User's Manual

Aqua2Trans

Conductivity / TDS

R1, Mar 2025

Forbes Marshall Pvt. Ltd.

B-85, Phase-II, Chakan Industrial Area
Sawardari, Chakan
Tal: Khed, District: Pune
Maharashtra, India - 410501
Tel: +91-21-35393400
Website: www.forbesmarshall.com

Contents

1. 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 Disposal

 It is necessary to dispose this product 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.

2. General information

 This User Manual describes the Aqua2Trans – 2-Wire Conductivity /TDS Transmitter, designed and manufactured by Forbes Marshall Pvt. Ltd. (FMPL).

FMPL reserves the right to make changes to the transmitter specifications, the transmitter and the manual at any time without prior notice.

FMPL is not liable for any direct, indirect or consequential damages resulting from any errors or omissions in this manual.

Safety

Please read this manual completely before proceeding with installation. Pay particular attention to all the caution and danger statements. Employ personnel who are trained to install, connect, power-up and operate the sensors and the transmitter. Install and use the transmitter only in the manner specified in this manual.

No unauthorized modifications to the transmitter are allowed. FMPL accepts no responsibility for damage caused by unauthorized modifications. The risk is borne entirely by the user.

Making electrical connections

Before wiring any high voltage/current cables, make sure that the power is off at the source and that the cables are not live. Connect the power Live, Neutral & Earth ground to the AC power plug. Connect the protective earth cable to the extreme right side Earth screw and use other three Earth screws for terminating the shields of sensors and communication cable. All the terminal connectors are pluggable and should be removed to insert and fasten the wires. Make sure that the routing of the sensor cables till the Transmitter prevents exposure to high Electromagnetic fields (e.g. Transmitters, motors and switching equipment). Exposure to these fields can cause inaccurate results.

Hazard info

 This indicates that a high risk of electrocution exists and will result in death if due care is not taken.

 This indicates that a high risk of electrical shock exists and could result in death or serious injury if due care is not taken.

 This indicates the presence of electrical potential and could result in serious injury if due care is not taken.

 This indicates that a certain action is prohibited. The user must take precaution to prevent damage to the transmitter, degradation in the transmitter's performance and/or injury to self.

 This indicates that the user must disconnect mains power to the transmitter before performing further actions.

Other info

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

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

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

Removal of transmitter from service

- Disconnect the cable wiring from the transmitter terminals.
- Remove the transmitter from the mounting hardware.

3. Overview

Aqua2Trans is a HART© compatible Microcontroller based two wire Conductivity /TDS Transmitter that accepts process sensor inputs and displays the measured values and transmits it in terms of 4-20mA (Loop Powered) HART© output.

This transmitter is capable of measuring Conductivity/ TDS and temperature. Thus Conductivity / TDS sensor in combination with temperature sensor can be used as process sensors. The measurement results are displayed on LCD display.

For Conductivity /TDS automatic temperature compensation through PT100 or PT1000 sensors is provided.

The transmitter has rugged, weatherproof housing. The enclosure meets IP66 Protection.

The output of this transmitter is fully scalable over the total range of sensor. During fault conditions the current output can be programmed for None or 3.55mA or 22mA as per need.

It communicates via HART with external devices.

Sensor inputs

Aqua2Trans accepts only one Conductivity/ TDS sensor connected at a time.

Analog outputs

Aqua2Trans drives one active 4-20 mA current output. Output is freely assignable to any of the fault conditions the output can be programmed None or 3.55mA or 22mA as per need.

User interface

Aqua2Trans has a large 128x 64 Pixels dots with FSTN mode graphical LCD display panel, minimal number of keys and an easy-to-understand menu structure, making it simple to operate.

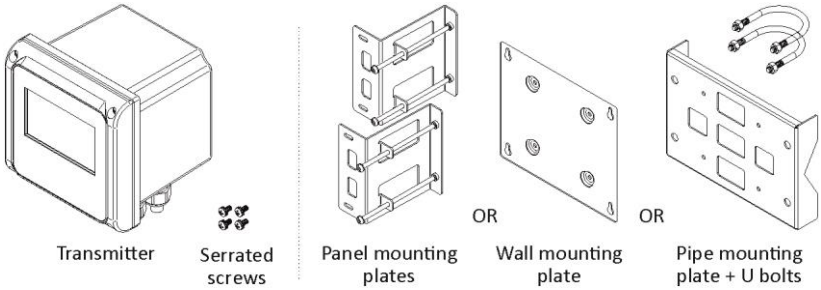
Mounting

Aqua2Trans is housed in an IP66-rated enclosure. Depending on the installation requirement it can be panel-mounted, wall-mounted or pipe-mounted using the accessories provided.

4. Installation

After unpacking

Confirm that you have received the Transmitter with attached Cable Glands and one of the mounting accessories as ordered by you.



Inspect all parts for any visible in-transit damage. Report any missing or damaged items immediately to FMPL support.

Tools required

Screw drivers

- Standard Phillips tip for M3 | M4 screws: enclosure lid, mounting and Earth connections
- Standard flat tip 0.4x1.6 to 04.x2.5 mm blade: terminal connectors

Side spanners

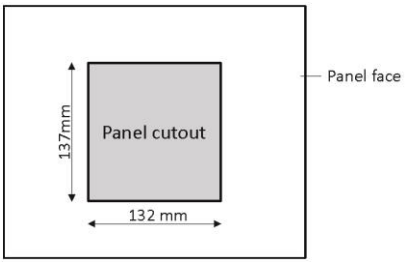
- Size 24: cable glands
- M8 spanner size 13: U-bolt hex nuts

Additional tools/ Items required while installation.

- Multimeter 3 ½ digit
- Conductivity /TDS Std. Solutions NOTE1 for sensor calibration

