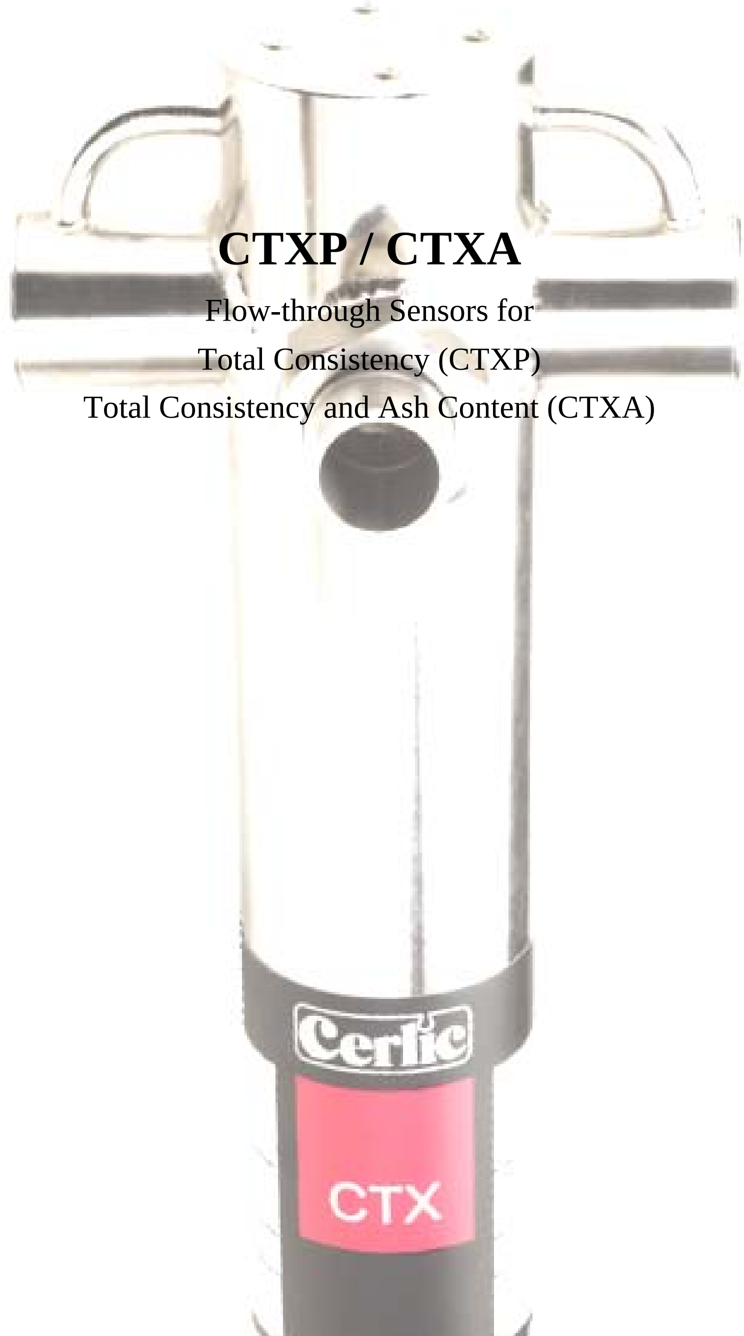
CTXP / CTXA

Flow-through Sensors for

Total Consistency (CTXP)

Total Consistency and Ash Content (CTXA)



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1. Introduction

The CTXP 03/25 (CTXP) consistency sensor is used in applications with variations in the ash content. When using standard attenuated transmission, the filler part of the pulp gives much higher influence on the measurement than the fiber part does. Using the ability of fibers to depolarize a polarized light beam, the CTXP sensor together with the BB2 signal processing unit can read a true total consistency over a wide range of ash contents.

The CTXA 03/25 (CTXA) consistency sensor is a further development of the CTXP. In addition to measuring the total consistency it also gives a reading of the actual ash content.

Examples of applications are around the paper machine for retention control, monitoring white waters and effluent control.

2. A few words about this manual

This manual primarily contains information about Cerlic CTXP/A consistency sensors. Menu functions and technical data of the BB2 control box can be found in the BB2 manual.

