 psi), MCA*i* F 25 bar (363 psi).

The measured consistency is usually compared to laboratory analyses. It is therefore important to use a good sampler (e.g. NOVE) and install it in accordance with the MCA*i* installation instructions.

NOTE: The MCAi-F /-FS sensors cannot be used for measuring unscreened pulps!

3.B. MCA*i* -F /-FS

The fork-type sensors MCA*i* -F and MCA*i*-FS are installed to the process through a process coupling welded to the pipeline. The sensor antennas must be directed against the pulp flow (Fig. 3.1). A sticker label on the sensor indicates the direction of flow. The process coupling must be installed in a horizontal position, to prevent dried pulp or any foreign objects in the process from accumulating there. This also prevents the accumulation of air. The position of the process coupling can be checked from the two notches on it: when installed, the notches must be parallel to the pipe direction, the smaller notch against the flow. A sticker label on the process coupling indicates the direction of flow. Installation drawing for the coupling is shown in App. 5.

Install the sensor to the process coupling so that the markers on the sensor body and coupling are aligned. The inner antenna will then be at the center of the smaller notch on the coupling.

NOTE: The sensor is fastened in position with a mounting clamp. The sensors are ceramic – be careful not to damage them!

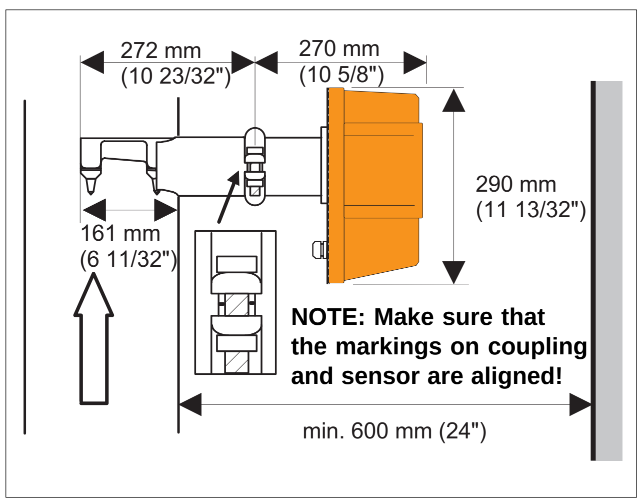
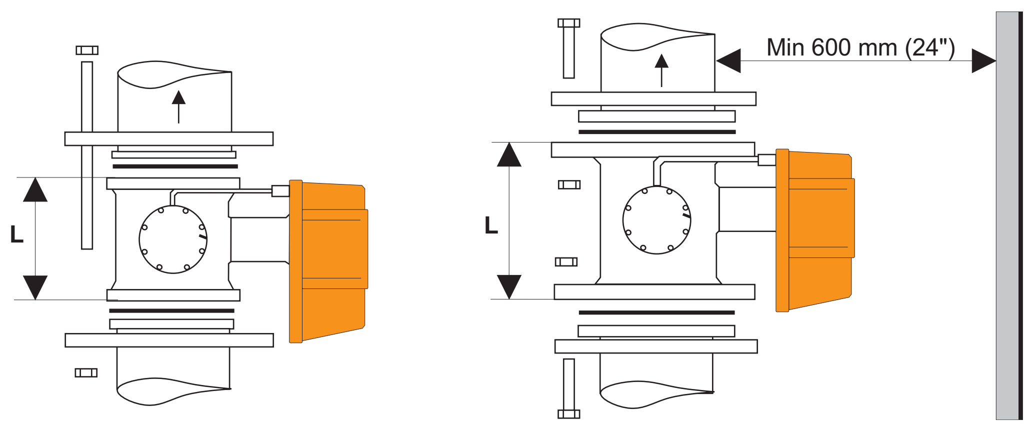


Fig. 3.1. Installation of MCAi-F sensor (seen from above).

3.C. MCA*i* -FT

When installed, the flow-through sensor forms part of the process pipeline (Fig. 3.2). The sensor must be installed so that the coupling of the Pt-100 temperature sensor (inserted at an angle into the pipe) faces downstream. A sticker label on the sensor indicates the direction of flow. Sensor models FT 150 and FT 200 contain no flanges; the sensor is fastened between the flanges of the process pipe with clamp bolts. Models FT 100, FT 250 and FT 300 have fixed flanges. The dimensions of the flanges and collars are given in Appendix 5 of this manual.



Model	L/mm	L/inch
150/6”	175	6 57/64
200/8”	225	8 55/64

Model	L/mm	L/inch
100/4”	300	11 13/16
250/10”	275	10 13/16
300/12”	350	13 25/32

3.2. Installation dimensions of MCAi-FT sensor (seen from above).

3.D. Display Unit + Shield

The shield protects the Display Unit from damage. Choose an easily accessible location, and mount the shield on the wall with three screws. Watch the distance between Display Unit and sensor – the length of the connection cable is 10m (33 ft). The dimensions of the shield are shown in Fig. 3.3.

Fasten the Display Unit to the shield with three screws. First hang the unit to the topmost screw, and then attach the screws in the lower corners. Fig. 3.4 shows the installation dimensions of the Display Unit.

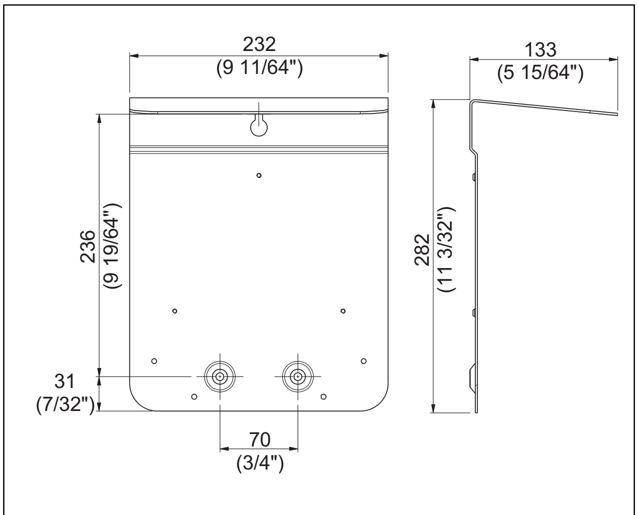


Fig. 3.3. Shield of the Display Unit.

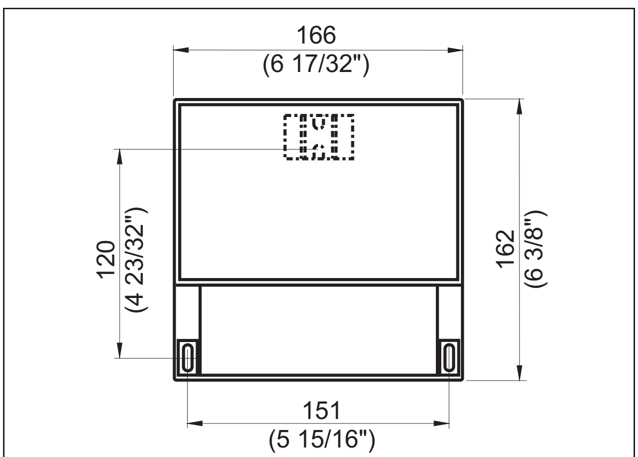


Fig. 3.4. Installation dimensions of the MCAi Display Unit.

3.E. Shield for Communicator

If the Communicator (option) will be used, choose a location close to the Display Unit and mount the Communicator's shield on the wall with three screws. Place the Communicator in its bracket, and connect it to the MCA*i* Display Unit when needed. The dimensions of the shield are shown in Fig. 3.5.

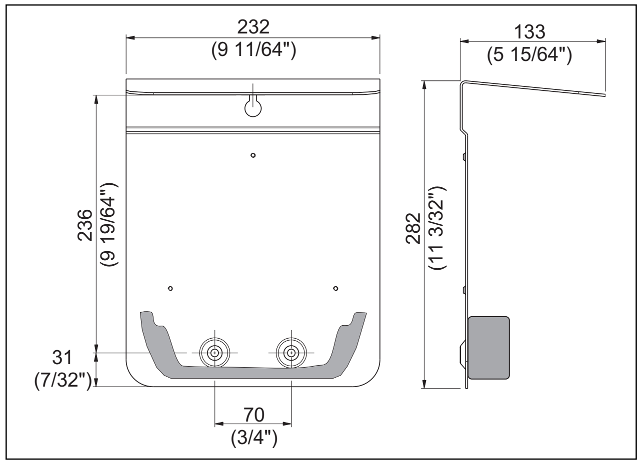


Fig. 3.5. Installation dimensions of the Communicator's shield.

3.F. Electric Connections

NOTE: Before connecting the mains power wires, make sure that the wires are not powered!

NOTE: First complete all connections and ensure that the mains voltage selector is set correctly – only after this connect power to the wires!

3.F.1. Display Unit cable

1. Insert the Display Unit cable to the Field Connection Board through the cable inlet bushings.
2. Connect the wires as shown in Fig. 3.7.

NOTE: Place the sensor cable on an instrumentation cable rack or other protected place. However, keep it away from the power supply cables to avoid electric interference.

The sensor cable transmits 24VDC operating voltage to the sensor's electronics, and the signals

- to Display Unit,
- to Communicator-i & HART Communicator,
- Cs current signal,
- to RS-232 for PC-connection.

3.F.2. Current signals

The consistency current signal can be taken either from the MCA*i* Display Unit or from the Field Connection Board (sensor electronics). Current signals for temperature and chemical concentration can only be taken from the Field Connection Board.

If the current signals for temperature and/or chemical concentration will be used, it is best to connect even the consistency signal from the Field Connection Board (terminals 30+ and 31-) – in this way all current signals can be connected using only one cable. If the temperature or chemical concentration signals will not be used, the Cs signal is in most cases easiest to connect from the Display Unit, terminals 10- and 11+.

NOTE: Connect the consistency signal using only one of these alternatives (at sensor 30+ 31-, or at Display Unit 10- 11+) – not both of them!

NOTE: Place the current signal cable on an instrumentation cable rack or other protected place. However, keep it away from the power supply cables to avoid electric interference.

Fig. 3.7 shows the current signal connections:

- Current output 1 (consistency), Display Unit terminals 10– and 11+.
- Current output 2 (Aout2, temperature), sensor terminals 32+ and 33–.
- Current output 3 (Aout3, chemical concentration), sensor terminals 34+ and 35–.

Current outputs 1 & 2 are isolated, current output 3 is non-isolated. Default connection is: temperature in output 2, chemical concentration in output 3. If necessary, the order can be switched as instructed in sections 6.B and 12.B.3 of this manual.

NOTE: The current outputs use the device's own operating voltage – do not connect any external power supply to them!

3.F.3. Alarm output
Connect the alarm output to the sensor's Field Connection Board. The alarm output can be either normally-closed or normally-open. A normally-closed relay output is provided across terminals 17 & 19, a normally-open output across terminals 18 & 19.

3.F.4. Grounding
Ground the shield of the connection cable between Display Unit and MCA*i* sensor to the sensor electronics' ground bar, and to Display Unit terminal 16.

Ground the cables for current signals and alarm output at one end only; for example, only ground them at the automation system end.

3.F.5. Mains power
Connect the mains power, 90...260V, to the terminal located on the left side of the Display Unit housing; see Fig. 3.7.

3.F.6. Communicator-i
Connect the Communicator-i to the terminal located on the lower edge of the MCA*i* Display Unit; Fig. 3.6.

3.F.7. HART® communicator
Using clip connectors, connect the HART® communicator to the connecting pins on the keyboard card of the MCA*i* Display Unit; see Fig. 5.5.

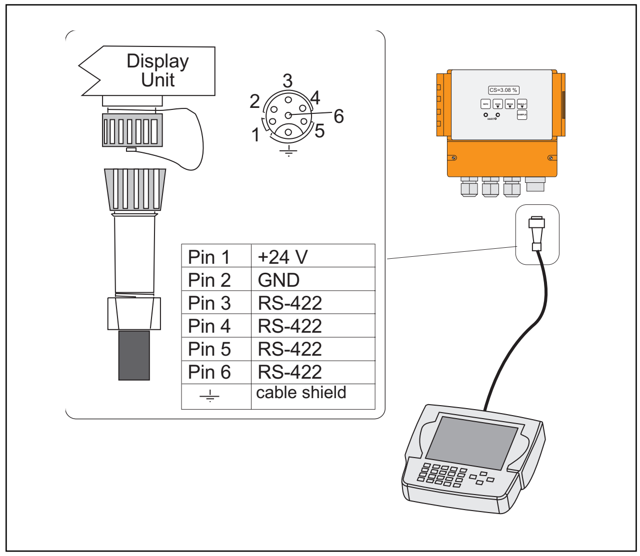
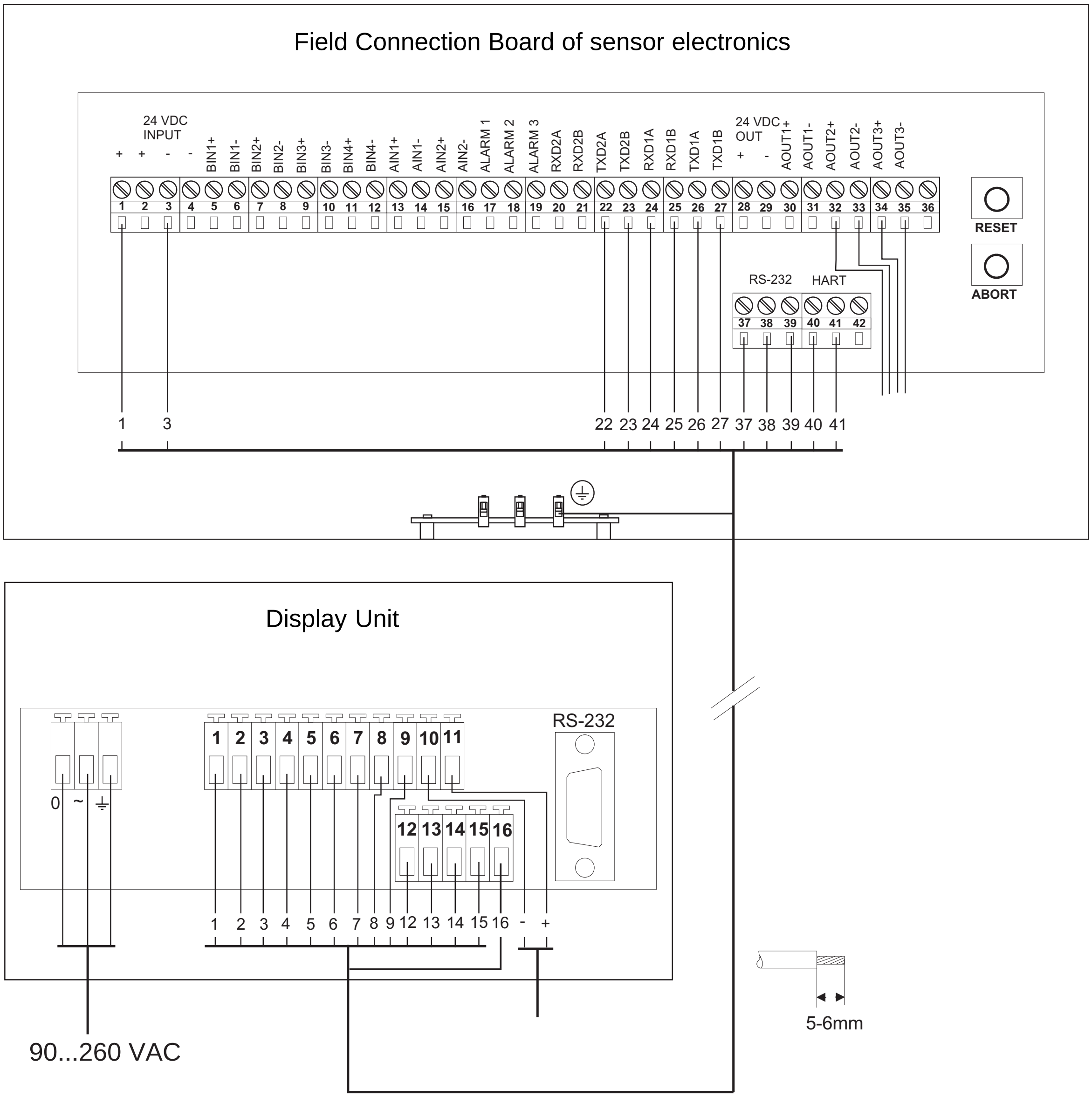


Fig. 3.6. Connecting Communicator-i to the Display Unit.



Terminal (Display unit)	Terminal (MCA*i*)	Signal	Wire color
1	1	+24VDC to MCA*i*	Brown
2	3	0 VDC to MCA*i*	White
3	38	PC-conn. RS232 TX	Purple
4	37	PC-conn. RS232 RX	Black
5	39	PC-conn. RS232 GND	Red
6	41	Aout1– & Hart	Blue
7	40	Aout1+ & Hart	Pink
8	22	TDX2A (RS485 RX/TX+ to display	Grey
9	23	TDX2B (RS485 TX/TX- to display	Yellow
10		Aout1– (Cs current signal– to DCS)	
11		Aout1+ (Cs current signal+ to DCS)	
12	26	TDX1A (RS485 TX+ to Communicator-i)	Green
13	27	TDX1B (RS485 TX- to Communicator-i)	Brown-green
14	24	TDX1B (RS485 RX+ to Communicator-i)	White-green
15	25	TDX1B (RS485 RX- to Communicator-i)	Red-blue
16	Ground bar	Prot. GND	Yellow-green

Fig. 3.7. Electric connections.

4. Start-up

4.A. Mechanics Check

1. Make sure that the delivery is consistent with the order.
2. Check the equipment for damage that may have occurred during shipment or installation work.
3. Make sure that the connectors of the Display Unit and all cables are in their proper places.

4.B. Installation

Install the sensor to process following the installation instructions.

4.C. Checking the Cable Connections

1. Make sure that the mains voltage cables are correctly made and connected.
2. Make sure that the current output cables are correctly connected.
3. Make sure that the alarm output cable is correctly connected.
4. Make sure that the analog and binary output cables (if any) are correctly connected.
4. Make sure that the cable between sensor and Display Unit is correctly connected.

4.D. Checking Electric Operation

1. Plug the Communicator-i to the quick connector on the bottom of the Display Unit.
2. Switch power on to the system.
3. Make sure that the display of the Communicator-i shows an image.

NOTE: Allow the sensor to warm up for about 3 hours before commencing the start-up!

4.E. Configuration

1. If the Communicator-i shows the Main Menu, do Reset-Abort. If the Communicator-i prompts you to select the sensor type, you may continue without Reset-Abort.
2. Complete the initial configuration as instructed in section 6.A.
3. Calibrate the sensor as instructed in section 7.A.
4. Scale the necessary current outputs as instructed in section 6.B.

   The sensor is now ready to start measurement.

5. User Interfaces & Operating

5.A. User Interfaces & Communication

Three alternative ways can be used to configure the sensor and to monitor its measurements:

1. Communicator-i

The sensor's operating terminal. The instructions in this manual are based on the displays of Communicator-i.

2. HART® communicator

See section 12 of this manual for instructions.

3. MCA*i* Display Unit

The sensor can also be operated to some extent using the Display Unit. See section 5.F for instructions.

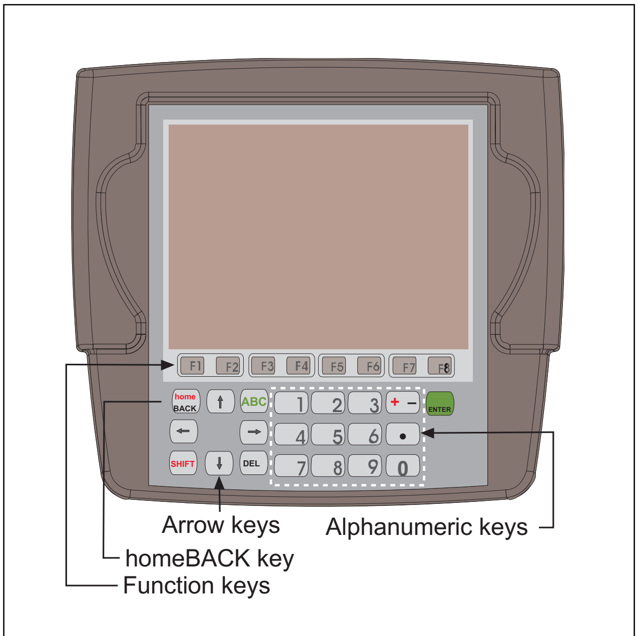


Fig. 5.1. Communicator-i.

5.B. Communicator-i

The Communicator-i is shown in Fig. 5.1.

Plug the Communicator-i to the quick connector on the bottom of the Display Unit. The Communicator-i can be kept for short times in the shield (option). Press [homeBACK] to display the menu pages and to start operation.

Adjusting display contrast:

- Press [SHIFT] + ⇑ for sharper contrast.
- Press [SHIFT] + ⇓ to reduce contrast.

The bottom line of the display is the "status line". Texts SHIFT, ABC and abc on this line indicate when the corresponding keys are activated.

Using the RED keys

(f9–f16, HOME, +, display contrast):

- Press [SHIFT] to activate the key,
- press [SHIFT] again for normal mode.

Capital letters:

- Press [ABC] and the desired key.
  Example: to type B, press [ABC] and [2] quickly two times.
- Press [ABC] + [ABC] for the normal mode.

Small letters:

- Press [ABC] + [ABC] + required key, as above.
- Press [ABC] for the normal mode.

Special characters (Table 5.1):

- Press [ABC] + [1] several times, until the desired character appears on the screen.
- Press [ABC] + [ABC] for the normal mode.

Table 5.1. Characters and corresponding key combinations.

Keys	Characters
ABC + 1	(space) % * ? ! , : " ` & $ ( ) /
ABC + 2	A B C
ABC + 3	D E F
ABC + 4	G H I
ABC + 5	J K L
ABC + 6	M N O
ABC + 7	P Q R S
ABC + 8	T U V
ABC + 9	W X Y Z

5.C. Communicator-i Setup Menu

If the Communicator-i main menu does not appear on the screen when the terminal is connected to the Display Unit, the basic setup is probably incorrect.

To check the setup press [ENTER] while switching power on. Give the password when prompted (3121, the same for all Communicator-i units), and the Setup menu will appear (Fig. 5.2). Make sure that the settings are identical with those shown in the picture. Make the necessary changes by pressing the indicated function key (F1, F2, etc.) until the correct setting appears. When the setup is ready, press [ENTER] to exit and save the changes.

Fig. 5.2 shows the basic setup.

Parameters (defaults shown in Fig. 5.2):

- **F1 Baudrate:** communication speed, alternatives 300, 1200, 2400, 4800, 9600, 19200, 28800, 38400 and 57600. When using the higher baudrates, make sure not to send too large amounts of data to Communicator-i at the same time; the 5000-byte serial buffer may be overfilled.
- **F2 Emulation:** select which standard (VT100 or TVI-925) the Communicator-i will use to display data on the screen.
- **F3 Text mode:** three alternative modes are available for the screen. These are 40x20, 40x24 and 40x30. In each mode, max. 40 characters can be shown on one line, but the number of lines per screen can be selected (20, 24, or 30).
- **F4 Screensaver delay:** the delay after which the screen goes blank can be selected in the range 1–10 minutes. The screensaver can also be disabled altogether.
- **F5 Keyboard beep:** the response tone of the keyboard can be set on and off. Note that this setting only affects the keyboard, not other sound signals of the device!
- **F6 RS-485 Mode:** type of the RS-485 serial cable, 2-wire or 4-wire. In the 4-wire mode the serial communication uses 4 wires, in the 2-wire mode only two.
- **F7 Shift Locking:** the [SHIFT] key can be set to lock in position. When this setting is ON, SHIFT-mode remains active until the [SHIFT] key is pressed again.
- **F8 Startup Info:** this field determines whether or not the Communicator-i will display the start-up information screen during power-up.
- **F9 [SHIFT + F1] Character set:** coding of Scandinavian characters.
- **F10 [SHIFT + F2] CR-mode:** selects whether the CR-character sent to the device stands for only carriage return (CR) or carriage return + line feed (CR+LF).

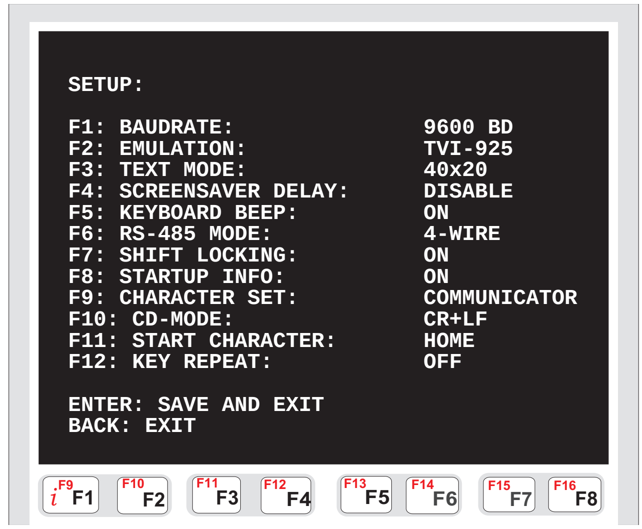


Fig. 5.2. MCAi Setup menu.

- **F11 [SHIFT + F3] Start character:** selects whether the terminal sends an XON or HOME character when it is switched on. Alternatives: DISABLED (= no start character), XON, HOME.
- **F12 [SHIFT + F4] Key repeat:** when this field is set ON, the same character keeps repeating until the pressed key is released; when OFF, the character only appears on the screen once per pressed key.

5.D. Operating

The operating chart is shown in Fig. 5.3.

The “softkeys” in the bottom of each display guide the operator: to execute a function, press either one of the function keys below each indicated function. Example: to select SELF DIAGNOSTICS press either F7 or F8 – in this manual indicated as [F7&F8]. Press [homeBACK] on any display page to return to the previous level menu.

Editing:

- Moving from field to field press ⇑ ⇓ or [ENTER].
- Deleting characters – press [DEL].
- Scrolling available alternatives – press [+ -].

Some parameters have certain preset limits, and all values entered in these fields must be within the limits to be accepted. If the entered value is outside these limits, the cursor will remain in the field until an acceptable value is given.

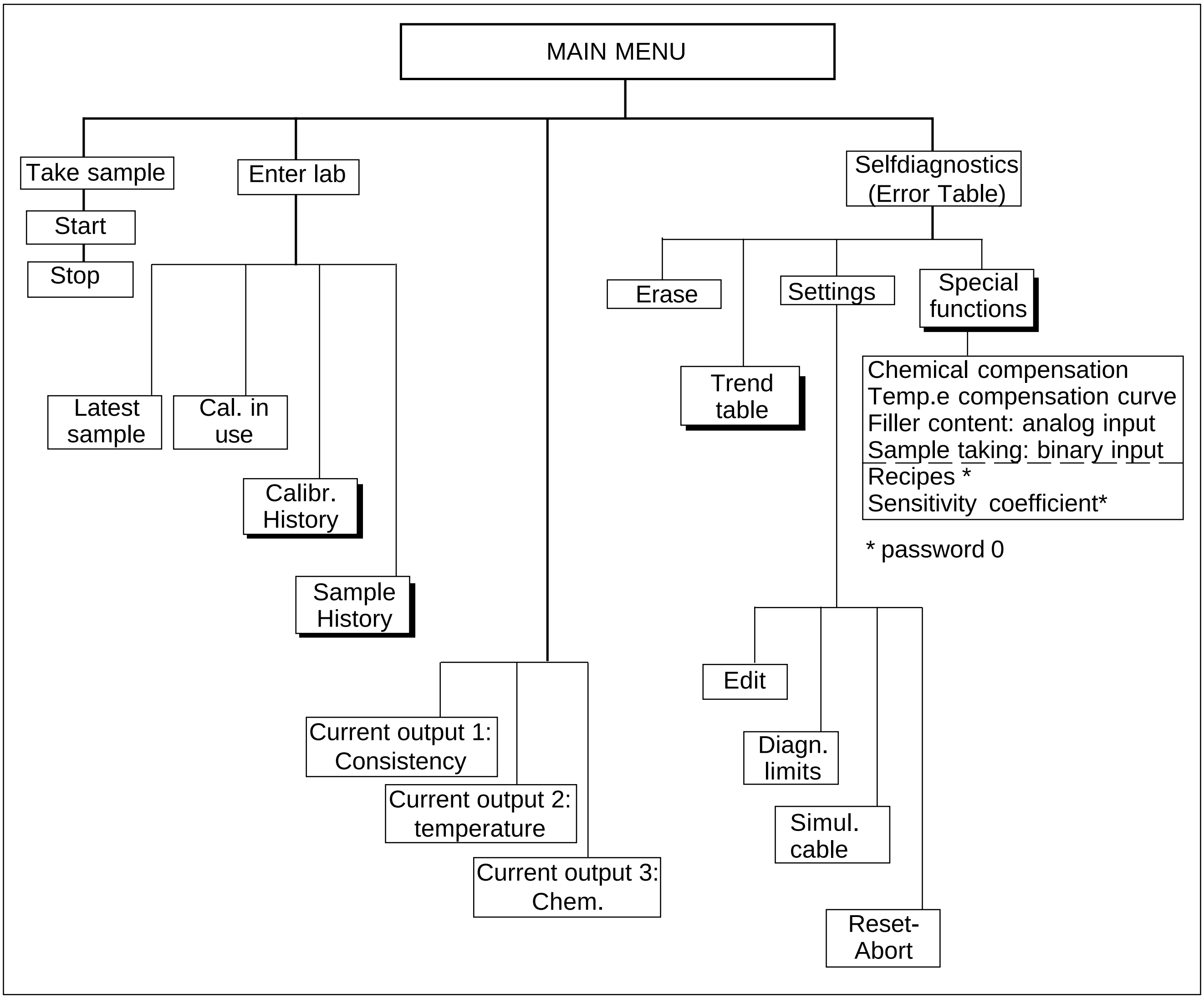


Fig. 5.3. Operating chart.

