Thermo Scientific AquaSensors™ DataStick™ Wide Range Turbidity Measurement System

User Guide

Thermo
S C I E N T I F I C

<u>Preface</u>

This instruction manual serves to explain the use of the Thermo Scientific AquaSensors High-Range Turbidity System and is written to cover as many applications as possible. Please do not hesitate to contact Thermo Fisher Scientific or an authorized representative with questions or concerns.

The information presented in this instruction manual is subject to change without notice as improvements are made, and does not represent any commitment whatsoever on the part of Thermo Fisher Scientific.

Thermo Fisher Scientific cannot accept any responsibility for damage or malfunction of the sensor due to improper use.

<u>Contact Information</u>

To contact Thermo Scientific AquaSensors Technical Support:

Within the United States call 1.800.225.1480 or fax 978-232-6015.

Outside the United States call 978.232.6000 or fax 978.232.6031.

In Europe, the Middle East and Africa, contact your local authorized dealer.

Visit us on the web at www.thermo.com/processwater

<u>Safety Information</u>

The High-Range Turbidity System shall be installed and operated only in the manner specified. Only a skilled, trained or authorized person should carry out installation, setup and operation of the sensor system.

Before using the system, make sure that is connected as specified. Failure to do so may result in permanent damage to the system of its components.

Protection against electric shock will be achieved only by observance of the corresponding installation rules.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. General Information

Thank you for purchasing the Thermo Scientific AquaSensors High-Range Turbidimeter.

The product is designed for continuous use in industrial process applications and complies with safety regulations currently in force. Improper use could lead to hazards for the user or a third-party, and/or adverse effects to the plant or other equipment.

Thermo Fisher Scientific does not accept any liability for damage that may arise if information in this manual is not followed. Therefore, the operating instructions and specifications must be read and understood by all persons involved in installation and operation of this equipment.

This manual identifies safety instructions and additional information by means of the following symbols:

⚠	This symbol draws attention to **safety instructions and warnings of potential danger**, which if neglected, could result in injury to persons and/or damage to property.

☞	This symbol identifies **additional information and instructions**, which if neglected, could lead to inefficient operation and possible loss of production.

It is recommended that this manual be made accessible to everyone who may need it as a reference.

Please contact Thermo Fisher Scientific or an authorized representative with any questions.

1.2. Intended use

The High-Range Turbidity System is used for continuous monitoring turbidity in raw water applications where the range of measurement is between 0.1 NTU to 4000 NTU. The system also measures water temperature.

Any other use, or use not mentioned here, that is incompatible with the technical specifications is deemed inappropriate. The operator is solely responsible for any damage arising from such use.

Other prerequisites for appropriate use include:

- Observing the instructions, notes and requirements set out in this instruction manual.
- Observing all local safety regulations.
- Observing all warnings and cautions in the documentation regarding all products used in this measurement system, including the sensor, mounting hardware, AV38 electronics and cabling.
- Observing the prescribed environmental and operational conditions.
- Observing chemical compatibility with all wetted materials.

1.3. Safety Instructions

The Turbidity System should be installed and operated only by personnel familiar with the sensor and qualified for such work.

A defective Turbidity System should be returned to Thermo Fisher Scientific for repair or replacement. Contact Thermo Fisher Scientific to obtain a Return Material Authorization (RMA) number.

No modifications to the Turbidity System are allowed. The manufacturer/supplier accepts no responsibility for damage caused by unauthorized modifications. The risk is borne entirely by the user.

1.4. Removal from Service / Correct Disposal of the Turbidity System

Removal from Service

- Disconnect the cable wiring from the controller terminal block.
- Remove the Turbidity System from the mounting hardware.

Correct Disposal of Unit

- When the Turbidity System is taken out of service, observe the local environmental regulations for correct disposal.

2. PRODUCT DESCRIPTION

The High-Range Turbidity System is used for continuous monitoring of turbidity from of 0.1 NTU to 4000 NTU. The system also measures temperature from 0°C to 100°C. The optical sensor head is pre-calibrated with a 4000 NTU Formazin standard and the zero is factory set. The sensor retains calibration values and does not require a new calibration when the system is connected to a new AV38 Display Unit, PC, or PLC.

Any communications protocol that Thermo Fisher Scientific supports can be configured in this system by plugging in one of many types of cabled communications adapters. All Thermo Scientific AquaSensors communications adapters support measurement, calibration, configuration and diagnostics functions which can be accessed locally or remotely without an analyzer or controller electronics box.

Plug-in Communications Adapter

Modbus RTU
Modbus 232
Modbus TCP
DeviceNet
CANopen
Ethernet/IP
PCCC
Web Browser
USB
RS-232

Optical Turbidity Sensor Body

90° Light Detection

IR LED

Reference Light Detection
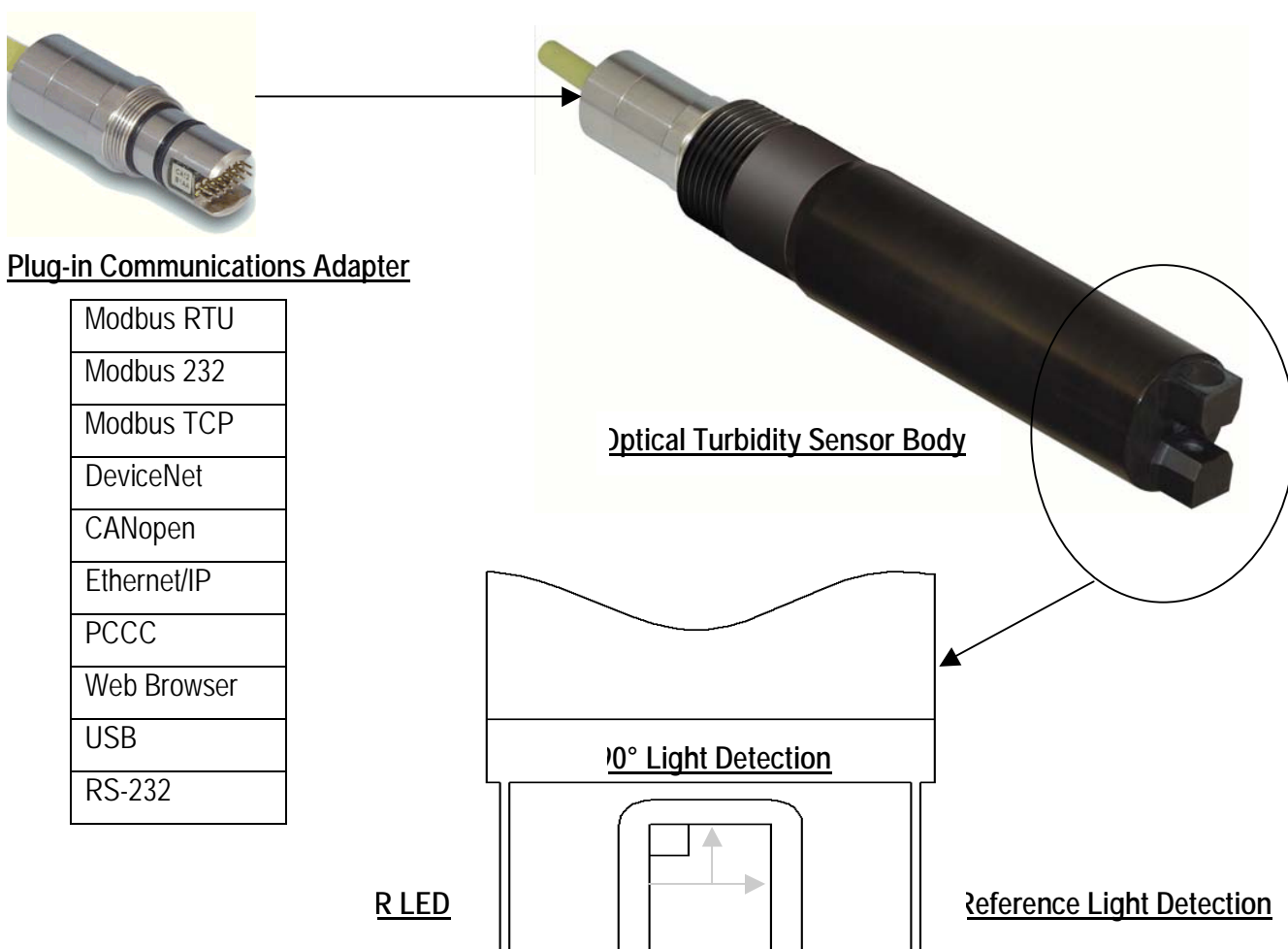
The sensor in this system uses a near infrared light and detects 90 degree scatter from particles suspended in the liquid. Path lengths are 1 centimeter and conform to the ISO7027 measurement technique. Method enhancements include detection of transmitted light for reference compensation.

