CTX

Flow-through

Suspended Solids Sensors

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1. Introduction

The CTX flow-through sensor is used to measure suspended solids in liquids. Combined with the BB2 control box, the sensor is used to measure suspended solids in liquids. Examples of applications are suspended solids in Water Treatment Plants, Waste Water Treatment Plants, Industrial applications like slurry's or process applications.

2. A few words about this manual

The manual primarily contains information about the Cerlic CTX sensors. Menu functions and technical data of the BB2 control box can be found in the BB2 service manual.

3. Design

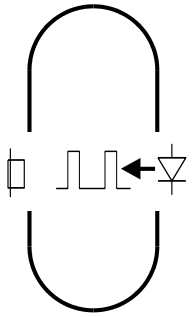
The CTX sensor is made in 316 stainless steel and is mounted with pipe fittings (DN25) directly onto a 25 mm (1") pipe or 1" npt fitting (US market). The sensor has a self cleaning design since it necks down to 20 mm at the lenses from 25 mm or 1" inlet which permits precise and reliable measurement with minimum maintenance possible, even in critical applications. The measuring lenses in the sensor are made of sapphire glass in order to withstand abrasive liquids. Electronic and optical components are well protected within the SS enclosure to handle very demanding environments.

The sensors are available with 50 mm (2" NPT in US) connections for CTX20/50 and 25 mm (1" NPT in US) connections for CTX20/25, CTX20/25LC & CTX03/25. The LC sensor is a special design for very low suspended solids concentrations like 0-10 ppm up to 2,000 ppm. The CTX03/25 is a high solids sensor with 3 mm lens gap rather than 20 mm like the other units.

A shielded M12 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. Other Cable lengths are available.

4. Measuring principle

The CTX measures transmitted light through the liquid. The measuring principle is based on the suspended particles' ability to absorb and reflect light .The light source is a light emitting diode (LED) that pulses monochromatic NIR light at high power. The detected measuring signal is inversely logarithmical proportional to the suspended solids. Signal treatment is done by the BB2 control box. The temperature is measured by the transmitter to be used for temperature compensation of the measured value. Temperature is temperature inside sensor head and not true liquid temperature.



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**
• 1” npt x 25 mm union with nut, 316SS for CTX 20/25	31104016
• Gasket, teflon for 25 mm union	21603365
• 2” npt x 50 mm union with nut, 316SS for CTX 20/50	31104017
• Gasket, teflon for 50 mm union	21603319
• 25 mm hose adapter DN25 for CTX 20/25	10305122
• 0.66 m (2 ft) M12 signal cable	30804063
• 10 m (33 ft) M12 signal cable	20805510
• 30 m (100 ft) M12 signal cable	30804062
• M12 Y-splitter for two sensors, 24” long	30804065
• Brush cleaning assembly for CTX 20/25 and CTX 20/25 LC	11203178B
• Brush for cleaning device, SS shaft	10603261
• Mounting plate for CTX with brush cleaning device (outside US)	12705528
• Mounting plate for CTX with brush cleaning device (US)	31204066
• Solenoid valve for flushing (US)	1705516B

6. Mounting sensor

The CTX20/25 can be mounted directly in a 25mm (1") pipe, CTX20/50 in a 50mm (2") pipe. With larger pipes a by-pass line should be used. The sensor shall always be mounted with the cable connector pointing downwards.

There are three ways to mount the sensors – butt weld end connection, NPT-couplings (US) or hose connections. See Dimensions section for more information.

In all applications the valve after the sensor shall be used for throttling. Never throttle prior to sensor. The BB2 control box can control flushing automatically with the cleaning relay. .

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 suspended solids. 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.
- For CTX 20/25 and CTX 20/50 the by-pass pipe should be 25 mm (1") and 50 mm (2") respectively.
- The by-pass pipe should not have any throttling valve or pipe bend closer than 0.5 m (20") before the sensor.
- The by-pass pipe should be made to avoid dewatering of the suspended solids during a shutdown. If there is 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 20 l/min (10 gpm) for CTX20/25 and 40 l/min (20 gpm) for CTX 20/50 sensors. At lower rates, there is a risk for dewatering and build up on the sapphire windows. With automatic flushing, then the flushing water pressure should be at least the same pressure as the air pressure to the cleaning device.