5.E. Main Menu

The MCA*i* main menu is shown in Fig. 5.4.

The main menu page shows the measured consistency and temperature. If the self-diagnostics function detects an error, the name of the error is shown on the "Status" line; otherwise this line reads "OK".

- **Consistency:** measured consistency, %.
- **Temperature:** temperature in the process.
- **Status:** shows a description of possible errors; when no errors have been detected, this line reads "OK".

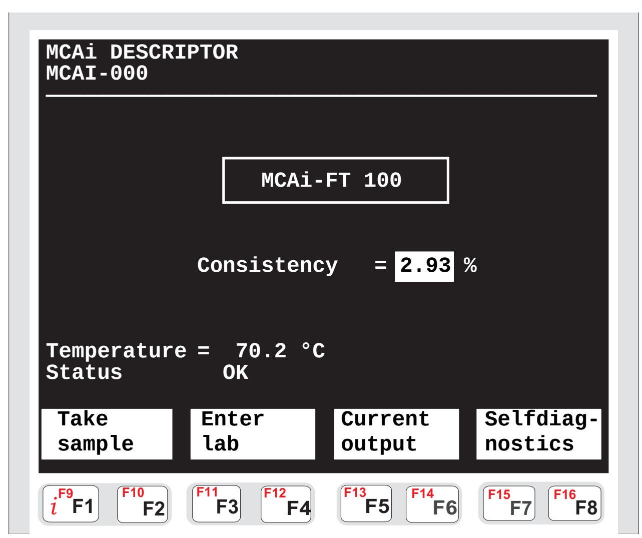


Fig. 5.4. Main Menu.

5.F. Operating with Display Unit

The Display Unit functions as a fixed display for MCA*i* measurements. The Display Unit can also be used for some operations – sample taking, reading measured values, self-diagnostics, and device information – so that the portable terminal need not be used in all cases. For instructions see the later sections of this manual.

Function keys of the Display Unit (Fig. 5.5):

- SAMPLE: starts and stops sample taking.
- RESULTS: scrolls the sample measurement values on the screen.
- MEAS: scrolls the momentary measurement values on the screen.
- DIAG: reports the device status, scrolls occurred errors on the screen.
- INFO: shows the device information.

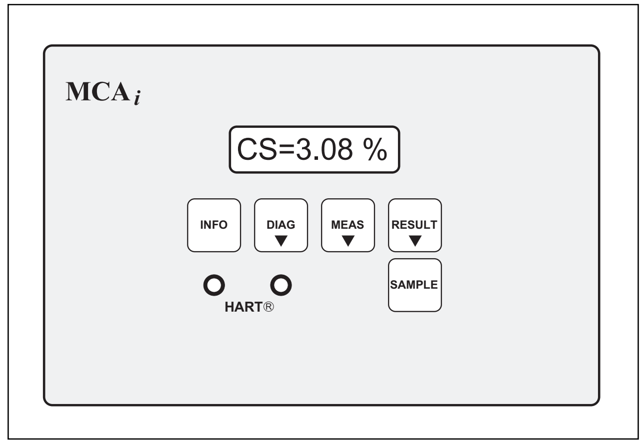


Fig. 5.5. Display Unit.

5.F.1. Reading measured values

Press the MEAS button, and the Display Unit will show the momentary consistency (Cs). When the MEAS button is pressed several times, the MCA*i* will show the following measured values:

- CS: consistency (%Cs).
- DEV: standard deviation of consistency.
- T: temperature (°C or °F).
- ML: signal level (u).
- CH: chemical amount (u).
- CC: chemical compensation value.

5.F.2. Reading device information

The set device information can be scrolled on the Display Unit. Press the INFO button, and the MCA*i* Display Unit will show the sensor type, e.g. FT-200. When the INFO button is pressed several times, the MCA*i* will show the date when the sensor was started up, and its software version.

5.F.3. Taking samples

To start sample taking press the SAMPLE button, and the Display Unit will read “Sampling”. Take a sample, and then press again the SAMPLE button. When the sample taking has been stopped, the Display Unit will read “Ready”. Press the RESULTS button to scroll the following results on the screen:

- CS: consistency (%Cs).
- DEV: standard deviation of consistency.
- T: temperature (°C or °F).
- ML: signal level (u).
- CH: chemical amount (u).
- CC: chemical compensation value.

5.F.4. Reading diagnostics data

Press the DIAG button, and the Display Unit will show the current status of the sensor. If the device is operating without problems, the screen should read “OK” (if recipes are used, also the recipe number will be shown). If the self-diagnostics feature has detected an error, the screen will show an error message. When the DIAG button is pressed again, the sensor will show if any other error messages are currently active.

The possible error codes are:

- Error 1: Measurement signal level low.
- Error 2: Measurement signal level high.
- Error 3: Reference signal level low.
- Error 4: Measurement signal unstable.
- Error 5: Reference signal unstable.
- Error 6: Temperature measurement error.
- Error 7: Consistency is higher than current output high limit.
- Error 8: Consistency is lower than current output low limit.

6. Configuration

6.A. Initial Configuration of Sensor

When the sensor has been installed to the process, it can be powered up. The sensor software has been designed in such a way that the compulsory configuration must be completed before the Main Menu appears. Configuration includes choosing the software language and sensor type, and setting the signal level. Each configuration display and the data required during each step will be described in the following sections.

NOTE: Always complete the initial configuration and calibration in normal process conditions! If this is not possible for some reason, check the sensor calibration as soon as the process conditions are again back to normal.

6.A.1. Software language

When the sensor is powered up, a language selection menu will appear on the screen (Fig. 6.1). If not, do Reset-Abort. Select the required language with the arrow keys and then press [F7&F8] CONTINUE. The software version (MCAi SW Vx.x) is also shown on the screen.

6.A.2. Sensor type

Sensor type is selected from the display shown in Fig. 6.2. It is important to select the correct sensor type, because the MCA*i* selects its calculation parameters accordingly. The type can be selected from the sensor's device plate. Instead of sensor type, it is possible to choose the date when the sensor has been started up and calibrated. This alternative is used for example when doing software updates or sensor service, to be sure that the correct settings (calibration + configuration) will be used.

Select the required alternative from the list with the arrow keys and press [F7&F8] CONTINUE. Next the software will ask for confirmation of the sensor type; press YES, or return to the sensor type alternatives by pressing NO.

NOTE: Always make sure to select the correct sensor type when starting up a new sensor! The start-up procedure stored in the sensor memory has been made during final testing, and it does NOT correspond to the actual process conditions.

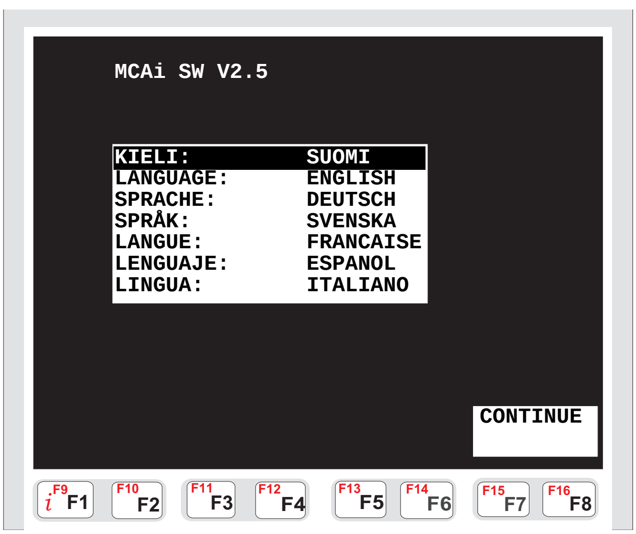


Fig. 6.1. Language selection menu.

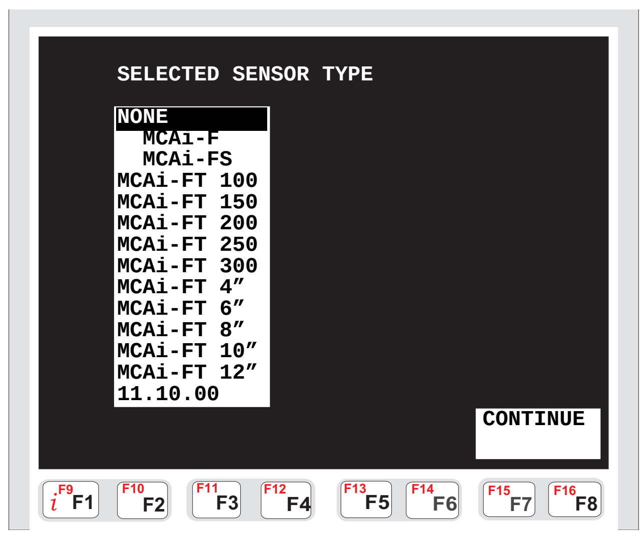


Fig. 6.2. Sensor type menu.

6.A.3. Device info (Enter date, time...)

The display shown in Fig. 6.3 contains settings for date, time, temperature unit, tag number, installation point, and password. Use the UP/DOWN arrow keys to move from field to field, and press [ENTER] to accept the selected values. Select the required temperature unit and password usage with [F5&F6] Next. The fields are:

- **Date:** enter the date of start-up.
- **Time:** enter the correct time.
- **Installation info:** location (not compulsory).
- **Tag number:** tag for sensor identification (not compulsory).
- **Temperature unit:** Celsius or Fahrenheit.
- **Use password:** select whether the software will ask for password e.g. before opening the “Enter lab” display.

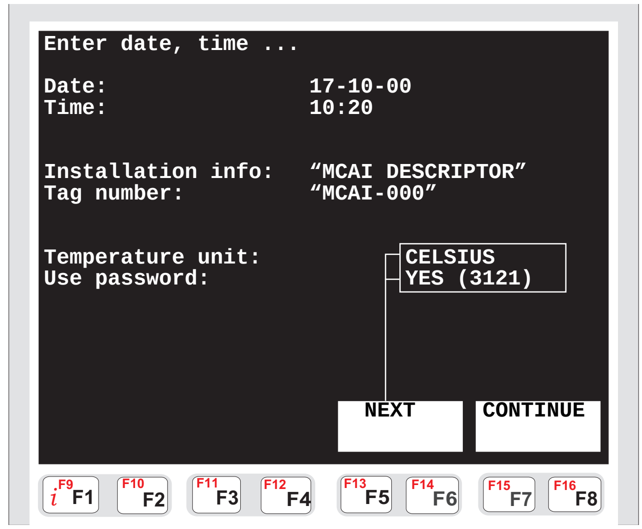


Fig. 6.3. Device info display.

6.A.4. Signal level

The microwave signal level is set in the display shown in Fig. 6.4. The received microwave signal must remain within a certain operating range. The signal level is affected by the temperature and conductivity of the measured medium.

As default, the MCA*i* adjusts the signal level to the middle of the operating range, so that there is maximum room for adjustment to both directions. This is the best setting if no large temperature or conductivity swings occur in the process. However, if the process temperature or conductivity show large variation, these must be taken into account when setting the signal level.

A higher chemicals content will lower the signal level, and a lower temperature has the same effect. If such changes are likely to take place in the process, the signal level must be set closer to the high limit to make sure that it remains within the correct range also during process variations. Similarly, a lower chemicals content and higher temperature will push the signal level upwards. If such changes are expected, the signal level must be set closer to the low limit to make sure that it remains within the correct range.

In the signal level setting menu, accept the default signal level or give a new target level and press [F1&F2] Set. The sensor will adjust the signal level as close to the target as possible, and display the set level on the screen. Press [F7&F8] OK to accept.

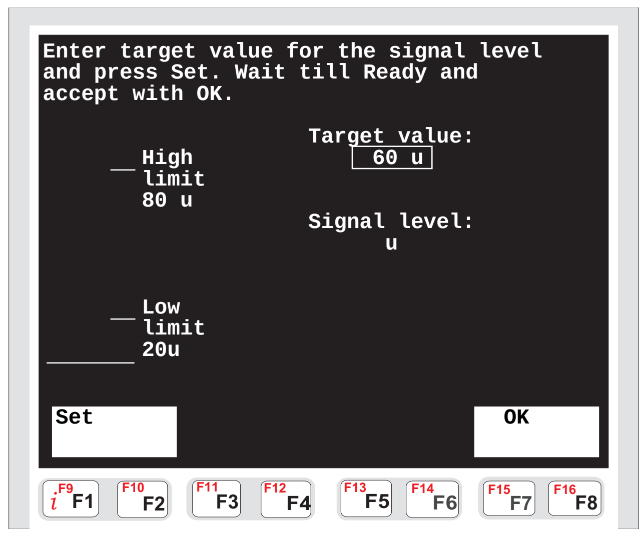


Fig. 6.4. Signal level setting display.

6.A.5. Initial configuration ready

When the signal level has been set, the software will initialize the measurement; this takes 1–2 minutes to complete. When the setup is ready, the Main Menu (Fig. 6.5) will appear. The next steps in the start-up procedure are consistency calibration (section 7.A) and current output scaling (section 6.B). If these steps have not been completed, the text UNDONE is shown above the name of the function. The MCA*i* is ready to start measurement once these configurations are ready.

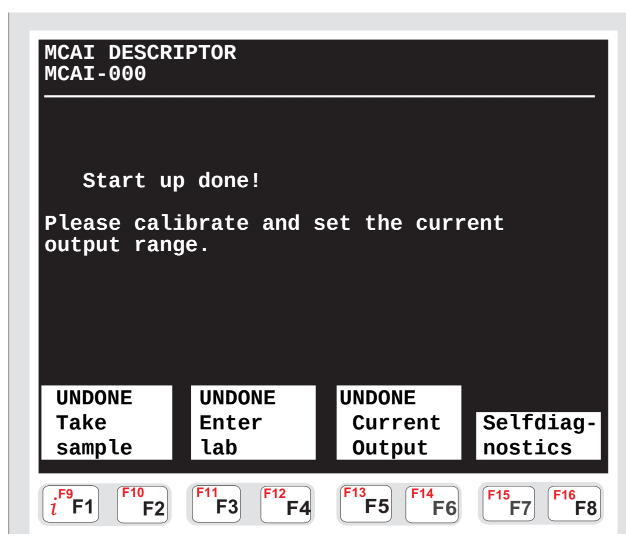


Fig. 6.5. Main Menu display after initial configuration.

6.B. Current Output Scaling

The MCA*i* Field Connection Board contains current outputs for consistency, temperature, and the relative chemical content measurement. Current output 2 is isolated, current output 3 non-isolated. A current output for consistency is also provided among the connections on the Display Unit.

After initial configuration and calibration, the current output scaling is still UNDONE. Go from Main Menu => Current Output, and scale the outputs.

6.B.1. Scaling the current output for consistency

Go from Main Menu => Current Output (Current output 1, Fig. 6.6). Press [F1&F2] Edit to edit.

1. Enter the consistency value corresponding to the low limit (4mA).
2. Enter the consistency value corresponding to the high limit (20mA).
3. Enter the filtering time for the output (usually 1 second is suitable).
4. Select how the current output will react to error situations, by pressing [F7&F8] Roll alarm until the required alternative appears:
   - **Freeze:** when an error occurs, the value is frozen to the level prior to the error.
   - **0, 4 or 20 mA:** the output is set to 0, 4 or 20 mA.
5. Press [F3&F4] Save to save the changes.

NOTE: Step 4, current output value during errors, is set to all three outputs at the same time, in the "Current Output 1" display!

6.B.2. Scaling the current output for temperature

Go from Main Menu => Current Output => Next (Current output 2, Fig. 6.7). Press [F1&F2] Edit to edit the output.

1. Enter the temperature value corresponding to the low limit (4mA).
2. Enter the temperature value corresponding to the high limit (20mA).
3. Enter the filtering time for the output (usually 1 second is suitable).
4. Press [F3&F4] Save to save the changes.

NOTE: If required, the outputs 2 & 3 can be switched so that current output 2 is scaled for chemical content, output 3 for temperature. To do this, press Next => [F5&F6] Temp -> Chemicals.

NOTE: Current output 2 is isolated, current output 3 non-isolated.

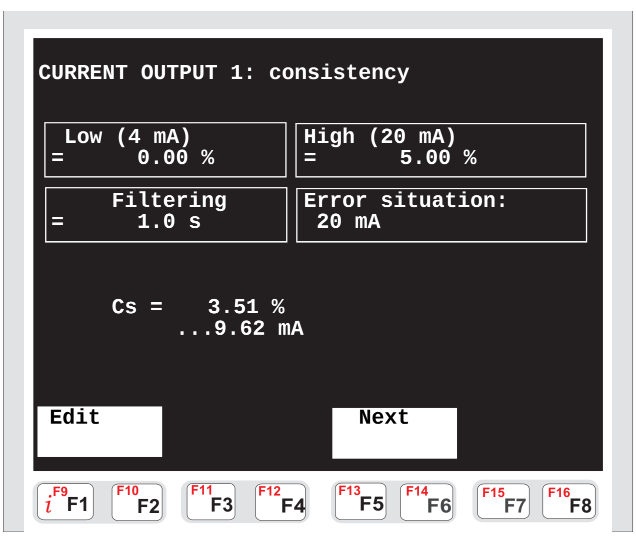


Fig. 6.6. Current output 1, consistency.

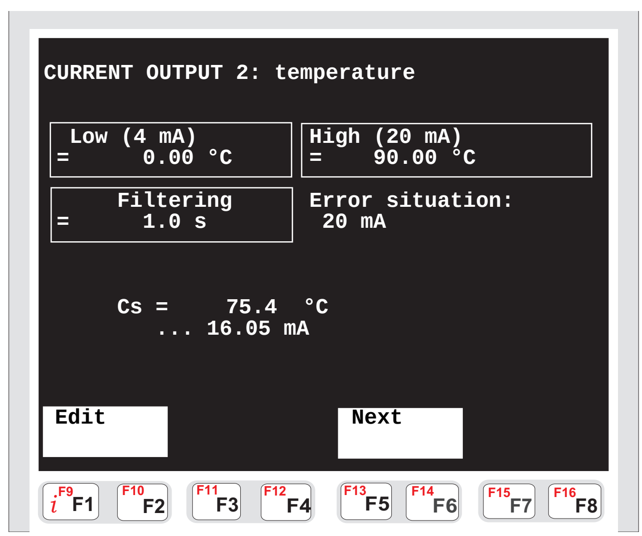


Fig. 6.7. Current output 2, temperature.

6.B.3. Scaling the current output for chemical content

Main Menu => Current Output => Next => Next (Current output 3, Fig. 6.8).

This output indicates variations in the chemicals content of the pulp, based on the microwave signal level measurement. When scaling this output, pay attention to some differences between it and the other current outputs.

Scale the chemicals output in such a way that the chemical content measured at the time of calibration corresponds to zero signal level units (0 u corresponds to 12 mA). The current signal will then indicate directly if the chemical content has increased or decreased in comparison to the “calibration level” (decreased < 12 mA < increased). When scaling the output, also enter the conductivity value of the consistency calibration sample; this reading is needed to compensate for the effect of temperature on the signal level.

If the conductivity of the Cs calibration sample is not known, calibrate as follows:

1. Take a sample.
2. Determine its conductivity.
3. In the “Latest sample” display, enter the Cs reported by the MCA*i* as the laboratory value.

This ensures that the Cs calibration remains unchanged but the conductivity will be determined. See section 7 for more detailed instructions.

Press [F1&F2] Edit to edit the output.

1. Enter the signal level corresponding to the low limit (4mA).
2. Enter the signal level corresponding to the high limit (20mA).
3. Enter the filtering time for the output (usually 1 second is suitable).
4. Press [F3&F4] Save to save the changes.
5. Press [F3&F4] Enter conduct, and give the conductivity of the Cs calibration sample.
6. Press [F3&F4] Save to save the changes.

NOTE: If required, the outputs 2 & 3 can be switched so that current output 2 is scaled for chemical content, output 3 for temperature. To do this, press NEXT => [F5&F6] TEMP -> CHEMICALS.

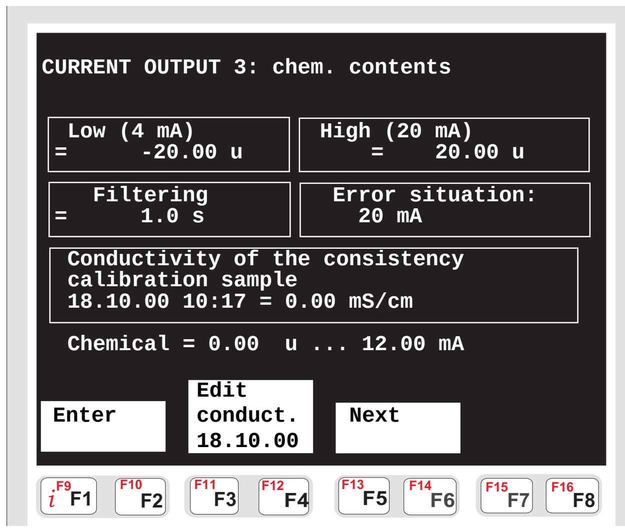


Fig. 6.8. Current output 3, chemical contents.

6.C. Editing Device Information

Selfdiagnostics => Settings (Fig. 6.10).

Device information can be edited in the "Settings" display. Press [F1&F2] Edit to start editing. Type the required values with the keypad; in the last three fields changes can be made by pressing [F5&F6] Roll. Press [F3&F4] Save to save the changes.

Settings in this display:

- **Installation info:** you can type here a text describing the installation point; this text will be shown in the top left corner of the Main Menu.
- **Tag number:** the sensor's identification number; will be shown in the top left corner of the Main Menu.
- **Use password:** select YES or NO.
- **Temperature unit:** select Celsius or Fahrenheit degrees (°C/°F).
- **Language:** select display language.

6.D. Reset-Abort

Selfdiagnostics => Settings (Fig. 6.10).

Press [F7&F8] Reset-Abort to reset the settings. The software will ask for confirmation before proceeding. If YES is selected, the software will be reset and has to be configured again as instructed in section 6.A.

The Reset-Abort command can also be given with the corresponding buttons located on the Field Connection Board of sensor electronics.

NOTE: Reset-Abort will erase all stored configurations from the memory and initialize the device with system defaults!

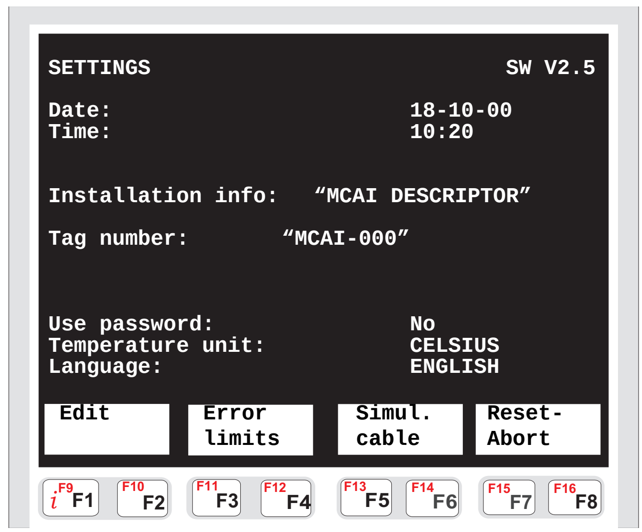


Fig. 6.10. Device info (settings) display.

7. Calibration

7.A. First Calibration

The MCA*i* is calibrated using single-point calibration; only one sample at some process consistency level is needed. In addition, the laboratory consistency value of the process sample is needed. The following sections describe the first calibration after initial configuration (see section 6.A).

7.A.1. Sample taking

MAIN MENU => TAKE SAMPLE.

Press [F1&F2] START to begin calibration. The software begins to collect measurement results, and the data is also shown on the trend display. Take laboratory samples for calibration at the same time: collect at least three samples, and then press [F3&F4] to stop sampling. The measured consistency, process temperature, signal level, and average level of chemicals compensation will be shown on the screen.

For reliable calibration, the standard deviation of the calibration results must be small. This can be verified by looking at the trend graph while the measurement results are being collected. The curve must not show any large swings. If the measurement result deviation is very large, the measurement must be repeated.

The MCA*i* always overwrites the previous sample data, and thus only the latest sample remains in memory. The display (Fig. 7.1) contains the following data:

- **Cs %:** average measured consistency.
- **Temp °C:** average measured temperature.
- **Std dev:** standard deviation of the consistency measurements; appears on the screen when the sample is stopped.
- **Mlev u:** signal level (u).
- **Chem c:** average value of chemical compensation.

7.A.2. Entering laboratory result

Go from MAIN MENU => ENTER LAB => LATEST SAMPLE.

When calibrating for the first time, the laboratory result is always given in the “Latest sample” display (Fig. 7.2). Press [F1&F2] EDIT, type the laboratory measurement result in the field “Lab”, and press [ENTER] to accept. If the measured stock contains fillers, also give the average filler content and filler component contents. Sufficient accuracy for the average filler content is 5% so it can be evaluated (does not have to be determined from a laboratory sample).

When all the required data have been entered, press [F3&F4] SAVE. The software will ask if the new calibration should be taken into use; reply YES to accept, or NO to cancel (the old calibration will then be used). The “Calibration in use” display will then appear, and the values can be edited from this screen if necessary.

When the first calibration has been made, the LATEST SAMPLE button is no more available; new laboratory values must be entered in the “Calibration in use” display.

The display shown in Fig. 7.2 contains the following data:

- **Temp:** temperature in the process.
- **MCA:** measured consistency.
- **Lab:** consistency measured in laboratory.
- **Average filler content:** given in per cent of the total consistency. The different filler components are given as percentages of the total fillers (their total sum must be 100%).

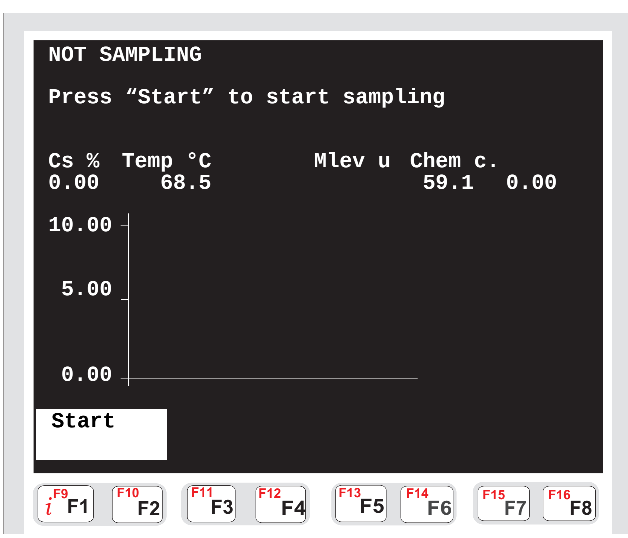


Fig. 7.1. Starting the sampling.