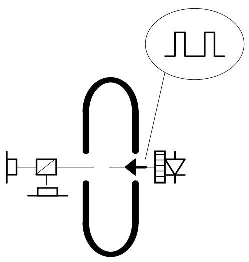
3. Design

The CTXP/A is made in acid proof stainless steel and is mounted with pipe fittings (DN25) directly onto a 25 mm (1") pipe. The sensor has a self cleaning design which permits precise and reliable measurement with minimum maintenance possible, even in critical applications. The measuring windows in the steel cell are made of quartz glass (suprasil). Electronic and optical components are well protected within the steel enclosure to handle very demanding environments.

A shielded 10 m (33 ft) cable is used for communication between the sensor and the BB2 control box. The cable is made of polyurethane and highly resistant to aggressive substances.

4. Measuring principle

The CTXP/A sensors measures through the medium. The transmission is made with polarized, monochromatic light. The measuring principle is based on the ability of fibers to depolarize the light to a much greater degree than solid particles. The light source consists of a light-emitting diode (LED) which is pulsed with high power. The light is polarized before entering the cell. Two detectors measure the V and H polarization planes. The detector signals are processed in the BB2 and presented as total consistency and ash content (ash content only CTXA). The temperature is measured for temperature compensation of the measured values.



5. Unpacking sensor

The unit has been tested and approved before shipping.

Content

Please check that the content corresponds to your order and packing list.

Damages

If damages occurred during the shipment, immediately contact the carrier as well as your Cerlic representative. The shipment can be returned only after contact has been made with Cerlic.

Packaging

The original packaging is designed to protect the equipment and should be used for storage or if the goods must be returned.

Optional parts can be ordered	P/N
• Butt weld end DN25 - 30x25 mm	11203082
• 25 mm hose adapter DN25	10305122
• 10 m (33 ft) signal cable. Max 10x10 m (10x33 ft)	20805510
• Connection box for two sensors to one BB2 control box with 1 m (3 ft) cable to connect to BB2	11505748

6. Mounting sensor

The CTXP/A is mounted directly in a 25 mm (1”) pipe with the cable connector pointing downwards (glass windows vertically). With larger pipes, a 1” by-pass pipe should be used.

There are three alternatives to mount the CTXP/A sensor - butt weld end connection, NPT-couplings (US) or hose connection. See the Dimension section for more information.

Please carefully study these installation guidelines to reach maximum performance

- The inlet to the by-pass pipe should be located where the suspension is well mixed and the flow is turbulent. Appropriate distance from a pump discharge or a pipe elbow is about five pipe diameters downstream.
- The by-pass pipe should be as short and straight as possible.
- A turbulent flow gives a better representation of the consistency. In order to obtain the highest possible flow rate in the by-pass pipe, install the by-pass pipe inlet before an elbow or pipe reduction.
- To avoid the water film on pipe walls, the by-pass pipe should extend at least 20 mm (¾”) into the pipe.
- The by-pass pipe should be 25 mm (1”) and should not have any throttling valve or pipe bend closer than 0.5 m (20”) upstream the sensor.
- The by-pass pipe should be made to avoid dewatering of the pulp stock at shutdown. If there is still a risk for this, then the valve upstream the sensor should be closed automatically when the pump stops.
- The flow rate in the by-pass pipe should be at least equivalent to the main pipe but not less than 0.5 m/s (1.5 ft/s). At lower rates, there is a risk for dewatering and build up on the glass windows. For pulp stock with resin and printing ink, the flow rate should be twice as high.
- If the flow through the by-pass pipe causes cavitation in the sensor, the valve after the sensor should be throttled back.

- The temperature of the sensor must not exceed 65°C (150°F)
- Install the sensor to avoid exposure to considerable and fast changes in temperature
- Avoid installation where the sensor is exposed to severe cold weather or direct sunlight
- Protect the sensor from high pressure water spraying
- The sensor should never be submerged under water
- Always install the cables between sensor and control box in conduit when possible
- Install the sensor to avoid extreme vibrations
- The sensor must not be removed while still under process pressure
- The sensor must not be used as a ground point for welding
- If welding is to be done on the pipe system, the cable and the sensor should be removed
- Always remount the protective cover on the sensor connector when the cable is removed

Automatic flushing

Two three-way valves can be used to automatically flush the sensor with water. The flush water temperature shall be close to the temperature of the measured media to avoid temperature stress of the sensor. In some applications where dilution of the measured media is allowed, only one three-way valve can be used, and the flush water can go out the same way as the media. The valves before the sensor must not in any way reduce the flow when open. If there is a risk of turbulence in the valve, it must be placed more than 0.5 m (20”) before the sensor.