The high-range turbidity system can be connected directly to a digital network, an AV38 local display or a personal computer running AquaComm™ software. The following schematic illustrates:
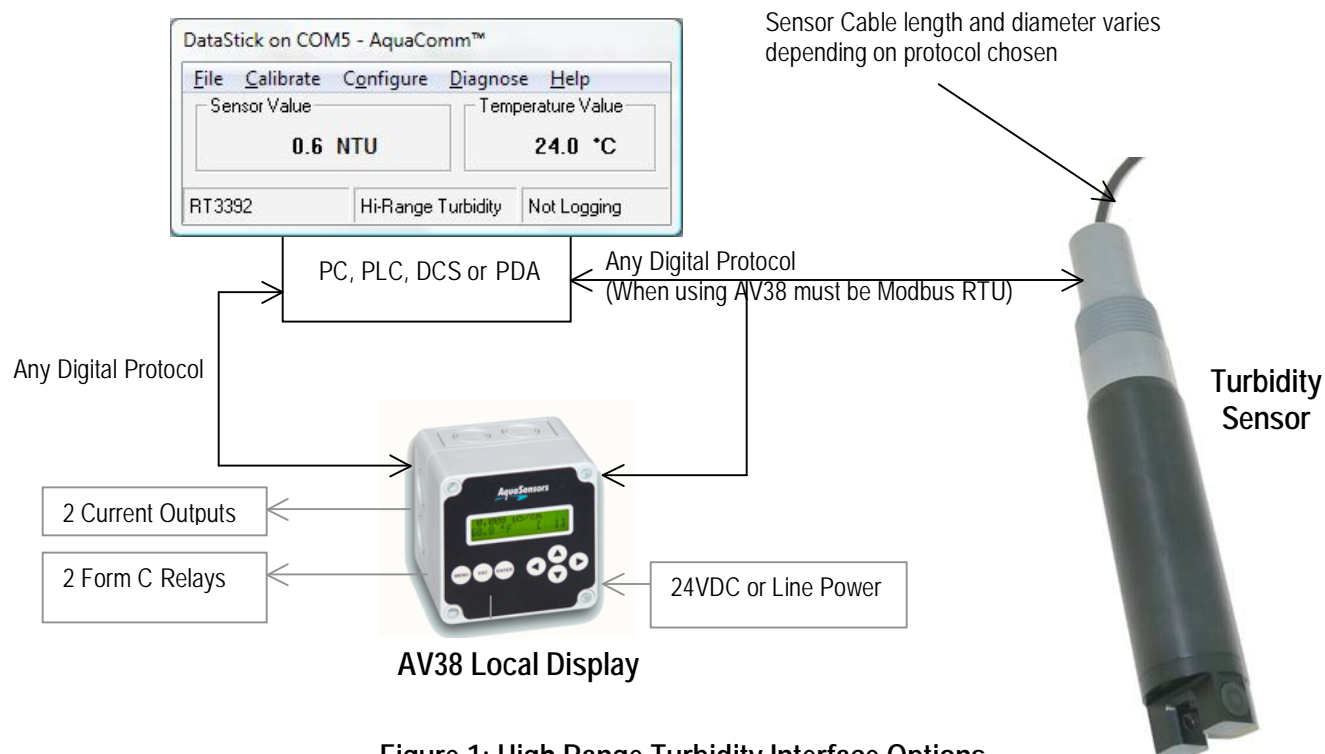
Figure 1: High Range Turbidity Interface Options

Communications	Suggested Application	Standard Interface	Reference
USB ASCII	Laboratory PC, Field Laptop	AquaComm™, Hyper Terminal®	USB Adapter Manual
RS-232 ASCII	Laboratory PC	AquaComm™, Hyper Terminal®	ASCII Commands and Responses detailed in the appendix of the DataStick manual.
Modbus RTU	AV38 Local Display	AV38 Local Display	AV38 Local Display Manual
	PLC with Modbus Network	Modbus PLC Tools	Modbus Communications Manual
DeviceNet	PLC with DeviceNet Network	DeviceNet PLC Tools	DeviceNet Communications Manual
CANbus	PLC with CANbus Network	CANbus PLC Tools	CANbus Communications Manual
Ethernet/IP	DeviceNet over Ethernet	PoE Switch with DeviceNet Tools	Ethernet Manual
PCCC	Allen Bradly SL/C 500 Series	PoE Switch with PCCC Tools	Ethernet Manual
Modbus/TCP	Modbus over Ethernet	PoE Switch with Modbus Tools	Ethernet Manual
TCP/IP	PC	PoE Switch with Internet Explorer	Ethernet Manual

Profibus DP connections are made through Thermo Scientific AquaSensors Profibus DP gateway which connects up to 30 DataSticks with integral Modbus RTU comms adapters.

The sensor is designed for continuous use and has 1-inch NPT mounting threads for union tee and immersion hardware. The parts of the sensor system are show here:

Communications cable type and length varies depending on protocol chosen

Communications Adapter (Various Types) plug into sensor body and is tightened down with a retaining nut.

1-inch NPT threads for Union Tee and Immersion mount Hardware

Sensor Body stores calibration points and calculates turbidity

Optical Measurement Head measures transmitted and reflected IR light. Custom configurations can be made for spectral measurements.

Product Highlights:
  ➢ 0 to 4000 NTU Measurement Range
  ➢ Conforms to ISO 7027
  ➢ Calibration stored in Sensor (Does not require recalibration after connection to Analyzer/Controller)
  ➢ Insertion and Immersion Mounting Options
  ➢ 0.1 NTU Resolution
  ➢ Fast Response
  ➢ Provides measurement, calibration, configuration and diagnostic functions without Analyzer/Controller
  ➢ Works with AV38 for local display, current output data reporting, and relay control with sensor wash.
  ➢ Temperature measurement included
  ➢ Can be connected to Modbus, DeviceNet, Ethernet, USB, RS-232 and CANopen networks.

3. Mounting Hardware

The High-Range Turbidity Measurement System is mounted using the 1-inch NPT threads on the back of the sensor body. When configured with a plug-in communications adapter the sensor is 8.52 inches long from sensor tip to the end of the communications adapter body. The largest diameter of the body is 1.45 inches.
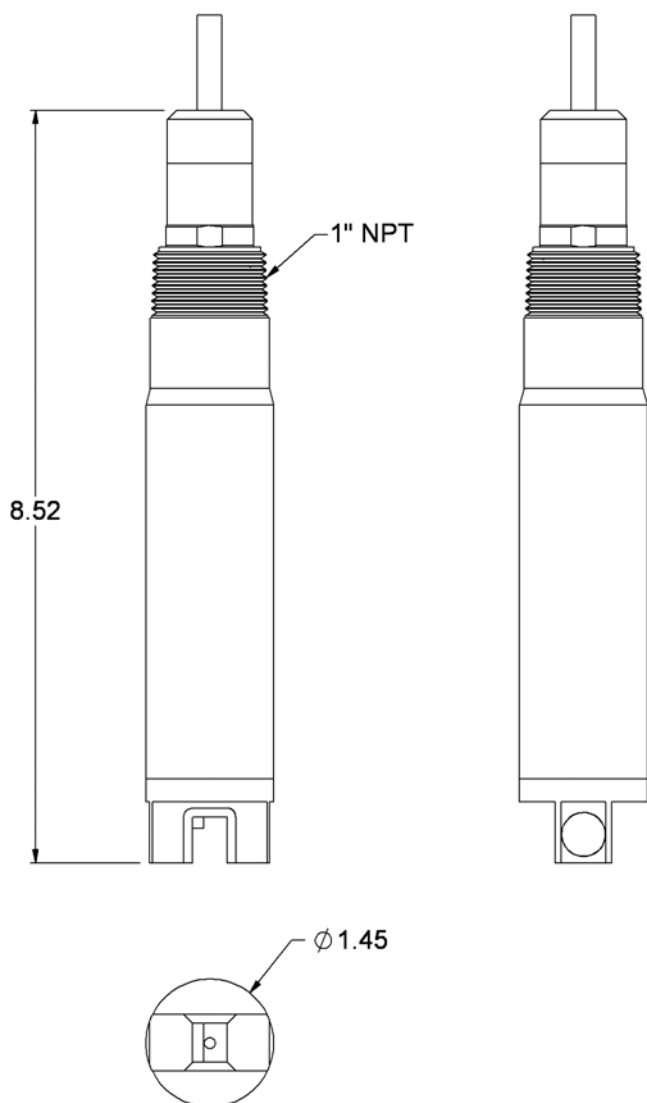
To mount this sensor into a pipe, Thermo Scientific AquaSensors 2-inch union mount tee is used. For immersion mounting Thermo Scientific AquaSensors immersion mount hardware with hand rail mounting and ball float is available.

3.1. <u>Union Tee</u>

The High-Range Turbidity Sensor is threaded into the Union Tee adapter. The adapter is then set into the tee and the retaining ring is tightened down. Be sure to light up the sensor head so that the fingers of the sensor minimize blockage in the pipe.

Mounting Threads for High-Range Turbidity Sensor with Communications Adapter

Route sensor cable

Thread turbidity sensor into Union Adapter

Retaining ring: Tighten to install.

Tee Extension must be set to the correct height so the sensor will be positioned properly in the process

Process Pipe.

When inserting the sensor into the pipe, orient the fingers of the sensor to minimize flow restriction as shown.

3.2. Immersion Hardware

For immersion mounting applications the sensor is threaded on to the end of a pipe and wired into a junction box at the other end. An extension cable is then wired from the junction box to the controller. The standard pipe length is 7 feet and the assembly is often mounted onto a hand rail assembly for easy repositioning of the sensor in a pond or tank.
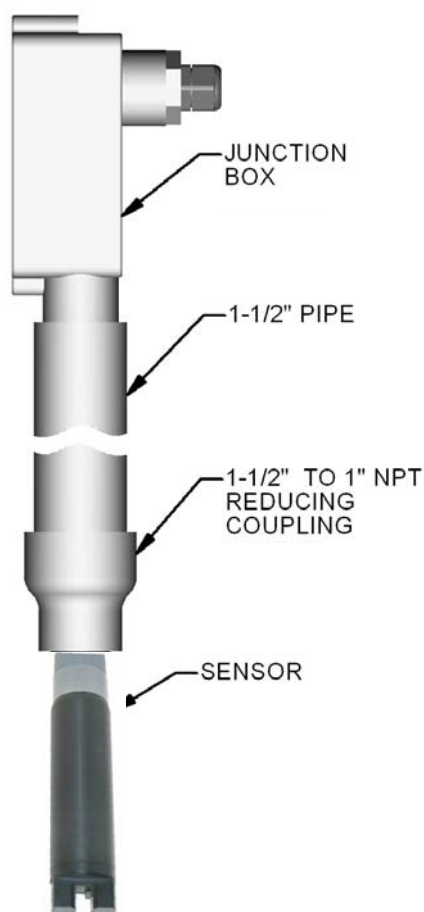
This immersion mount assembly can be ordered by itself, with a hand rail mounting assembly or with a ball float that keeps the sensor as a fixed distance below the surface of the water.

