CMC
Microwave Total Solids Meter

Table of contents

1 Contact

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2 Quick start-up guide

Quick guide leads the way to install, start-up and configure necessary parameters in normal case.

2.1 Preparing installation

- Installation point should have over 1.5 bar (22psi) pressure
- Conductivity level should be below specification
- Note installation direction of sensor, indicated by the arrow on the side of the sensor body.
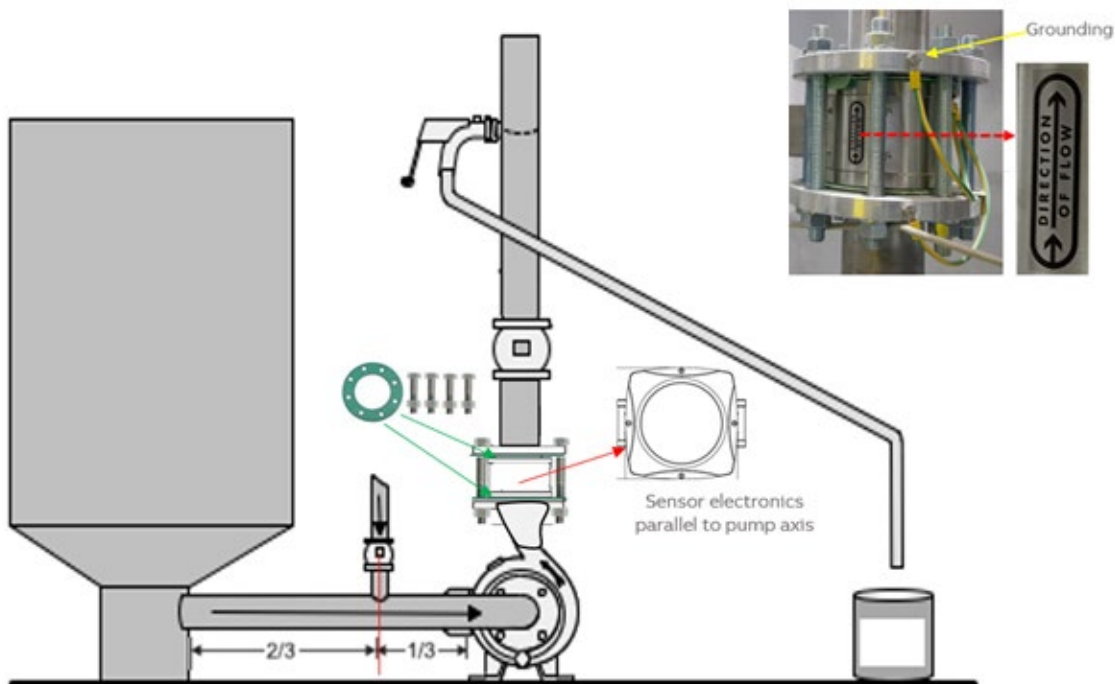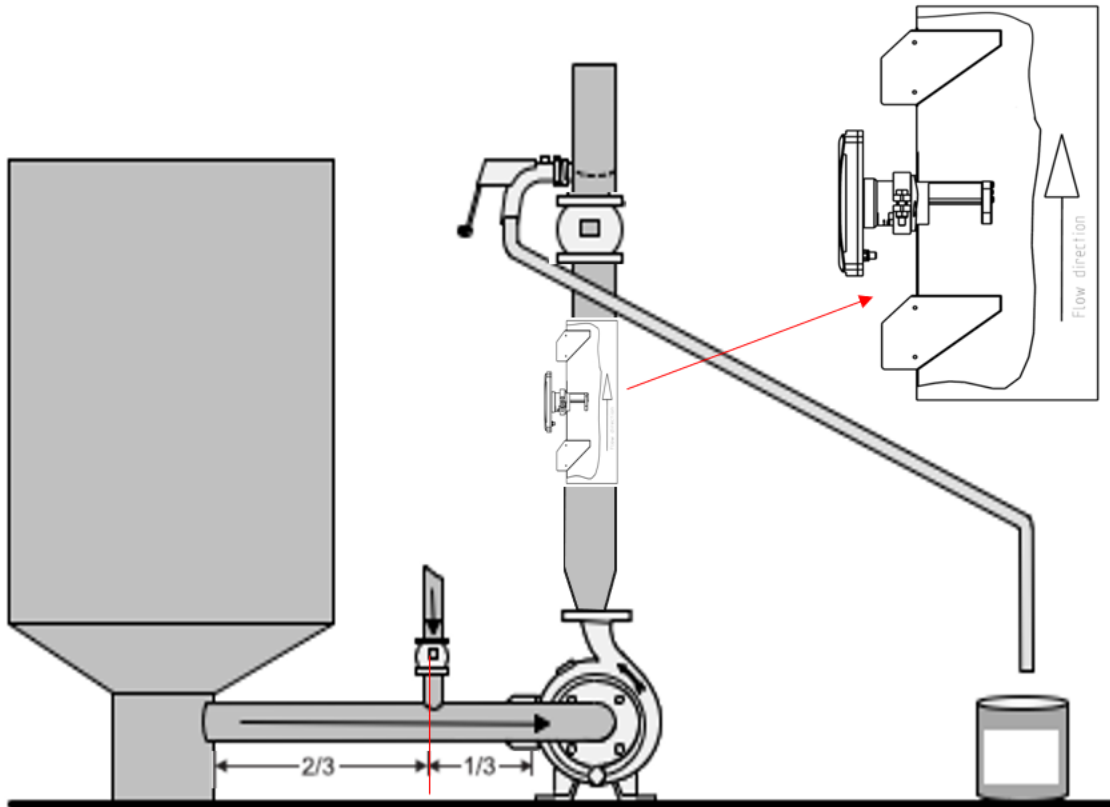
2.2 Sensor unit installation

- Sensor is installed between flanges; inst. length 100 mm
- Check installation direction of sensor

2.3 Display unit installation

- Install display in the place where is easy access
- Interconnect cable length is 10 meters between display and sensor

2.4 Power on

The CMC is delivered with factory calibration, which means that it will measure total solids concentration as soon as you switch the power on.

When power is switched on first time, the CMC goes to start-up wizard. The wizard guides through the mandatory settings, after wizard is completed, the CMC is ready to measure and outputs consistency to the DCS. Mandatory settings are analog output scaling for total solids concentration output.

2.5 Calibration

Please check the calibration reading by taking laboratory sample.
Take one laboratory sample and press sample button to store CMC readings.
In case reading differs please make 1 point calibration, by entering laboratory value in CMC and performing calibration calculation. Solids concentration calibration is done by changing slope, S-value.

$TS\% = S * M + Z$, where M is measurement value of CMC and Z=offset =0.

2.6   Final tuning

Additional tuning can be done in PARAMETER menu.

3   Description

3.1   System components

CMC microwave total solids concentration transmitter system includes sensor, display unit and interconnect cable.

Sensor of Flow through type (FT) which is installed between DIN, AISI or JIS flanges (wafer type, flanges to be supplied by customer). Pipe dimensions from 50 mm to 300 mm.

Display unit is supplied with 10 meters interconnect cable.
The power supply required is 86 – 264 VAC, 50 – 60 Hz. The display unit supplies power to the sensor and communicates with the sensor. Display unit outputs the analog outputs and alarms to the DCS.
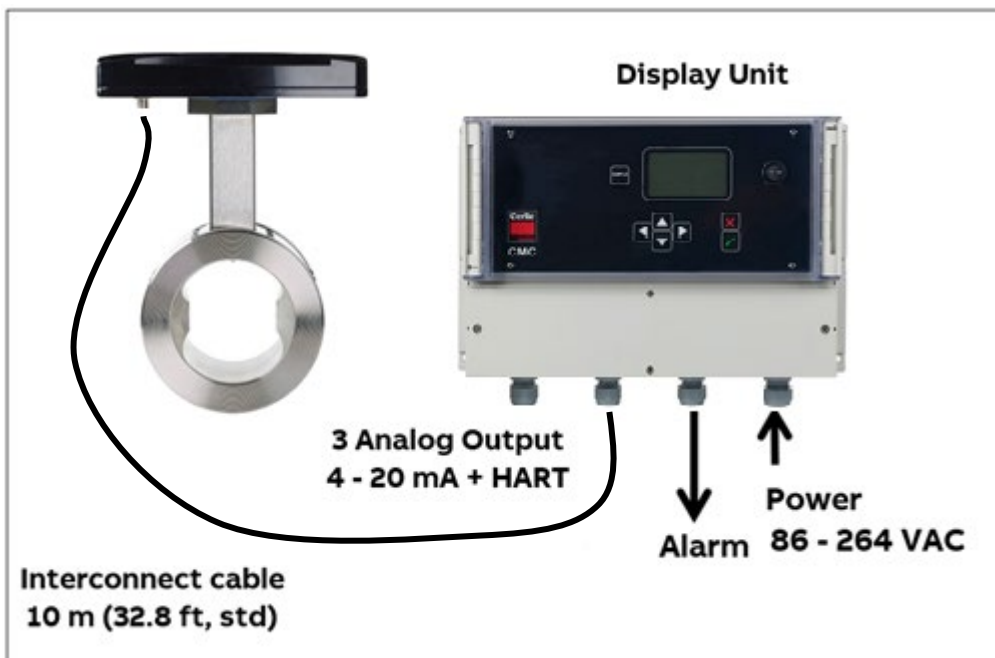
3.2   Measurement principle

CMC Microwave total solids concentration transmitter measurement is based on the travel speed of the microwave signal in sludge. Measurement method is called true-phase method.

Transmitter has 2 antennas (transmitter and receiver) between which microwave signal travels. Antennas are positioned on both sides of transmitter.

Microwaves are electromagnetic radiation; the travelling time between antennas depends on the media's dielectric constant. Travelling time is proportional to media concentration. In water microwaves moves at a much slower speed that in sludge. Therefore, concentration can be calculated based on the time it takes the microwaves to travel through the measured sludge. Measured time is directly proportional to the concentration.

Measurement is very fast, so velocity of the pumped sludge has no effect.

It is essential that there is no free air in the sludge, so requested pressure is over 1.5 bar which keeps air dissolved in sludge. Microwave speed in air is much faster (light speed) than in water

and in case air bubbles are present this will have disturbing effect on the dry solids concentration sludge measurement.

The conductivity of the sludge has effect on microwave signal level and distance travelled. For this reason, each sensor type has own maximum conductivity level below which it can work.