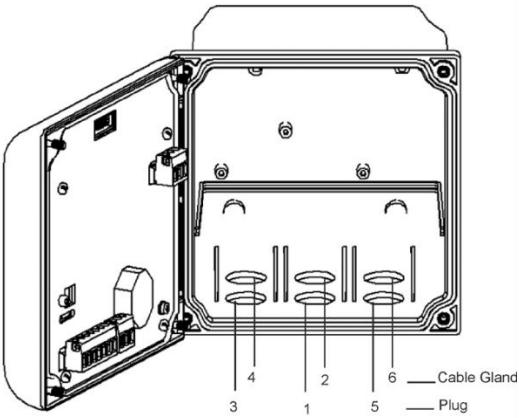
NOTE1 To be arranged by the purchaser

Panel cut-out



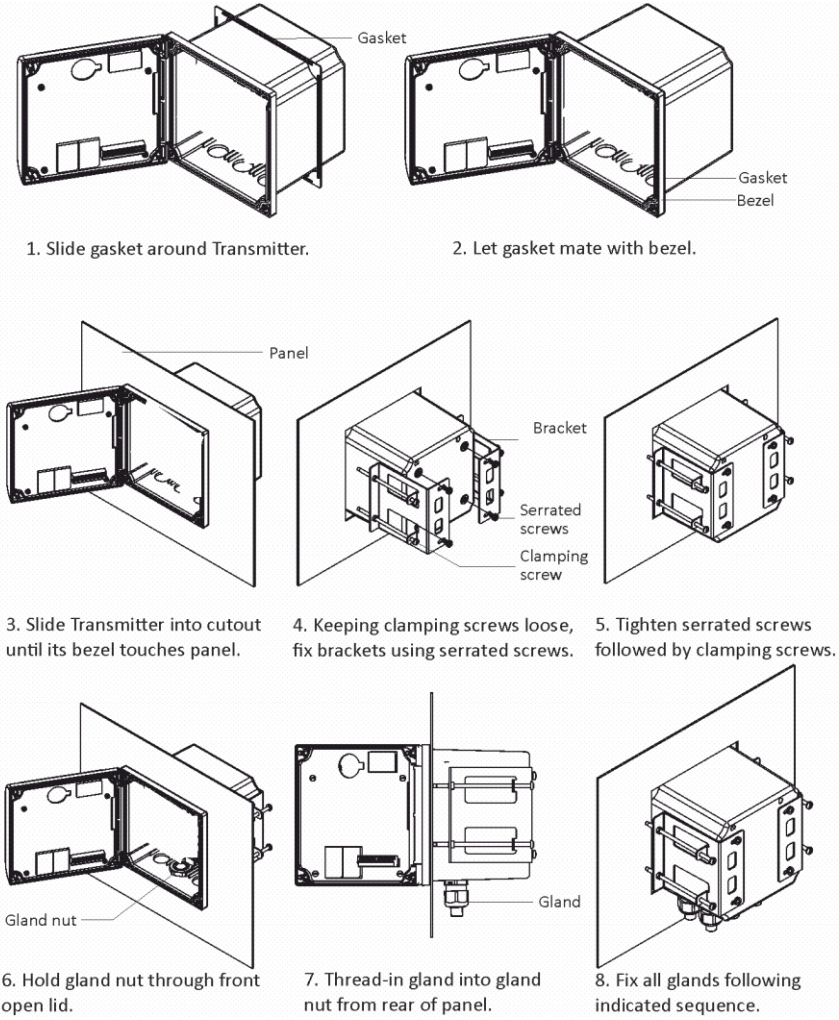
Cable gland sequence

Ensure that the mounting face of the panel has a cut-out as stated in the Specifications. Once mounted onto the panel, follow the sequence shown below when fixing the cable glands.

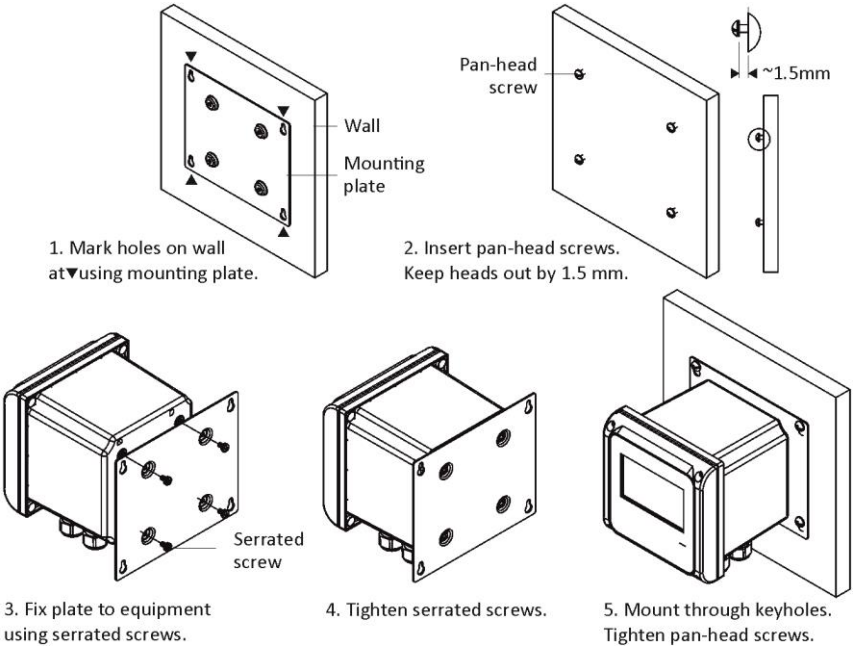


Cable Gland & Plug Fixing sequence

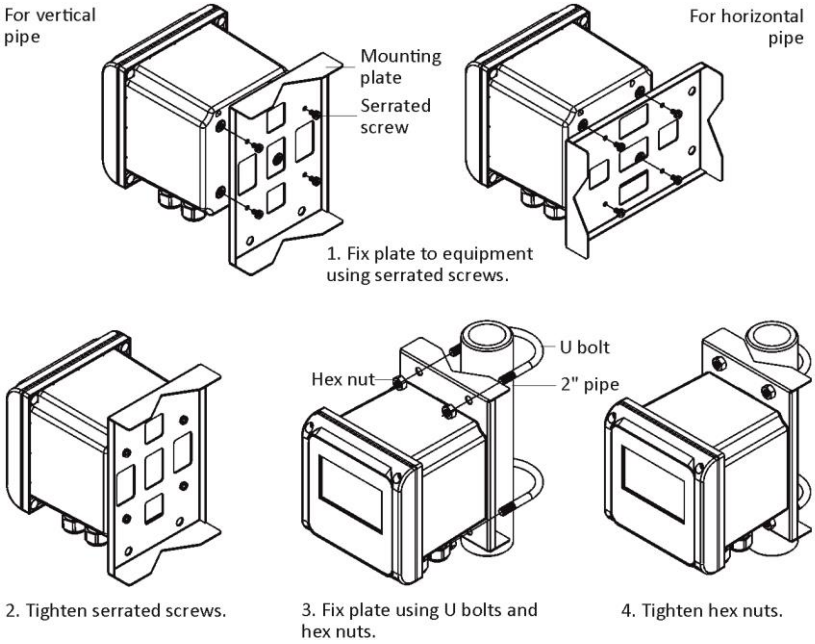
Panel Mounting



Wall mounting



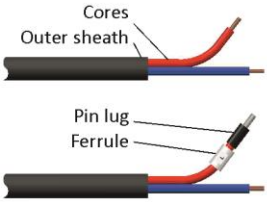
Pipe mounting



5. Electrical connections

Recommended cable preparation practices

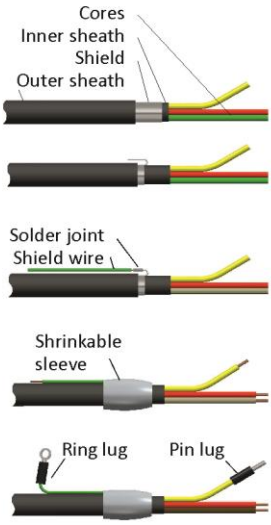
Unshielded cables



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

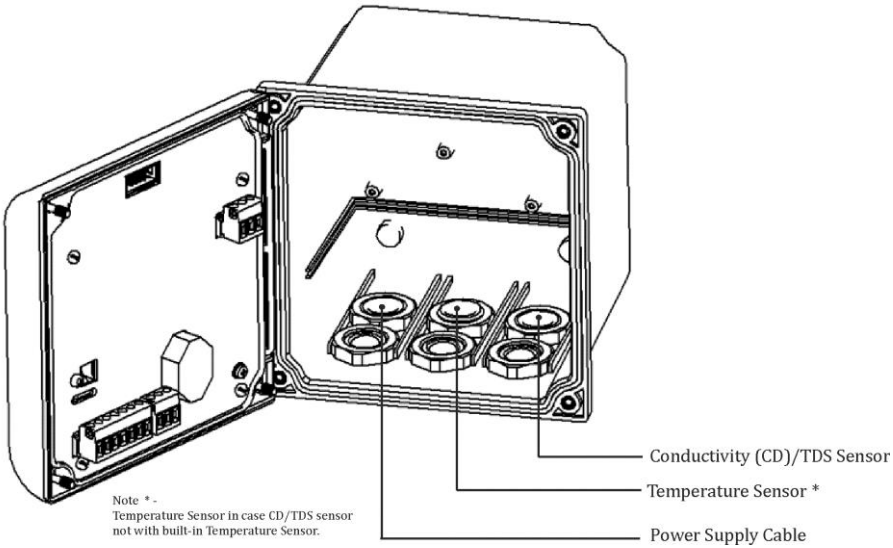
Separate out the shield braid
Tie together the shield strands
Fold backwards

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

Cable gland allocation



Run the prepared cables through the indicated cable glands. Detach the plug from its module. Insert and connect the respective wires according to the termination chart. Plug in. Pull back any extra cable length within the Transmitter and tighten the cable gland nuts.

Power Supply Cabling and Wiring;

Supply cable wires should be clearly marked/color coded for +24V and ground to avoid polarity reversal.

It is mandatory to connect the Earth terminal to the nearest earth pit ensuring proper connectivity.

If conduit is used, Ensure the conduit end is properly terminated in cable gland on transmitter side.