Part numbers for the three assemblies is shown in the following table.

Assembly	1.5 Inch Sensor Part Number	1.0 Inch Sensor Part Number
Immersion Assembly	MH2083	MH3083
Immersion Assembly w/Swivel Rail Mounting	MH2242	MH1242
Immersion Assembly w/Swivel and Ball Float	MH2252	MH1252

3.3. Ball Valve

1.0 Inch NPT threads can be installed in 1.5 inch and 2 inch ball valve assemblies. The threads on the back of the sensor mate with threads on the end of an o-ring sealed pipe inside the ball valve assembly.
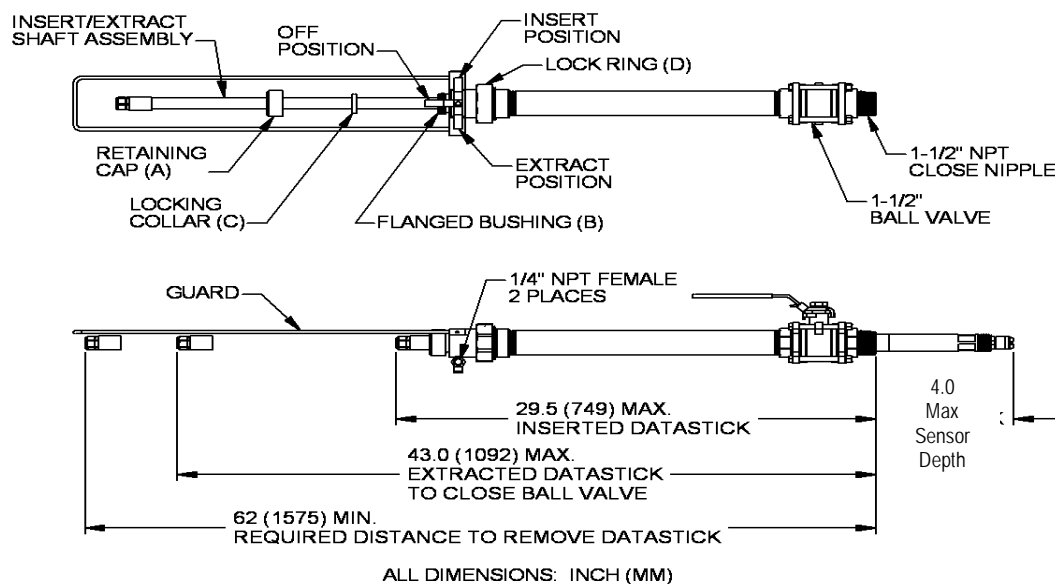
3.4. Wash Head

In application where the sensor head is quickly fouled with sediment, a wash head assembly can be attached. The head slips on the body of the sensor and the wash nozzle is aligned with the sensor fingers. A single screw is tightened to secure the wash head to the sensor. A hose is connected from the wash head to an air compressor or water source valve that is controlled by an AV38 wash relay that is programmed with a wash interval and duration.
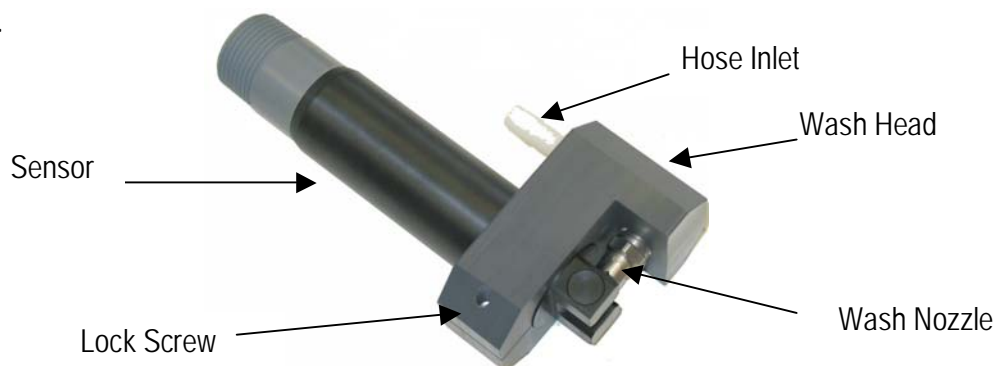
4. Wiring

Each communications adapter has a label printed at the end of the cable that indicates the supported protocol and the corresponding wiring chart. The standard cable length is 10 feet with the idea that the cable will terminate in a junction box. It is however possible to order the communications adapter with any length of cable up to the maximum allowed by the particular protocol being used. In practice all adapters have four wires and a shield. Any Class 2 DC power supply that provides 24VDC can be used.

For DeviceNet, Modbus and RS-232 cables, the RED and BLACK wires are for power, the BLUE and WHITE wires are for communications, and a bare shield wire is connected to EARTH GROUND for safety and electromagnetic immunity and emissions.
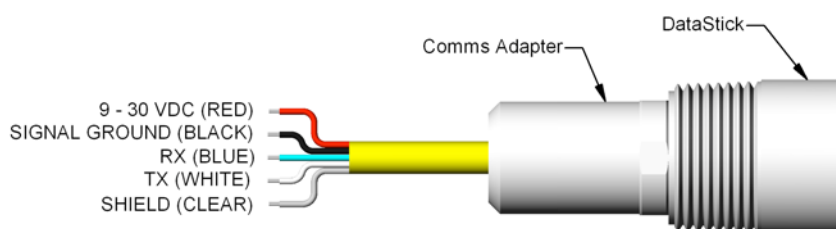
Color	DeviceNet	Modbus RTU	RS-232
RED	24 VDC	12 to 30 VDC	12 to 30 VDC
BLACK	Signal Ground	Signal Ground	Signal Ground
BLUE	CAN_L	Comms (-)	Rx
WHITE	CAN_H	Comms (+)	Tx
SHIELD	Earth	Earth	Earth

All Ethernet Adapters (Ethernet/IP, Modbus TCP, PCCC and TCP/IP) are terminated with an RJ45 connector that plugs in to any PoE switch or power injector.

All USB Adapters are terminated with a USB connector that plugs into most PC's. Power is supplied by the host computer.

When an AV38 local display is used, the sensor must be configured with a Modbus RTU communications adapter.

The communications adapters are keyed and plug into the end of the DataStick™ marked "Communication Adapter". Insert the communications adapter until it bottoms out. Rotate the adapter until it engages with the connector. Push in gently and then tighten the retaining ring with a 15/16-inch wrench.

Communications adapters can be inserted into the "Sensor Head" end of the DataStick™ but the adapter is not long enough to reach the internal connector. Likewise, any sensor head can be inserted into the communications adapter end of the DataStick™ but it will be too long for the retaining ring to be engaged.

O-Ring seal should be free of dirt when inserted in the turbidity sensor body.

Retaining Ring:
Insert the Adapter into the DataStick™ and rotated until it engages.

Tighten the retaining ring to lock down the adapter. Use a 15/16 inch (24mm) wrench. Rotate clockwise to tighten.

Potted Serial number and Part number.

5. AV38 Local Display Interface

For detailed information on configuration of AV38 current outputs, relays, host communications, please refer to the AV38 manual. This manual will describe basic calibration and configuration functions directly related to high-range turbidity.

The AV38 is a universal display interface for DataStick sensor systems which includes the high-range turbidity system. The enclosure has ¼ DIN dimensions for easy mounting and is rated NEMA 4X for outdoor use. It uses a liquid crystal display (LCD) with a high contrast backlight for best readability and is powered with 24 volts DC or optionally with line power (90 VAC to 240 VAC).

The AV38 automatically recognizes the type of DataStick connected to the system and provides the appropriate calibration, configuration and diagnostic menus. It has options for two 4-20 current loops, two alarm/control/wash relays and network communications to a host computer. In addition, the AV38 can address up to 247 DataStick sensors.

DataStick sensors connected to the AV38 communicate via Modbus RTU. As such, the AV38 can be used to select one of several DataStick sensors on the bus for display, current output reporting and relay alarms by selecting the desired station address. When there is no DataStick sensor connected at the selected network address, the measure screen will indicate "no DataStick".

There are seven keys for menu navigation. The MENU key is used to toggle between the menu and the measure screen. Pressing the Menu key provides options for calibration, configuration, communications, outputs and relays. Refer to the AV38 Manual for Details.

5.1. Measure Screen Overview

The AV38 user interface is shown in Figure 5.1. It consists of an LCD module that contains two lines of 16 alphanumeric characters and seven keys to navigate the menu. The contrast of the LCD module can be adjusted by simultaneously pressing the escape and up-arrow keys (for more contrast) or the escape and down-arrow keys (for less contrast).
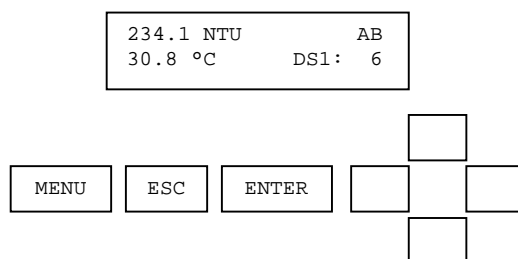
Figure 5.1: The elements of the measure screen

When the turbidity sensor and communications adapter are connected to the AV38 display but the optical sensor head is absent, the measure screen indicates the fault as shown in Figure 3.2.

```
┌─────────────────────┐
│ Sensor Head         │
│ Absent              │
│                     │
└─────────────────────┘
                        ┌─────┐
                        │     │
┌──────┐ ┌──────┐ ┌──────┐ └─────┘ ┌─────┐
│ MENU │ │ ESC  │ │ENTER │ │     │ │     │
└──────┘ └──────┘ └──────┘ └─────┘ └─────┘
                        ┌─────┐
                        │     │
                        └─────┘
```
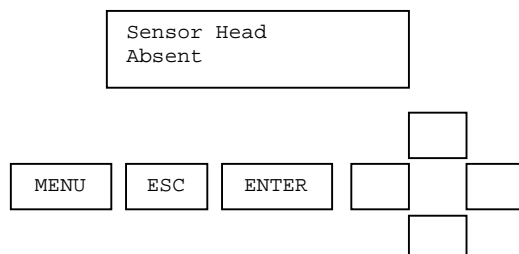
Figure 5.2: The measure screen when the Sensor Head is absent.