- The temperature of the sensor must not exceed 95°C (203°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 or put into 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 install the M12 protective cover on the sensor when the M12 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).

For further instructions on white and green liquor applications, please refer to Appendix 1.

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.

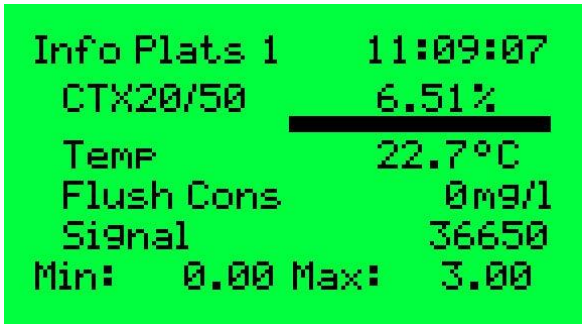
8. Service and maintenance

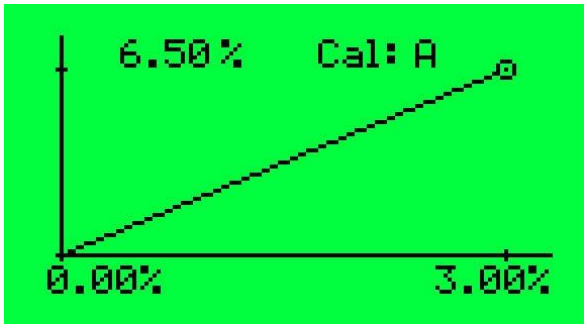
In some applications the measuring cell may need to be cleaned. Use warm water and a small bottle brush to clean the cell; do not use a metallic brush or sharp tools. An acid solution can be used to dissolve coating in the measure cell. Plug one end of the cell and fill it with 5 % hydrochloric acid 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 alpha/numeric characters) shown on the main display
Calibration	Calibration set ”A”-“D” or “Extern”. “Extern” will allow remote selection of calibration set from DCS. Normally only use one calibration curve unless you are measuring different type of solids or liquid with the same sensor.
I-Time(s)	Integration time, dampening the output signal, 0 – 999, normally 15 sec
Unit	”%” solids, ”mg/l”, “g/l” or ”ppm”
Decimals	”Std” or ”Extra” for 0.1 intervals, number of decimals on 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” or “Clean”. If two outputs are chosen, the first will always give the primary value. The second will either give the temperature (0-100°C) of the internal sensor temperature, “=Prim” gives the same signal as the Analog 1 and “Clean” shows the measured value at the last flushing.

Calibrate

Selected Cal	”A”-“D” or “Extern”, selection of calibration curve
Used Cal	Selected calibration set (A-D)
Adjust	**Contact Factory Prior to using 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” or “# 1”-“# 5”, see Calibration section
Cons	Actual suspended solids 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

Cleaning

Cleaner	”None”, ”Brush” or ”Flush” (“Brush” for CTX20/25 or CTX20/25LC sensors only)
Interval min	Time (minutes) between cleaning cycles
Length sec	Duration (seconds) of flushing cycle or strokes of brush like 5 sec = 3 strokes
Freeze sec	Extra freeze time or recovery of output signal after a flushing/brush cycle
Relay	”-”, ”#1”, ”#2”, “Along #1” or “Along #2”. Select relay to operate solenoid for flush/brush 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 could 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 at 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, all “0’s” inactivates the alarm
Low-Alarm	Reading to activate low alarm, all “0’s” inactivates the alarm
Alarm Relay	”-”, ”1 and 2”, ”#1” or ”#2”. Check that it is not being 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 suspended solids 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	Suspended Solids reading
SA 0	SA value for zero sample on clean water
SA 1	SA value sample #1
Cons 1	Lab test sample #1
Ch1a	Raw value channel 1 (1000-40000)
Ch1	Raw value channel 1, compensated for intensity
Intens.	Current intensity (150-25000)
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. Calibrating suspended solids
3. Adjusting calibration of suspended solids – CONTACT FACTORY BEFORE USING THIS OPTION!

- Warm Up of Sensor - It is important that the sensor has been in operation for at least 30 minutes before calibration to have a stable operation
- 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. The CTX 20/25 LC sensor cannot be zero calibrated in the plant, it has to be performed by Cerlic.

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.