The cable used for 24V supply to transmitter should be routed through cable gland.

The Supply cable should be routed away from the Power cabling.

Use proper size of lug suitable for 0.5 to 1 sq mm wire with length of 0.6 ~ 0.8 mm for terminations on transmitter side.

The Aqua2Trans works on wide range of supply voltage from 12VDC to 36VDC. The supply voltage at the transmitter input terminals must be at least 12VDC. The power supply should be capable of taking the loads (minimum 250 Ohms for HART©) and the cable resistance.

For HART© communication the minimum load resistance of 250 Ohms is a must. To supply 12VDC at Transmitter end the power supply voltage must be at least 17.5VDC.

The power supply should be capable of supplying the surge current at start up.

For Hazardous area (Ex proof) applications ref. EX Supplementary manual supplied with transmitter for safety precautions and wiring reference.

(Note – Use P&F make KFD2-STC5-EX1 zener barrier for power supply protection.)

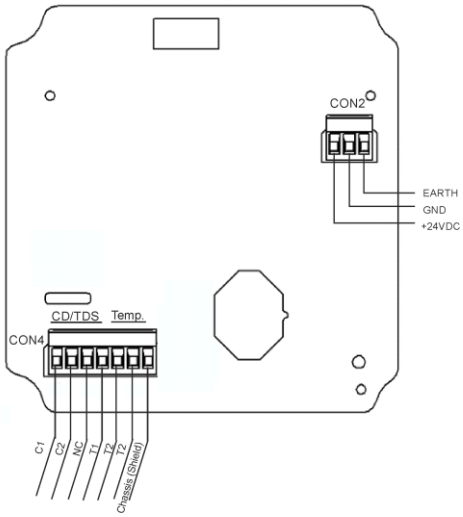

Terminate the shields of the various signal cables onto the Chassis Screws using ring type crimp lugs.

Sensor connections

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 sensor module, and the shield to the chassis screws within the transmitter.


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

Conductivity sensors



CON4:

1: C1

2: C2

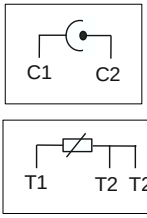
3: NC

4: T1

5: T2

6: T2

7: Chassis – Shield



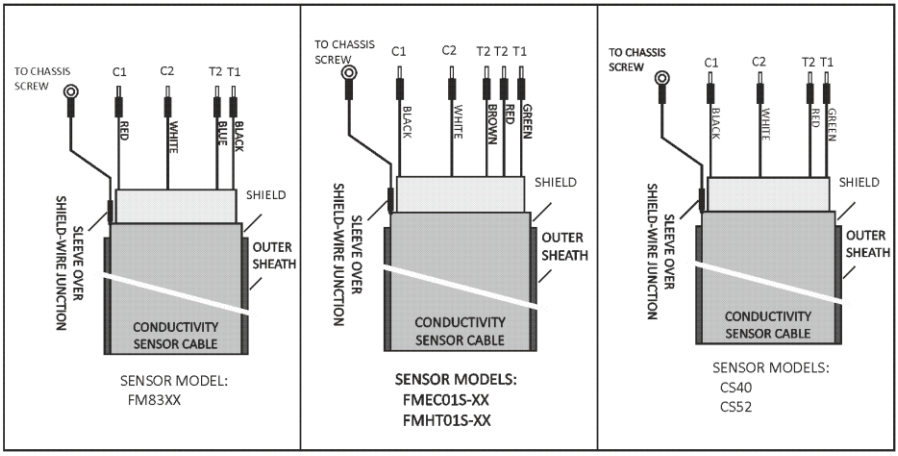
CON2:

+24VDC

GND

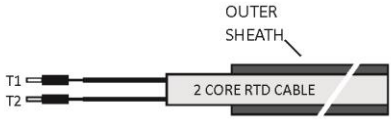
Earth (pit earth)

Refer Sensor Models as below with different colour codes for sensor connections:



Temperature sensor (2 –wire Pt100/Pt1000)

Not applicable if using conductivity sensor with inbuilt temperature sensing element. It is necessary to use the temperature sensor for auto compensation of the measured conductivity value. A typical cable for the RTD sensor is shown below.



The temperature input is used during conductivity sensor calibration with a standard solution. Insert the temperature sensor also into the solution when calibrating the conductivity sensor.

Terminating lugs

Use pin type lugs suitable for 0.5-1.0 mm^2 conductor with pin length of 6-8 mm.

Conductivity / TDS sensor connection details

Electrode	Conductivity /TDS Sensor		Temperature Sensor		
	C1	C2	PT1 -T 1	PT2 – T2	PT3 – T2
FM83XX Series	RED	WHITE	BLACK	BLUE	
FMEC015XX / FMHT015XX Series	BLACK	WHITE	GREEN	RED	BROWN
CS40/42/52 Series	BLACK	WHITE	GREEN	RED	

6. The First Power-up

Checks before power-up

Unscrew and hinge-open the Transmitter's lid.

Check and confirm that

- only the specified sensor has been connected
- the required wiring has been correctly done
- no wires are loose
- protective plate is installed
- all the connectors have been properly plugged into their receptacles
- all shields have been firmly connected to the chassis screws

Close and fasten the Transmitter's lid.

Powering up

Switch on the mains power. The display momentarily shows the sign-on screen followed by a default runtime screen. Read the section User Interface for details.

Quick start: putting into operation

The Transmitter is normally dispatched pre-configured with required settings, if you have provided these when ordering.

Use the ▲ key to scroll through the Runtime screens. These show the measured parameter values (primary and secondary variables), the current output values and the relay status on consecutive screens.

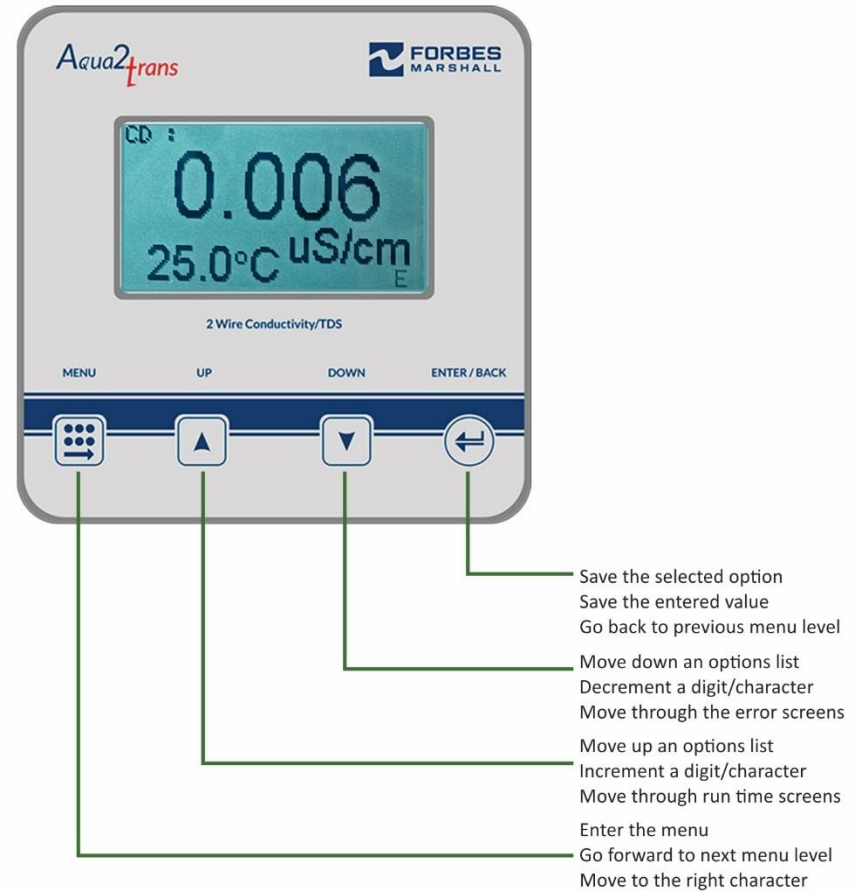

Note that the values and status displayed will be in line with the actual conditions of the process at that time. At this point in time, you might observe a difference between the displayed and expected values as the transmitter has not yet been calibrated along with the connected sensors.