When the DataStick or communications adapter are not connected to the AV38 display, the measure screen indicates the fault as shown in Figure 3.2.

```
┌─────────────────────┐
│ DataStick           │
│ Absent              │
│                     │
└─────────────────────┘
                        ┌─────┐
                        │     │
┌──────┐ ┌──────┐ ┌──────┐ └─────┘ ┌─────┐
│ MENU │ │ ESC  │ │ENTER │ │     │ │     │
└──────┘ └──────┘ └──────┘ └─────┘ └─────┘
                        ┌─────┐
                        │     │
                        └─────┘
```
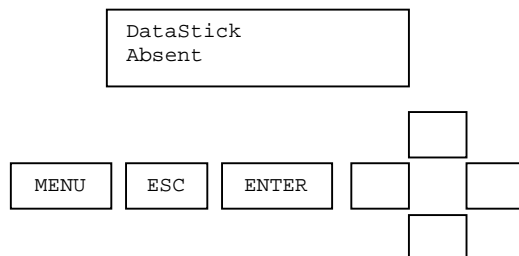
Figure 5.3: The measure screen when the DataStick is absent.

Refer to the AV38 Manual for detailed information on User Interface operation.

5.2. Menu Structure

Pressing the menu key while a measure screen is displayed accesses the main menu. The items in the main menu are the same regardless of the type of sensor head that is installed in the DataStick. Table 5.1 shows all accessible functions including optional features.

Table 5.1: AV38 Main Menu Functions

Main Menu Option	Function
Calibrate (Station Number)	Sensor calibration choices are automatically available for installed sensor head. Enter the MENU from the measure display of interest – station in lower right.
Configure (Station Number)	Configuration choices are automatically available for the installed sensor head. Enter the MENU from the measure display of interest – station in lower right.
DataStick Comms	Set the station address, baud rate and parity for the Modbus DataStick of interest.
Chlorine Configure	Select total, HOCL or OCL⁻ concentration for output. Select pH compensation – manual set or active measure. (Only when Chlorine DataStick Present).
Hold Outputs	Holds the 4-20 mA and Relay outputs
Analog Output 1	Set 4 mA and 20 mA values. Calibrate and test the current output with a meter.
Analog Output 2 (option)	Set 4 mA and 20 mA values. Calibrate and test the current output with a meter.
PID Controller	Set up PID control functions for analog outputs. Available with pH or Conductivity.
Relay A (option)	Set timer, alarm, or control functions. (Optional)
Relay B (option)	Set timer, alarm, or control functions. (Optional)
Help	Indicates AV38 software version
Reset AV38	Resets AV38 configuration to default current output, relay and PID settings.
Exit	Returns to the measure screen

The main menu is navigated using the up/down arrows to display a desired function. The ( ) symbol is used to indicate main menu choices.

To select a menu choice, press the ENTER key when the desired choice is displayed.

To return to the measure screen, press the ESC key.

When ever there is a value to be entered or a choice to be made, the second line of the display will be surrounded by parentheses (( )). The name of the value being entered or choice being made will appear on the upper line of the screen and be appended with a question mark (?) to indicate that the user is to provide input. Figure 4.1 shows the list of standard menu choices and optional menu choices in the context of the AV38 display presentation.
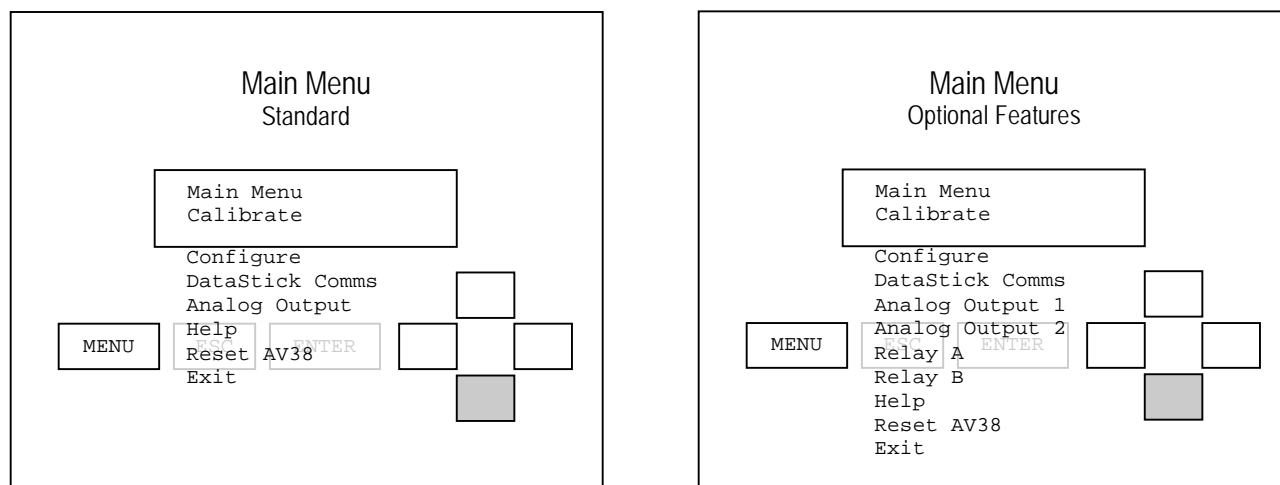
Figure 4.1: The main menu (standard and optional feature lists)

To illustrate navigation through the main menu the following sequence of down arrow key presses is shown. The up arrow can always be used to scroll up through the list.

A pressed key is identified by a gray background, e.g. ESC .

From the measure screen, press MENU to display the list of options. Generally, Calibration will be the first option. To select a calibration function, press ENTER. Press the down arrow to scroll through the list. Press ESC to return to the measure screen.
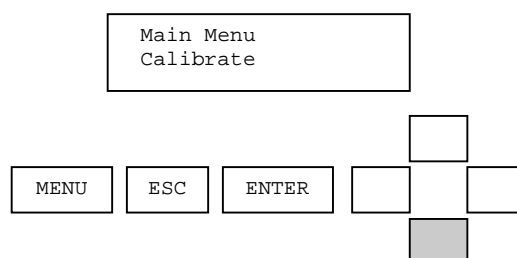
Pressing the down arrow from Calibration will display Configure. To select Configure functions, press ENTER To continue scrolling the list, press the down arrow. Press ESC to return to the measure screen.

```
Main Menu
Configure
```

```
MENU   ESC   ENTER   [ ]
                    [ ]   [ ]
                    [ ]
```
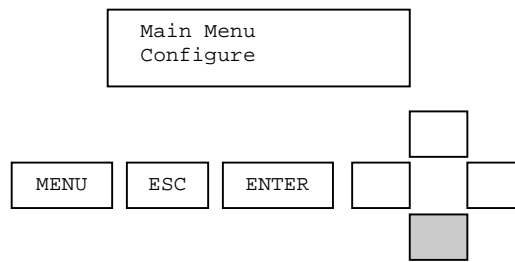
Pressing the down arrow from Configure will display DataStick Comms. To select DataStick Comms functions, press ENTER. To continue scrolling the list, press the down arrow. Press ESC to return to the measure screen.

```
Main Menu
DataStick Comms
```

```
MENU   ESC   ENTER   [ ]
                    [ ]   [ ]
                    [ ]
```
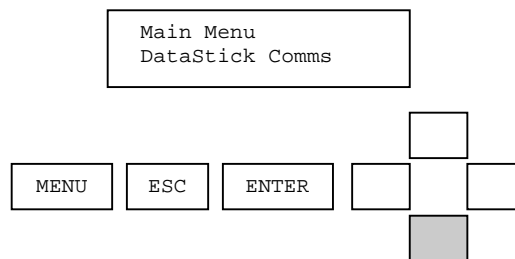
Pressing the down arrow from DataStick Comms will display Analog Output. To select analog output functions, press ENTER To continue scrolling the list, press the down arrow. Press ESC to return to the measure screen.

```
Main Menu
Analog Output
```

```
MENU   ESC   ENTER   [ ]
                    [ ]   [ ]
                    [ ]
```
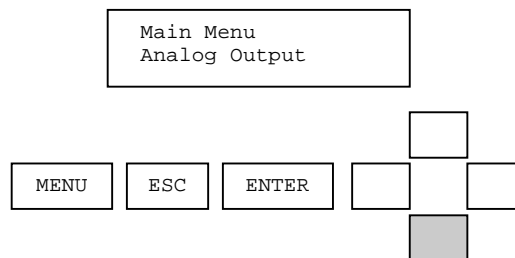
Pressing the down arrow from Analog Output will display Help. To select Help functions, press ENTER To continue scrolling the list, press the down arrow. Press ESC to return to the measure screen.

```
Main Menu
Help
```

```
MENU   ESC   ENTER   [ ]
                    [ ]   [ ]
                    [ ]
```
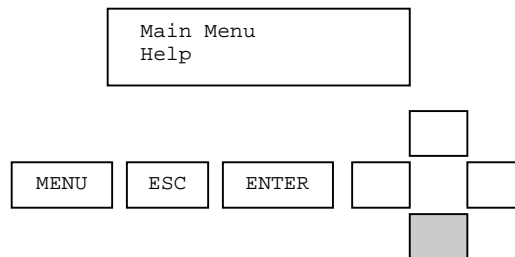
Pressing the down arrow from Help will display Reset AV38. To select Reset functions, press ENTER To continue scrolling the list, press the down arrow. Press ESC to return to the measure screen.

```
                   ┌─────────────────────┐
                   │ Main Menu           │
                   │ Reset AV38          │
                   └─────────────────────┘

                                ┌──────┐
                                │      │
                                └──────┘
          ┌──────┐ ┌──────┐ ┌────────┐ ┌──────┐ ┌──────┐
          │ MENU │ │ ESC  │ │ ENTER  │ │      │ │      │
          └──────┘ └──────┘ └────────┘ └──────┘ └──────┘
                                ┌──────┐
                                │▓▓▓▓▓▓│
                                └──────┘
```
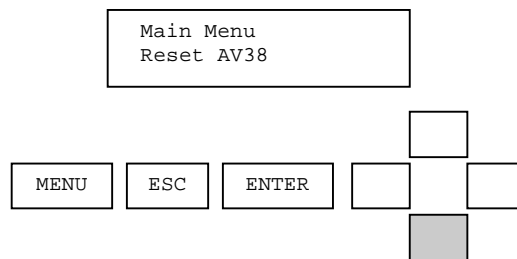
To return to the measure screen press ENTER when in the EXIT screen. Pressing ESC from any screen will take the user up one level. In this example ESC will also take the user to the measure screen. Since this screen is at the bottom of the main menu list, the down arrow will not work here. The up arrow can be used to go back through the list.

```
                   ┌─────────────────────┐
                   │ Main Menu           │
                   │ Exit                │
                   └─────────────────────┘

                                ┌──────┐
                                │      │
                                └──────┘
          ┌──────┐ ┌──────┐ ┌────────┐ ┌──────┐ ┌──────┐
          │ MENU │ │ ESC  │ │▓ENTER ▓│ │      │ │      │
          └──────┘ └──────┘ └────────┘ └──────┘ └──────┘
                                ┌──────┐
                                │      │
                                └──────┘
```
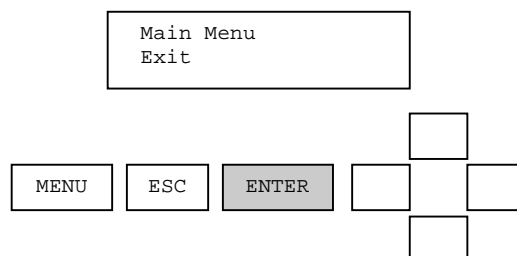
5.3.   1-Point (Span) Calibration