Sometimes the sensor may need manual cleaning using a bottle brush and diluted acid (5 % hydrochloric acid or sulphamic acid).

7. Removing sensor

- Close all valves to isolate the sensor.
- Disconnect the sensor from the by-pass pipe by using the couplings on each side of the sensor. Remove the sensor and save the Teflon gaskets for reassembly.
- Clean the sensor with a clean cloth. Do not use a wire brush!
- Flush through the sensor thoroughly.

Before the sensor is disconnected the valves in the by-pass pipes must be closed. Make sure that no flow passes through the pipe. If the sensor is disconnected under process pressure this could cause serious injury or even death. Cerlic does not accept any responsibility for accidents caused when the sensor is disconnected while still under line pressure.

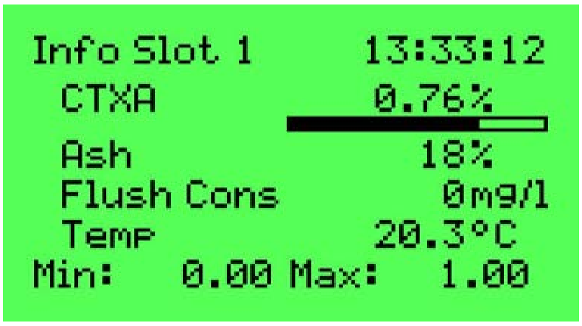
8. Service and maintenance

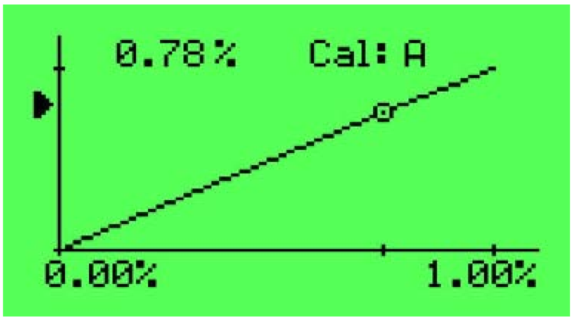
In some applications the measuring cell may need to be cleaned. Use warm water and a small bottle brush to clean the cell; do not use a metallic brush or sharp tools. An acid solution can be used to dissolve coating in the measure cell. Plug one end of the cell and fill it with 5 % hydrochloric acid or sulphamic acid. Leave the sensor for a couple of hours and then flush the cell with plenty of clean water. Repeat the treatment if necessary. If hydrochloric acid does not dissolve the coating, other chemicals may be used as long as they don’t affect the O-rings made of Viton

The sensor housing may not be opened, except by Cerlic service personel. Opening the sensor housing will void all warrenty.

9. Sensor information displays

Press ⬇ and ENTER simultaneously to switch between main menu and the sensor display #1. This first display shows some additional readings to the main values (temperature, the value measured during last cleaning). Press ⬇ and ENTER simultaneously again to reach the display #2 showing the current calibration set graphically. By pressing ⬇ and ENTER simultaneously a third time you return to the main display.





10. Sensor menu

Use ⬆ or ⬇ to select the sensor in the main display. Press ENTER for five seconds to access the menu for the selected sensor.

Settings

Tag	Name of the sensor (10 characters) shown in the main display
Calibration	Calibration set ”A”-“D”, or “Extern”. “Extern” will allow remote selection of calibration set from DCS.
I-Time(s)	Integration time, dampening the output signal
Integrate	”Normal” integrates the raw values, “Extra” additionally integrates the calculated consistency value.
Unit	”%”, ”ppm”, ”g/l” or ”mg/l”
Decimals	”Std” or ”Extra”, number of decimals for the reading
Analog	”None” , ”Ch1”, ”Ch2”, ”Ch3”, ”Ch4”, ”Ch1+2” or ”Ch3+4”. Pick the analog output(s) to be used with sensor. Ch3-4 are optional.
Second	”Temp”, ”=Prim”, “Clean”, “Raw value” or “Ash” are available. If two outputs are chosen, the first will always give the primary value. The second will either give the temperature (0-100°C), the same signal as the first, the measured value at the last flushing, raw values (for test) or ash content (0-100 %).