Temperature has an effect on microwave speed and true delay, and it is compensated inside the unit.
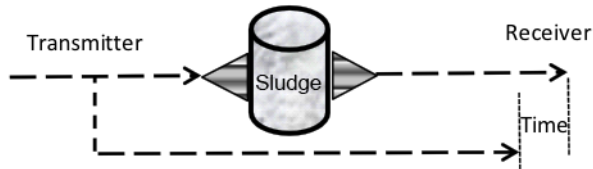
Operating principle
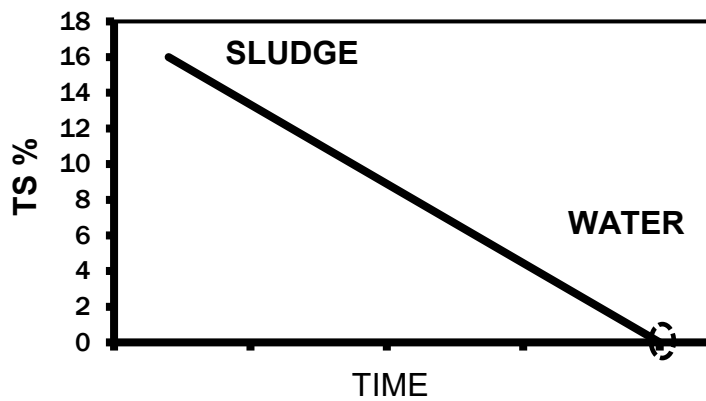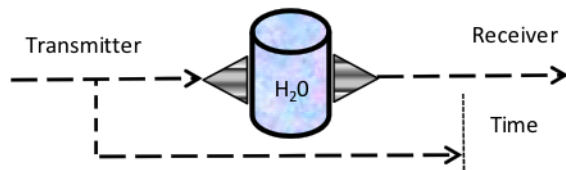
Linear response

4 Installation instructions

4.1 Delivery limits

Manufacturer supplied components:

- CMC sensor unit, 1 item
- Display unit, 1 item
- Interconnect cable, 1 item

4.2 Display unit installation

Install the display unit to the wall for easy access. Standard interconnect cable length is 10 meters to the sensor, but longer cables are available. Cable has quick connector at sensor end and display unit end has strip connectors.
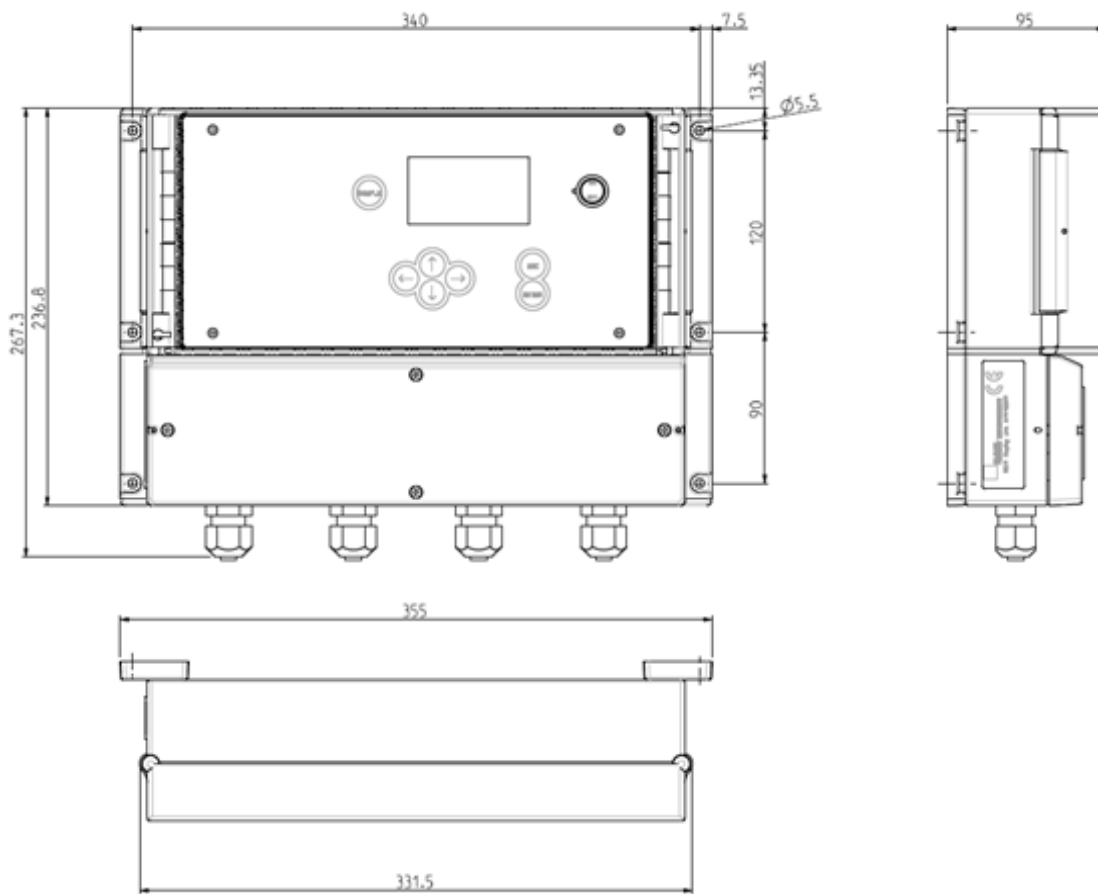
Display unit dimensions.

4.3 Sensor installation

> **⚠ WARNING**
>
> Make sure that the process pipe is empty and depressurized before installing any mounting parts!

> **⚠ WARNING**
>
> Make sure that operating voltage is not connected when there are any welding works performed near the devices!

The CMC Flow through senor is installed so called sandwich installation (wafer type) between flanges.

Flanges are not supplied with the sensor, because they are normally site standards and the flange dimensions depend on the process pipe size and pressure class. Gaskets are not included in delivery, use same gaskets as in other installations at site. The gasket material selected must be compatible with the process fluids and operating conditions.

 Sandwich installation

Sensor can be installed in vertical pipeline, horizontal pipeline or inclined pipeline.

Vertical pipelines install sensor so that main flow is directed between antennas. The sensor can be installed directly after pump. Antennas shall be perpendicularly with the pump shaft.
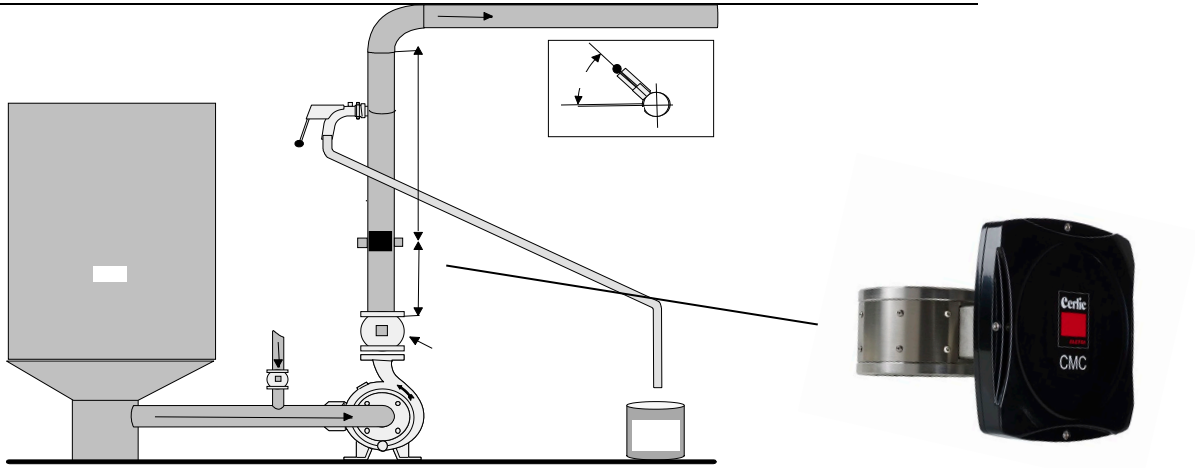
Vertical pipeline installation.

In horizontal pipelines locate antennas horizontally and electronics on the top of pipeline. This will ensure that antenna is on side of pipeline and not on the top where is possibility to have air pocket.
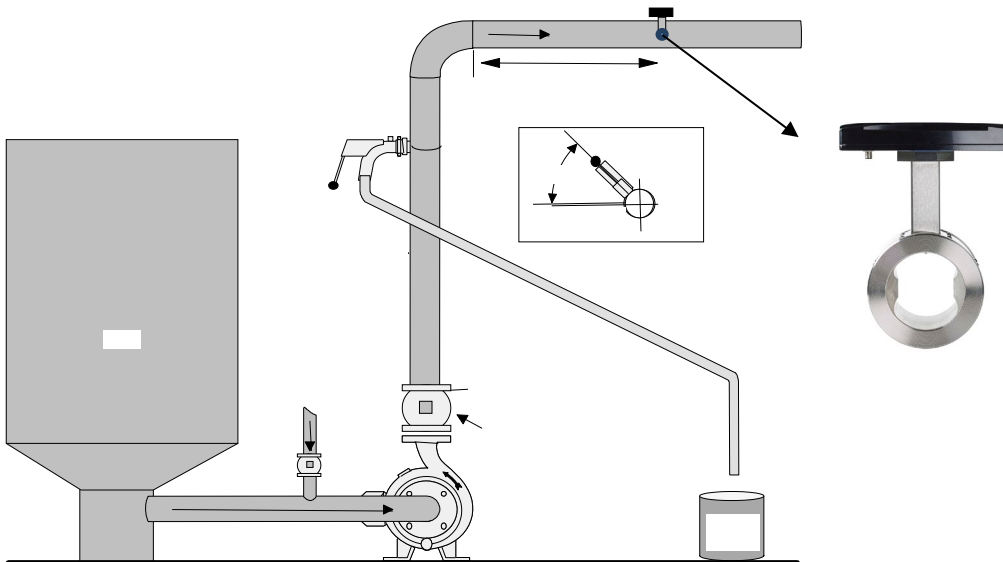
4.4 Installation of sandwich sensor Gaskets

The sensor requires a gasket at each of its connections to piping. The gasket material selected must be compatible with the process fluid and operating conditions.

