



Thermo Scientific™ Orion Star™ T900 Series Laboratory Titrator

User Manual

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Overview

Summary

Thermo Scientific™ Orion Star™ T900 series laboratory titrators are designed to increase your lab productivity by automating potentiometric titrations. These compact titrators are simple to use with easy navigation from setup to live titration analysis to data transfer, all on a large color graphic touchscreen display. Create and save up to ten custom user-defined methods or use preprogrammed protocols, all with onscreen instructions and help menus, so everyone in your lab can be up to speed quickly and easily.

We have integrated our core electrochemistry technology with a state-of-the-art reagent dispensing system to create a modern, simplified automated titrator designed to make performing titrations easier, more reliable, more reproducible and faster than manual titrations. Our automated titrators expand the number of ions and compounds that can be measured beyond direct electrode analysis and offer dynamic process controls that adjust the titration to optimize analysis results.

The Orion Star T900 series titrators include four models, the Orion Star T910 pH titrator, Orion Star T920 redox titrator, Orion Star T930 ion titrator and Orion Star T940 all-in-one titrator. These titrators have the ability to calibrate the electrode (sensor), standardize titrants and perform various types of potentiometric titrations. The Orion Star T930 ion titrator and Orion Star T940 all-in-one titrator offer the added benefit of multiple known addition (MKA) analysis, where the titrator performs an automated calibration and calculation of sample concentration by adding aliquots of standard to sample.

Ideally suited for dedicated, routine measurements, the Orion Star T900 series titrators are designed to help laboratories overcome problems of sample throughput or analytical complexity through automation of analysis. What differentiates the Orion Star T900 series titrators from other single parameter instruments and automatic titrators are their simplicity. All of the setup procedures appear on the display in the form of easy-to-understand, sequential menus. Because the analysis is automated, each titration step is carried out consistently time after time, operator to operator, using a high precision burette that meets ISO 8655 standard. Whether your analysis is acidity of juices, alkalinity of water, surfactants in shampoo, fluoride in drinking water or Vitamin C in juices, the Orion Star T900 series titrators offer a simple system to automate your measurements.

This user manual provides instructions for the Orion Star T910 pH titrator, Orion Star T920 redox titrator, Orion Star T930 ion titrator and Orion Star T940 all-in-one titrator. Detailed information on titrator installation, setup, operation and features is provided in the appropriate sections of this user manual. Please visit www.thermofisher.com/water for additional information on Thermo Scientific Orion instruments, electrodes and solutions.

Use the Orion Star T910 pH titrator for dedicated acid-base titrations including titratable acidity of juices and wines, acidity of food products, alkalinity of waters, acidity and alkalinity of consumer products, total acid number (TAN) and total base number (TBN). Titration techniques include equivalence point titrations and preset pH endpoint titrations.

Use the Orion Star T920 redox titrator for dedicated redox titrations including sulfite/SO₂ and reducing sugar in juice and wine, ascorbic acid (vitamin C) and peroxide value in food products, dissolved oxygen in wastewater by Winkler titration and organic matter in soil. Titration techniques include equivalence point titrations and preset mV endpoint titrations.

Use the Orion Star T930 ion titrator for dedicated ion concentration titrations including salt in food products, chloride in drinking water and wastewater, ammonia and Total Kjeldahl Nitrogen (TKN) of wastewater, surfactants in consumer products and total hardness of drinking water and wastewater. Titration techniques include equivalence point titrations and preset mV endpoint titrations plus multiple known addition (MKA) mode. Using MKA mode, the titrator performs an automated calibration and calculation of sample concentration by adding aliquots of standard to sample, removing the need for a separate calibration and minimizing matrix effects.

Use the Orion Star T940 all-in-one titrator for flexible pH, redox and ion concentration titrations including equivalence point titrations, preset pH or mV endpoint titrations plus multiple known addition (MKA) mode for automated known addition of various ions.

Terminology

The terminologies used in this user manual is explained here

Titration

The device used to perform the titration, titrant standardization or direct measurement.

Titration

Reagent of known concentration that is added to a sample and results in an observable reaction and endpoint or equivalence point.

Sample

Solution of unknown concentration that is titrated using a titrant to determine the concentration.

Burette

Component that dispenses a measured volume of titrant into the sample by pulling the titrant from the reagent bottle into the burette and then pushing the titrant from the burette to the dispensing probe and into the sample.

Electrode

Also called probe or sensor, the device in the solution performing the measurement.

Mode

Measurement type being used by the titrator (pH, mV, ISE).

Method

A set of saved parameters and values for a particular titration including the electrode, titrant and titration setup parameters as well as electrode calibration and titrant standardization when applicable.

pH

pH measurements compares the relative acidity or alkalinity of a solution at a given temperature. A pH of 7 describes a neutral solution because the activities of hydrogen and hydroxide ions are equal. When the pH is below 7, the solution is described as acidic because the activity of hydrogen ion is greater than that of hydroxide ion. A solution is more acidic as the hydrogen ion activity increases and the pH value decreases. Conversely, when the pH is above 7, the solution is described as basic (or alkaline) because the activity of hydroxide ion is greater than that of hydrogen ion.

Redox / ORP

ORP (Oxidation / Reduction Potential) measures the oxidizing or reducing nature of a sample. This gives an overall indication of how "reactive" the sample is. ORP measurements are common in water, wastewater, process water and plating bath applications.

ISE (Ion Selective Electrode)

Ion selective electrodes measure the concentration of specific ions in sample solutions such as water, wastewater, consumer goods and pharmaceuticals. Ion selective electrodes are available for ammonia, ammonium, bromide, cadmium, calcium, carbon dioxide, chloride, chlorine, cupric, cyanide, fluoride, fluoroborate, iodide, lead, nitrate, potassium, silver, sodium, sulfide, surfactant and thiocyanate.

All-in-One

Titrator that combines the functionality of the pH, redox and ion titrators into one unit.

Titration

Technique that is based upon the addition of a reagent (titrant) that reacts with the sample species. The changes in electrode potential are observed and sample concentration is calculated from the volume of reagent that is chemically equivalent to the sample species.

Equivalence/Inflection Point Titration

Technique of adding small aliquots of a titrant to the sample, recording the potential changes, and applying a first derivative analysis to the data, from which the endpoint is calculated. The technique assumes that the change in mV reading per volume of titrant added will be greatest at the endpoint. This technique is a very precise technique for performing routine titrations.

Preset Endpoint Titration

Type of titration where aliquots of the titrant are added until a predetermined mV or pH value is reached. This is a fast way to do a titration, but requires that the sample and its reaction with the titrant be well known. The preset endpoint technique is useful for analyses without a clearly defined endpoint and is often a technique required by industry standards.

Multiple Known Addition (MKA)

Known addition is a technique of adding small aliquots of the species of interest to the sample and calculating the original sample concentration from the observed changes in potential. The electrode chosen for analysis should sense the species of interest. This technique helps minimize matrix effects and offers greater precision than direct calibration measurement.

In multiple known addition, three or more additions are made to the sample allowing electrode slope, E_o , sample concentration and a spike recovery to be calculated. This is a very precise technique because the calibration is performed directly in the sample matrix during analysis.

Unique benefits of multiple known addition include the level of precision of the analysis may be chosen and each sample analysis is automatically verified by a spike recovery analysis.

Direct Titration

Technique in which the titrant reacts directly with the chemicals in the sample solution and titrant consumption is directly related to the quantity of the chemicals in the sample.

Back Titration

Technique in which excess quantity of a reagent is added to the sample, so that the entire sample reacts with the reagent and some un-reacted reagent remains. The un-reacted excess reagent is titrated with suitable titrant. If the amount of reagent added to the sample is known, the sample concentration can be calculated.

Blank Titration

A blank is used when performing a back titration or when a background correction is necessary (background level of the measured species is present prior to analysis). The blank value can be manually entered or calculated by performing a titration. If a blank value is entered, make sure that all samples analyzed by that method are prepared in the same manner. Most routine titration methods do not require a blank.

ROSS pH Electrodes

Not all pH electrodes are created equal – It is critical that the measurements customers perform day-to-day are accurate and reproducible. Customers rely on their pH electrodes to measure their samples quickly and precisely, making pH electrodes an essential part of the lab. ROSS pH electrodes offer superior measurement stability, fast response, high accuracy and precision even in samples with varying temperatures, no long-term drift and long lifespan.

