



User's Manual

MULTIPARAMETER ANALYSER CX2000



CX2000 Multiparameter Analyser Panel



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Purpose of this Document

The purpose of this document is to equip the reader with the necessary information required for the safe installation, operation and maintenance of this device, prior to its commissioning. The information within this document is aimed towards those individuals who are technically qualified and experienced in the assembly, installation and operation/maintenance of the device.

To avoid personal injury or property damage it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings. If you have any questions about these instructions, contact the customer support division of the Manufacturer before proceeding.

Whilst the information in this document aims to be as accurate as possible, the Manufacturer makes no warranty or representations with respect to the information herein. The proper utilization of this information is ultimately the responsibility of the Customer.

Intended use

In order to ensure optimum functionality, the device needs to be utilized solely for those purposes and in those manners as prescribed herein. The Customer is responsible for making certain that the operating conditions for the device correspond to the technical specifications defined. Furthermore, the Customer is also responsible for ensuring that any personnel that operate or maintain the device are made aware of the implications of using or operating the device in unsuitable conditions.

The Manufacturer does not assume any liability for damages resulting from the failure to use the device for its intended purpose or for damage caused by external forces or any other external factors.

Qualified Personnel

The product described in this documentation may be installed, operated and maintained only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products.

The Customer must ensure that operating personnel read and understand these instructions as well as the specified hazard statements, warning and caution notes. Furthermore, the operating personnel must be familiar with the applicable health, safety and accident prevention regulations and comply with them.

General Safety & Security

The Customer must consider for the necessity of any protective clothing for its employees in the vicinity in order to provide protection against hazards of temperature (high or low), chemicals, radiation, dangers to eyes and face, noise and falling objects.

There is always a possibility of risk of injury if heavy products are handled manually. Customers are requested to analyze the risk and use appropriate handling methods by taking into consideration the task, the individual, the working environment and the load. Furthermore, it is the Customer's responsibility to ensure that general instructions for proper use of tools and safety of equipment, piping and plant construction must also be complied with and "Warning Notices" need to be put up wherever necessary.

The Customer is solely responsible to prevent unauthorized access to its plants, systems, machines and networks, its information technology infrastructure, firewalls network, internet and appropriate security measures.

Incorrect installation, operation or maintenance of the device in potentially explosive atmospheres may lead to ignition of the atmosphere and cause risk of fatal injury, death or damage to personal property. Please note that the Customer is solely liable for any hazards, damage or injury caused to its personnel or property due to the Customer's failure to comply with the safety instructions above and as established throughout the course of this manual.

Limitation of Liability and Optimum performance

For optimum performance, the Product should only be used in conjunction with components and accessories supplied by the Manufacturer. If the product accessories and components from other manufacturers are used, these must be recommended or approved by the Manufacturer.

The Manufacturer shall not be liable and the Warranty shall not apply, if the Product (i) is used in any manner that is inconsistent with the intended purpose or design of the Product as described in user manual, product literature and/or technical documentation provided by the Manufacturer of the Product; (ii) is altered in any way; (iii) is used or maintained in any manner that is inconsistent with Manufacturer's instructions or warnings ("User Instructions") provided along with the Product; (iv) subjected to any other misuse, lack of proper storage & handling, commissioning, maintenance, faulty repair, neglect, or servicing by persons other than Manufacturer's authorized person and/or failure to operate in permissible ambient conditions.

Compliance with Laws & Directives

Observe the test certification, provisions and laws applicable in your country during connection, assembly and operation.

Product and E-waste Disposal



It is necessary to dispose of this product and E-waste only in accordance with local regulations at the authorized, qualified collecting point specified for equipment and its parts. Kindly refer to the components mentioned in this document. Please follow all waste disposal guidelines (Management & Handling) as published by local governing authorities and local environmental laws.



Read this User Manual thoroughly and understand its contents completely, before installing and powering-up the positioner.

Nomenclature and symbols

Product

Product refers to the **CX2000 Multiparameter Analyser**.

Nomenclature

This manual contains notes and instructions, which the user must observe to ensure the safety of all user personnel and to protect the product and equipment connected to it. These are highlighted using specific symbols and appear based on the severity levels as follows.



This indicates that the user must read an important note and / or observe the instruction during installation, connection and/ or use of the analyser.



DANGER
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous possibility of electrical shock, which, if not avoided could be fatal.



This indicates the presence of modules with electronic devices that are susceptible to electrostatic discharge. Hence caution - do not touch the devices!



If used with the safety alert symbol indicates a potentially hazardous situation which if not avoided may result in minor to moderate level injury.

CAUTION

If used without the safety alert symbol indicates a potentially hazardous situation which if not avoided may result in damage to property.

NOTICE

If used without the safety alert symbol indicates a potentially hazardous situation which if not avoided may result in undesirable state or result.

NOTE

This highlights important information about the product, using the product or part of the documentation that will be beneficial to the user.



This indicates that you must use only the recommended tools or tools appropriate for the immediate task.

General Notes

NOTE

Dear User,

This manual does not provide for every possible contingency situation that may arise during the installation, operation and maintenance of the product.

For information or situations not covered by this manual, please contact your local Forbes Marshall customer service support.

The content herein is based on the latest data available at the time of going to print and is subject to change due to ongoing product improvements in the future.

WARNING

Unplug the mains cable and battery power before handling any electrical or electronic parts in the analyser.

WARNING

The analyser uses hazardous chemical reagents. Use all necessary protective clothes, glasses and gloves before handling the reagent containers.

WARNING

While not in use, the analyser should be stored in a packed condition and in a dry area.



WARNING

After the successful calibration or validation, the used standard solutions or pH buffer solution should be discarded. Never reuse a buffer solution and never return it to its original storage container.

⚠️WARNING
Cleaning solution



The cleaning solution is required to clean the fluidic path of analyser for better accuracy. It is recommended to clean the fluidic path before and after each calibration, as well as per cleaning frequency configuration settings.

The cleaning solution is diluted **Sulphuric Acid (90% Distilled Water + 10% H₂SO₄)**.



Before any manipulation, wear protective clothes, glasses and gloves.

In case of contact with skin, immediately flush with plenty of water for 15 minutes and call a doctor.



In case of contact with eyes, immediately flush gently with water and call a doctor, and continue to wash until arrival of doctor.

⚠️WARNING
pH Sensor



After each buffer calibration or validation, the pH sensor should be rinsed again with deionized water and dried with tissue paper. When drying the sensor, care must be taken not to rub the membrane, i.e. only dab the electrode with tissue paper. Under no circumstances must an electrode be rubbed. This could introduce static electricity into the glass shaft of the sensor which could upset the accuracy of the pH calibration for hours.

⚠️WARNING

The successful operation of this product depends on its proper handling, installation, operation and maintenance.

This product must be used for the sole purpose described in this manual.

Safety Instructions



If used with the safety alert symbol indicates a potentially hazardous situation which if not avoided may result in minor to moderate level injury.

	This instrument must be earthed! To prevent electric shock, verify that the power socket used for this instrument has an earth connection in accordance with the regulations.
	Some cleaning or calibration solutions may be corrosive and/or toxic! Take special measures to protect eyes, skin and clothes. Do not inhale vapors! In case of accident or if you feel unwell, seek medical advice immediately. Observe special regulations when handling these substances!
	During normal operation, keep this instrument locked! Only qualified people may open this instrument. To prevent electric shock, unplug the power cord before any servicing or manipulation inside.
	Caution! To prevent an electric shock, ensure the incoming voltage between Neutral and Earth of the power supply cable is less than 1.5 VAC.

Tools



Allen Key – 3mm, 4mm, 6mm, 10mm

Spanner – M6 Box Spanner

1. Introduction

1.1. Introduction



The CX2000 is a multi-parameter water quality monitoring analyser. Which utilizes UV Vis Absorption spectroscopy, which is a reliable and stable method to analyze specific parameters such as chemical oxygen demand (COD), biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS). Additionally, it measures pH with the help of glass electrode. The system is designed for high reliability, low operating cost, and small size, and is suitable to use in various applications such as industrial plants, municipal water treatment facilities, and research.



NOTE
As per the CX2000 model parameter ranges are factory set.
(E.g.. CX2000-3922 model will have factory setting for COD range as 0 – 800mg/L)
Ref. Chapter 3 – Range section for all parameter ranges.
(Note – CX2000-3922 Analyser screens are displayed in this user's manual for reference.)

1.2. Measurement Principle

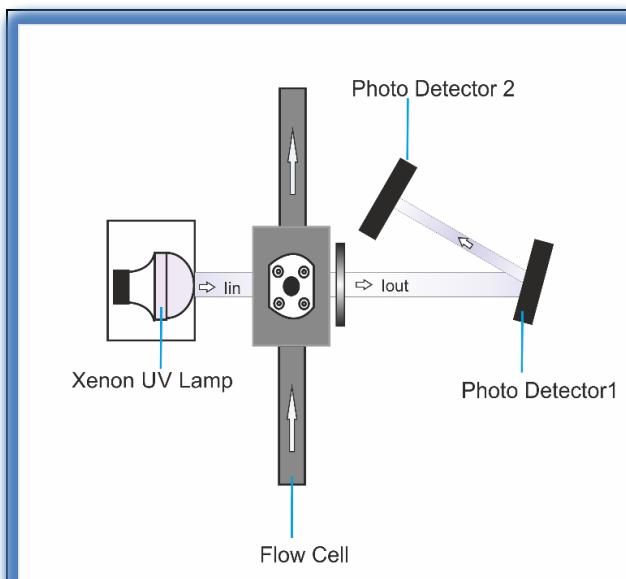


Fig. 1

COD/BOD/TSS: UV Vis Absorption Spectroscopy (Dual Beam with Entire Spectrum Scanning) (Ref. Fig.1)
For pH: Combination type GLASS Sensor.
The measuring principle is in accordance to the Beer-Lambert law:
$$[C] = K \log (I_{in} / I_{out})$$

With
[C]: sample concentration
K: absorption coefficient (specific to each molecule)
I_{in}: light intensity at the input of the sample
I_{out}: light intensity at the output of the sample

(Ref. Annexure 6 for additional details.)

1.3. Compensation for Turbidity

Turbidity, suspended solids and dirt on the flow cell are automatically compensated for by a differential measurement with a second detector at a reference wavelength.

1.4. Parts List

Part	Qty
Analyser Unit	1
Strainer Set	1
Neoprene Tube for Sampling Pump	2
PU Tube for Outlet (10m)	1
Bracket	1
Cleaning Brush (As per analyser model)	1
3mm Allen Key	1
4mm Allen Key	1
M6 Box Spanner	1
Door Key	2
Documentation User Manual Test Report Warranty Card	1 each

This is an approximate list only for your reference; the most up-to-date list of accessories that comes with your particular Analyser can be found in the Accessories Checklist that came in the packaging for your Analyser.

1.5. Operating Characteristics

Item/ Parameter	Specification
Display	7" TFT
Power Supply	110--240 VAC / 50-60Hz, 150W (UPS recommended)
Operating Limits	0 to 50 °C
Approvals	Electromagnetic compatibility EN50081-2, EN50082-2, EN55011
Enclosure	IP54, coated steel
Dimensions	W 494 x H 612x D 251 mm
Weight	26.5 kg

Regarding the operating environment, the humidity should be between 0-95% while the operating temperature should be between 0-122 °F (0-50 °C). The sample inside the analyser must not be allowed to freeze.

2. Mechanical Dimensions

(Ref. *Fig. 2*) as below.

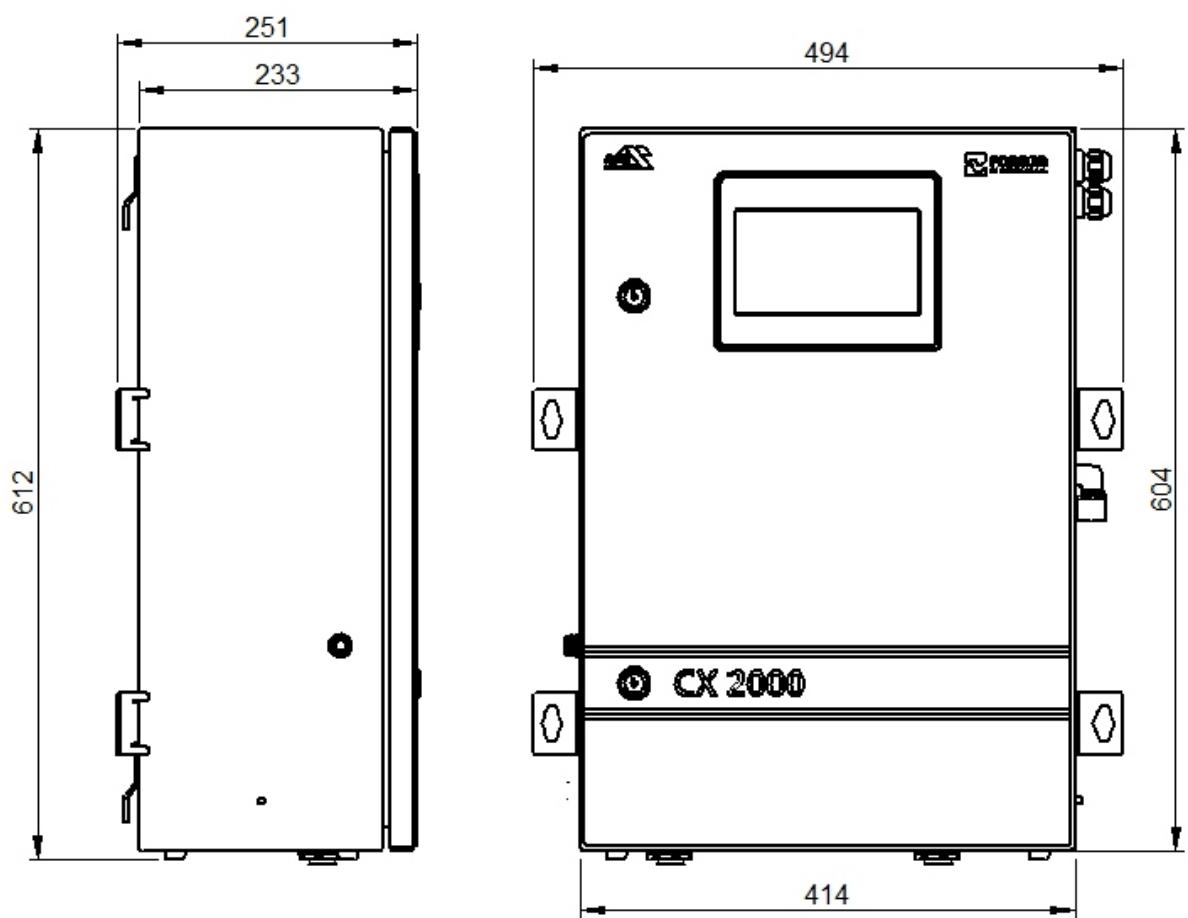


Fig. 2

3. Specifications

Operating specifications		
Product name	MULTIPARAMETER ANALYSER	
Model	CX2000 39XX	
Type	Single stream online multiparameter analyser	
Parameter	COD/BOD/TSS/TOC	pH/Temperature
Principle	UV-Vis Absorption	Potentiometric with combination sensor
Type	Advanced microcontroller-based system	
Display	7" TFT color display with backlight. Resolution: 800 x 480 pixels	
Graphics	Graphic trend analysis, time based	
Programming	User defined, freely programmable, menu prompt, two level password protected	
User input	Via touch screen	
Data storage	3 months log with a minimum cycle time of 15min for all 5 parameters – COD, BOD, TSS, TOC, pH, Temperature	
Diagnostics	PD1, PD2, tank empty, sample temperature, last 10 calibrations	
Input Power Supply	110 ~ 240VAC, 50/60Hz, 150W	
Performance parameters		
Accuracy	$\pm 2\% - 5\%$ - of Full Scale with standard (KHP + Formazine) solutions, $\pm 5\% - 10\%$ - of Full Scale on process validation, for pH: 0.1pH	
Performance features		
Operation	Reagent and chemical free analysis	
Operation cycle	Continuous / Batch, Programmable, normally 3~5 minutes	
Auto Zero	Auto Zero during cleaning cycle	
Interference	Interference correction with reference photodetector	
Turbidity compensation	Auto compensation with reference photodetector	
Calibration	Manual calibration facility (Automatic Zero)	
Outputs / Inputs		
Analog outputs	4 no's x 4~20mA, active, freely configurable, 24VDC @ 600Ω, isolated	
Digital Outputs	8 no's : Potential free SPDT contacts, freely configurable, Alarm High / Low,	
Digital Inputs	1 no: For level switch (empty tank), potential free	
Digital Connectivity		
RS485 MODBUS (COM-2)	To transfer data to remote server.	
RS485 MODBUS (COM-3)	Date/time stamping on calibration data, Scale & Cal factor, Error codes over MODBUS or for connection to a to a DCS/PLC or Cloud connectivity with an external FM make RTru / Black Box unit.	

Ranges				
Model	CX2000-3912	CX2000-3922	CX2000-3932	CX2000-3952
COD (mg/L)	0 - 300	0 - 800	0 - 2000	0 - 5000
BOD (mg/L)	0 - 150	0 - 400	0 - 1000	0 - 2500
TSS (mg/L)	0 - 450	0 - 750	0 - 1500	0 - 2000
pH (pH)	0 - 14	0 - 14	0 - 14	0 - 14
TOC (mg/L)	0 - 99	0 - 264	0 - 660	0 - 1650

Ambient conditions	
Operating temperature	0 -50°C
Storage temperature	0 -50°C
Humidity	95% non-condensing
Certification EMI EMC	Conforms to IEC61326-1

Product Approvals	
Ingress Protection	IP54 IEC 13947
EMI/EMC	IEC 61000-04

Enclosure	
MOC (Enclosure)	M.S. Powder Coating
MOC (Wetted parts)	Non-metallic within analyser Inlet & outlet tubing: PE Measuring flow cell : Glass +PVC
Product weight	26.5kg
Mounting	Wall Mount or Panel Mount (with bracket)

4. Installation

4.1. Overview

Always try to mount the analyser indoors. For wall mounting use the mounting bracket provided. A wall plug appropriate for the weight of the analyser, which is about 26.5 kg, should be used.

The maximum vertical height from the sampling point to the analyser should be 5 meter.

4.2. Mounting Options

4.2.1. Wall Mounting - Bracket Installation (Ref. Fig.3)

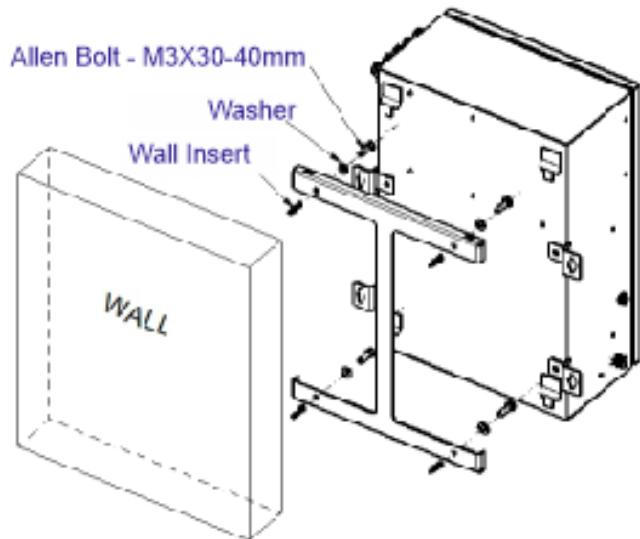


Fig. 3

4.2.2. Wall Mounting – Without Bracket Installation (Ref. Fig.4)

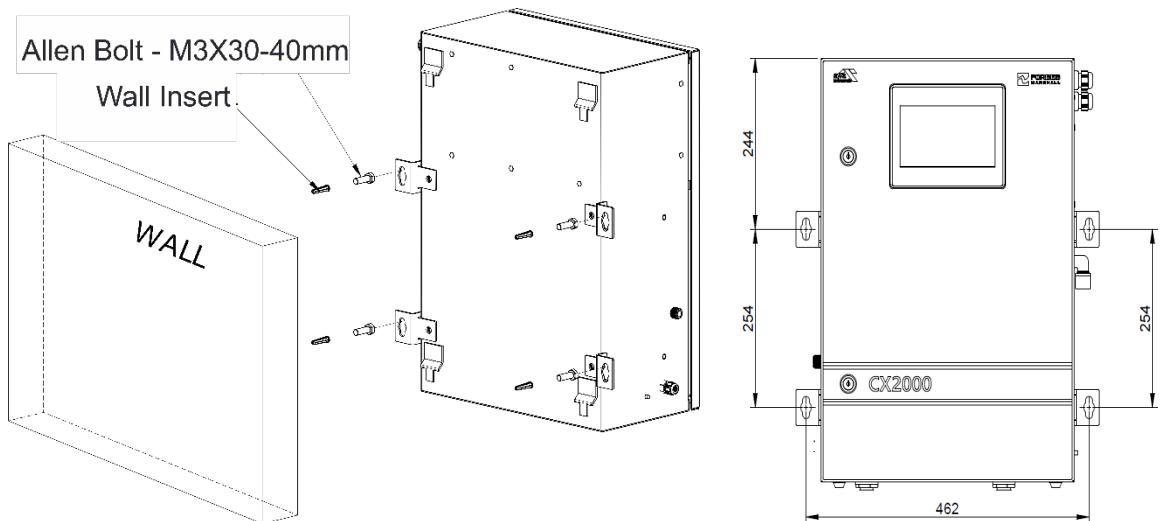


Fig. 4

Installation Procedure

- Ref. *Fig.3* for mounting without bracket or Ref. *Fig.4* for mounting with bracket options.
- Locate a wall with a suitably smooth surface to mount the Analyser for wall mounting.
- Using the wall bracket provided, mark 4 holes on the wall for the position of the bracket holes.
- Drill 4 holes at 8 mm or 10 mm size.
- Mount the Analyser onto the bracket slot.
- Ensure the Analyser is securely placed.

4.3. Sample Inlet and Outlet Connections

Cut the 3/8" x 1/4" (9.6 x 6.4 mm) flexible PE tubes to the required lengths and connect them to the inlet and outlet of the Analyser. Analyser comes with a sample pump and cleaning (peristaltic) pump.

- The sample pressure must not exceed 1 bar(g)
- The maximum pumping height is 5 meters.

Ensure a sealed connection on the inlet fitting of the peristaltic pump to prevent bubbles in the analysis flow cell.

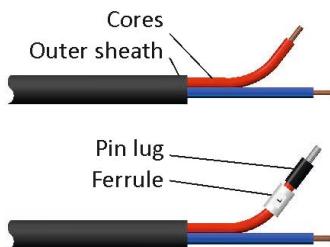
4.4. Electrical connections



Before making any connections, switch off power and disconnect the mains supply if already connected to the analyser.

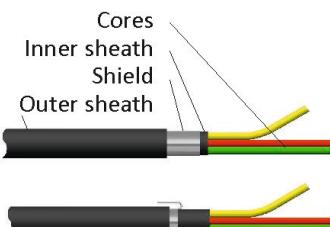
Recommended cable preparation practices

Unshielded cables



- Without damaging inner cores:
>Strip off the outer sheath
>Strip off the insulation of each core
Repeat for all cores
- Slide in a Ferrule
Crimp a pin Lug
Repeat for all cores

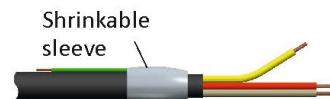
Shielded cables



- Without damaging shield and cores:
>Strip off outermost sheath
>Strip off inner sheath
This exposes the shield and the cores
- Separate out the shield braid
Tie together the shield strands
Fold backwards



- Tin the shield end with solder gun
Solder a length of wire to the shield



- Strip off the insulation of the cores
Slide a heat-shrinkable sleeve over solder joint
Shrink the sleeve completely



- Crimp a pin Lug to the core
Repeat for all cores
Crimp a ring Lug to the shield wire



Do not terminate the shield directly without lug. Use a sleeve over the shield and a ring-type lug before terminating. This lug must always be terminated to the chassis screw.

!WARNING !DANGER



- Confirm that the cables are not live and do not carry any potential before attempting, to make any electrical connections.
- Analyzer comes with 9no.s of cable glands for different input and output cables entry.
- Refer (*Fig. 5*) Encloser Cable gland side view as below,

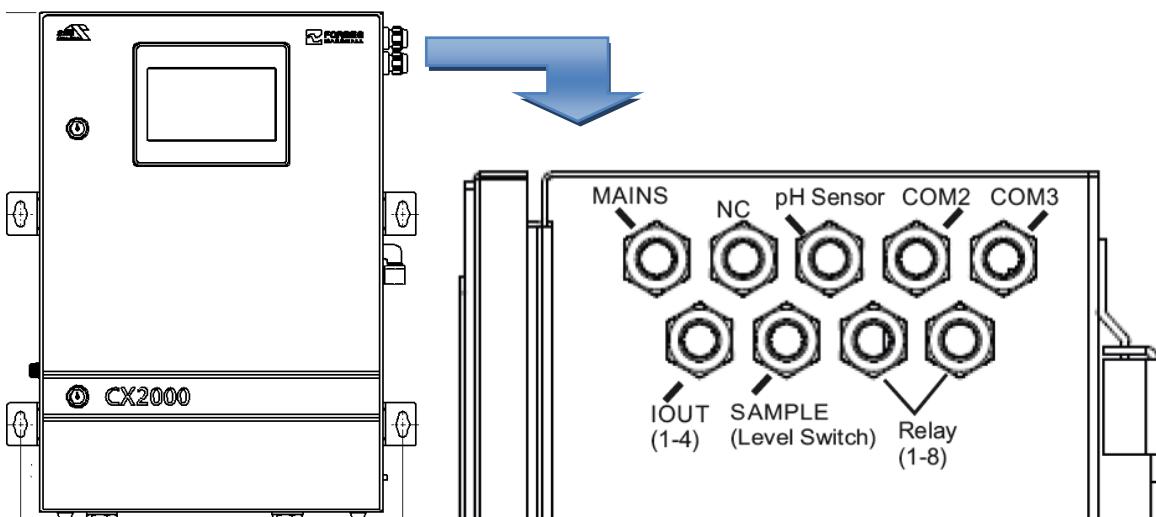


Fig. 5

- Before connections check that the cable is of the specified type and its open ends have been properly ferruled and lugged.
- Open Enclosure front door by unlocking two locks provided on the door front by using, respective keys.
- Insert the respective (Mains Supply, Input Sensor, Output Signal, Relay and Communication) cable (as shown in Fig.1) through the respective cable gland nut, rubber grommet of the appropriate internal diameter and then run it through the upper left one (as seen from front) cable gland. Pull it gently outwards after it enters, the Enclosure.