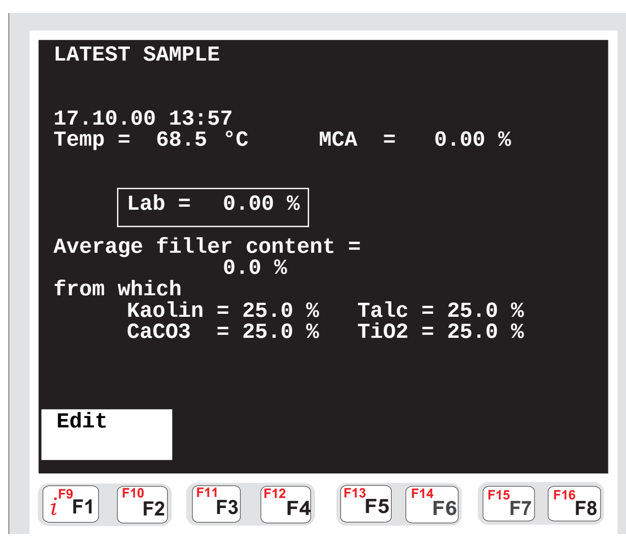


Fig. 7.2. “Latest sample” display.

7.B. Modifying the Calibration

If calibration remains inaccurate for some reason, a constant level difference will be observed between the measured consistency and the laboratory analysis result. This level difference can be corrected without repeating the sampling process, using the “Calibration in use” display (Fig. 7.3).

Example: if the MCA*i* steadily shows about 0.2% higher consistency than laboratory, correct as follows:

1. Go from MAIN MENU => ENTER LAB => CALIBR. IN USE. The previous completed calibration will appear on the screen.
2. Press [F1&F2] EDIT, and enter a value that is 0.2% lower than the currently set “Lab” value (i.e. “Lab” = 3.15%).
3. Press [F3&F4] SAVE to save the changes.
4. Press [F5&F6] YES to change the calibration.

When modifying the calibration, also the average filler content can be changed; this is necessary if the filler content values have changed by more than 5%.

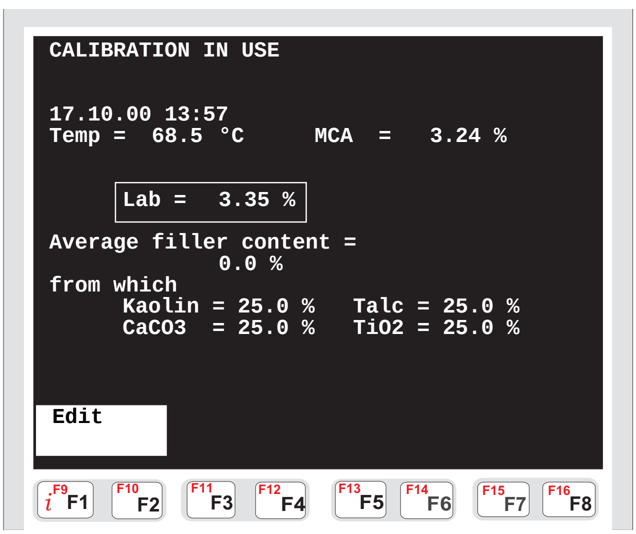


Fig. 7.3. “Calibration in use” display.

7.C. Calibration and Sample History

All samplings and changes to calibration are stored as history data in the memory. The data can be scrolled using the following displays.

7.C.1. Calibration history

Go from MAIN MENU => ENTER LAB => CALIBR. HISTORY (Fig. 7.4).

This display lists the performed calibrations, arranged according to date. The display also shows the following data:

- **Sample:** date when the calibration sample was taken.
- **Temp °C:** temperature in the process.
- **MCAi %:** measured process consistency.
- **Lab %:** laboratory consistency used in calibration.
- **Fil %:** filler content value used in calibration.

Use keys [F3&F4] PAGE BACKWARDS and [F1&F2] PAGE FORWARDS to scroll the history table back and forth.

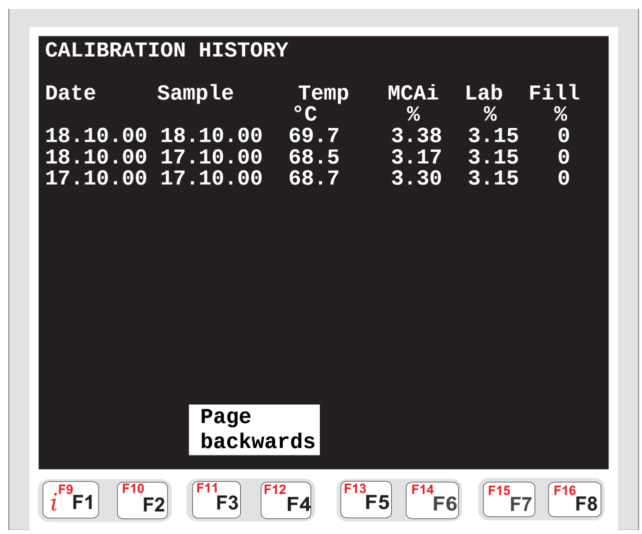


Fig. 7.4. “Calibration history” display.

7.C.2. Sample history

Go from MAIN MENU => ENTER LAB => SAMPLE HISTORY (Fig. 7.5).

The taken samples are stored in the history table, arranged according to the date of sampling. The display shows the following data:

- **Sample:** date and time of sampling.
- **MCAi %:** measured process consistency.
- **Lab %:** laboratory consistency used in calibration.
- **Temp °C:** temperature in the process.
- **Mlev u:** signal level of the measurement channel at this consistency.
- **Rlev V:** signal level of reference channel (u).
- **Ccom %:** chemical compensation value.

Using the “Sample history” display, the Lab. value of any sample can be edited also afterwards. To edit the laboratory value, press [F5&F6] ENTER LAB.

Use keys [F3&F4] PAGE BACKWARDS and [F1&F2] PAGE FORWARDS to scroll the history table back and forth.

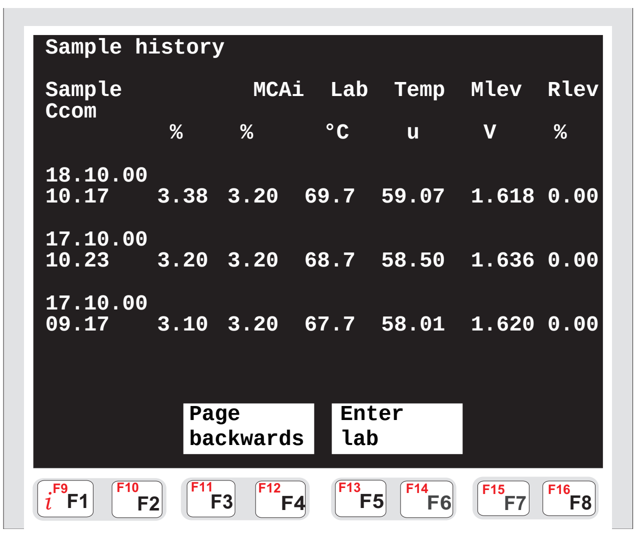


Fig. 7.5. “Sample history” display.

8. Data Collection

8.A. Trend Table

Main Menu => Selfdiagnostics => Trend table (Fig. 8.1).

The MCA*i* stores measurement results in a trend table which can be scrolled using this display. The display shows a graph of the selected measurement result, and other measured values from the ongoing measurement. Use the LEFT/RIGHT arrow keys to move the small arrow cursor shown in the bottom of the graph; this cursor always points at one measurement point for which the data is shown on the screen. Use the UP/DOWN arrow keys to move the cursor to the left or right, 10 measurements at a time. The following data is shown on the screen:

- **Start:** starting time of graph.
- **Stop:** end time of graph.
- **Cursor:** measurement time and Cs result indicated by the arrow cursor.
- **Trend interval:** the measurement is carried out at set intervals (default: every 10 minutes). Note that a shorter trend interval will also shorten the time that the table covers.
- **Length:** size of the trend table.

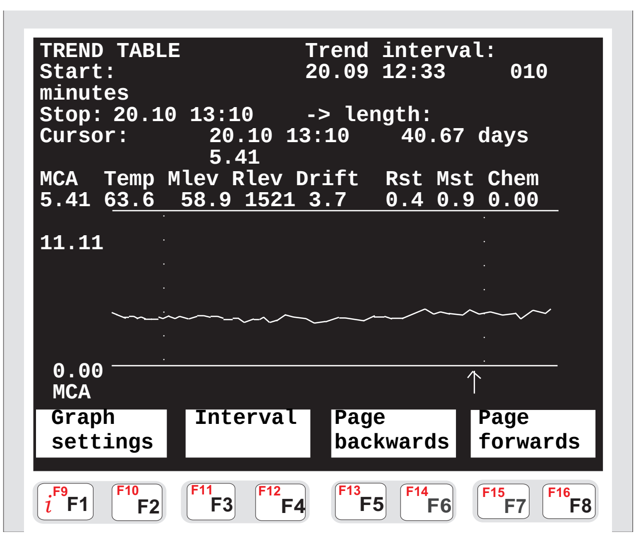


Fig. 8.1. "Trend table" display.

The following measured values will be shown for the time indicated by the cursor:

- **MCA:** measured process consistency (%).
- **Temp:** process temperature (°C or °F).
- **Mlev:** signal level of measurement channel (u).
- **Rlev:** signal level of reference channel (u).
- **Drift:** compensation for electronics drifting.
- **Rst:** stability of reference channel.
- **Mst:** stability of measurement channel.
- **Chem:** chemical compensation value.
- **Cabin:** temperature inside the electronics housing (can be displayed by changing the trend variable; see section 8.A.1).

Thus the trend interval shows the measurement interval for the sensor. Press [F3&F4] Interval to edit the trend interval setting. Enter the required value and press [F7&F8] Save.

Use keys [F5&F6] Page backwards and [F7&F8] Page forwards to scroll the table back and forth.

8.A.1. Graph settings

Go from Main Menu => Selfdiagnostics => Trend table => Graph settings (Fig. 8.2).

This display allows you to change the trend table variable shown on the Y-axis. Press [F3&F4] Select variable to change the variable shown on the Y-axis. Press [F5&F6] Enter y-scale to change the Y-axis scaling; either give the low and high limits manually, or let the software do the scaling. Finally press [F7&F8] to save changes.

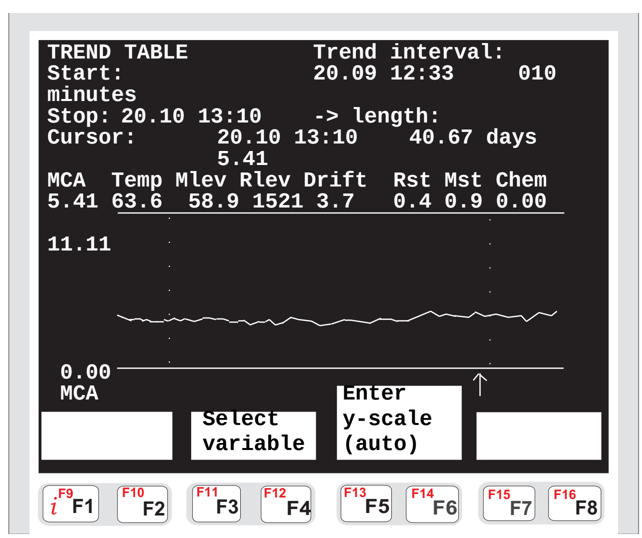


Fig. 8.2. "Trend graph settings" display.

9. Special Functions

9.A. Special Functions

Go from Main Menu => Selfdiagnostics => Special functions (Fig. 9.1).

The "Special functions" menu contains functions for chemical content and temperature compensation, filler content, sampling, recipes, and sensitivity coefficient.

- Chemicals compensation is needed if large variations occur in the chemicals content of the process.
- Temperature compensation can be applied to correct the measurement, section by section, using a linear curve. This correction is needed if the process temperature may go below 30°C (86°F).
- The filler content information can be connected to the sensor as an analog signal, the sampling information as a binary signal.
- The recipe function can be used in cases when the process conditions vary so much that one calibration cannot cover the entire range.
- The sensitivity coefficient function can be applied to change the Cs sensitivity of the MCA*i* sensor.

The last two functions are mainly needed in applications outside the pulp & paper industry.

NOTE: The last two functions are normally not visible in the menu – to display them, press 0 (zero)!

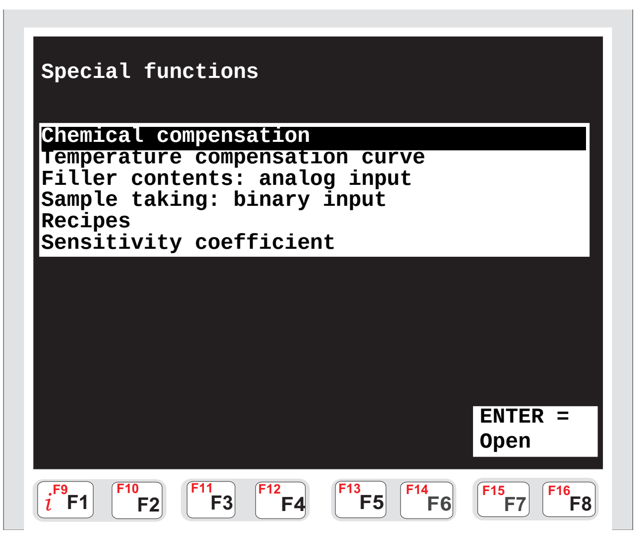


Fig. 9.1. "Special functions" menu.

9.B. Chemicals compensation

9.B.1. Principle

Large variations in the chemicals content of the pulp affect the measurement of microwave propagation time. As a result, the MCA*i* will show a too high reading when the chemicals content increases. Chemicals also affect the attenuation of the microwave signal, causing a lower signal level result (u). Thus there is a correlation between the consistency error (MCA*i* – Lab. value) and the measured signal level. Based on this correlation, the Cs measurement error caused by the chemicals content can be eliminated by applying the correct chemicals compensation factors.

If large variations occur in the chemicals content of the process, the consistency, signal level and temperature measured by the MCA*i* should be included in the laboratory follow-up, as well as the conductivity and consistency measured in laboratory. Based on the collected data, the signal level measurement can be corrected by chemicals compensation if needed. Fig. 9.2 shows an example graph based on laboratory follow-up results; in the graph the consistency error (MCA*i* – Lab.) is on the Y-axis, signal level on the X-axis. Mlev is the abbreviation used for the MCA*i* signal level.

As the graph shows, the consistency error (MCA*i* – Lab) correlates with the signal level. This indicates that the error is caused by chemicals and thus it can be eliminated by chemicals compensation. To make sure, we can make a graph with conductivity (reflecting the chemicals content) is on the X-axis. The graph should then be a rising straight line; the error (MCA*i* – Lab.) grows when conductivity increases.

Chemicals compensation is determined by means of two-point calibration.

NOTE: Select the calibration points so that the difference between their chemicals contents and signal levels is as great as possible.

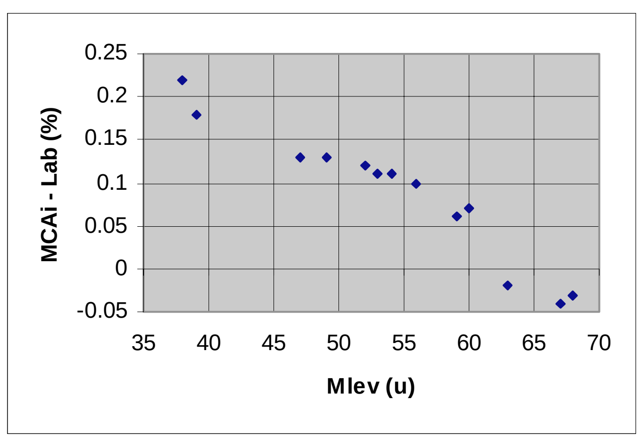


Fig. 9.2. Correlation of Cs error to signal level.

9.B.2. Setting chemicals compensation

In the example shown in Fig. 9.2, the calibration points are selected from the laboratory follow-up data as follows:

1. Choose a calibration point with a high signal level. At this point the chemicals content has been low and the MCA*i* has not shown a too high reading (Sample 1, Fig. 9.3).
2. Choose a calibration point with a low signal level. At this point the chemicals content has increased and the MCA*i* has shown a high reading (Sample 2, Fig. 9.3).
3. Enter the Lab. and MCA*i* values of the calibration points to the sensor: laboratory consistency and conductivity, and consistency, temperature and signal level measured by the MCA*i* sensor. Make sure to give the consistencies measured by the MCA*i* and laboratory so that the error (MCA*i* – Lab.) is of the right magnitude; the absolute Cs levels have no significance. In other words, it does not matter whether the Cs values for sample 2 are MCA*i* = 3.2 and Lab = 3.0 or MCA*i* = 5.2, Lab = 5.0. Before determining the compensation graph through samples 1 & 2, the MCA*i* will perform temperature compensation based on the temperature and conductivity.

When the chemicals compensation is in use, the MCA*i* will place the measured signal level result (Mlev) on the compensation line, determine the error (MCA*i* – Lab.) and correct the measured consistency by the calculated amount.

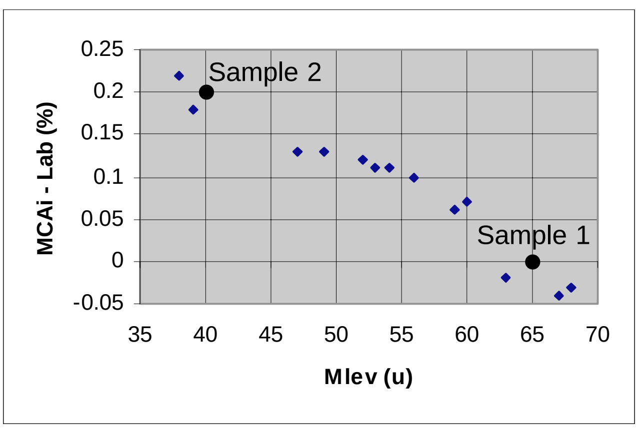


Fig. 9.3. Choosing the calibration points.

9.B.3. Performing chemical compensation

Go from MAIN MENU => SELFDIAGNOSTICS => SPECIAL FUNCTIONS => CHEMICAL COMPENSATION (Fig. 9.4).

The graph shows the total error (MCA – Lab.) of calibration points 1 & 2 as a function of signal level Mlev. Calibration point 1 has been temperature-compensated to make it correspond to the temperature of calibration point 2, and the result is the point 1'. The temperature and conductivity of each sample is also shown below the graph.

NOTE: Before the first calibration the graph is blank!

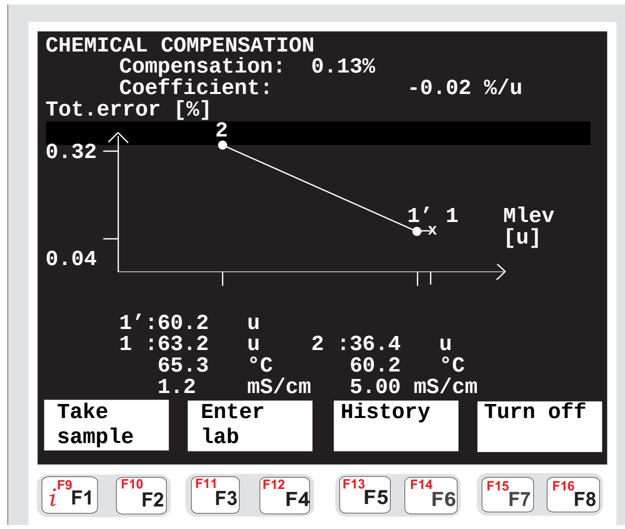


Fig. 9.4. "Chemical compensation" display.

Sample taking

NOTE: Enter data on two sample points selected from laboratory follow-up data (see section 7.A.2), or take new calibration samples as described below.

Samples are taken in the same way as for consistency calibration, but in this case we need two points (= two samples). Go from MAIN MENU => SELFDIAGNOSTICS => SPECIAL FUNCTIONS => CHEMICAL COMPENSATION => TAKE SAMPLE (Fig. 9.5).

1. Choose the sample number with the function key [F1&F2] START SAMPLE 1. Press the start key for sample 1, and take calibration samples – at least three parallel samples.
2. Then press [F5&F6] STOP. Analyze the consistency and conductivity of the samples in laboratory.

Entering laboratory values

Go from MAIN MENU => SELFDIAGNOSTICS => SPECIAL FUNCTIONS => CHEMICAL COMPENSATION => ENTER LAB (Fig. 9.6).

1. Press [F1&F2] Latest sample 1 to open the display shown in Fig. 9.7.
2. Press [F1&F2] ENTER LAB, and move the cursor to the laboratory Cs and conductivity fields. Enter the laboratory values and press [F5&F6] SAVE LAB.

The values measured by the sensor are automatically saved here when the sample is taken as described above. If you wish to enter the sensor values too, for example when using data from laboratory follow-up, press [F3&F4] ENTER MEASUREM. and then enter the measured values in the same way. Press [F5&F6] SAVE MEASUREM. to save the changes.

When changes have occurred in the chemicals content of the process, calibrate the second sample in the same way.

NOTE: Do not change the consistency calibration while performing the chemicals compensation!

If the consistency calibration is changed before the second chemicals compensation sample has been taken, the MCA*i* will delete the data on the first sample!

When both calibration points have been saved, the MCA*i* will ask "Take latest sample 1 and latest sample 2 into use?" when the ENTER LAB menu is opened. Press YES and the MCA*i* will activate the chemicals compensation. In the "Enter laboratory values" display (Fig. 9.6) the sample pair will then be moved from the LATEST SAMPLE 1/2 menus to the CAL. IN USE 1/2 menus. "Chemical compensation" display (Fig. 9.4) shows the current compensation value, and data on the sample pair.

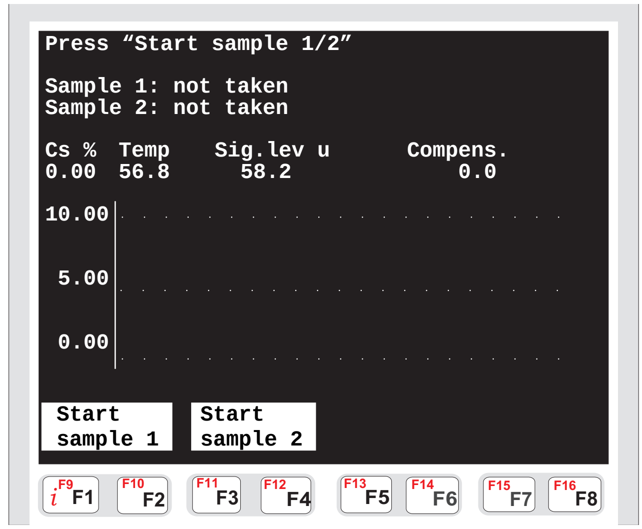


Fig. 9.5. "Sampling" display.

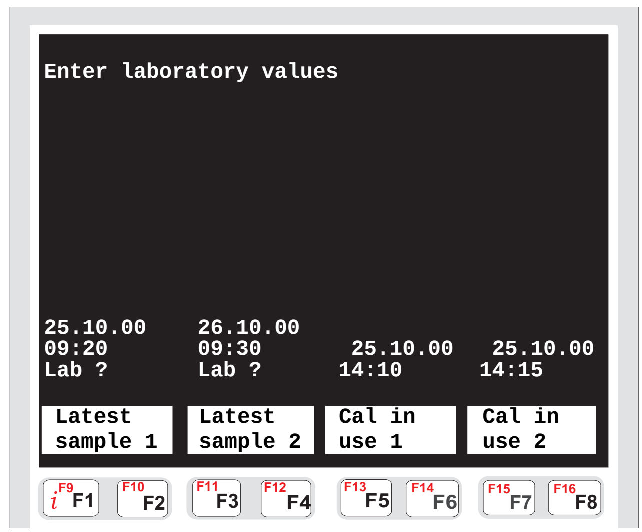


Fig. 9.6. Menu for entering the laboratory values.

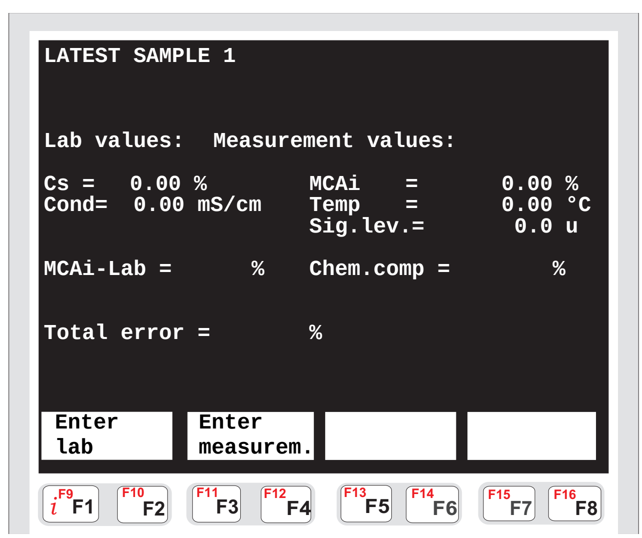


Fig. 9.7. "Latest sample 1" display.

If required, chemicals compensation can be deactivated in the "Chemical compensation" menu (Fig. 9.4) by pressing [F7&F8] TURN OFF. The "Chemical compensation" display then reads "Not in use", and the function key text TURN OFF turns into TAKE INTO USE.

Changing the compensation

Chemicals compensation can be changed by either entering a new calibration sample pair or by editing the existing calibration values.

Calibration with a new sample pair is done as described above, with one exception: when the "Enter Lab" menu of chemicals compensation is opened, the MCA*i* will ask "Replace Cal in Use 1 and Cal in Use 2 with Latest Sample 1 and Latest Sample 2?".

The existing chemicals compensation can be readjusted if necessary, based on the laboratory follow-up results. Use menus ENTER LABORATORY RESULTS (Fig. 9.6): CAL IN USE 1 / 2. To change the degree of compensation at the signal level of the selected sample point, change the Lab. consistency value of the point as follows:

For example, if the MCA*i* measured correctly at the chemicals level (Mlev) of calibration point CAL IN USE 1 but shows 0.1% too much at the signal level of point CAL IN USE 2, the MCA-Lab value of the second calibration point must be changed by 0.1%. Go to menu CAL IN USE 2, press [F1&F2] ENTER LAB, set the Lab-value 0.1% lower, and then press [F5&F6] SAVE LAB.

9.B.4. Compensation history

Go from MAIN MENU => SELFDIAGNOSTICS => SPECIAL FUNCTIONS => CHEMICAL COMPENSATION => HISTORY.

Chemicals compensation settings made earlier can be viewed on the "History" page. The screen shows data on the calibration points, and the time and date when the compensation was taken in use. Scroll with function keys [F1&F2] NEXT and [F3&F4] PREVIOUS.

9.C. Correction Curve for Temperature Compensation

Water temperature affects the propagation velocity of microwaves. The sensor therefore measures process temperature with a Pt-100 temperature sensor, and performs linear temperature compensation. However, at temperatures below 30°C (86°F) the effect of temperature is not quite linear. If the process temperature is below 30°C (86°F) – either permanently or from time to time – a correction curve is needed for the temperature compensation.

9.C.1. Determining the correction curve

The correction curve is determined by using the results of laboratory follow-up. The laboratory follow-up data must include consistency measured by the laboratory and by the MCA*i*, and the process temperature measured by the MCA*i* sensor. The sensor's results can be read either from the main menu, or by taking follow-up samples with the SAMPLE button of Display Unit.

Using the laboratory results, draw a graph with temperature on the X-axis and the (MCA*i* – Lab. Cs) on the Y-axis. Enter the correction curve as point pairs on the resulting graph (temperature / MCA*i* – Lab. Cs). The MCA*i* will create the correction curve by drawing a line between the entered points and then extending the line outside the last points at both ends.

NOTE: Do not make any changes to the consistency calibration or chemicals compensation during the laboratory follow-up period!

At least two points are needed for the curve. To avoid compensation errors due to inaccurate laboratory results, make sure that the points are not too close to each other. The recommended minimum difference between the points is about 5°C (9°F). When determining the curve for a larger temperature range, it is advisable to take a sufficient number of points, at regular intervals. The following examples illustrate the principle of entering the correction curve for temperature compensation.

Example 1.

The normal process temperature is 40...50°C (104...122°F) but drops temporarily to 20°C (68°F) when the process is started up. The graph (MCA*i* – Lab Cs vs. Temperature) shown in Fig. 9.8 was drawn by using laboratory samples taken while the process was being started. This graph shows that when the temperature gets below 30°C (86°F) it has an effect on the MCA*i* measurement. Enter the graph as the correction curve as follows:

1. Go from Main Menu => Selfdiagnostics => Special functions => Temperature compensation curve (Fig. 9.9).
2. Choose max. 6 point pairs (Temp. / MCA*i* – Lab. Cs) from the curve, at regular temperature intervals.
3. Press [F1&F2] Edit and type the point pair values in fields “T” and “MCAi – Lab” below the graph.