Gaskets
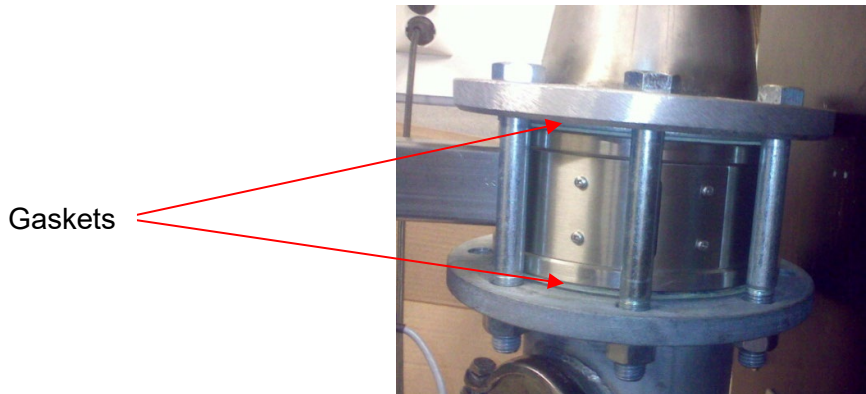
4.5 Flange Bolts

Tighten bolts evenly. Tightening of the flange bolts please follow the following torquing sequence.
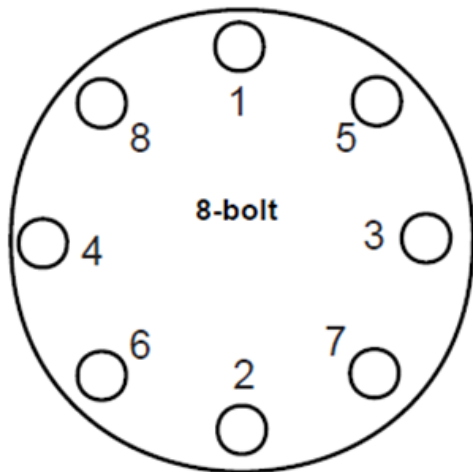
4.6 Grounding

Grounding of sensor is important especially on pipelines which do not automatically make grounding. Grounding is also recommended in metal pipes where plastic seals are being used.
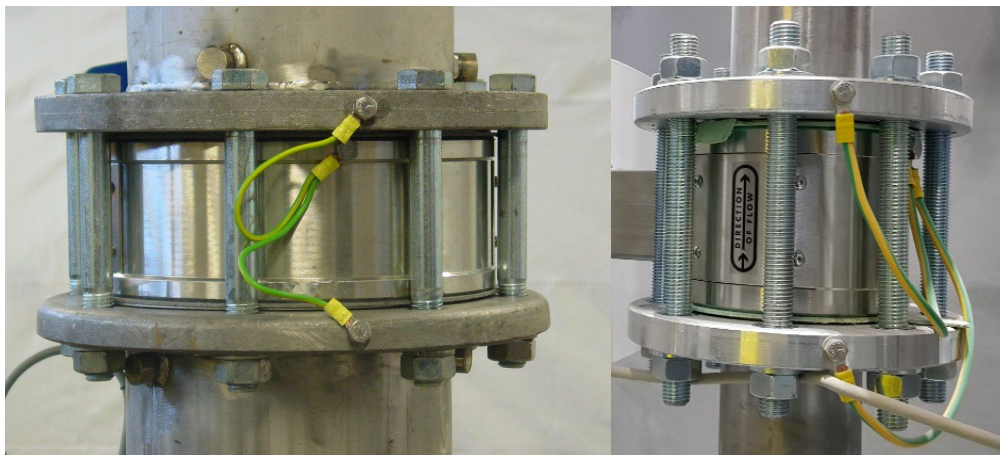
Grounding of sensor

4.7   CMC-IT Installation

Install sensor so that main flow is directed between antennas. Recommended sensor location: 3 times pipe dia. after pump. If enough pressure (>1.5 bar) is not available, install the sensor right after pump.
Minimum pipe diameter where IT sensor can be installed is DN150.
Antena tip must be facing against flow.
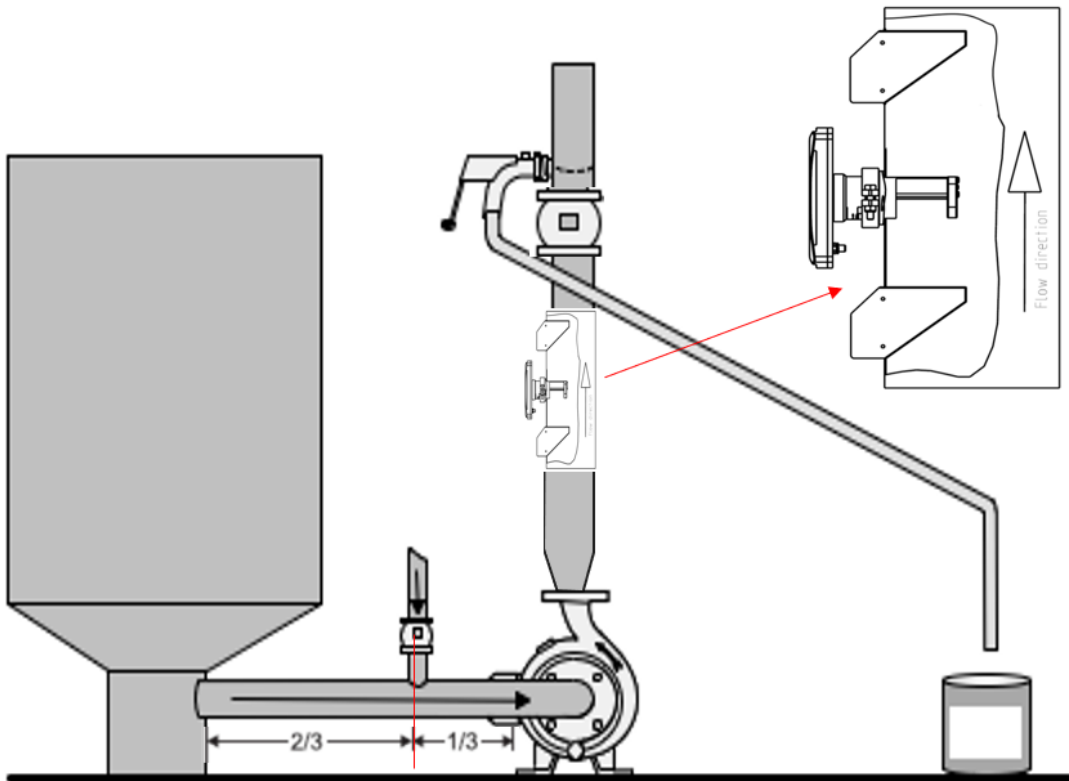
Fig. 4.8. Pipeline installation of CMC-IT model.

> **⚠ WARNING**
>
> Verify that the process is shut down and de-energized, appropriate valves are closed and the pressure inside the pipe is fully released. The process pipe must be empty.

Welding instructions in fig below.

- Verify that the process is shut down, appropriate valves are closed and the pressure inside the pipe is fully released. The pipe should be empty.

- Cut a hole Ø72 mm (2.8") in the pipe. To prevent fiber debris from collecting on the edge of the cut-out, ensure that the edges of the hole inside the pipe are ground smooth. Fiber debris collected at this point can interfere the measurement.

- Shape the saddle to fit the process pipe diameter. (Saddle is precut for pipe DN100 (4") and must be modified for larger line sizes).

- Place the saddle over the hole in the pipe. Verify that the hole is centered with respect to the saddle and the appropriate distance from the pipe is maintained. Fillet weld around the entire perimeter of the saddle to attach it to the pipe. Saddle must be welded exactly parallel to process pipe.

DETAIL Z
1:2

22mm ± 1mm
0.87" ± 0.04"

90°⁺⁰·⁵°₋₀·₅°

Ø72mm Hole
Ø2.83"

DETAIL Z

90°⁺⁰·⁵°₋₀·₅°

22mm ±1mm
0.87" ±0.04"

105mm±10mm
4.13" ±0.4"

1:15

A

CROSS-SECTION VIEW
A-A

Flow direction

30mm
1.2"

30mm
1.2"

A

Use Ø5mm sticks in holes to set depth of protector blade.

** Edges of the hole inside the pipe must be ground smooth.

•1, •2, •3, •4   Welding sequence for protector blades.
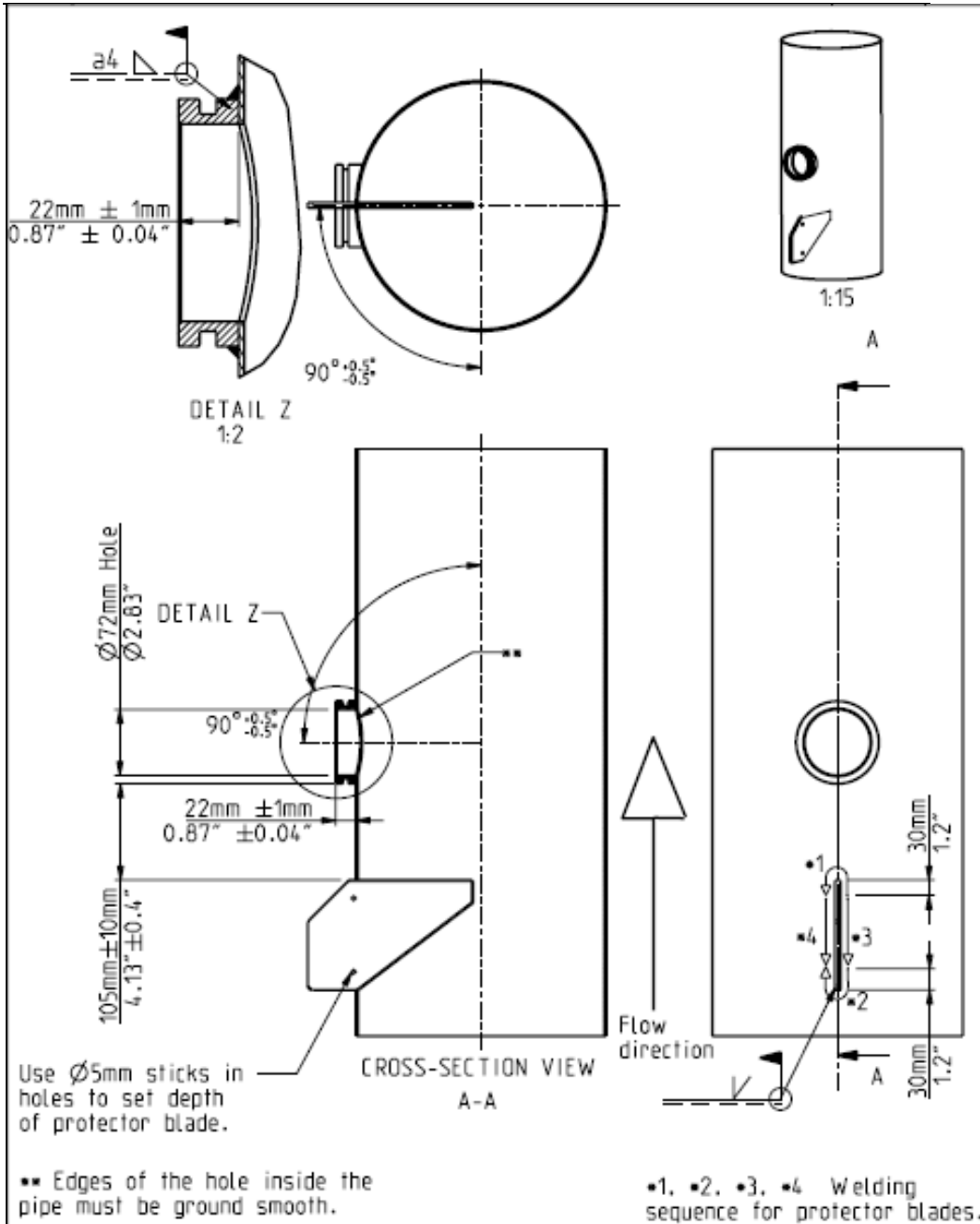
4.8 Supply power safety switch or circuit breaker

Use a safety switch or clearly labelled circuit breaker for supply power and locate it near to the transmitter and according to local electrical requirements and standards.