Calibrate

Selected Cal	”A”-“D” or “Extern”, selection of calibration set
Used Cal	Selected calibration set (A-D)
Adjust	”No”, ”Store” or ”Lab”. “Store” stores the present reading of the sensor and after input of the corresponding lab result through “Lab” the old lab result under “Sample #1” is automatically adjusted
Take sample	“No”, “Zero”, “# 1”-“# 5”, see Calibration section
Cons	Actual consistency reading
Sample # 1	Lab test sample # 1
Sample # 2	Lab test sample # 2
Sample # 3	Lab test sample# 3
Sample # 4	Lab test sample # 4
Sample # 5	Lab test sample # 5
Adv. CTXA	Advanced menu for CTXA
Fiber g	Fiber gain, automatically set at sample #1 calibration when ash content is entered
Filler g	Filler gain, automatically set at sample #1 calibration when ash content is entered
@ ash	Ash content entered at sample #1 calibration
Raw fib	Current raw fiber signal, multiplied with fiber gain to get actual fiber part of the total consistency
Raw fil	Current raw filler signal, multiplied with filler gain to get actual fiber part of the total consistency
CC	Chalk compensation, compensates for filler reading as fiber
FC	Fiber compensation, compensates for fiber reading as filler
Ch1_water	Channel 1 (polarized) reading at last zero calibration
Ch2_water	Channel 2 (depolarized) reading at last zero calibration

Cleaning

Cleaner	”None”, ”Brush” or ”Flush” (“Brush” does not exist for this sensor)
Interval min	Time (minutes) between cleaning cycles
Length sec	Duration (seconds) of flushing cycle
Freeze sec	Extra freeze time of output signal after a flushing cycle
Relay	”-”, ”#1”, ”#2”, “Along #1” or “Along #2”. Select relay to operate solenoid for flush cycle if this sensor is a master with its own relay, or relay used by master if this sensor is a slave. These same relays can be used as “Alarm relay” below.
Next time	The next scheduled cleaning time. Pushing “Enter” on this line will set the time to current time and start a cleaning cycle. This could be used to test the “Flush” cycle.
Clean	Reading in the end of the last flushing cycle

Scale / Alarm

Max	Reading corresponding to 20 mA output signal
Min	Reading corresponding to 4 mA output signal
Hi-Alarm	Reading to activate high alarm, 0 inactivates the alarm
Low-Alarm	Reading to activate low alarm, 0 inactivates the alarm
Alarm Relay	”-”, ”1 and 2”, ”#1” or ”#2”. Check that it is not used for cleaning

System

Type	Type of sensor
Serial	Serial number of sensor
SoftW	Software version of sensor
Temp	Sensor temperature
MaxTemp	The highest sensor temperature recorded
Samples	Sub menu to view SA values and consistency values for this calibration set
Selected Cal	”A”-“D” or “Extern”, selection of calibration set
Used Cal	Selected calibration set (A-D)
SA 0	SA value zero sample (clean water)
SA 1	SA value sample #1
Cons 1	Lab test sample #1
.....	And so on for sample #2-5

Info	Menu for Cerlic internal use
MS	Linearized light signal, which are SA values in calibration chart
Con	Consistency reading, same as the main display
SA 0	SA value zero sample on clean water
SA 1	SA value sample #1
Cons 1	Lab test sample #1
Ch1	Raw value channel 1
Ch2	Raw value channel 2
Ch1i	Raw value channel 1, compensated for intensity
Ch2i	Raw value channel 2, compensated for intensity
Ch1/Ch2	Ratio channel 1 and 2
Intens.	Current intensity
Zero Int	Intensity for clean water, set during zero calibration
I-offset	Intensity offset, set during zero calibration
Temp Calib	Temperature compensation constant.
Samp/s	Samples per second
Service	Not accessible for users

11. Calibration

Overview

Calibration is made in a number of steps performed in a consecutive order. Each step is described further down. If one step is redone, all later steps have to be redone:

1. Zero calibration, made on clean water by Cerlic before shipping
2. Setting CC and FC constants (only CTXA)
3. Calibrating total consistency and ash content (ash content only CTXA)
4. Adjusting calibration of total consistency and ash content (ash content only CTXA)

- It is important that the sensor has been in operation for at least 30 minutes before calibration to have a stable operation
- CC, FC and ash content only apply to CTXA
- Single point calibration is recommended. In case of multiple point calibration, sample #2-5 can be calibrated when steps 1-4 above are finalized for sample #1

Zero Calibration

The sensor is zero calibrated at the factory, and does normally not need recalibration. Before doing a zero calibration make sure that it is really needed. The zero point is common for all four calibration sets. If the zero point is recalibrated it will affect all other calibration points in all calibration sets of the sensor.