In case the required settings have not been provided when ordering, the Transmitter is configured to default values; see the section Default Settings. Please read the sections Menu and Configuration and perform the required settings.

7. User Interface

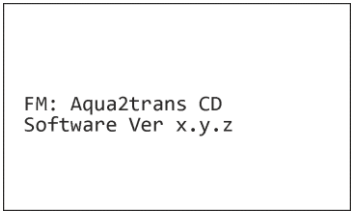
Aqua2Trans has a large backlit alphanumeric display panel, four tactile keys and an easy to understand menu structure, making it simple to operate.

Set the runtime screen to display the data of either both the channels simultaneously or single channel at a time, values of current outputs.

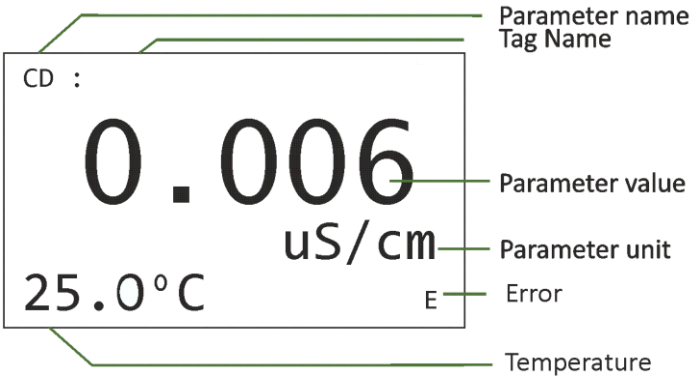


Runtime screens

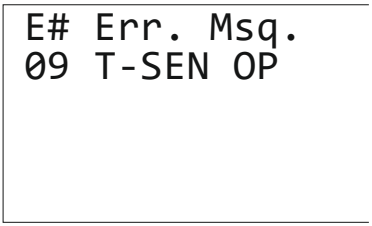
At power up, Aqua2Trans initially displays the FM logo, version details, and date and time.



After few seconds, it displays that runtime screen as previously configured.



Use the key to scroll through the runtime Error screens shown below.



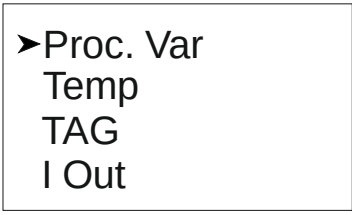
8. Menu: overview

Type of menu screens

The menu screens have different formats, illustrated as examples below.

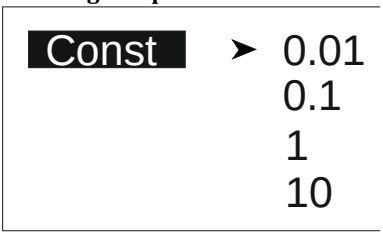
Main menu list

Sub menu list level 1

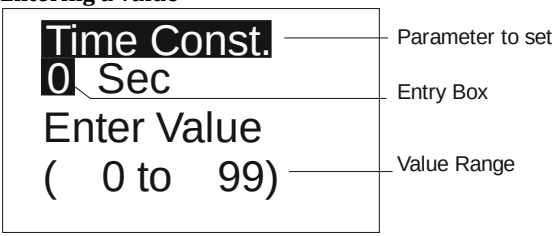


Sub menu list Level 2

Selecting an option

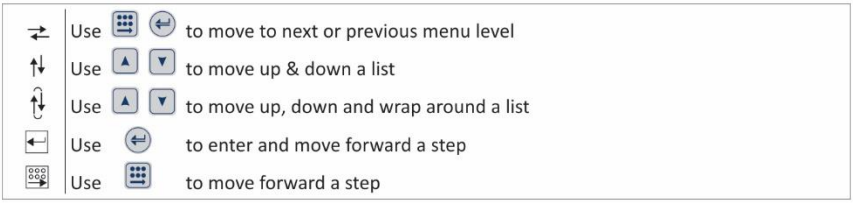


Entering a value



Navigating the menu

Use the four keys to navigate the menu. For simplicity, these keys have been represented with compact icons in the flow charts, as shown below.