4.9 CMC sensor dimensions
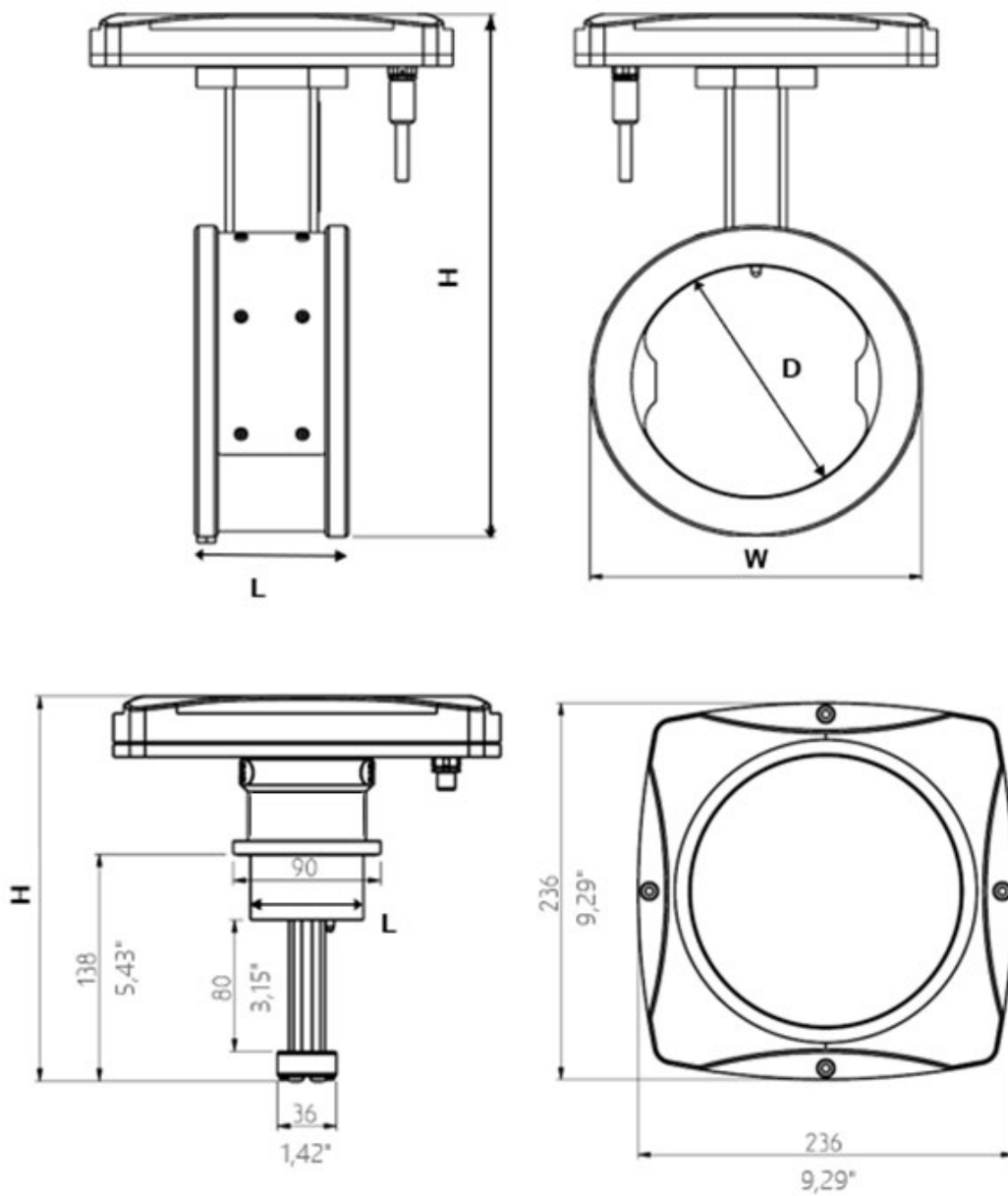
Sensor	H (mm)	W (mm)	L (mm)	kg
CMC 80	285	138	100	10
CMC 100	307	160	100	12
CMC 150	363	216	100	16
CMC 200	417	270	100	20
CMC 250	467	320	100	25
CMC 300	521	374	100	30
CMC-IT	233	69	69	12

11

5 Wiring

> **NOTE**
>
> Always check input supply voltage & frequency before making any connections. Incorrect connections will damage the equipment!

> ⚠️ **WARNING**
>
> Applicable electrical safety regulations must be closely followed in all installation work!
>
> All electric connections must be done by authorized persons!

The terminals for the electrical cables are located under the bottom cover of the display unit. The layout of the connection board is shown in figure 4.1.
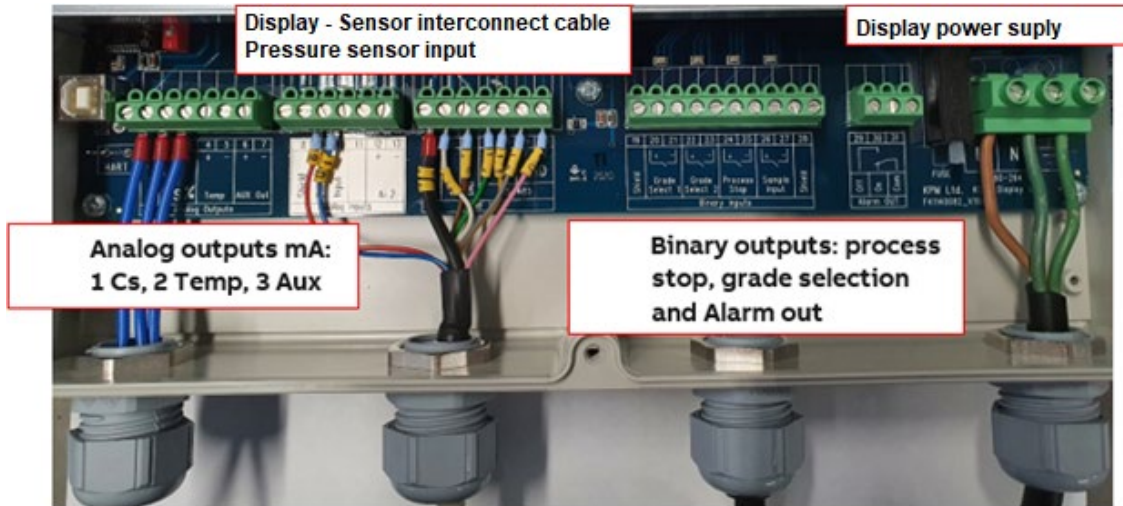
Figure 4.1. Display Unit terminal strip

5.1 Electric connections

Display unit is connected to sensor unit with 10 meters interconnect cable. Cable will be connected to strip terminals from Display unit end and quick connector from sensor end. Locate the display unit in place for easy access.

Connect power (86 – 264 VAC, 47 – 63 Hz) to terminal strip on the right side in display unit.

Sensor cable (Interconnect cable) connection to terminals 9, 10 and 14 - 20.

Current output terminals are 2 and 3 for concentration. Terminals 4 and 5 are reserved for Temperature. Terminals 6 and 7 are for optional AUX output, selectable, process pressure, conductivity or diagnostic signal.

Alarm relay OFF is normally closed. It opens in case the built-in self-diagnostics detects a failure. If power is lost or turned off the alarm relay OFF is OPEN. Alarm ON works the opposite way.
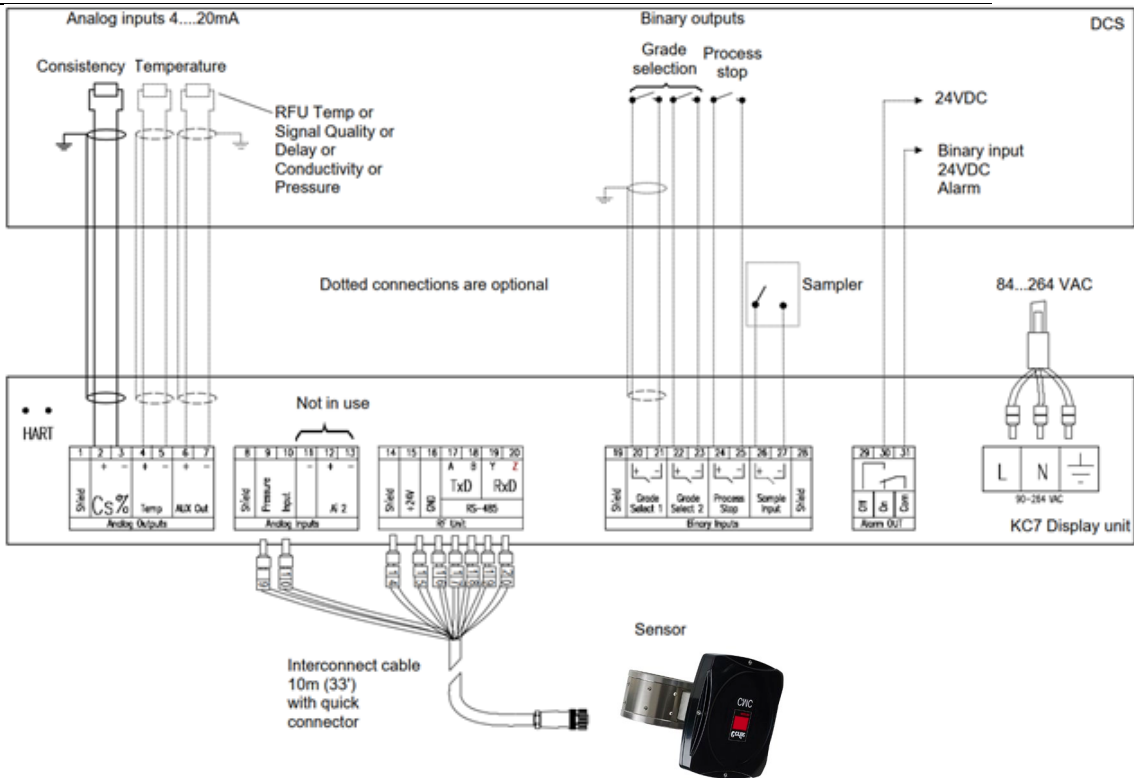
Figure 4.2. Electrical connections

5.2 Analog outputs

Analog output wiring is provided by customer (see figures 5.1 and 5.2). Analog outputs are active, no voltage supply required.