Calibrating Samples #1-#5 for suspended solids concentrations

- Select “Calibrate”, “Take sample”, select “#1” (thru “#5”) and press “ENTER”
- Press ”ENTER” (again) to calibrate and grab sample of liquid at the same time for the lab
- Take the sample to the lab for analyzing of the suspended solids
- The lab results are entered under “Calibrate” and “Sample #1 (thru #5)”

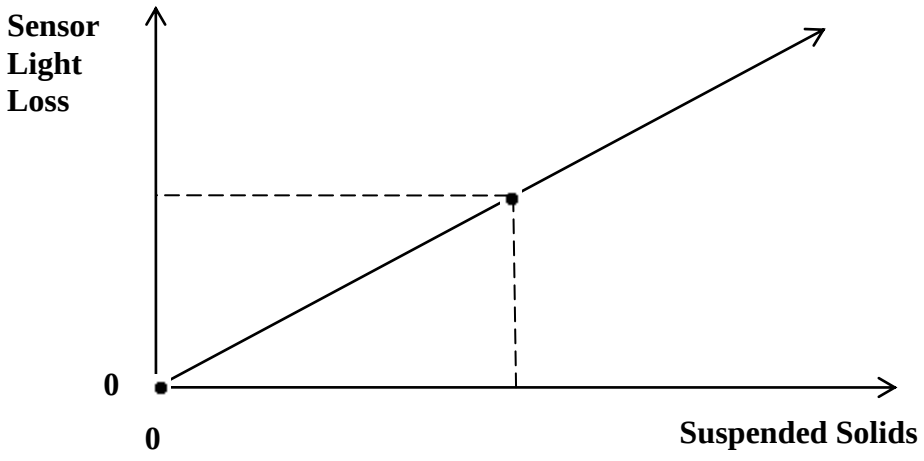
  Note: Sensor remembers SA or light value at the time you told it to calibrate. You enter lab value for suspended solids at any time after this like 2 hours or 2 days. Sensor compares light loss from SA0 – SA1 to lab value.

Adjusting calibration of suspended solids – Consult Factory prior to using this option!!

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 readings 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 1,000 ppm it shall be changed to 1,050 ppm. 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 curve is built from the zero calibration point and at least one calibration point. A calibration point can be disabled or not used by setting the suspended solids value to zero or -----.



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

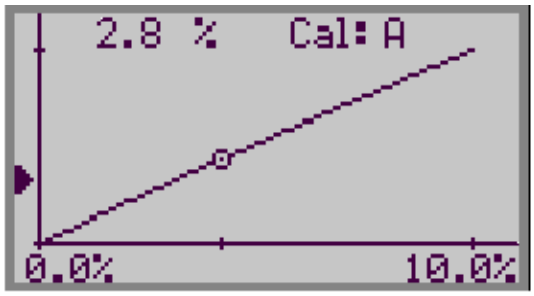
Calibration with multiple points

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 suspended solids concentrations.

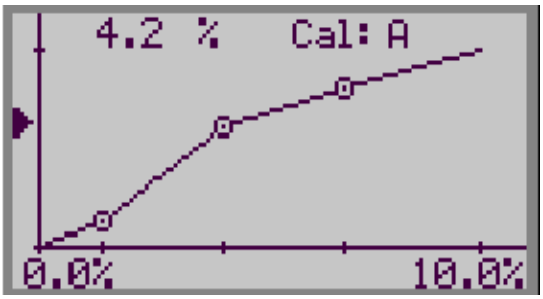
Use the same procedure described in “Calibrating Suspended Solids (sample #1)” but select sample #2, #3, #4 or #5.

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 graph. By pressing ⬇ and ENTER simultaneously a third time you return to the main display.