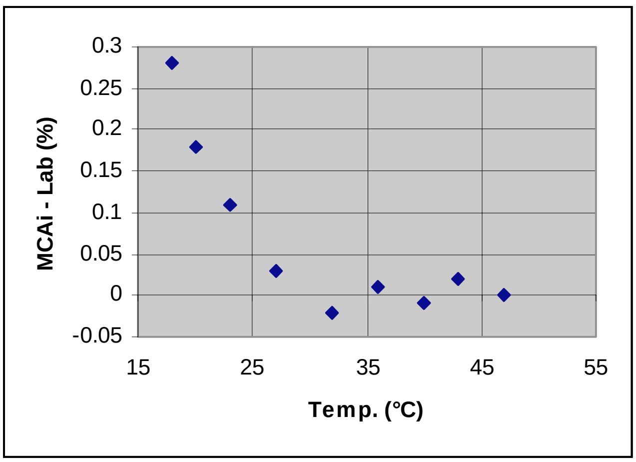


Fig. 9.8. Effect of temperature on consistency error.

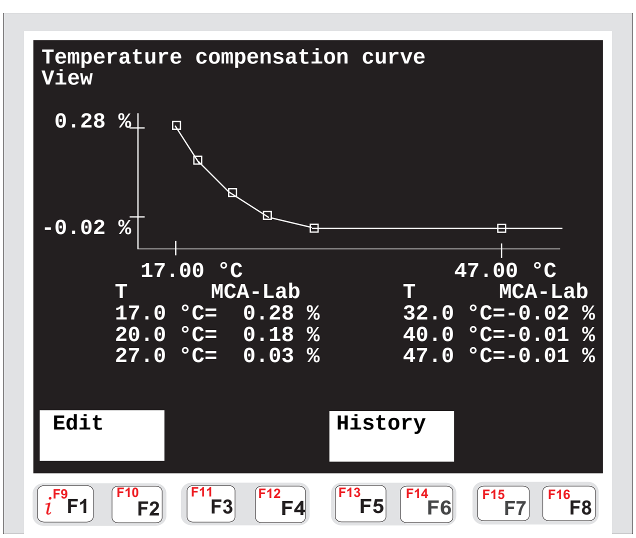


Fig. 9.9. “Temperature compensation curve” display.

NOTE: Make sure that you use the same “MCAi – Lab” value for the last two points! Otherwise the correction curve will continue using the slope between the last two points.

4. If required, press [F5&F6] Preview to see the resulting curve before storing it.
5. Press [F3&F4] Store, and you will still be prompted to confirm the changes. Accept with YES, and the MCA*i* will draw the correction curve and take it into use.

Example 2.

The process temperature is in the range 20...25°C (68...77°F), and thus errors in the temperature compensation can be expected. The obtained “MCA*i* – Lab. Cs vs. Temperature” curve, based on laboratory results, is shown in Fig. 9.10.

In this case two points are sufficient to determine the temperature effect. Use for example the points 20°C = 0.2% and 25°C = -0.1%, and enter them to the sensor as described in the previous example.

NOTE: Make sure that you use the same “MCAi – Lab” value for the last two points! Otherwise the correction curve will continue using the slope between the last two points.

9.C.2. Adjusting the compensation curve

To change the temperature compensation, press [F1&F2] Edit to edit the existing curve. In this mode you can edit the existing values, add new point pairs (max. 6 pairs), or delete a point by setting its temperature and MCA*i* – Lab values to zero.

9.C.3. History

In the “Temperature compensation curve” display press [F5&F6] History to view compensation curves used earlier. Scroll with keys [F1&F2] Next and [F3&F4] Previous.

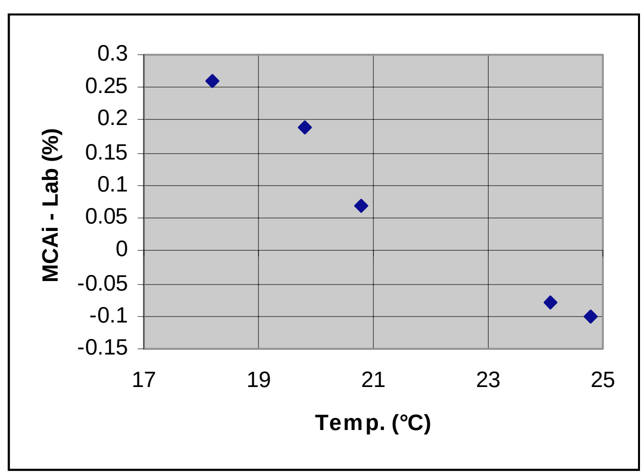


Fig. 9.10. Effect of temperature on consistency error.

9.D. Recipes

The recipe function can be used when the process conditions vary so much that one calibration cannot cover the entire range. Such process changes may be caused by a conductivity or temperature change that takes the signal level out of the normal operating range, or by a consistency change that exceeds the measurement dynamics (about 15%). In such cases the sensor can be configured separately for each distinct process situation. These setups can be saved as recipes (max. 7).

As the recipe function is needed only rarely, it is password-protected. To edit the recipes go from Main menu => Selfdiagnostics => Special functions and then press the number key **0** (zero). When two or more recipes have been calibrated, the recipe function is automatically visible in the "Special functions" menu.

Select Recipes and press [ENTER] to open the display shown in Fig. 9.11. Each of the calibrated recipes reads "Ready", and the currently used recipe is also indicated by the text "In use".

9.D.1. Selecting a recipe

Recipes are selected using either the Communicator or the binary inputs. Set the selection mode with the function key [F5&F6] Keyboard / Binary inputs, and the set method will be shown under the heading Recipe selection. Recipes can be activated only with the method set in this menu.

Selection mode: keyboard

When using this selection mode, first select the recipe from the list with arrow keys and then press [F1&F2] Take into use.

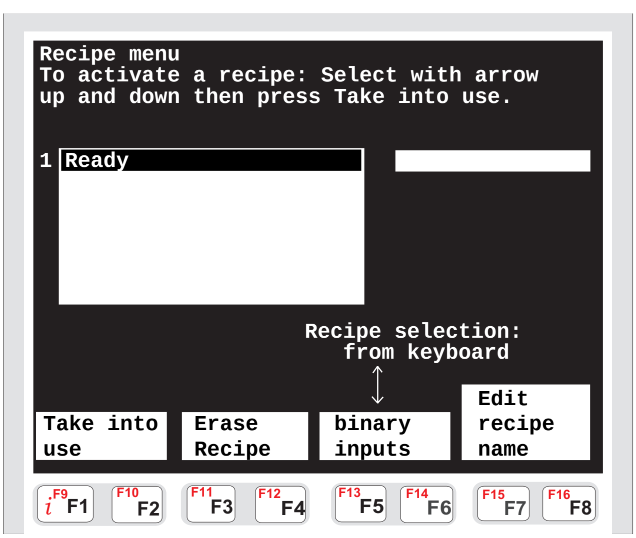


Fig. 9.11. "Recipe menu" display.

Selection mode: binary inputs

When this selection mode is used, the MCA*i* will use the recipe number set to binary inputs bin1...bin3 (where input bin1 is the least significant). For more information see section 9.D.5.

9.D.2. Taking a new recipe into use

• Selection mode: keyboard

Select the desired recipe number (must be blank!) with the arrow keys and press [F1&F2] Take into use. The MCA*i* will prompt: "The selected recipe is empty. Start-up and calibrate the device for the recipe X?" Press [F5&F6] Yes to accept, and the MCA*i* will go to the start-up mode for signal level setting. Starting with signal level setting, perform start-up and calibration as instructed in sections 6.A and 7.A of this manual. After this the recipe is ready and will be taken into use.

• Selection mode: binary inputs

Select the desired recipe number (must be blank!) with the binary inputs. The function Take into use will then appear in the Recipe menu. This function will not appear if an already calibrated recipe is selected with the inputs. Press Take into use and the MCAi will prompt: "The selected recipe is empty. Start-up and calibrate the device for the recipe X?". Press Yes to accept, and the MCA*i* will go to the start-up mode for signal level setting. Starting with signal level setting, perform start-up and calibration as instructed in sections 6.A and 7.A of this manual. After this the recipe is ready and will be taken into use.

As long as the start-up and calibration for the new recipe have not been completed, the sensor will interpret the situation as an error. This means that the current output is set to the error mode defined for the previously used recipe (0, 4, 20 mA or freeze). If the recipe is changed before either the consistency calibration or current output scaling has been performed for the new recipe, the new recipe will disappear.

9.D.3. Erasing and overwriting recipes

If you wish to write a new recipe over an existing one, you must first erase the old recipe. This can only be done using the "Keyboard" selection mode. Select the recipe with the arrow keys and press [F3&F4] Erase Recipe. The MCA*i* will first ask you to confirm the command; press Yes and the recipe number will be free to be used again.

NOTE: Recipe 1 and the recipe marked "In use" cannot be erased!

9.D.4. Naming a recipe

Name the recipes as follows:

1. In the "Recipe" menu press [F7&F8] EDIT RECIPE NAME.
2. Type the desired recipe name in the table that appears on the screen.
3. Press [F1&F2] SAVE.

NOTE: This function only applies to the recipe currently in use!

Even if another recipe was selected, the name will be given to the currently used recipe. When a recipe has been named, both the recipe table (in "Recipe menu") and the status line of the main menu will show the recipe name instead of its number.

9.D.5. Connecting binary inputs

The binary inputs are isolated. The recipe number can be entered either from the mill system or manually with a switch. A binary number is converted into a recipe number with the formula:

Recipe number = 1 x bin1 + 2 x bin2 + 4 x bin3

where bin1, bin2, bin3
= 0 at input voltage 0–2 V
= 1 at input voltage 12–48 V

The accepted recipe numbers are 1–7. If zero is entered to the binary inputs, the MCA*i* will automatically activate recipe 1. Table 9.1 illustrates recipe selection with the binary inputs.

Table 9.1. Status of binary inputs for the selection of recipes.

bin3	bin2	bin1	Recipe in use
0	0	0 or 1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

The number (or name) of the currently used recipe is shown on the Status line in the bottom of the Main menu, e.g. *Recipe 4*. If the selected recipe is blank, the Status line will read *Blank recipe*.

Table 9.2 shows the binary inputs needed when using different numbers of recipes.

Table 9.2. Binary inputs needed when using different numbers of recipes.

Number of inputs	Inputs	Recipes	Number of recipes
1	Bin 2	1, 2	2
2	Bin1, 2	1, 2, 3	3
2	Bin 2, 3	1, 2, 4, 6	4
3	Bin 1, 2, 3	1–7	7

NOTE: When two inputs are used, the number of available recipes is either 3 or 4, depending on the connections! This is because binary numbers 0 and 1 both refer to recipe 1.

NOTE: Pay attention to the coding of recipe numbers when connecting two inputs to Bin2 and Bin3!

9.D.6. MCAi recipe selector

Fig. 9.12 shows an example of connecting the MCA*i*-recipe selector to the binary inputs.

Connect the operating power and the positive poles (+) of the binary inputs from Field Connection Board to the selector's terminal block using a four-wire cable. Ground the negative poles (–) of the binary inputs at the Field Connection Board to the operating power ground.

NOTE: When numbers 0, 8 or 9 are set with the recipe selector, the MCAi will activate recipe 1.

9.D.7. Automation system

Connect the binary outputs from the automation system directly to the binary inputs of MCAi Field Connection Board.

Ground the cables at one end only; for example, only ground them at the automation system end.

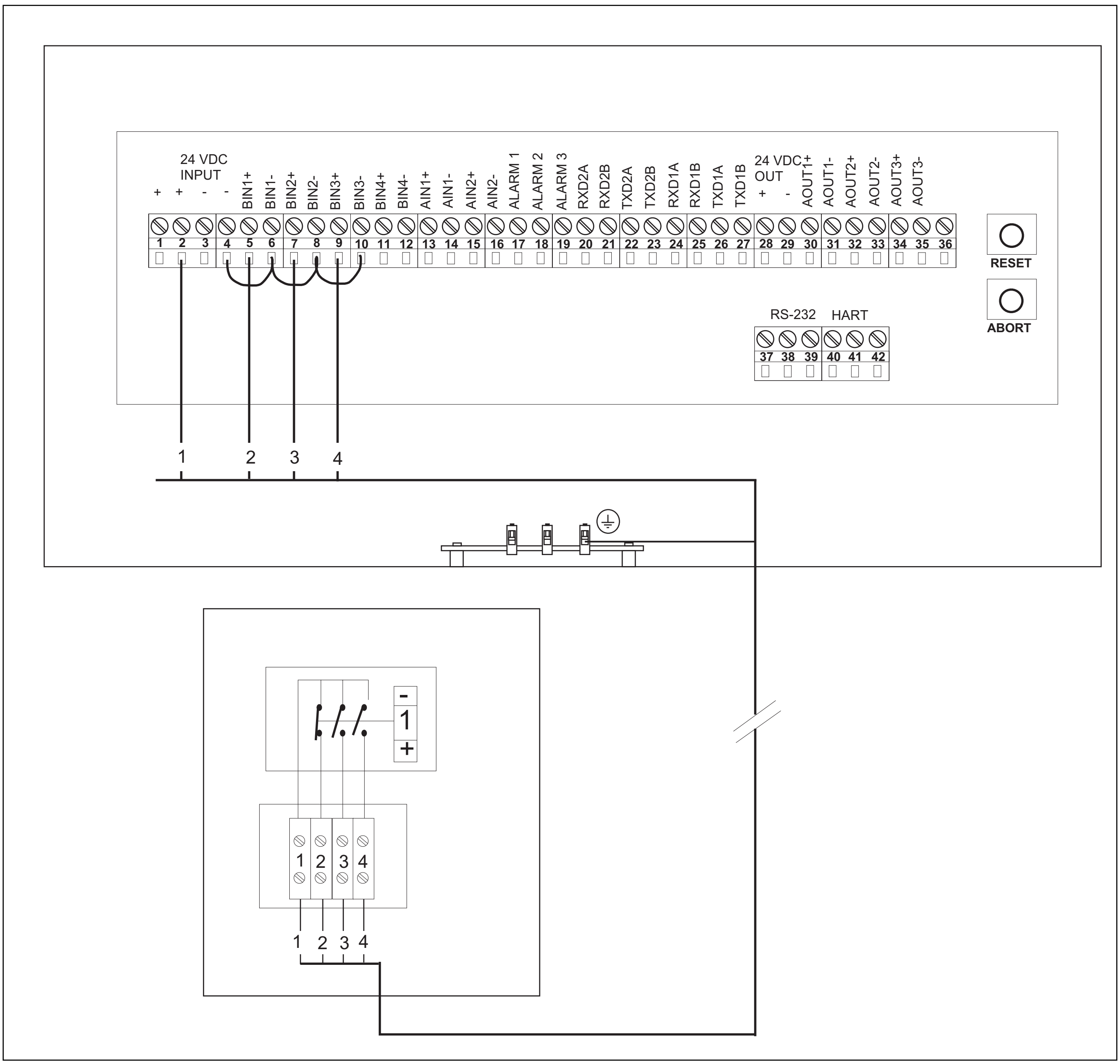


Fig. 9.12. Connection of MCAi recipe selector (example).

9.E. Filler Correction through Analog Input

The MCA*i* is less sensitive to fillers than to fibers. In practice the sensor measured slightly over a half of a change in filler content. Table 9.3 illustrates the sensor's sensitivity to different fillers relative to its sensitivity to fibers.

Table 9.3. Sensitivity of MCAi to different fillers.

Filler	MCAi sensitivity
Kaolin	0.61
$CaCO_3$	0.47
Talc	0.7
TiO_2	0.1

Example: at 3% process consistency the filler content (100% kaolin) changes by 10 % points, which corresponds to 0.3% Cs. The MCA*i* sees this as a (0.61 x 0.3 %) = 0.18 % change, and thus the error will be 0.12%.

The filler content information can be connected to the isolated analog input Ain1 (on Field Connection Board) as either a current or voltage signal. If a current signal will be used, it must be converted into a voltage by connecting a resistor across the positive and negative poles of analog input Ain1. The voltage is then derived from the formula:

$$\boxed{U = R \times I}$$

where R = resistance and I = current signal value.

Scale the voltage into a filler content value as follows:

1. Go from Main Menu => Selfdiagnostics => Special functions => Filler contents: analog input (Fig. 9.13).
2. Press [F1&F2] Edit and then type the voltage signal value and the corresponding filler content for the low and high limits. You can also increase the filtering if necessary.
3. Press [F3&F4] Save. The MCA*i* will prompt: "Change scaling of the filler contents?" Press Yes and the MCA*i* will correct the measured consistency according to the entered filler content.

Filler content correction can be deactivated and activated by pressing [F7&F8] Turn off and [F7&F8] Take into use.

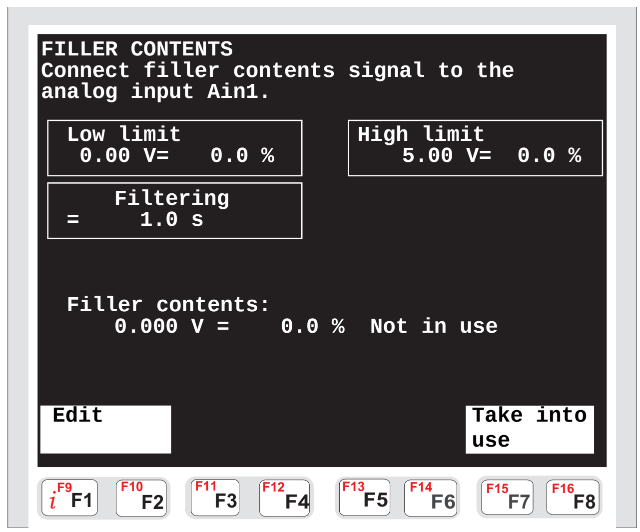


Fig. 9.13. "Filler contents" display.

9.F. Sampling Signal to Binary Input

If samples for laboratory follow-up are taken from the MCA*i* measurement point, information of sampling should also be taken to the MCA*i*. This ensures that at the time of sampling the MCA*i* will store its measurement results (consistency, temperature, signal level, chemicals compensation) in the sample history table (see section 7.C.2). The data can then be read from the table later on, either manually or with a PC, for various analyses. The sampling signal is connected to the isolated input Bin4. When a sample is being taken, the Status line of the Main menu will read "Sampling" but the obtained results will only be shown in the sample history table (not in the Main menu).

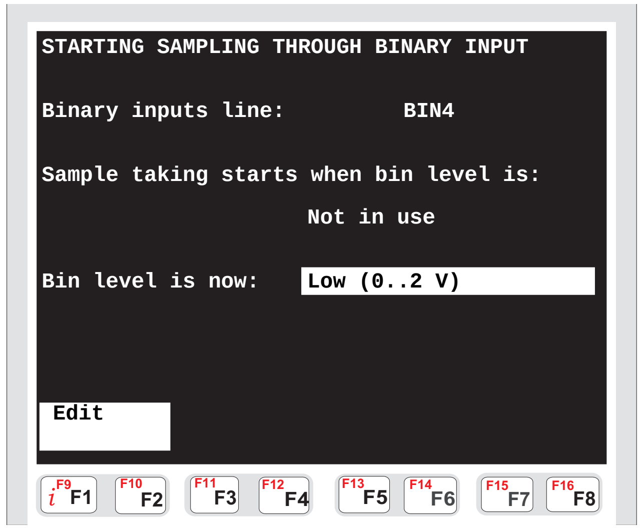


Fig. 9.14. "Starting sampling through binary input" display.

Configuring the binary input

Go from Main Menu => Selfdiagnostics => Special functions => Sample taking: binary input (Fig. 9.14).

Press [F1&F2] Edit and select the binary input level where sampling should begin. Press [F5&F6] Change and then select High if you wish the sampling to connect voltage to the binary input, or Low if you wish the sampling to connect the voltage off. Press [F3&F4] Save.

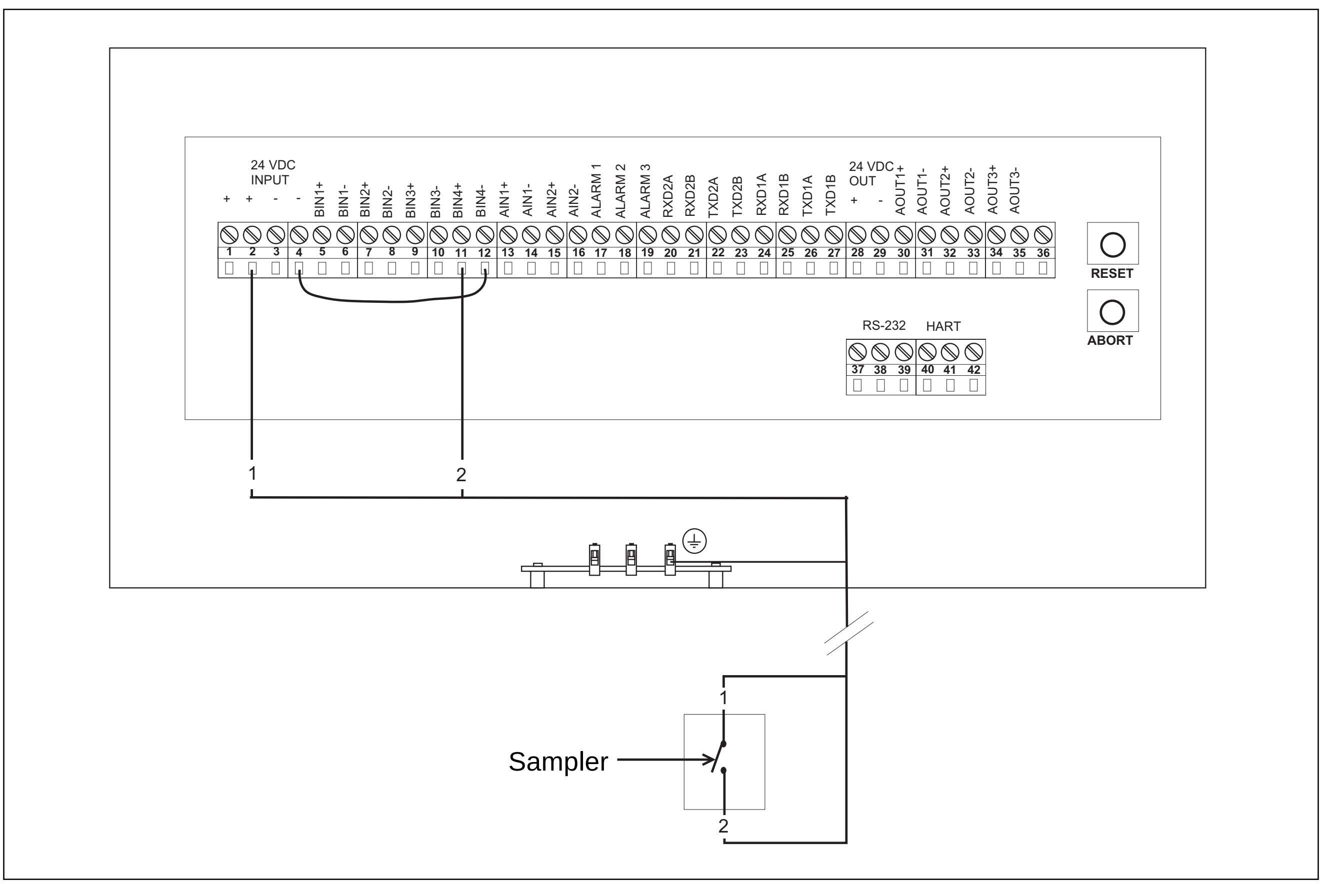


Fig. 9.15. Connecting the sampling signal to binary input 4.

Connecting the binary input

In the connection shown in Fig. 9.15, the sampler controls a switch which receives +24V voltage from the MCA*i* Field Connection Board. The negative pole of the binary input Bin4 is connected to MCA*i* ground. The voltage can also be taken from another source instead of the MCA*i*, and in this case the negative pole of Bin4 must be connected to the ground of the power source. Pay attention to the voltages corresponding to the high and low levels of the binary input: high = 12...48 V, low = 0...2 V.

The switch control can be arranged for example by branching a pressure line from a pressure-controlled sampler to a pressure switch that provides the signal.

9.G. Sensitivity Correction

As the main applications of the MCA*i* are in the pulp and paper industry, its consistency sensitivity is tuned for wood fibers. In other applications the consistency sensitivity must be defined and corrected specifically for each process.

Consistency sensitivity is determined by means of laboratory follow-up:

1. Take a sufficient number of samples, covering as wide a consistency range as possible. The larger the consistency range and the more samples, the more reliable the result.
2. Plot the results in an "MCA*i* – Cs vs. Lab Cs" graph.

NOTE: MCA*i* values on the Y-axis, laboratory consistency on the X-axis!

3. Calculate the slope of the linear regression line, i.e. the ratio between MCA*i* change and Lab Cs change.
4. Go from MAIN MENU => SELFDIAGNOSTICS=> SPECIAL FUNCTIONS => press number key 0 => SENSITIVITY COEFFICIENT (Fig. 9.16). This function is hidden as it is mainly needed in applications outside the pulp & paper industry.
5. Press [F1&F2] EDIT, and the cursor will appear in the field "dMCA / dLab Coefficient". Enter the obtained slope and press [F3&F4] SAVE to save the changes. The MCA*i* will calculate the new consistency sensitivity by applying the new slope (= coefficient).

The sensor's sensitivity is defined as relative to wood fibers, sensitivity to wood fibers being = 1.

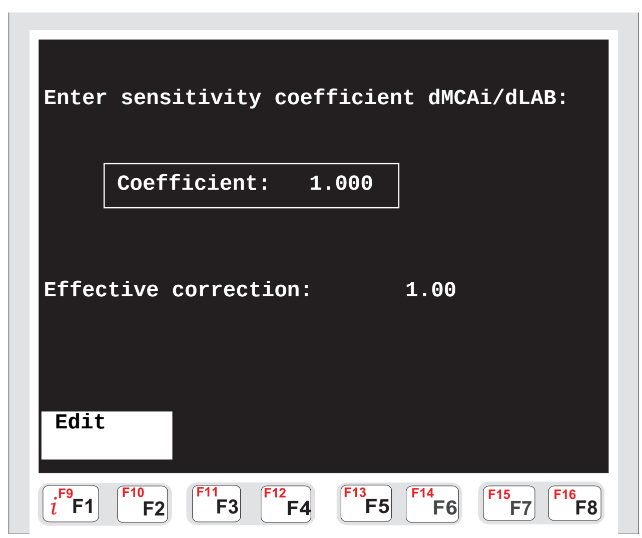


Fig. 9.16. "Enter sensitivity coefficient" display.

10. Self Diagnostics

10.A. Self-Diagnostics Functions

Go from MAIN MENU => SELFDIAGNOSTICS (Fig. 10.1).

This display contains functions necessary for the monitoring and testing of the MCA*i*sensor. The error table, Reset-Abort and other settings are accessible from this display. In addition, the special functions contain temperature and chemical compensation, filler content, sampling, recipes, and sensitivity coefficient; these are described in section 9 of this manual.

The following sections give information on the functions needed for sensor monitoring and testing.

10.B. Error Table

Go from MAIN MENU => SELFDIAGNOSTICS (Fig. 10.1).

This display shows the error messages, if errors have occurred. For example, the display shown in Fig. 10.1 contains two error messages. The display shows a description of the error, the date and time when it occurred, and whether or not the error is still active. "VALID" indicated that the error is active, and when an error is corrected, the time of correction will appear.

The latest error message is always shown on the first line. Up to 50 error messages can be stored in the table. Use the UP/DOWN arrow keys to scroll the table on the screen, and press [F1&F2] ERASE to clear it.

In addition to error messages, the screen also shows the temperature inside the MCA*i* sensor's electronics cabinet ("Cabin temperature"). In a hot installation point the temperature may rise very high, which will shorten the lifetime of the sensor's electronics.

NOTE: If the temperature inside the electronics is over 70°C (158°F), the Vortex cooler is strongly recommended! For more information see section 11.C.4.

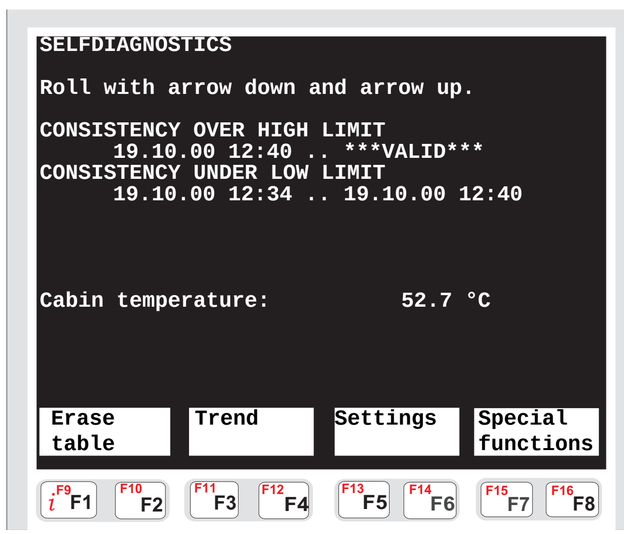


Fig. 10.1. "Error table" display.