- Consistency analog output is connected to terminals 2 (+) and 3 (-)
- Temperature analog output is connected to terminals 4 (+) and 5 (-)
- AUX analog output is connected to terminals 6 (+) and 7 (-)
- Terminal 1 is for cable shield. Only connect cable shield at one end (DCS)

13

5.3 Analog inputs

- Analog input 1 is used for pressure sensor measurement. Wires 9 and 10 of interconnect cable are connected to analog input terminals 9 (Pressure) and 10 (Input).

Interconnect cable
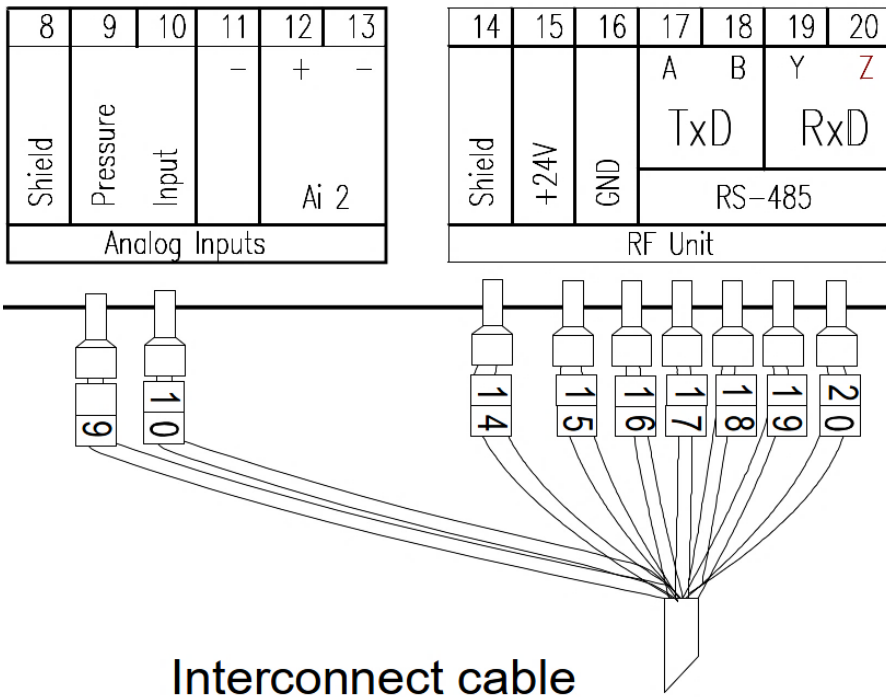
5.4 Binary inputs

Binary inputs are closing contacts only. No supply voltage needed.
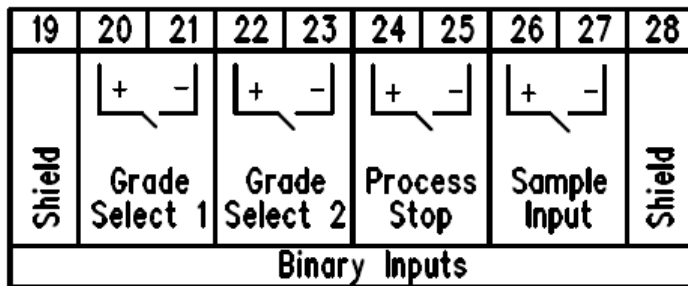
Terminals 20, 21 are for Grade Select 1

Terminals 22, 23 are for Grade Select 2

Grade selection table is based on binary inputs:

Grade	Grade select 1 (20,21)	Grade select 2 (22,23)
Grade 1 (Name A)	0	0
Grade 2 (Name B)	1	0
Grade 3 (Name C)	0	1
Grade 4 (Name D)	1	1

Terminals 24, 25 are for Process Stop. Close = process stop, Open=Run

Use process pump running/not running information or similar to activate the process stop.

Terminals 26, 27 are for Sampler information to give timestamp to save readings

No need to connect with KPM KC7.

Terminals 19 and 28 are for cable shield. Only connect shield at one end (DCS)

5.5   Binary output - alarm

There is one binary output for system alarm. Output can be open or closing contact. Terminals 31 is common, 29 is alarm relay OFF/normally closed. Contact opens in case the built-in self-diagnostics detects a failure. If power is lost or turned off, the alarm relay OFF is OPEN.

Alarm ON works in the opposite way, 30 is alarm relay ON/normally open. Contact closes in case the built-in self-diagnostics detects a failure. If power is lost or turned off, the alarm relay ON is CLOSED.
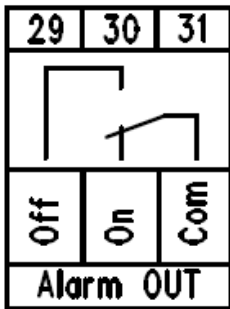
5.6   Sensor communication RS-485

The communication between sensor RFU and display is using 4-wire RS-485 protocol.
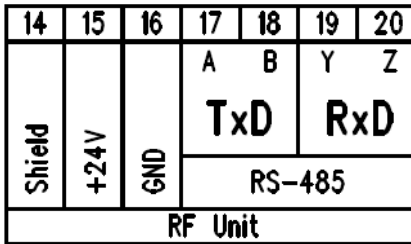
Terminals 15 (+ 24 VDC) and 16 (GND) are used to power the sensor.

Terminals 17-18-19-20 are used for RS-485.

Sensor cable colors and connections:

Display end numbers	Wire color	Function	Phoenix connector pin number	Phoenix connector pin number	Wire color	AMP connector
14	shield	shield				
15	white	+ 24 VDC	1	1	white	8
16	brown	GND	2	2	brown	7
17	green	RS-485 TX	3	3	green	1
18	yellow	RS-485 TX	4	4	yellow	4
19	grey	RS-485 RX	5	5	grey	3
20	pink	RS-485 RX	6	6	pink	2
9	blue	Pressure -	7	7	red	2*
10	red	Pressure +	8	8	blue	1*
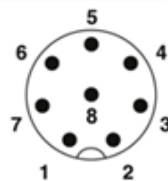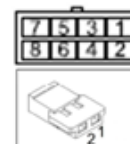
6 Display unit operation and configuration

6.1 Display and operating keyboard
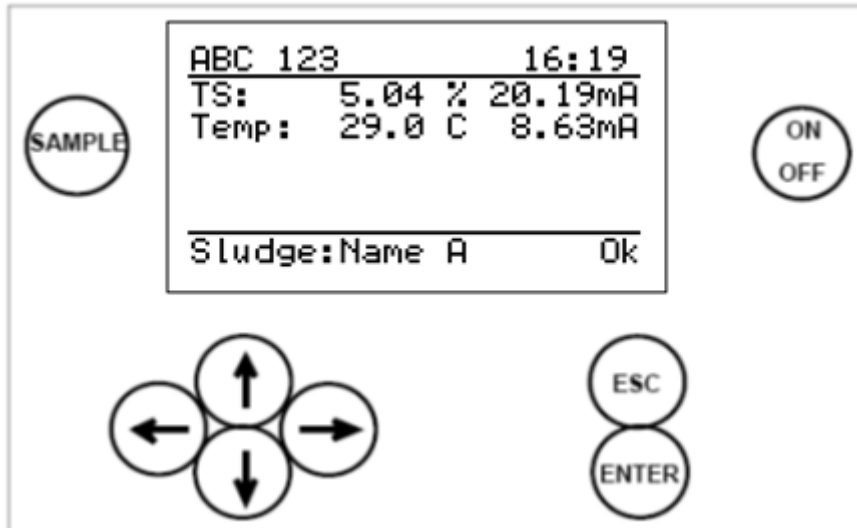
Figure 6.1. Display and keyboard.

The display contains 7 lines, with 21 characters in a line. The main display (fig 6.1) shows:
- Tag number and time.
- Concentration signal level as percentage and output in milliamps.
- Temperature as degrees (C / F) and output in milliamps
- Recipe and status.

Common properties in other menus:
- Selected line is highlighted
- Upper right corner shows:
  - Number of lines/pages in that menu.
  - Arrow shows, if hidden lines.
- Help menus in bottom.

Keyboard
- **ON/OFF button**: Switch the mains on/off.
- **Arrows**: Scroll the menus and rows or adjust values.
- **Esc**: Delete changes and/or return back to the previous menu.
- **Enter**: Accept data and input changes.
- **Sample**: Averages the measured values. After sampling the program asks if the values will be stored (ENTER) or discarded ESC). In case nothing is pressed then sensor stores sample automatically after 3 minutes.

6.2 Main menu

```
ABC 123            16:19
TS:      5.04 %  20.19mA
Temp:   29.0 C   8.63mA



Sludge:Name A         Ok
```

Arrow right or left brings trend data of dry solids concentration. There are three levels in time (2 min, 1 hour and 24 hour).
From trend data menu the down arrow brings Temperature trend.

Arrow up or down shows other menus.

```
Main menu
Parameters
Calibration
Maintenace
```

6.3 Parameters

Parameter menu is to read and list all existing parameters in the same display. This menu also allows changes. Please note that before changing any parameter there should be reason to change it.

```
Parameters    (1/22) ↓      Parameters    (12/22)↕
TS Low limit:    1.00%      Proc.stop:        4.0mA
TS High limit:   5.00%      Hart ID:             0
TS Filter:         10s      Time:            15:45
Z:                0.00      Date:       2014-08-12
S:                1.00      Sampling time:     10s
Error mode:     No eff      Language:      English
```

AO1/TS = Analog output 1 (for TS concentration output)
Calibration paramters: Z= zero and S=slope.
Error mode = Effect on display when self diagnostics detects an error.
Proc.Stop = Analog output level when Process stop bibary input is activated.
Hart id= address,
Time and Date: for sampling identification and error log,
Sampling time = averaging time when sample button is pressed
Language: for local settings (English, Swedish, German and Finnish available)

```
Parameters    (18/22)↕
 Temp unit:    Celsius
 Password:        000
 Contrast:         15
 Auto level ctl:   On
 Detect empty pipe: On
 Control mode:    Local
```

Temperature unit for local settings (Celcius and Fahrenheit available)
Password to operate CMC display, in case 000 no password requested,
Contrast to change display intensity
Auto level ctl: On, this adjust signal strength when needed. Keep this parameter On
Detect empty pipe: On, this is to detect when process pipe is empty. Works with bigger KC7 FT sizes FT200-FT300. Can be set Off in smaller FT-sizes and with IT model

Control mode: Local, grade is set manually as parameter 19; Pulp

Remote, grade changed by binary inputs. Grade selection is based on binary inputs (table below)

Grade	Grade select 1 (20,21)	Grade select 2 (22,23)
Grade 1 (Name A)	0 (open contact)	0
Grade 2 (Name B)	1 (closed contact)	0
Grade 3 (Name C)	0	1
Grade 4 (Name D)	1	1

6.4 Analog Output

Analog output scaling and filtering can be done in Parameters menu. Output 1 is for concentration and output 2 for temperature. Output number 3 is not in use.