- For Mains Supply connection use a single 3-core cable with individual core colors of red (LIVE), blue or black (NEUTRAL) and green or yellow/green (EARTH). As an example, use a 3-core cable, 1.0 mm² core cross section.
- Check that all the electrical connections secured to ensure that no leakage been, done as described in this manual.

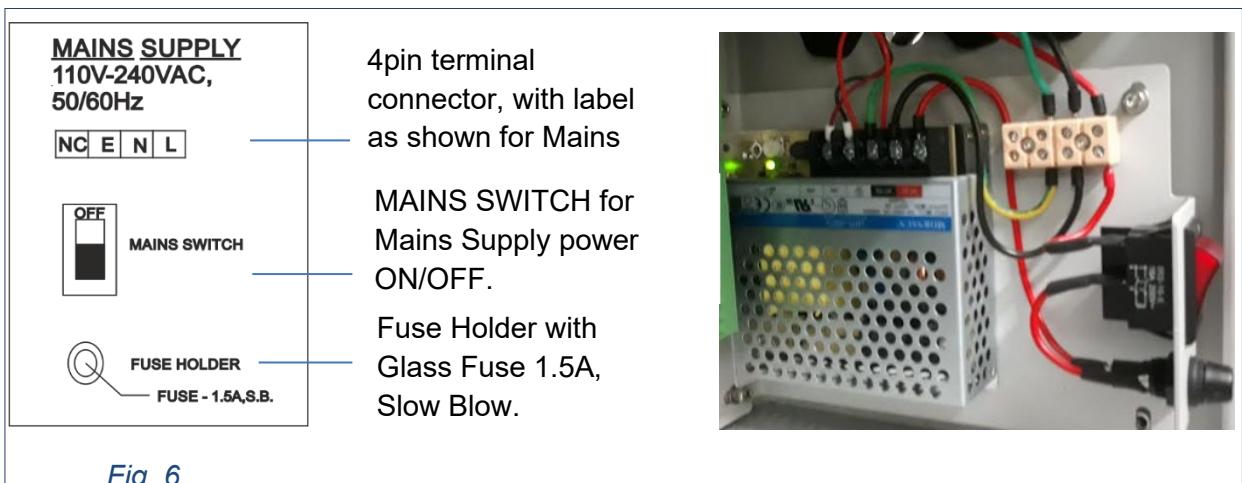
4.5. Mains Power Supply

CX2000 Analyser works on mains supply 110 ~ 240VAC, 50/60Hz, 150W.



For Mains Supply connection use a single 3-core insulated cable with individual core colors of red (LIVE), blue or back (NEUTRAL) and green or yellow/green (EARTH). As an example, use a 3 core insulated cable, 1.0 mm² core cross section.

The Mains Supply cable must be installed through the cable gland. Refer *Fig. 6* for the connection of the Mains Supply, as well refer additional details as shown.



4.6. pH Sensor Connections – (Ref. Fig. 8, 10)

The cable consists of a screw cap at one end which fits to the sensor end. In some cases the cable could be integral to the sensor at its end. The four conductors at the other end must be connected to the terminal plugs of the appropriate module (Ref. Fig. 10), and the shield to the chassis screws within the analyser.

4.7. Analog Output Connections – (Ref. Fig. 8, 11, 12)

4.8. Relay output Connections – (Ref. Fig. 8, 13, 14)

4.9. RS485 Connections – (Ref. Fig. 8, 15)

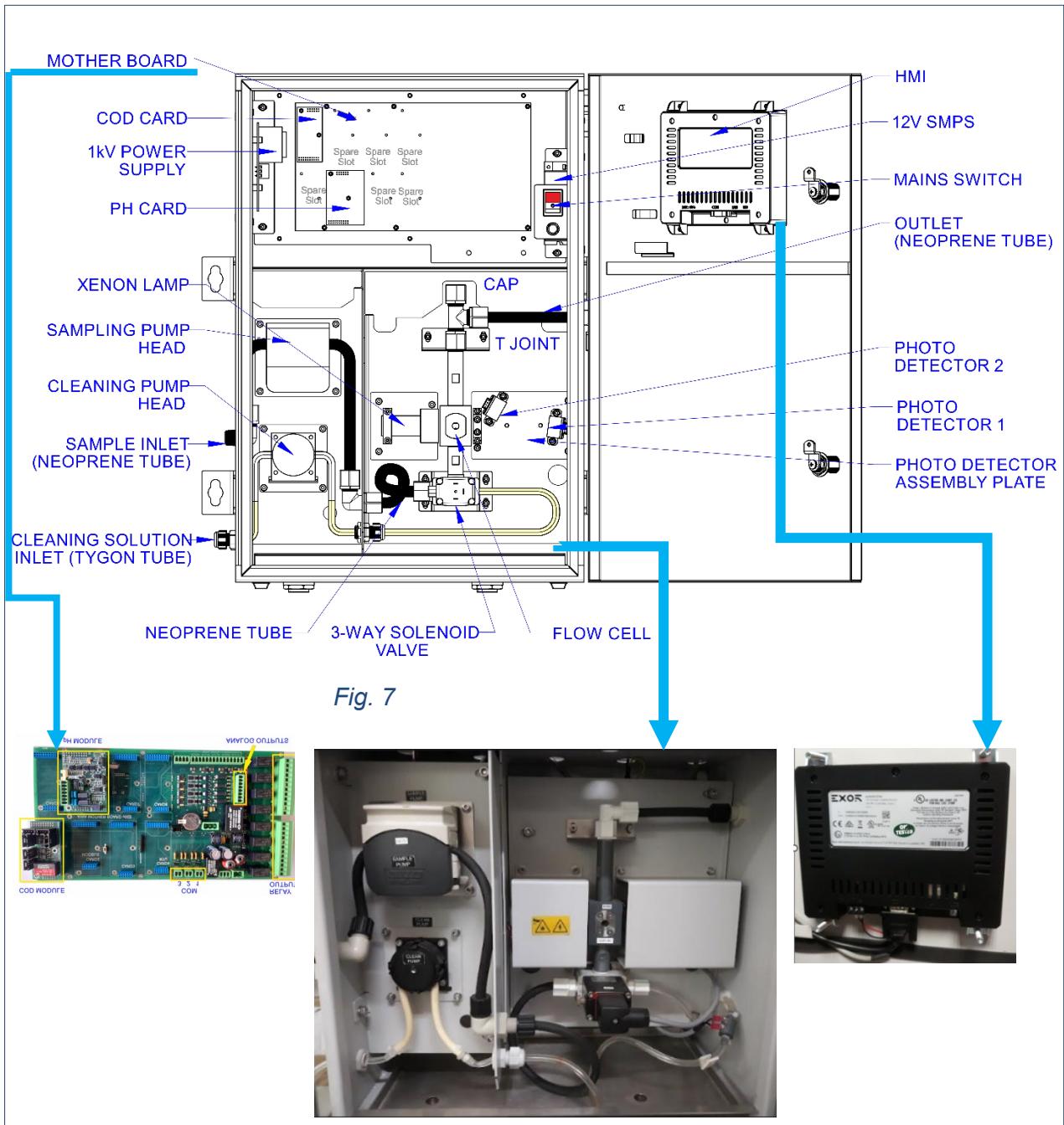
4.10. No sample detection Connections – (Ref. Fig. 8, 16)



Do not terminate the shield directly without lug. Use a sleeve over the shield and a ring-type lug before terminating. This lug must always be terminated to the chassis screw.

5. Internal layout

Refer (*Fig. 7*) for enclosure internal view as below,



5.1. Mother Board:

 COD, pH modules, Analog output , Relay Outputs, HMI supply, Flow switch & No sample connections, 3 COM ports, Solenoid, sample pump, Cleaning pump all connections and respective components are on mother board. Refer (Fig. 8) for Mother Board details,

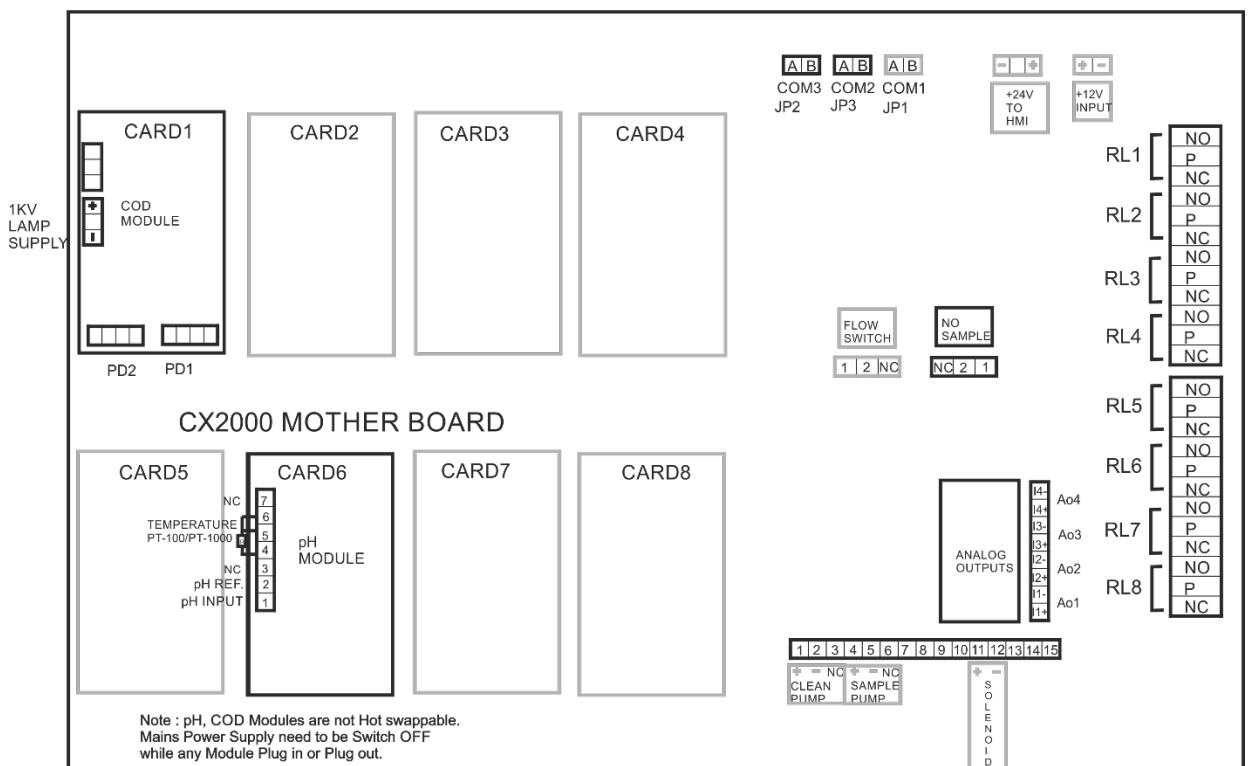
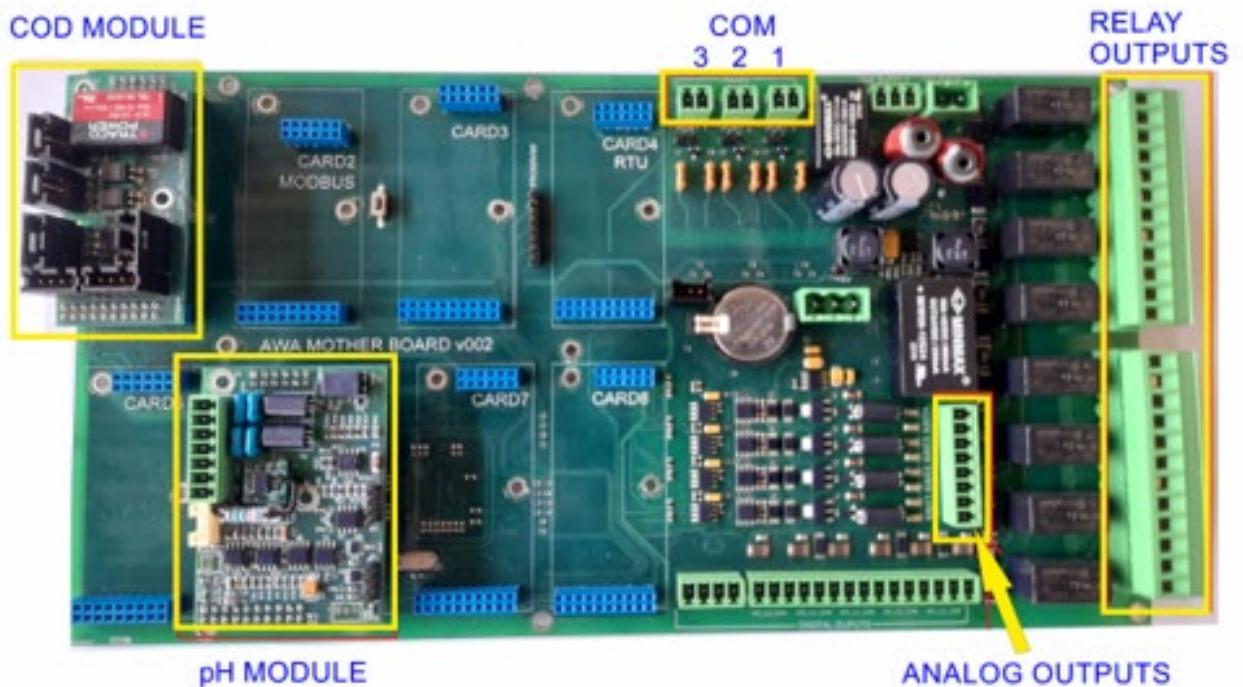


Fig. 8

5.2. COD Module (1no.)

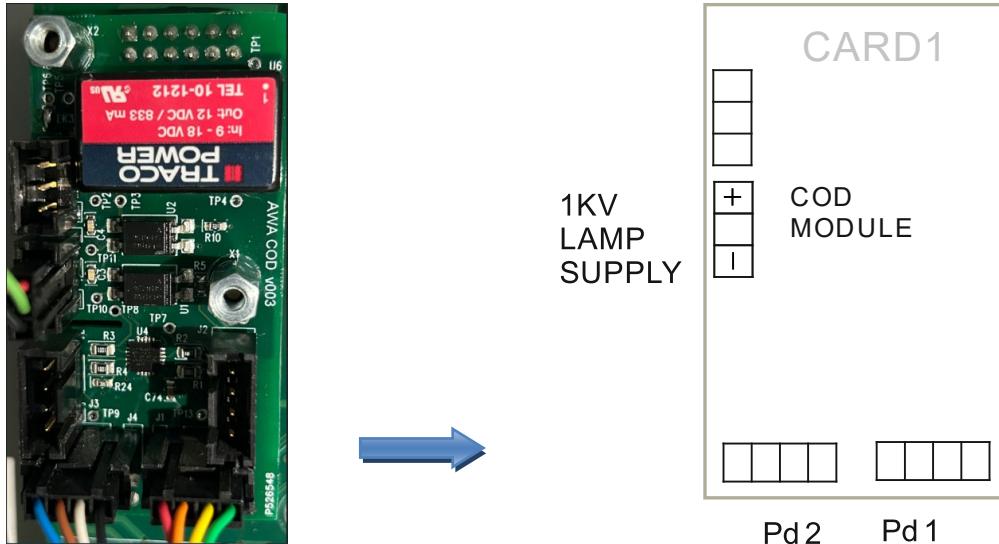


Fig. 9

COD Module (Ref. *Fig.9*) is fitted in location Card1 on the mother board. No external wiring required for this module. As PD1 (Photo Detector 1), PD2 (Photo detector 2) and optical lamp (1KV) connections are connected by factory. COD Module works for Inlet sample signal conditioning for COD measurements. Same data used for further calculations for BOD/TSS/TOC measurements. Measurement range will be factory set as per the CX2000 model.



COD module is not hot swappable. Mains supply need to Switch 'OFF' before module plug in or plug out.

5.3. pH Module (1no.)

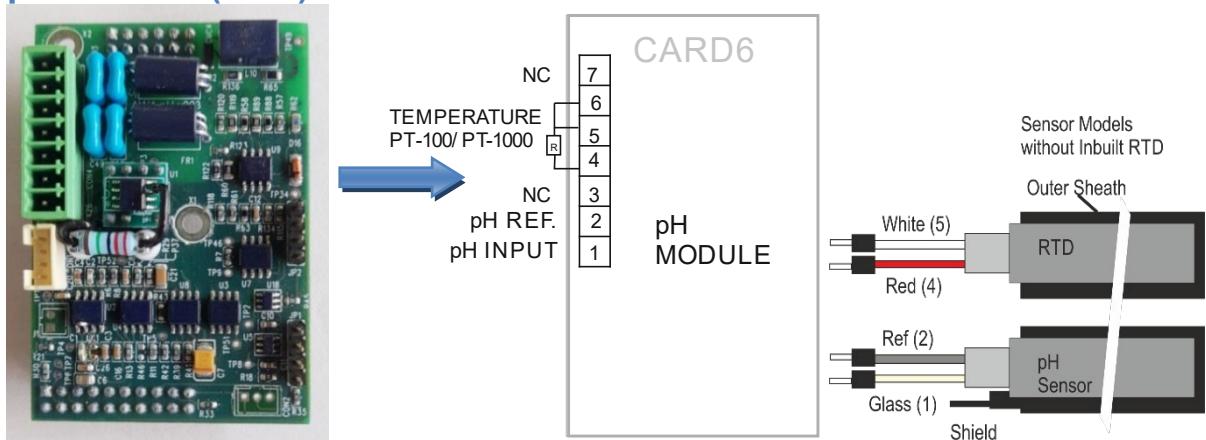


Fig. 10

pH Module is fitted in location Card6 on the mother board.

The external pH sensor is to be directly connected to 7pin plug-in screw terminals provided on pH module. You need to switch off the unit mains supply and unplug the respective

terminal connector for wiring. The Sensor cable must be installed through the cable gland. Refer Fig. 10 for the connection of the pH Sensor. (Connections of Sensor Model pH sensor, E.g., Polilite Pro 120 without inbuilt RTD shown for additional reference.)



pH module is not hot swappable. Mains supply need to Switch 'OFF' before module plug in or plug out.

5.4. 4-20mA Analog Output (4nos.)

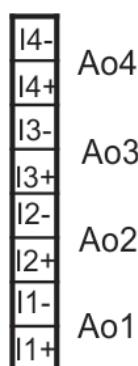


Fig. 11

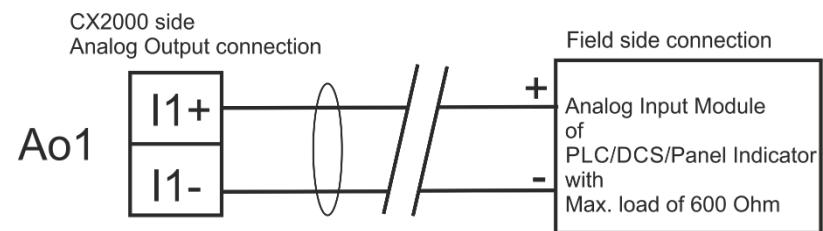


Fig. 12

4-20mA Analog Outputs(4nos.) are available on 8pin plug-in screw terminals (Ref. Fig. 8 & 11) provided on motherboard. You need switch off the unit mains supply and to unplug the respective terminal connector for wiring. The analog output cable must be installed through the reference cable gland. (Refer Fig. 11 & 12) for the connection of the analog outputs. Each current output operates as a current generator.



Notes:

- Ensure the polarity right and no voltages are present on wires while connections.
- Connected load should not exceed $600\ \Omega$
- Over-voltage on the 4-20mA DC output cable may damage the card permanently.

5.5. Relays (8nos.)



Potential free 8 relay contacts are available on (2nos.) 12pin plug-in screw terminals provided on mother board. You need to switch off the unit mains supply and to unplug the respective terminal connector for wiring. The relay output cable must be installed through the cable gland. (Refer Fig. 11) for the connection of the 8 relays.

RL1	[NO
		P
		NC
RL2	[NO
		P
		NC
	[NO
RL3		P
		NC
	[NO
RL4		P
		NC
RL5	[NO
		P
		NC
RL6	[NO
		P
		NC
RL7	[NO
		P
		NC
	[NO
RL8		P
		NC

Fig. 13

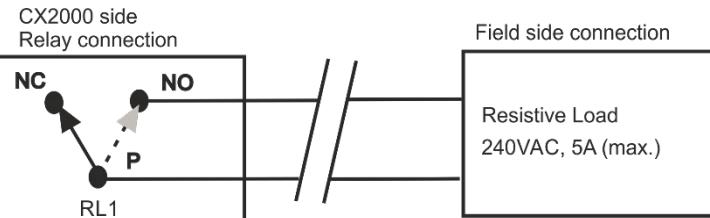


Fig. 14

The relays are normally open, and the maximum current is 5A at 240 VAC (max.) for resistive loads (Ref. Fig. 8, 13 &14).

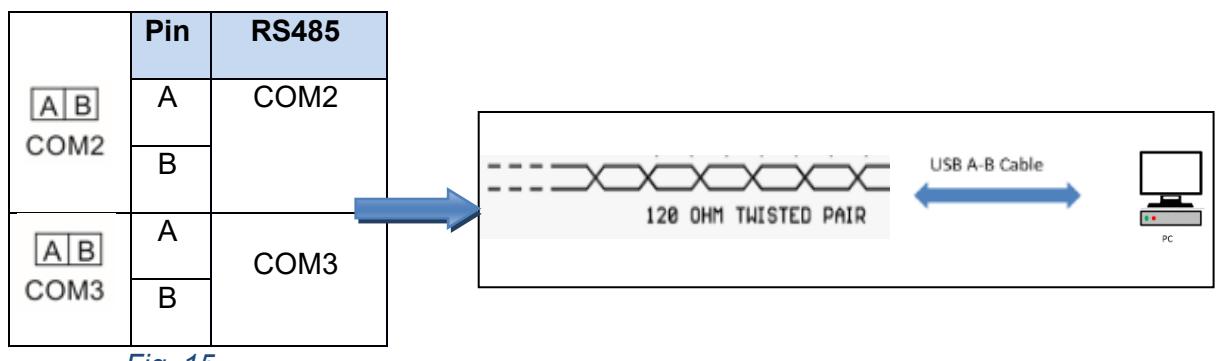
5.6. RS485 Communications (2nos.)



RS485 Communications (2nos.) are available on (2nos.) 2pin plug-in screw terminals (Ref. Fig. 8) provided on motherboard. You need switch off the unit mains supply and to unplug the respective terminal connector for wiring. The RS485 Communications cable (recommended 0.5 Sq. mm., twisted pair, shielded cable) must be installed through the respective cable gland. (Refer Fig. 15) for the connection of the RS485 Communications cable via MODBUS to USB converter to PC.

The RS485 signals have a 1000 V galvanic isolation from the other parts of the instrument. To select the baud rate, select the slave number, specify the MODBUS® protocol, refer to the section Configuration – COMMS and Ref. MODBUS ADDRESS Table as per ANNEXTURE 2.

Note - While multi drop connections for last analyser jumper link need to be shorted on Mother Board JP3 for COM2 (Port 2) and JP2 for COM3 (Port 1)to connect internal termination resistor of value 120 Ohm.



5.7. No Sample

Inlet Sample tank level detection available in CX2000 analyser as diagnostics feature. For that level float switch need to be connected as shown in (Ref. Fig. 16) connections for sample or no sample detection. No sample condition will be displayed as an error for user reference to take corrective action.

	Pin	Float Switch
	1	1
2	2	
NC	No Connection	

Fig. 16

6. Checks before power-up



Check and confirm that.

- only the specified mains power source has been connected.
- the required wiring has been correctly done.
- no wires are loose.
- all the connectors have been properly plugged into their receptacles.
- all shields have been firmly connected to the chassis screws.\
- Close and lock the lid of the Enclosure.

6.1. Powering up

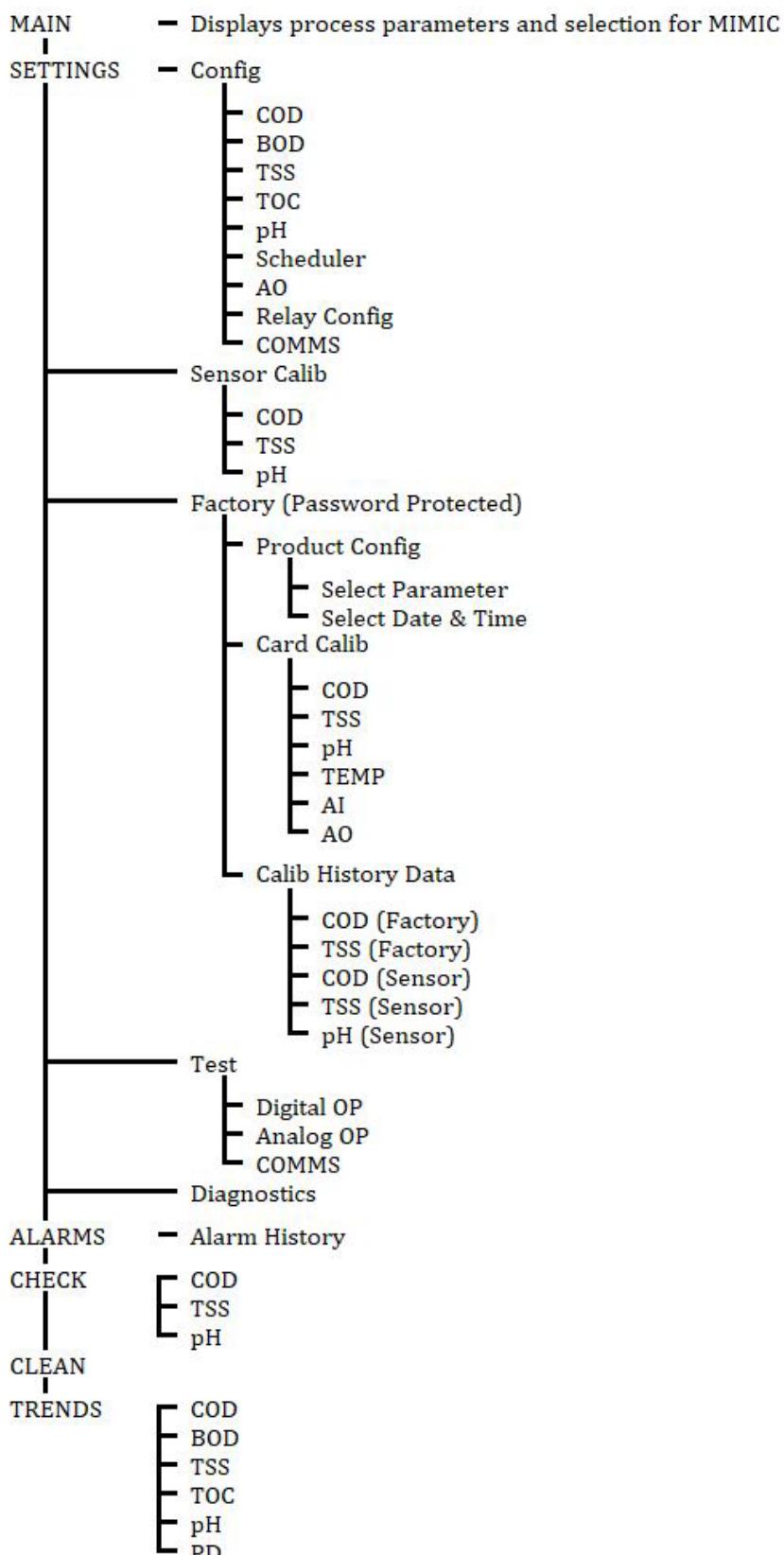


Before powering ON, disconnect the power connector connections and check the incoming AC supply. Confirm the following voltages at the incoming supply:

- Between Phase and Neutral is between 110 ~ 240VAC
- Between Neutral and Earth is < 1.5VAC

Re-connect the power supply connector connections and switch on the mains power.