Orion Ion Selective Electrodes (ISEs)

Measurement by an ion selective electrode (ISE) can be performed in virtually every laboratory. Efficient and Economical - Electrode measurements are simpler and faster than other analytical techniques. Time consuming sample steps such as filtration and distillations are rarely needed and analysis time is typically 1-2 minutes per sample. Compared to other analysis methods, there is a relatively small setup cost. Ion selective electrodes can be used for determination of a titration end point and are useful as end point detectors because they are unaffected by sample color or turbidity.

Orion Electrochemistry Solutions

Customers need to be able to rely on their measurements and using high-quality solutions to calibrate and maintain electrodes is the best way to ensure data is both accurate and reproducible. Using low-quality, home-made, or expired buffers can lead to measurement errors, which require lengthy troubleshooting, or even worse – can go unnoticed. Using high-quality solutions eliminates one of the major causes of measurement inaccuracy.

Orion solutions are manufactured for accuracy and repeatability to the highest quality standard in the industry. Orion solutions are produced in controlled batches using ultra pure water and undergo rigorous quality testing throughout the process to prevent contamination before and after bottling. Buffers and standards have lot-specific certificates of analysis with NIST-traceable testing results.

Safety Precautions

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. Thermo Fisher Scientific will not be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. Thermo Fisher Scientific reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the Thermo Fisher Scientific website. Intended operators should read and understand the entire manual before operating this system. Special attention should be given to all safety and caution notes contained in this manual and the Low voltage Directive (LVD) document. Failure to do so could result in serious injury to the operator or damage to the equipment.



WARNING: Indicates situations where dangerous voltages exist and potential for electrical shock is present.



This symbol indicates that a risk of explosion is present.

Orion Star T900 Series titrators utilize instrument technology that complies with all industry recognized safety rules. Certain hazards may arise in extraneous circumstances. NEVER open the housing of the instrument. It is not meant to be maintained or repaired by the user. Opening the instrument may jeopardize the safety and accuracy of the instrument. If you ever have problems with your instrument, contact your authorized Thermo Fisher dealer or service representative.

Definition of Signal Warnings and Symbols

Safety notes are marked with signal words and warning symbols. These show safety issues and warnings. Ignoring the safety notes may lead to personal injury, damage to the instrument, malfunctions and false results. Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.



CAUTION: Indicates a hazardous situation with low risk, resulting in damage to the device or the property or in loss of data, or minor or medium injuries if not avoided.



WARNING: Indicates a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided.

ATTENTION: Indicates important function of the product.

Note: Indicates useful information about the product.

Intended Use

This instrument is designed to perform potentiometric titrations in laboratory environment by knowledgeable laboratory technicians trained to operate titrations. It is suitable for the processing of reagents and solvents. The use requires knowledge and experience in working with toxic and corrosive substances which pose inherent danger. Use of this instrument requires knowledge and experience working with application specific reagents, which may be toxic or hazardous.

Location Safety

The instrument has to be operated indoor only and must not be used in explosive environment. Place the instrument in a well ventilated location at which it can rest in leveled position, protected from direct sunlight or sources of excessive heat, corrosive atmosphere and mechanical upset (danger of being knocked down, exposed to strong vibrations etc.). Operate at temperatures between 5°C and 40°C. Avoid environment with frequent temperature changes as they influence bubble formation and potentially affect the accuracy.



CAUTION: Always wear protective clothing in the laboratory when working with the instrument. A lab coat and eye protection such as goggles should be worn. Use appropriate (and undamaged) gloves when handling chemicals or hazardous substances.



WARNING! Risk of electric shock: Power to your instrument is supplied with a 3-pin grounded power cable. Always maintain the grounding of the instrument for safety reasons. Never use ungrounded electrical outlet or extension cables without grounding conductors. NEVER defeat the grounding intentionally.

WARNING! Risk of corrosion: Tubing, connections and loose titration vessels are a safety risk. They all can leak corrosive liquids. To prevent this:

1. Make sure all connections are tightened well by hand, avoiding excessive force to prevent damage.
2. When making tubing connections, be careful to avoid cross threading of the fitting.
3. Inspect all tubing for signs of rupture or other damage.
4. Inspect all vessels for signs of damage or leaks.
5. Before using corrosive or toxic reagents, run the test with water to make sure all leak free and safe.



WARNING! Flammable solvents:

All relevant safety measures must be observed when working with flammable solvents and chemicals. Always consult SDS (Safety Data Sheet) for the liquids that will be used.



1. Your workplace must not be in proximity of any sources of flame or excessive heat.
2. Always consult and comply with SDS (Safety Data Sheet) and recommendations from the manufacturer for any solvents and chemicals.
3. Always observe general lab safety rules.



WARNING! Chemicals: All relevant safety measures are to be observed when working with chemicals.

1. Set up the instrument in a well-ventilated location.
2. Any spills should be wiped off immediately.
3. Always consult and comply with MSDS and recommendations from the manufacturer for any solvents and chemicals.



WEEE Compliance: This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2012/19/EU. It is marked with the symbol shown here. Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State and this product should be disposed of or recycled through them. Further information on compliance with these directives, the recyclers in your country, and information on Thermo Scientific Orion products that may assist the detection of substances subject to the RoHS Directive are available by contacting us using the WLP information on the back page of this user manual.

Unpacking and Initial Setup

Unpacking Titrator

Unpack the Orion Star T900 Series Titrator from its shipping carton and inspect it for damage. Verify that all the parts listed here are included.

If damage is evident or if the shipment is incomplete, please contact the Customer Service Department. It is recommended that you keep the titrator box, and do not destroy it during unpacking, so it can be used for possible future use.

The box contains the following:

- Titrator
- 20 mL Burette
- Burette Cover
- Electrode Holder
- Stirrer Probe
- Dispenser Probe
- Tubing Kit
- Desiccant Tube
- Reagent Bottle Holder
- 1 L Plastic Reagent Bottle
- GL38 Reagent Bottle Cap
- USB Computer Cable
- USB Flash Drive with User Manual
- 110-240 V Power Adapters

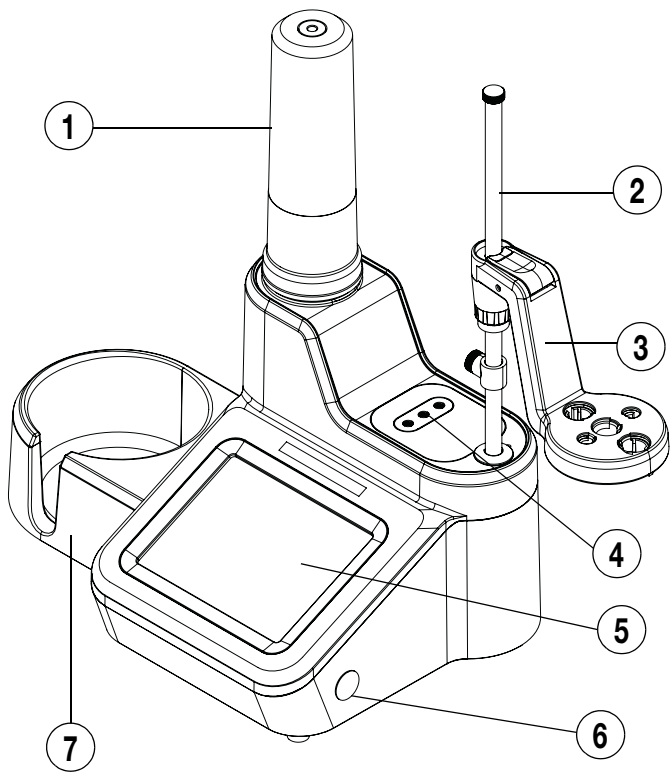


Figure 1. Laboratory Titrator and Components

1	Burette Cover	5	Touch Screen
2	Electrode Holder Shaft	6	On/Off Button
3	Electrode Holder Head	7	Reagent Bottle Holder
4	Tubing Connections		

Attaching the Electrode Holder Shaft Assembly to the Titrator Unit

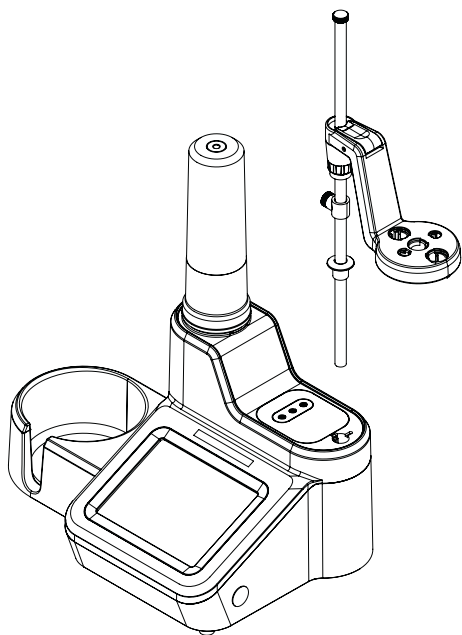


Figure 2. Electrode Holder Shaft Attachment

1. Install Electrode Holder Shaft by inserting the shaft into the hole on the top of the titrator and align the slots on the shaft with the tracks on the holder. Refer **Figure 2**.
2. Fasten Electrode Holder Shaft to Titrator by tilting the unit and tightening the supplied fastener. The fastener is a captive screw accessible through the hole on the bottom of the Titrator. A Torx T20 drive type screwdriver is included with the titrator for this step of installation. Refer **Figure 3**.