Error mode for Analog Output signal can be configured of following selection:

No effect, 3.5 mA, 22 mA or freeze. Error mode selection determines how Analog Output 1 behaves when self-diagnostic finds an error in the device.

Process stop binary input can be used to force measurement to certain value during process is down. When process pipeline is empty CMC measurement will show very high concentration number and then analog output signal will show 20 mA. This may be unwanted situation for operators. Analog output can be forced for example to 4 mA during process stop when binary input is connected.

Process stop signal level (No effect, 4.0 mA, 20 mA or freeze) can be determined for cases when binary input (24,25) is active.

Hart address is for communicating with HART through Analog output 1.

Analog inputs are not in use in CMC
Date and time are set for sampling purposes and for data logging
Languages available at a moment are English, Swedish, German and Finnish
Temperature unit can be changed Celsius/ Fahrenheit
Password 000 means no password needed
Contrast will change display intensity

6.5 Calibration

The CMC is delivered with factory calibration, which means that it will measure concentration as soon as you switch the power on. Factory calibration is performed during the final testing using clean water.

We recommend that you check the calibration or calibrate the device to the actual sludge and laboratory procedures. This allows the device settings to be optimized for the sludge properties in which it will be used.

Calibration parameters Z (=zero) and S (=slope) are for calibrating the unit to adjust the output to the laboratory samples.

Calibration is normally done with 1 point calibration by changing the Slope=S–value.

```
Calibration     (1/5)
Change Z and S
Lab values
Calib.calculation
Water calibration
Conductivity
```

```
Change Z and S
Z:                50.00
S:                 1.00


Enter -> accept
Esc   -> cancel
```

Warning will appear when active existing calibration is changed. Active means grade which is selected to Analog Output.

```
Warning!
Modifying values will
change the output

Enter-> edit anyway
Esc-> cancel
```

6.5.1 Lab values

Laboratory values can be entered after sample has been stored into CMC memory. When sample button has been pressed, then raw measurements are stored into CMC memory. This can be done by pressing ENTER button right after sample taking or CMC stores values automatically after 5 minutes if no button is pressed.

Entering laboratory values first choose sample based on date and time. Last sample is always set number 1 and there are 20 samples stored in the memory. When new sample is stored it will delete the oldest sample in case memory is full.

```
Sample: 1
 2014-08-12 16:06:36
 Lab  TS:    5.00%
 Meas TS:    5.10%
 M:     5.11 Dif:   0.0
 Temp:   28.9C
Enter to edit sample
```

6.5.2 Water Calibration

Water calibration is normally not needed to do at all.

Water Calibration can be performed in special cases when it is assumed that for example ceramic windows are getting dirty. When doing water calibration it is essential that pipeline is filled with clean water and no air bubbles are present.

```
Water calibration
Measure water Z
Water Z:        0.00
```

```
Warning!
Water calibration.
Make sure pipe is
filled with water
only!
Enter -> accept
Esc   -> cancel
```

6.5.3 Single point calibration

Perform calibration by taking a TS-concentration sample and pressing sample button to store measured values. When measured concentration differs from laboratory value, please calculate new SLOPE S-value following:

New S = Old S * (Lab-value / CMC-value)

For example, CMC display = 3,20 % and laboratory result is 3.33 %. Old S=1.00.

New S= 1.00 * (3.33 / 3.20) = 1.04

Enter new slope value into Change Z and S: menu in place of S:

To perform this calculation in CMC display You can enter Laboratory value in

CALIBRATION -> LAB VALUES. After this point has been entered, please perform CALIB. CALCULATION and choose grade and save calculation result by ENTER.

6.5.4 Multi point calibration

Multi point calibration can be used when minimum 2 samples are stored into sensor memory. Pressing Sample button, sensor stores measured values in memory with a time stamp. Storing happens when Enter is pressed or after 5 minutes when no button is pressed.

Pressing the Esc button within 5 minutes of pressing Sample button cancels storing the sample.

Laboratory values should be entered respectively in CMC memory. When 2 or more samples are stored calculation can be performed. Laboratory value 0.0 % means that this point is not included in calibration. Default value for slope is S=1.0 and for offset Z=0.0.

Please note that there shall be some variation in concentration readings (about 1.0 %) before slope calculation gives reliable value.

6.6 Maintenance

```
Maintenace   (1/10) ↓     Maintenace   (10/10)↑
Device information        Event log
On-line signals           Alarms          (1)
Output signals            Sensor settings
Datalog                   Simulation
Event log                 Default settings
Alarms          (1)       Factory settings
```

Device information is to display existing display and sensor type, software version and serial number.

```
Device information        Sensor unit
Display unit              Type:    PN100
Sensor unit               Sn:      12170014
                          Fw ver:V1.01B5 0406 0
                          Hw ver:1.5A
```

```
Display unit
Type:    CMC
Tag:     ABC 123
Sn:      14331080
Fw ver:1.07 120814
Dcs if:3 Analog/Hart
```

On-line signals will display measured signal levels, which may be needed for troubleshooting purposes.

```
On-line signals   1/3     On-line signals   2/3
Delay:      3305.8ps       Rfu temp:       32.0C
N:             5.059       Bin.inputs:     0000
M:             5.059       Rf level:     -22.6dB
TS:            5.05%       Signal quality:   29
Sldg temp:     28.9C       Rel.phase:    0.5805
```

```
On-line signals   3/3
Truephase:    5.7171
Ref.level:    -38.4dB
Ref.phase:    0.8512
Ref.truep:    4.8721
Ref.delay: 3079.59ps
Ref.quality:       8
```

Delay: The measured microwave signal delay in picoseconds
N: Concentration measurement before water calibration
M: Concentration measurement after compensations
Sldg Temp: temperature of the sludge
RFU temp: temperature of the electronics of the sensor
Bin. Inputs: status of the binary inputs
RF level: attenuation of the received microwave signal in dB
Signal quality: quality of the measurement signal, shall be below 50
Rel phase: phase measurement
Truephase: Phase including full counts of n

Ref. level: attenuation of the reference microwave signal in dB
Ref. phase: phase measurement of the reference channel
Ref. truep: Phase including full counts of n of the ref. channel
Ref. delay: The reference signal delay in picoseconds
Signal quality: quality of the reference signal, shall be below 20

Output signal will display existing Analog output as milliamps and percentage.

```
Output signals
Out1:TS         20.20mA
 Ok             101.2%
Out2:Temp        8.63mA
 Ok              28.9%
```

Datalog collects minimum and maximum values since clearance time. Please, remember to clear these counters during start-up time.

```
Datalog         (1/2)        Datalog         (2/2)
           min   max                    min    max
Delay:       0 10160ps       Quality:     5      5
TS %:     0.00 356.90
Sldg Temp: -99  515C         Datalog cleared:
Rfu temp:    0   52C         2012-06-18 15:54
RF level:  -42    0          Enter->clear datalog
```

Event log collects all configuration changes and boot-ups etc. In memory stays 250 last modifications. By selecting event and pressing ENTER you will find more about that event. Plus means when event has happened and minus when it has ended.

```
Event log        (1/9)
16:15 12.08 TS high
16:12 12.08 TS high
16:09 12.08 TS high
16:08 12.08 TS high
15:57 12.08 Calib
```

Alarm menu will display active alarms at that moment. In case there are no alarms then nothing is displayed. In case more than one alarm is active at same time then there is number of alarms in brackets.

```
Alarms            (1)

    RF level too
    low


+ 13:33:36 31.10.2011
```

Sensor settings will display:

Auto Level Control ON or OFF. Normally it is ON.
This feature will set automatically signal level to optimal depending on process conditions for example because of conductivity changes.
Detect empty pipe: This is normally OFF.
Empty pipe detection can be used sometimes when pipe is getting empty during shut down. Signal quality works as detection limit for empty pipe detection. Normally signal Quality is over 100, when pipeline is empty.
RFU GD check: this is normally ON. In case of extreme conditions OFF can be used.

```
Sensor settings      ↓
Auto level ctrl:    On
Detect empty pipe:  On
Empty pipe limit:  100
RFU GD check:      Off
```

Simulation simulates Analog output signal for Concentration and Temperature.
Raw simulation simulates calculation

```
Simulation                    TS simulation
TS simulation                 Set TS:         4.00%
Temp simulation               OUT1:20.25mA   101.5%
Raw simulation
                              Low limit:       1.00%
                              High limit:      5.00%


Raw simulation                Temp simulation
Set delay:       10000        Set temperature: 40C
Set temperature:  40C         OUT2: 8.63mA     28.9%

N:      -452.900
M:      -452.900              Low limit:       0.0C
Cs:     -452.89%              High limit:    100.0C
```

Default settings will reset parameters to default setting of the unit.

```
Default settings

Press Enter to
confirm reset
```

6.7 Factory settings

Factory setting is for basic configuration of the unit. Customer does not need to enter this menu.

```
Factory settings

   Enter password

        600
```

7 Start-up

7.1 Sensor installation

1. Make sure that the sensor is installed correctly, and pressure and conductivity requirements are filled. Pressure should be over 1.5 bar to avoid free air in pulp
2. Connect the sensor cable, turn the power ON.

7.2 Set-up

The CMC is delivered with factory calibration, which means that it will measure consistency as soon as you switch the power on.

When power is switched on first time, the CMC goes to start-up wizard. The wizard guides through the mandatory settings, after wizard is completed, the CMC is ready to measure and outputs concentration to the DCS.

```
CMC Start-up      1/5
This wizard will help
you to setup the most
important parameters
↑/↓  -Select language
Enter-Continue
Esc  -Skip wizard
```

```
CMC Start-up      2/5




Enter now TS output
low limit:    01.00TS%
```

```
CMC Start-up      3/5
Low limit:    1.00TS%




Enter now TS output
high limit:  05.00TS%
```

```
CMC Start-up      4/5
Low limit:    1.00TS%
High limit:   5.00TS%



Enter now TS output
filter           10s
```

```
CMC Start-up      5/5
Low limit:    1.00TS%
High limit:   5.00TS%
Filter:          10s
CMC is now ready for
measuring TS.
Press Enter
```

If the Wizard is not used, the configuration of the Analog output can be done the following way:

Please configure Analog output scaling and filtering in Parameter menu and unit is ready measuring concentration of dry solids.