Make sure the windows are clean, and use clean de-aerated water to check the meter reading. Tap water is best de-aerated in an open bucket for at least two hours.

To run a zero calibration:

- Remove the sensor from the process and clean it thoroughly
- Plug one end of the sensor and fill the cell with clean de-aerated water

NOTE! The sensor must not be submerged into the bucket!

- Select the sensor to be calibrated in the menu by using ⬆ or ⬇ arrows
- Press ENTER for five seconds to enter the sensor menu
- Use ⬆ and ⬇ arrows to select “Calibrate” and select ”Take sample”
- Select ”Zero” and press ENTER
- If you really want to destroy the existing calibrations, change “No” to “Yes”, then press ENTER
- After you have filled the sensor with water, press ENTER again
- Wait for the zero calibration to finish. It will take approximately thirty seconds before the unit returns to the menu.

For more information concerning use of menu/dialogues, refer to the manual for BB2.

Setting CC and FC constants (only CTXA)

The **CC** constant is used to compensate for fillers (chalk, GCC, PCC) depolarizing the light and reading partly as fiber, resulting in lower ash content than the actual. Changing CC will destroy all calibration points in the current calibration set except the zero calibration. There is a separate CC for each of the four calibration sets.

Select CC out of typical values for Kaolin=0.00 / PCC=0.90 / GCC=1.25 / Chalk=1.40

Another way to find the CC to be used with a filler type is to mix about 4 g/l suspension of the filler in clean water. Set the integration time to zero during this test (Settings/I-time). Plug one end of the sensor and pure the suspension into the measuring cell. Shake the sensor to avoid sedimentation and wait 5-10 s for stable signal. Adjust CC in the advanced CTXA calibration menu to get a raw fiber reading of zero. Raw fiber reading before setting CC is typically 0.00-0.50

For white water CC is always set to 0.00 independent of filler type.

The **FC** constant is used to compensate for fiber (fines) not completely depolarizing the light and reading partly as filler, resulting in higher ash content than the actual. Changing FC will destroy all calibration points in the current calibration set except the zero calibration. There is a separate CC for each of the four calibration sets

Select FC out of typical values for Bleached Kraft=0.00 / TMP=0.65

Another way to find the FC to be used with a certain fiber mixture is to mix about 4 g/l suspension of the fibers in clean water. Set the integration time to zero during this test (Settings/I-time). Plug one end of the sensor and pure the suspension into the measuring cell. Shake the sensor to avoid sedimentation and wait 5-10 s for stable signal. Adjust FC in the advanced CTXA calibration menu to get a raw filler reading of zero. Raw filler reading before setting FC is typically 0.00-0.50

For white water FC is always set to 0.00 independent of pulp type.

Calibrating total consistency and ash content (ash content only CTXA)

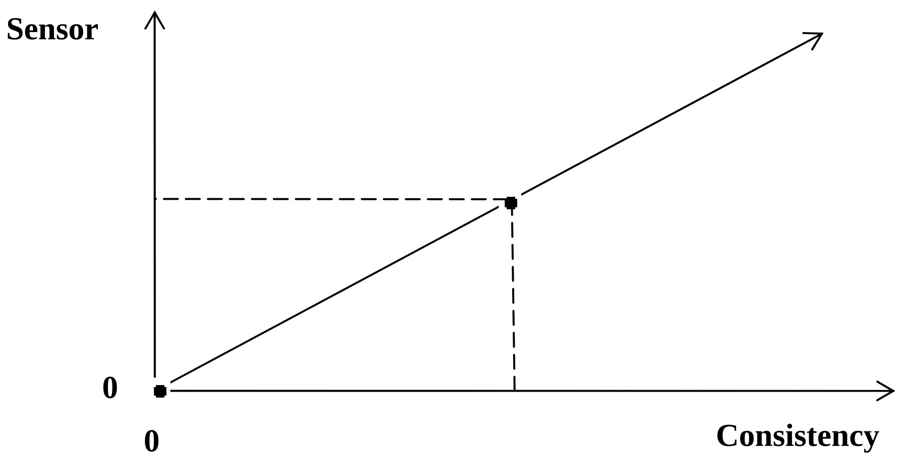
- Select “Calibrate”, “Take sample”, “#1” and press “ENTER”
- Press ”ENTER” to calibrate and take a lab sample
- Take the sample to the lab for analyzing total consistency and ash content
- The lab results are entered in “Calibrate” and “Sample #1”
- After the total consistency is entered a dialogue box pops up, asking if a new ash value shall be entered. To enter an ash value, first select yes, then press enter to get the value box. In the new dialogue box the ash content value for can be entered. When a new value has been entered the BB2 will calculate new fiber and filler gain. All calibration points except point 1 will be reset. The ash content should to be between 10 and 90 % to obtain an acceptable calibration.