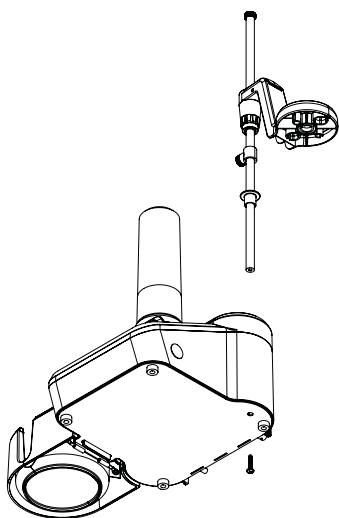


Figure 3. Fastener Location for Tightening the Electrode Holder Shaft

3. Adjust the Electrode Holder Head onto the Electrode Holder Shaft by depressing the release button and sliding it to the appropriate location on the shaft. Refer to **Figure 4**.

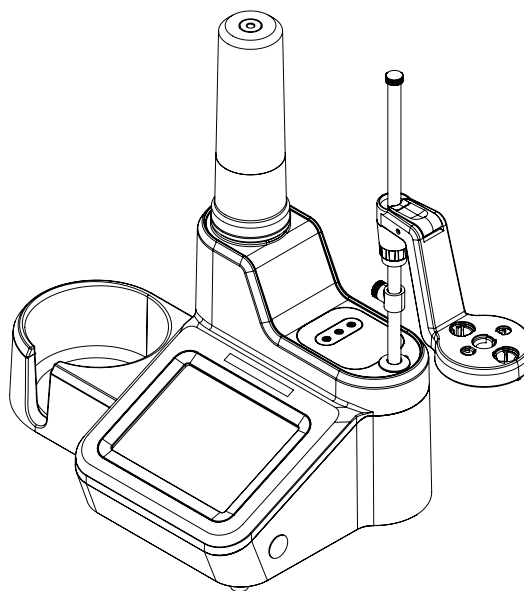


Figure 4. Positioning the Electrode Holder to the Electrode Holder Shaft

4. Insert the electrodes and probes into the labeled slots on the electrode holder head.
5. As appropriate, adjust the location of the stopper on the electrode holder shaft to limit how far down the electrode holder head can be moved. This may be helpful to prevent electrode breakage.
6. As appropriate, use the cable management accessory to organize electrode cables and wires.

Installing the Burette

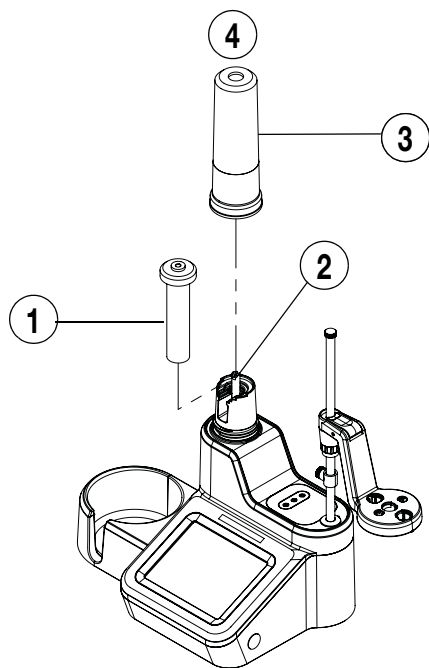
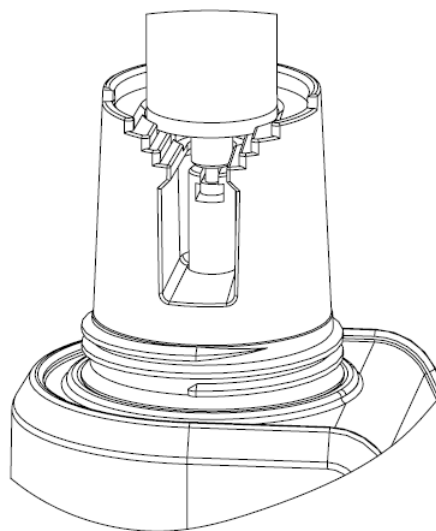
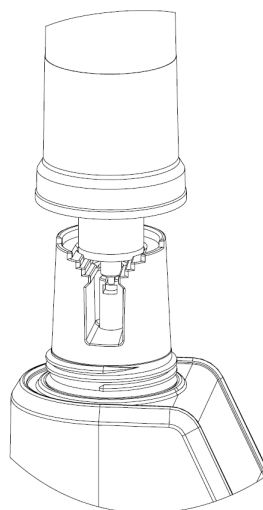


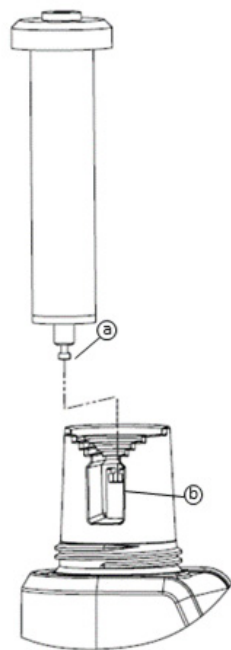
Figure 5. Positioning the Burette to the Unit



2. Seat the glass cylinder of the burette onto the alignment rings of the titrator by gently pressing down on the burette.



3. Place the burette cover over the burette, gently screw on the cover and ensure the top of the burette is aligned with the opening on the cover.



1. Holding the center of the glass burette, gently align the piston ball on the burette (a) with the clasp on the titrator (b).

Installing the Tubing

The Orion Star T900 series tubing kit contains three different tubings - burette to valve tubing with blue fittings, reagent bottle cap to valve tubing with white fittings and dispenser probe to valve tubing with black fittings. The connection ports are listed in **Figure 6**.

Burette:

Connect the tubing with blue fittings to the valve port labeled “burette” and the burette cap.

Bottle:

Connect tubing with white fittings to the valve port labeled “bottle” and the reagent bottle cap.

Dispenser:

Connect the tubing with black fittings to the valve port labeled “dispenser” and the dispenser probe.

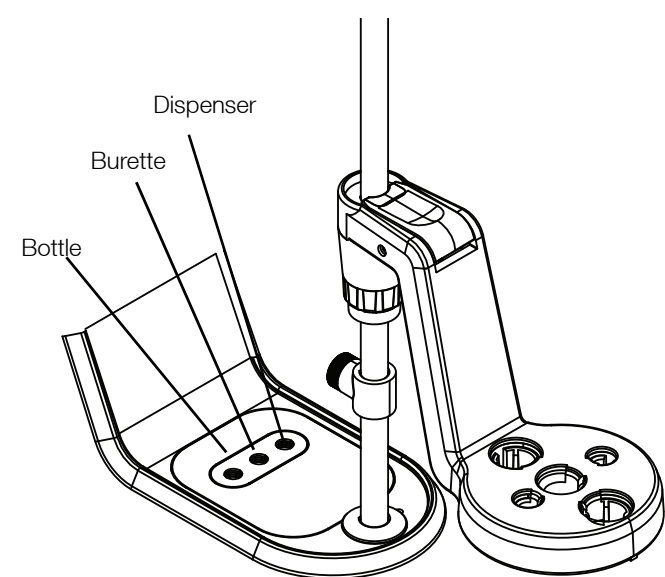


Figure 6. Connection Ports

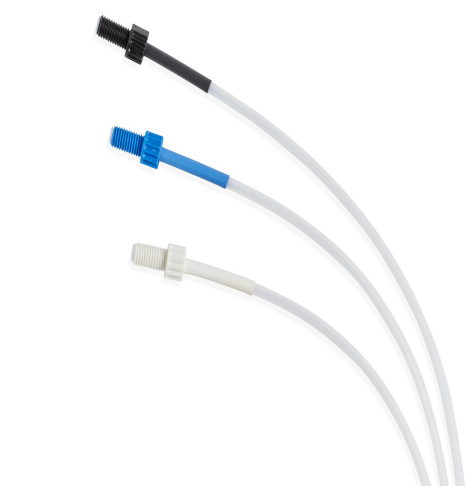


Figure 7. Tube Set of the Titrator

Note: When replacing tubing, always ensure that fittings are clean and free of debris prior to making connections with ports.