To calibrate the span for the High-Range Turbidity System:

1.   Place the sensor in a suspension of Formazin. We recommend that the calibration sample be 4000 NTU but other values can be used. Because this is a span calibration it is important to do this with a calibration sample that is at the highest NTU possible.

2.   Give the calibration solution a gentle stir and allow the sensor reading to stabilize.

3.   Perform a 1-point sample calibration as shown in the following menu tree.

The complete calibrate menu for the turbidity and suspended solids is shown.

```
                   ┌─────────────────────┐
                   │ Calibrate           │
                   │ 1-Point Sample      │
                   └─────────────────────┘
```

```
                                    Zero
                                    Temperature
                                    Exit
                                                    ┌──────┐
                                                    │▓▓▓▓▓▓│
        ┌───────┐ ┌───────┐ ┌────────┐             └──────┘
        │ MENU  │ │  ESC  │ │ ENTER  │   ┌──────┐          ┌──────┐
        └───────┘ └───────┘ └────────┘   │      │          │      │
                                          └──────┘          └──────┘
                                                    ┌──────┐
                                                    │▓▓▓▓▓▓│
                                                    └──────┘
```

From the measure screen, press MENU.

```
                           ┌─────────────────────────┐
                           │  785.1 NTU              │
                           │   13.1 °C               │
                           └─────────────────────────┘

                                                    ┌──────┐
                                                    │      │
        ┌───────┐ ┌───────┐ ┌────────┐             └──────┘
        │▓MENU▓▓│ │  ESC  │ │ ENTER  │   ┌──────┐          ┌──────┐
        └───────┘ └───────┘ └────────┘   │      │          │      │
                                          └──────┘          └──────┘
                                                    ┌──────┐
                                                    │      │
                                                    └──────┘
```
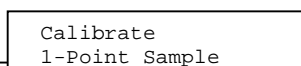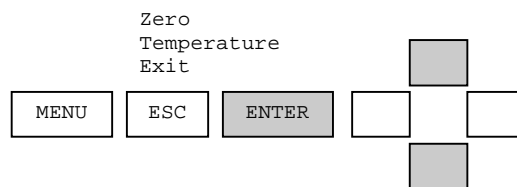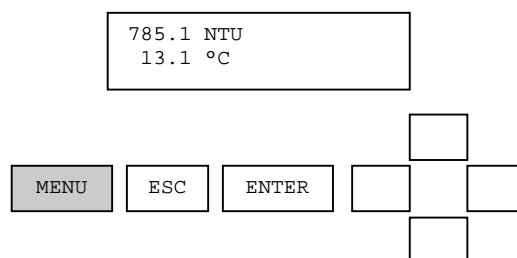
From the Main Menu, use the up/down arrows to select Calibrate. Then press ENTER.

```
                           ┌─────────────────────────┐
                           │   Main Menu             │
                           │   Calibrate             │
                           └─────────────────────────┘

                                                    ┌──────┐
                                                    │      │
        ┌───────┐ ┌───────┐ ┌────────┐             └──────┘
        │ MENU  │ │  ESC  │ │▓ENTER▓▓│   ┌──────┐          ┌──────┐
        └───────┘ └───────┘ └────────┘   │      │          │      │
                                          └──────┘          └──────┘
                                                    ┌──────┐
                                                    │      │
                                                    └──────┘
```
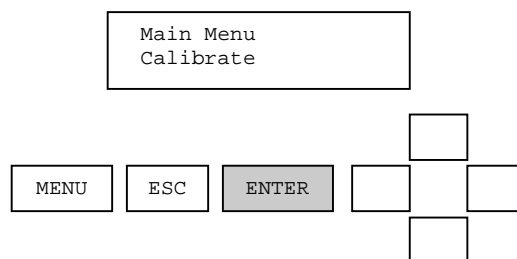
From the Calibrate Menu, use the up/down arrows to select 1-Point Sample. Then press ENTER.

```
                       ┌─────────────────────────┐
                       │   Calibrate             │
                       │   1-Point Sample        │
                       └─────────────────────────┘

                                                ┌──────┐
                                                │      │
    ┌───────┐ ┌───────┐ ┌────────┐             └──────┘
    │ MENU  │ │  ESC  │ │▓ENTER▓▓│   ┌──────┐          ┌──────┐
    └───────┘ └───────┘ └────────┘   │      │          │      │
                                      └──────┘          └──────┘
                                                ┌──────┐
                                                │      │
                                                └──────┘
```
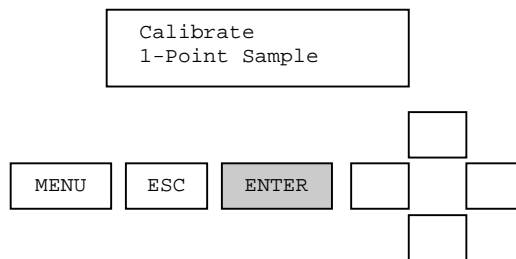
The current sensor value is dynamically displayed and asks the user to be sure the measurement is ready for calibration before proceeding. When ready, press the ENTER key.

```
785.1 NTU
Sensor ready?
```

| MENU | ESC | ENTER |
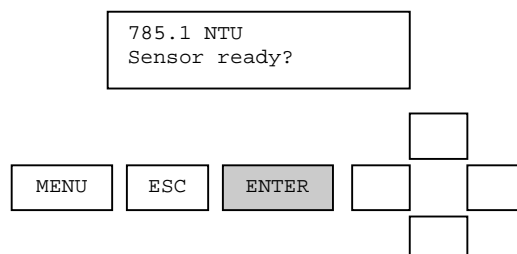
The calibration value can be adjusted with the arrow keys. Use the up/down arrows for fine adjust and the left/right arrows for course adjust. After the calibration value is adjusted to the desired value, press the ENTER key.

```
1-Point Sample?
(    800.0) NTU
```

| MENU | ESC | ENTER |
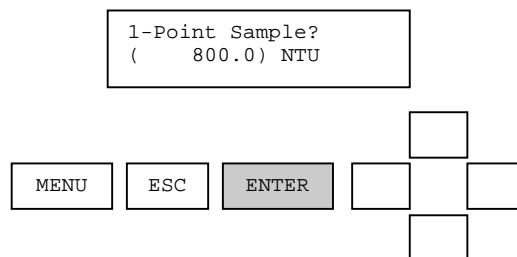
One the actual 1-point sample calibration has been initiated; the display will indicate that a calculation is progressing. During this calculation it is important that nothing disturb the measurement sample. To abort the calibration during this calculation, press ESC.

```
1-Point Sample
Calibrating...
```
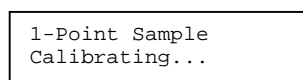
When the calibration calculation is complete, the result will be displayed on the second line of the display. If the calibration is su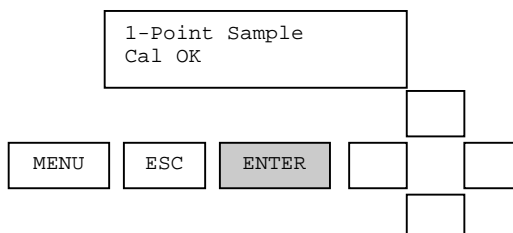ccessful, the message will be CAL OK. If the calibration is not successful, the message will be CAL FAIL. In either case, press ENTER to continue.

```
1-Point Sample
Cal OK
```

```
MENU    ESC    ENTER
```

If the calibration is successful, pressing ENTER will return to the measure screen. If the calibration is not successful, pressing ENTER will return to the beginning of the 1-point sample calibration. Reasons for calibration failure include a sample that is not in the correct measurement range or is changing in value too quickly.