7. Menu Tree



7.1. Menu Screens

CX2000 Analyser is designed with an advanced microcontroller-based system with HMI display of 7" TFT color display with backlight, resolution 800 x 480 pixels and user input via touch screen. Facilitates user defined, freely programmable menu, two level password protection with Parameter measurements, calibration, testing with time based graphic trend analysis available for Measuring parameters like COD, BOD, TSS, pH etc.

Refer chapter 7 - Menu tree for understanding menu navigation. The following screens will be displayed after Power ON. Immediately after Power ON initially Forbes Marshall Logo will display, then within 5 sec. Main screen will gets display. Then as per the requirement user can navigate different menu (Main/Settings/Alarm/Check/ Clean/Trend/Mimic) and sub-menu options (Config/Calib/Test/Diagnostics/Factory) to select the specific parameter for required action.

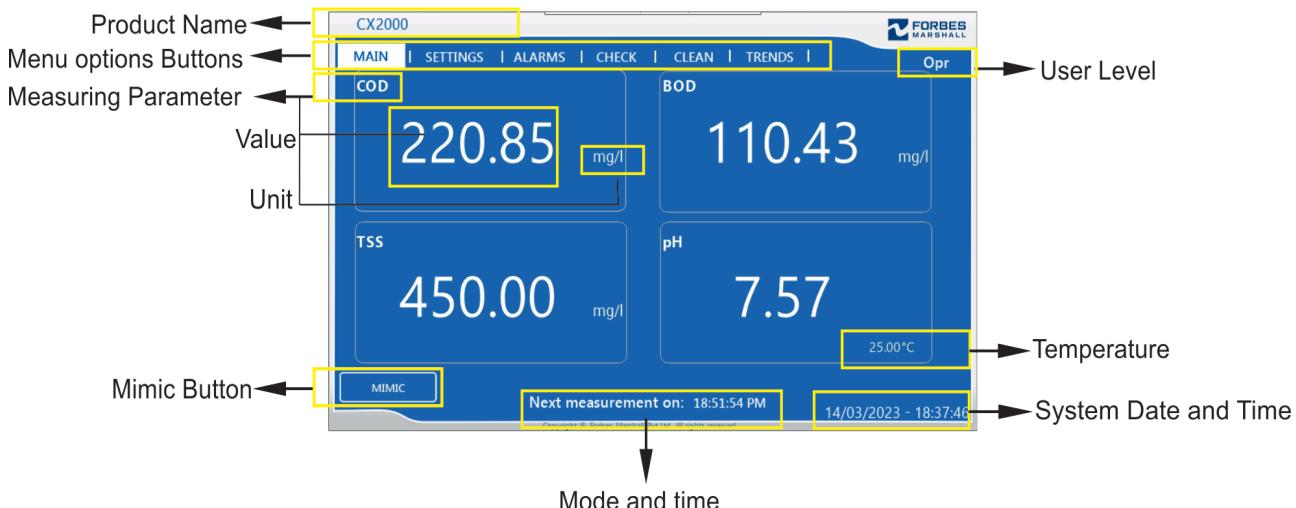


Note - It is advisable to use the Factory and Check menu by a Forbes Marshall trained personnel / Forbes Marshall Customer Support Engineer only.

7.1.1. Main screen:

Displays process parameters (Name, Value, Unit), user level, system date and time, cycle details and buttons for different menu option selection. After powering ON, all parameters' values are shown as "zero" and will update as per the current process values after first sample reading.

Main screen details:



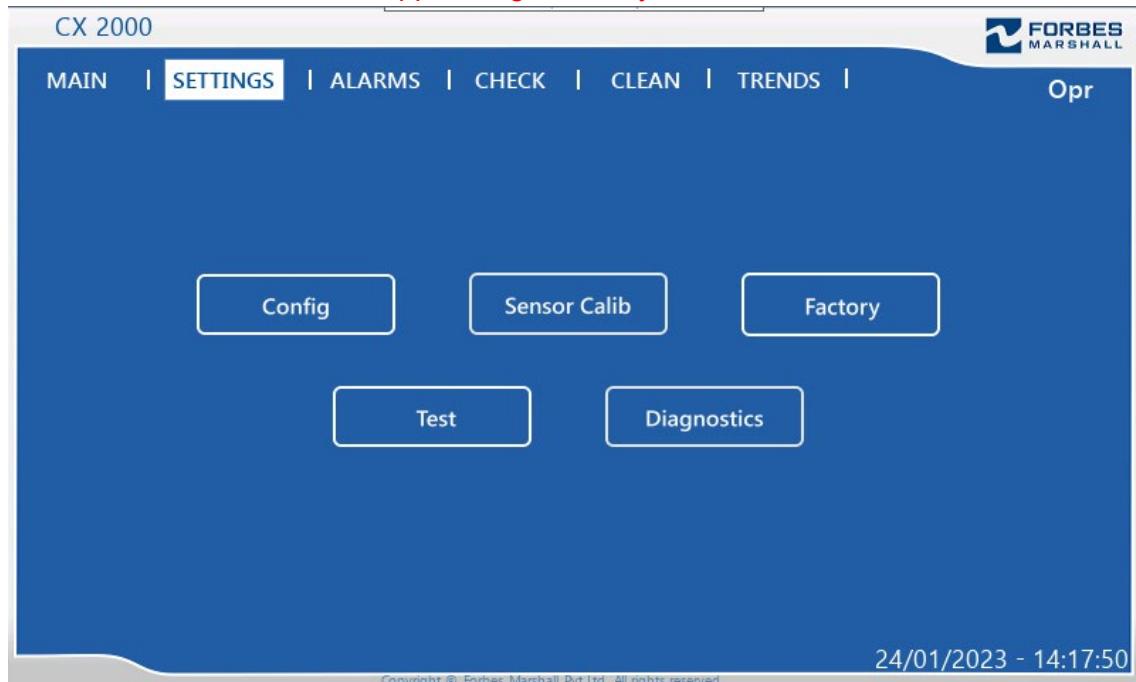
7.1.2. Settings screen:

Displays 5 buttons (Config, Sensor Calib, Factory, Test and Diagnostics) for user reference to view or change required settings.



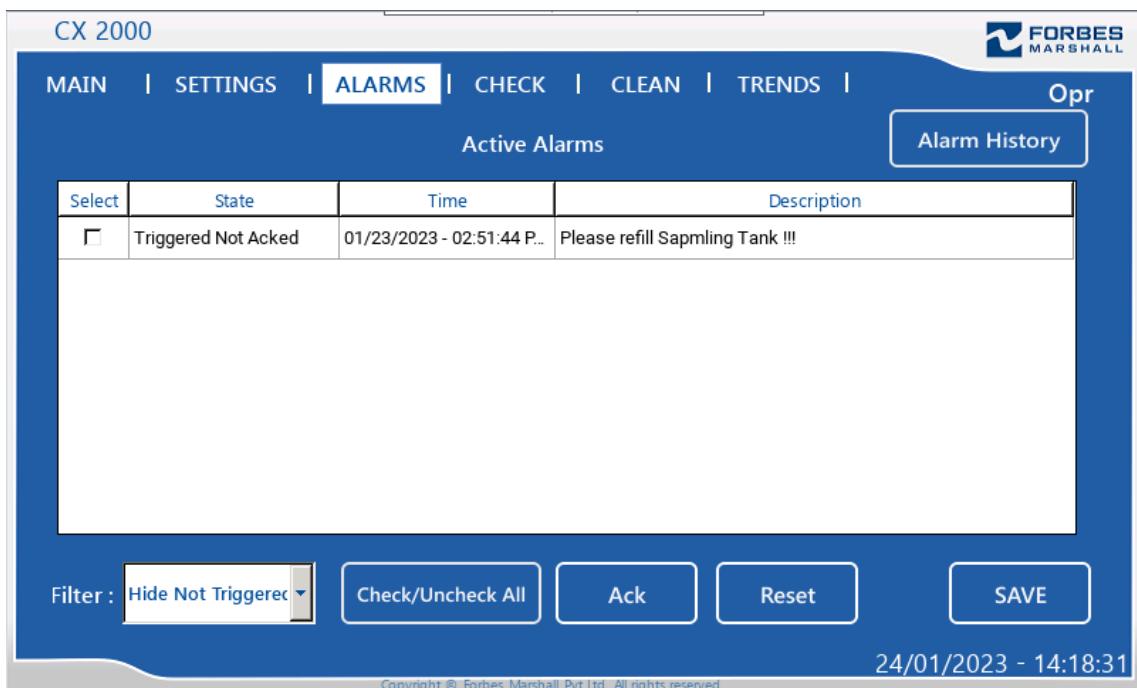
NOTE

Note - It is advisable to use the Factory menu by a Forbes Marshall trained personal / Forbes Marshall Customer Support Engineer only.



7.1.3. Alarm screen:

Displays status of all alarms with selection for check or uncheck alarm with filter to hide active or triggered alarms, check uncheck all alarm, with acknowledge, reset and save options. As well history of all the alarms.



7.1.4. Check screen:

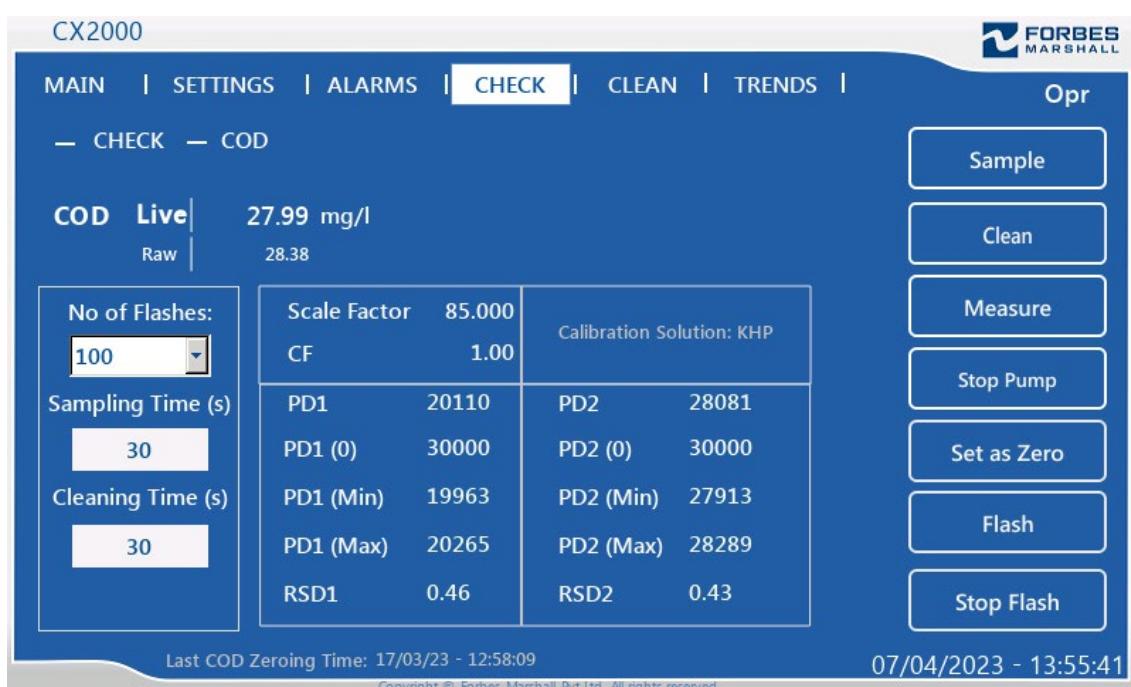
COD, TSS and pH buttons are available for checking respective reference data, settings and check screens for sample calibration and to study sample cycles as well as measurement. These screen options are used to check specific parameters of sample. There are many diagnostics parameters displayed during “Sample Checking”. As well as displays software version for HMI and firmware version for embedded hardware.

NOTE

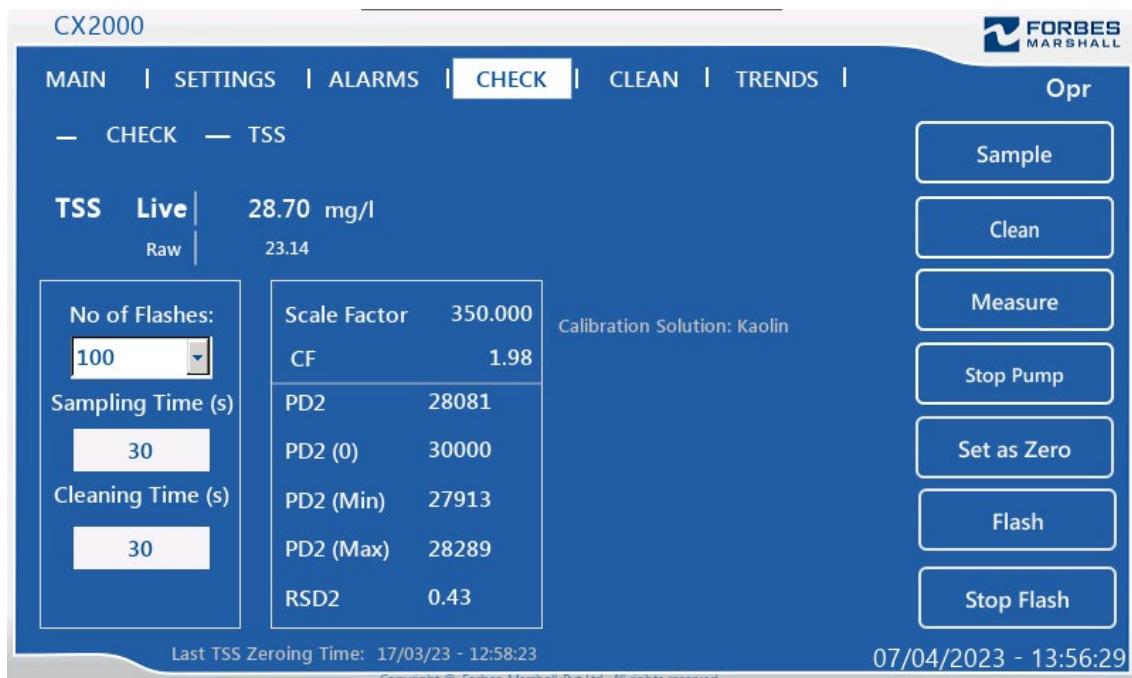
Note - It is advisable to use this menu by a Forbes Marshall trained personal / Forbes Marshall Customer Support Engineer only.



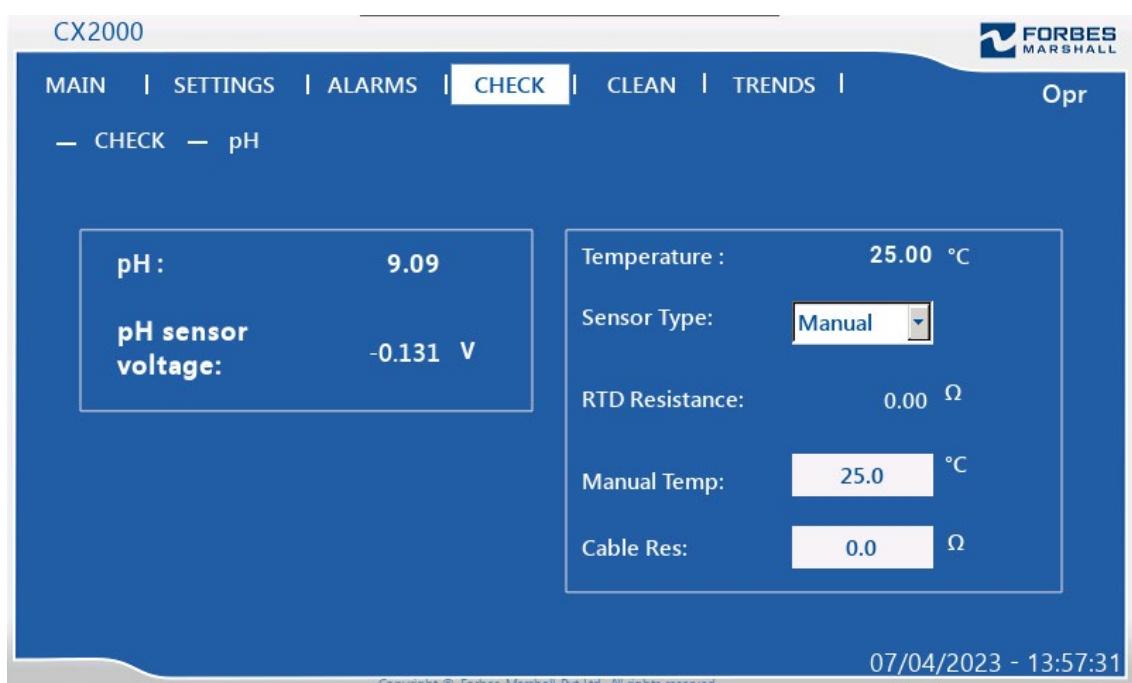
CHECK - COD



CHECK - TSS

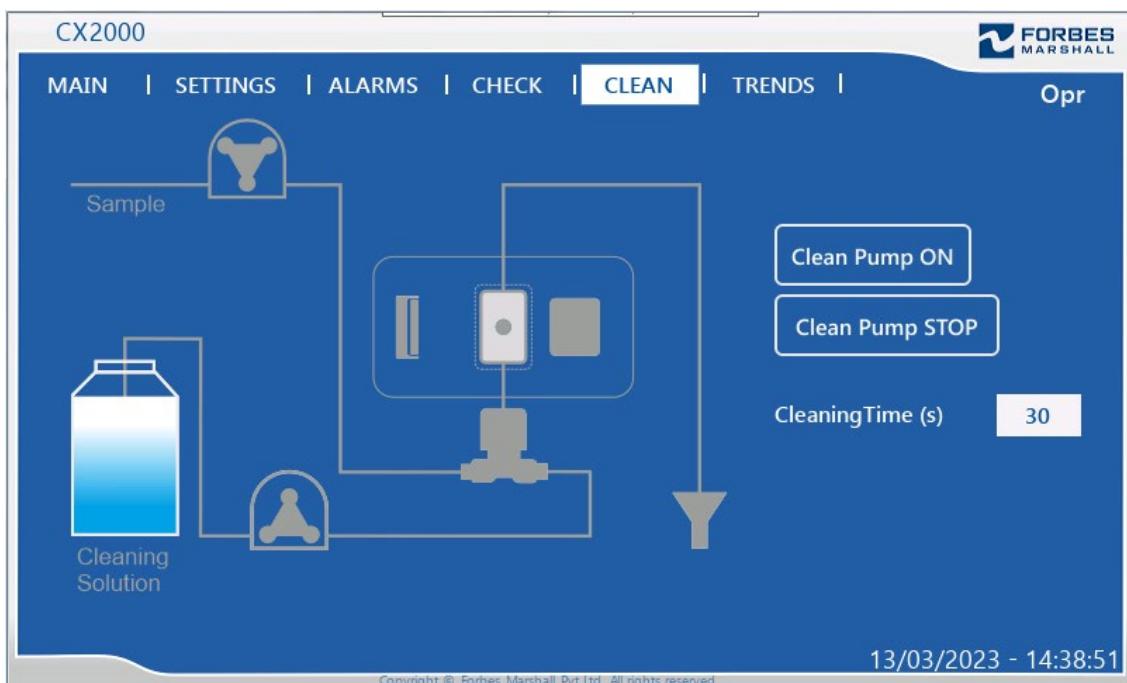


CHECK - pH



7.1.5. Clean screen:

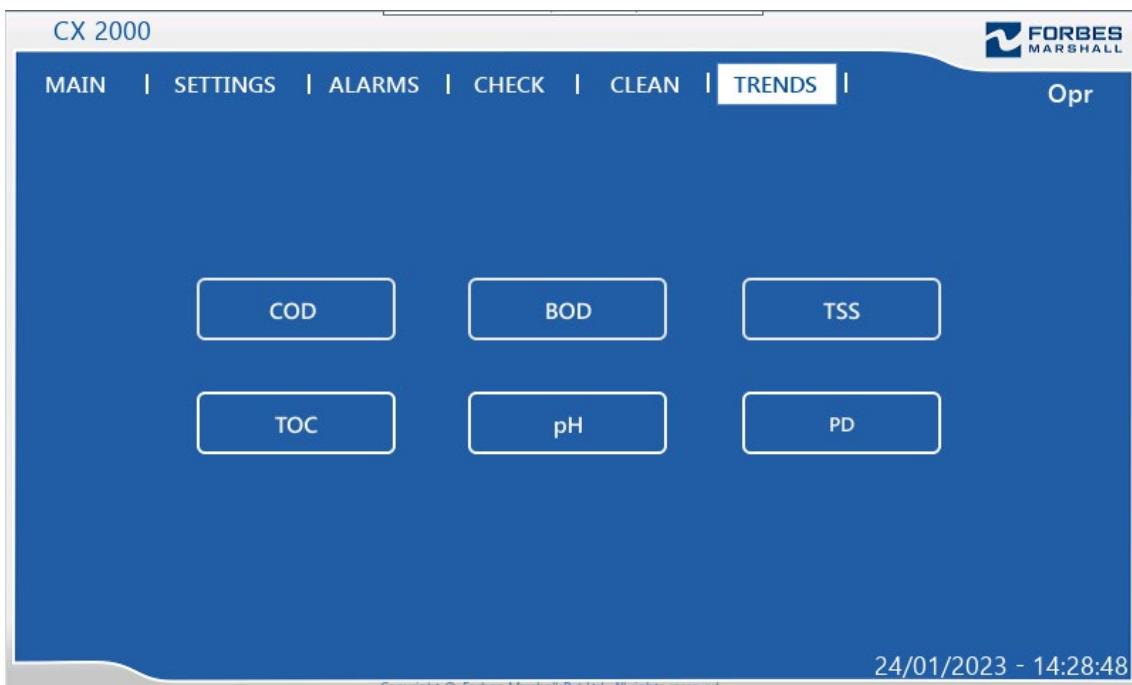
CX2000 analyser mimic with clean pump ON and Clean pump STOP buttons and cleaning time in sec. and Waiting Time in sec. setting windows. This menu is used to initiate manual cleaning operation or to check while operating auto clean cycle as per scheduler settings.



Cleaning Time is the cleaning pump on time to complete the cleaning cycle, by default it is 30Sec. As per the process requirement cleaning time can be increased.

7.1.6. Trends Screen:

COD, BOD, TSS, TOC, pH and PD buttons are available for respective parameter trend selection.



8. Modes of operation

The CX2000 has two Measurement modes of operation:

- **Batch**
- **Continuous**

Settings for Measurement modes enable or disable, Cleaning Cycle, Sampling time, cleaning time and respective Waiting times, Auto Zero enable or disable are available in the Scheduler screen. Settings to be done as per the testing schedule requirements for each parameter followed by data updates saving by pressing 'SAVE' button.

Cleaning Time is the cleaning pump on time to complete the cleaning cycle, by default it is 30Sec. As per the process requirement cleaning time can be changed.

Sampling Time is the time to get fresh sample in flow chamber and is set to 30sec as default.

Waiting Time is the time between sampling and actual measurement of the sample. This is set 1Sec. by default. In this time Air Bubbles settles down and sample reaches to steady state condition. It can be increased as per sample requirement.

Cleaning cycle is by default set to once in 24Hrs, once a day is standard. Cleaning frequency can be changed as per process requirement.

Batch mode measurement cycle is by default set to once in 15min., this frequency can be changed as per process requirement.

Auto Zero – If Auto Zero enabled, the analyzer readings are zeroed, using cleaning solution (90% Distilled Water + 10% H₂SO₄) as reference. To do proper auto zero, it is important to note that good quality distilled water (E.g. Distilled water – Merck 1.94507.5021 can be used) is to be used for preparing zero (cleaning) solution. Analyzer will show wrong reading if it is auto zeroed with wrong zero (cleaning) solution.