Please check the measurement reading by taking laboratory sample.
Take one laboratory sample and press sample button to store CMC readings.
In case reading differs please make 1 point calibration.

7.3 Parameters

Parameter list is the place to make unit configuration and set-up. There are analog output scaling and configuration for Total Solids Concentration and Temperature Outputs.

1. In Parameters menu set Analog output 1 scaling. Set AO1 Low limit value for 4 mA, AO2 High limit for 20 mA and AO1 Filter for damping.
2. Calibration parameters Z = zero and S = slope.
3. Error mode is analog output 1 mode in case error is detected (no effect, freeze, 22   mA, 3,5 mA)
4. Process stop effect on analog output 1, when Binary input for process stop is activated. Binary input is contact information only. This is normally used to force measurement to 4 mA when pipeline is empty or when pump is not running.
5. Hart ID is Hart communication address
6. Set date and time
7. Set sampling duration time to store measurement values
8. Set Language
9. Set Temperature unit
10. Set password; 000 means no password needed
11. Set display contrast
12. Set Auto level control ON. This is normally always ON.
13. Detect empty pipe: ON, this is to detect when process pipe is empty. Works with bigger CMC sizes DN200-DN300. Can be set OFF in smaller sizes and with IT model.

7.4 Calibration

The CMC is delivered with factory calibration, which means that it will measure concentration as soon as you switch the power on. Factory calibration is performed on the device in connection with final testing using clean water.

We recommend that you check the calibration or calibrate the device again when setting it up. This allows the device settings to be optimized for the conditions in which it will be used.

7.4.1 Single point calibration

The single point calibration can be done by 2 different ways:

1. Perform calibration by taking a concentration sample and pressing sample button to store measured values.

2. If measured total solids concentration differs from laboratory value, calculate new S (Slope) in CMC display.
   Enter Laboratory value in

   CALIBRATION -> LAB VALUES.

   after entered, please perform CALIB. CALCULATION and choose grade and save calculation result (S= slope) by ENTER

   Or calculate the new S (Slope) value manually by:
   New S = Old S * (Lab-value / CMC value)
   Enter new slope value into Calibration menu.

7.4.2 Multi point calibration

Multi point calibration can be used when minimum 2 samples are stored into sensor memory. Taking multiple samples by pressing Sample button, sensor stores measured values in memory. Laboratory values should be entered respectively in CMC memory. When 2 or more samples are stored calculation can be performed.

Please note that there shall be some variation in total solids readings (about 1.0 %) before slope calculation gives reliable value.

Default value for slope is S= 1.0 and for offset Z=0.0.

8 Maintenance

8.1 Regular maintenance

Periodic maintenance and care are necessary to obtain reliable slurry measurement over time. Because the TS meter has no moving parts, no mechanical maintenance is required. The sensor antennas must be kept as clean as possible, this can for example be achieved by flushing with hot water or removing the CMC for manual cleaning. When the sensor starts to show a big difference to the analysed lab value, a recalibration may be necessary.

8.2 Alarms

Alarms can be checked from Maintenance menu – Alarms. The number of alarms in brackets.

Alarm/error message	Possible reason
sensor-unit communication time out	- Sensor has no power or communication is not working. - Interconnect cable wire, connector or connector pin is disconnected or damaged. - Check the cable wires, connector and connector pins
Empty pipe	- No sludge or water in process pipe - Signal quality over given limit (default 100) - Air content very high.
Delay out of limits	- Values depends on sensor model: e.g. very high consistency. Consult manufacturer.
Sensor or sludge temp too high	Over 100°C
Sensor or sludge temp too low	Below 0°C
TS%- reading too high	Over given TS (analog output) high limit value
TS%- reading too low	Below given TS (analog output) low limit value
RF level too low	- Signal below -35 dB. - Conductivity too high.
Problem	
Calibration	If variation between lab and CMC measurement - Air content is too high and effects on signal level, increasing measured consistency value. - Conductivity is too high. Check attenuation level (must be below 110 dB). - Contamination on antennas.
Display does not switch on	- Power supply not connected - Measuring board broken → check/reset internal fuse - Power supply broken (measure +5VDC and +12VDC) - Power switch broken
Measurement error	Online signals: - RF level is normally around -25 dB (-20…-30 dB). When below -30 dB, sensor is out of normal operation range, but might still work until -45 - Attenuation in measurement. Normally below 110 dB. If level is higher than 110 dB sensor is in its maximum performance level, maybe conductivity is too high or something else…

	- Signal quality is normally below 50. Lower number means better signal quality. Signal quality being over 50 means poor quality. Normally over 100 means air in pulp/pipe is empty. Maximum number is 360. - Reference channel delay values are displayed on third page and normally stay stable +/- 5 units. - Delay measurement is stable or constant. Normally, delay is changing when consistency or temperature change. - Consistency signal unstable due to dirt/material stuck between antennas. - RF-unit might be damaged.
Problem	
Process pressure above/below normal range	- Wiring disconnected - Scaling wrong - Pressure sensor broken

8.3 Troubleshooting

For troubleshooting purposes please read On-Line signal values on maintenance menu.
- Delay value depends on meter size, concentration, and temperature.
    - RF level is normally around -25 dB.
    - Signal Quality is normally below 20. Lower number means better signal quality. Signal quality being over 50 means poor quality
    - Relative phase and True phase values are basic raw measurements
    - Reference channel values are displayed on third page and normally stay stable.

Appendix 1: Spare parts of CMC Display

Part	Description
1	CMC Measuring board
2	CMC Analog board
3	CMC Display plate assembly
4	Connection base
5	Mounting brackets (2 pieces)
6	Cover
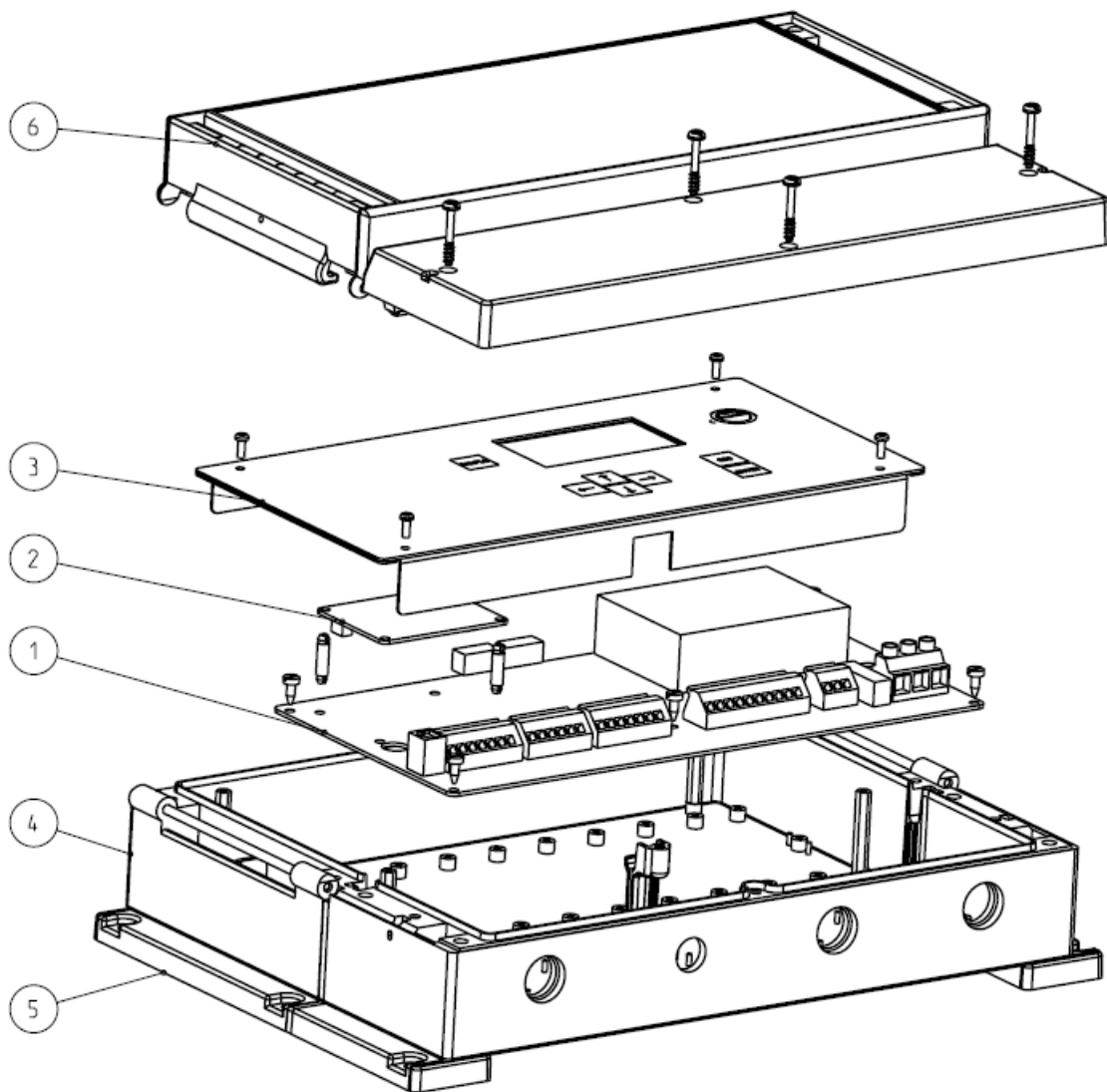
Appendix 2: Spare parts of CMC models
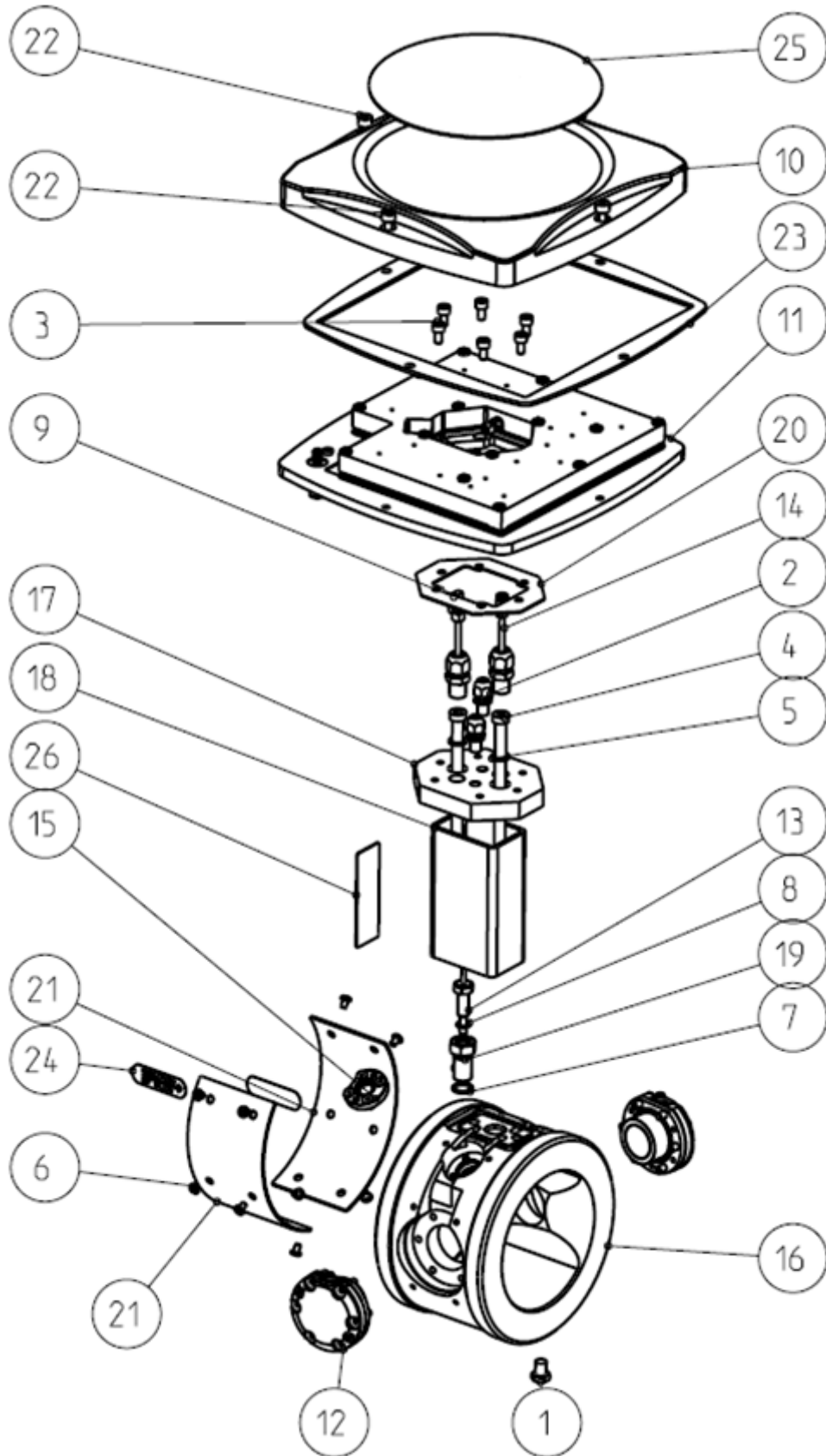
Part	Description
1	Screw M8*10
2	Cable Bushing M8*1
3	Screw M5*10
4	Screw M8*120
5	Washer M8
6	Screw M4*6
7	O-ring 12*1.5
8	O-ring 7*1.5
9	Receptacle housing AMP 280359
10	Cover
11	RF Unit assembly
12	Antenna assembly
13	PT-100 assembly
14	Antenna cable
15	Pressure sensor assembly
16	Frame body
17	Adapter plate
18	Neck
19	PT-100 Adapter
20	Gasket
21	Cover plate
22	CMC Cover screw
23	Flat Gasket for Cover
24	Direction of flow
25	CMC Sensor label
26	CMC Device label