5.4.   Zero Calibration

The zero calibration should not be adjusted unless the sample water if filtered with a 0.2 micron filter and is free of bubbles.

1. Place the sensor in a beaker of filtered water.

2. Perform a zero calibration as shown in the following menu tree.

From the Calibrate menu, use the UP/DOWN arrows to display ZERO calibration. Press ENTER to select.

```
Calibrate
Zero
```

```
1-Point Sample
Temperature
Exit
```

```
MENU    ESC    ENTER
```
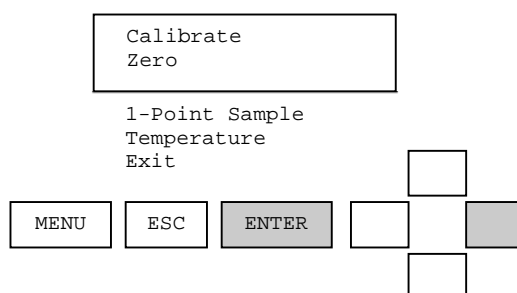
Be sure the filtered water has had an opportunity to release any air bubbles.

Press ENTER to initiate zero calibration.

```
0.020 NTU
Sample Ready?
```

```
MENU    ESC    ENTER
```
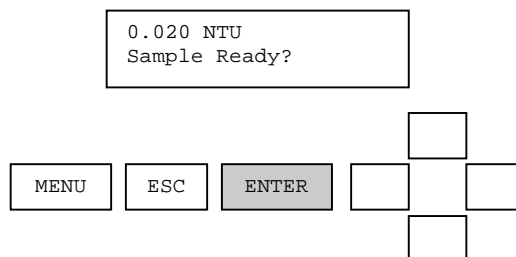
A zero calibration may take some time, as the zero must be calibrated over a wide dynamic range. During this process the calibrating… message is shown.

```
Zero
Calibrating…
```

```
MENU    ESC    ENTER
```
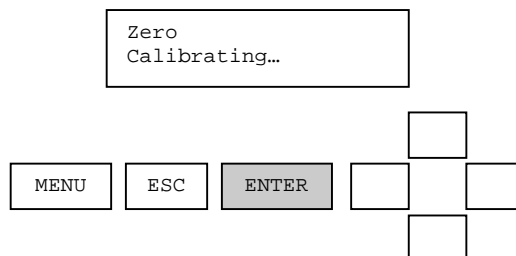
When the zero calibration is complete the user will be asked to confirm the result with the ENTER key.

```
Zero
Confirm cal ok?
```

```
MENU    ESC    ENTER
```
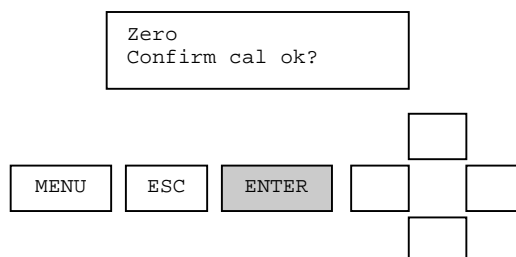
After pressing ENTER to confirm Calibration is okay, the Measure screen will be displayed.

```
0.0 NTU        AB
13.1 °C    DS1:  6
```

```
MENU    ESC    ENTER
```
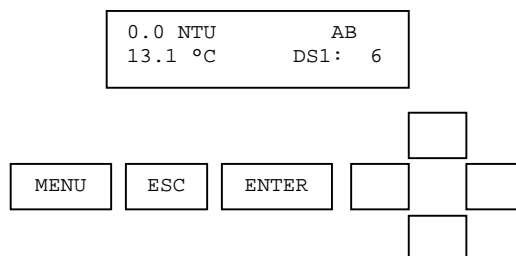
If an error occurs during calibration, the reason for the failure is shown.

```
Zero
Cal Fail
```

```
      ┌──────┐
      │      │
┌──────┐┌──────┐┌──────┐┌──────┐┌──────┐
│ MENU ││ ESC  ││ENTER ││      ││      │
└──────┘└──────┘└──────┘└──────┘└──────┘
      ┌──────┐
      │      │
      └──────┘
```
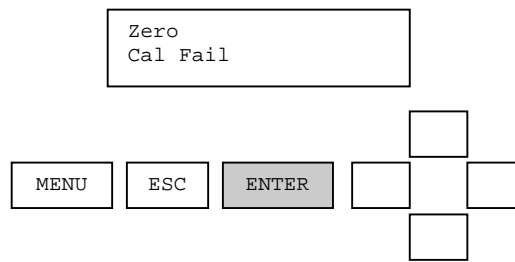
Press ENTER to acknowledge the calibration failure and return to the measure screen.

```
0.0 NTU           AB
13.1 °C    DS1:  6
```

```
      ┌──────┐
      │      │
┌──────┐┌──────┐┌──────┐┌──────┐┌──────┐
│ MENU ││ ESC  ││ENTER ││      ││      │
└──────┘└──────┘└──────┘└──────┘└──────┘
      ┌──────┐
      │      │
      └──────┘
```
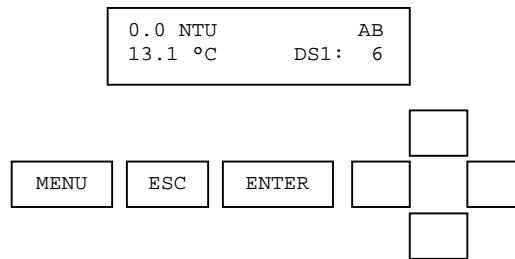
5.5.   Temperature Calibration

Press the ENTER key from the TEMPERATURE calibration menu to initiate the calibration process.

```
Calibrate
Temperature
```

```
      ┌──────┐
      │      │
┌──────┐┌──────┐┌──────┐┌──────┐┌──────┐
│ MENU ││ ESC  ││ENTER ││      ││      │
└──────┘└──────┘└──────┘└──────┘└──────┘
      ┌──────┐
      │      │
      └──────┘
```
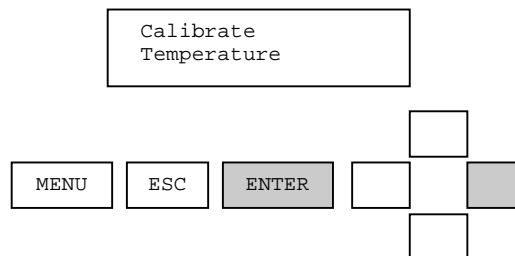
When the temperature calibration procedure is started, the analog output is placed into hold mode. The user is prompted to prepare the sensor. The sensor value is dynamically updated during this step.

```
25.3 °C
Sensor ready?
```

```
MENU   ESC   [ENTER]
```
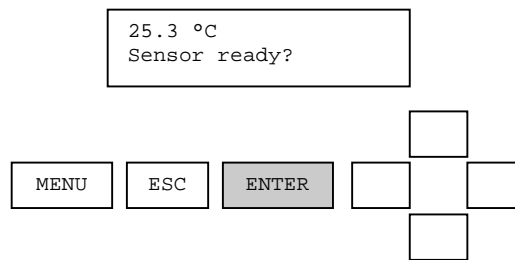
When the sensor is ready, the ENTER key is pressed and the user is presented with a calibration value for editing. Please note that it is best to calibrate temperature when the sample chamber is full of flowing process water.

```
Temperature?
(   25.3) °C
```

```
MENU   ESC   ENTER
```
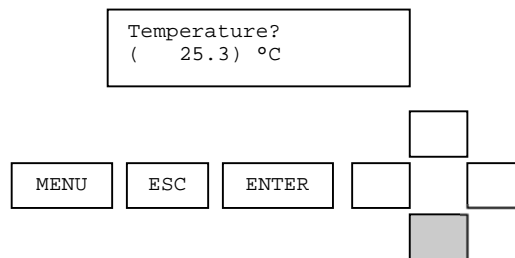
When the value has been edited as desired, the enter key is pressed and the calibration of the point is started.

```
Temperature?
(   25.0) °C
```

```
MENU   ESC   [ENTER]
```
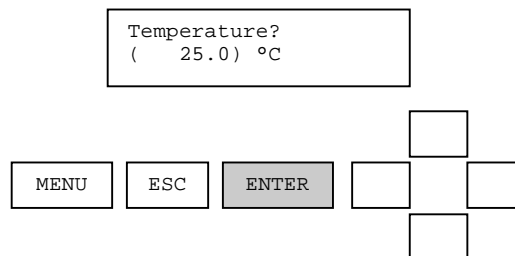
During this time, the calibration procedure can be aborted by pressing the escape key.

```
Temperature
Calibrating...
```

```
MENU   ESC   ENTER
```
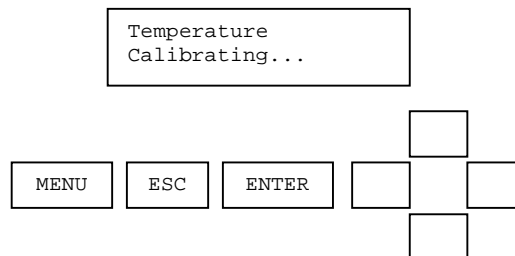
After the calibration point has been stored, the user is prompted to confirm a successful calibration procedure.

```
          ┌─────────────────────────┐
          │ Temperature             │
          │ Confirm cal OK          │
          └─────────────────────────┘
                              ┌──────┐
                              │      │
                              └──────┘
  ┌──────┐ ┌──────┐ ┌════════┐ ┌──────┐ ┌──────┐
  │ MENU │ │ ESC  │ ║ ENTER  ║ │      │ │      │
  └──────┘ └──────┘ └════════┘ └──────┘ └──────┘
                              ┌──────┐
                              │      │
                              └──────┘
```
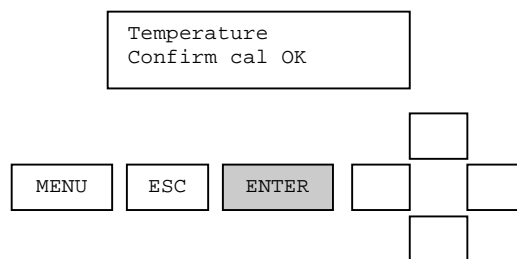
When the enter key is pressed, the analog output is placed into active mode and the monitoring of sensor and temperature values is resumed. This successfully completes the temperature calibration procedure.

```
          ┌─────────────────────────┐
          │ 456.1 NTU          AB   │
          │ 25.0 °C      DS1:  6    │
          └─────────────────────────┘
                              ┌──────┐
                              │      │
                              └──────┘
  ┌──────┐ ┌──────┐ ┌────────┐ ┌──────┐ ┌──────┐
  │ MENU │ │ ESC  │ │ ENTER  │ │      │ │      │
  └──────┘ └──────┘ └────────┘ └──────┘ └──────┘
                              ┌──────┐
                              │      │
                              └──────┘
```
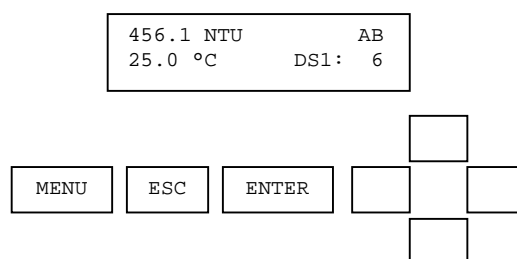
If an error occurs during calibration that causes the procedure to fail, the reason for the failure will be shown.