10.C. Simulation Cable Test

Go from Main Menu => Selfdiagnostics => Settings => Simul. cable (Fig. 10.2).

The simulation cable test can be used to check for possibly faulty sensor electronics; this may be necessary if the signal level from the measurement level is low while the reference channel is OK. In the test, the measurement from the process is replaced by a simulation cable and a microwave attenuator of a known rating. Proceed as follows:

1. Disconnect the antenna cables as instructed in section 11.C.2.
2. Connect the simulation cable and microwave attenuator to the antenna connectors on the Microwave Module.
3. Go to Selfdiagnostics => Settings => Simul. cable and press [F1&F2] Measure. The MCA*i* sensor will measure the attenuation of the microwave attenuator in dB. The measured attenuation must not differ more than ±5 dB from the true attenuation of the device. E.g. if the attenuator rating is 60dB, the measured result must be in the range 55–65 dB.

If the measurement result is in the acceptable range, the signal level deviation is caused either by the process, antennas, or antenna cables (see section 11).

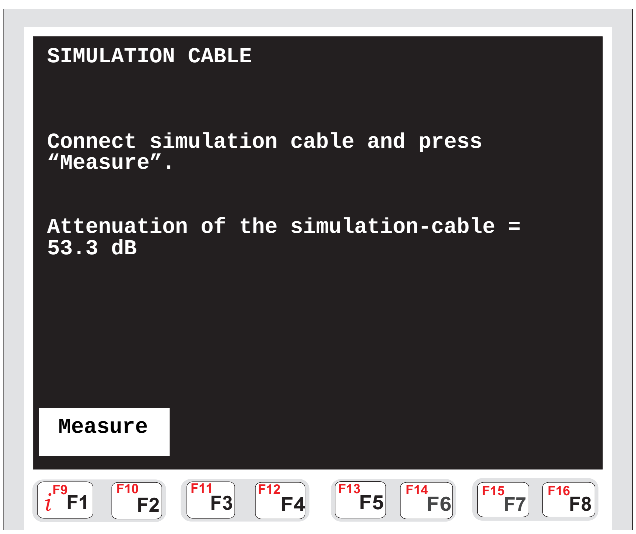


Fig. 10.2. "Simulation cable" display.

10.D. Error Limits

Go from Main Menu => Selfdiagnostics => Settings => Diagn. limits (Fig. 10.3).

Limits and functions for each error can be configured on this page. Press [F1&F2] Edit to change the limits. Also the current output and alarm relay functions can be changed here (Yes/No). Press [F3&F4] Default values in the edit mode to apply the program defaults to all settings.

When the values have been configured as required, press [F7&F8] to save.

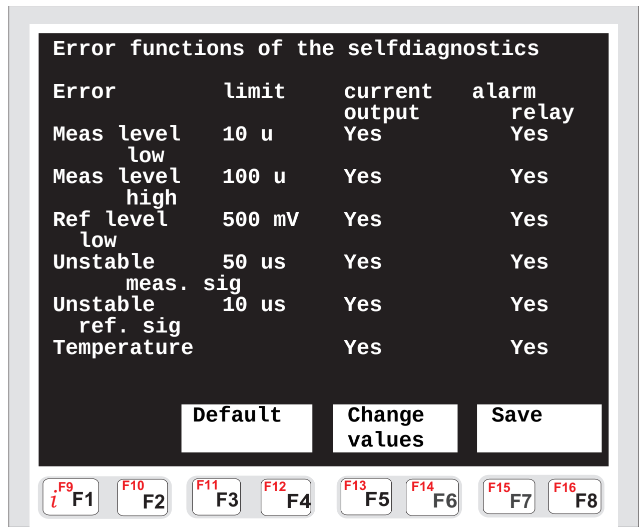


Fig. 10.3. "Diagnostics limits" display.

11. Troubleshooting & Service

NOTE: Before detaching a sensor or the antenna of a flow-through model, make sure that the process pipeline is empty and unpressurized, and that the work can proceed safely!

The kajaaniMCA*i* does not require any regular maintenance. This chapter contains instructions for possible fault situations.

11.A. Troubleshooting

The sensor contains a process measurement channel, an internal reference channel, and a process temperature measurement. All of these measurements are monitored by the sensor's self-diagnostics. When an error or fault is detected, the self-diagnostics will give an error message. However, it cannot precisely locate the unit or module where the fault originated. To locate the origin of a fault, follow the diagram shown in Fig. 11.1.

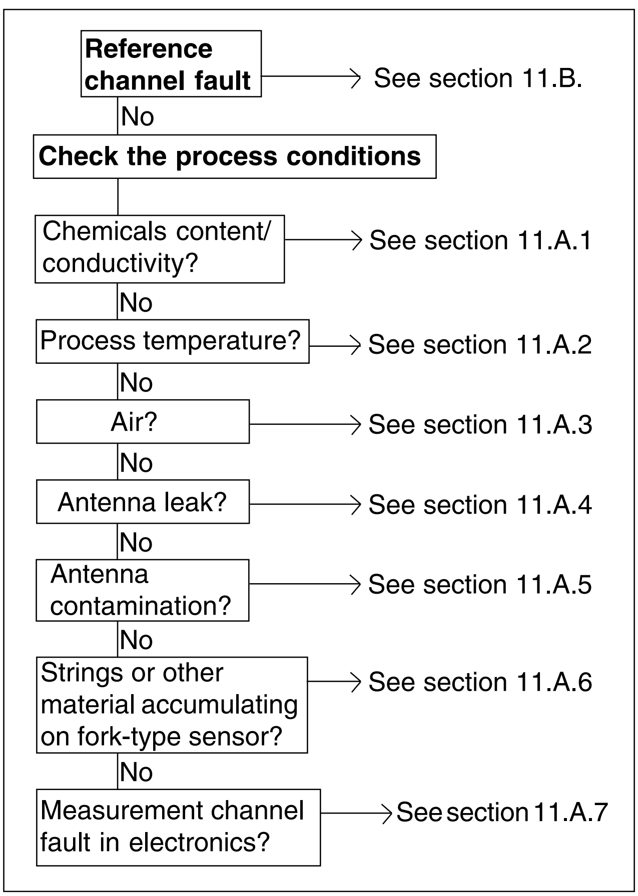


Fig. 11.1. Troubleshooting diagram.

11.A.1. Chemicals content

Chemicals dissolved in the process attenuate the microwave signal. A substantial increase in the chemicals content may attenuate the signal level below the low limit set for the self-diagnostics. The signal level can be increased by performing a new start-up (section 6.A) at the new, higher signal level.

Large variations in the chemicals content may also cause error in the measurement, even if the signal level stays within the operating range. In this case, use chemicals compensation to eliminate the error; see instructions in section 9.B or 12.C.1 (HART communicator).

11.A.2. Temperature

Water temperature affects the propagation velocity of microwaves. A substantial drop in process temperature may attenuate the signal level below the low limit set for the self-diagnostics. The signal level can be increased by performing a new start-up (section 6.A) at the new, higher signal level.

If the signal level stays within the correct operating range but the measurement shows a temperature effect, use temperature compensation to eliminate the error; see instructions in section 8.C or 12.C.2 (HART communicator).

11.A.3. Air

Air in the process is a disturbing factor that increases the consistency reading. To eliminate this, the minimum process pressure specified for the MCA*i* is 1.5 bar (21.8 psi). At pressures above this limit the contained air is dissolved in the water and thus will not disturb the measurement.

Large air bubbles do not dissolve in water, and thus it is not possible to give precise pressure specifications for eliminating them. Large bubbles are generated e.g. when pulp is dropped into a chest while the level is low, and especially if pulp is dropped to the intake side of a pump. The resulting air bubbles have no time to disappear and they will pass into the pipelines. Also strong agitation while the level in the chest or tank is low may generate a whirl that sucks air into the stock. Another source of air in the pulp are possibly leaking joints at the intake side of a pump.

11.A.4. Leak in microwave antenna

This problem will appear as a slow drift of the measurement signal to one direction, most likely downwards. The signal level may also decrease slightly. If a leak is detected, replace the antenna with its antenna cable. To check an antenna for leaks, open the antenna cable casing, at the antenna end, and see if it contains water.

11.A.5. Antenna contamination

Contamination problems will appear as an upwards drift of the measurement. If the antenna gets cleaned from time to time, for example when the wood species changes, the drift may disappear. The antennas are made of glazed ceramic, and contamination may be caused by some substance adhering to the glass surface.

11.A.6. String or other material attached to the fork-type sensor

This kind of problems appear either as a drift in the measurement (most likely upwards), or as a rapid level change, depending on whether the material accumulates gradually on the sensor or gets suddenly stuck to it. If such problems are expected or observed, install a deflector plate to divert this kind of materials past the sensor. The deflector plate is available as option.

11.A.7. Measurement channel fault in electronics

Fault in the measurement channel may appear as a very low signal level, unstable measurement signal, measurement drift, or a sudden level change. Especially a sudden level change most probably indicates an electronics fault. The other effects may also be caused by process conditions, leaks in the antennas, contamination, and the accumulation of strings or other material on a fork-type sensor.

The signal level of the measurement channel can be checked by using a simulation cable (see section 10.C). If the test shows that the measurement channel (electronics) is faulty, replace the unit and perform a new start-up as instructed in section 6.A or in chapter 12. (HART communicator).

11.A.8. Current signal fault

If the MCA*i* reading and the current signal value do not match, the current signal (in electronics) is faulty. Before replacing the electronics, make sure that the current signal cables are correctly connected – a wrong connection may cause the problem!

Note that the MCA*i* current signals use their own power supply. Do not connect an external power supply to the current signals!

11.B. Error Messages of Selfdiagnostics

When the sensor's self-diagnostics detects a fault, the current signal is set to the selected fault status (0, 4, 20 mA, or freeze) and gives an alarm through the alarm relay. In addition, an error message will appear on the Status line in the bottom of the Communicator-i Main Menu and in the *Device status* menu of the HART communicator, and the fault will appear in the error history. The following error messages are possible:

Reference channel fault

This fault is always caused by the Electronics Unit. It may appear either as a low reference signal level or unstable signal, detected by the self-diagnostics:

• Reference signal level low

The reference signal level is below the low limit set to self-diagnostics. Replace the Electronics Unit and perform a new start-up as instructed in section 6.A or in chapter 12. (HART communicator).

• Unstable reference signal

Rapid fluctuations in the reference signal. The electronics Unit is faulty. Replace the Electronics Unit and perform a new start-up as instructed in section 6.A or in chapter 12. (HART communicator).

Measurement signal level low

The measurement signal level is below the low limit set to self-diagnostics. Possible causes:

- fault in Electronics Unit,
- significant increase in the chemicals content (conductivity) of the process,
- significant drop in process temperature,
- damaged microwave antenna.

Measurement signal level high

The measurement signal level is over the high limit set to self-diagnostics. This phenomenon is caused either by a substantial decrease in the chemicals content (conductivity) of the process or an increase in temperature, not by any device fault. This error message may also come up if the process pipeline is empty.

Measurement signal unstable

Rapid fluctuations (duration less than 1 second) in the measurement signal. Possible causes: large air pockets in the stock.

Temperature measurement error

Process temperature measured by the sensor is below 0°C (32°F). Possible causes:

- Pt-100 sensor connector is disconnected from the Field Connection Board,
- defective Pt-100 sensor cable,
- defective Pt-100 sensor,
- fault in Electronics Unit.

First make sure that the Pt-100 sensor connector is securely connected to the Field Connection Board, connector P4. If this connection is OK, connect a Pt-100 simulator to replace the Pt-100 temperature sensor. The temperature measured by MCA*i* must be within ± 2°C (± 3.6°F) of the reading marked on the simulator. If not, the Electronics Unit is faulty. Replace the Electronics Unit and perform a new start-up as instructed in section 6.A or in chapter 12. (HART communicator).

If the MCA*i* sensor measures the Pt-100 simulator correctly, either the Pt-100 sensor, its cable or connector is defective. Replace the Pt-100 sensor (see section 11.C.5).

The Pt-100 sensor and wires can be checked with a multimeter, as follows:

1. Switch power off from the MCA*i*, either by switching the supply power off or by disconnecting the power ground connector from the Field Connection Board.
2. Measure the resistance of the Pt-100 sensor from its pins soldered to connector P4 (on Field Connection Board).

Two red wires and two white wires are connected to the connector. The wires must be connected alternately: red – white – red – white. It does not matter which color comes first.

The red wires are connected together at the Pt-100 sensor, and the resistance between them must be < 2 Ohm (wire resistance). If the resistance is infinite, the wire is either broken or come loose from the connector. If you cannot locate the break in the wire, contact the supplier's service.

Also the white wires are connected together, and the resistance between them must be < 2 Ohm. If the resistance is infinite, the wire is either broken or come loose from the connector. If you cannot locate the break in the wire, contact the supplier's service.

The resistance between any wire and ground (sensor body) must be > 1 MOhm. If there is a short circuit, the wire insulation is faulty. If you cannot locate the faulty point, contact the supplier's service.

If all of the above tests show that the wires are OK, the Pt-100 sensor is faulty. Contact the supplier's service.

Table 11.1. Resistance values of the Pt-100 sensor.

Measurement	Resistance
Between the 2 red wires and between the 2 white wires	< 2 Ω
Between GND and any wire of Pt-100	>1 MΩ

11.C. Replacing Components

The following sections contain instructions for the replacement of sensor electronics, antenna cables, and antennas of the flow-through sensor. The antennas of the fork-type sensor are not included in spare parts, and they must always be replaced by the manufacturer. The following instructions apply for all MCA*i* sensor types.

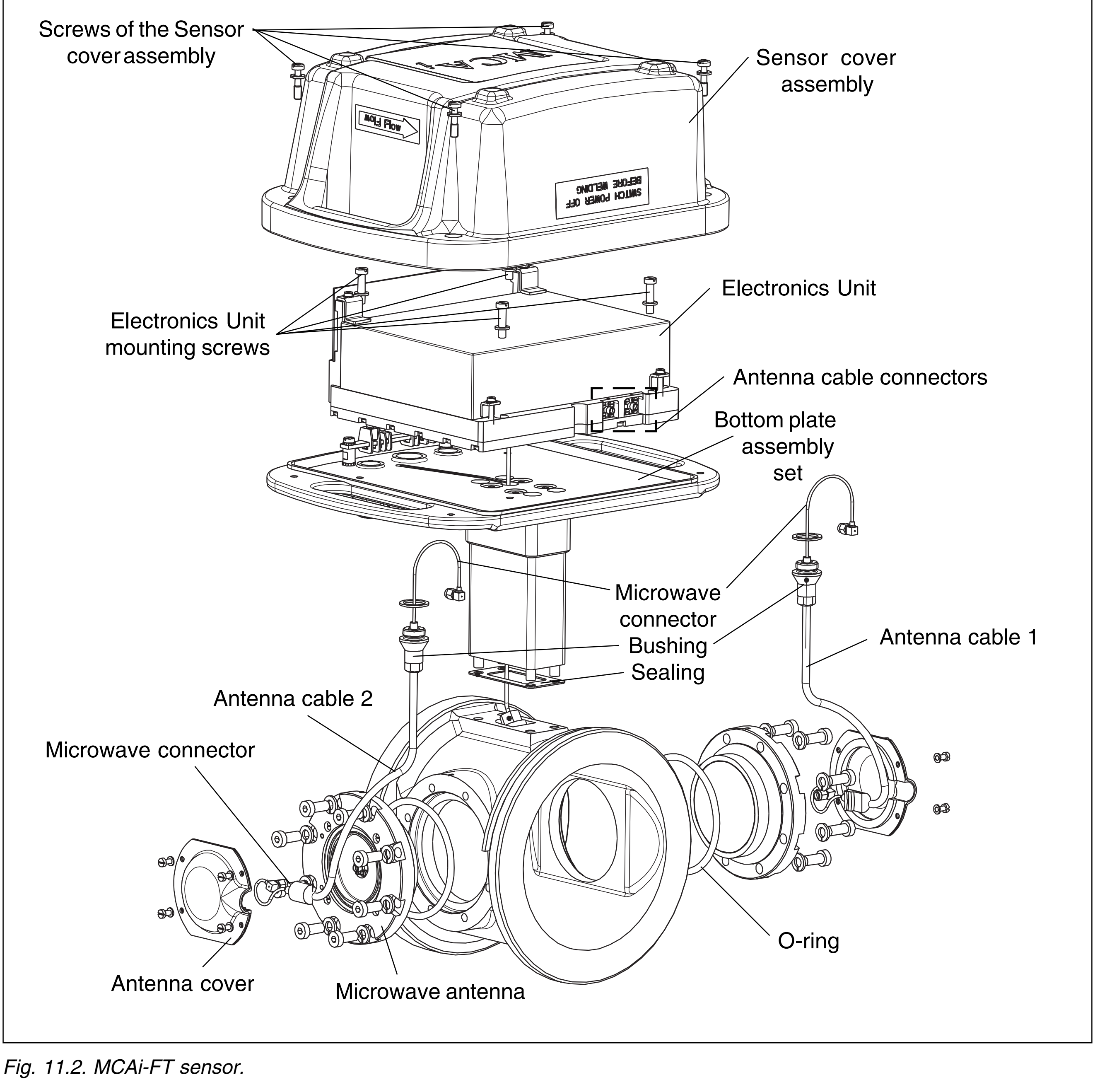


Fig. 11.2. MCAi-FT sensor.

11.C.1. Replacing the Electronics Unit (Fig. 11.2)

• Removing:

1. Switch power off from the sensor.
2. Remove the sensor sensor cover assembly.
3. Disconnect all wires from the Field Connection Board.
4. Disconnect the antenna cables.
5. Remove the four mounting screws, located in the corners of the Electronics Unit, and lift the unit off.

• Installing:

1. Fasten the Electronics Unit in position with the four screws. Apply hydraulic sealing on the screws.
2. Connect the antenna cables.
3. Connect the necessary wires to the sensor's Field Connection Board.
4. Install the sensor sensor cover assembly back.
5. Switch operating power on.

11.C.2. MCA*i*-FT antenna cables (Fig. 11.2)

NOTE: With the unflanged sensor models FT-150 and FT-200, disconnecting or connecting the antenna cables requires a PROCESS SHUTDOWN because the pin bolts next to the antenna cables must be removed!

• Removing:

1. Models FT 150 & FT 200: Remove the three pin bolts next to the antenna cable.
2. Open the four mounting screws of the antenna casing, and take the casing off.
3. Detach the microwave connector from the antenna.
4. Unscrew the bushings of the protective casing (attached to sensor electronics bottom plate) and slide them downwards.
5. Remove the sensor sensor cover assembly.
6. Carefully lift the antenna cable from its mounting groove on the sensor body, at the antenna end. Do not bend the cable any more than necessary.
7. Unscrew the microwave connector of the antenna cable from the Electronics Unit, and push the antenna cable out of the antenna casing.

NOTE: Do NOT try to remove the bushing from the antenna cable!

• Installing:

NOTE: When tightening the connectors, only use the special torque spanner provided for this purpose!

1. Push the antenna cable through the hole on the bottom plate, and screw the microwave connector to the bottom plate.
2. Apply a very small amount of some mild locking glue on the exposed threads, e.g. using the tip of a thin screwdriver.
3. Tighten the microwave connector with the torque spanner to its final tightness.
4. Press the antenna cable into its mounting groove on the sensor body.
5. Install the sensor sensor cover assembly back.
6. Screw the cable's microwave connector to the antenna, about halfway through.
7. Apply a very small amount of some mild locking glue on the exposed threads, e.g. using the tip of a thin screwdriver.
8. Tighten the microwave connector with the torque spanner to its final tightness.
9. Place the antenna cable casing back in position and tighten with the four mounting screws.
10. With models FT-150 & FT-200: install the pin bolts.
11. Check sensor calibration with a calibration sample. If necessary, perform a new calibration.

11.C.3. MCAi-FT microwave antennas (Fig. 11.2)

• Removing:

1. Disconnect the antenna cables as instructed in section 11.C.2.
2. Open the 8 antenna mounting screws and remove the antenna. You need a 5mm Allen key to open the screws.
3. Keep the O-ring safe.

• Installing:

1. Place the O-ring around the antenna.
2. Place the antenna in the correct position. The notch on the antenna flange must be aligned with the notch on the sensor body.

NOTE: Make sure that the antennas are installed in the correct position (i.e. with the notches well aligned)! There is no positioner to prevent incorrect mounting.

3. Fasten the antenna in position with the 8 screws. You need a 5mm Allen key for the screws.
4. Install the antenna cables as instructed in section 11.C.2.
5. Perform a new start-up and calibration.

11.C.4. Installing a Vortex cooler

A Vortex cooler is available as option, order code A4610977 (Vortex cooler assembly, sensors FT) and A4611009 (Vortex cooler assembly, sensors F/FS).

The cooler is installed to keep the sensor's Electronics Unit sufficiently cool. Cooling is needed if the sensor is installed in a place where the temperature inside the Electronics Unit rises to 70°C (158°F) or higher. The temperature inside the Electronics Unit can be checked with Communicator-i, SELFDIAGNOSTICS.

The Vortex cooler mounting kit contains the following parts:

1. Cooler, with diam. 6mm hose connector
2. Screws M6 x 20, 2 pcs
3. Spring washers M6, 2 pcs
4. Heat-conductive grease

• Installing:

1. Remove the two M6 plug screws from the bottom plate, next to the connecting pipe.
2. Spread a thin, uniform layer of heat-conductive grease on the black cooler body, mounting side (smooth).
3. Place the cooler on the bottom plate so that the mounting holes are aligned and the outlet pipe points either upwards or to the side, depending on the position of the sensor in the tube.
4. Install the screws and washers.
5. Connect an air tube (inside diameter 6 mm, 15/64") to the hose connector and secure with a hose clamp.

• Cooling:

Maximum volume flow in the air inlet is 230 Nl/min (8.6 scfm). If no flow meter is used, start the air inlet carefully and gradually increase the supply until the required cooling efficiency is obtained.

NOTE: The outlet pipe blows hot air! Make sure that there are no cables or other objects touching the tube or close to its outlet end.

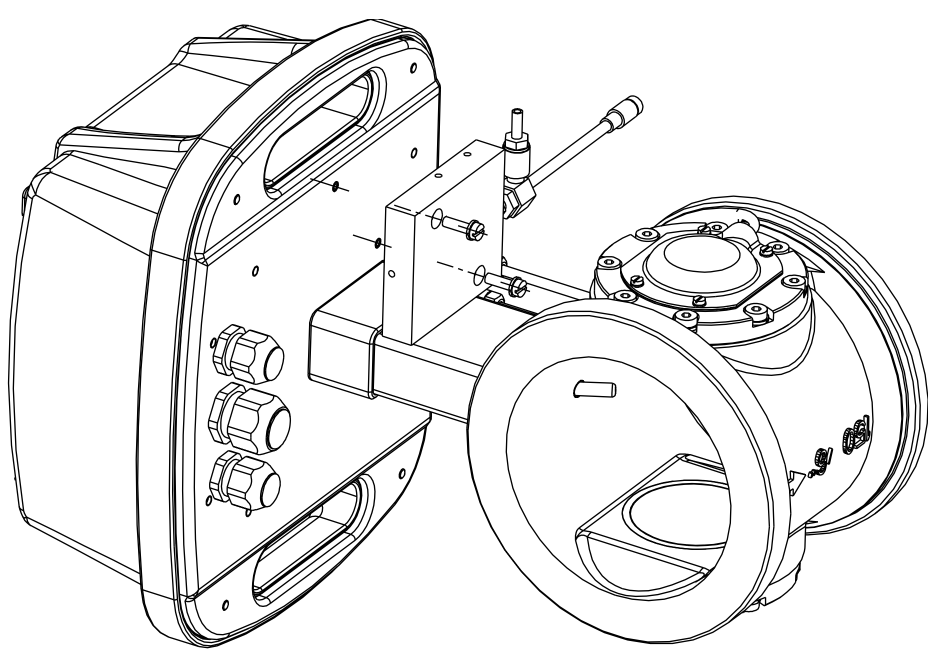


Fig. 11.3. Installing a Vortex cooler to an MCAi-FT sensor.

11.C.5. Replacing a Pt-100 temperature sensor in MCAi-FT

NOTE: The process pipeline must be empty when the temperature sensor is replaced!

1. Switch operating power off.
2. Remove the sensor cover assembly.
3. Remove the sensor electronics (see section 11.C.1).
4. Disconnect the antenna cables (see section 11.C.2).
5. Disconnect the current signal cables and Display Unit cable from the bottom plate.
6. Carefully detach the Pt-100 wire from the groove on the bottom plate.
7. Detach the bottom plate assembly from the sensor body (4 outermost hex socket screws).
8. Push the Pt-100 through the bottom plate assembly.
9. Detach the defective Pt-100 assembly from the sensor body.
10. Reassemble the sensor in reverse order.

NOTE: Make sure to push the Pt-100 wire into the groove on the bottom plate – this protects the wire from being squeezed between the Electronics Unit and bottom plate!

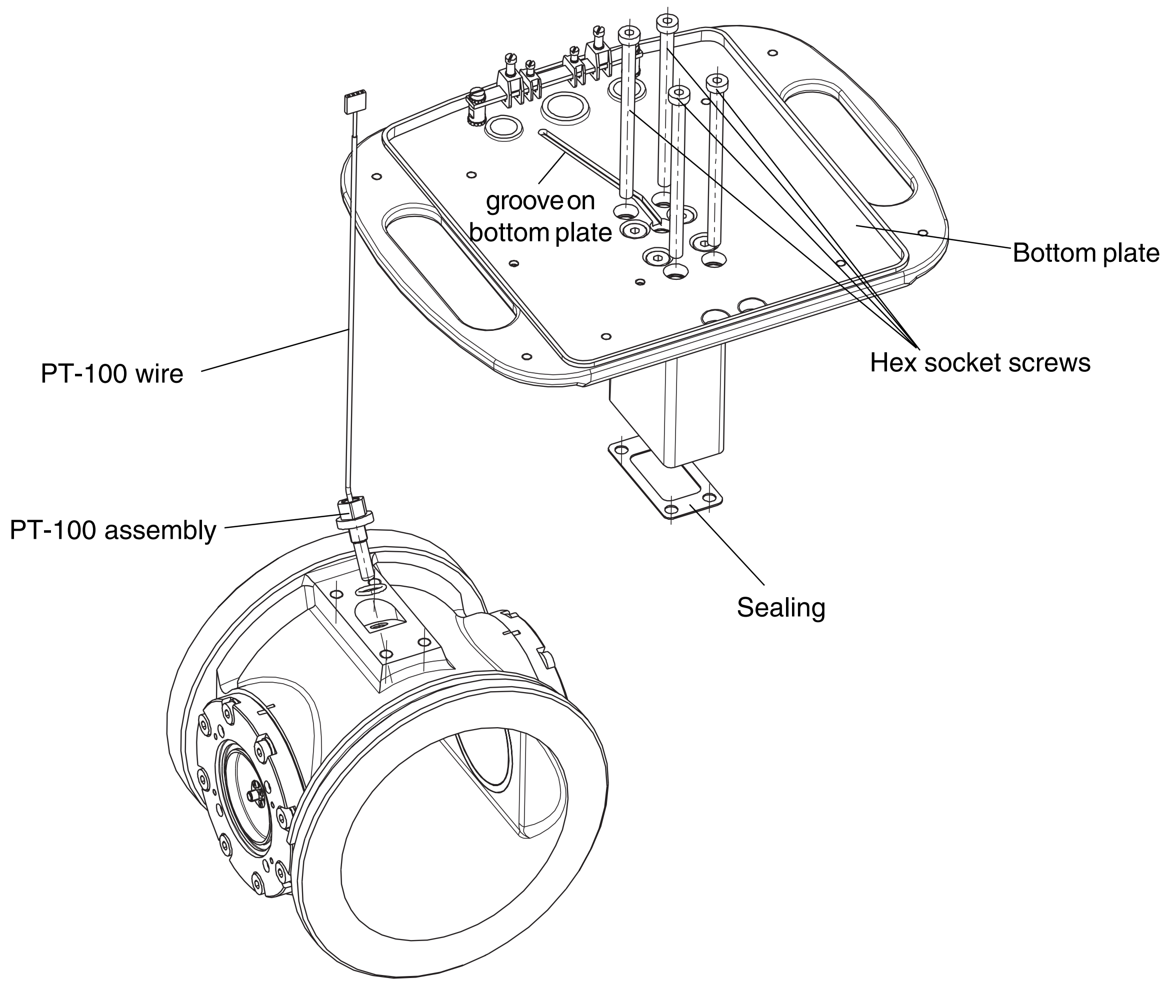


Fig. 11.4. Replacing the Pt-100 sensor.