9. Configuration

9.1. Configuration - Scheduler

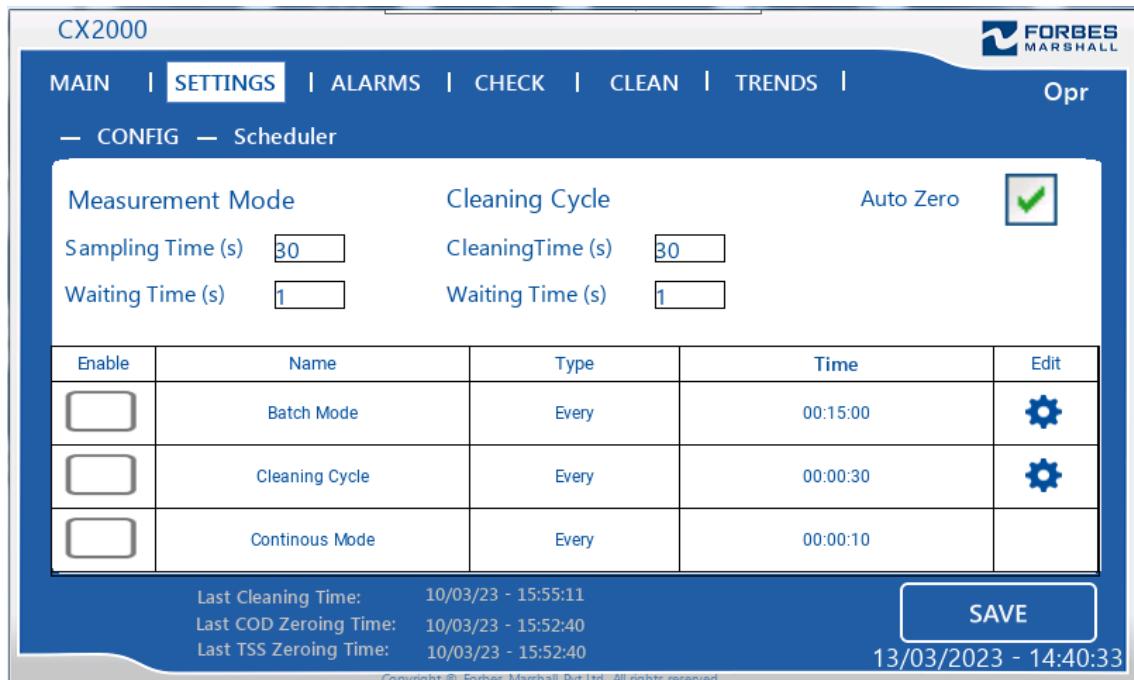
MAIN > SETTINGS > Press [Config] >Press[Scheduler]

By default, 'Batch Mode' and 'Cleaning Cycle' will be enabled while factory set. User can select 'Continuous Mode' as per requirement.

For most of the application the batch mode is used, in batch mode sample is analyzed every 15min.

(As per setting Batch Mode, Every, 15min. ref. screen as below.) and data is displayed on the screen.

This Batch Time is user settable and can be changed from typically 3min to 15min as per plant requirement.



Note – Scheduler will be active only for Main, Alarms and Trends menu selection.

9.2. Configuration - COD Configuration

MAIN>SETTINGS>Press[Config]>Press[COD]

The entire configuration required for a particular analyzer range is done at factory and it is advised user should not change the same.



The following can be edited and saved:

- Unit of COD : mg/L [default] or ppm
- Calibration Solution (KHP [default] / Process Sample)
- Sensor Calibration Coefficients

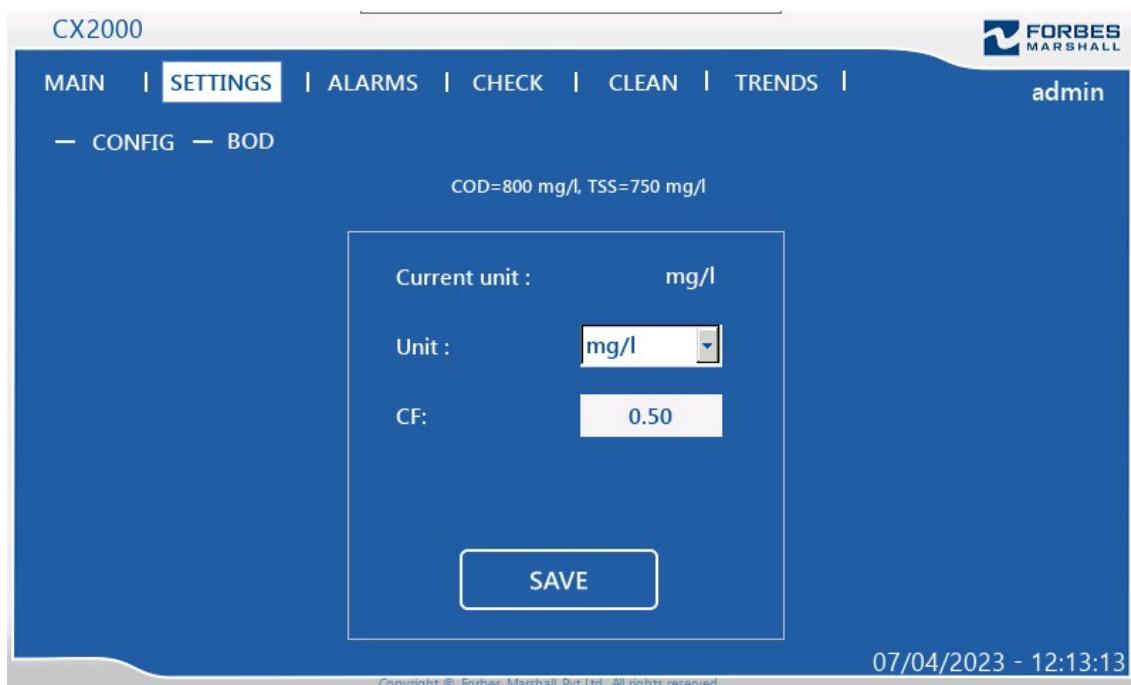
NOTE

[Notes –

- KHP salt (MERCK) Part No. 1.93215.0521 is suitable for making CX2000 COD calibration solution.
- MERCK Sigma-Aldrich COD Standard Solution, CRM Part no. 125034 Supelco (traceable to SRM from NIST 8000 mg/l in H₂O) is suitable CRM for CX2000 COD calibration]

9.3. Configuration - BOD Configuration

MAIN>SETTINGS>Press[Config]>Press[BOD]



The following can be edited and saved:

- Unit of BOD unit : mg/L or ppm
- CF

Here, CF – is set to 0.5 as default. This factor is used to calculate the BOD reading from basic COD reading ($BOD = CF \times COD$).

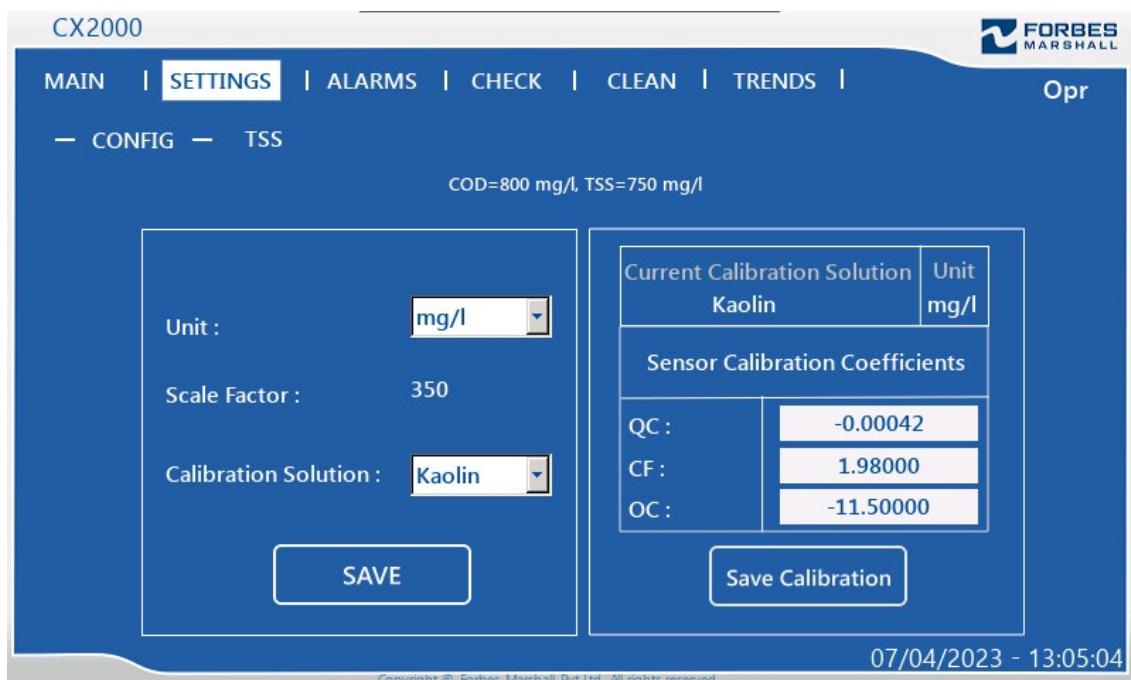


NOTE

[Note- CF can be changed by user as per lab results of Process Sample.]

9.4. Configuration - TSS Configuration

MAIN>SETTINGS>Press[Config]>Press[TSS]



The following can be edited and saved:

- Unit of TSS unit : mg/L [default] or ppm
- Calibration Solution (Kaolin [default] / Formazin / Process Sample)
- Sensor Calibration Coefficients

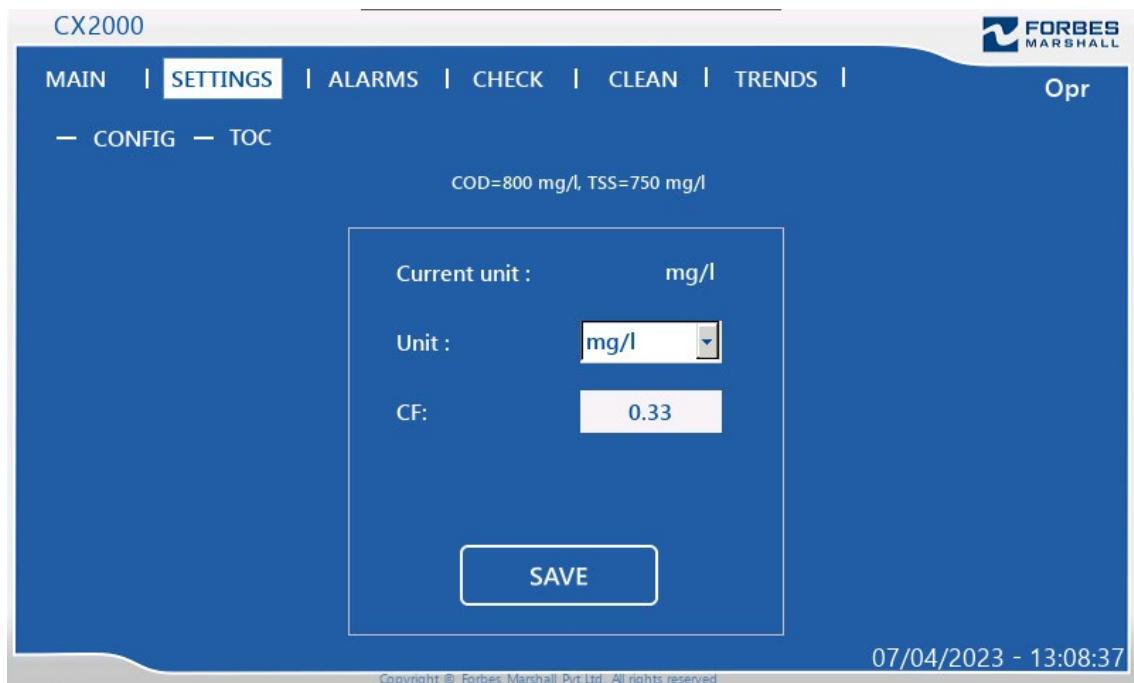
NOTE

[Note –

1. Kaolin powder (MERCK) Part no. K7375-1KG is suitable for making CX2000 TSS calibration solution.
2. Turbidity 4000 NTU Calibration Standard – Formazin (MERCK) - Part no. TURB4000-1L is suitable for making CX2000 TSS calibration solution.]

9.5. Configuration - TOC Configuration

MAIN>SETTINGS>Press[Config]>Press[TOC]



The following can be edited and saved:

- Unit of TOC: mg/L or ppm
- CF

Here, CF – is set to 0.33 as default. This factor is used to calculate the TOC reading from basic COD reading ($TOC = CF \times COD$).

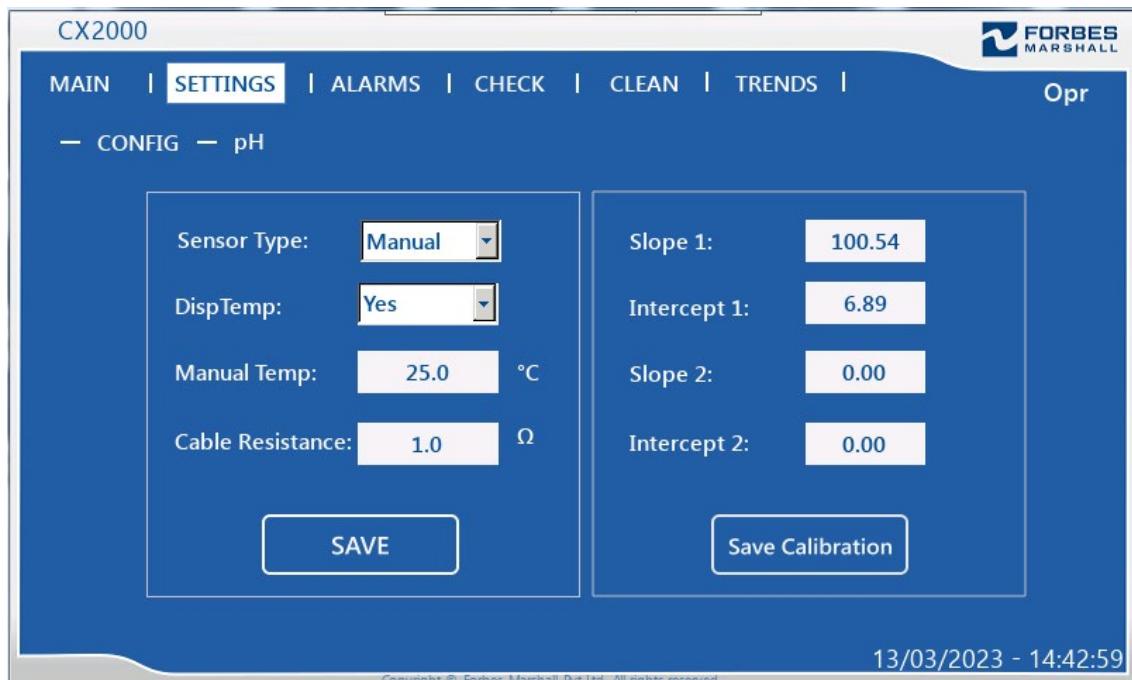


NOTE

[Note- CF can be changed by user as per lab results of Process Sample.]

9.6. Configuration - pH Configuration

MAIN>SETTINGS>Press[Config]>Press[pH]



The following can be edited and saved:

- Sensor Type: Pt100 / Pt1000 / Manual
- Disp Temp: Yes / No
- Manual Temp
- Cable Res.
- Slope 1
- Intercept 1
- Slope 2
- Intercept 2

9.7. Configuration - (AO) Analog Current Output

MAIN>SETTINGS>Press[Config]>Press[AO]

CX2000

FORBES MARSHALL

MAIN | SETTINGS | ALARMS | CHECK | CLEAN | TRENDS | Opr

— CONFIG — AO

	Para	Min	Max
AO1	COD	0.0	800.0
AO2	BOD	0.0	400.0
AO3	TSS	0.0	750.0
AO4	pH	0.0	14.0

SAVE

07/04/2023 - 18:46:06

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9.8. Configuration - Relay Configuration

MAIN>SETTINGS>Press[Config]>Press[RELAY]

CX2000

FORBES MARSHALL

MAIN | SETTINGS | ALARMS | CHECK | CLEAN | TRENDS | Opr

— CONFIG — RELAY

	PARAMETER	HIGH / LOW	THRESHOLD	HYSERESIS %
REL1	COD	HIGH	640.0	20.0
REL2	COD	LOW	160.0	20.0
REL3	BOD	HIGH	320.0	20.0
REL4	BOD	LOW	80.0	20.0
REL5	TSS	HIGH	600.0	20.0
REL6	TSS	HIGH	150.0	20.0
REL7	pH	HIGH	11.2	20.0
REL8	pH	LOW	2.8	20.0

SAVE

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9.9. Configuration - COMMS Configuration

MAIN>SETTINGS>Press[Config]>Press[COMMS]



10. Test Modes

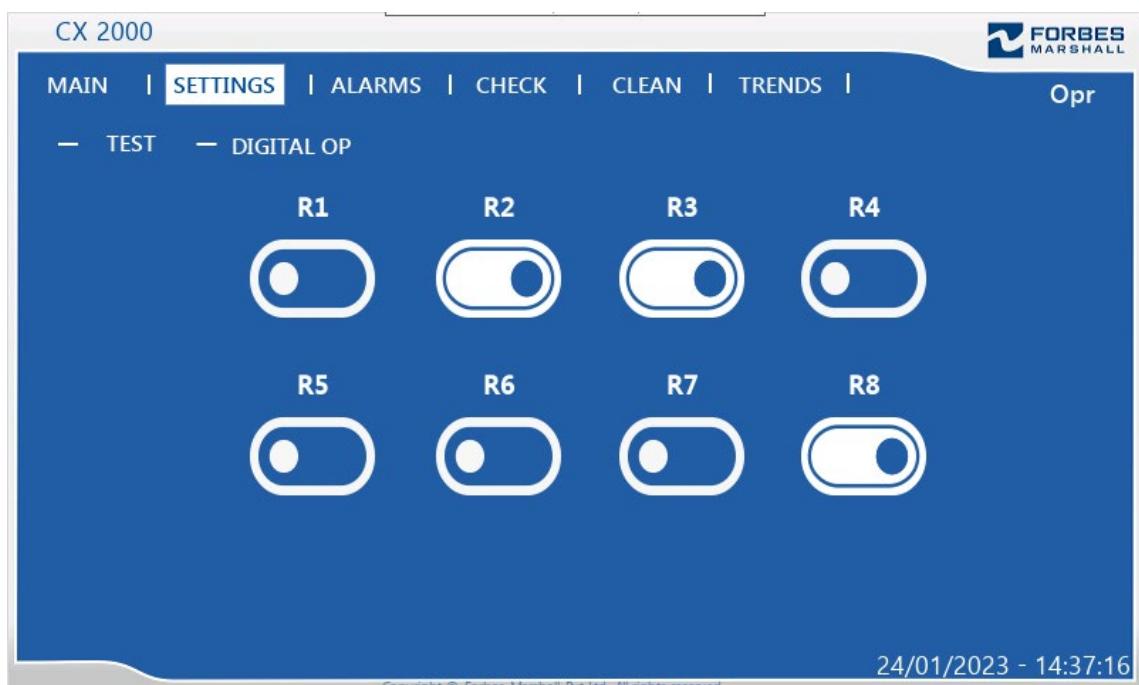
10.1. Test Mode – Digital Output Test

The relay outputs can be tested by selecting respective digital output R1 to R8 one by one.

MAIN>SETTING>Test>Digital OP

E.g., For Relay output 1 (RL1) checking,

- Connect digital multimeter across RL1 relay output respective terminals (NC-P) or (P-NO) (Ref. Fig.8) on mother board with setting done for resistance measurement or continuity mode.
- Relay normally will be closed (therefore across terminals P and NC - digital multimeter will show 0 Ohm or continuity and across terminals P and NO will show open)
- After R1 selection on display - RL1 will become open, (therefore across terminals P and NC – digital multimeter will show open or no continuity and across terminals P and NO will show 0 Ohm or continuity).



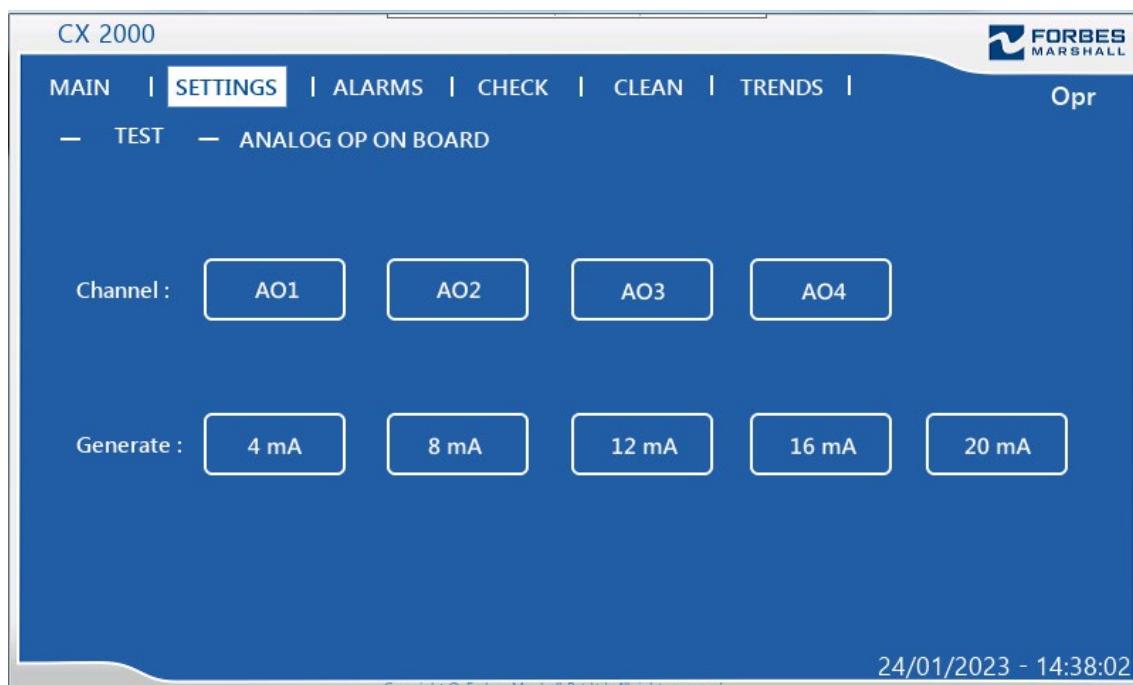
10.2. Test Mode – Analog Output Test

The analog outputs can be tested by selecting:
MAIN>SETTING>Test>Analog OP

Select the required Analog Output (1-4) and the current output value to generate the respective current by selecting the respective buttons (for current output – 4/8/12/16/20mA DC).

E.g., For Analog output 1 (AO1) checking,

- Connect digital multimeter across IO1 terminals (+ and -) (Ref. Fig.8) on mother board with setting done for 4-20 mA DC current measurement mode.
- Select AO1 and 4mA selection on display - Digital multimeter will show 4.00mA DC.
- Select AO1 and 8mA selection on display - Digital multimeter will show 8.00mA DC.
- And so on test for remaining current output readings (12, 16, 20mA).



10.3. Test Mode – Communication COMM2 and COMM3 Test

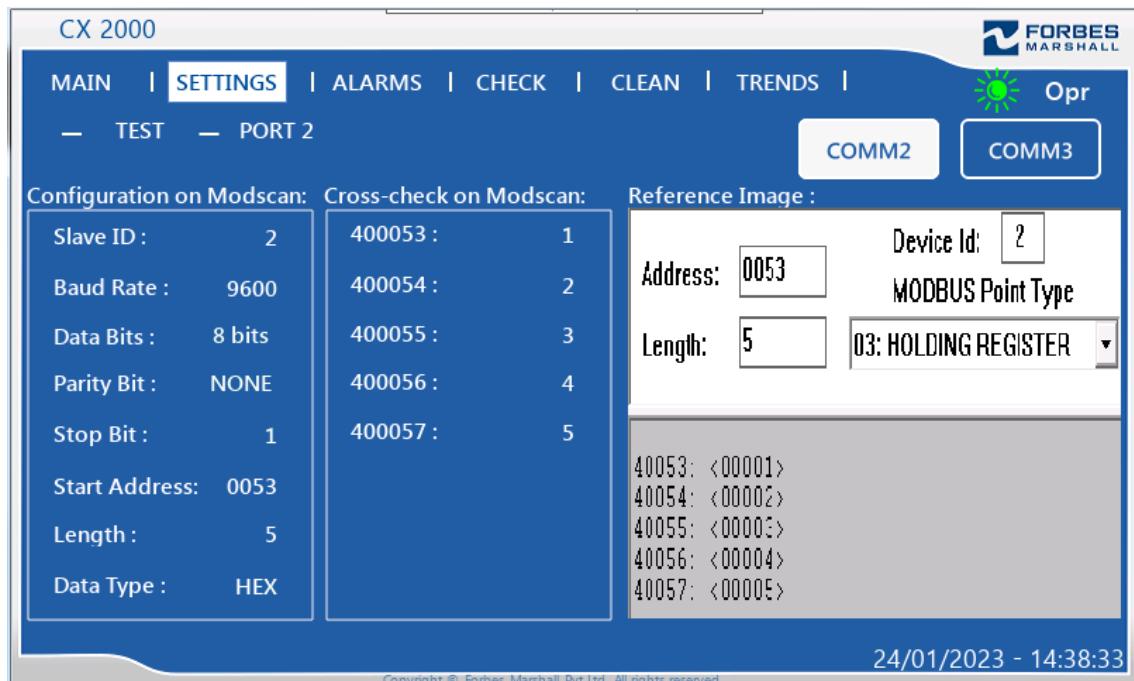
10.3.1. Test Mode – Communication COMM2 Test

The RS485 Modbus communication on port COMM2 can be tested by selecting MAIN>SETTING>Test>COMM2

press [COMM2]

Make COM2 (Port2 as per mother board PCB legend) RS485 connections as per (Ref. Fig. 8 & Fig. 15) and test COM2 communication as shown below.

Below image shows COM2 testing for Modscan Configuration and crosscheck for Modscan address with respective values and reference image for test validation.