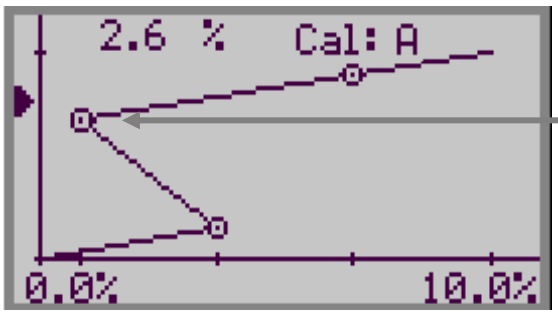
Single point calibration



Multiple point calibration

A calibration set normally consists of zero point (SA0) and one suspended solids sample (single point calibration like SA1). 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 suspended solids concentration, from M**in** (4 mA) to M**ax** (20 mA)
- Y-scale displays the raw sensor signal loss like SA0 – SA1 or 50,000 – 47,500 = 2,500 light unit loss and SA0 = 0 light loss
- Actual measured value at this time is displayed on the top left of the graph and with the arrow to the left of the Y-axis
- Samples outside the min & max scale are not displayed but are still used in the graph calculations. If you want to see a point outside the scale, you may temporarily change the scale in the Scale / Alarm sensor menu.

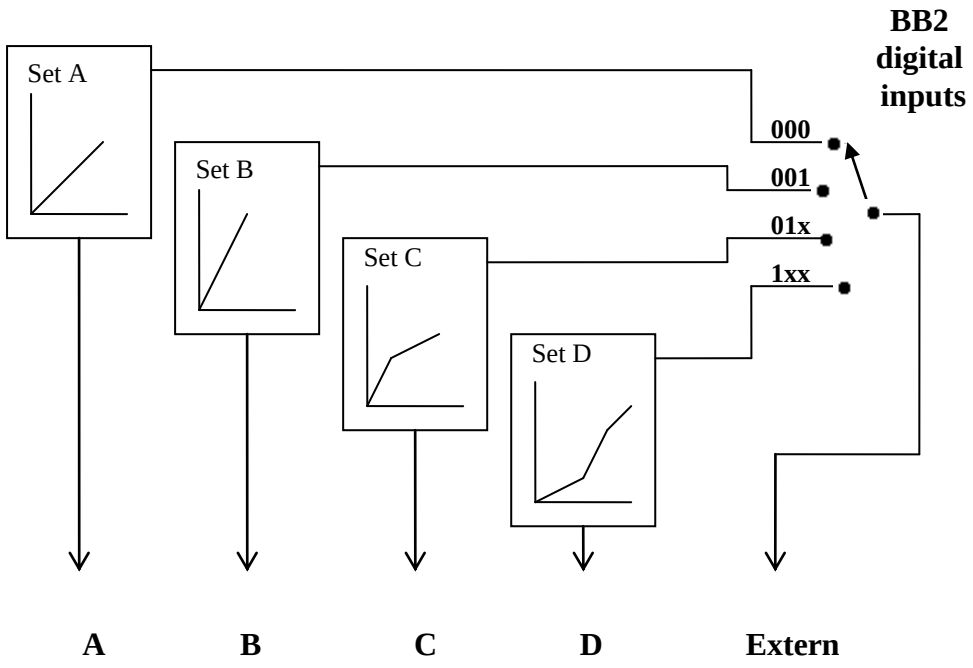


Two samples have probably been exchanged when entering the lab results. The Y-value must always increase with increasing X-value.

Multiple Calibration Graphs – only used for multiple types of liquid applications

The sensor can handle four independent calibration sets for different types and qualities of liquid with suspended solids. 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 two sensors are connected to one common BB2, both sensors will change simultaneously to the set selected (A-D)



12. Deposits – alarm and compensation

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. Technical data

CTX20/25	P/N 11305503
Process connection	1” NPT connection in US or DN25, butt weld ends 30x25 mm (outside US)
Material	SIS2343 / 316SS
Pressure rating	PN25 / 365 psig
Enclosure	IP65 / NEMA4X
Process temperature	0 - 95°C / 32 - 203°F
Process pressure	Min 1 bar / 15 psig
Light source	GaAs diode, 880 nm monochromatic
Measuring principle	Straight transmission, 20 mm measuring gap
Connection cable	5-pin M12 connector
Weight	3.7 kg / 8 lbs
Measuring range	Min 0-100 mg/l
	Max 3 % suspended solids depending on type of solids

CTX20/25 LC	P/N 11305531, low suspended solids sensor
Process temperature	0 - 50°C / 32 - 122 °F
Flow	15 – 100 l/min / 4 - 25 gpm
Measuring range	Min 0 –10 mg/l (resolution 0.1 mg/l)
	Max 0 – 200 mg/l (measures up to 2000 mg/l but not fully linear)
Other technical data	Refer to CTX20/25