Appendix 3: Spare parts of CMC IT model

CMC - IT model

1:4
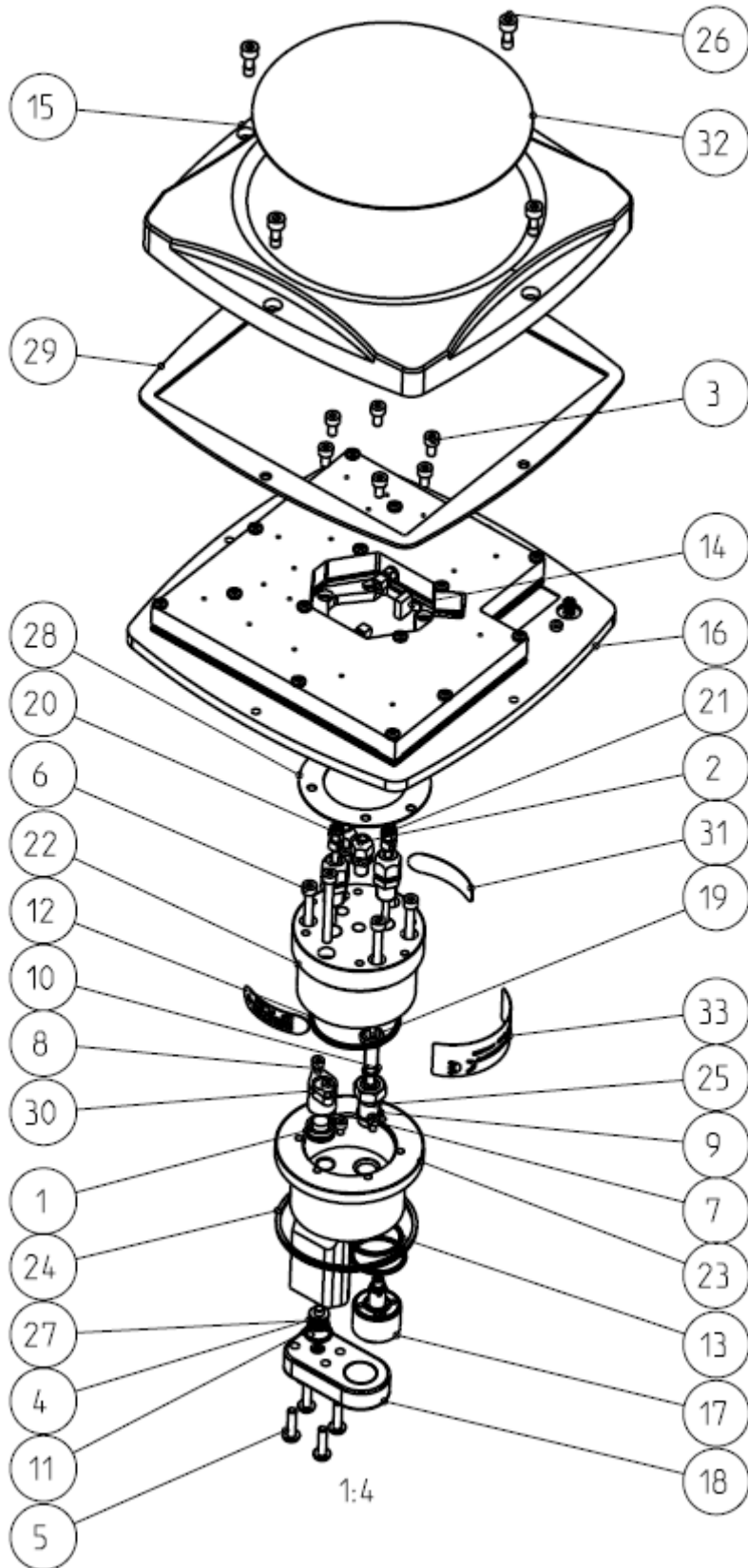
CMC - IT model

Part	Description
1	Pressure sensor
2	Cable Bushing M8*1
3	Screw M5*10
4	Lock ring
5	Screw M5*20
6	Screw M5*50
7	Screw M4*6
8	Screw M4*10
9	O-ring 12*1.5
10	O-ring 7*1.5
11	O-ring 14*1.5
12	O-ring 50.3*2.4
13	O-ring 30*2
14	Receptacle housing AMP 280359
15	Cover
16	RF unit assembly
17	IT Rear Antenna
18	IT Front Antenna
19	CMC PT-100 assembly
20	CMC IT Front Antenna Cable
21	CMC IT Rear Antenna Cable
22	CMC IT Base
23	CMC IT body
24	Gasket
25	PT100 Adapter
26	CMC Cover Screw
27	IT Ring
28	IT Gasket
29	Flat Gasket for Cover
31	Direction of flow
32	CMC Sensor Label
33	CMC Device Label

Appendix 4: Technical specifications

SENSOR TYPE:	Microwave Consistency Transmitter
OUTPUT SIGNAL:	3 x Analog outputs 4 – 20 mA + HART
BINARY INPUTS:	24 VDC supplied by CMC, Process Stop, Grade Change (2) and Sampler Input
BINARY OUTPUT:	12 – 48 VDC max 10mA, Dry Contact
ANALOG INPUT:	1 x internal input, 4 – 20 mA, Isolated. Process pressure 0… 10 bar (0…145 psi) referential (zero at atmospheric pressure).
MEAS. RANGE:	0 – 16 % TS
REPEATABILITY:	0.01 % TS
RESOLUTION:	0.001 % TS for sizes DN 80 – 300 mm (3" – 12")
	0.002 % TS for 50 mm (2") size
INSTALLATION:	Wafer type between flanges or Sandvik NS65 mm
LENGTH:	100 mm all models except IT.
WEIGHTS kg:	DN50 9kg, DN80 10 kg, DN100 12 kg, DN150 15.5 kg, DN200 20kg
	DN250 25 kg, DN300 30 kg, DN400 42 kg, Insertion type (IT) 12kg
	Display 2.3kg
PROCESS TEMP:	0 – 100°C (32 – 212°F)
PROCESS PRESS.:	Recommendation >1.5 bar (>22 psi), no air
PROCESS pH:	2,5 - 11,5 pH

CONDUCTIVITY LIMITS mS/cm: 30 – 70°C

50 mm	80 mm	100 mm	150 mm	200	250	300	400	IT
25	25	20	20	15	15	15	10	25

AMBIENT TEMP:	Sensor 0 – 70°C (32 – 158°F), Display 0 – 60°C (32 – 140°F)
FLOW VELOCITY:	No effect, Insertion type max flow 5 m/s (16.4 ft/s)
MATERIALS:	Sensor: SS 316L; Window: Ceramic, Display: Polycarbonate
APPROVALS:	EMC, CE, PED (Directive 2014/68/EU, Article 13,1, (b) substances and mixtures
ENCLOSURE CLASS:	Sensor IP66 (Nema 4x), Display Unit IP65 (Nema 4)
POWER SUPPLY:	86 to 264 VAC, 47 – 63 Hz; 20VA
PRESSURE SENSOR:	Measurement 0 – 10 bar (0 – 145 psi), max. 40 bar (580 psi)
	Temperature range -10 – 80 C (14 – 176 F)

Waste Electronics and Electrical Equipment (WEEE)

This product is labelled with this symbol in accordance with European Directive 2012/19/EU, to indicate that it must not be disposed with your other household waste. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

In the European Union
Please contact your local Cerlic Controls representative who will inform you about the take-back of the product. Small products (and small amounts) might be taken back by your local collection facilities.

In countries outside the European Union
Please contact your local authorities and ask for the correct method of disposal.