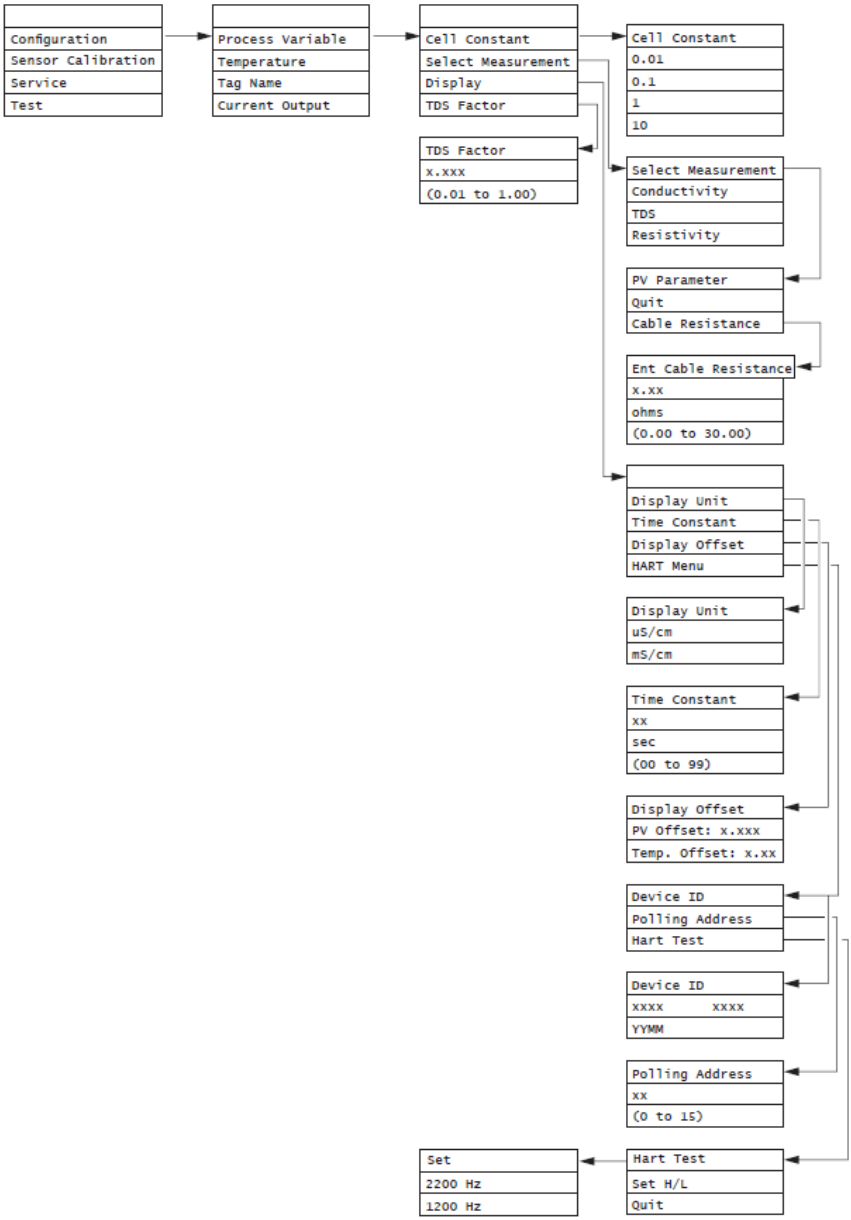
9. Configuration menu

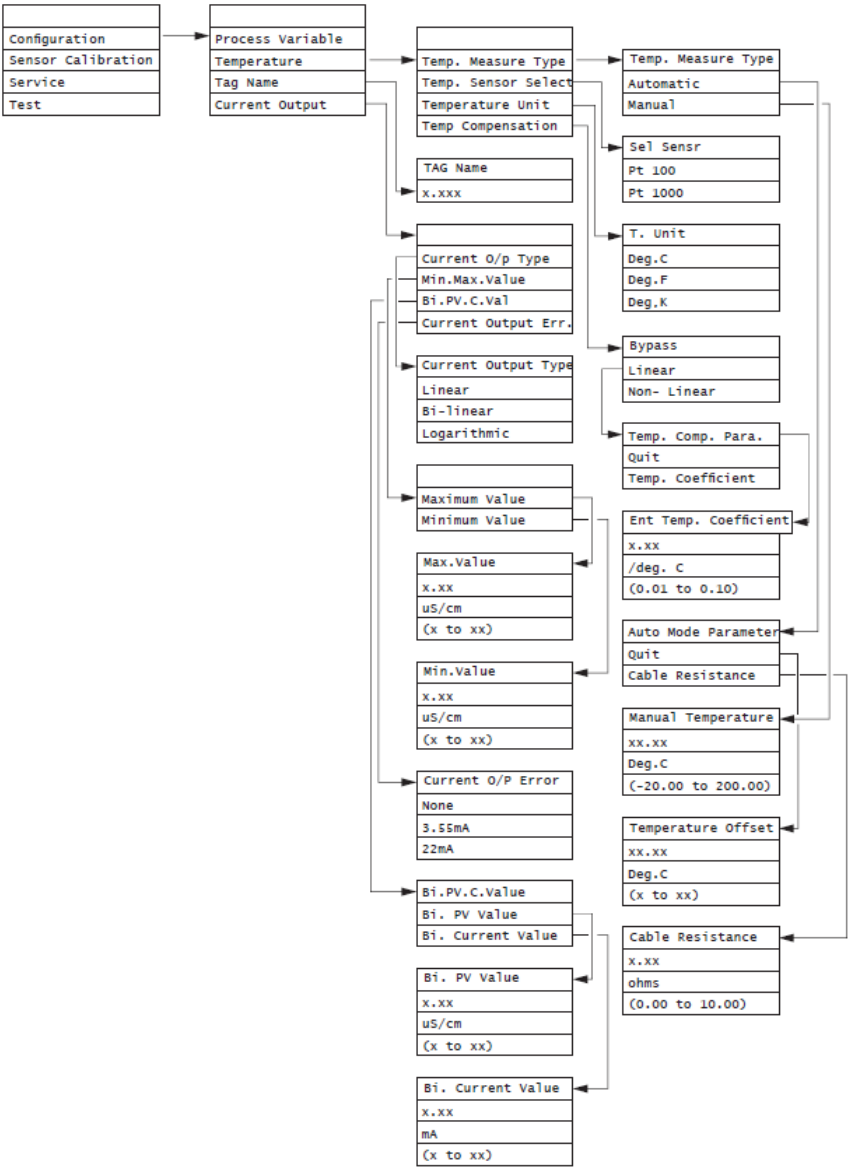
Use this menu to configure various parameters related to the

- Sensor inputs of channels A and B depending on the module type inserted
- Four current outputs
- Date and time

Refer to the following sections for details.

Top level


Configuration
Sensor Calibration
Service
Test
Process Variable
Temperature
Tag Name
Current Output
Cell Constant
Select Measurement
Display
TDS Factor
Cell Constant
0.01
0.1
1
10
TDS Factor
x.xxx
(0.01 to 1.00)
Select Measurement
Conductivity
TDS
Resistivity
PV Parameter
Quit
Cable Resistance
Ent Cable Resistance
x.xx
ohms
(0.00 to 30.00)
Display Unit
Time Constant
Display Offset
HART Menu
Display Unit
uS/cm
mS/cm
Time Constant
xx
sec
(00 to 99)
Display Offset
PV Offset: x.xxx
Temp. Offset: x.xx
Device ID
Polling Address
Hart Test
Device ID
xxxx xxxx
YYMM
Polling Address
xx
(0 to 15)
Hart Test
Set H/L
Quit
Set
2200 Hz
1200 Hz

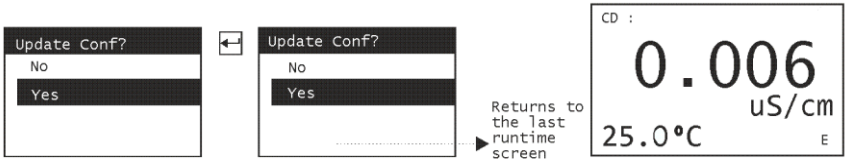


Configuration: Current Output

Assign Current Output to either error which is a parked value – None or 22mA or 3.55mA.

Update Configuration

If you have modified any of the configuration parameters, you will be prompted with the following question before exiting the menu to runtime screen. Select 'Yes' or 'No' appropriately.



10. HART© communication configurations

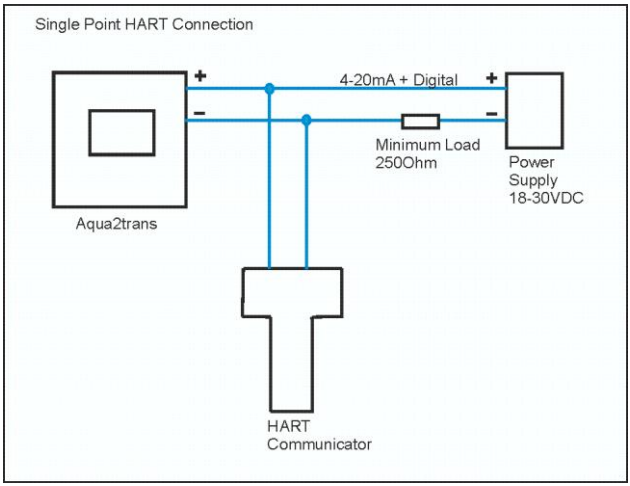
The Aqua2trans is equipped with HART© communication.

The transmitter can be used in multi drop configuration or as a Single HART© instrument.

Following configuration is used to set the Aqua2trans.

Connect the HART© communicator to terminals to configure /monitor the transmitter parameters.

Single point configuration is shown below. This configuration is used to set and check the transmitters locally.

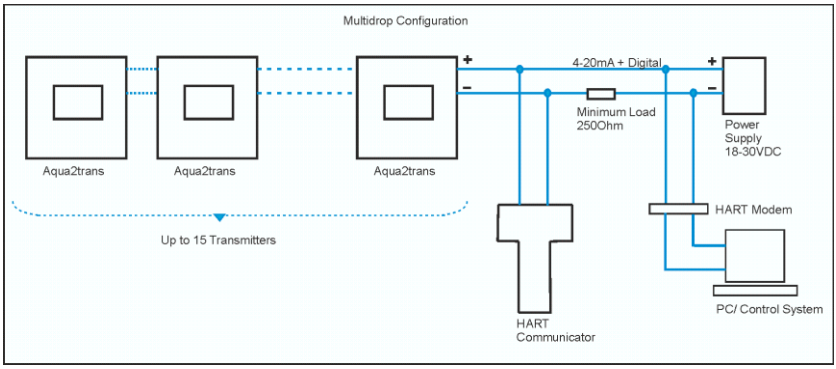


Note – For HART Commands - Refer Annexure 'HART Commands'

Multipoint configuration is shown below.

This configuration is used to set and check up to 15 transmitters.
The cables carry only digital signals, The loop current is set to 4mA.

Monitoring data is available on control system/ PC as shown.