12. HART® Communication

HART® is a registered trademark of HART Communication Foundation. HART® communication is a digital method for data communication between a field instrument and the HART® host device (terminal or control system). HART® communication is implemented by applying FSK-modulation compatible with the Bell202 modem standard; in this method, a high-frequency communication signal is incorporated in a DC-level measurement signal. The average level of the FSK-signal is zero, and thus it does not distort the 4–20 mA measurement signal.

The HART communicator is connected parallel to the current signal line, for example to the HART connectors on the kajaaniMCA*i* Display Unit. From version V1.4 upwards, the kajaaniMCA*i* software is provided with device-specific HART programming. In addition, the HART communicator must contain the kajaaniMCA*i* command set. Without the command set, only the standard HART communications are available, and these are not sufficient for start-up and calibration. The MCA*i*'s HART software tree is illustrated in Fig. 12.2.

Fig. 12.1. HART® communicator.

To access a function with the HART communicator, select the function with the cursor and then press the RIGHT arrow (functions provided with an arrow symbol) or function key [F4] Enter (functions with no arrow symbol). The data configured on the display can be sent to the MCA*i* by pressing [F2] Send or [F4] OK.

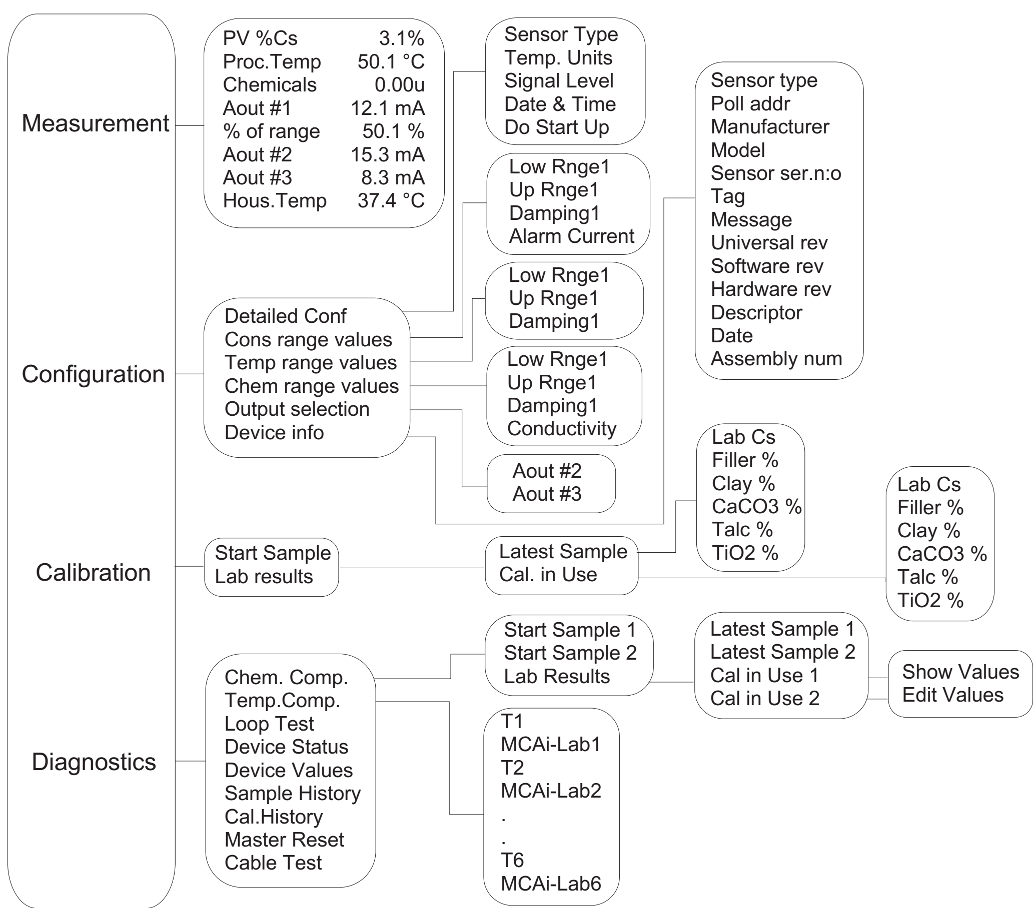


Fig. 12.1. Operating chart of the HART® communicator.

If all functions of a menu cannot be displayed at the same time, a downward arrow symbol will appear in the bottom left corner of the display. Press the DOWN arrow key to scroll all functions on the display.

12.A. Starting up

NOTE: The process must be runnin in normal status when the device is started up! After powering on, allow the unit to warm up for 3 hours before start-up.

NOTE: Before start-up, do Master Reset to the MCA*i* sensor.

Master Reset procedure: Select DIAGNOSTICS. Then select MASTER RESET and press [F4] OK to clear the messages that appear on the display. When Master Reset is complete the HART communicator will show the text: “Master reset OK. Do the start up in the Detailed Configuration menu”. Press [F4] OK to accept.

Then select CONFIGURATION => DETAILED CONFIGURATION, and the display shown in Fig. 12.3 will appear. Configure the correct settings in fields 1...4.

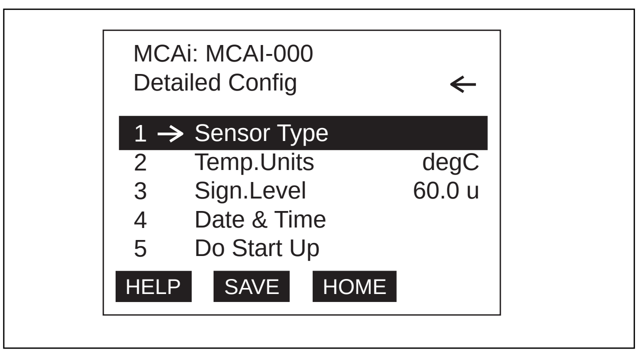


Fig. 12.3. Configuration menu.

Sensor type

If necessary, check the sensor type from the device plate. The last alternative in the list is *Prev* (Previous). When this option is selected, the MCA*i* will read the previous start-up and calibration from memory. Use this option only after a software update, when there is no need to repeat the start-up and calibration procedure.

When starting up a new sensor, make sure to select the correct sensor type – in this case the previous start-up was made during final testing and it does not correspond to the actual process conditions!

Temp. units

Select the required temperature unit, °C or °F.

Signal level

Target signal level during start-up, default 60 u (unit). The signal level should remain in all process conditions within the range 20...80 u.

It may be necessary to change the target signal level if large chemical content or temperature variations occur in the process. A higher chemicals content will lower the signal level, and a lower temperature has the same effect. If such changes are likely to take place in the process, the signal level must be set closer to the high limit (80 u) to make sure that it remains within the correct range also during process variations. Similarly, a lower chemicals content and higher temperature will push the signal level upwards. If such changes are likely to take place in the process, the signal level must be set closer to the low limit (20 u) to make sure that it remains within the correct range also during process variations.

Date & Time

Set the correct date and time for the timing of calibration samples.

Use the SEND command to send the configured data to the MCA*i*. If “Prev” was selected as the sensor type, the MCA*i* will read the previous calibration from memory and thus does not require a new calibration.

If another sensor type than “Previous” was selected, select next DO START UP. The MCA*i* will first ask you to confirm the selected sensor type and target signal level. If these are correct press OK, otherwise press ABORT and select the correct settings. When OK is pressed, the MCA*i* will first adjust the signal level as close as possible to the set target and display the achieved signal level. Press again OK to accept, and the MCA*i* will initialize the measurement; this takes about 1–2 minutes. The percentage running on the screen indicates the progress of initialization. When the initialization is complete, the device prompts you to calibrate it and to scale the current output. Complete these steps as instructed in the following sections, and after this the MCA*i* is ready for operation.

12.B.1. Reading the measured values

The MCA*i* reports the measured values in the Measurements menu (Fig. 12.4). Menu items:

- **PV**: Consistency (Primary Variable).
- **Process**: Process temperature, in the unit (°C or °F) selected by the user.
- **Chemicals**: Change in chemicals content compared to the time of calibration, measured at the microwave signal level with the effect of temperature eliminated by compensation. The applied unit is the signal level unit u.
- **Aout 1 mA**: Value of consistency current output, in mA.
- **% of range**: Value of consistency current output, as percentage of the current output range.
- **Aout 2**: The value of the second current output (temperature or chemicals content), in mA.
- **Aout 3**: The value of the third current output (chemicals content or temperature), in mA.
- **Housing**: Temperature of sensor electronics.

```
MCAi: MCAI-000
Measurements          ←

1 → PV            3.05 %
2   Process     52.3 degC
3   Chemicals       0.0 u
4   Aout 1 mA     12.3 mA
↓5  % of range    50.6 %
.   .
.   .
6   Aout 2         7.5 mA
7   Aout 3        12.1 mA
8   Housing     35.3 degC

HELP  SAVE  HOME
```

Fig. 12.4. Measurements menu.

12.B.2. Calibration

Consistency calibration of the MCA*i* is made using the Calibration menu shown in Fig. 12.5.

```
MCAi: MCAI-000
Calibration           ←

1 → Start Sample
2   Lab results

HELP  SAVE  HOME
```

Fig. 12.5. Calibration menu.

Sampling

The MCA*i* consistency measurement is calibrated using a single calibration point. In the Calibration menu select Start Sample; the MCA*i* begins to average its measurement result and responds "Sampling". Take at least three parallel samples, and then press OK. The unit then displays the averaged consistency (Average) and standard deviation (Deviation) during sampling, and the Temperature, Signal Level and Chem Comp (chemical compensation) values. Press OK to accept.

Entering laboratory values

When the laboratory analyses are ready, select Calibration => Lab results and the display shown in Fig. 12.6 will appear.

The MCA*i* stores the latest measured sample results in the Latest Sample table. Select this menu item with the cursor and press ENTER; the MCA*i* will ask for the laboratory value of the latest sample. Enter the value and press ENTER. Next the device asks for the filler content; give the value as a percentage of the total consistency. This reading does not have to be an exact laboratory value, an estimate with 5% accuracy is sufficient. If a value other than zero was entered, the device will next ask for the relative amounts of filler components (kaolin, calcium carbonate, talc, titanium dioxide). Their sum must be 100%; if not, the display shows a warning and the calibration will not be saved. If this occurs, type the calibration values again in the Latest Sample menu. If the filler content is given as zero, the components are not needed.

Press OK to accept the displayed messages, and the HART communicator will send the configured data to the MCA*i* sensor.

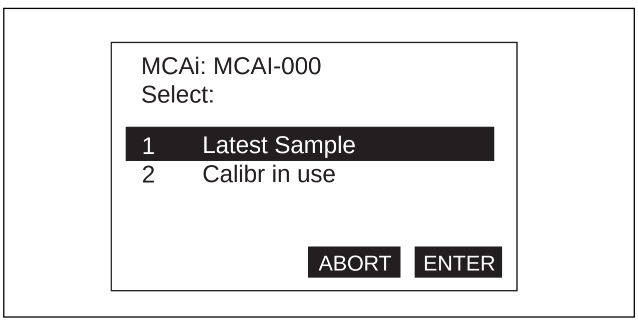


Fig. 12.6. Menu for entering the laboratory values.

Correcting the calibration

If the first calibration is inaccurate for some reason, laboratory follow-up will show a continuous level difference between the sensor and laboratory results. To remove this level difference, the best way is not to take a new sample and enter its lab. value using the Calibration => Lab results => Latest sample menu, as in this case the calibration would again rely on only one sample point and the results from laboratory follow-up could not be utilized. Instead, the preferred method is to perform level correction in the Calibr in Use menu. Example: if the MCA*i* steadily shows about 0.2% higher consistency than laboratory, correct as follows:

Select Calibration => Lab results and then select function Calibr in use to display the laboratory value of the currently valid calibration. Correct the level difference by deducting from the laboratory value the MCA*i*'s "excessive" 0.2%. Press OK to accept the existing filler content value, and the HART communicator will send the data to the MCA*i* sensor. The sensor will then correct its consistency level by 0.2%.

Changing the filler content

Changes in filler content can also be set using the Calibr in Use display. This may be necessary if the total filler content changes by more than 5%.

12.B.3. Scaling and configuring the current outputs

The current outputs for consistency, temperature and chemicals content are scaled in the Configuration menu (Fig. 12.7).

NOTE: Section Detailed Config deals with the sensor start-up, described at the beginning of this chapter.

- **Cons range values:** current output for consistency, Aout 1.
- **Temp range values**: current output for temperature, Aout 2 or Aout 3.
- **Chem range values**: current output for chemicals content, Aout 2 or Aout 3.
- **Output selection**: selects the variable (temperature or chemicals content) for current outputs 2 & 3. Default variables: temperature in current output 2 (isolated), chemicals content in current output 3 (non-isolated).
- **Device info**: this menu contains the following information:
  - Sensor type: type selected during start-up.
  - Poll addr: HART address of the device.
  - Manufacturer: manufacturer of the device (Metso).
  - Model: name of device (MCAi).
  - Sensor ser.n:o: serial number of sensor.
  - Tag: user-defined text, shown at the top of the screen, after device name.
  - Message: user-defined text.
  - Universal rev: Universal Device Description revision supported by the device.
  - Fld dev rev: Specifid Device Description revision supported by the device.
  - Software rev: software revision.
  - Hardware rev: revision number of sensor electronics.
  - Descriptor: user-defined text.
  - Date: freely adjustable fixed date.
  - Final asbly num: field device identification number.

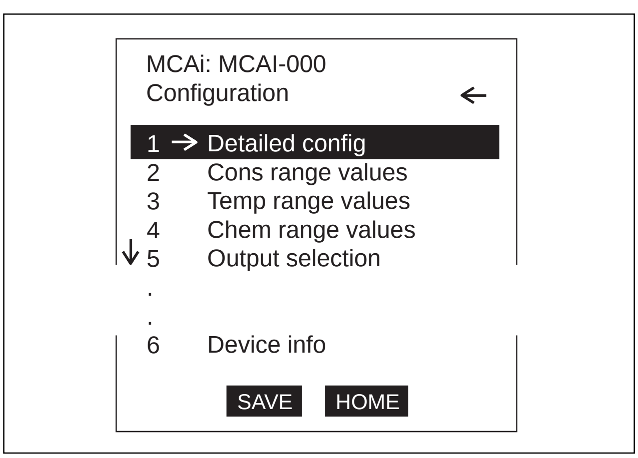


Fig. 12.7. Configuration menu.

Current output for consistency

Select Cons range values and enter the following data:

- **LowRnge**: measurement result corresponding to the low limit (4 mA) of the current signal.
- **UppRnge**: measurement result corresponding to the high limit (20 mA) of the current signal.
- **Damping**: filtering time for the current signal.
- **Alarm curr**: how the current signal behaves when self-diagnostics detects an error. Alternatives: 0 / 4 / 20 mA and Freeze.

Current output for temperature

Select Temp range values and enter the following data:

- **LowRnge**: measurement result corresponding to the low limit (4 mA) of the current signal.
- **UppRnge**: measurement result corresponding to the high limit (20 mA) of the current signal.
- **Damping**: filtering time for the current signal.

As default, the temperature signal is set to current output Aout 2 (isolated). If necessary, it can also be set to the non-isolated output Aout3 by using function Output Selection.

Current output for chemicals content

Select Chem range values and enter the following data:

- **LowRnge**: measurement result corresponding to the low limit (4 mA) of the current signal.
- **UppRnge**: measurement result corresponding to the high limit (20 mA) of the current signal.
- **Damping**: filtering time for the current signal.
- **Conductivity**: conductivity of the Cs calibration sample, needed for temperature compensation of the chemicals content measurement.

If the conductivity value is not known, proceed as follows: Select Calibration => Start sample to take a new sample. Determine the sample conductivity. Go to Calibration => Latest Sample and enter the conductivity value measured by MCA*i* for the sample. This method ensures that the consistency calibration remains unchanged.

Chemicals content is measured from the attenuation of the microwave signal level, with the effect of temperature elimintedby compensation. The result is reported using the same units as in signal level measurement, u (unit). The current signal indicates changes in chemicals content in comparison to the time of consistency calibration. During calibration the value is zero. When the chemicals content decreases the measurement result will be negative; when the chemicals content increases the result will be positive.

Output selection

As default, the chemicals content signal is set to current output Aout 3 (non-isolated). If necessary, it can also be set to the isolated output Aout2 by using function Output Selection.

12.B.4. Diagnostics

The DIAGNOSTICS menu is shown in Fig. 12.8.

The first two functions (temperature & chemicals compensation) are described in section 12.C of this manual. The other functions of the menu are described below.

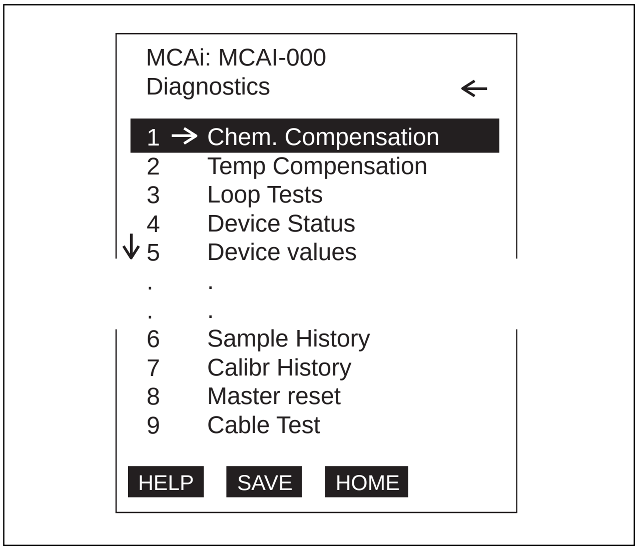


Fig. 12.8. Diagnostics menu.

Loop test

Each of the MCA*i* sensor's current outputs can be set to a desired value to test the current loop.

Device Status

This function lists all error types of the self-diagnostics and indicates whether an error is on or not (ON/OFF).

Device values

From this menu you can read the following measured values:

- **Mlev** = measurement signal level (u),
- **Rlev** = reference signal level (V),
- **Meas stab** = stability of measurement signal,
- **Ref stab** = stability of reference signal,
- **Chem comp** = chemicals compensation value (%).

Sample History

This table contains the measured values of the latest 30 samples, identified with running numbers (1–30). Type a sample number and press ENTER to display the sample date and time and the measured values. The latest sample is always no. 1.

Calibration History

A table where changes made to the calibration are stored. The changes are identified with running numbers 1–30. Type a number and press ENTER to display data of the selected change: date, sample date, temperature, laboratory consistency, MCA*i* consistency, and ash content. Change number 1 is always the latest change.

Master Reset

This command performs Master Reset to the device. It is used in connection with start-up.

Cable Test

This function can be used to measure the attenuation of the measurement channel in dB. The function is used when locating a fault by using a simulation cable. For more information see section 10.C of this manual.

The following functions can be used to eliminate the disturbing effect of various process variables.

Chemicals compensation may be needed if the chemicals content of the process varies considerably.

If the measurement appears to be affected by process temperature, the temperature compensation can be corrected, section by section, by applying a linear curve. Correction is needed if the process temperature goes below 30°C (84°F).

12.C.1. Chemical compensation

• Principle

Large variations in the chemicals content of the pulp affect the measurement of microwave propagation time. As a result, the MCA*i* will show a too high reading when the chemicals content increases. Chemicals also affect the attenuation of the microwave signal, causing a lower signal level result. Thus a correlation can be found between the consistency error (MCA*i* – Lab) and the measured signal level, and this correlation can be applied to eliminate the measurement error caused by changes in the chemical content.

If large variations occur in the chemicals content of the process, the consistency, signal level and temperature measured by the MCA*i* should be included in the laboratory follow-up, as well as the conductivity and consistency measured in laboratory. Based on the collected data, the signal level measurement can be corrected by chemicals compensation if needed.

Fig. 12.9 shows an example graph based on laboratory follow-up results; consistency error (MCA*i*–Lab.) is on the Y-axis, signal level on the X-axis. Mlev is the abbreviation used for the MCA*i* signal level.

As the graph shows, the consistency error (MCA*i* – Lab) correlates with the signal level. This indicates that the error is caused by chemicals and thus it can be eliminated by chemicals compensation. To make sure, we can make a graph with conductivity (reflecting the chemicals content) is on the X-axis. The graph should then be a rising straight line; the error (MCA*i* – Lab.) grows when conductivity increases.

• Setting chemicals compensation

NOTE: Select the calibration points so that the difference between their chemicals contents and signal levels is as great as possible.

To define the calibration points take two calibration samples, or use samples entered earlier (new sampling is then not needed). The latter method is more reliable if there is data from a long-time laboratory follow-up, as a larger number of sample points are then available.

In the example shown in Fig. 12.10, the calibration points are selected from the laboratory follow-up data as follows: Choose a calibration point with a high signal level. At this point the chemicals content has been low and the MCA*i* has not shown a too high reading. Choose a second calibration point with a low signal level. At this point the chemicals content has increased and the MCA*i* has shown a high reading.

Then enter the values of laboratory and MCA*i* measurements to the sensor: lab. Cs and conductivity, and consistency, temperature and signal level measured by the MCA*i*. Make sure to give the consistencies measured by the MCA*i* and laboratory so that the error (MCA*i* – Lab.) is of the right magnitude; the absolute Cs levels have no significance. In other words, it does not matter whether the Cs values for sample 2 are MCA*i* = 3.2 and Lab = 3.0 or MCA*i* = 5.2, Lab = 5.0. Before determining the compensation graph through samples 1 & 2, the MCA*i* will perform temperature compensation based on the temperature and conductivity.

When the chemicals compensation is in use, the MCA*i* will place the measured signal level result (Mlev) on the compensation line, determine the error (MCA*i* – Lab.) and correct the measured consistency by the calculated amount.

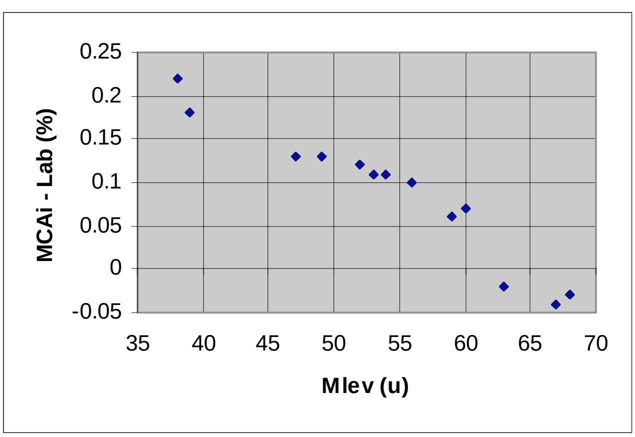


Fig. 12.9. Consistency error caused by changes in chemical content.

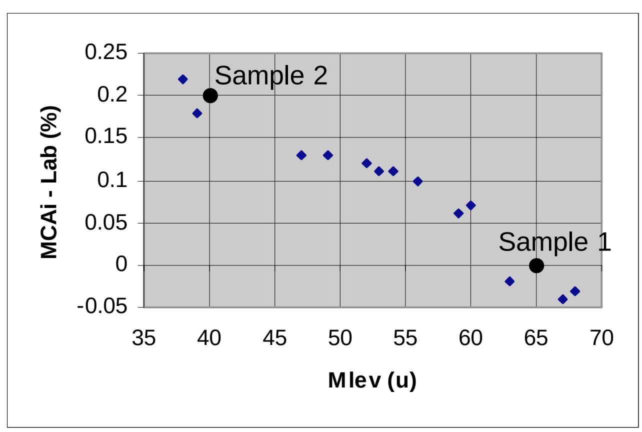


Fig. 12.10. Choosing the calibration points.

• Compensation with HART

When using the HART communicator, proceed as follows: In the Diagnostics menu select Chem. compensation with the cursor and then press the RIGHT arrow key to display the menu shown in Fig. 12.11.

Use function Chem Comp to switch chemicals compensation on and off.

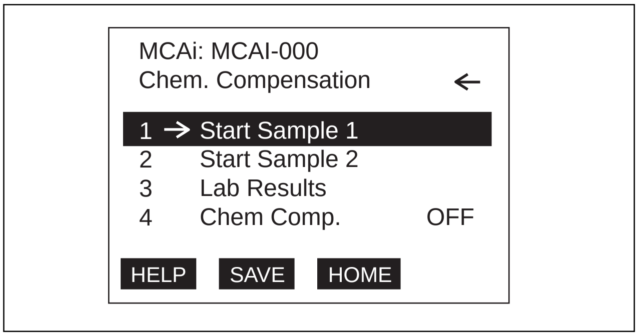


Fig. 12.11. "Chemical compensation" display.

• Sample taking

NOTE: Enter data on two sample points selected from laboratory follow-up data, or take new calibration samples as described below.

In the chemicals compensation menu, select Start Sample 1 or Start Sample 2. The display will read "Sampling" and the MCA*i* begins averaging its measurement result. Take at least three parallel calibration samples. The press OK to stop sampling, and the display will show the MCA*i* measurement results: consistency (Average) and its Deviation, Temperature, Signal Level, and the current chemical compensation value (Chem Comp). Press OK to accept. The results will be saved in the chemicals compensation table Lab Results => Latest Sample and wait for the laboratory values of consistency and conductivity. When the chemical content of the process has changed, repeat this procedure for the second calibration sample.

NOTE: Do not change the consistency calibration while performing the chemicals compensation!

If the consistency calibration is changed before the second chemicals compensation sample has been taken, the MCA*i* will delete the data on the first sample!

• Entering laboratory values

Select Diagnostics => Chem. comp. => Lab results and the display shown in Fig. 12.12 will appear.

Select function Latest Sample for the desired sample. MCA*i* will show the sample data and ask for laboratory consistency. Type the laboratory Cs value and press Enter. Also enter the laboratory conductivity (note the unit: mS/cm), MCA*i* Cs, temperature, and signal level.

If the samples were taken using the function Start Sample 1/2, the MCA*i* measurement values (Cs, temperature, signal level) are already there. Press OK to accept them.

When entering values based on earlier laboratory follow-up, select representative values for conductivity, temperature and signal level values from the plotted (MCA*i* – Lab vs. signal level) graph, and choose the MCA*i* and laboratory consistency values so that the difference between them is correct. The absolute consistency values are not significant.

When both of the calibration points have been sent to the MCA*i* sensor, activate chemicals compensation by function Chem Comp = ON.

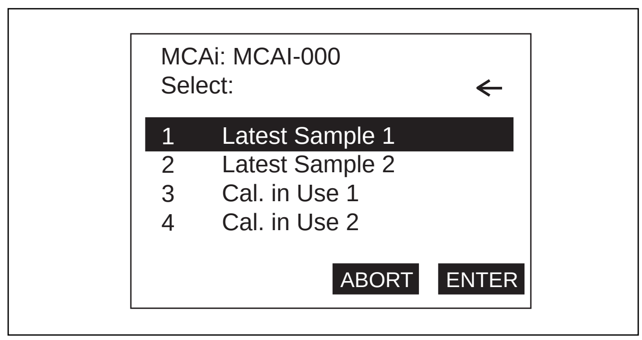


Fig. 12.12. Entering laboratory values.

• Changing the compensation

Chemicals compensation can be changed by either changing the values of existing calibration points, or by determining new calibration samples as instructed above. When taking new calibration samples, remember that the MCA*i* treats the calibration samples as a sample pair – the compensation will not change before values are determined for BOTH samples!

Existing calibration points can be edited as follows: The calibration samples are stored in tables Cal in Use 1 and Cal in Use 2 (Fig. 12.13).

To view data on the existing calibration points, use function Show Values and the measured values will appear on the screen (Fig. 12.14).

Press OK to view the correction values calculated by the MCA*i* (Fig. 12.15).

where

- **MCA – Lab** = consistency error of MCA.
- **Chem comp** = chemicals compensation value (%).
- **Total comp** = total compensation calculated from the above values.

Press ABORT to exit.

Press Edit Values to change the values of the calibration samples. The MCA*i* will then ask for the calibration point data, in the same way as in the menu Latest Sample. Only change the laboratory consistency so that the difference between MCA*i* and Laboratory at that signal level is correct, and press OK to accept the other values.