Adjusting calibration of total consistency and ash content (ash content only CTXA)

Statistic adjustment of the lab sample value is a much better way to good measurement than frequent recalibration. This is done comparing the lab results with the instrument reading over time. If a systematic discrepancy is detected, the value of the lab sample used in BB2 is changed accordingly. If for example several lab results for a period of time in average shows 5 % more than the instrument, the sample value in BB2 shall be increased 5 % of its value, e.g. if the sample value is 1.00 % it shall be changed to 1.05 %. Using statistic adjustment will gradually improve the accuracy and reliability while a new calibration will restart from scratch. An Excel sheet to help doing statistical adjustment of the calibration can be downloaded from http://www.cerlic.com.

Calibration points

The calibration set is built up of the zero calibration point and at least one calibration point. A calibration point can be disabled by setting the consistency value to zero.



Automatic adjustment of the calibration

The function ”Adjust” in the calibration menu is used to automatically adjust the calibration in an easy way. When a sample is taken for the lab, BB2 stores the reading. When the sample has been analyzed, the result is keyed into the BB2 who will compare it to the stored reading and calculate a new sample #1 value. Automatic adjustment only works for single point calibration and is primarily intended as an easy way to get started with a new sensor. Once the automatic adjustment is done, and the sensor gives a sensible reading, statistical adjustment is recommended.

- Select sensor in the menu by using ⬆ or ⬇
- Press ENTER for five seconds to enter the sensor menu
- Select “Calibrate”, “Adjust” and then “Store”
- Press ENTER when taking the lab sample
- Get the sample analyzed
- Select “Calibrate”, “Adjust” and then “Lab”
- Press ENTER
- Key in the lab result, then press ENTER
- BB2 will show current and suggested new value for ”Sample #1”, acknowledge the change by pressing ENTER or abort using ⬆ or ⬇.

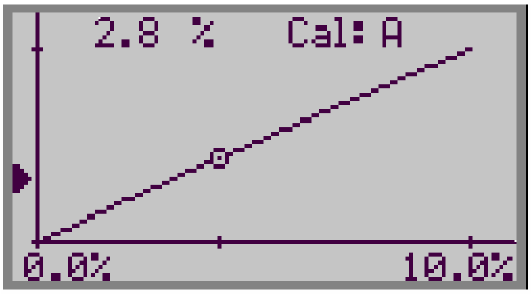
Calibration with multiple points

The only cases where multiple calibration point is useful are when the sensor signal is non linear or when the sensor has to be very accurate at widely separated consistencies.

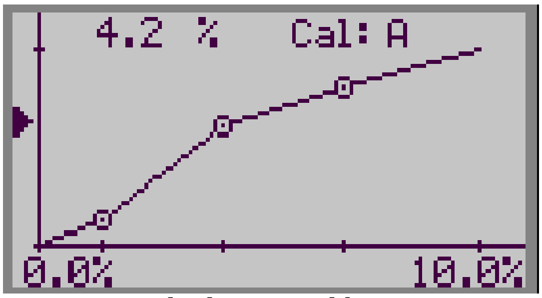
Use the same procedure described in “Calibrating total consistency and ash content (sample #1)” but select sample #2, #3, #4 or #5.

Calibration display

Press ⬇ and ENTER simultaneously to switch between main menu and the sensor display #1. This first display shows some additional readings to the main value (temperature, the value measured during last cleaning, raw value of the measurement). Press ⬇ and ENTER simultaneously again to reach the display #2 showing the current calibration set graphically. By pressing ⬇ and ENTER simultaneously a third time you return to the main display.