CTX03/25	P/N 11305682, high suspended solids sensor
Process temperature	0 - 50°C / 32 - 122 °F
Flow	15 – 100 l/min / 4 - 25 gpm
Measuring range	7 times higher than CTX20/25 due to 3 mm lens gap
	Max 15 – 70 % suspended solids depending on to type of solids being measured.
Measuring principle	Straight transmission, 3 mm measuring gap
Other technical data	Refer to CTX20/25

CTX20/50	P/N 11305506, 2” sensor
Process connection	2” NPT connections in US or DN50, butt weld ends 54x50 mm (outside US)
Measuring range	Min 0-100 mg/l Max 5 % in by-pass pipe or 8 % directly in pipe depending on type of suspended solids being measured
Other technical data	Refer to CTX 20/25

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 contained in the product documentation:

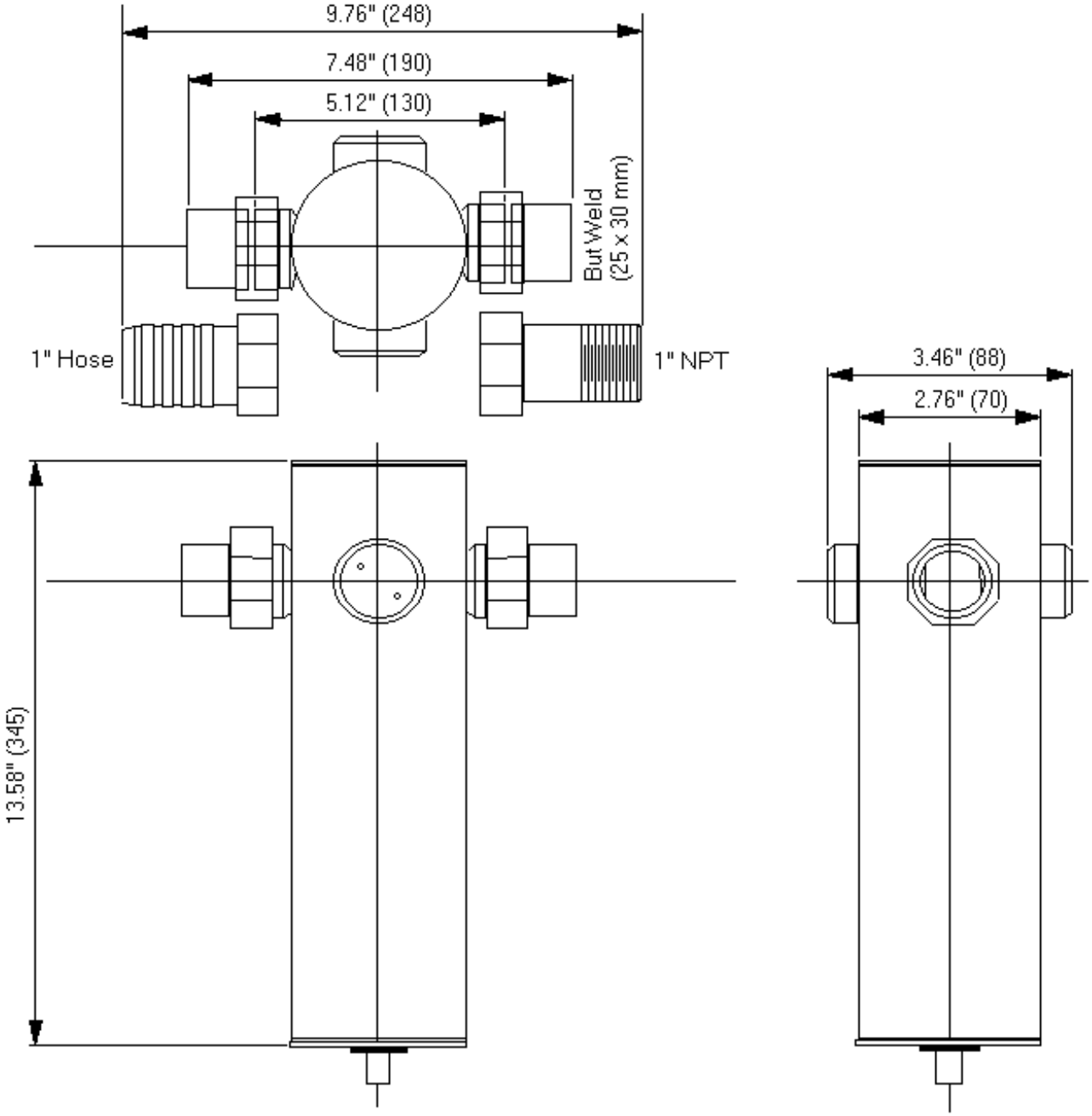
73/23/EEC	Low Voltage Directive as amended by 93/68/EEC
89/336/EEC	EMC Directive as amended by 92/31/EEC and 93/68/EEC