Connecting the Titrator with Accessories and Devices

Back Panel



Figure 8. Back Panel of the Titrator

1	Electrode BNC	5	USB A (2)
2	Electrode REF	6	USB B
3	ATC	7	Power
4	Stirrer		

Universal Power Adapter

The power adapter is of universal type and can be used for any voltage in the range 100-240 V AC, 50-60 Hz. It is a bench-top style with a barrel type connector for input into the instrument.

1. Select the power cord that fits your regional power outlet and plug it into the IEC receptacle on the power adapter.
2. Plug the barrel type connector into corresponding power inlet on the instrument.
3. Plug in the power cord into the power outlet.

Note: A universal power adapter and country specific AC power cords for US, EU, UK, AU, and China are included with the Orion Star T900 series titrator. Use of other power adapters can damage the titrator and will void the warranty.

Note: The use of a surge protector or uninterrupted power supply (UPS) is also recommended.

Connecting Electrodes and Stirrer Probe

- a. Connect the sensing electrode to the **BNC** input.
- b. If appropriate, connect the half-cell reference electrode to the **REF** input.
- c. If appropriate, connect the **ATC** temperature probe to the **ATC** input.
- d. Connect the stirrer probe to the **STIRRER** input.
- e. Connect appropriate external devices to the **USB A** and **USB B** inputs.
- f. Connect the power supply to the **POWER** input.

Note: Care should be taken to properly use the locking feature on the ATC connector to lock on to the instrument housing.

For proper accuracy, stirrer is a necessity. The titrator is equipped with a probe style stirrer which should be connected to the 3.5 mm phone connector on the back panel, and the body should be placed into the middle position on the electrode holder arm. This arrangement of the electrodes, dispensing tip and stirrer aids in effective stirring and accuracy. Stirrer speed is adjustable depending on the conditions, liquid volume etc.

Connecting a Printer

Use the USB A connector to connect the titrator to the compact printer, catalog number STARA-106. After establishing physical connection with the printer using USB cable, the titrator will automatically detect the printer. No further setup is needed.

Connecting a USB device

Use USB A connector on the back panel to connect external devices to the titrator including a USB flash drive (USB memory stick, USB thumb drive). In this case, Titrator will be a host to devices.

Computer

Use the USB B connector on the back panel to connect to a computer. The Orion Star T900 Series Computer Software, Cat. No. START-PC1, is available for data transfer from the titrator to a computer.

Operation

User Interface

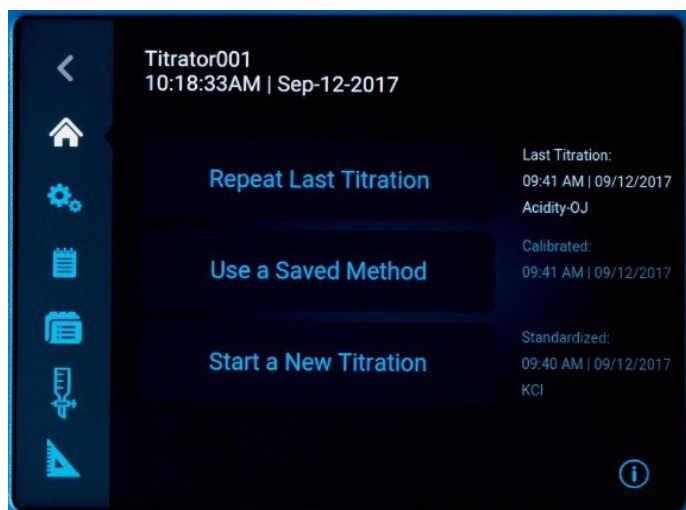
Titration Startup

To start up the Titrator, complete the following steps

1. Plug the titrator into the power outlet.
2. Press the power switch located on the side of the titrator.
3. The Thermo Scientific logo is displayed on the front screen.
4. If this is the first time the titrator is turned on, the Instrument Setup Wizard will be shown. Tap the “Start Setup” button to initiate. The screens walk through general settings including language, time and format, date and format, temperature units and instrument name.
5. After the Instrument Setup Wizard is completed, the next time the titrator is powered on it will proceed directly to the home screen.

Home Screen

The Home screen will display the buttons and information appropriate for the current conditions and settings, so not all buttons may be shown at all times.



For example, the first time the titrator is started, only the “Start a New Titration” button will be shown.

- The “Start a New Titration” button will access the step-by-step workflow for setting up a new titration, including setting electrode, titrant and titration parameters.
- The “Repeat Last Titration” button will navigate directly to the Titration Pre-Check screen – the most recently used set of electrode, titrant and titration setup parameters, as well as electrode calibration and titrant standardization results (when appropriate), will be used to calculate the titration results.
- The “Use a Saved Method” button will navigate to the Methods section used to create, edit or run a method.

The left-side navigation area contains the icons for Back (navigation), Home, General Settings, Logs, Methods, Burette and Direct Measure

	The “Back” icon will navigate to the last displayed screen when it is active – it will be colored blue when it is active and colored grey when it is not active
	The “Home” icon will navigator back to the Home screen
	The “General Settings” icon will navigate to the General Settings section
	The “Logs” icon will navigate to the Logs: Titration, Titrant, Calibration and Direct Measure section
	The “Methods” icon will navigate to the Methods section
	The “Burette” icon will navigate to the Burette Setup and Maintenance section
	The “Direct Measure” icon will navigate to the Direct Measure section

The lower right hand corner of the home screen contains an “information” icon that provides screen-specific information and guidance.

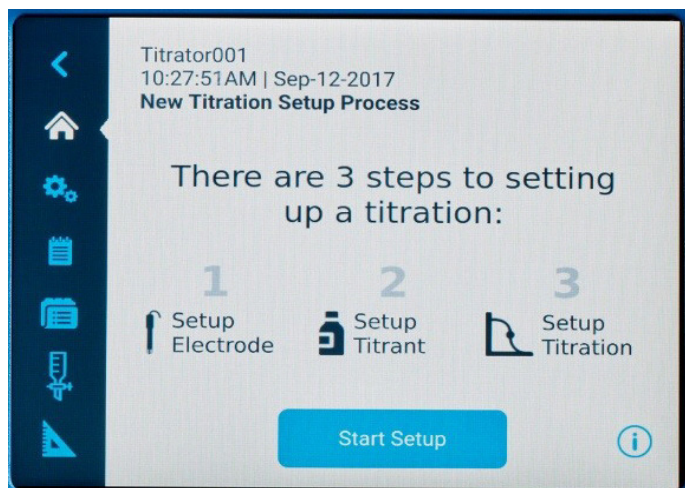
The right-side navigation area contains the most recent titration information after a sample titration is performed, as well as electrode calibration and titrant standardization information when appropriate.

When a method is not active:

- The “Electrode” button will be shown and will navigate to the Electrode Setup section for an unsaved method
- The “Titrant” button will navigate to the Titrant Setup section for an unsaved method
- The “Titration” button will navigate to the Titration setup section for an unsaved method

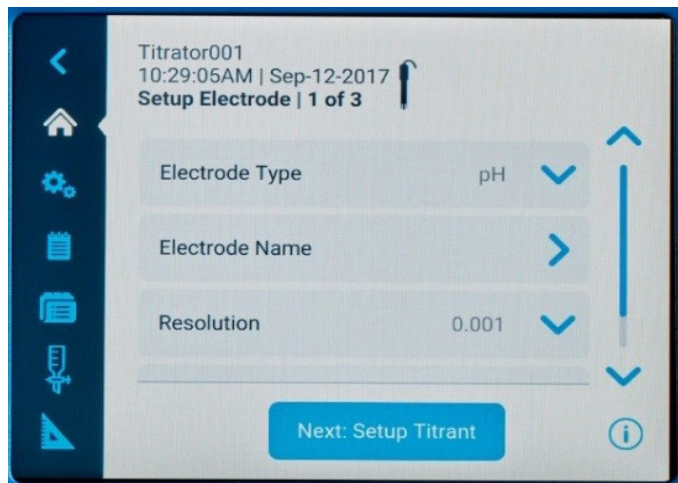
Start a New Titration

From the Home screen, when the “Start a New Titration” button is pressed, the titrator will display a series of screens designed to walk the user through the setup and actions needed to complete a titration.