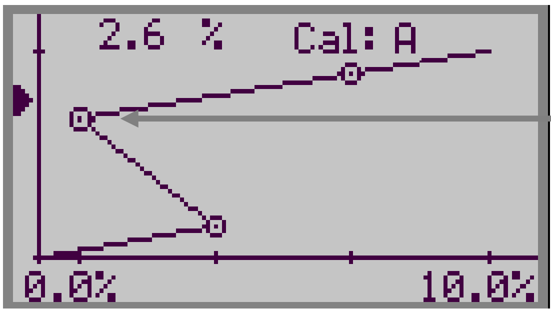
Single point calibration



Multiple point calibration

A calibration set normally consists of zero point and one consistency sample (single point calibration). Up to five samples may be used to create a calibration curve (multiple point calibration). The samples are sorted internally in order of signal intensity. The calibration display shows the calibration set in a graph:

- X-scale displays consistency, from M**in** (4 mA) to M**ax** (20 mA)
- Y-scale displays the raw sensor signal
- Actual measuring value is shown in numbers and with the arrow on the Y-axis
- Samples outside the scale are not displayed but still used in the calculations. If you want to see a point outside the scale, you may temporarily change the scale in the Scale / Alarm sensor menu.

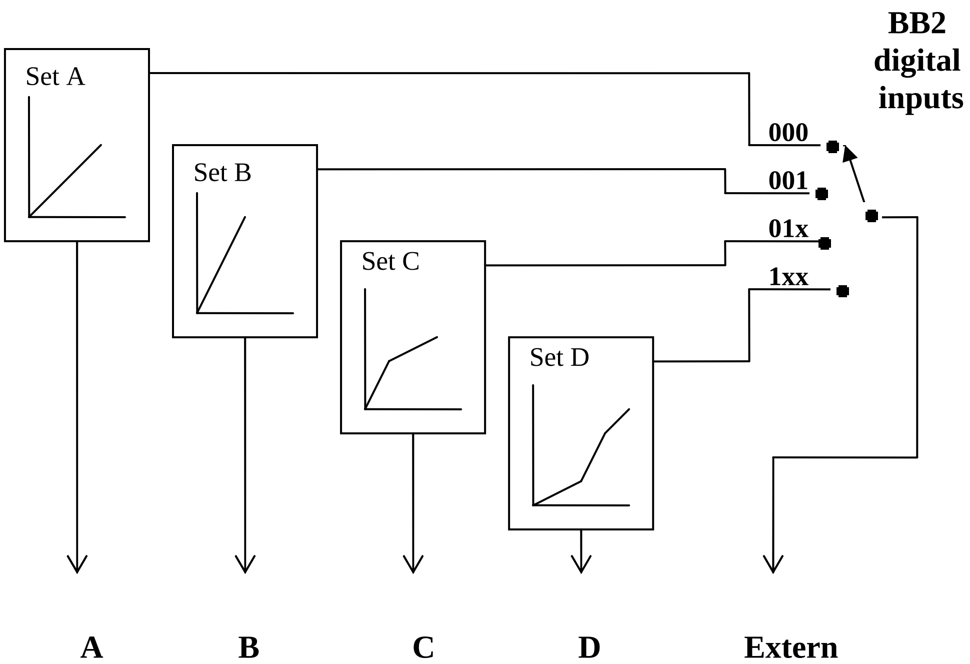


Two samples have probably been exchanged when entering the lab results. The Y-value must always increase with increasing X-value.

Multiple Calibration sets

The sensor can handle four independent calibration sets for different types and qualities of pulp. Each set has up to five calibration points. All four sets have a common zero calibration. The selection of calibration set is done in the menu for setup and calibration or from an external device (DCS). At external selection:

- The external selection overrides the manual selection
- If several sensors are connected to one common BB2, all sensors will change simultaneously to the set selected (A-D)



12. Deposits – alarm and compensation (only CTXP)

BB2 has a choice to output the measured value during the last flushing on its second 4-20 mA output. This is useful in demanding applications where it can be used to trigger an alarm to manually clean the sensor. The signal can also be used to compensate the reading for deposits in the sensor, extending the interval between manual cleaning.

13. Scaling

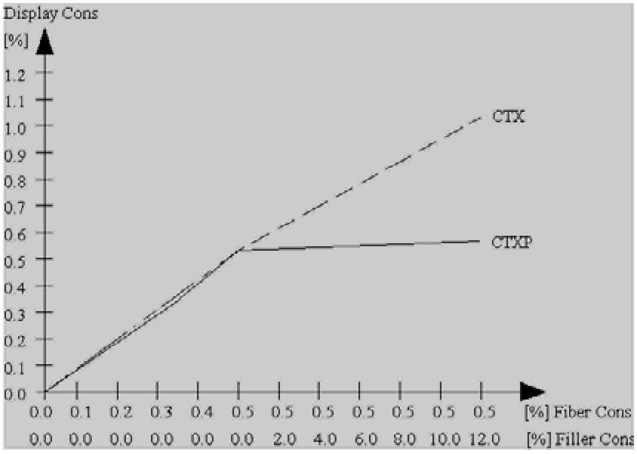
On the "Scale / Alarm" menu the range of the 4-20 mA is selected, as well as alarm limits:

Max	sets the 20 mA point output
Min	sets the 4 mA point output
Hi-Alarm	sets the high alarm set point; a value of zero inactivates the alarm
Low-Alarm	sets the how alarm set point; a value of zero inactivates the alarm

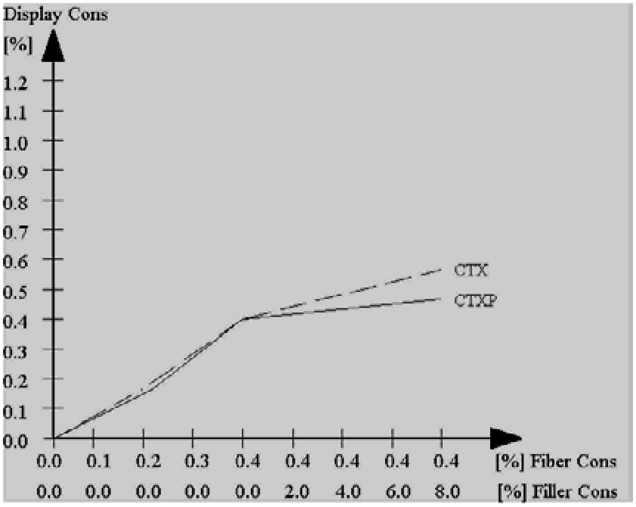
14. In-Depth Technical Description

The measuring principle is based on the ability of fibers to depolarize NIR (Near Infra Red) light polarized into one plane. The light source is a pulsed diode. Two detectors register the V- and H-planes of the transmitted light, and the BB2 makes a calculation of these signals to obtain the current fiber consistency. The following diagrams show how the CTXP/CTXA reacts to fibers and different fillers as compared to how a CTX transmitter with straight transmission reacts.

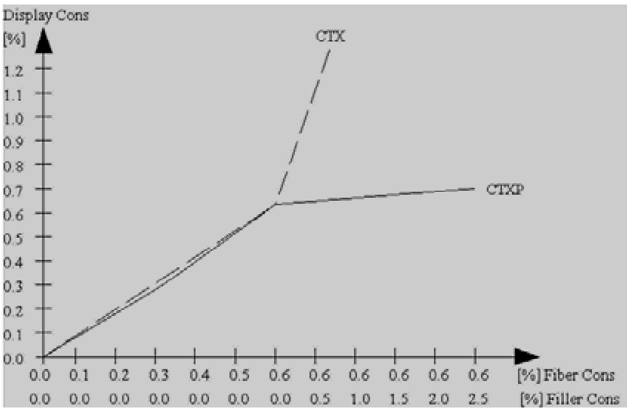
Hardwood kraft pulp / Clay



Groundwood pulp / Chalk



Hardwood kraft pulp / Titanium dioxide



15. Technical data

CTXP 03/25	P/N 11305537
CTXA 03/25	P/N 11305783
Material	SIS 2343 / 316SS
Process connection	DN25, butt weld ends 30x25 mm (1” NPT connections)
Pressure rating	PN25 / 365 psig
Enclosure	IP65 / NEMA4X
Process temperature	0 - 65°C / 32 - 150°F
Process pressure	Min 1 bar / 15 psig
Light source	GaAs diode, 880 nm monochromatic
Measuring principle	Straight transmission and depolarization, 3 mm measuring gap
Connection cable	5-pin M12 connector
Weight	3.7 kg / 8 lbs
Measuring range	Max total consistency 2 % at 50 % ash content

Certificate of conformity

The CTX sensors along with their central unit BB2 are in conformance with the following EC Directive(s) when installed in accordance with the installation instructions:

73/23/EEC	Low Voltage Directive as amended by 93/68/EEC
89/336/EEC	EMC Directive as amended by 92/31/EEC and 93/68/EEC

The following standards and/or technical specifications have been applied:

EN 61000-6-4:2001	Electromagnetic compatibility (EMC) Part 6-4 Generic standards – Emission standard for industrial environments
EN 61000-6-2:2001	Electromagnetic compatibility (EMC) Part 6-2 Generic standards - Immunity for industrial environments
EN 61010-1:2001	Safety requirements for electrical equipment for measurement, control, and laboratory use

16. Dimensions