10.3.2. Test Mode – Communication COMM 3 Test

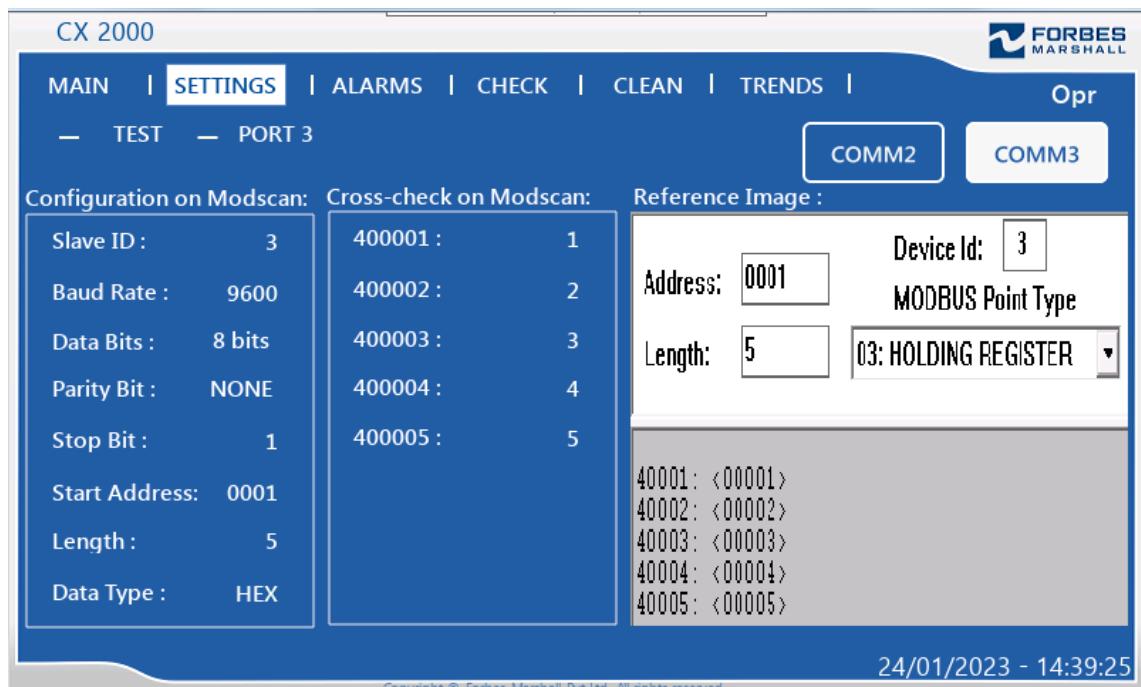
The RS485 Modbus communication on port COMM2 can be tested by selecting.

MAIN>SETTING>Test>COMM2

press [COMM3]

Make COM3 (Port1 as per mother board PCB legend) RS485 connections as per (Ref. *Fig 8 & Fig. 15*) and test COM3 communication as shown below.

Below image shows COM3 testing for Modscan Configuration and crosscheck for Modscan address with respective values and reference image for test validation.



11. Sensor Calibration

11.1. Sensor Calibration – COD



NOTE

Before performing the sensor calibration, you must perform zeroing of the analyser with the distilled water (e.g. distilled water –Merck 1.94507.5021 can be used).

As well ref. ANNEXURE - 1

The procedure to do so is the following:

1. Dip the inlet tube of the cleaning pump into the distilled water
2. Go to **CHECK > COD**
2. Enter Cleaning Time (default 30 s)
3. Press the **Clean** button and wait for the Cleaning Time set
4. Press **Measure**
5. Press the **Set as Zero** button; zeroing for COD is done.

Now, perform the 2 point or 3 point calibration:

To calibrate COD with KHP solution:

The Calibration Solution is by default selected as KHP solution, so there is no need of any change in settings to calibrate COD with KHP solution. To ensure that KHP Solution is selected, one can check whether “Calibrate with: KHP Solution” message is there in **SETTINGS > Sensor Calib > COD**.

To calibrate COD with Process Sample:

Go to **SETTINGS > Config > COD**; in **Calibration Solution** select **Process**. To ensure that Process Sample is selected, one can check whether “Calibrate with: Process Sample” message is there in **SETTINGS > Sensor Calib > COD**.

(Note: The 2 point or 3 point calibration is typically done at the customer site with the customer process sample (Ref. Annexure -1). This will help to set customer analyzer calibrated with customer process sample. The frequency of calibration can be decided by the user as weekly, fortnightly, monthly based on the “Process changes”, “Contamination of flow chamber” or for “Large difference in lab vs. analyzer readings”.)

The following procedure is common for any of the **Calibration Solution**:

Go to **SETTINGS > Sensor Calib > COD**

2 Point Calibration

CX2000

MAIN | **SETTINGS** | ALARMS | CHECK | CLEAN | TRENDS |

— SENSOR CALIB — COD

COD Live: 0.00 mg/l Calibrate with: KHP Solution

Enter Sample Value:	0.000	300.000
COD:	0.000	300.000

Sensor Calibration Coefficients

CF :	1.00
OC :	0.00

Pump Select :

- Sampling Pump
- Stop Pump

07/04/2023 - 13:15:53

3 Point Calibration

CX2000

MAIN | **SETTINGS** | ALARMS | CHECK | CLEAN | TRENDS |

— SENSOR CALIB — COD

COD Live: 0.00 mg/l Calibrate with: KHP Solution

Enter Sample Value:	0.0	300.000	0.000
COD:	0.000	300.000	0.032

Sensor Calibration Coefficients

QC :	0.00000
CF :	1.00000
OC :	0.00000

Pump Select :

- Sampling Pump
- Stop Pump

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1. **Select 2 Point or 3 Point**
2. Pump Select: Cleaning Pump/Sampling Pump. The selection of pump can be changed for each point of calibration.
3. For each calibration point, enter the actual COD value in Enter Sample Value.
4. For each calibration point, dip the inlet tube of the selected pump into each sample you want to perform the calibration with.
5. Press **Read Sample** button.
6. Press **Stop Pump** button if needed.
7. After you are done with 2 or 3 Point calibration, press **Calibrate** button.

11.2. Sensor Calibration - TSS Sensor



NOTE

Before performing the sensor calibration, you must perform zeroing of the analyser with the distilled water (eg. distilled water –Merck 1.94507.5021 can be used).

The procedure to do so is the following:

1. Dip the inlet tube of the cleaning pump into the distilled water
2. Go to **CHECK > TSS**
2. Enter Cleaning Time (default 30 s)
3. Press the **Clean** button and wait for the Cleaning Time set
4. Press **Measure**
5. Press **Set as Zero** button; zeroing for TSS is done.

Now, perform the 2 point or 3 point calibration:

To calibrate TSS with Kaolin solution:

The Calibration Solution is by default selected as Kaolin solution, so there is no need of any change in settings to calibrate TSS with Kaolin solution. To ensure that Kaolin Solution is selected, one can check whether ‘Calibrate with: Kaolin Solution’ message is there in **SETTINGS > Sensor Calib> TSS**.

To calibrate TSS with Process Sample:

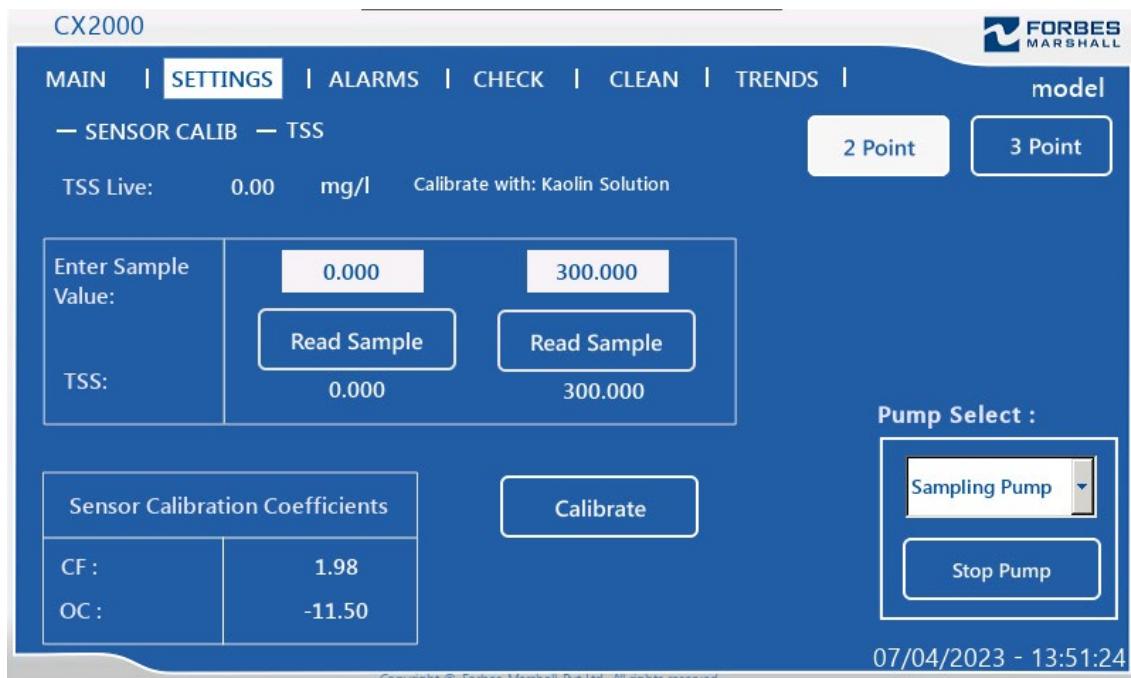
Go to **SETTINGS >Config> TSS**; in **Calibration Solution** select **Process**. To ensure that Process Sample is selected, one can check whether ‘Calibrate with: Process Sample’ message is there in **SETTINGS > Sensor Calib> TSS**.

(Note: The 2 point or 3 point calibration is typically done at the customer site with the customer process sample (Ref. Annexure -1). This will help to set customer analyzer calibrated with customer process sample. The frequency of calibration can be decided by the user as weekly, fortnightly, monthly based on the “Process changes”, “Contamination of flow chamber” or for “Large difference in lab vs. analyzer readings”.)

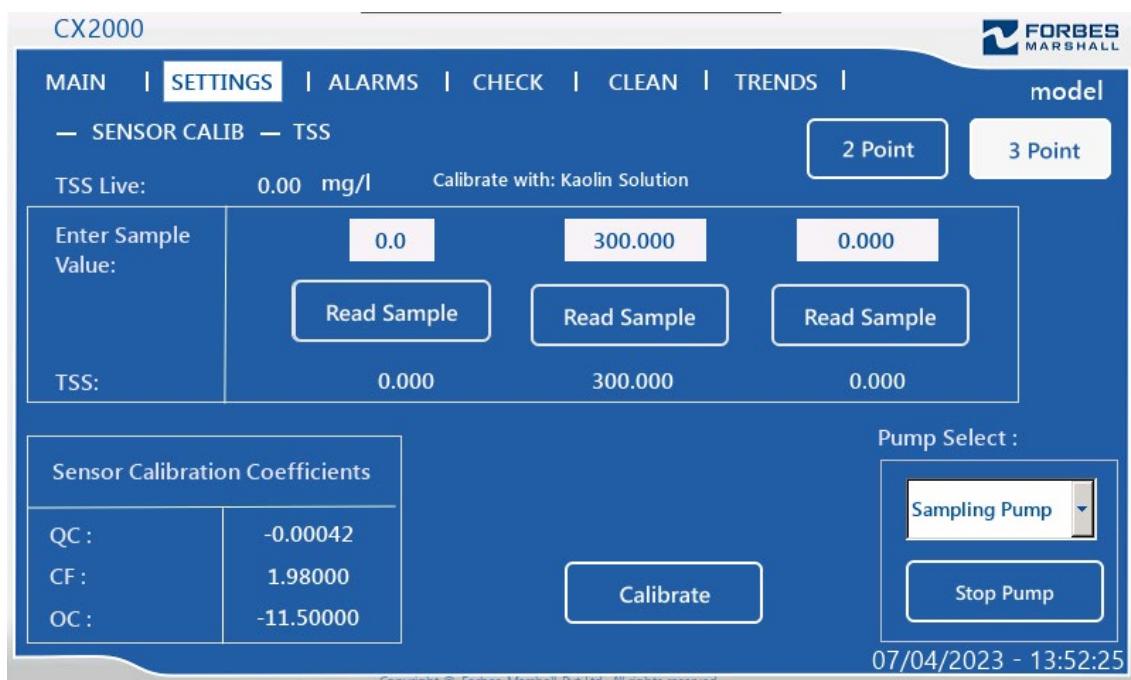
The following procedure is common for any of the **Calibration Solution**:

Go to **SETTINGS > Sensor Calib> TSS**

2 Point Calibration



3 Point Calibration



1. Select 2 Point or 3 Point
2. Pump Select: Cleaning Pump/Sampling Pump. The selection of pump can be changed for each point of calibration.
3. For each calibration point, enter the actual TSS value in Enter Sample Value.
4. For each calibration point, dip the inlet tube of the selected pump into each sample you want to perform the calibration with.
5. Press **Read Sample** button.
6. Press **Stop Pump** button if needed.
7. After you are done with 2 or 3 Point calibration, press **Calibrate** button.

 **NOTE**

[Note - User has been given flexibility to select the “Sample Pump”, “Cleaning pump” to extract the “Calibration Solutions”, “Customer Samples” to the analyzer. Enough care needs to be taken to ensure that the flow cell is completely clean with “New (/Next) Process Solution”. This can be done by running the pump for more time to ensure that the “Point1(previous) “ sample is drained completely and “Point2 (new)” sample is only available in flow chamber. This is common for both COD and TSS calibration.]

11.3. Sensor Calibration - pH Sensor

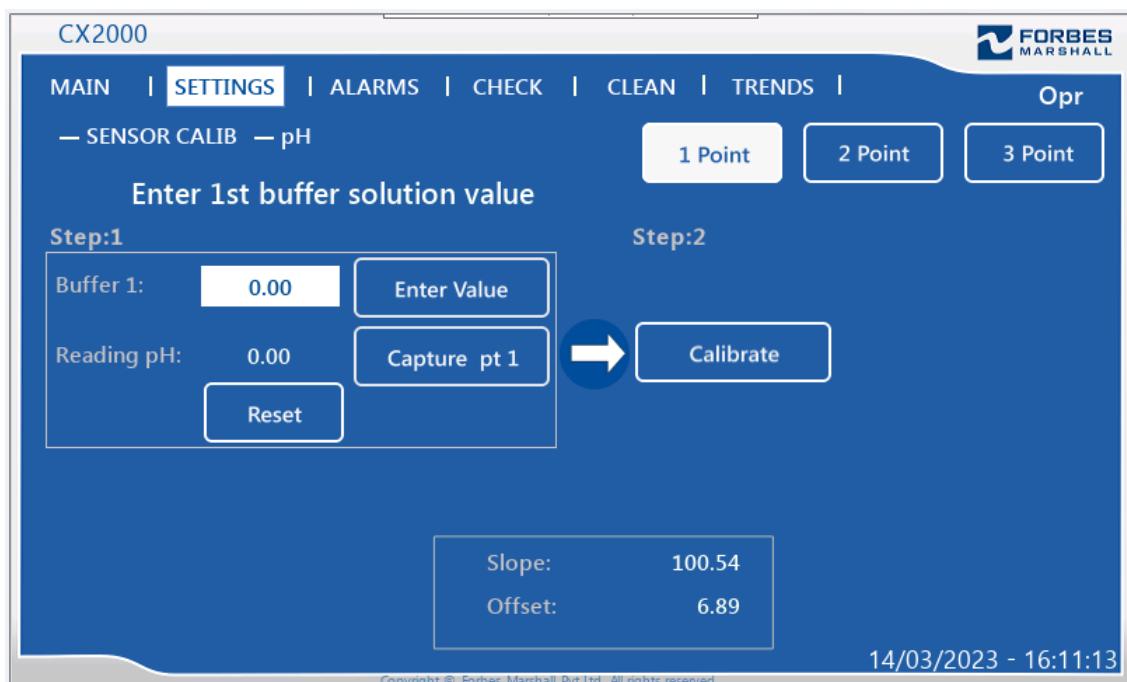
SETTINGS > Sensor Calib> pH > 1 Point

Calibration Criteria: SLOPE \leq 70% AND \geq 130%, OFFSET \leq 6 pH AND \geq 7 pH

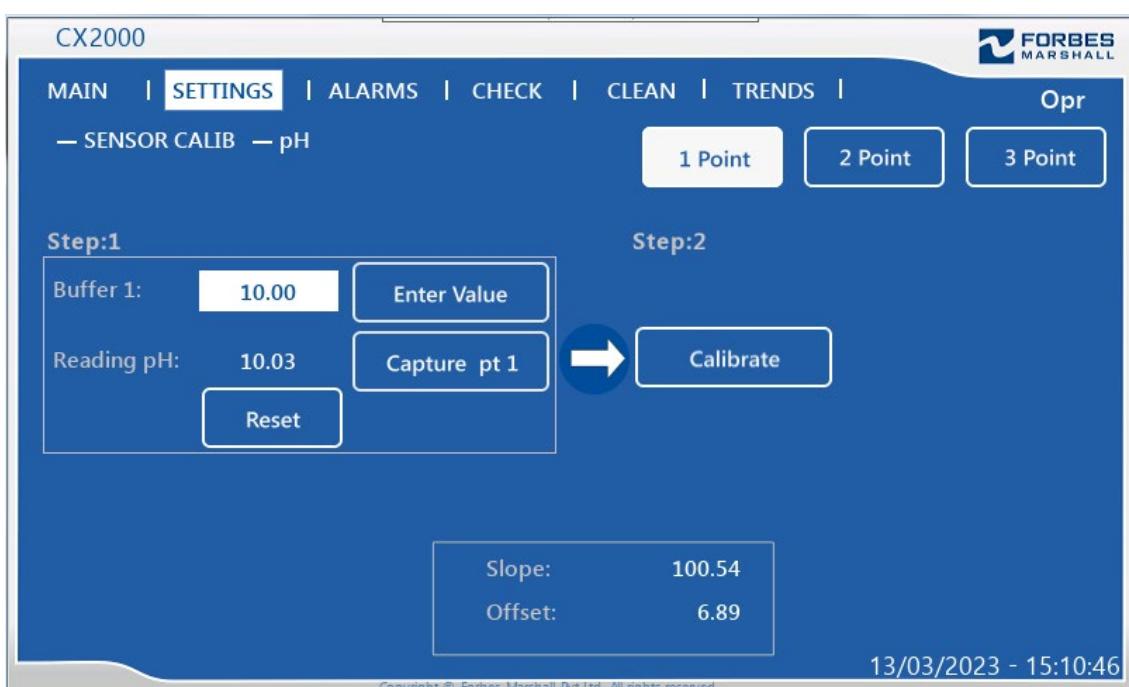
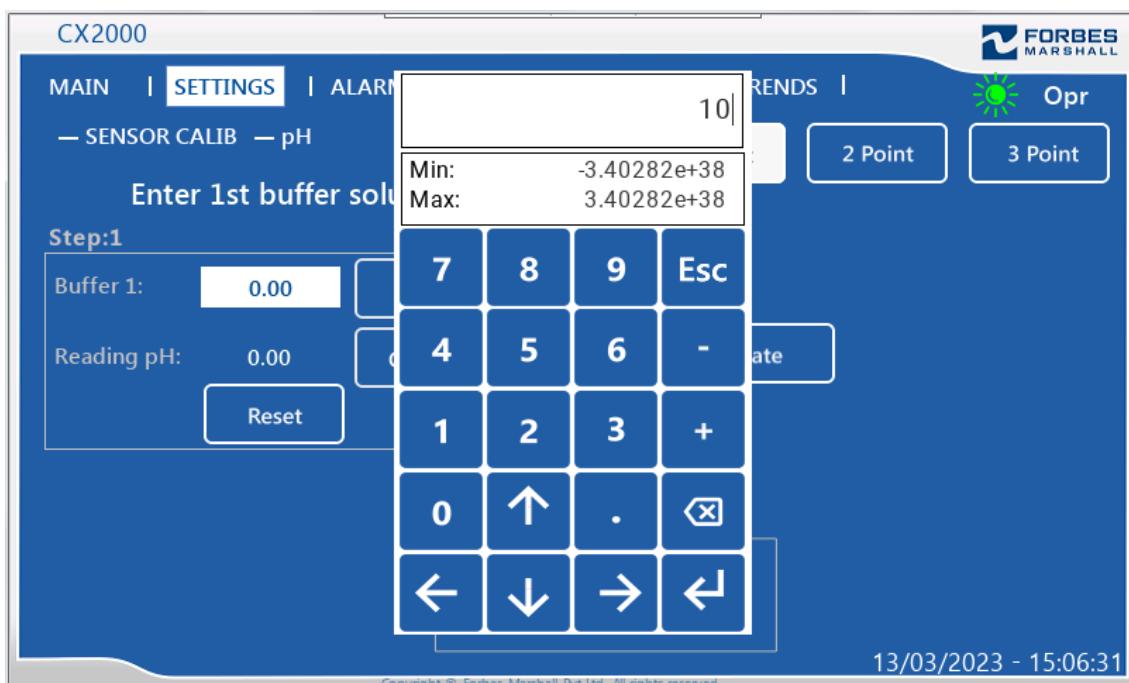
PROGRAMMING

Press the '**Reset**' button to clear the '**Buffer 1**' and '**Reading pH**' value.

Enter 1st buffer solution value message will appear on the top of the



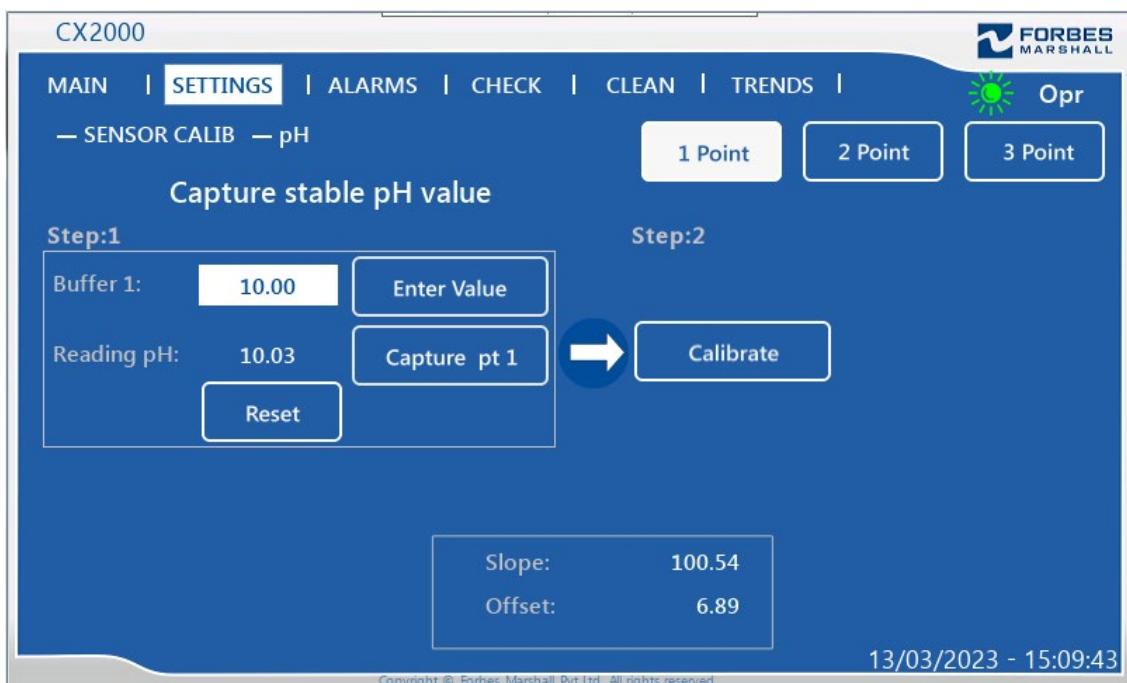
Tap on the entry box for '**Buffer 1**' and enter the desired value using the keypad that appears on the screen and press enter key on the keyboard.



Dip the pH sensor in the respective buffer solution and press the '**Enter Value**' button to start the sensor reading. After pressing, '**Capture stable pH value**' message will appear on the top of the screen; continuous values will be displayed in the 'Reading pH' row.

NOTE

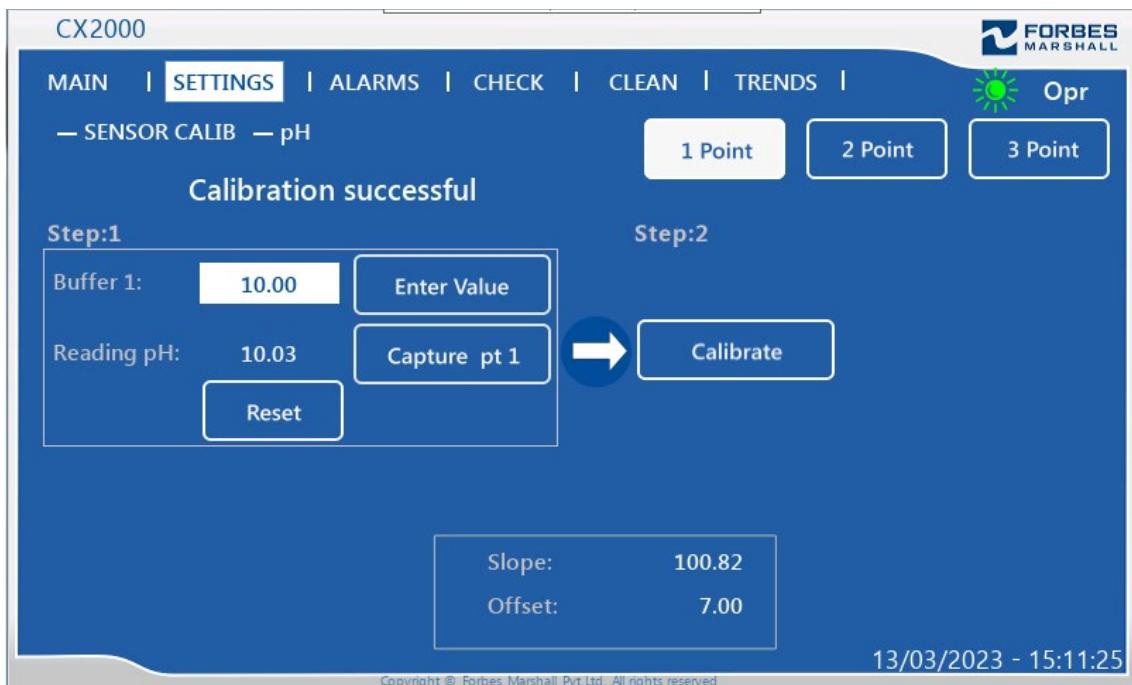
Note - This value will keep fluctuating and will become stable as the value reaches the value of the buffer solution.



Press '**Capture pt 1**' once the value is stable, the message will disappear.



Note - If you are convinced with the results, press the '**Calibrate**' button. To redo the entire process you can press the '**Reset**' button.