Step 1: Setup of Electrode

Parameters related to the electrode will be displayed and editable. Not all parameters may be shown, depending on the titrator model and previous parameter selections.

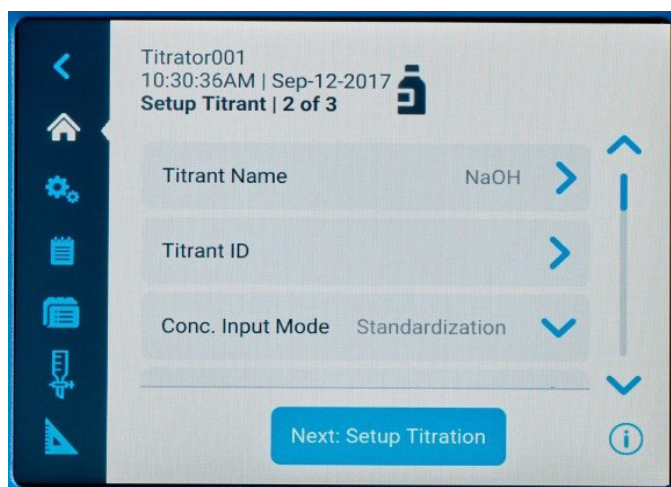


- Electrode Type (Orion Star T930 and Orion Star T940 only): Select what type of titration can be performed.
 - pH = titration using a pH electrode
 - Redox = titration using a redox electrode
 - ISE-Titration = titration using an ion selective electrode
 - ISE-MKA = Multiple Known Addition analysis using an ion selective electrode

- Electrode Name: Enter a name using up to 14 alphanumeric characters.
- For pH as electrode type (Orion Star T910 and Orion Star T940 only):
 - Resolution: Select 0.1, 0.01 or 0.001 pH resolution
 - Buffer Group: Select USA (1.68, 4.01, 7.00, 10.01, 12.46) or DIN (1.68, 4.01, 6.86, 9.18)
- For ISE as electrode type (Orion Star T930 and Orion Star T940 only):
 - ISE Type: Lists the Ion Selective Electrodes that can be used in titrations including generic ions such as X^- and X^+
 - Significant Digits: Select 1, 2, 3 or 4 significant digit resolution
 - Direct Measure Units: Select the unit for the measurement value in the direct measure mode

Step 2: Setup of Titrant

Parameters related to the titrant are displayed and editable. Not all parameters may be shown, depending on the titrator model and previous parameter selections.

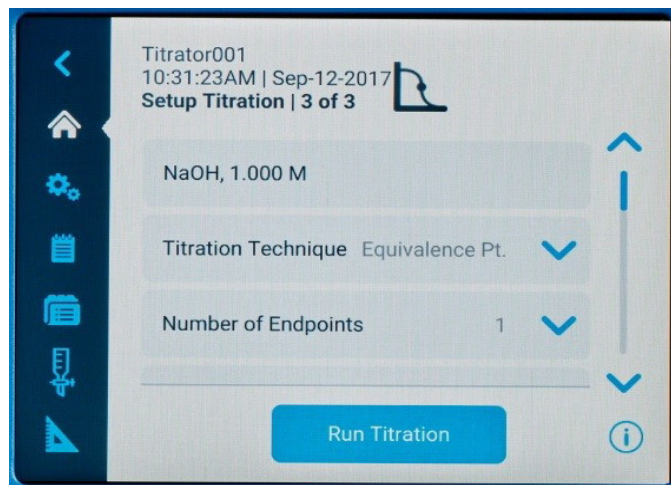


- Titrant Name: Select a common titrant from the list or select "User Defined"
 - User Defined Titrant Name: Enter a name using up to 14 alphanumeric characters
- Titrant ID: Enter a titrant ID using up to 14 alphanumeric characters – the ID can help identify and track the titrant in a method.

- **Conc. Input Mode:** Select how the concentration of the titrant will be determined
 - Select “Manual Entry” to enter the exact concentration of the titrant in M or mM
 - Select “Standardization” to run a titration to determine the exact concentration of the titrant
- **Nominal Concentration:** Enter the expected concentration value of the titrant to be standardized in M or mM.
- **Standardize Tech.:** Select “Equivalence Point” or “Preset Endpoint” as the titration technique that will be used to determine the titrate concentration.
- **Result Units:** Select M or mM as the units displayed for the determined titrant concentration value.
- **Standardize Reaction Ratio:** Enter the stoichiometric reaction of the standard to titrant, as moles standard divided by moles titrant.
- **Standard Name:** Select a common standard from the list or select “User Defined”
 - **User Defined Standard Name:** Enter a name using up to 14 alphanumeric characters
- **Standard Amount:** Select the method the standard amount will be entered:
 - Select “Fixed Weight” or “Fixed Volume” if the amount of standard will be the same for repeated cycles and then enter the value in grams or mL
 - Select “Variable Weight” or “Variable Volume” if the amount of standard will be different for repeated cycles –before each standardization cycle, enter the value in grams or mL
- **Standard Molecular Weight:** Enter the molecular weight of the chemical used as the standard.
- **Standard Purity:** Enter the percentage of actual chemical in the material used as the standard.
- **Standard Concentration:** Enter the concentration of the chemical used as the standard in M.
- **Pre-dose Titrant Volume:** When the endpoint volume is well known, enter a volume of titrant to be added to the standard before the titration begins to shorten titration time.
- **Max Total Titrant Volume:** Enter the maximum amount of titrant to be added during the titration as a safety feature to stop the analysis if the endpoint is not determined.
- **Standardization Process Control:** Select “Routine”, “Quick”, “Careful” or “User Defined” to set the dynamical process controls that adjust the titration to optimize analysis results.
- **Pre-stir Duration:** Enter the time in seconds to stir the solution prior to the start of the titration to ensure mixing.
- **Stir speed:** Select the speed of the stirrer probe as “Very Slow”, “Slow”, “Medium”, “Fast” or “Very Fast” to mix the solution thoroughly without causing a vortex, bubbles or splashes.

Step 3: Setup Titration

Parameters related to the titration are displayed and editable. Not all parameters may be shown, depending on the titrator model and previous parameter selections.



- The titrant information is shown in the first row for reference only.
- **Titration Technique:** Select “Equivalence Point” or “Preset Endpoint” as the titration technique that will be used to determine the sample concentration.
- **Number of Endpoints:** Select 1 or 2 equivalence points or select 1, 2 or 3 preset endpoints.
- **Endpoint Values:** If Preset Endpoint is selected, enter the values of the endpoints.
- **Display Units:** If pH Equivalence Point is selected, select the displayed units as “pH” or “mV”.
- **Titration Type:** Select “Direct Titration” or “Back Titration” as the titration type that will be used to determine the sample concentration
 - If Back Titration is selected, the following parameters will be shown, some dependent on previous parameter selections:
 - Reagent Reaction Ratio
 - Titrant Reaction Ratio
 - Reagent Amount
 - Reagent Molecular Weight
 - Reagent Purity
 - Reagent Weight
 - Reagent Volume
 - Reagent Concentration
- **Blank Required (Fixed):** Select “No”, “Fixed” or “Variable” for the blank value entry method.

- **Result Units:** Select the units from the list that will be used for the sample concentration results
 - **F* Consumption mmol:** Enter a value for the factor (no units), factor value will be multiplied by the result millimoles
- **Reaction Ratio:** Enter the stoichiometric reaction of the sample to titrant, as moles sample divided by moles titrant.
- **Sample Molecular Weight:** Enter the molecular weight of the chemical used as the sample.
- **Sample Amount:** Select the method the sample amount will be entered:
 - Select “Fixed Weight” or “Fixed Volume” if the amount of sample will be the same for repeated cycles and then enter the value in grams or mL
 - Select “Variable Weight” or “Variable Volume” if the amount of sample will be different for repeated cycles –before each titration cycle, enter the value in grams or mL
- **Sample Density:** Enter the density of the chemical used as the sample.
- **Pre-dose Titrant Volume:** When the endpoint volume is well known, enter a volume of titrant to be added to the sample before the titration begins to shorten titration time.
- **Max Total Titrant Volume:** Enter the maximum amount of titrant to be added during the titration as a safety feature to stop the analysis if the endpoint is not determined.
- **Standardization Process Control:** Select “Routine”, “Quick”, “Careful” or “User Defined” to set the dynamical process controls that adjust the titration to optimize analysis results.
- **Pre-stir Duration:** Enter the time in seconds to stir the solution prior to the start of the titration to ensure mixing.
- **Stir speed:** Select the speed of the stirrer probe as “Very Slow”, “Slow”, “Medium”, “Fast” or “Very Fast” to mix the solution thoroughly without causing a vortex, bubbles or splashes.
- **Sample ID:** Select “None”, “Auto-Incremental” or “Manual” for the sample identification mode:
 - For Auto-Incremental, enter up to 11 alphanumeric characters and three number places will be added that will automatically increase with each titration run, beginning with 001
 - For Manual, before each titration run enter the sample ID

General Settings

The General Settings screen will display a list of titrator settings for Diagnostics, Display, Files and Info and Notifications.