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

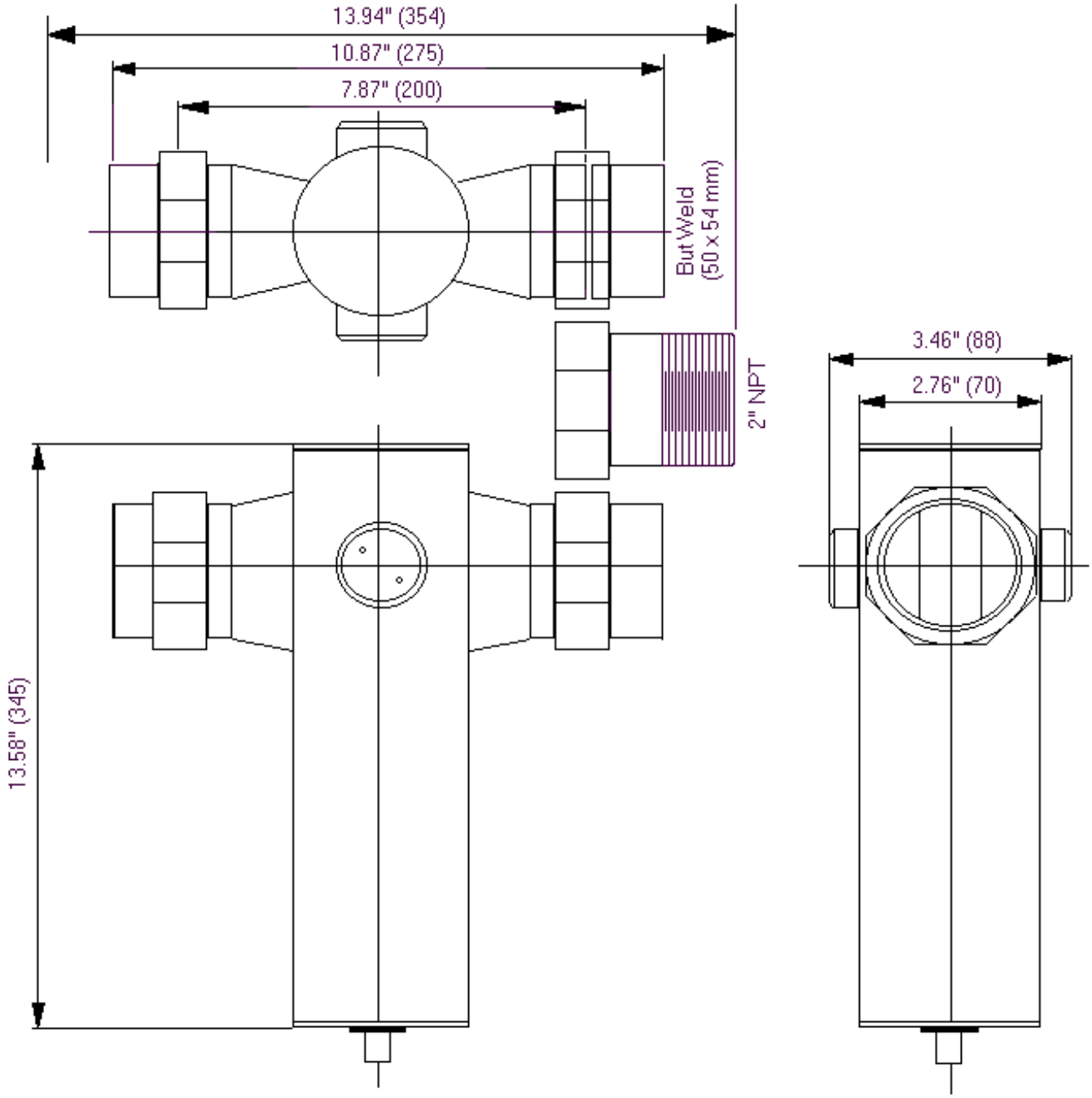
EN 61000-6-4:2001	Electromagnetic compatibility (EMC) Part 6-4 Generic standards – Emission standard for industrial environments
EN 61000-6-2:2001	Electromagnetic compatibility (EMC) Part 6-2 Generic standards - Immunity for industrial environments
EN 61010-1:2001	Safety requirements for electrical equipment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