SETTINGS > Sensor Calib> pH > 2 Point

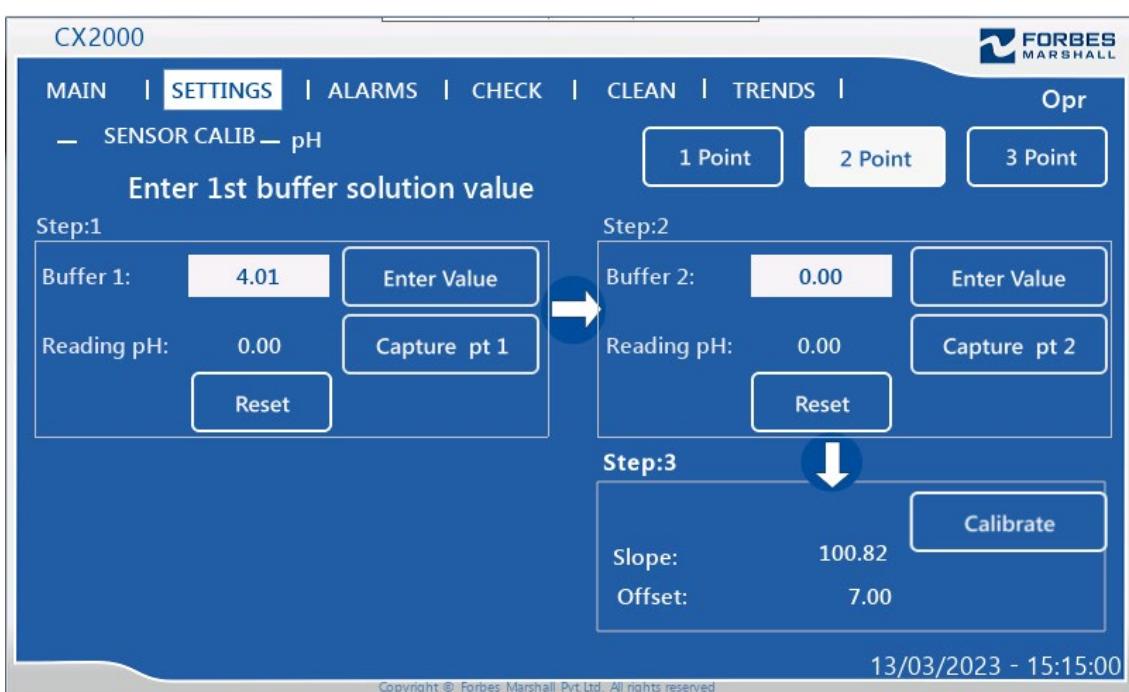
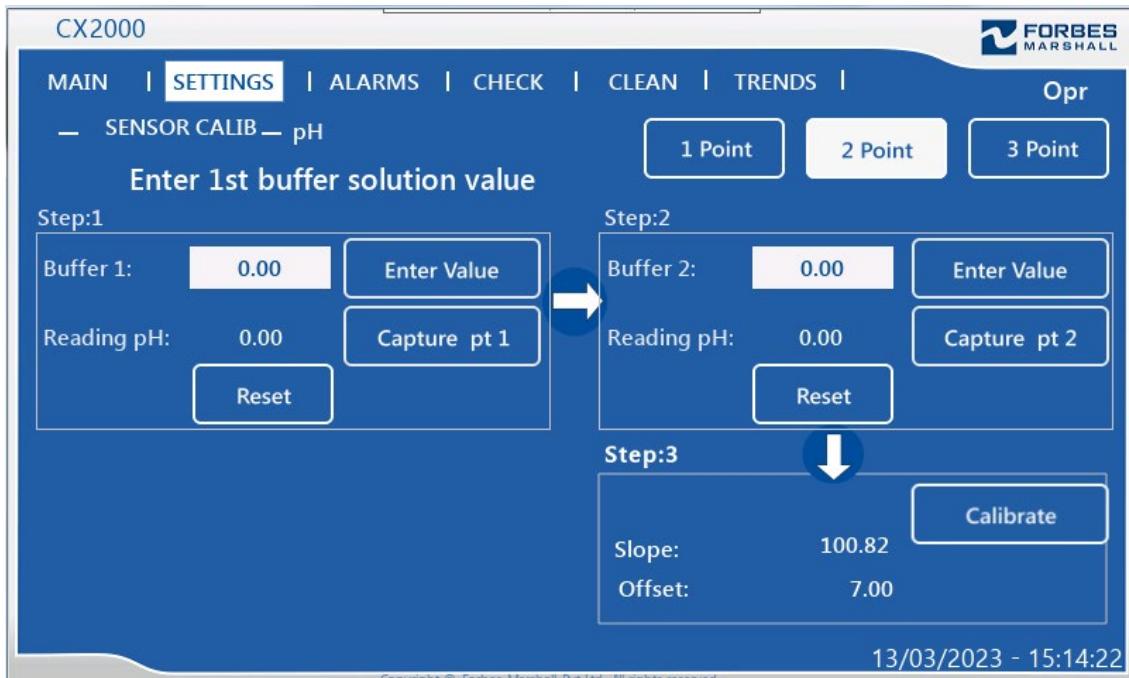
Calibration Criteria: SLOPE \leq 70% AND \geq 130%, OFFSET \leq 6 pH AND \geq 7 pH

PROGRAMMING

Press the 'Reset' button to clear the 'Buffer 1' and 'Reading pH' value.

Enter 1st buffer solution value message will appear on the top of the screen.

Enter the value of the desired buffer solution in 'Buffer 1' using the keypad.

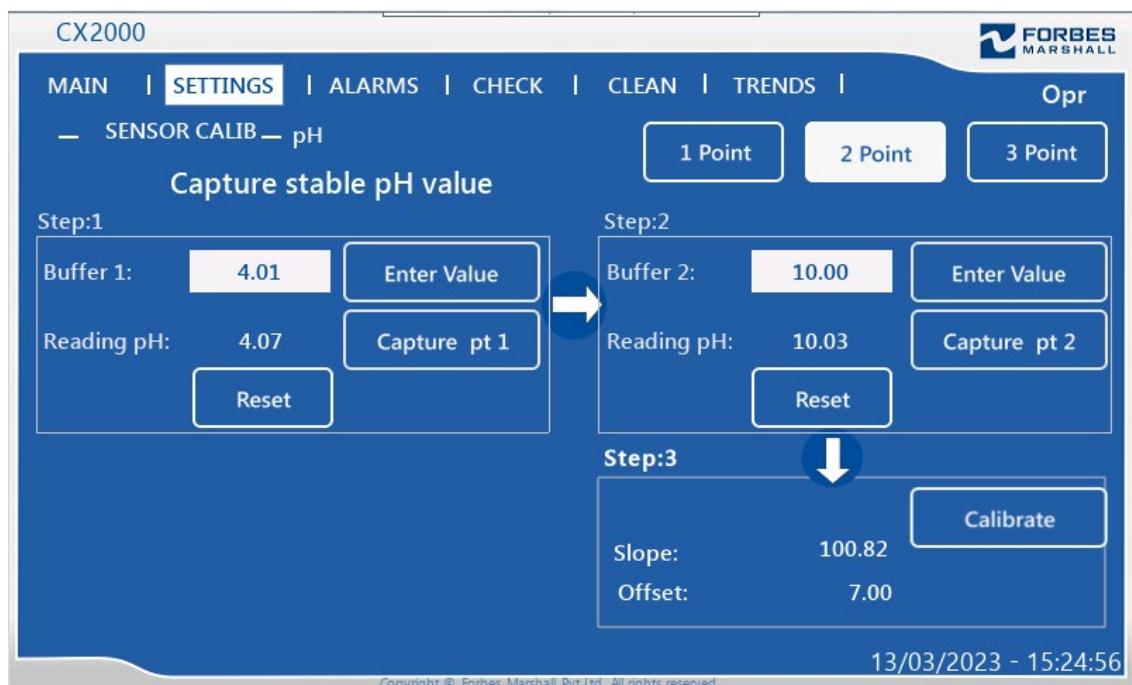


Dip the pH sensor in the respective buffer solution and press the 'Enter Value' button to start the sensor reading.

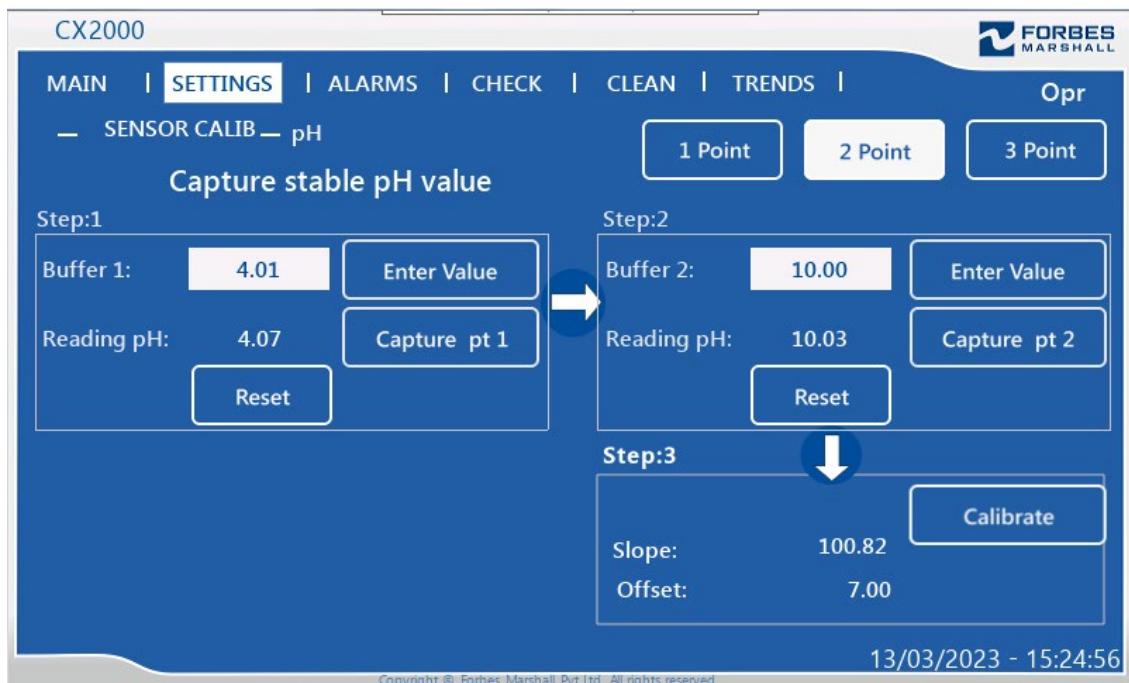
After pressing, '**Capture stable pH value**' message will appear on the top of the screen; continuous values will be displayed in the 'Reading pH' row.

NOTE

Note - This value will keep fluctuating and will become stable as the value reaches the value of the buffer solution.



Press '**Capture pt 1**' once the value is stable, the message will disappear.

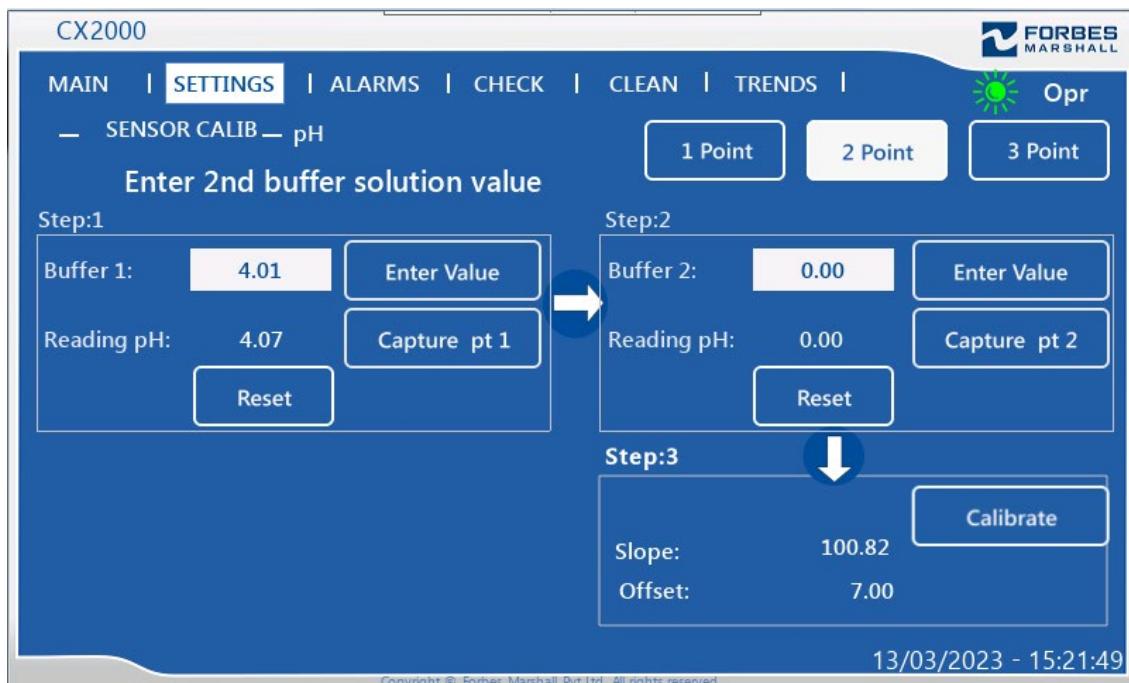


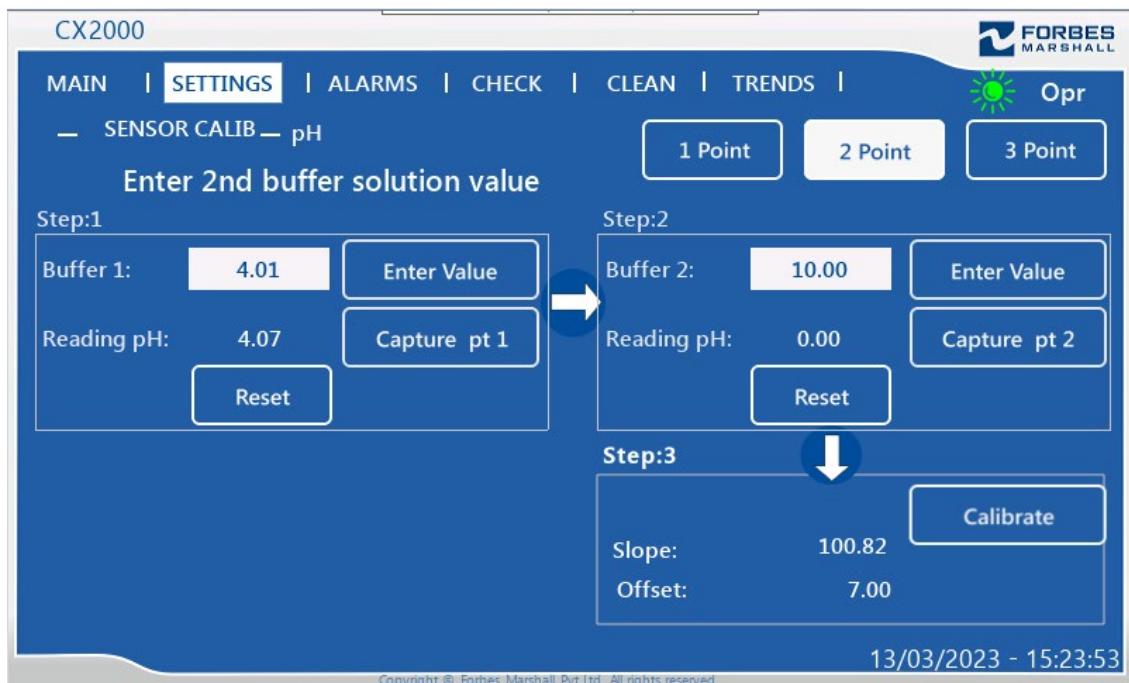
PROGRAMMING

Press the 'Reset' button to clear the 'Buffer 2' and 'Reading pH' value.

'Enter 2st buffer solution value' message will appear on the top of the screen.

Enter the value of the desired buffer solution in 'Buffer 2' using the keypad.



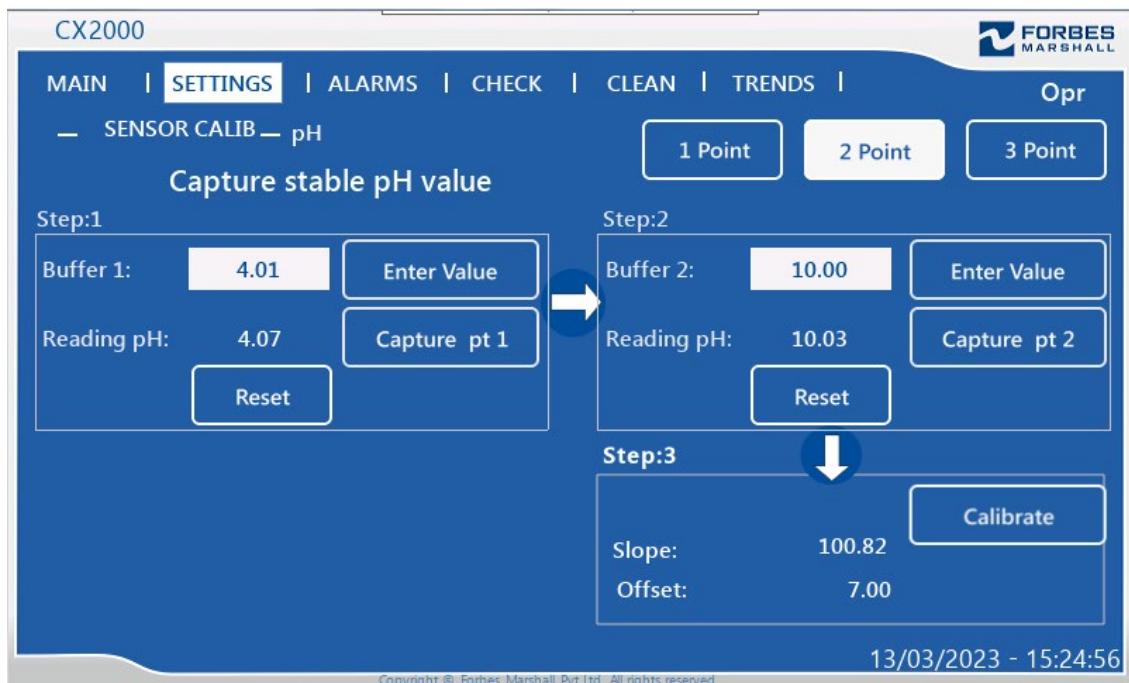


Dip the pH sensor in the respective buffer solution and press the 'Enter Value' button to start the sensor reading.

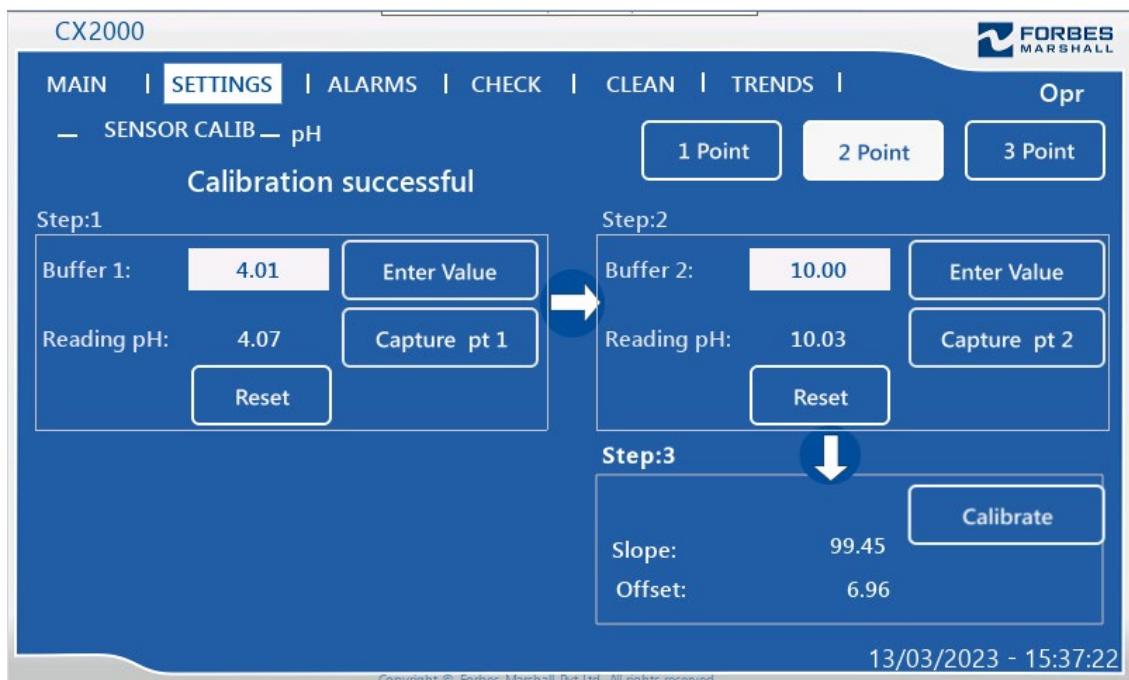
After pressing, '**Capture stable pH value**' message will appear on the top of the screen; continuous values will be displayed in the 'Reading pH' row.

NOTE

Note - This value will keep fluctuating and will become stable as the value reaches the value of the buffer solution.

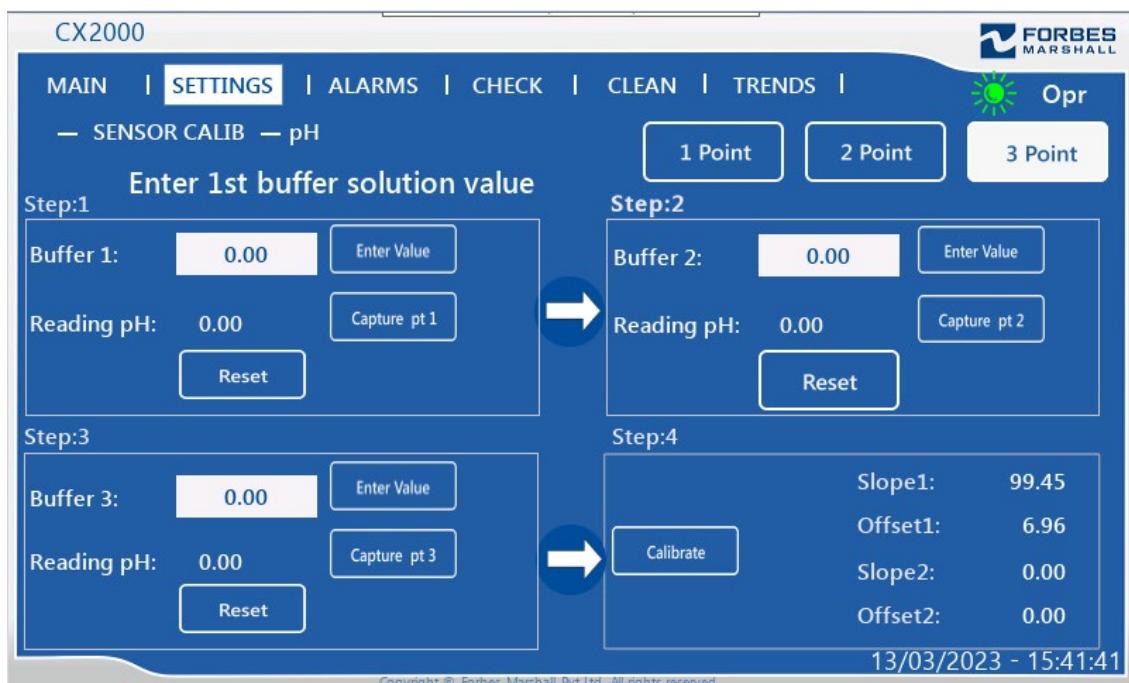


If you are convinced with the results, press the ‘**Calibrate**’ button. To redo the entire process you can press the ‘**Reset**’ button.



SETTINGS > Sensor Calib> pH > 3 Point

Calibration Criteria: SLOPE \leq 70% AND \geq 130%, OFFSET \leq 6 pH AND \geq 7 pH



PROGRAMMING

Press the 'Reset' button to clear the 'Buffer 1' and 'Reading pH' value.

'Enter 1st buffer solution value' message will appear on the top of the screen.

Enter the value of the desired buffer solution in 'Buffer 1' using the keypad.

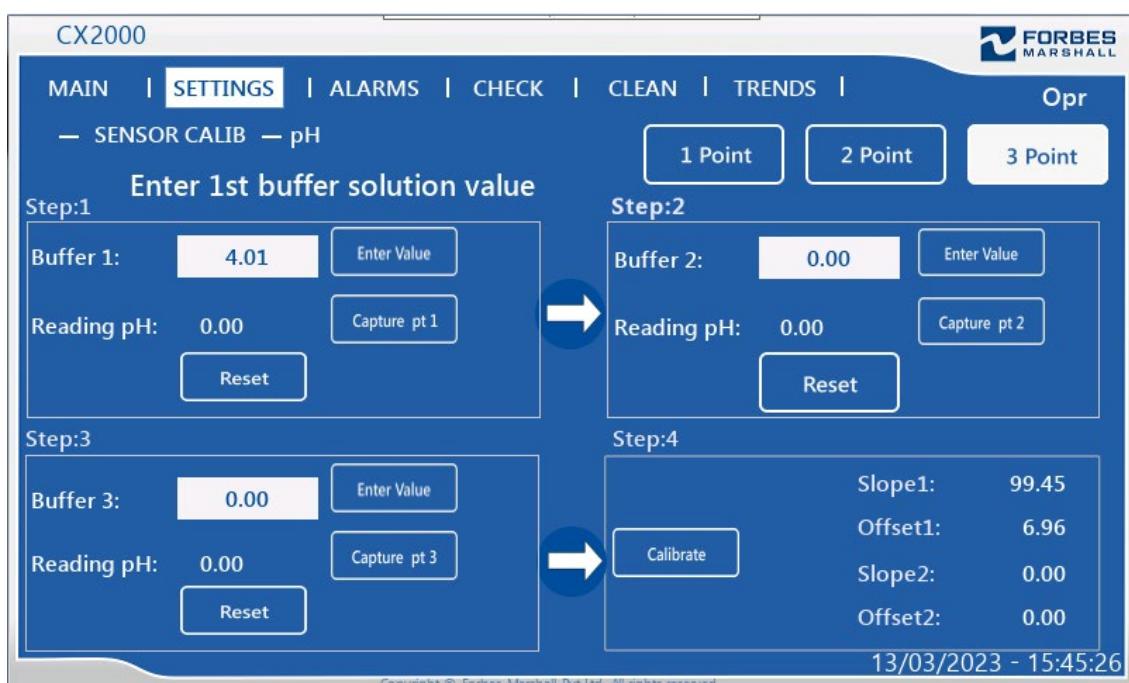
Dip the pH sensor value in the desired buffer solution and press 'Enter Value' button.