Tap the Diagnostics button to access the factory reset option for the titrator.

Tap the Display button to access settings for the display brightness, instrument name, date and date format, time and time format, language, temperature input and temperature units.

Tap the Files and Info button to view the serial number, model number and firmware revision for the titrator and to perform an update on the titrator firmware.

Tap the Notifications button to access the Titration Cycle Complete, Maximum Titrant Volume, Data Log Full, Calibration Due and Maintenance Due settings. Each setting can be turned off or on. When a notification is on, an audible beep is transmitted, with a popup warning as needed, when the appropriate conditions are met.

- **Titration Cycle Complete** – Audible beep when the titration cycle is done.
- **Maximum Titrant Volume** – Audible beep when the titration maximum volume is reached.
- **Data Log Full** – Audible beep and warning popup when any of the available data logs (Titration, Titrant, Calibration and Direct Measure) are within 5% of being full.
- **Calibration due** – Audible beep and warning popup when the entered number of hours has elapsed without a calibration being performed for the selected electrode type.
- **Maintenance Due** – Audible beep and warning popup when the selected maintenance time interval of 1 month, 3 months, 6 months or 12 months has elapsed, designed as general reminder for changing items such as the tubing, valve, burette or electrode.

Logs

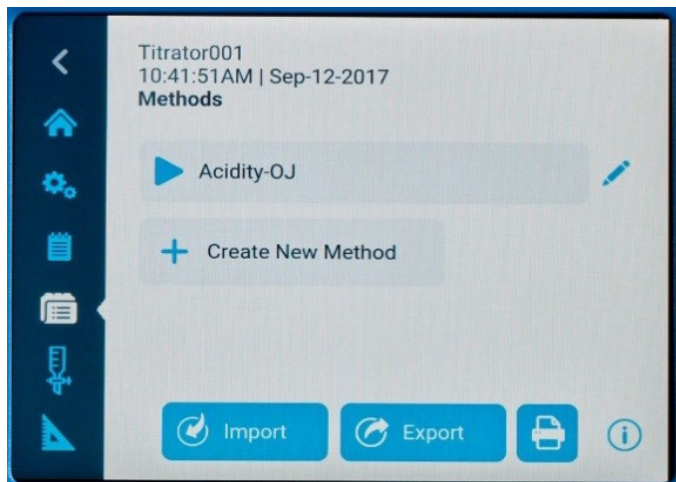
The Logs screen will display the active data logs: Titration Log, Titrant Log, Calibration Log and Direct Measure Log.

Each data log will save up to 100 data sets and once full, the oldest data set will be overwritten with the newest data set.

Data logs can be exported to a USB flash drive as a CSV or Report (PDF) file in short or long format and send to the compact printer (Cat. No. STARA-106) in short or long format.

Methods

The Methods screen will display a list of all available methods followed by the “Create a New Method” button.



A total of ten unique methods may be saved, edited, imported or exported.

When a saved method is password protected, a Lock icon will be shown in addition to the Edit icon to the right of the method name

- Press an existing method to directly proceed to the Pre-Check screen of the titration using the selected method
- Press and hold an existing method to view a popup Quick View window with a summary of key method information, then choose to cancel viewing, edit or use the method
- Press the "Edit" icon to the right of a saved method name to edit the method including Edit Name and Password, Edit Electrode, Edit Titrant, Edit Titration, Copy Method and Delete Method
- Press the "Create New Method" button to create a new method
- Press the "Print" icon to print the saved methods

When a USB flash drive that contains recognizable methods is connected with the titrator, the titrator will detect the presence of methods on the USB flash drive. Methods can be imported from the Methods screen by pressing the "Import" button.

When a USB flash drive is connected with the titrator, methods can be exported to the connected USB drive by pressing the "Export" button on the Methods screen – exported methods can be saved as a backup or imported onto another titrator.

Burette

The Burette screen will display burette setup and maintenance items.

- Burette Size: Tap to select the burette size from the dropdown list of 10 mL, 20 mL or 50 mL.
- Installation Data: Tap to enter the installation data of the burette, designed as general reminder for changing the burette.
- Rinse Cycles: Tap the decrease (-) or increase (+) icons to change the number of rinse cycles for the burette and then press the "Rinse" button to start the rinse cycles.

Note: Place a waste beaker under the dispenser probe before starting the rinse cycles!

- Dispense Volume: Tap the field below Dispense Volume to select "Continuous" or "Preset Value".
 - For the Continuous setting, press and hold the "Dispense" button to manually flush a desired amount of solution through the burette
 - For the Preset Value setting, enter a volume of solution and then press the "Dispense" button to dispense the set volume through the burette

Direct Measure

The Direct Measure screen will display a live electrode reading, helpful for checking sample measurements before performing a titration.

Frequently Asked Questions

What is titration?

Titration is an analytical technique which allows the quantitative determination of a specific substance (analyte) dissolved in a sample. It is based on a complete chemical reaction between the analyte and a reagent (titrant) of known concentration which is added to the sample:

Analyte (sample) + Titrant (Reagent) → Reaction Products

The titrant is added until the analyte is either neutralized or completely reacted. In order to be suitable for a determination, the end of the titration reaction has to be observable. This means that the reaction has to be monitored (indicated) by appropriate techniques such as a sensor or by color. The volume of the dispensed titrant is used in the calculation of the analyte concentration based on the stoichiometry of the chemical reaction. Titration reactions ideally are fast, complete, unambiguous and observable. A well-known example is the titration of acetic acid in vinegar with sodium hydroxide.

Which types of chemical reactions are used in titration?

The most common assay reactions used in titration are the following:

- Acid/Base reactions for example: Acid content in wine or milk or ketchup
- Ion Selective reactions for example: Chloride content in snack foods such as potato crisps/chips or ketchup
- Precipitation reactions for example: Salt content in snack foods such as potato crisps/chips or ketchup; Sulfate content in mineral water; Sulfate content in electroplating bath
- Redox reactions for example: Copper, Chromium and/or Nickel content in electroplating baths
- Complexometric reactions for example: Total hardness of water (Mg and Ca); Calcium content in Milk and Cheese or Cement
- Colloidal precipitation reaction for example: Anionic surfactant content in detergents, washing powders or liquid cleanser

What is the difference between preset endpoint and equivalence point titration?

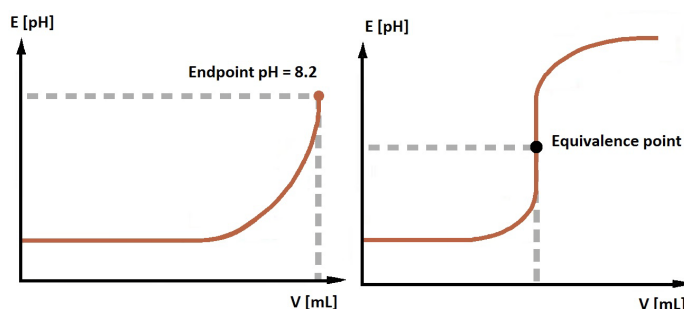
The equivalence point is the exact point in a titration when moles of one titrant equal the moles of the analyte. The preset endpoint is the point where the system changes when the moles of the reacting titrant exceed the moles of the analyte.

Preset Endpoint titration mode (EP):

The preset endpoint mode represents the classical titration procedure: the titrant is added until the end of the reaction is observed, e.g., complete reaction of the analyte with titrant. With an automated titrator, the sample is titrated until a predefined value is reached, e.g. pH = 8.2.

Equivalence point titration mode (EQP):

The equivalence point, or stoichiometric point, of a chemical reaction is the point at which chemically equivalent quantities of titrant and analyte have been mixed.



What are the common sensor indication methods used in titration?