MCAi: MCAI-000
Select: ←

1	Show Values
2	Edit Values

ABORT ENTER

Fig. 12.13. Changing the chemicals compensation.

MCAi: MCAI-000
Measurements ←

Cal in Use	1 dd-mm-yy
Lab Cons	3.2 %Cs
Conduct	1.2 mS/cm
MCA Cons	3.1 %Cs
Temp	55.2 degC
Mlevel	58.7 u

ABORT OK

Fig. 12.14. Measured values of a sample.

MCAi: MCAI-000
Compensation Values

MCA-Lab	-0.10 %Cs
Chem Comp	0.00 %Cs
Tot Comp	0.10 %Cs

ABORT OK

Fig. 12.15. Correction of chemical compensation.

12.C.2. Correction curve for temperature compensation

Water temperature affects the propagation velocity of microwaves. The sensor therefore measures process temperature with a Pt-100 temperature sensor, and performs linear temperature compensation. However, at temperatures below 30°C (86°F) the effect of temperature is not quite linear. If the process temperature is below 30°C (86°F) – either permanently or from time to time – a correction curve is needed for the temperature compensation.

The correction curve is determined by using the results of laboratory follow-up. The laboratory follow-up data must include consistency measured by the laboratory and by the MCA*i*, and the process temperature measured by the MCA*i* sensor. You can either read the MCA*i* results from the Main Menu, or take follow-up samples by using the START SAMPLE function (see section 12.B.2). The latter alternative will directly give the average values during sampling.

Using the laboratory results, draw a graph with temperature on the X-axis and the (MCA*i* – Lab. Cs) on the Y-axis. Enter the correction curve as point pairs on the resulting graph (temperature / MCA*i* – Lab. Cs). The MCA*i* will create the correction curve by drawing a line between the entered points and then extending the line outside the last points at both ends.

NOTE: Do not make any changes to the consistency calibration or chemicals compensation during the laboratory follow-up period!

At least two points are needed for the curve. To avoid compensation errors due to inaccurate laboratory results, make sure that the points are not too close to each other. The recommended minimum difference between the points is about 5°C (9°F). When determining the curve for a larger temperature range, it is advisable to take a sufficient number of points, at regular intervals. The following examples illustrate the principle of entering the correction curve for temperature compensation.

• Example 1.

The normal process temperature is 40...50°C (104...122°F) but drops temporarily to 20°C (68°F) when the process is started up. The graph (MCA*i* – Lab Cs vs. Temperature) shown in Fig. 12.16 was drawn by using laboratory samples taken while the process was being started.

This graph shows that when the temperature gets below 30°C (86°F) it has an effect on the MCA*i* measurement. Enter the graph as the correction curve as follows:

1. Select DIAGNOSTICS/TEMP.COMP (Fig. 12.16).
2. Choose max. 6 point pairs (temperature, MCA*i* – Lab) from the curve "MCA*i* – Lab vs. temperature". Choose point pairs at even temperature intervals, so that when the MCA*i* connects the points with lines the resulting graph is representative of the original.

Note that the error must be calculated by deducting the laboratory consistency from the MCA*i* reading, NOT vice versa!

3. Enter the point pairs (Temp1, MCA – Lab1) on the display and press function key SEND. The HART communicator will send the data to the MCA*i*.

NOTE: Make sure that you use the same "MCAi – Lab" value for the last two points! Otherwise the correction curve will continue using the slope between the last two points.

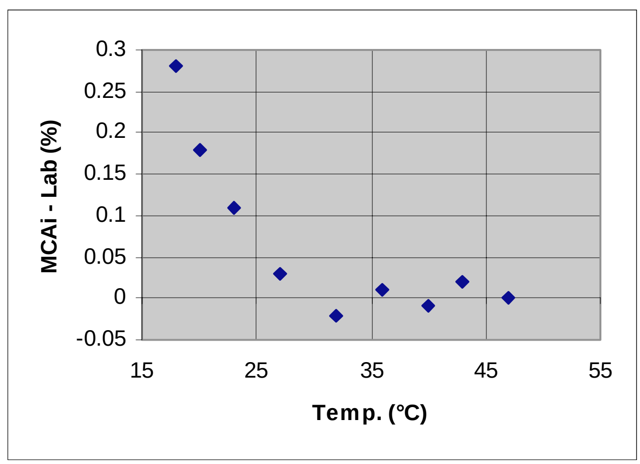


Fig. 12.16. Effect of temperature on the consistency error.

• Example 2.

The process temperature is in the range 20...25°C (68...77°F), and thus errors in the temperature compensation can be expected. The obtained "MCA*i* – Lab. Cs vs. Temperature" curve, based on laboratory results, is shown in Fig. 12.17.

In this case two points are sufficient to determine the temperature effect. Use for example the points 20°C = 0.2% and 25°C = -0.1%, and enter them to the sensor as described in the previous example.

NOTE: Make sure that you use the same "MCAi – Lab" value for the last two points! Otherwise the correction curve will continue using the slope between the last two points.

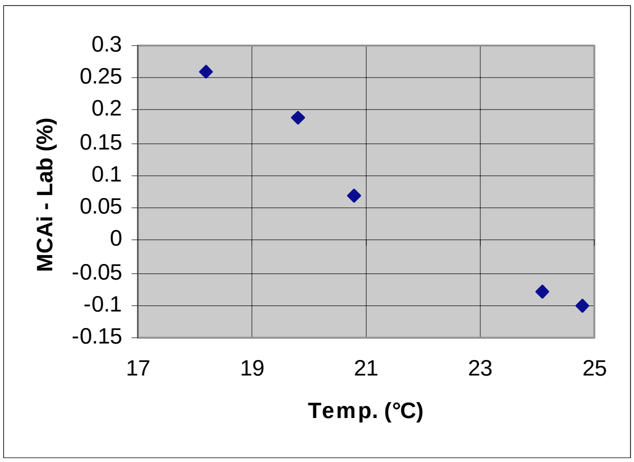


Fig. 12.17. Effect of temperature on consistency error.

• Adjusting the temperature compensation curve

To change the temperature compensation, edit the existing curve. In this mode you can edit the existing values, add new point pairs (max. 6 pairs), or delete a point by setting its temperature and MCA*i* – Lab values to zero.

App. 1 - Technical specifications

kajaaniMCAi Technical Specifications

Measuring range ....0 – 75 % (if >15 % consult with Metso Automation)

Repeatability................................±0.01% Cs

Sensitivity.....................................0.001 % Cs

Ambient temperature................-20...+50°C (-4...+122°F)

Sensor materials........................AISI 316L, Titanium, Glazed ceramics

Material options
MCAi-F and MCAi-FS..................AISI 316 replaced with Titanium or Hastelloy

Process couplings
MCAi-F and MCAi-FS..................Welding neck L, material AISI 316L; .... options: Hastelloy, Titanium

MCAi-FT
- FT100&4"...............................solid flange
- FT150/6".................................no flange
- FT200/8".................................no flange
- FT250&10"..............................solid flange
- FT300&12"..............................solid flange

The solid flanges according to DIN, ANSI or JIS standards.

Housing class..............................IP 65 (NEMA 9)

Operating voltage ....90...260 VAC, 49...61 Hz, 0.1...0.2 A

Microwave power.......................15 mW

Analog outputs
Current output 1 ....Consistency 4–20 mA, isolated; HART® communication
Current output 2 ....Temperature or chemicals content, 4–20 mA, isolated
Current output 3 ....Chemicals content or temperature, 4-20 mA, not isolated
Max. load for the current signals is 1 kΩ

Alarm output ....open/closed contact, 48VDC/0.5A

Binary inputs........................4 inputs, isolated, 12–48 VDC

Analog Inputs.......................2 inputs, one isolated, one not isolated

Serial communication ....RS-232 PC-connection RS-485 Communicator

Weights
- MCAi-F and MCAi-FS ....14 kg (30.9 lbs)
- MCAi-FT 100&4"......................................25 kg (55.1 lbs)
- MCAi-FT 150&6"......................................25 kg (55.1 lbs)
- MCAi-FT 200&8"......................................30 kg (66.1 lbs)
- MCAi-FT 250&10"..................................89 kg (196.2 lbs)
- MCAi-FT 300&12"....................................93 kg (205 lbs)

Process information

pH-range ....2.5 – 11.5

Process temperature............... ...0…+100°C (32…212°F)

Process pressure
Minimum ....1.5 bar / 150 kPa / 22 psi

Pressure Ratings
- MCAi-F and MCAi-FS PN25
- MCAi-FT.................DIN PN16 /ANSI Class 150 /JIS 10k

Flow coefficient (Cv)

FT 200/8” ....4200 (±7.2%)
FT 250/10”..7800 (±2.4%)
FT 300/12”..9700 (±7.2%)

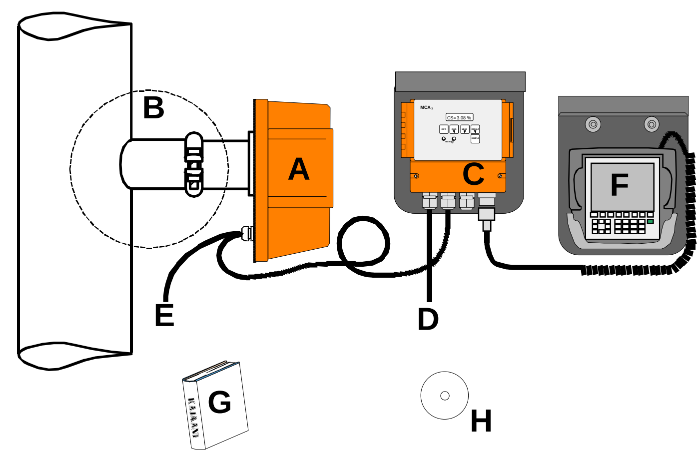
Vibration..................................... ..Max. 20 m/s^2, 10–200 Hz

Conductivity

	min.	max.
MCAi-F		10 mS/cm
MCAi-FS		15 mS/cm
MCAi-FT 100&4"	0 mS/cm <35°C or 2 mS/cm>35°C	15mS/cm
MCAi-FT 150&6"		9 mS/cm
MCAi-FT 200&8"		7 mS/cm
MCAi-FT 250&10"		7 mS/cm
MCAi-FT 300&12"		5 mS/cm

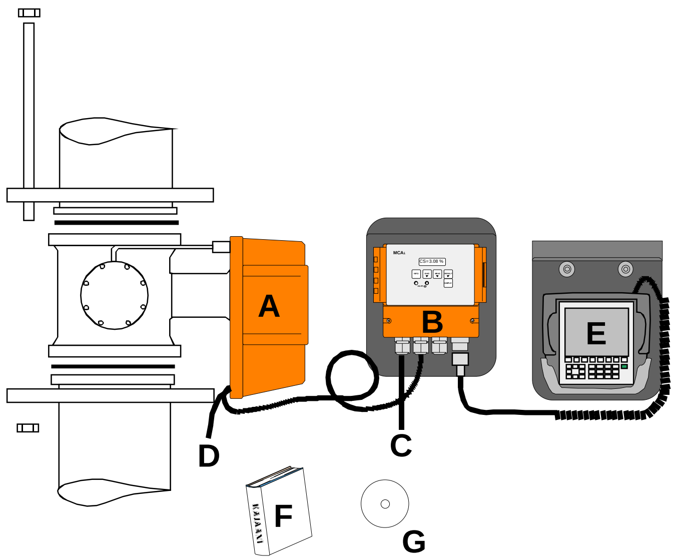
App. 2 - Contents of delivery

kajaaniMCAi -F/-FS Contents of Delivery



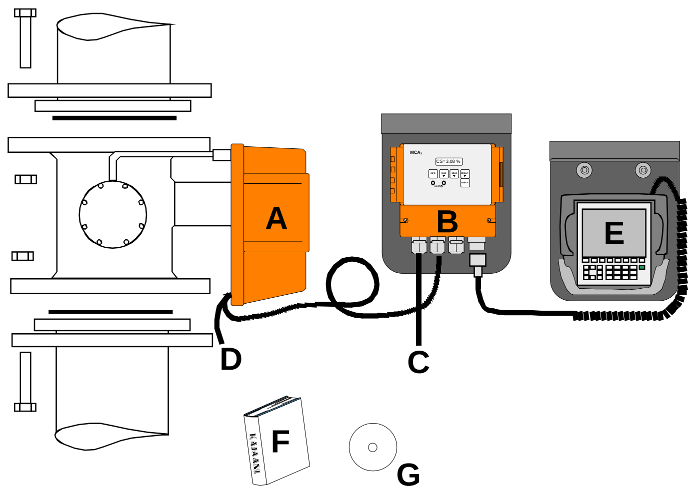
Select	Code	Item	pcs	symb.	Metso	Cust.
	M800511	kajaaniMCAi –F AISI 316L or	1	A	x	
	M800531	kajaaniMCAi –F Hastelloy C276 or	1	A	x	
	M800561	kajaaniMCAi –F Titanium GR2 or	1	A	x	
	M800510	kajaaniMCAi –FS AISI 316L or	1	A	x	
	M800530	kajaaniMCAi –FS Hastelloy C276 or	1	A	x	
	M800560	kajaaniMCAi –FS Titanium GR3	1	A	x	
	M800219	kajaaniMCAi –F /FS installation set AISI 316L or	1	B	x	
	M800220	kajaaniMCAi –F /FS installation set Hastelloy C276 or	1	B	x	
	M800221	kajaaniMCAi –F /FS installation set Titanium GR 2	1	B	x	
	M800502	MCAi Display Unit + 10 m sensor cable	1	C	x	
		Operating power cabling 90...260 VAC	1	D		x
		Current output cabling	3	E		x
		Alarm output cabling	1	E		x
		Binary input cabling	4	E		x
		Current input cabling	2	E		x
	A4611009	Vortex cooler	1		option	
	M800505	Communicatorı	1	F	option	
	M800503	kajaaniMCAi deflector plate AISI 316L or	1		option	
	M800533	kajaaniMCAi deflector plate Hastelloy C276 or	1		option	
	M800563	kajaaniMCAi deflector plate Titanium GR2	1		option	
	W610201	Installation, operating & service manual	1	G	x	
	W4610229	kajaaniMCAi user manual CD	1	H	x	

kajaaniMCAi-FT150/6", 200/25", Contents of Delivery



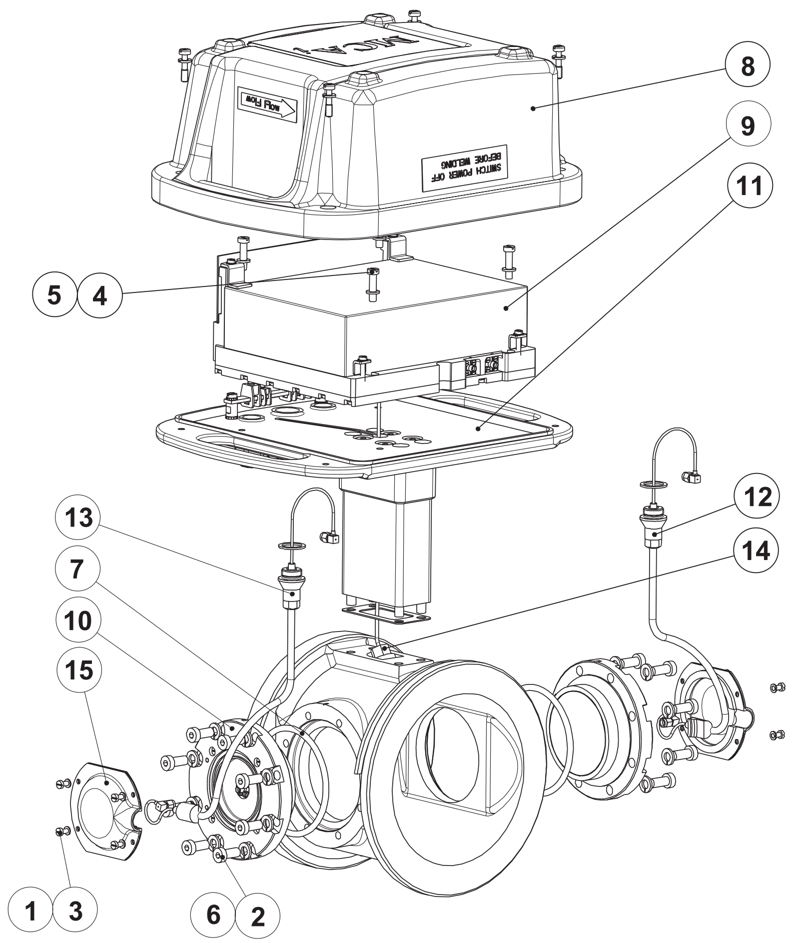
Select	Code	Item	pcs	symb.	Metso	Cust.
	M800512	kajaaniMCAi –FT 150/6" or	1	A	x	
	M800513	kajaaniMCAi –FT 200/8"	1	A	x	
	M800502	MCAi Display Unit + 10 m sensor cable	1	B	x	
		Operating power cabling 90...260 VAC	1	C		x
		Current output cabling	3	D		x
		Alarm output cabling	1	D		x
		Binary input cabling	4	D		x
		Current input cabling	2	D		x
	A4610977	Vortex Cooler	1		option	
	M800505	Communicator$_I$	1	E	option	
	W610201	Installation, operating & service manual	1	F	x	
	W4610229	kajaaniMCAi user manual CD	1	G	x	

kajaaniMCAi-FT100/4", 250/10", 300/12" Contents of Delivery



Select	Code	Item	pcs	symb.	Metso	Cust.
	M800516	kajaaniMCAi –FT100/4" PN16 or	1	A	x	
	M800514	kajaaniMCAi –FT 250/10" PN16 or	1	A	x	
	M800515	kajaaniMCAi –FT 300/12" PN16 or	1	A	x	
	M800526	kajaaniMCAi –FT 100/4" ANSI class 150 or	1	A	x	
	M800524	kajaaniMCAi –FT 250/10" ANSI class 150 or	1	A	x	
	M800525	kajaaniMCAi –FT 300/12" ANSI class 150 or	1	A	x	
	M800550	kajaaniMCAi –FT 100/4" JIS 10k or	1	A	x	
	M800554	kajaaniMCAi –FT 250/10" JIS 10k or	1	A	x	
	M800555	kajaaniMCAi –FT 300/12" JIS 10k	1	A	x	
	M800502	MCAi Display Unit + 10 m sensor cable	1	B	x	
		Operating power cabling 90...260 VAC	1	C		x
		Current output cabling	3	D		x
		Alarm output cabling	1	D		x
		Binary input cabling	4	D		x
		Current input cabling	2	D		x
	A4610977	Vortex Cooler	1		option	
	M800505	Communicator	1	E	option	
	W610201	Installation, operating & service manual	1	F	x	
	W4610229	kajaaniMCAi user manual CD	1	G	x	

App. 3 - MCA*i*-FT construction drawing



No	Code	Item	Standard	pcs
1	5060011	Spring washer	DIN 127-B4 A4	8
2	5060014	Lockwasher	DIN127-B8 A4	16
3	5160015	Slothead screw	DIN 84-M4x8 A4	8
4	5160021	Lockwasher	DIN127-B6 A4	4
5	5160023	Slothead screw	DIN84-M6X25 A4	4
6	5460020	Screw	DIN 7984-M8x18 A4	16
7	8060029	O-ring	89.69 x 5.33 VITON	2
8	A4610007	Sensor cover assembly		1
9	A4610020	Electronics unit		1
10	P4610013	Microwave antenna		2
11	A4610931	Assembly set		1
12		Microwave cable 1	see Table 1	1
13		Microwave cable 2	see Table 1	1
14	A4610011	Pt-100 assembly		1
15	A4610939	Antenna cover assembly		2

Table 1

MCAi FT 100	A4610951	Microwave Cable 1
	A4610952	Microwave Cable 2
MCAi FT 150	A4610936	Microwave Cable 1
	A4610937	Microwave Cable 2
MCAi FT 200	A4610953	Microwave Cable 1
	A4610954	Microwave Cable 2
MCAi FT 250	A4610955	Microwave Cable 1
	A4610956	Microwave Cable 2
MCAi FT 300	A4610957	Microwave Cable 1
	A4610958	Microwave Cable 2

App. 4 - Spare parts

kajaaniMCAi Spare parts

MCAi Service Kit M800685

Code	Description	Standard	Pcs
A4610168	Suitcase & Accessories		1
P4610050	Electronics Unit		1
A4610194	Simulation Cable		1
A4600689	Pt-100 Simulator		1
8360011	Loctite 242		1
8360012	Loctite 542		1
8960011	SMA Torque wrench		1
7460011	Fuse Display Unit 500mA		3
7460016	Fuse Display Unit 250mA		3
8060029	O-ring	89.69 x 5.33 VITON	2
5060013	Lock Washer	DIN127-B6 A4	5
5160023	Slothead Screw	DIN84-M6X25 A4	5
5060011	Spring Washer	DIN 127-B4 A4	5
5160025	Slothead Screw	DIN 84-M4x8 A4	5
5460020	Screw	DIN 7984-M8x18 A4	5
5060014	Lock Washer	DIN127-B8 A4	5

Service Kit Options

Code	Description
P4610013	Microwave Antenna
	Microwave Cables for V1.0 sensors
	RF-cable
A4611032	Microwave Cable Set for MCAi FT 100 V1.0
A4611033	Microwave Cable Set for MCAi FT 150 V1.0
A4611034	Microwave Cable Set for MCAi FT 200 V1.0
A4611035	Microwave Cable Set for MCAi FT 250 V1.0
A4611036	Microwave Cable Set for MCAi FT 300 V1.0
	Microwave Cables for V2.0 sensors
A4611037	Microwave Cable Set for MCAi FT 100 V2.0
A4611038	Microwave Cable Set for MCAi FT 150 V2.0
A4611039	Microwave Cable Set for MCAi FT 200 V2.0
A4611040	Microwave Cable Set for MCAi FT 250 V2.0
A4611041	Microwave Cable Set for MCAi FT 300 V2.0

Other Spare Parts

Code	Description
M800505	MCAi Communicator P4610004V1.0
M800502	Display Unit
A4610933	Display Unit Front Panel

App. 5 - Installation instruction

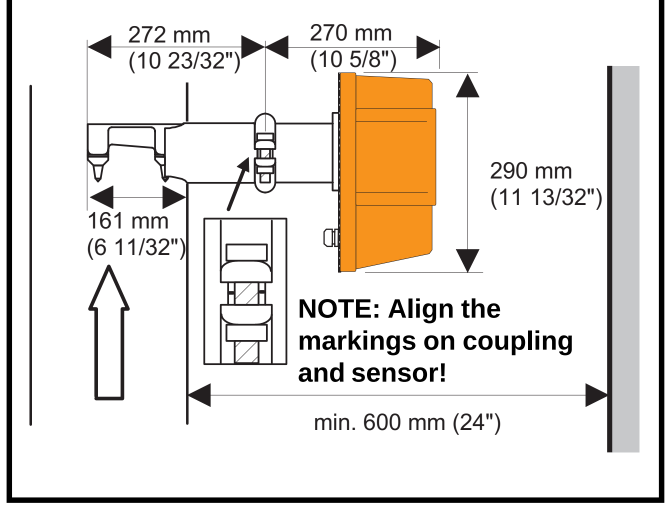
Installing an MCAi-F / MCAi-FS consistency sensor

Check List for MCAi installation

NOTE: Before any installation work, make sure that the process pipeline is not pressurized and that the installation will be safe!

1. Pay attention to the following requirements for the installation point:
   - process temperature max. 100 °C (+212 °F)
   - pH 2.5 – 11.5
   - pressure 1.5–25 bar (22–363 psi)
   - do not install the sensor to the suction side of a pump
   - conductivity in accordance with the sensor specifications (see App. 1)
2. Make sure that the FLOW arrow on the sensor housing is aligned with the process flow direction.
3. Make sure that the installation point and sensor position are in accordance with the instructions.
4. Protect the sensor and Display Unit from direct heat radiation (sun).
5. Make sure that the clamping collar of the process coupling is properly tightened.
6. The sensors are ceramic – be careful not to damage them!

Installation dimensions of the sensor



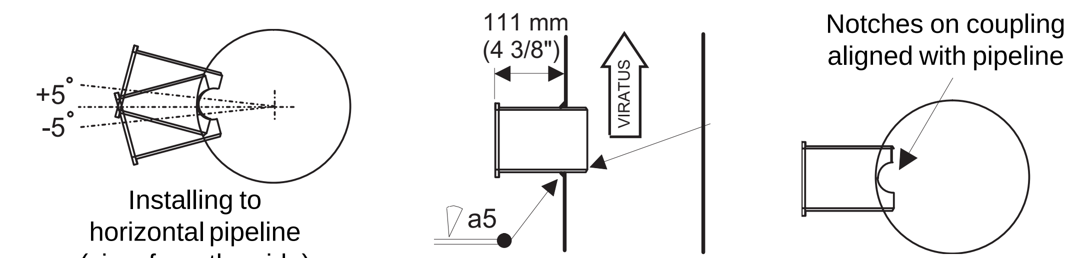
MCAi-F &FS process coupling

Installing (welding) the process coupling to a horizontal pipeline:

- Install to a horizontal pipe as shown below – the coupling must be within ±5º of the horizontal plane.
- Notches on the coupling aligned with the pipeline, the smaller notch against the flow (label on the coupling indicates the correct flow direction)!

Installing (welding) the process coupling to a vertical pipeline:

- Install to a vertical pipe as shown below – the coupling must be within ±5º of the horizontal plane.
- Notches on the coupling aligned with the pipeline, the smaller notch against the flow (label on the coupling indicates the correct flow direction)!