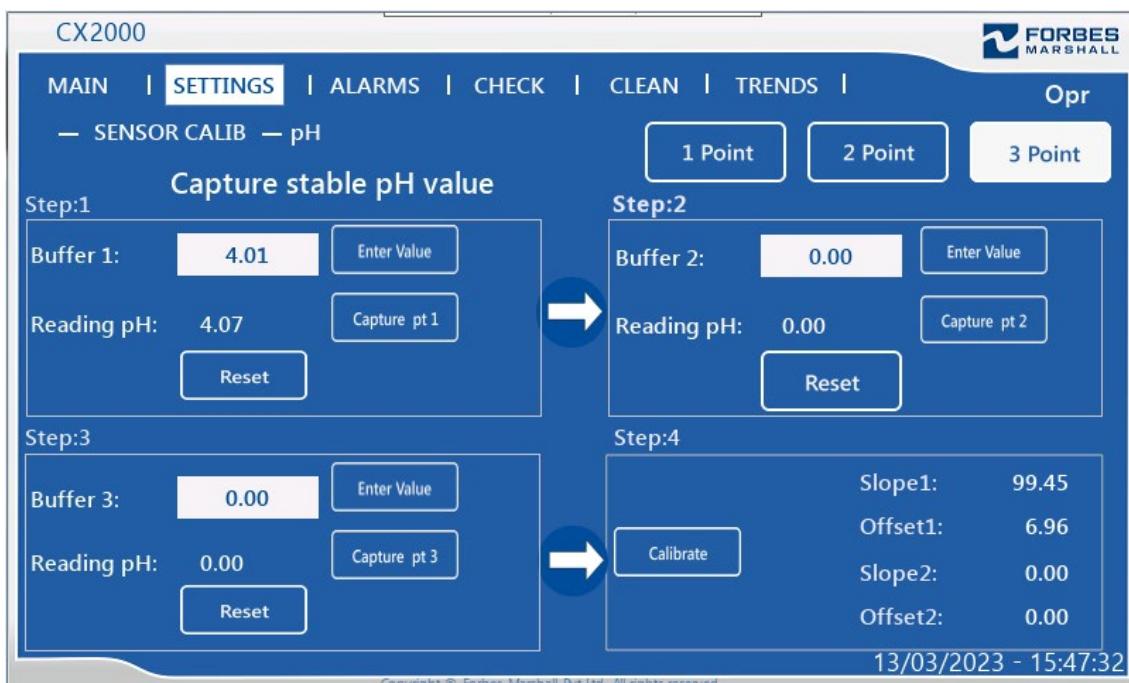
After pressing, 'Capture stable pH value' message will appear on the top of the screen; continuous values will be displayed in the 'Reading pH' row.



Note - This value will keep fluctuating and will become stable as the value reaches the value of the buffer solution.

Press 'Capture pt 1' once the value is stable, the message will disappear.





Press the '**Reset**' button to clear the '**Buffer 2**' and '**Reading pH**' value.

Enter 2st buffer solution value message will appear on the top of the screen.

Enter the value of the desired buffer solution in '**Buffer 2**' using the keypad.

Dip the pH sensor value in the desired buffer solution and press '**Enter Value**' button.

After pressing, '**Capture stable pH value**' message will appear on the top of the screen; continuous values will be displayed in the '**Reading pH**' row.

NOTE

Note - This value will keep fluctuating and will become stable as the value reaches the value of the buffer solution.

Press '**Capture pt 2**' once the value is stable, the message will disappear.

CX2000

MAIN | SETTINGS | ALARMS | CHECK | CLEAN | TRENDS | Opr

— SENSOR CALIB — pH

Enter 2nd buffer solution value

Step:1

Buffer 1:	4.01	Enter Value
Reading pH:	4.07	Capture pt 1
Reset		

Step:2

Buffer 2:	0.00	Enter Value
Reading pH:	0.00	Capture pt 2
Reset		

Step:3

Buffer 3:	0.00	Enter Value
Reading pH:	0.00	Capture pt 3
Reset		

Step:4

Slope1:	99.45
Offset1:	6.96
Slope2:	0.00
Offset2:	0.00

Calibrate

13/03/2023 - 15:50:44

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CX2000

MAIN | SETTINGS | ALARMS | CHECK | CLEAN | TRENDS | Opr

— SENSOR CALIB — pH

Enter 2nd buffer solution value

Step:1

Buffer 1:	4.01	Enter Value
Reading pH:	4.07	Capture pt 1
Reset		

Step:2

Buffer 2:	7.00	Enter Value
Reading pH:	0.00	Capture pt 2
Reset		

Step:3

Buffer 3:	0.00	Enter Value
Reading pH:	0.00	Capture pt 3
Reset		

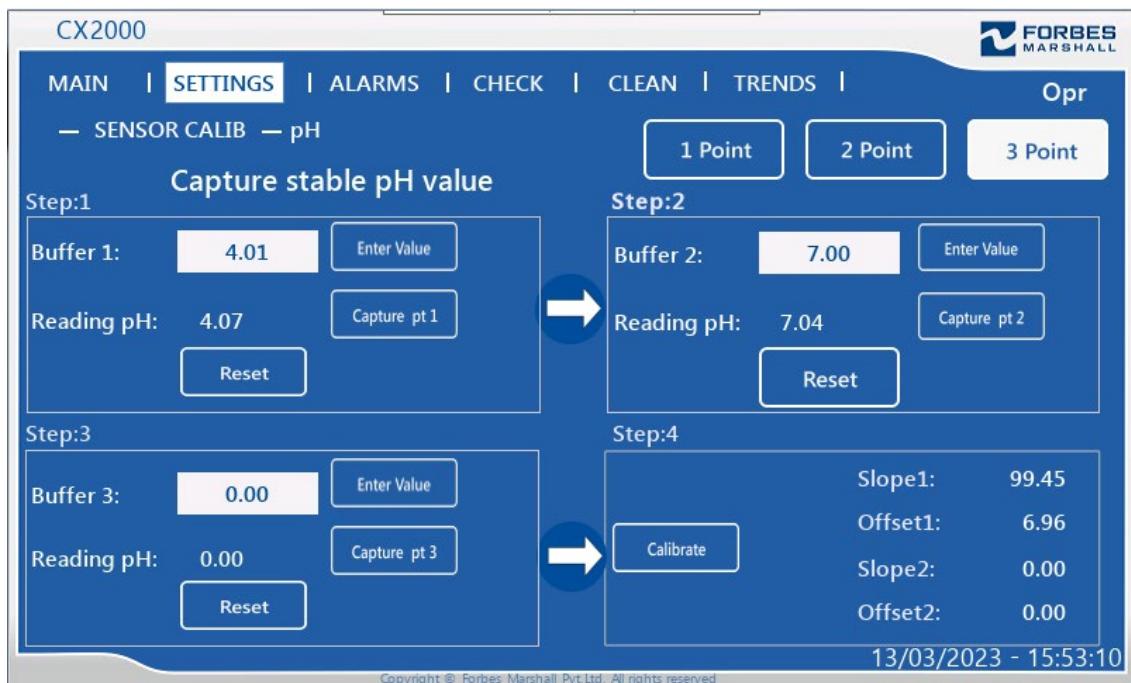
Step:4

Slope1:	99.45
Offset1:	6.96
Slope2:	0.00
Offset2:	0.00

Calibrate

13/03/2023 - 15:51:46

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Press the '**Reset**' button to clear the '**Buffer 3**' and '**Reading pH**' value.

Enter 3st buffer solution value message will appear on the top of the screen.

Enter the value of the desired buffer solution in '**Buffer 3**' using the keypad.

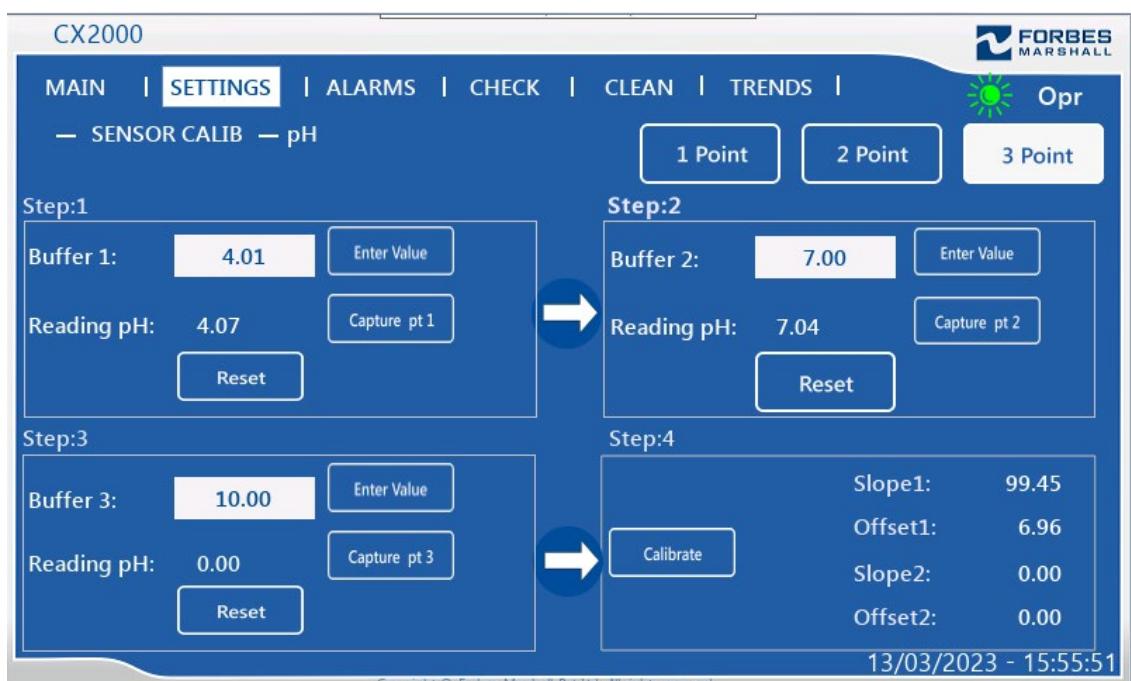
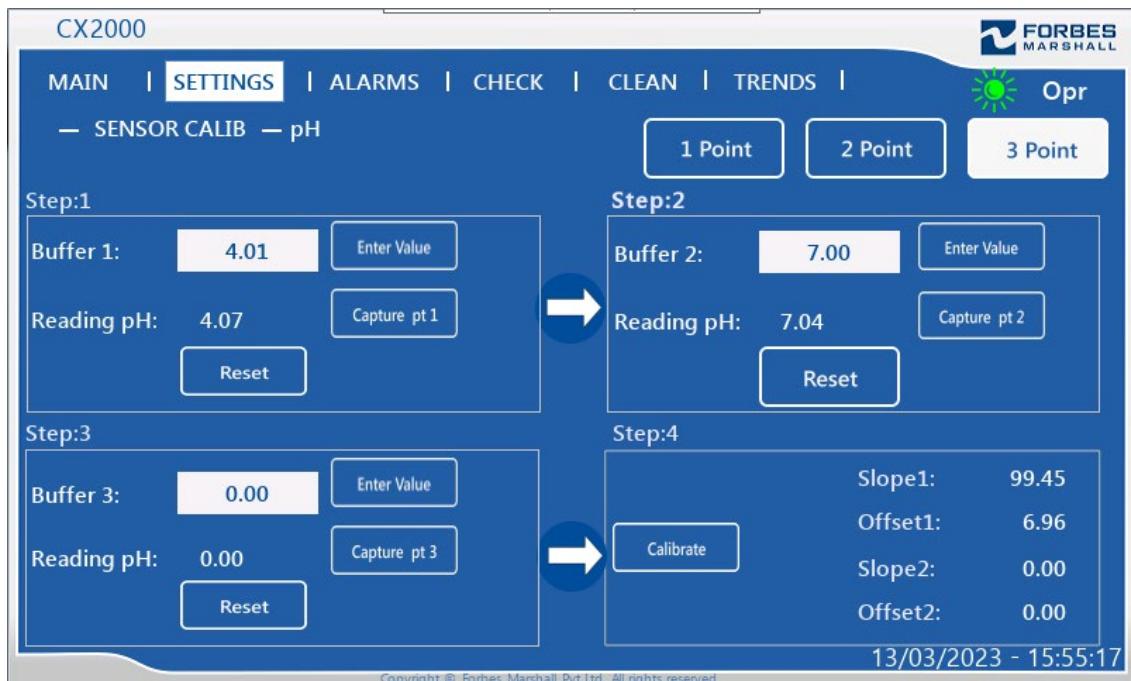
Dip the pH sensor value in the desired buffer solution and press '**Enter Value**' button.

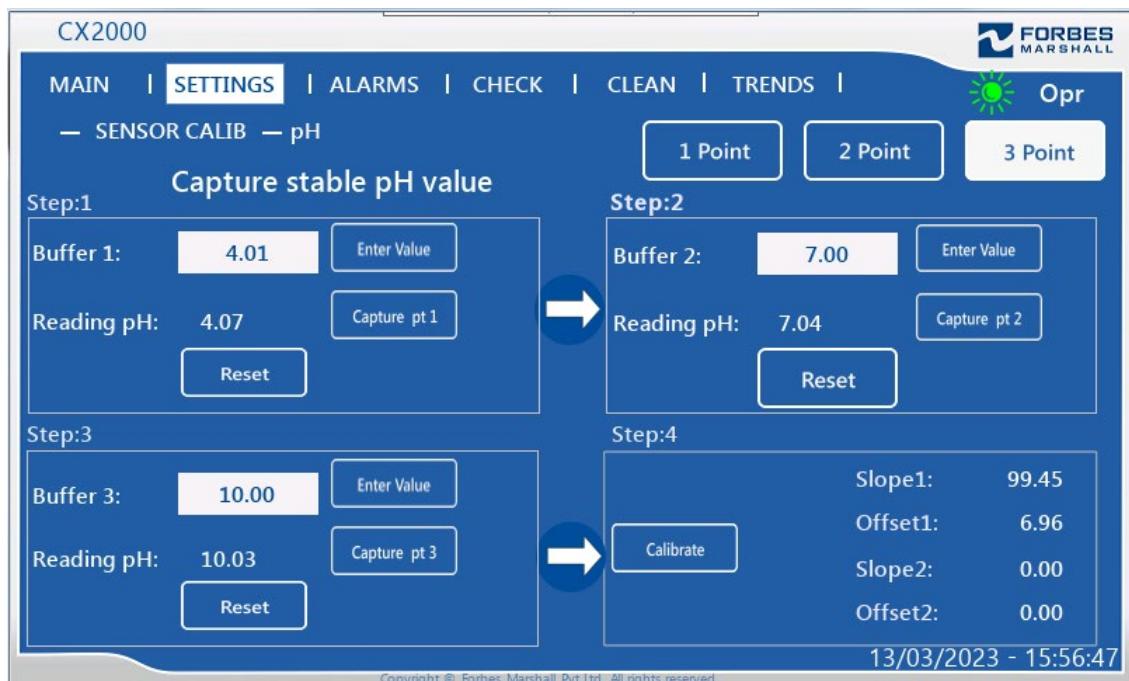
After pressing, '**Capture stable pH value**' message will appear on the top of the screen; continuous values will be displayed in the '**Reading pH**' row.

NOTE

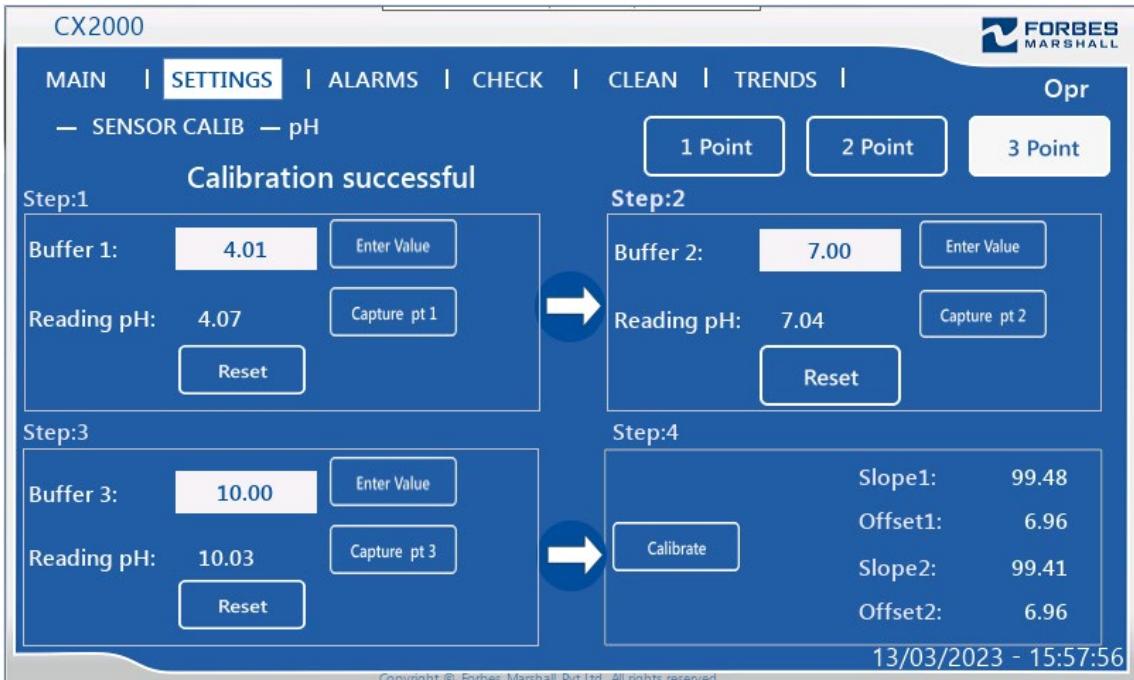
Note - This value will keep fluctuating and will become stable as the value reaches the value of the buffer solution.

Press '**Capture pt 3**' once the value is stable, the message will disappear.





If you are convinced with the results, press the '**Calibrate**' button. To redo the entire process, you can press the '**Reset**' button.



12. Errors and Warnings



12.1. Errors messages

Sample Tank Empty

Error Description – Make sure sample is available.

12.2. Warnings messages

Clean Tank Empty

Error Description – Top-up Cleaning solution

13. Maintenance Schedule



NOTICE

13.1. Regular maintenance

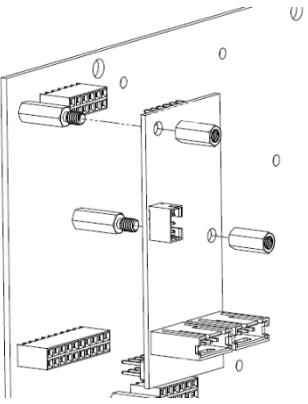
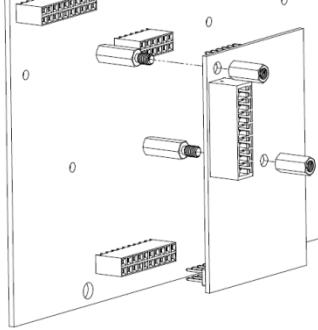
- To do proper auto zero, it is important to note that good quality distilled water. (Ref. distilled water –Merck 1.94507.5021) is to be used for preparing zero (cleaning) solution.
- Inlet sample tube change – frequency as per sample conditions (@ 6month for 15min.)

13.2 Calibration

- The frequency of calibration can be decided by the user as weekly, forth nightly, monthly based on the “Process changes”, “Contamination of flow chamber” or for “Large difference in lab vs. analyzer readings”.

13.3. Module replacement

To add (or replace) the module, please proceed strictly as follows:

<p>COD Module :</p>  <p>pH Module :</p> 	<p>Disconnect the mains supply on the instrument.</p> <p>Remove the fastening hex studs of the module to be replaced.</p> <p>Unplug the existing module, if any, otherwise plug in the new module.</p> <p>Check that all the pins are correctly plugged and that the module is in the right position.</p> <p>Secure the module with the correct fastening hex studs. Install the provided input cables. Reconnect the mains.</p> <p>The newly added or replaced module is automatically detected and ready to use on power-up. Change the default configuration if necessary.</p>
	<p> Do not touch any of the components on the module. Immediately place the module in an anti-static zip-pouch and seal. Remove the replacement module from its anti-static zip-pouch only when you are about to insert it.</p> <p>  </p> <p>pH /COD module is not hot swappable. Mains supply need to Switch 'OFF' before module plug in or plug out.</p>

14. DON'Ts and DO's



DON'Ts

- Do not connect any voltages exceeding the specifications of the Analyzer.
- Do not connect inlet sample without strainer.

DO's

- Ensure proper Earth is connected to the dedicated Earth tab of the Analyzer Body.
- Sample inlet and outlet tube connection done properly and not leaking.
- Cleaning of Inlet and Outlet ports done as per maintenance guidelines / as per sample quality requirements.
- Confirm cleaning solution availability in the cleaning tank as per testing requirements.
- Cleaning solution preparation done with Distilled water 90% + H₂SO₄ 10% max.

15. Checks before commissioning

The diagram illustrates the CX2000 ANALYSER and CX2000 ANALYSER PANEL. The CX2000 ANALYSER is a blue rectangular unit with a small screen and a keypad. The CX2000 ANALYSER PANEL is a white cabinet containing the CX2000 unit. Labels indicate the Sample Inlet, Cleaning Solution Inlet, and Outlet on the analyser, and the Process Sample Inlet and Drain Connection on the panel. Yellow circles highlight the Process Sample Inlet and Drain Connection on the panel.

COMMISSIONING READINESS CHECKLIST		
Sr. No.	Description	Status (Yes/No)
1	110/240 VAC/1KVA Online UPS output (110/240AC) is connected to Junction box terminal connector for CX2000 Analyser connections.	<input type="checkbox"/>
2	Proper instrumentation earth is connected, Voltage between Neutral & Earth is less than 1.5 VAC	<input type="checkbox"/>
3	Process sample is connected at Sample Inlet port. (Ref. Fig. 7 and CX2000 Analyser & Panel Images as above)	<input type="checkbox"/>
4	Dedicated Drain line Pipe to be connected and should be open to atmospheric pressure. (Ref. Fig. 7 and CX2000 Panel image as above)	<input type="checkbox"/>
5	Cable used for Modbus communication should be, 0.5 Sq.mm, twisted pair, multi-stranded, aluminum foil, shielded, armoured cable.	<input type="checkbox"/>
6	Signal /current output /Modbus cables should not overlap above power cables in cable tray, it should be routed separately as per standards.	<input type="checkbox"/>
7	Cleaning solution readiness (made from DI water)	<input type="checkbox"/>

15.1 Commissioning Steps

- Once commissioning checklist 7 points are taken care and completed, then Power 'ON' MCB.
- Power 'ON' Mains switch (Red) inside CX2000 analyser (Ref. [Fig.7](#))
- Analyser Display will Power 'ON' and it will start its batch operation normally.



NOTE

- Note: Analyser is already factory calibrated, so no need to calibrate again, If customer insist to cross check then they can validate and if required can calibrate it on standard solutions of COD, TOC, TSS & pH. Refer user manual chapter 11 (for menu options Check – COD/TSS/pH, Settings>Config & Settings> Calib > COD/TSS/pH) and ref. sections are as below,
 - 11.1 – For Sensor Calibration COD,
 - 11.2 – For Sensor Calibration TSS and
 - 11.3 – For Sensor Calibration pH
- If the sample is colored or have different chemical matrix the process calibration is preferred with respect to lab results.
- Sample Chloride content limit is 5000ppm.

16. Trouble Shooting:

Sr. No.	Parameter	Symptoms	Steps / Probable Cause
1	COD/BOD/ TSS/TOC	Reading is Zero	Wrong auto-zero: Due to cleaning solution not prepared with standard procedure or fault in the cleaning system (no flow)
2	COD/BOD/ TSS/TOC	Reading is too low	Wrong auto-zero: Due to cleaning solution not prepared with standard procedure or fault in the cleaning system (no flow) Wrong calibration: check reading with lower value (E.g., 5-10% of Range) standard calibration solution, in case of wrong reading with this standard, redo the calibration as per chapter 11 - section for COD - 11.1 for TSS -11.2
3	COD/BOD/ TSS/TOC	Reading is too high	Check whether lamp is flashing (check visually). Check flow cell contamination (check visually), if found contamination, clean by brush supplied with analyzer. Wrong calibration: check reading with standard calibration solution, in case of wrong reading with this standard, redo the calibration as per chapter 11 =section for COD - 11.1 for TSS -11.2
4	COD/BOD/ TSS/TOC	Unstable value	No water in the flow cell (clogging, bad inlet connection, fault in the peristaltic pump) Bubbles in the sample (check peristaltic pump inlet fitting) Check flow cell contamination (check visually, pure hydrochloric acid may be exceptionally used during a short time if the cleaning solution is not efficient, take precautions) Check manually after transportation - optical parts (E.g., Flow cell, Xenon Lamp etc.) are not moving.
5	pH	Reading not accurate	Remove pH sensor from flow through chamber, do cleaning (as recommended in manual section general notes for pH Sensor) and reconfirm by installing again in flow through chamber. If still not matching, then (Ref. Section 11.3) and confirm with standard buffer solution. If not matching with standard solution, then confirm by recalibration. If still not OK - Remove pH sensor and connect wire link across pH input terminals (Ref. Fig. 8 & 10) and confirm pH reading should show 7pH. If OK – Replace Sensor or If not OK – Replace pH Module or Contact FM Customer Support..