When the enter key is pressed, the calibrate menu is displayed. This ends the temperature calibration procedure. The user has the option of repeating the procedure if desired.


```
          ┌─────────────────────────┐
          │   Calibrate             │
          │   Temperature           │
          └─────────────────────────┘
                              ┌──────┐
                              │      │
                              └──────┘
  ┌──────┐ ┌──────┐ ┌────────┐ ┌──────┐ ┌──────┐
  │ MENU │ │ ESC  │ │ ENTER  │ │      │ │      │
  └──────┘ └──────┘ └────────┘ └──────┘ └──────┘
                              ┌──────┐
                              │      │
                              └──────┘
```
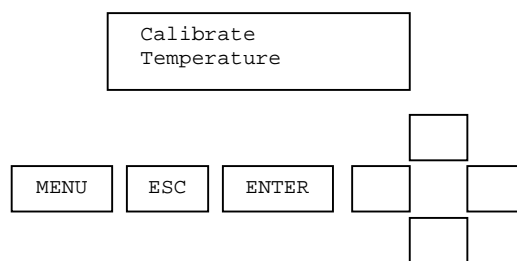
5.6.   Configuration

The complete configure menu for turbidity is shown.

```
┌─────────────────────────┐
│  Configure              │
│  Sensor Filter          │
│                         │
│  Temp Filter            │
│  Temp Units             │
│  Exit                   │
└─────────────────────────┘
```

```
┌────────┐  ┌─────┐  ┌───────┐        ┌───┐
│ MENU   │  │ ESC │  │ ENTER │        └───┘
└────────┘  └─────┘  └───────┘     ┌───┐ ┌───┐
                                   └───┘ └───┘
                                      ┌───┐
                                      └───┘
```
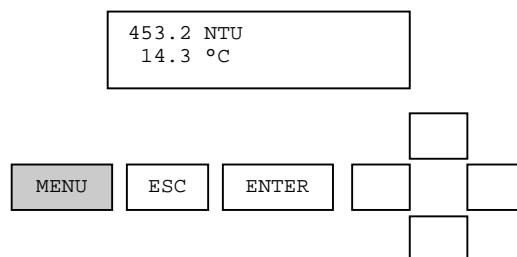
From the measure screen, press MENU.

```
┌─────────────────────────┐
│  453.2 NTU              │
│  14.3 °C               │
│                         │
└─────────────────────────┘
```

```
┌────────┐  ┌─────┐  ┌───────┐        ┌───┐
│ MENU   │  │ ESC │  │ ENTER │        └───┘
└────────┘  └─────┘  └───────┘     ┌───┐ ┌───┐
                                   └───┘ └───┘
                                      ┌───┐
                                      └───┘
```
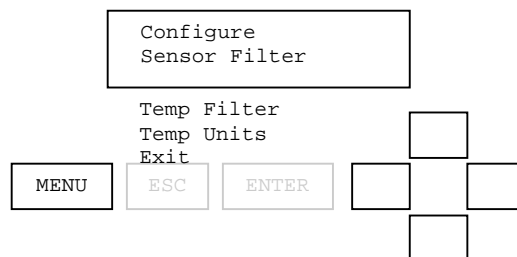
From the Main Menu, use the up/down arrows to select Configure. Then press ENTER.

```
┌─────────────────────────┐
│  Main Menu              │
│  Configure              │
│                         │
└─────────────────────────┘
```

```
┌────────┐  ┌─────┐  ┌───────┐        ┌───┐
│ MENU   │  │ ESC │  │ ENTER │        └───┘
└────────┘  └─────┘  └───────┘     ┌───┐ ┌───┐
                                   └───┘ └───┘
                                      ┌───┐
                                      └───┘
```
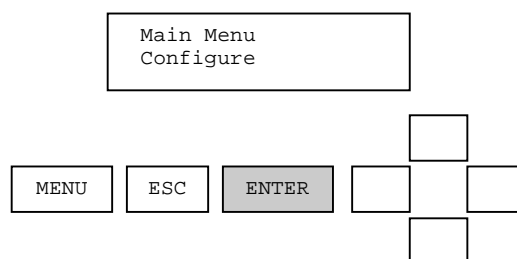
From the Configure menu, use the up/down arrows to select Sensor Filter. Then press ENTER.

```
┌─────────────────────────┐
│  Configure              │
│  Sensor Filter          │
│                         │
└─────────────────────────┘
```

```
┌────────┐  ┌─────┐  ┌───────┐        ┌───┐
│ MENU   │  │ ESC │  │ ENTER │        └───┘
└────────┘  └─────┘  └───────┘     ┌───┐ ┌───┐
                                   └───┘ └───┘
                                      ┌───┐
                                      └───┘
```
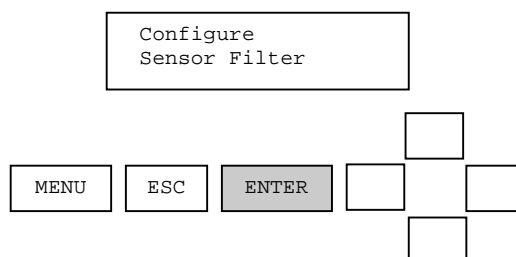
Edit the sensor filter with the up/down arrows. Press ENTER to select a new filter value. Press ESC to abort the new sensor value. The temperature filter edit screen works the same way.

```
Sensor Filter?
(  1) seconds
```

```
MENU    ESC    ENTER
```
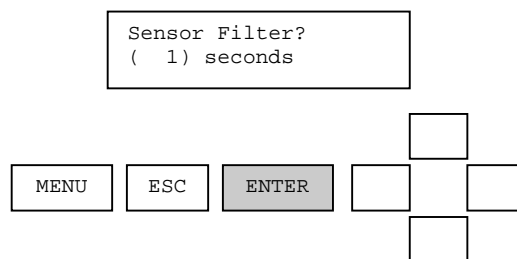
The Temperature units selection offers °C and °F in the edit screen.

5.7.   Analog Output Overview

The analog output menu is used to setup the 4milliamp to 20 milliamp analog output in the AV38.   This function allows the following assignments:

- Parameter: Assign either turbidity or temperature to the output.

- 4mA Value: Assign the lowest value of turbidity or temperature to be reported.

- 20mA Value: Assign the highest value of turbidity or temperature to be reported.

- Calibrate: Use an external ammeter to calibrate the output for precise current readings.

When the AV38 is configured with two current outputs then the main menu list shows "Analog Output 1" and "Analog Output 2" The menu system for each output is identical.

Note: During calibration, the analog output is held at its present value.

Refer to the AV38 Manual for detailed current output operation and setup.

5.8. Relay Function Overview

Relay A and Relay B are optional features on the AV38. Relays are Form C with normally open and normally closed contacts – 120 Volts, 3 Amps. Connections are made with the optional terminal block on the left side of the back panel.

When installed, configuration of relay action is accessed through the "Relay A" and "Relay B" in the main menu.

Top-level configuration of the relays is as follows:

- **Set Function:** Sets the relay function for alarm, control or wash operation.
- **Parameter:** Assigns either sensor (turbidity) or temperature to the relay function.
- **Activation:** Configures the relay activation setpoints, deadbands and on/off delays settings.

The activation parameters depend on which function is selected.

- When set for ALARM the relays will activate based on the settings of low and high limits.
- When set for CONTROL the relays will activate based on the settings of phase and a single setpoint.
- When set for WASH the relay will activate based on programmed interval, duration and off-delay.