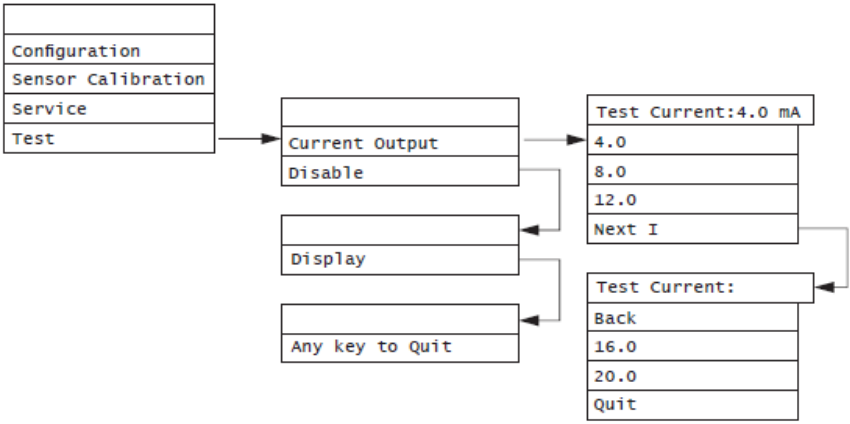


Note – For HART Commands - Refer Annexure 'HART Commands'

11. Test menu

Use this menu to test the hardware as follows -

- Current output: Connect a DMM on 200mA DC range across the respective outputs. Force either of 4/8/12/16/20 mA and confirm against the value indicated on the DMM. Quit the test mode.
- Display : This tests LCD Display. Each digit of LCD Display will get ON then OFF – total 6 times and then asks for hit any key to return to test menu and enter key for further back.



12. Calibration menu

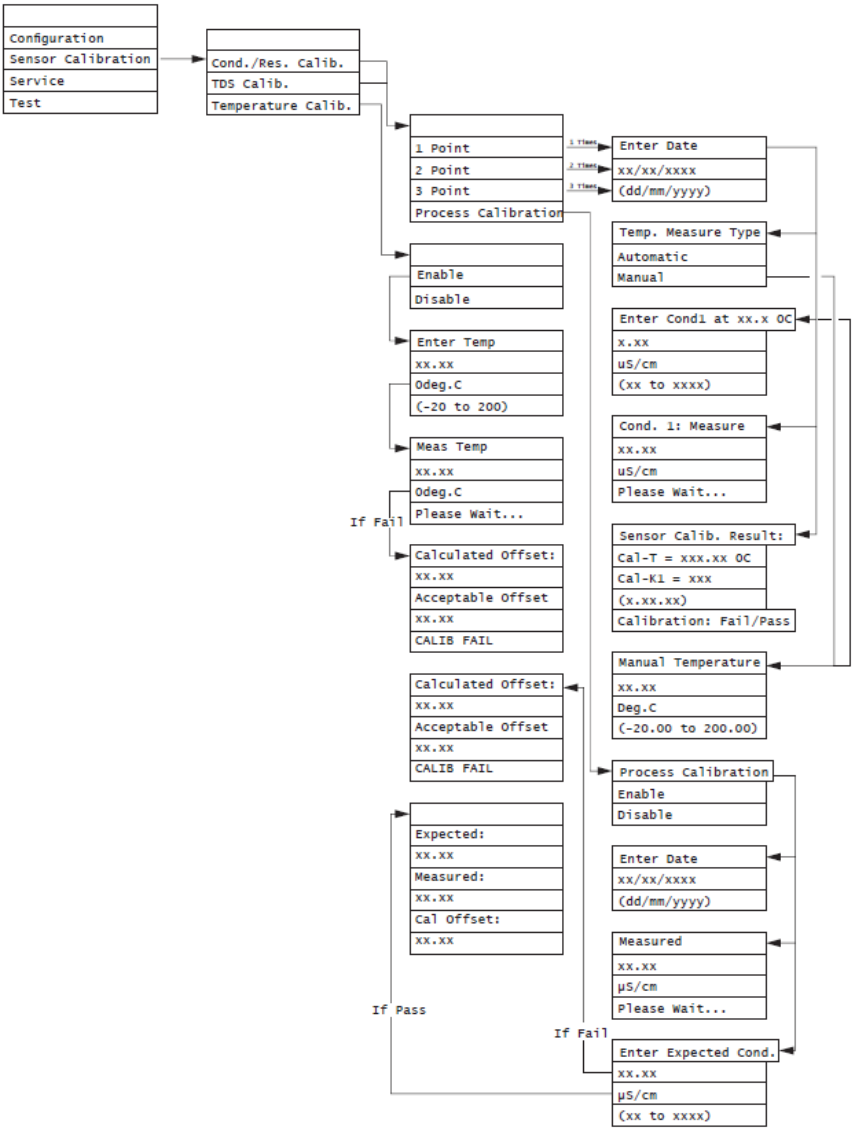
Calibration: Conductivity/ TDS

Select between 1/2/3 Point calibration and keep the corresponding standard solutions ready. If you have enabled temperature compensation, ensure that under Configuration you have either.

- Set the temperature measurement to Manual and also set the required temperature value OR
- Set the temperature measurement to Auto and the temperature sensor is functional.

Immerse the Conductivity / TDS sensor and the temperature sensor (if not inbuilt with the Conductivity / TDS sensor) into the buffer solution.

Depending on the number of points selected complete the calibration as prompted on the display.


Configuration
Sensor Calibration
Service
Test
Cond./Res. Calib.
TDS Calib.
Temperature Calib.
1 Point
2 Point
3 Point
Process Calibration
1 Times
2 Times
3 Times
Enter Date
xx/xx/xxxx
(dd/mm/yyyy)
Temp. Measure Type
Automatic
Manual
Enable
Disable
Enter Cond1 at xx.x 0C
x.xx
uS/cm
(xx to xxxx)
Enter Temp
xx.xx
0deg.C
(-20 to 200)
Cond. 1: Measure
xx.xx
uS/cm
Please Wait...
Meas Temp
xx.xx
0deg.C
Please Wait...
If Fail
Sensor Calib. Result:
Cal-T = xxx.xx 0C
Cal-K1 = xxx
(x.xx.xx)
Calibration: Fail/Pass
Calculated Offset:
xx.xx
Acceptable Offset
xx.xx
CALIB FAIL
Manual Temperature
xx.xx
Deg.C
(-20.00 to 200.00)
Calculated Offset:
xx.xx
Acceptable Offset
xx.xx
CALIB FAIL
Process Calibration
Enable
Disable
Enter Date
xx/xx/xxxx
(dd/mm/yyyy)
Expected:
xx.xx
Measured:
xx.xx
Cal Offset:
xx.xx
Measured
xx.xx
µS/cm
Please Wait...
If Pass
If Fail
Enter Expected Cond.
xx.xx
µS/cm
(xx to xxxx)

13. Maintenance & troubleshooting: conductivity

Sensor care

Conductivity sensors require maintenance at regular intervals. The interval – typically between 1 and 3 months - is decided by the user depending on the process fluid and conditions.

 Please check for useful tips on sensor care if provided in the sensor instruction manual.

Cleaning the sensor

Clean the sensor electrode with isopropyl alcohol IPA and allow it to dry completely before use.

 In case of heavy deposits, keep immersed in IPA overnight, before use. It is recommended to clean the sensor electrode before each sensor calibration.

Storing a new sensor for long time

While no special care is required for a conductivity sensor, store it in its original packing and in a dry area, avoiding extreme temperature and climatic conditions.

Storing a sensor after use

Remove the sensor from the process and allow it to dry completely. In case of any surface deposits, clean the sensor electrode with IPA before storing.

 In case of heavy deposits, keep immersed in IPA overnight, before storing.

Do's and Don'ts for sensor

Read the instruction manual provided if any with the sensor.

Before putting the sensor to use, remove any special transportation cover wrapped over it during transportation.

Clean the sensor electrode under low pressure running water or any cleaning solution recommended in the sensor instruction manual.

Always calibrate the transmitter along with the sensor as a system. If you change/replace either the transmitter or the sensor, recalibrate as a system.

 Calibrate the sensor at planned regular intervals.

Error messages

The Aqua2Trans issues messages on the display. User can identify the possible causes of the problems and take corrective actions. The error messages and their meanings are given below.