Titration can be classified according to the indication principles and the chemical reaction occurring:

Potentiometry

The concentration-dependent potential (mV) of a solution is measured against a reference potential. Examples: Acid/Base (aqueous/non-aqueous), Ion Selective Electrode (ISE), Redox, precipitation reactions.

Voltammetry

The concentration-dependent potential of a solution (mV) is measured at a constant polarizing electric current. Example: Karl Fischer water determination.

What is an automated titrator?

Automated titrators are microprocessor-controlled instruments which allow the automation of all operations involved in titration:

1. Calibration of electrode
2. Standardize the titrant
3. Titration Method Setup
4. Titration Run (Cycle)
 - a. Titrant addition
 - b. Monitoring of the reaction (Signal acquisition)
 - c. Recognition of the reaction progress
 - d. Data storage
 - e. Calculation
 - f. Results storage
 - g. Transfer of data to printer or computer/external system

How does an automated titrator work?

Automated titrators follow a defined sequence of operations. This sequence is basically the same for all point of the titration reaction is reached (titration cycle). The titration cycle consists mainly of 4 steps:

1. Titrant addition
2. Titration reaction
3. Signal acquisition
4. Evaluation

Each step has different specific parameters (e.g. increment size) which have to be defined according to the specific titration method. Additional steps are included when running complex applications. For example, pre-dose dispense reagent to adjust pH value to a starting point, dispense of an additional reagent for back titrations, and dilution of the sample are a few examples. These steps and the corresponding parameters are outlined in the titration method.

How can I find out what the software version is of my instrument?

At the home screen, press the "General Settings" icon. In the general settings screen, tap the "Files and Info" button. The serial number, model number and firmware revision for the titrator will be displayed.

How should my electrode be stored?

In most cases the best storage medium is the electrolyte contained in the reference system, as this will ensure no electrolyte movement through the junction.

In the case of half cells, there are three main types in use. The first type of half-cells is for pH, where the best storage medium is a pH 7 buffer. The second type of half-cell in common use is the ion sensitive electrode (ISE). For short-term storage most ISEs are stored in dilute (0.001M) solutions of the ion to be measured. This ensures that the electrode is

always ready for use. For long-term storage most ISEs are stored dry. The third half-cell type is the double junction (or single junction) reference electrode. This electrode should be stored in bridging electrolyte for short-term storage and should be emptied and stored dry for the long term.

How often do I need to standardize my titrant?

This depends on the stability of the titrant and storage conditions. The most common include the storage of light sensitive titrants in dark bottles e.g. iodine solutions; the protection of Karl Fischer titrants from moisture using e.g. molecular sieve or silica gel, and the protection of certain strong bases e.g. sodium hydroxide, from absorption of carbon dioxide.

How often should I calibrate my electrode?

This depends on the samples that are being measured with the electrode, but as a general rule the electrode should be calibrated at least once per day.

Why is temperature compensation important in pH measurements?

When measuring the pH of a solution there are 3 main temperature effects that should be considered.

The first is the slope of the pH electrode calibration curve given by the Nernst equation is temperature dependent. Provided the temperature of the buffers is taken into account during calibration, any difference between this temperature and that of the actual samples being measured can be mathematically compensated for. With most modern pH meters and titrators this can be done automatically.

A second effect involves real changes in pH of a sample with temperature. For e.g., a weak acid that only partly dissociates in solution. The higher the temperature of the solution, the greater will be the degree of dissociation of the acid, and therefore the lower the pH will be. This effect is sample dependent and cannot be compensated with any pH meter or titrator.

The third effect relates to the second but involves the calibration with the pH buffers. As pH buffers are often made up of acids and bases, their pH is also temperature dependent. In order that a pH meter or titrator can be calibrated correctly, it is necessary for the instrument to "know" the temperature of the buffer.

Why are my results half or double those expected?

There are two main possibilities.

Confirm the burette size has been correctly defined; e.g., titrator has been told that there is a 10 mL burette in use when in fact the burette is a 20 mL burette. In this case the results will be half of those expected.

Confirm the reaction ratio equivalent number or valency is correct. Make sure that you are titrating to the correct equivalence point.

Why is my equivalence point titration result different from my manual color titration?

This discrepancy in results is primarily noticeable when performing acid/base titrations using one of the pH color indicators. The pH indicators change color over a pH range rather than at a fixed value. The actual point at which the color change occurs is very much sample dependent and may not coincide with the chemical equivalence point. This can result in a small discrepancy. Recommendation is to standardize the titrant.

The second reason for this difference is primarily one of the sensitivity of the human eye to color change. While a color change may have already started to occur, the human eye has still not detected any change. In the typical acid/base titration using potentiometric indication with a pH sensor, the sharp change in signal occurs at the first instance of excess acid (or base).

What electrode should I use for non-aqueous titrations?

Generally there are three main electrode problems when performing a non-aqueous titration.

The first is the problem of having an aqueous electrolyte with a non-aqueous solvent. Replacing the electrolyte in the electrode easily solves this.

The second problem relates to the fact that the sample is non-conductive, resulting in a poor electrical circuit between measuring and reference half-cells or parts of the electrode if combined. This results in a noisy signal, particularly when using a sensor with a standard ceramic junction in the reference.

The third problem is associated with handling of the sensor. In order for a glass (pH) sensor to function correctly, it is necessary that the glass membrane (bulb of electrode) be hydrated. This is achieved by conditioning the electrode in deionized water.

During the non-aqueous titration this membrane is gradually dehydrated reducing the response of the electrode. To prevent this or rectify this problem the electrode should be regularly reconditioned by soaking in water.

Maintenance and Customer Service

Maintenance Schedule

- Conduct a thorough inspection of the titrator and perform any necessary maintenance every 3 months for normal operation. For strong acids, strong bases or other aggressive titrants, increase the inspection and maintenance frequency as needed.
- Inspect for cleanliness and tight seal of the burette piston. Inspect whether moisture has penetrated below the piston. If any damage or leaking is noticed, replace the burette. Pay special attention to the edges of the glass and inspect for chips or other damage.
- Inspect for cleanliness of the connections and the seals of the tubing are securely fastened. Check for damage to the fittings and the tubing, including the tubing flare at the ends, which is required to be complete and uniform in order to maintain a seal. Tubing should be replaced as needed, typically every 3 months.
- Inspect for cleanliness of the dispenser, especially at the tip, make sure there is no particle blockage, no leaks at the tubing connections and no leaks at the dispenser tip. If damage or contamination is found, replace the effected component. Dispenser probe should be replaced as needed, typically every 12 months.
- Inspect for visible damage or contamination of the electrical connections.
- Wipe off spills of chemicals to avoid discoloration or damage to the case.
- The titrator must be kept dry. Liquid must not penetrate into the interior of the instrument.
- The solenoid valve should last the life of the titrator; however, it may become clogged or damaged if proper maintenance is not performed on the titrator - in the event of failure, a valve replacement kit is available.
- Store and maintain electrodes per the manufacturer's instructions.

1. Complete these steps with Deionized Water to ensure burette is stored clean for next use.
2. Replace reagent with deionized water.
3. Rinse burette 5 cycles.
4. Remove deionized water.
5. Run 3 additional cycles to flush the remaining water.
6. Remove the burette tube from the burette cap.
7. Gently grasp the burette cover, loosen and remove the cover by turning it to the left, about 4 to 6 turns.
8. Gently grasp the glass burette and pull up slightly to extend the burette piston drive shaft. Then move the burette forward to disengage the connection. The burette can be stored in it's included protective storage box.