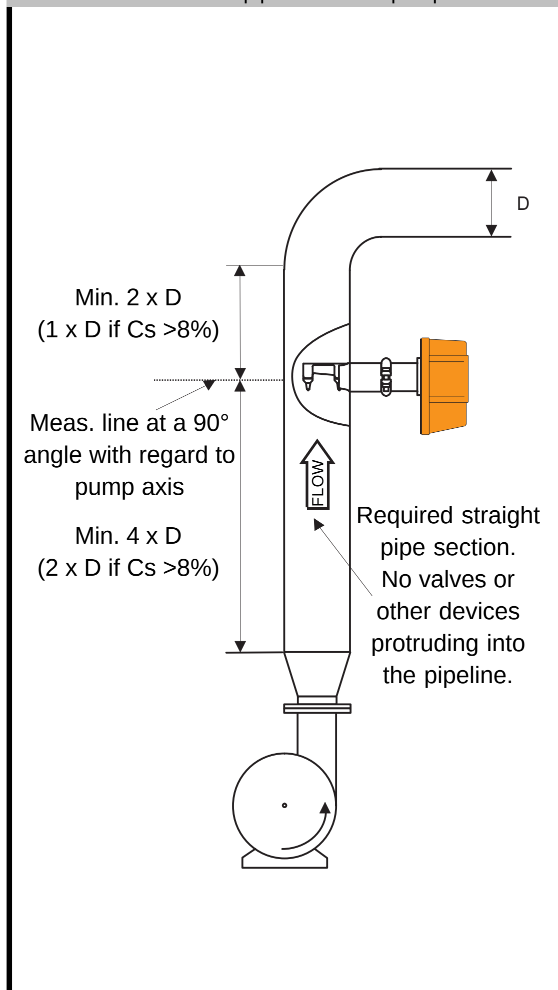
Installing to horizontal pipeline (view from the side)

Installing to vertical pipeline (view from the side)

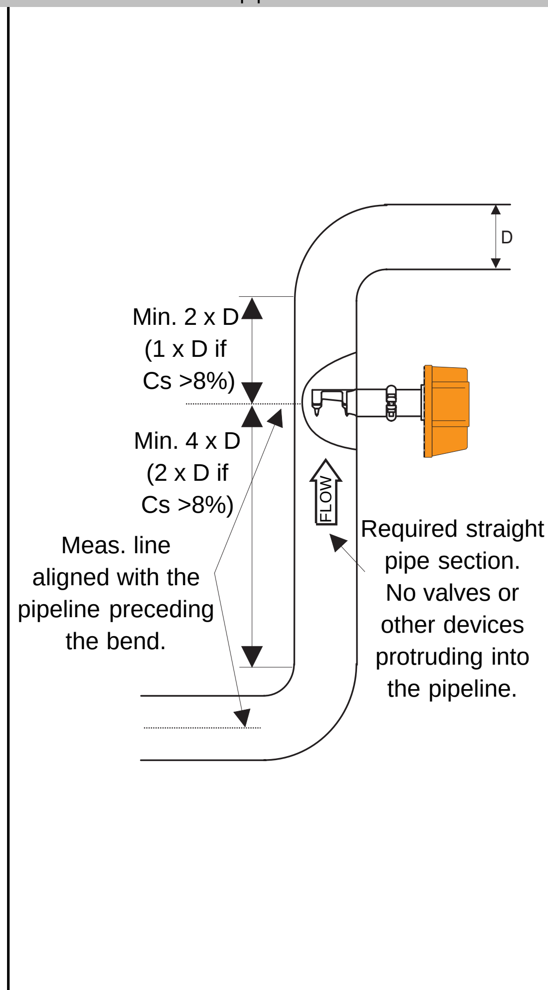
(view from above)

MCAi installation points

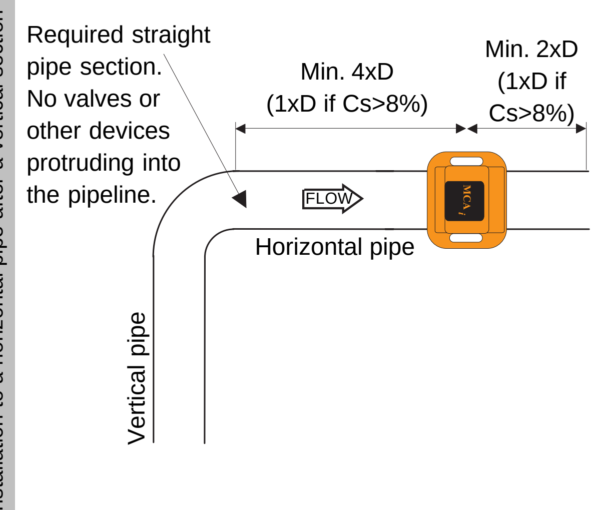
Installation to a vertical pipeline after a pump



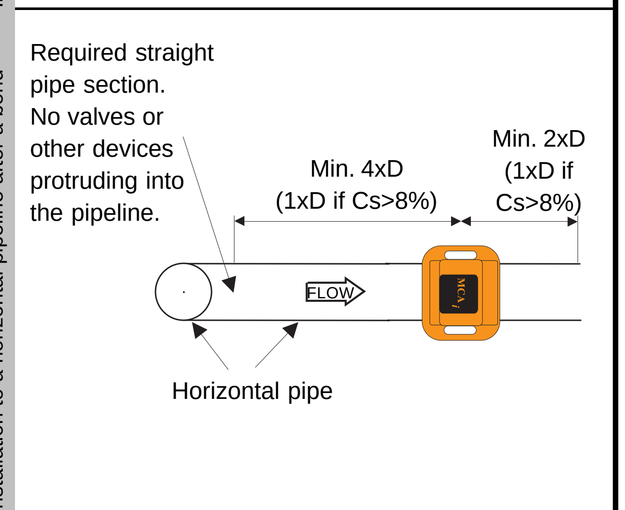
Installation to a vertical pipeline after a bend



Installation to a horizontal pipe after a vertical section

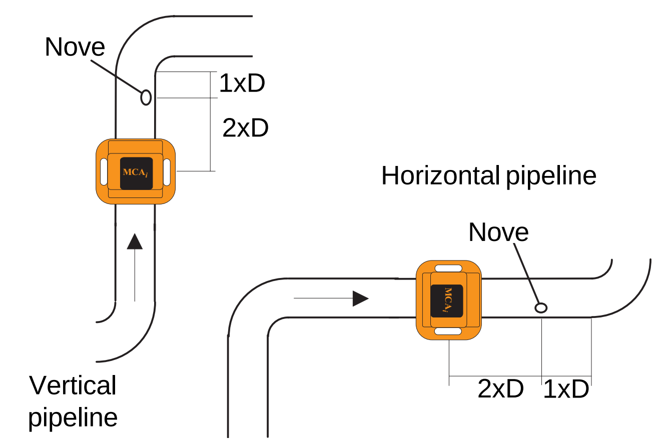


Installation to a horizontal pipeline after a bend



Installing a NOVE sampler

1. NOVE is usually installed after the MCA sensor. Make sure that the distance between NOVE and MCA is ³ 2 x D and ³1 x D of straight pipeline after the NOVE.
2. Install the NOVE at a 45° angle with respect to the MCA measuring line.
3. If the NOVE cannot be installed after the MCA, install it to the pipeline before MCA and make sure that there is ³4 x D of straight pipeline before the NOVE and ³1 x D after it.



D = pipe diameter

Installing an MCAi-FT consistency sensor

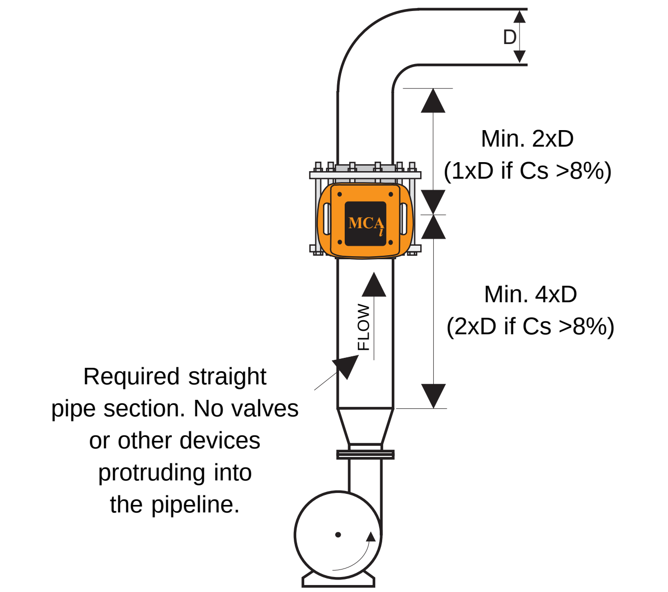
Check List for MCAi installation

NOTE: Before any installation work, make sure that the process pipeline is not pressurized and that the installation will be safe!

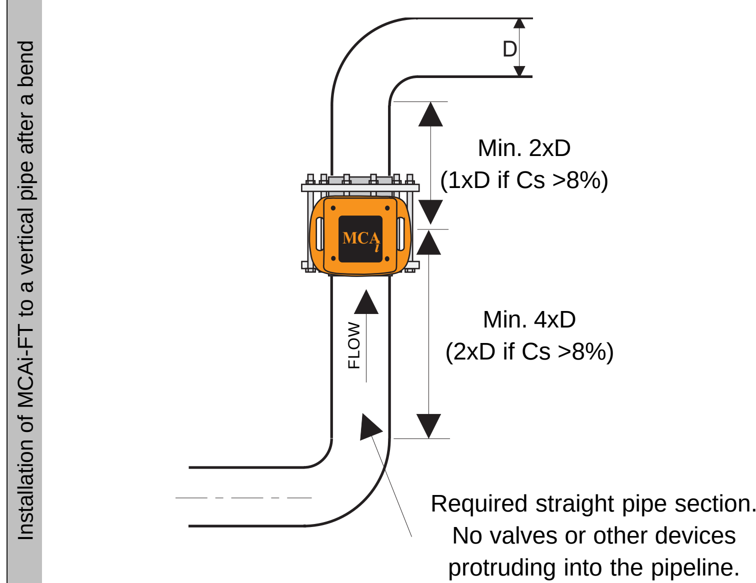
1. Pay attention to the following requirements for the installation point:
   - process temperature max. 100 °C (max. 212 °F)
   - pH 2.5 – 11.5
   - pressure 1.5–16 bar (22–232 psi)
   - do not install the sensor to the suction side of a pump
   - conductivity in accordance with the sensor specifications (see App. 1)
2. Make sure that the FLOW arrow on the sensor housing is aligned with the process flow direction.
3. Make sure that the installation point and sensor position are in accordance with the instructions.
4. Protect the sensor and Display Unit from direct heat radiation (sun).
5. Make sure that the seals between the MCAi flanges and process flanges are correctly installed and the flange bolts are properly tightened.

MCAi installation points

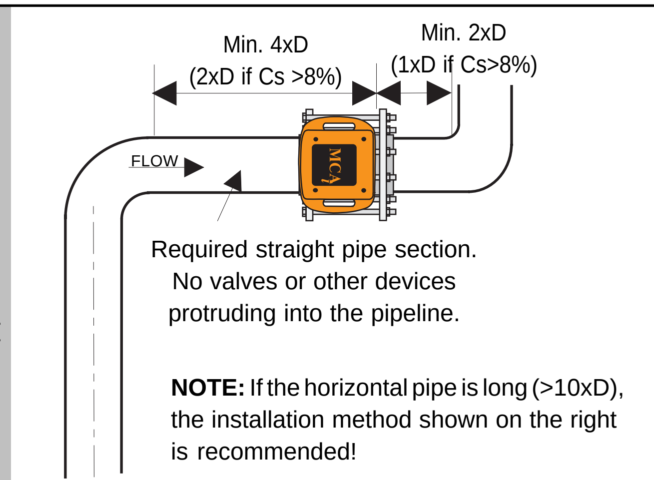
Installation of MCAi-FT to a vertical pipe after a pump



Installation of MCAi-FT to a vertical pipe after a bend

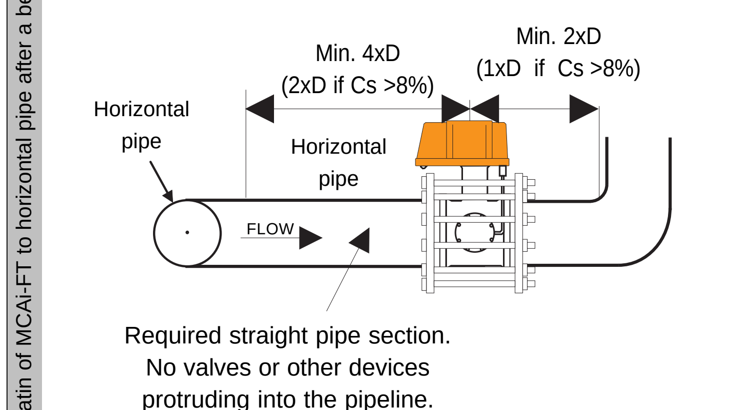


Installation of MCAi-FT to horizontal pipe after a vertical pipe



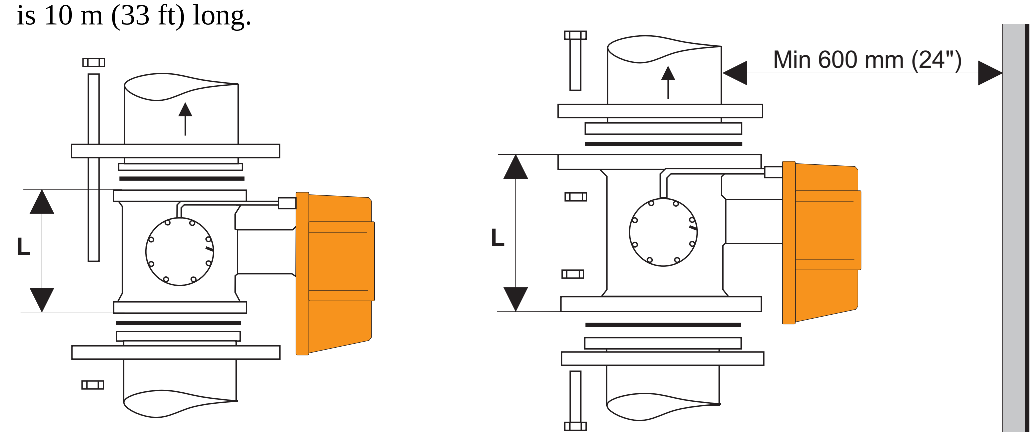
NOTE: If the horizontal pipe is long (>10xD), the installation method shown on the right is recommended!

Installatin of MCAi-FT to horizontal pipe after a bend



Installation dimensions of the sensor

- When choosing the installation point, pay attention to the space required for the sensor.
- Also make sure that the Display Unit can be installed – the cable between sensor and Display Unit is 10 m (33 ft) long.

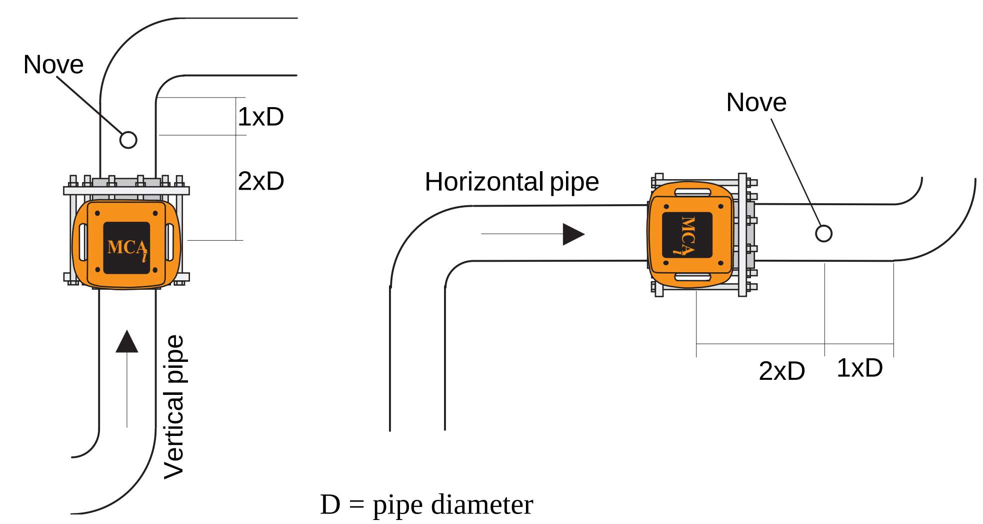


Model	L/mm	L/inch
150/6"	175	6 57/64
200/8"	225	8 55/64

Model	L/mm	L/inch
100/4"	300	11 13/16
250/10"	275	10 13/16
300/12"	350	13 25/32

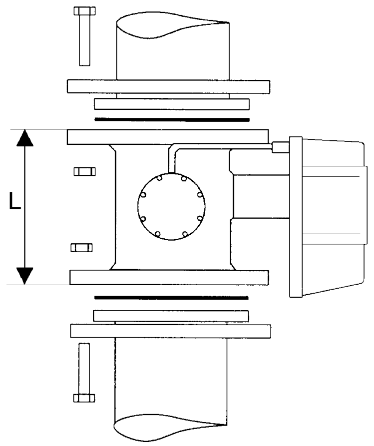
Installing a NOVE sampler

1. NOVE is usually installed after the MCA sensor. Make sure that the distance between NOVE and MCA is ≥ 2 x D and ≥ 1 x D of straight pipeline after the NOVE.
2. Install the NOVE to a vertical pipeline so that it is at a 90° angle with respect to the sensor measuring line. Always install NOVE to a horizontal pipeline from the side.
3. If the NOVE cannot be installed after the MCA, install it to the pipeline before MCA and make sure that there is ≥ 4 x D of straight pipeline before the NOVE and ≥ 1 x D after it.

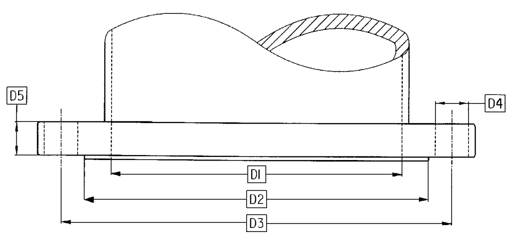


D = pipe diameter

MCAi-FT 100/4", 250/10" & 300/12" – installation dimensions



Model	L/mm	L/inch
100/4”	300	11 13/16
250/10”	275	10 13/16
300/12”	350	13 25/32



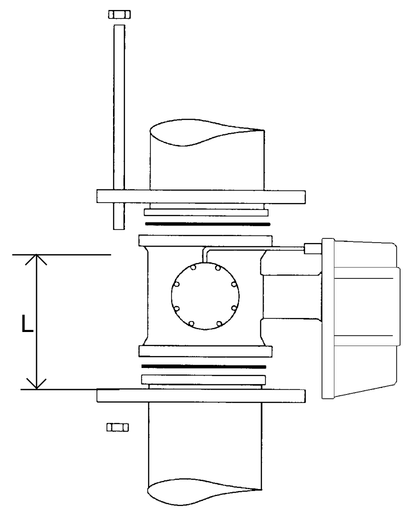
DIN PN 16	D1	D2	D3	D4	D5	No. of bolts
100/4"	105	158	180	18	18	8
250/10"	255	320	355	26	24	12
300/12"	305	378	410	26	28	12

ANSI 150	D1/mm	D2/mm	D3/mm	D4/mm	D5/mm	No. of bolts
100/4"	105	157.2	190.5	19.5	23.8	8
250/10"	255	324	361.9	25.4	30.2	12
300/12"	305	381	431.8	25.4	31.8	12

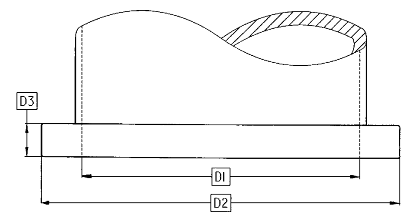
ANSI 150	D1/inch	D2/inch	D3/inch	D4/inch	D5/inch	No. of bolts
100/4"	4 1/8	6 3/16	7 1/2	25/32	15/16	8
250/10"	10 3/64	12 49/64	14 1/4	1	1 3/16	12
300/12"	12	15	17	1	1 1/4	12

JIS 10k	D1	D2	D3	D4	D5	No. of bolts
100/4"	105	160	185	23	22	8
250/10"	255	345	380	27	28	12
300/12"	305	395	430	27	30	16

MCAi-FT 150/6" & 200/8" – installation dimensions



Model	L/mm	L/inch
150/6”	175	6 57/64
200/8”	225	8 55/64



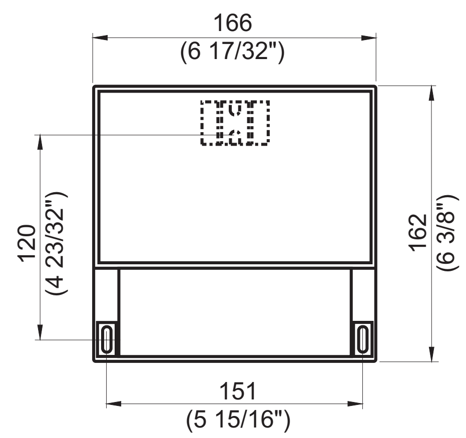
	D1/mm	D2/mm	D3/mm
150/6"	155	220	22.5
200/8"	205	270	22.5

	D1/inch	D2/inch	D3/inch
150/6"	6 3/16	8 21/32	7/8
200/8"	8 1/16	10 5/8	7/8

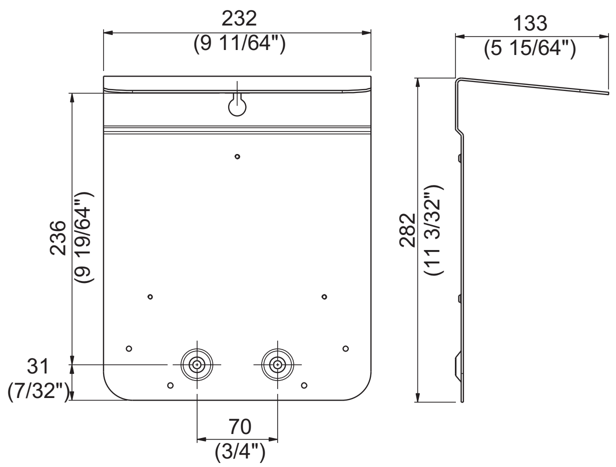
Installation and connections of MCAi sensor

Installing the Display Unit and its shield

1. Choose an easily accessible location, and mount the shield on the wall with three screws.
2. Watch the distance between Display Unit and sensor – the length of the connection cable is 10m (33 ft).
3. Fasten the Display Unit to the shield with three screws. First hang the unit to the topmost screw, and then attach the screws in the lower corners.



Dimensions of Display Unit



Dimensions of Display Unit shield

Connections of Display Unit:

- Mains power (90...260 VAC)
- RS232, PC-connection
- Communicator-connection
- HART-connection
- Cs current signal

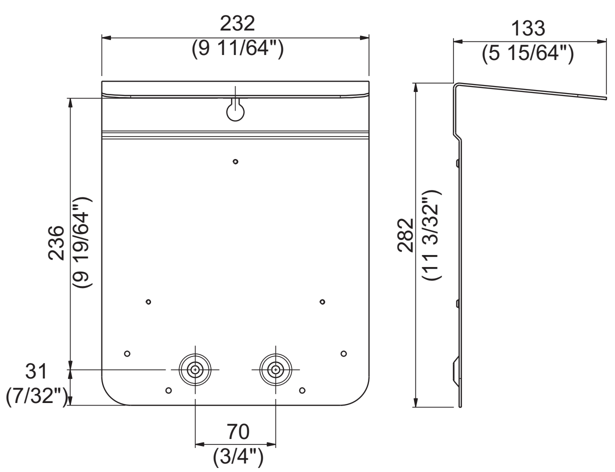
Electric connections

NOTE: Before connecting the mains power wires, make sure that the wires are not powered!

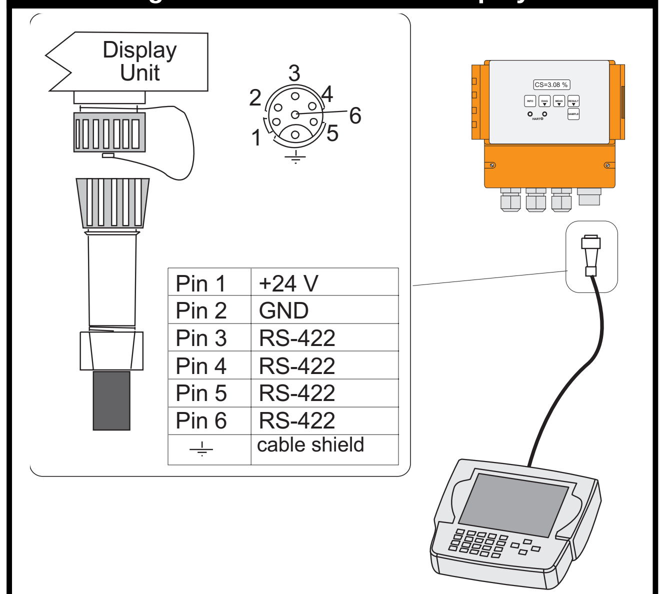
1. Insert the Display Unit cable to the Field Connection Board through the cable inlet bushings. Connect the wires as shown on the right.
2. Connect the necessary current signal cables to the analog outputs. Consistency signal – connect either to the Display Unit or to the sensor's Field Connection Board (not both).
3. Connect the alarm output (opening contact: terminals 17 & 18, closing contact: 18 & 19).
4. Ground the cable between sensor and Display Unit by connecting the cable shield to the sensor electronics' ground bar. Ground the current output and alarm output cables at only one end (not both).
5. Connect operating voltage (90... 260V) to the terminal on the left side of Display Unit.
6. Connect a Communicator-i or HART communicator (if used) to the unit.

Installing the Communicator-i shield

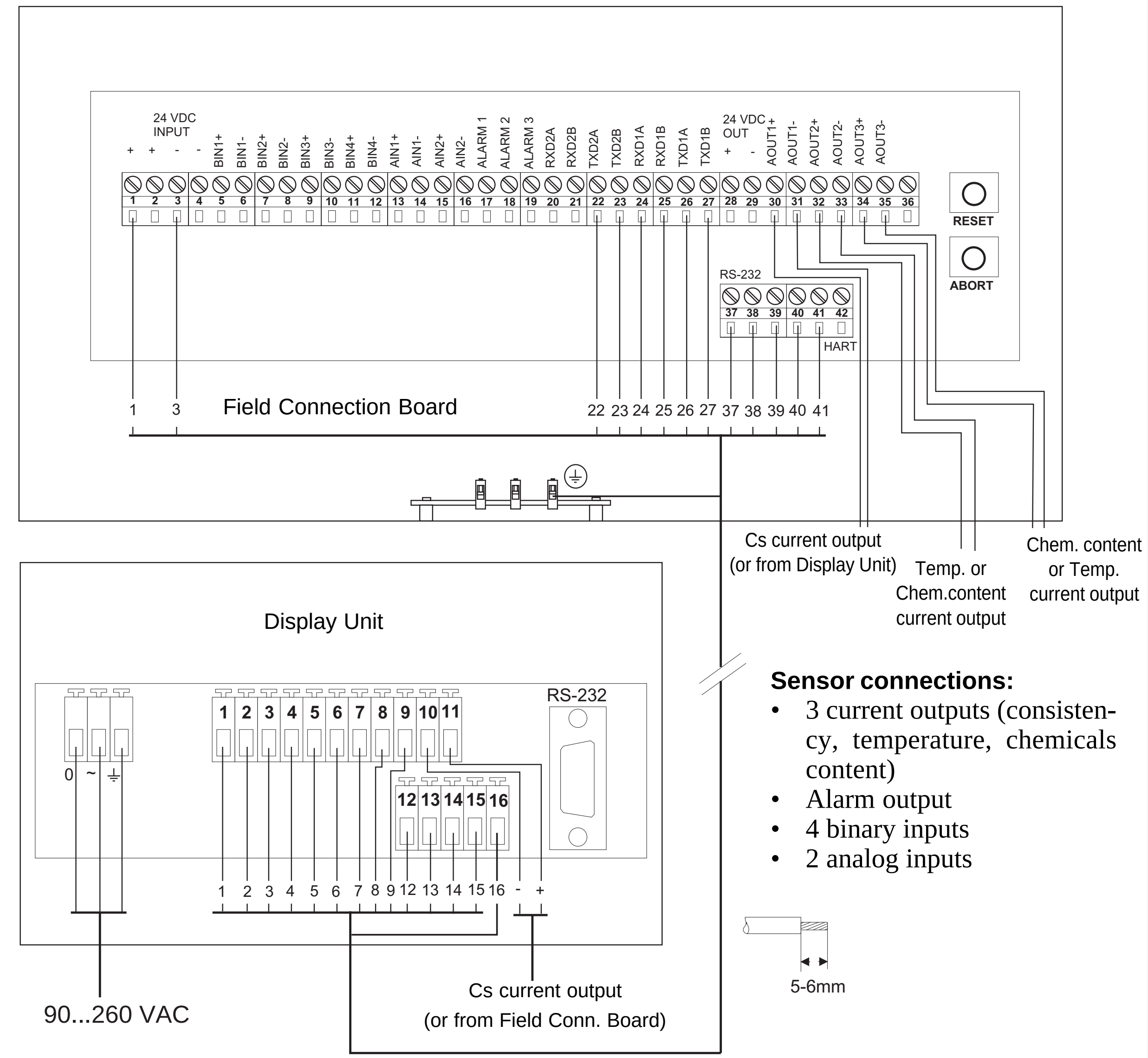
1. If the Communicator (option) will be used, choose a location close to the Display Unit and mount its shield on the wall with three screws.



Connecting a Communicator-i to Display Unit



Connection between MCAi Field Connection Board and Display Unit



Sensor connections:

- 3 current outputs (consistency, temperature, chemicals content)
- Alarm output
- 4 binary inputs
- 2 analog inputs

Terminal (Display unit)	Term. (MCA*i*)	Signal	Wire color
1	1	+24VDC to MCA*i*	Brown
2	3	0 VDC to MCA*i*	White
3	38	PC-conn. RS232 TX	Purple
4	37	PC-conn. RS232 RX	Black
5	39	PC-conn. RS232 GND	Red
6	41	Aout1– & Hart	Blue
7	40	Aout1+ & Hart	Pink
8	22	TDX2A (RS485 RX/TX+ to display	Grey
9	23	TDX2B (RS485 TX/TX- to display	Yellow
10		Aout1– (Cs current signal– to DCS)	
11		Aout1+ (Cs current signal+ to DCS)	
12	26	TDX1A (RS485 TX+ to Communicator-i)	Green
13	27	TDX1B (RS485 TX- to Communicator-i)	Brown-green
14	24	TDX1B (RS485 RX+ to Communicator-i)	White-green
15	25	TDX1B (RS485 RX- to Communicator-i)	Red-blue
16	Ground bar	Prot. GND	Yellow-green

App. 6 - Specifications, Communicator-i

Communicator-i Technical Specifications

Voltage.....18…72 VDC/5W, power supplied from analyzer

Serial communication..........................RS-485 (full duplex)

Ambient temperature.................0…+50°C (+32°…+131°F)

Enclosure class..IP 64

Display operating .... 1/4 VGA, LCD with backlight

Keypad..Membrane keypad

Dimensions (h x w x d) ....180 x 198 x 40 mm
(6 5/16” x 7 51/64” x 1 37/64”)

Weight...1.4 kg (3.1 lbs)

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