Sr. No.	Parameter	Symptoms	Steps / Probable Cause
6	Temperature	Reading not accurate	Remove Temperature sensor and connect simulated resistance across RTD input terminals (Ref. Fig. 8 & 10, and chapter 11.3) and confirm temperature reading (as per Annexure 5) should show corresponding temperature reading. (E.g.. For PT-100 Sensor - Input resistance 138.50 Ohm – Reading required 100°C) Ref. Annexure 4. If OK – Replace Temperature Sensor or If not OK, do temperature calibration and reconfirm. Still not OK – pH module needs to replace or contact FM Customer Support.
7	Analog Output	Reading not accurate	Check wiring (Ref. Fig.11, 12) and configuration (Ref. Chapter 9.7) and Test Mode (Ref. chapter 10.2). Go to Analog output test mode and confirm test for specific output. If not OK – Mother Board not functioning, need to replace or contact FM Customer Support.
8	Relay Output	Relay output not working	Check wiring (Ref. Fig.13, 14) and configuration (Ref. Chapter 9.8) and Test Mode (Ref. chapter 10.1). Go to Relay output test mode and confirm test for specific output. If not OK – Mother Board not functioning, need to replace or contact FM Customer Support.
9	COM2 or COM3 RS485 Communication not working	COM2 or COM3 RS485 Communication not working	Check wiring (Ref. Fig.15) and configuration (Ref. Chapter 9.9) and Test Mode (Ref. chapter 10.3.1 or 10.3.2). Go to COMM2 or COMM3 respective test mode and confirm test for specific COM port. If not OK – Mother Board not functioning, need to replace or contact FM Customer Support.
10	No Sample	No sample output not working	Check wiring (Ref. Fig.16) and confirm test for No sample – Digital Output on respective terminals. If not OK – Check Flow switch for no sample condition visually for dust or float working manually – if not OK need to replace float switch. Still if not working Mother Board not functioning, need to replace or contact FM Customer Support.

17. Standard Spares:



Sr. No	Item Description	Item code
	Consumable Spares (Note – Ref. Items marked in ‘Blue’)	
1	Tubing set for CX2	AWA-CX2-TUBESET-INEXT
2	Tygon tube	AWA-HE780-FM
3	PU TUBE BLACK SAMPLE INLET	AWA-CX2HE762
4	PU Tube for sample catch pot	AWA-PUTUBE12MMODBL-FM
5	Sample pump tube	AWA-HE750-FM
6	Water detector	AWA-ME610
7	Cleaning brush 3912	C4E-BRUSH-OD13L200
8	Cleaning brush 3922	C4E-BRUSH-OD08L250
9	Canister, 5L	AWA-CX2HE111
10	pH sensor, Polilyte Pro 120	HT238411
	Standards & cleaning solution	
11	TSS Standard, Kaolin, 100 G Pack	C4E-KAOLIN_100G
12	COD standard, KHP powder, 100 G pack	C4E-KHP_100G
13	Sulphuric Acid	C4E-1016777_2L5
14	pH buffer solution, pH 4/7/9.2 Set of 3 X 500ml	HT238922
	Other Standard Spares list ref. as below:	
15	HMI for CX2000	AWA-CX2EA330SHMI1
16	Motherboard with firmware Version 1	AWA-CX2EA334MB1
17	Power Supply, 12 V	AWA-CX2EE890
18	MVUX Card (COD)	AWA-CX2EA313
19	pH card	AWA-CX2EA307
20	Xenon UV power supply card	AWA-EA370
21	Sampling pump motor	AWA-HE741
22	Sampling pump head	AWA-HE731-FM
23	Cleaning pump set (head, motor, tube)	AWA-HE720-FM
24	Xenon lamp set (lamp + trigger)	AWA-EE832-FM
25	Strainer set	AWA-CX2HE170S
	PD1 & PD2 ref set as below (Sr.No.25-32)	
26	PD1 & PD2 set with light guide	AWA-CX2EA393S
27	PD1 detector	AWA-CX2EA391S
28	PD2 detector	AWA-CX2EA392S
29	Optical Filter, 254nm	AWA-CX2OE254
30	Optical Filter, 550nm	AWA-CX2OE550
31	Light Guide	AWA-CX2ME565
32	Cable PD1/ PD2 detector to MUVX	AWA-CX2EA231

Sr. No	Item Description	Item code
33	Flowcell Assembly set consist of quartz disc, Long & short stem	(Depending on analyzer model no)
34	CX2000-3952	AWA_HA102_ME527_ME529-FM
35	CX2000-3932	AWA_HA103_ME527_ME529-FM
36	CX2000-3922	AWA_HA105_ME527_ME529-FM
37	CX2000-3912	AWA_HA110_ME527_ME529-FM
	Flow cell disc set consist of; items as below	
38	CX2-3912: 5*B10 DISC + 1*O-RING SET + 1*SILICON BAG	AWA-OE100-RING_SILBG
39	CX2-3922: 2*B5 DISC+ 3*B10 DISC + 1*O-RING SET + 1*SILICON BAG	AWA-OE104-OE100-RING_SILBG
40	CX2-3932: 2*B3 DISC+ 3*B10 DISC + 1*O-RING SET + 1*SILICON BAG	AWA-OE103-OE100-RING_SILBG
41	CX2-3952: 2*B2 DISC+ 3*B10 DISC + 1*O-RING SET + 1*SILICON BAG	AWA-OE104-OE100-RING_SILBG
42	Flowcell long & short stem	AWA_ME527_ME529_FM
	External system components	
43	8 channel Scanner	FMSCAN-FALCON - MINI24V_I
44	24 V P.S. FOR SCANNER	C4E-SMPS24V420MA
45	RS-485 TO USB CONVERTER	M4E-USB-I485
46	Fan in Panel	C4E-EXFAN4INCH230V

ANNEXURE -1

Process calibration at site with actual process sample:

Our online analyser CX2000 is factory calibrated with the standard solutions for COD and TSS. As per the pollution control board guidelines for OCEMS, both of these parameters require regular process calibration at site for better matrix matching (frequency depends on the sample condition).

For the process calibration, the sample should be given to a neat-equipped laboratory. The same grab sample should be kept for performing sensor calibration in CX2000.

Once you get the lab reading, follow the procedure for calibration in [section 11](#). Calibration on page no. 51.

Once the process calibration is done, CX2000 readings will start matching with the lab readings.

ANNEXURE - 2

MODBUS/RTU PARAMETER MAP:

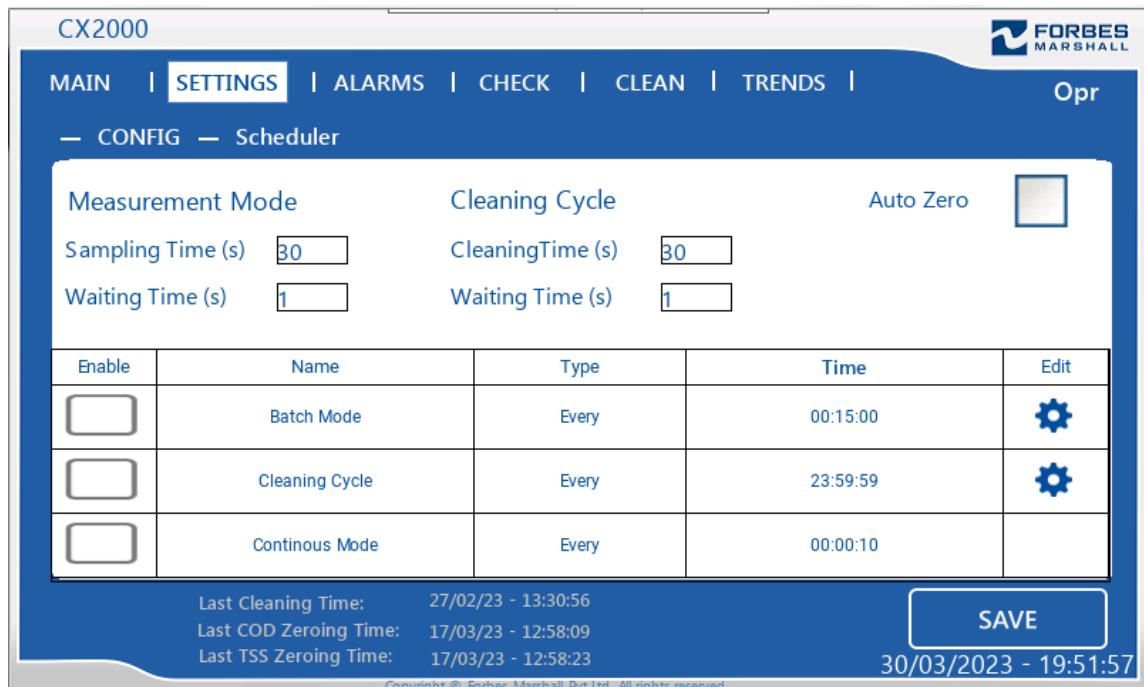
Sr. No.	Parameter Name	MODBUS Register	MODBUS Register	Format	Remark
1	COD_Value	40000	40001	Float	Default unit = mg/l
		40001	40002		
2	BOD_Value	40002	40003	Float	Default unit = mg/l
		40003	40004		
3	TOC_Value	40004	40005	Float	Default unit = mg/l
		40005	40006		
4	TSS_Value	40006	40007	Float	Default unit = mg/l
		40007	40008		
		40011	40012		
5	pH	40008	40009	Float	Default unit = pH
		40009	40010		
6	Temperature	40010	40011	Float	Default unit = °C
		40011	40012		
7	Cleaning Tank Solution Status	40014	40015	Float	OK - 1
		40015	40016		Error - 0
8	Sample Tank Solution Status	40016	40017	Float	OK - 1
		40017	40018		Error - 0

ANNEXURE - 3

Running modes:

Scheduler default screen will be as below for ref.,

- To enable specific mode - Click specific enable window (in the first column), will display 'Tick' (✓) mark inside the window means specific mode is enabled.
- To disable specific mode - Uncheck specific enable window, will display blank window means specific mode is disabled.
- After any change press 'SAVE' button to save the changes.

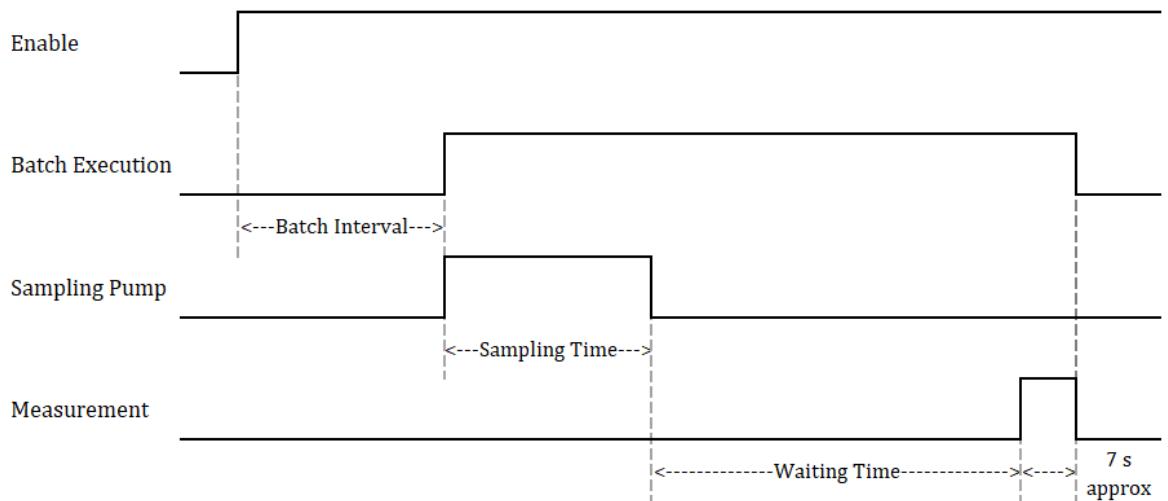


Batch Mode:

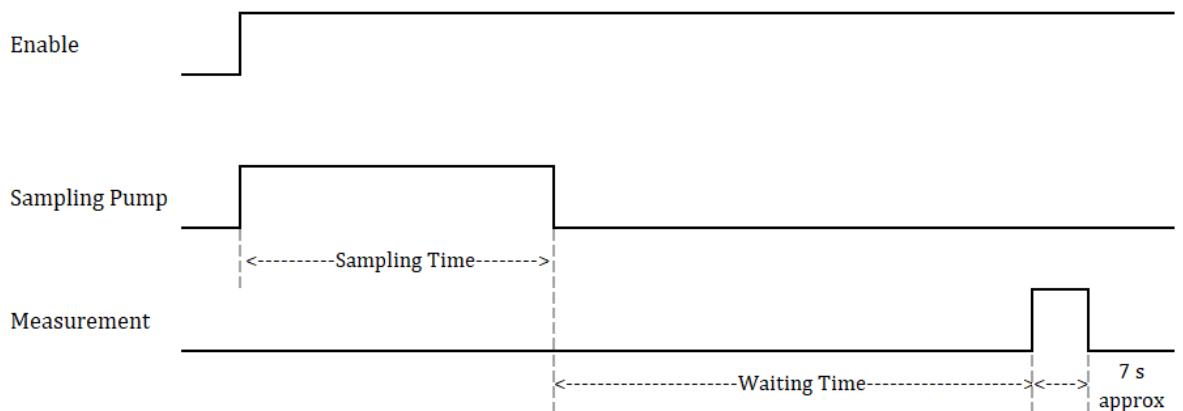
In the Scheduler, the following parameters can be set in this mode:

- Enable / Disable

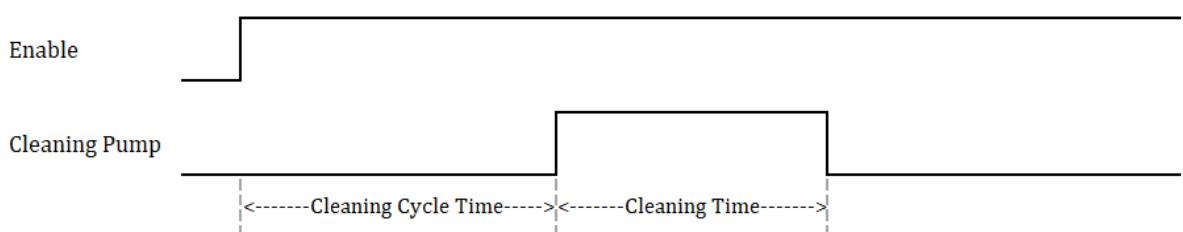
▪ Time (of batch interval)



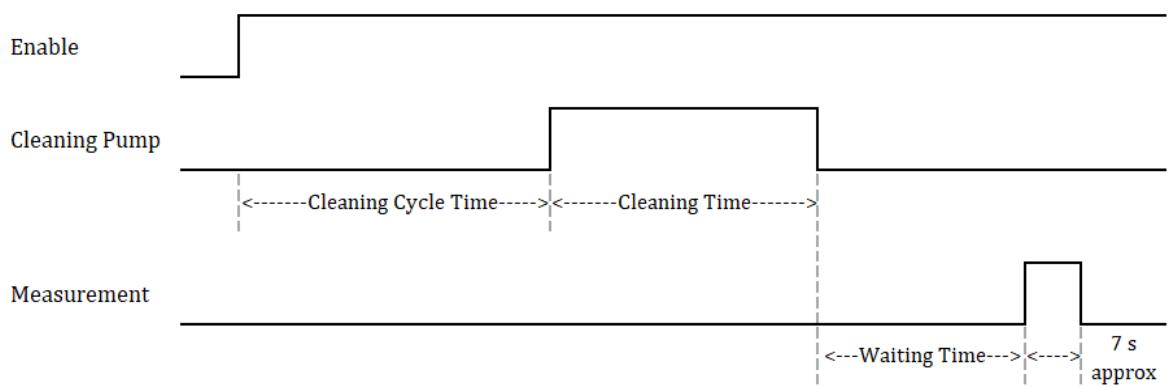
Continuous Mode:



Cleaning Mode with Auto Zero unchecked:



Cleaning Mode with Auto Zero checked (selected):



ANNEXURE - 4

pH versus mV table

pH	mV					
	0°C	20°C	25°C	50°C	80°C	100°C
0	379.4	407.1	414.4	448.8	490.5	518.2
1	325.2	349.0	355.2	384.7	420.5	444.2
2	271.0	290.8	296.0	320.6	350.4	370.2
3	216.8	232.6	236.8	256.5	280.3	296.1
4	162.6	174.5	177.6	192.3	210.3	222.1
5	108.4	116.4	118.4	128.3	140.2	148.1
6	54.20	58.15	59.20	64.10	70.05	74.00
7	0	0	0	0	0	0
8	-54.20	-58.15	-59.20	-64.10	-70.05	-74.00
9	-108.4	-116.4	-118.4	-128.3	-140.2	-148.1
10	-162.6	-174.5	-177.6	-192.3	-210.3	-222.1
11	-216.8	-232.6	-236.8	-256.5	-280.3	-296.1
12	-271.0	-290.8	-296.0	-320.6	-350.4	-370.2
13	-325.2	-349.0	-355.2	-384.7	-420.5	-444.2
14	-379.4	-407.1	-414.4	-448.8	-490.5	-518.2

RTD Table (PT-100/PT-1000)

Temperature °C	Pt100 Ω	Pt1000 Ω	Temperature °C	Pt100 Ω	Pt1000 Ω
-20	92.16	921.6	65	125.16	1251.6
-10	96.09	960.9	70	127.07	1270.7
0	100.00	1000.0	80	130.89	1308.9
5	101.95	1019.5	90	134.70	1347.0
10	103.90	1039.0	100	138.50	1385.0
15	105.85	1058.5	110	142.29	1422.9
20	107.79	1077.9	120	146.06	1460.6
25	109.73	1097.3	130	149.82	1498.2
30	111.67	1116.7	140	153.58	1535.8
35	113.61	1136.1	150	157.31	1573.1
40	115.54	1155.4	160	161.04	1610.4
45	117.47	1174.7	170	164.76	1647.6
50	119.40	1194.0	180	168.46	1684.6
55	121.32	1213.2	190	172.16	1721.6
60	123.24	1232.4	200	175.84	1758.4

ANNEXURE - 5

Flow Cell Cleaning Procedure

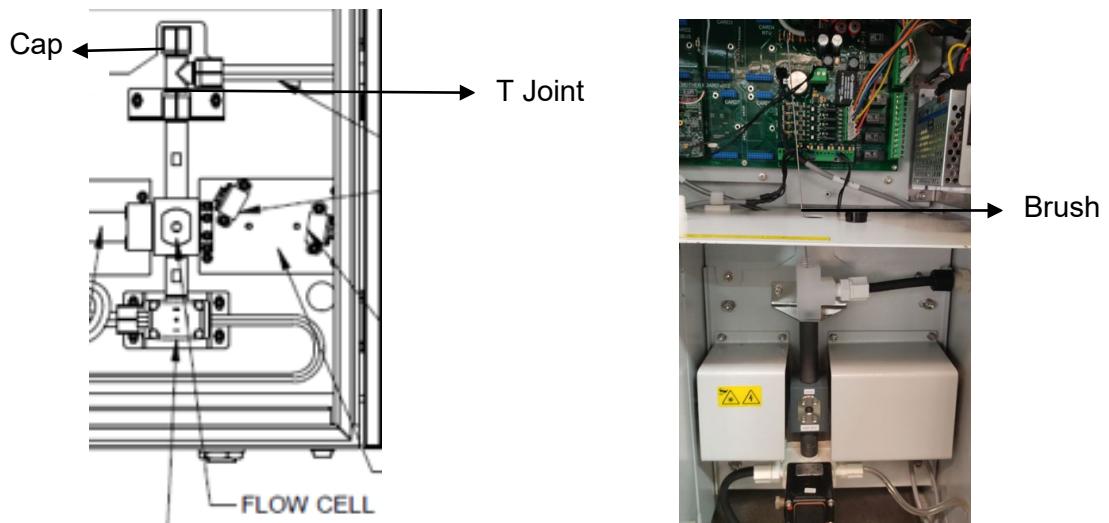
- It is recommended to clean flow cells to remove contamination as per frequency specified, or as per the sample conditions.



- As per the CX2000 models use only recommended brush for the flow cell cleaning.

CX2000 Model	Brush Code
Cleaning brush 3912	C4E-BRUSH-OD13L200
Cleaning brush 3922	C4E-BRUSH-OD08L250

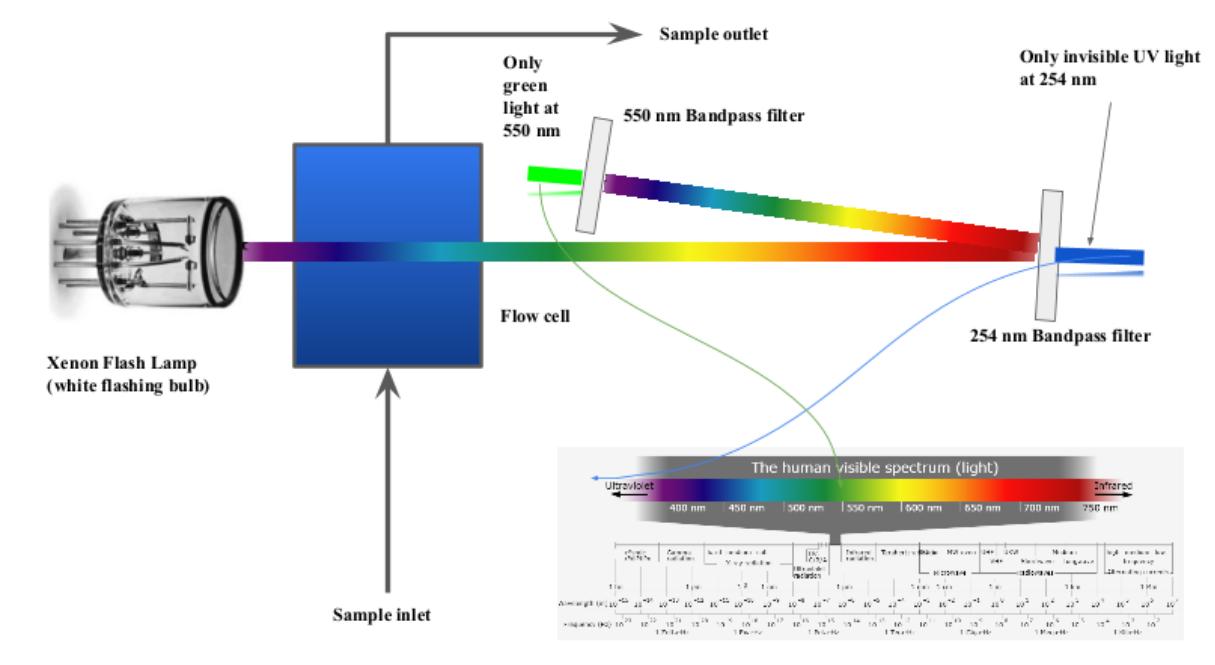
- For remaining CX2000 models recommended cleaning to be done without brush.
- CX2000 model specific brush will be supplied with Analyser, which will be fitted on Internal wall of door of Analyser enclosure.
- Ref. Fig 7 (or part image as below) for Flow cell T joint identification for cleaning.



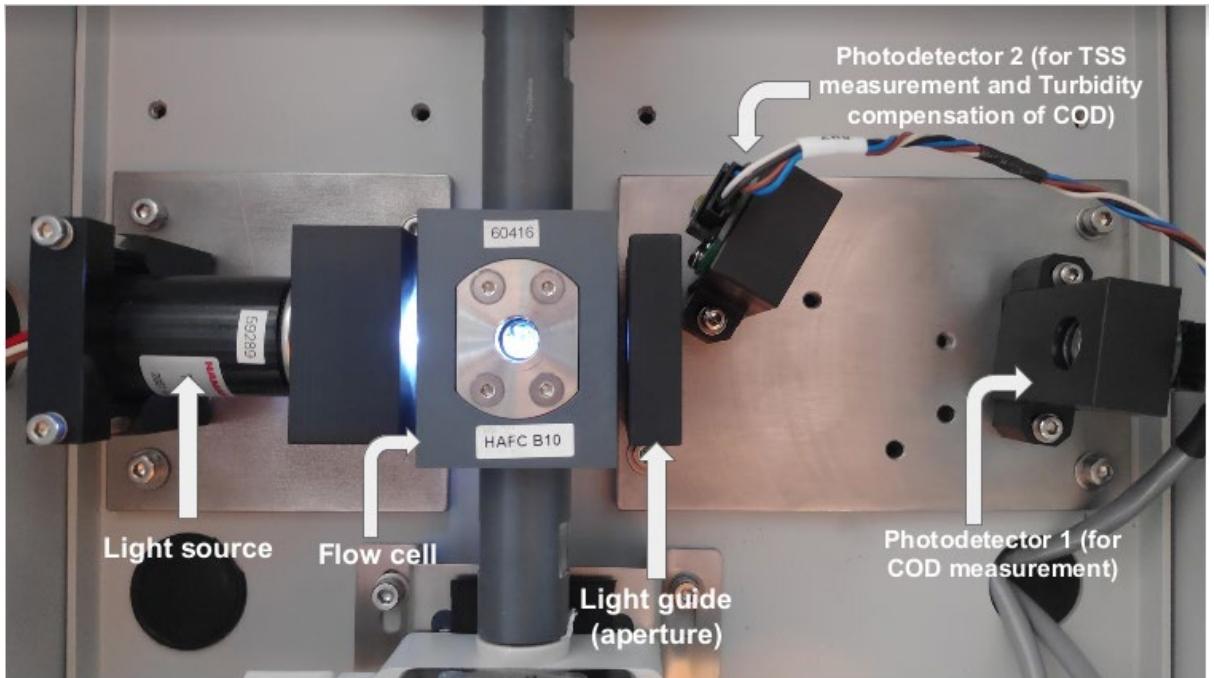
- Flow Cell Cleaning Procedure** as per steps below,
 - Run the cleaning cycle and get the cleaning solution filled in the fluidic path.
 - Switch 'OFF' the analyser mains power supply.
 - Open the flow cell T joint cap carefully.
 - Insert the specific size brush (as recommended as per CX2000 model) inside in the T joint (Ref. CX2000 image as above) and carefully move (up, down, circular) for cleaning the flow cell.
 - Close the flow cell T joint cap carefully.
 - Switch 'ON' the analyser mains power supply.
 - Run Cleaning cycle twice for rinsing fluid path.
 - After completing start the regular operations.

ANNEXURE - 6

CX2000 – Measurement Principle (Ref. Fig. 1) and additional images for ref. are as below.



CX2000 – Optical Assembly View



ANNEXURE - 7

Abbreviations

COD – Chemical oxygen demand

BOD – Biological oxygen demand

TOC – Total organic carbon

TSS – Total Suspended solids

pH – Potential of Hydrogen

PD1 – Photo Detector 1

PD2 - Photo Detector 2

C.F. – Calibration Factor

Sample – Process Sample under test

Config - Configuration

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