Error message	Action
PV-SENSOR FAIL	Check the sensor wires for open or loose connections. Reconnect the wires and check.
	Check the sensor wires for short. If short, replace the sensor.
	Disconnect the cable from the sensor. Check the resistance across the sensor terminals. It should show open. If it shows a low resistance or a short, remove the sensor from the process, clean, dry, and check again. If problem persists, replace the sensor.
T-SENSOR OPEN	Check the temperature sensor wires for open or loose connection. Reconnect the wires and check.
	Disconnect the sensor. Check the resistance of the RTD element. It should be: 109.73Ω at 25°C for PT100 1097.3Ω at 25°C for PT1000 If open, replace the sensor.
T-SENSOR SHORT	Check the temperature sensor wires for a short.
	Disconnect the sensor. Check the resistance of the RTD element. It should be: 109.73Ω at 25°C for PT100 1097.3Ω at 25°C for PT1000 If short, replace the sensor.

Note: For conductivity sensors with an inbuilt temperature sensor, replace the complete sensor.

Problems, causes and solutions

Problem	Cause	Solution
Incorrect conductivity value	Sensor not calibrated for long time.	Recalibrate the sensor.
	Sensor mechanically damaged.	Replace the sensor.
	Process fluid is dirty.	Clean the sensor as described earlier.
	Sensor improperly dipped into the process fluid.	Ensure that the fluid covers the sensor electrode completely.
	Electrical noise pickup.	Follow proper grounding and shielding procedures described earlier.

Problem in temperature measurement and calibration

Indicated temperature differs from that of a standard thermometer by more than ±1°C.

Check the following:

- Confirm that the standard thermometer, RTD, thermistor that is used as a reference is calibrated and is accurate.
- General purpose liquid in glass thermometers can have large errors.
- Are the measurements done at the same point?
- Is the standard thermometer dipped into the process up to the right level?

 It is necessary to calibrate the temperature sensor during installation and calibration.

Conductivity reading differs from lab reading

It is normal to see differences in the readings indicated by online instruments and the lab instruments.

This phenomenon is further amplified when measuring ultra pure of conductivity less than 10µS/cm. In practise the two will never match in this application.

The online instrument is subjected to the real process conditions of process temperature, stray voltages, pressure, supply voltage variations, etc.

The lab instrument works under standard controlled conditions. Some impurities are added, the temperature of the lab sample changes and such factors cause the differences to be observed.

How to minimize this difference?

Check both – the online and lab instruments by using the same buffer solution and comparing their readings.

If the difference is vast, calibrate both the instruments using the same standard solution.

Ensure that both the instruments use cell with the same cell constant; different cell constants exhibit different accuracy levels.

 Use single point calibration method to compare the two readings.

Is the transmitter working satisfactorily?

In case of problems that cannot be easily and confidently attributed to either the sensor or the transmitter, it is necessary to isolate the problem areas.

Simulate the conductivity input

Disconnect the conductivity sensor wires from the transmitter end. Connect standard resistance such as a standard resistance box to the transmitter. If the transmitter is healthy, it will indicate accurate conductivity values. Follow the procedure below.

i. Turn off the transmitter supply. Disconnect the sensor wires from the transmitter end.
ii. Connect the box to the conductivity inputs.

iii. Turn on the transmitter. Turn off auto temperature compensation and set to 25°C manually.
iv. Simulate conductivity using the box and check results.
v. Note down the cell constant and then set the cell constant as '1.0' via the menu.
vi. Save and exit the menu.
vii. Check the readings as per the table below. These must be within ±0.5%.

Resistance	Reading	Resistance	Reading
1MΩ	1.00 µS/cm	100kΩ	10.00 µS/cm
500kΩ	2.00 µS/cm	50kΩ	20.00 µS/cm
250kΩ	4.00 µS/cm	25kΩ	40.00 µS/cm
125kΩ	8.00 µS/cm	10kΩ	80.00 µS/cm

viii. If the readings are okay, clean and recalibrate the sensor.
ix. You can re-enter the cell constant noted down earlier.
x. Reconnect the sensor wires and continue normal operation.

Simulate temperature input

Disconnect the temperature sensor wires from the transmitter end. Connect standard resistance such as a standard resistance box to the transmitter. If the transmitter is healthy, it will indicate accurate temperature values. Follow the procedure below.

i. Turn off the transmitter supply. Disconnect the sensor wires from the transmitter end.
ii. Connect the box to the conductivity inputs.
iii. Turn on the transmitter.
iv. In case of Pt100 sensor, feed 109.73Ω from the box. (1097.3Ω in case of Pt1000)
v. The secondary display will show 25.0°C. Repeat this for different values of input resistance values.
vi. The indicated temperature may not match the standard RTD table values. This is due to the offset added/subtracted when the temperature sensor was calibrated.
vii. The same offset gets applied when the input is simulated. The transmitter is measuring temperature correctly if the difference between the two table readings and the same two transmitter readings is within ±0.5°C.
viii. For example, if an offset of 2°C is added during calibration, the transmitter will read the value of 115.54 as 40°C, but display it as 42°C.
ix. Refer annexure for RTD table.

Problems, causes and solutions

Problem in temperature measurement and calibration

Indicated temperature differs from that of a standard thermometer by more than ±1°C.

Check the following:

- Confirm that the standard thermometer, RTD, thermistor that is used as a reference is calibrated and is accurate.
- General purpose liquid in glass thermometers can have large errors.
- Are the measurements done at the same point?
- Is the standard thermometer dipped into the process up to the right level?

 It is necessary to calibrate the temperature sensor during installation and calibration.

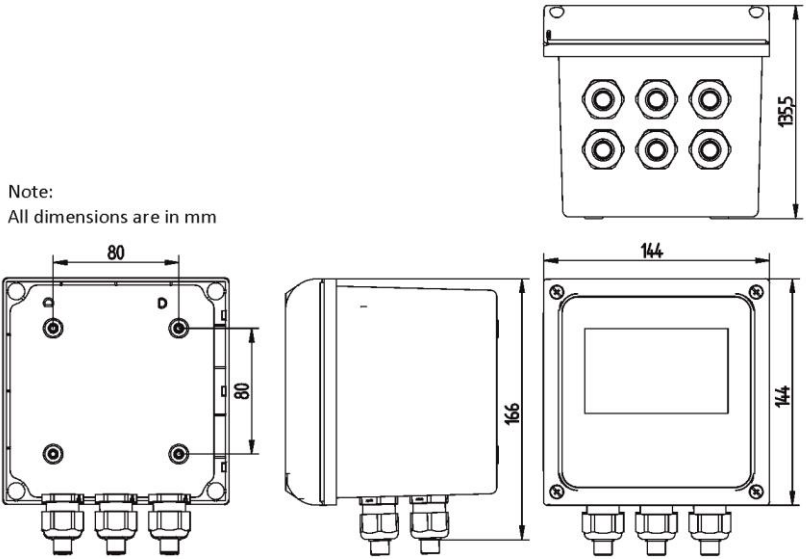
Simulate temperature input

Refer to the related procedure described under the section 'Maintenance and troubleshooting: Conductivity'.