Alarm and Control settings allow fine-tuning of activation criteria with deadband and delay functions. Activation parameters for Alarm, Control and Wash functions are listed in the Table 9.1

ALARM	CONTROL	WASH
Set Low Alarm	Set Phase	Set Interval
Set High Alarm	Set Setpoint	Set Duration
Set Low Deadband	Set Deadband	Set Off-Delay
Set High Deadband	Set Off-Delay	Exit
Set Off-Delay	Set On-Delay	
Set On-Delay	Exit	
Exit		

Refer to the AV38 Manual for detailed relay operation and setup.

6. AquaComm™ Interface

AquaComm™ is an application software package that runs on computers with Microsoft Windows operating systems. Refer to the USB Comms Adapter manual for installation and setup.

When the High-Range turbidity sensor is connected AquaComm™ will automatically recognize the sensor type and display turbidity and temperature.

To calibrate, configure, diagnose or create data log files, select the pull-down menus.

Multiple AquaComm™ windows may be opened for as many unique communications ports that are supported on the computer.
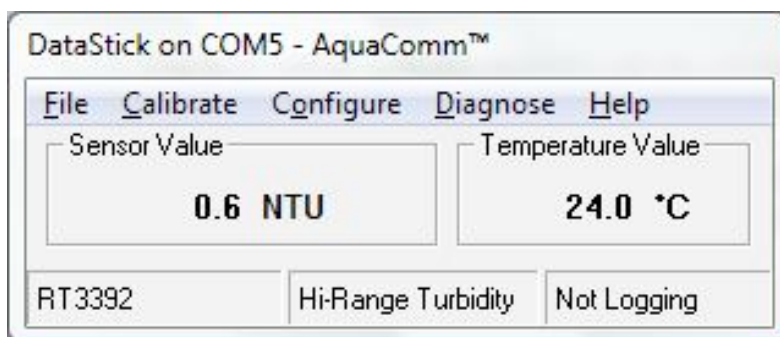
7. Direct PLC Connections

When a High-Range Turbidity system is connected directly to a computer network, all measurement, calibration, configuration and diagnostic functions are accessible by any user interface that is also connected to the network.

Refer to the appropriate Thermo Scientific AquaSensors communications manual to set up an interface.

Modbus uses a register map of floating point, integer and ASCII measure, calibrate and configure commands.

Ethernet communications adapters allow access to all functions through Internet Explorer.

DeviceNet and CANopen use an electronic file that is loaded for access to all functions.

Contact Thermo Fisher Scientific if assistance is needed in setting up an integrated interface to all DataStick measurement systems through a PLC network.

8. Specification

Measurement

Range: 0 to 4000 NTU

Resolution: 0.1 NTU

Accuracy: 0.2% of Range

Operational Environment

Water Temperature Range: -5°C to 50°C

Air Temperature Range: -20°C to 60°C

Power Requirements

Voltage Range: 24 VDC

Note: Class II DC power supply required

Construction

Sensor Head Material: Polycarbonate, Quartz Glass.

Weight: 1.2 lbs

Units of Measure

Measurement Units: NTU

Temperature Units: °C, °F

Calibration

Sample (Span): 1 point

Zero: 1 point

Temperature: 1 point

9. High-Range Turbidity Order Matrix and Accessories

Model Number
RT1   High Range Turbidity Measurement System. 0 to 4000 NTU Range. Polycarbonate sensor body. Fouling
Correction. Temperature measurement included. Precalibrated.

    Back-Body and Comms Adapter Material
    1   CPVC 1-Inch NPT
    2   316 Stainless Steel 1-Inch NPT

        DataStick Communications
        4   Modbus RTU. (Required for use with AV38 Local Display).
        5   DeviceNet
        6   CANopen
        7   Ethernet IP, Modbus TCP, TCP/IP. Connect to PoE Switch with RJ45 connector.
        8   USB 10 foot cable with A type connector for use with PC and portable computers.

            Cable Length
            1   10 Feet
            2   20 Feet
            3   30 Feet
            X   Where X = Number of Feet/10

RT1			

Local Interface	Description (Standard Configurations)	Part Number	Reference
AV38 Display	One 4-20mA output, PID. 24VDC.	AV38BB0A1	See Page 8
	Two 4-20mA outputs, PID, 2 Relays, Modbus Host, 24VDC.	AV38CB4A1	

Mounting Hardware	Description	Part Number
1.5" Union Mount	Stainless Steel	MH1041-RT
	CPVC	MH1042-RT
Immersion Assembly	7 ft PVC extension with junction box – 1" Sensors	MH3083
Immersion Assembly w/Swivel Rail Mounting	7 ft PVC extension with junction box – 1" Sensors With swivel hand rail mount.	MH1242
Immersion Assembly w/Swivel and Ball Float	7 ft PVC extension with junction box – 1" Sensors With swivel hand rail mount and inflatable float.	MH1252
1.5" Ball Valve	Low Pressure, CPVC	MH1112
	Low Pressure, Stainless Steel	MH1111
	High Pressure, CPVC	MH1122
	High Pressure, Stainless Steel	MH1121
Ball Float Platform	PVC Float Platform for up to 4 DataSticks	MHFB02
Wash Hardware	Attach air/water purge block to sensor body. Works with compressor & AV38 wash relay or PLC.	MH1222
Junction box	For extension cables. Terminal strip included.	JBOXX01
Extension Cable	DataStick Extension cable	DSECxx; xx=ft

Product	Description	Part Number
Formazin Stock	4000 NTU Stock Solution – 500ml bottle	FOR4K
Formazin Kit	40 NTU Calibration Kit. Injector and 500ml mix bottle.	FOR40

10. Limited Warranty

WARRANTY/REPLACEMENT PLAN

Thermo Fisher Scientific warrants its products against material and workmanship defect for a period of one year from the date of shipment.

In the event that a defect is discovered during the warranty period, Thermo Fisher Scientific agrees, at its option, to repair or replace the defective product. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products associated with this product including, but not limited to, chemical reagents and salt bridges.

Products may not be returned without authorization from Thermo Fisher Scientific. To obtain authorization, please call Thermo Fisher Scientific for a return material authorization number.

Limitations:
This warranty does not cover:
1. Damage caused by misuse, neglect (lack of appropriate maintenance), alteration, accident or improper application or installation.
2. Damage caused by any repair or attempted repair not authorized by Thermo Fisher Scientific.
3. Any product not used in accordance with the instructions furnished by Thermo Fisher Scientific.
4. Damage caused by acts of God, natural disaster, acts of war (declared or undeclared), acts of terrorism, work actions, or acts of any governmental jurisdiction.
5. Freight charges to return merchandise to Thermo Fisher Scientific.
6. Travel fees associated with on-site warranty repair.

This warranty is the sole expressed warranty made by Thermo Fisher Scientific in connection with its products. All other warranties, whether expressed or implied, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

The liability of Thermo Fisher Scientific shall be limited to the cost of the item giving rise to the claim. In no event shall Thermo Fisher Scientific be liable for incidental or consequential damages.

This warranty is the sole and complete warranty for Thermo Fisher Scientific. No person is authorized to make any warranties or representations on behalf of Thermo Fisher Scientific.

Thermo Fisher Scientific reserves the right to change or modify this warranty at any time.

11. Terms and Conditions

Terms and Conditions of Sale

The following terms and conditions will be presumed acceptable unless changes are made in writing and accepted by both parties in a reasonable amount of time.

Any standard or boilerplate terms and conditions supplied with a written purchase order will not be applicable unless accepted in writing by both parties.

Quotations: All quotations shall be in writing. Written quotations shall be valid for 30 days from the date issued. Verbal quotations or price lists are not valid.

Pricing: All pricing is in **US Dollars.** Thermo Fisher Scientific reserves the right to change pricing without notice.

Terms: Payment terms are **net 30 days** from the date of invoice with approved credit. Thermo Fisher Scientific reserves the right to deny credit or revoke previously extended credit. Past due accounts are subject to interest charges. Other acceptable payment terms are cash, certified check, money order, credit card or letter of credit confirmed by any United States of America bank. Other payment terms are not valid unless accepted in writing.

Sales taxes shall be included on the invoice unless a valid tax exemption certificate is supplied.

Return Material Authorization: Contact Thermo Fisher Scientific Customer Service for a Return Material Authorization (RMA) number. Items returned without an RMA number will be rejected.

All returned merchandise must be in unused, resalable condition, and must not be contaminated with hazardous materials.

Cancelled orders must be returned within 30 days of the date on the invoice and shall be subject to expenses incurred that may include, but are not limited to, inspection and restocking fees. Items returned within 60 days shall be subject to a restocking charge that is equal to 15% of the purchase price. Items returned after more than 60 days shall be subject to a restocking charge equal to 25% of the purchase price. Thermo Fisher Scientific reserves the right to reject any return that is not under warranty after 60 days. Non-stock items are normally not returnable.

Transportation: Orders are shipped FOB Thermo Fisher Scientific, or factory, by the most efficient means available. Appropriate charges, such as freight and insurance will be added to invoices. All shipments will be insured. Goods damaged in shipment must be reported by the recipient to the freight carrier for claims.

Thermo Fisher Scientific

Environmental Instruments
Process Water Instruments

North America
166 Cummings Center
Beverly, MA 01915 USA
Toll Free: 1-800-225-1480
Tel: 1-978-232-6000
Dom. Fax: 1-978-232-6015
Int'l Fax: 978-232-6031

Europe
P.O. Box 254, 3860 AG Nijkerk
Wallerstraat 125K, 3862 BN Nijkerk,
Netherlands
Tel: (31) 033-2463887
Fax: (31) 033-2460832

Asia Pacific
Blk 55, Ayer Rajah Crescent
#04-16/24, Singapore 139949
Tel: 65-6778-6876
Fax: 65-6773-0836

www.thermo.com/processwater

258485-001 Rev. A 01-09

Thermo
SCIENTIFIC