14. Dimensions

CTX20/25, CTX20/25LC & CTX03/25

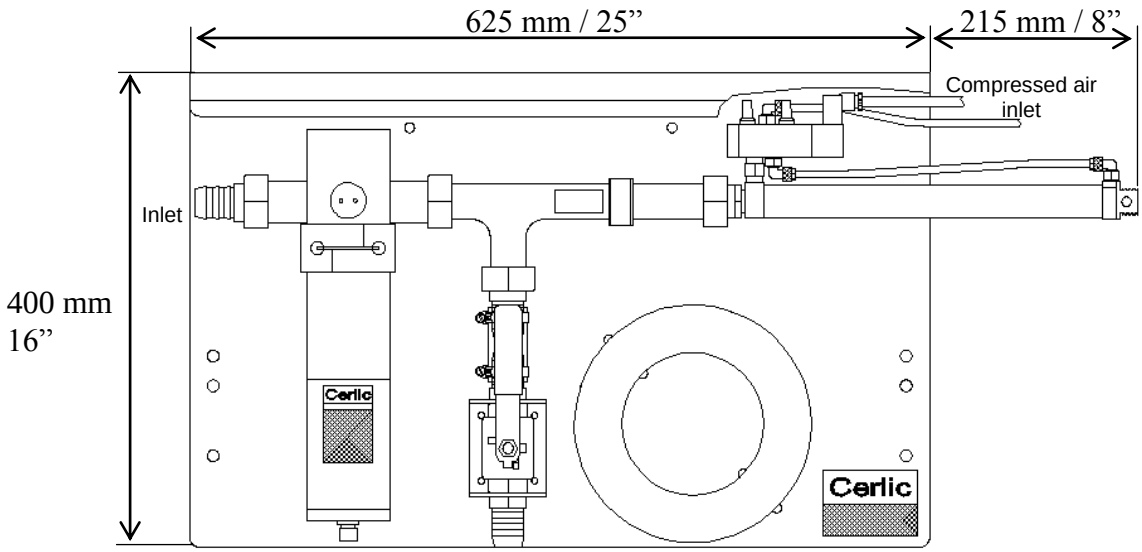


CTX20/50


13.94" (354)
10.87" (275)
7.87" (200)
But Weld
(50 x 54 mm)
2" NPT
13.58" (345)
3.46" (88)
2.76" (70)

Appendix 1 - Low suspended solids sensor with brush cleaning, CTX20/25LC sensor

Complete package for measuring of the suspended solids can be delivered on a common mounting plate, ready for installation. The equipment is normally supplied with an automatic brush-cleaning system to be controlled by the BB2 control box. Ref. drawing 102-S



Installation

The mounting plate is hung onto a handrail or mounted on a wall. Free space to the left is necessary for removal of brush for cleaning and maintenance.

Cleaning brush

- The cleaning is done by a brush, which is pushed into the sensor cell by a SS piston, controlled from the BB2 control box. Typical interval is 45 min.
- During the brush cleaning the output signal is frozen.
- The brush should be changed depending on the wear caused by the liquid, typically once per year.
- The compressed air to the 4-way solenoid valve should be about 80 psig.

Changing the brush

1. Close the valves before and after the sensor and the 80 psig air supply.
2. Loosen the nut that holds the piston assembly to the T-pipe.
3. Pull out the piston assembly from the T-pipe
4. Loosen the locking nut on the brush and remove the brush from the piston.
5. Attach the new brush, and tighten the locking nut.
6. Push the assembly back in the T-pipe and tighten the nut. Confirm you have the Teflon gasket.
7. Open the valves and the air supply. Check the function by going to the cleaning menu. Select “Next time” and push “Enter” to activate a cleaning cycle.