14. Technical specifications

General specifications

Feature	Details
Power Supply and Currrent Output	
Power Supply	12 ~ 36VDC, 18~30VDC for Ex (For HART® Ref. Image on page 27, 28)
Load Resistance	600 Ω @ 24VDC
mA Output	4 ~ 20mA HART® compatible
mA Accuracy	± 0.1mA
mA Format	Linear / Bilinear / Log
Error options	3.55mA DC / 22mA DC / NONE
Isolation	Galvanic isolation from the Sensor and Input
Temperature	
Sensors	Pt100 / Pt1000
Range	-20 ~ 200°C
Mode	Auto / Manual
Accuracy	± 0.5% FS
Display and keypad	
Display	128 x 64 Dot Matrix Liquid Crystal
Display function	Programmable for continuous or sequent
Keypad	Four tactile type keys Menu, Up, Down, Enter/Esc
Mode of operation	Linear, Bi-linear or Logarithmic.
Mechanical Specifications	
Housing material	Polycarbonate, 10% Glass filled.
Colour	Exterior - Satin Silver, Interior – Conductive Paint.
Dimensions	144(H) x 144(W) x 135.5(D) mm
Connections glands	M20x1.5 – 3 nos. (for Power Supply, Sensor, Temperature)
Weight	1.2kg approximately
Mounting type options	Panel / Wall / 2” Pipe type (vertical and horizontal)
Ingress Protection class	IP 66
Approvals	
Immunity (EMC)	EN61326-1
Emission (EMI)	EN61326-1
Ingress protection	IP66 - IEC60529
Vibration	IEC60068-2-6
Environmental Conditions	
Ambient temperature operating range	(-)20 to +60°C
Transport / storage temperature range	(-)20 to +70°C
Maximum relative humidity	95% RH, non-condensing at temperature up to 55°C



Mechanical dimensions

Measurement specifications: Conductivity

Parameter	Details			
Sensors	2 Pole Conductivity / TDS			
Cell Constants	0.01/0.1/1.0			
Units	µS/cm	ppm	mS/cm	ppt
Range	0 ~ 1	-	0 ~ 10	0 ~ 7
	0 ~ 10	0 ~ 7		
	0 ~ 100	0 ~ 70		
	0 ~ 1000	0 ~ 700		
	K = 0.01, 0 ~ 100 (0 ~ 1, 0 ~ 10, 0 ~ 100) K = 0.1, 0 ~ 1000 (0 ~ 10, 0 ~ 100, 0 ~ 1000) K = 1, 0 ~ 10000 (0 ~ 100, 0 ~ 1000, 0 ~ 10000)			
Resolution	1.000, 10.00, 100.0			
Display Accuracy	± 0.5% of full scale			
Span	5% of full scale			
Calibration				
Calibration points	1/2/3 point*			
	*Notes: 1. Limited by availability of standard conductivity solution in particular range. 2. Not applicable via HART®			
Excitation Frequency	70 Hz			
Resistivity				
Range (with Auto range facility)	Measuring Range	Cell Constant K	Resolution	
	100M Ω.cm ~ 10K Ω.cm	0.01	0.01M Ω.cm	
	10M Ω.cm ~ 1K Ω.cm	0.1	0.1M Ω.cm	
	1M Ω.cm ~ 0.1K Ω.cm	1	0.01K Ω.cm	
	0.1M Ω.cm ~ 0.1K Ω.cm	10	0.1K Ω.cm	
Temperature Coefficient	00.00 ~ 10.00 %			
TDS Constant	0.01 ~ 1.00			
Temperature				
Range	(-)20°C to +200°C			
Resolution	0.1°C			
Accuracy	±0.5% of FS ±1°C			
Sensor	Pt100 (Default) / Pt1000 (programmable)			
Temperature coefficient	0.01 to 1 % (programmable)			
Compensation	Automatic or Manual (programmable)			
Diagnostics				
Measurement mode	Sensor faulty			
	Temperature sensor open			
	Temperature sensor short			

Measurement specifications: TDS

To activate this option select 'Special Unit' in Conductivity configuration menu.

Parameter	Details		
Range (with Auto ranging feature)	Measuring range*	Cell Constant K	Resolution
	0 to 1.4 ppm	0.01	0.001 ppm
	0 to 14 ppm	0.01	0.01 ppm
	0 to 140 ppm	0.01	0.01 ppm
	0 to 1400 ppm	0.1	0.1 ppm
	0 to 14 ppt**	1	0.01 ppt
	0 to 140 ppt	10	0.1 ppt
	*Ranges calculated considering TDS Factor = 0.7 **implies parts per million equivalent to g/L		
TDS factor	0.1 to 1.00 (programmable)		
Accuracy	± 0.5 % of FS		
Temperature			
Range	(-)20°C to +200°C		
Resolution	0.1°C		
Accuracy	±0.5% of FS ±1°C		
Sensor	PT100 (default) / PT1000 (programmable)		
Temperature coefficient	0.01 to 1 % (programmable)		
Compensation	Automatic or Manual (programmable)		
Diagnostics			
Measurement mode	Sensor faulty		
	Temperature sensor open		
	Temperature sensor short		

15. Annexure

Default settings

Feature	Parameter	Sub parameter	Factory default
Conductivity	Process variable	Cell constant	0.01
		Range	0~200 µS/cm
		Display unit	µS/cm
		Special unit (text)	Ppm
		Special unit A0	0
		Special unit A1	0
		Process TC	0.02
	Temperature	Measurement	Manual
		Sensor type	PT100
		Display unit	°C
		Range	-20°C to +200°C
		Temperature offset	0.00000 °C
		Cable resistance	0.00000 Ω
		Manual mode temperature	25.00000 °C
	Tag name		TAG Ch-A
	Time constant		2.00000 s
Current output	Current output for		ChA: PV
	Output type		Linear
	Output range		4~20 mA
	Max value		100.000 mS/cm
	Min value		0.00000 mS/cm
	Ierror		3.55 mA
Conductivity calibration	Calibration points	One/ Two/ Three point	200.0000 µS/cm
	Offset conductivity		0.0000 µS/cm
Current calibration	Output	Current Low	5.0000 mA
		Current High	17.5000 mA
Test current output	Single		4 mA / 8mA / 12mA / 16mA / 20mA

Conductivity of common aqueous solutions at 25°C

Solution	Conductivity
Ultra pure water	0.055 µS/cm
Power plant boiler water	0.05-1.0 µS/cm
Distilled water	0.5 µS/cm
De-ionized water	0.1-10.0 µS/cm
De-mineralized water	1-80 µS/cm
Mountain water	10 µS/cm
Drinking water	0.5-1.0 mS/cm
Waste water	0.9-9 mS/cm
Potable water (max)	1.5 mS/cm
Brackish water	1-80 mS/cm
Industrial process water	7-140 mS/cm
Ocean water	53 mS/cm

Temperature dependence of conductivity

Conductivity as a function of temperature: $C_t = C_{25}/(1+a*(t-25))$, where

C_t = conductivity at temperature t

a = temperature coefficient expressed in % / °C

t = process temperature in °C

As an example:

Let C_t = 100µS/cm, A = 2%/°C and T = 30°C

The transmitter will indicate the normalized value as below

$C_{25} = C_{30}/(1+0.02*(30-25))$ = 90.90µS/cm at 25°C

HART commands

The Aqua2Trans supports the following HART® commands.

Command No	Description
Command 0	Read Device Identification
Command 1	Read PV variable
Command 2	Read loop current of range
	% of range related to primary variable
Command 3	Read loop current of range
	Read PV variable
	Read PV variable units
	Read SV variable
	Read SV variable units
Command 4	Reserved
Command 5	Reserved
Command 6	Write polling address & loop current mode
Command 7	Read polling address & loop current mode
Command 8	Read Dynamic variable classification
Command 9	Read device variable & status
Command 11	Read Unique Identifier Associated with Tag
Command 12	Read message
Command 13	Read Tag, Descriptor, Date
Command 14	Read Primary Variable Transducer Information
Command 15	Read Device Information
Command 16	Read Final Assembly Number
Command 17	Write Message
Command 18	Write Tag, Descriptor, Date
Command 19	Write Final Assembly Number
command 20	Read Long Tag
Command 21	Read Unique Identifier Associated with Long Tag
Command 22	Write Long Tag
Command 38	Reset Configuration Changed Flag
Command 48	Read Additional Device Status

RTD table

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

Recommended spares

Aqua2Trans has been designed and manufactured to deliver reliable operation over long periods of time. However, in the unlikely event of under-performance we recommend that you stock the following spares to ensure high uptime of the product.

Sr. No.	Item	Order code
1	Conductivity Main PCB	
2	Cable gland	
3	Mounting brackets	

Ordering information

Model		Order code
Aqua2trans – Conductivity / TDS	Aqua2trans – Conductivity / TDS	
	Aqua2trans – Conductivity / TDS -EX	

Forbes Marshall Pvt. Ltd.

B-85, Phase-II, Chakan Industrial Area
Sawardari, Chakan
Tal: Khed, District: Pune
Maharashtra, India – 410501
Tel: +91-21-35393400
Website: www.forbesmarshall.com
Email: support@forbesmarshall.com