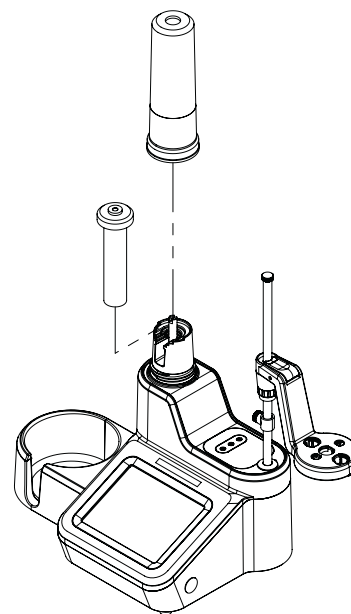


Figure 9. Removal of Burette from the Unit

Titration and Burette Storage

For short term and long term storage, the Titration Burette should be flushed with the following procedure:

Ordering Information

Cat.No.	Description
START9100	Orion Star T910 pH titrator, includes 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9101	Orion Star T910 pH titrator standard ROSS kit, includes 8102BNUWP ROSS Ultra pH electrode, 927007MD ATC probe, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9102	Orion Star T910 pH titrator Sure-Flow ROSS kit, includes 8172BNWP ROSS Sure-Flow pH electrode, 927007MD ATC probe, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9200	Orion Star T920 redox titrator, includes 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9201	Orion Star T920 redox titrator standard kit, includes 9778BNWP glass-body redox electrode, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9300	Orion Star T930 ion titrator, includes 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9301	Orion Star T930 ion titrator salt kit, includes 9780SC silver billet electrode, 91CBNC electrode cable, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9302	Orion Star T930 ion titrator chloride kit, includes 9616BNWP silver/sulfide electrode, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9303	Orion Star T930 ion titrator sodium kit, includes 8611BNWP ROSS sodium electrode, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9304	Orion Star T930 ion titrator ammonia kit, includes 9512HPBNWP high performance ammonia electrode, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9305	Orion Star T930 ion titrator surfactant kit, includes 9342BN surfactant electrode, 900200 reference electrode, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9306	Orion Star T930 ion titrator hardness kit, includes 9629BNWP cupric electrode, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9400	Orion Star T940 all-in-one titrator, includes 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9401	Orion Star T940 all-in-one standard ROSS kit, includes 8102BNUWP ROSS Ultra pH electrode, 927007MD ATC probe, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies
START9402	Orion Star T940 all-in-one Sure-Flow ROSS kit, includes 8172BNWP ROSS Sure-Flow pH electrode, 927007MD ATC probe, 20 mL burette, stirrer probe, dispenser probe, standard tubing kit, 1 L plastic bottle, GL38 bottle cap with desiccant tube, computer cable, literature on USB drive, 110-240 V power supplies

Accessories and Replacement Parts

Cat.No.	Description
STARA-106	Orion Compact Ink Ribbon Printer, 100-240 V
START-PC1	Orion Star T900 series computer software for data transfer
START-B10	Orion Star T900 series 10 mL burette
START-B20	Orion Star T900 series 20 mL burette
START-B50	Orion Star T900 series 50 mL burette
START-TB1	Orion Star T900 series standard tubing kit, one each of burette tubing, reagent bottle tubing and dispenser tubing
START-TB2	Orion Star T900 series light blocking tubing kit, one each of burette tubing, reagent bottle tubing and dispenser tubing with light blocking opacity
START-TB4	Orion Star T900 series burette tubing
START-TB5	Orion Star T900 series reagent bottle tubing
START-TB6	Orion Star T900 series dispenser tubing
START-BT1	Orion Star T900 series 1 L plastic bottle
START-BT2	Orion Star T900 series 1 L glass amber bottle
START-BT3	Orion Star T900 series 1 L plastic bottles, 12 pack
START-BT4	Orion Star T900 series 1 L glass amber bottles, 12 pack
START-CP1	Orion Star T900 series GL38 reagent bottle cap
START-CP2	Orion Star T900 series GL45 reagent bottle
START-CP3	Orion Star T900 series Orion pint bottle cap
START-DS1	Orion Star T900 series dispenser probecap
START-DVK	Orion Star T900 series dispense verification kit
START-B00	Orion Star T900 series burette cover
START-BT0	Orion Star T900 series reagent bottle holder
START-EH1	Orion Star T900 series electrode holder assembly
START-EH2	Orion Star T900 series stopper for electrode holder
START-EH3	Orion Star T900 series cable management accessory
START-PS1	Orion Star T900 series 110 V US/Japan power supply
START-PS2	Orion Star T900 series 220 V Euro power supply
START-PS3	Orion Star T900 series 240 V UK/Singapore power supply
START-PS4	Orion Star T900 series 230 V Australia/New Zealand power supply
START-PS5	Orion Star T900 series 220 V China power supply
START-TB3	Orion Star T900 series drying tube

Cat.No.	Description
START-UM1	Orion Star T900 series user manual on USB flash drive
START-USB	Orion Star T900 series USB computer cable
START-VK1	Orion Star T900 series valve replacement kit

Specifications

	Orion Star T910 pH Titrator	Orion Star T920 Redox Titrator	Orion Star T930 Ion Titrator	Orion Star T940 All-in-One Titrator
Titration Technique	Equivalence point or preset endpoint			
Incremental Technique	-	-	Multiple Known Addition (MKA)	
Equivalence Points	1 or 2			
Preset Endpoints	1, 2 or 3			
MKA Points	-	-	Upto 5	
Titration Types	Direct or back titration			
Blank Options	Fixed value or variable value using titration			
Cycles Per Titration Run	Up to 5 cycles with option to exclude cycles from average results and RSD calculations			
Titrant Determination	Standardization titration or manual concentration input			
Titration Process Control	Routine, quick, careful or user defined			
Titration Precision	±0.5% RSD, dependent on environment and handling conditions			
Stirrer Probe Speeds	5 selectable speeds, 250 to 3700 RPM			
Sample ID	Auto-incremental, manual or off			
Titration Setup Wizard	Yes, using Start a New Titration workflow			
Methods	Up to 10 customizable methods with optional password protection			
Methods Transfer	Import/export via USB flash drive, summary to computer software or compact printer			
Data Logs	Sample titration, titrant standardization, calibration, direct measure – 100 data sets each			
Data Log Export	CSV or Report (PDF) file, short or long format			
Time and Date	Yes, with nonvolatile battery backup			
Direct Measure Mode	pH	Redox	Ion concentration	pH, redox, ion concentration
pH Range	-2.000 to 20.000 pH	-	-	-2.000 to 20.000 pH
pH Resolution	0.001, 0.01, 0.1 (user selectable)			0.001, 0.01, 0.1 (user selectable)
pH Relative Accuracy	±0.002 pH			±0.002 pH
mV Range	-2000.0 to +2000.0 mV	-2000.0 to +2000.0 mV	-2000.0 to +2000.0 mV	-2000.0 to +2000.0 mV
mV Resolution	0.1 mV	0.1 mV	0.1 mV	0.1 mV
mV Relative Accuracy	±0.2 mV	±0.2 mV	±0.2 mV	±0.2 mV
ISE Range	-	-	0.0001 to 19990	0.0001 to 19990

	Orion Star T910 pH Titrator	Orion Star T920 Redox Titrator	Orion Star T930 Ion Titrator	Orion Star T940 All-in-One Titrator
ISE Resolution	-	-	0.0001 minimum, 1 to 4 significant digits (user selectable)	0.0001 minimum, 1 to 4 significant digits (user selectable)
ISE Relative Accuracy	-	-	±0.2 mV or ±0.05% of reading, whichever is greater	±0.2 mV or ±0.05% of reading, whichever is greater
Temperature Range	-5.0 to 100.0 °C; 23.0 to 212 °F	-5.0 to 100.0 °C; 23.0 to 212 °F	-5.0 to 100.0 °C; 23.0 to 212 °F	-5.0 to 100.0 °C; 23.0 to 212 °F
Temperature Resolution	0.1 °C; 0.1 °F	0.1 °C; 0.1 °F	0.1 °C; 0.1 °F	0.1 °C; 0.1 °F
Temperature Relative Accuracy	±0.2 °C	±0.2 °C	±0.2 °C	±0.2 °C
Calibration Modes	1 to 5 point pH	1 point relative mV	1 to 5 point ISE	1 to 5 point pH, 1 point relative mV, 1 to 5 point ISE
Temperature Input	Manual or automatic with optional 1 point ATC probe offset calibration			
Display Type	5.7" color capacitive touchscreen, 640 x 480 resolution, with lab glove compatibility			
Display Backlight	Yes, with adjustable brightness			
Languages	Chinese, English, French, German, Italian, Japanese, Korean, Portuguese, Spanish			
Titration Setup Wizard	Yes			
Audible Notifications	Titration Cycle Complete, Maximum Titrant Volume, Data Log Full, Calibration Due, Maintenance Reminder			
Updateable Firmware	Yes, using USB flash drive			
Burette Sizes	10 mL, 20 mL (included), 50 mL			
Burette Resolution	Advanced micro-step technology provides 25,600 micro-steps per motor revolution for smooth and precise burette positioning (2 million micro-steps over full burette stroke range)			
Burette Dosing Accuracy	Meets ISO8655-3 requirements			
Burette Functions	Automatic rinse cycles for flushing and discrete dispense volume with continuous option			
Certifications	CE, cTUVus, KC, NOM, RCM, Kvalitet, FCC, EN/EIC61326-1, IEC 61010, IP-51			
Dimensions	10" x 16" x 14" (L x W x H); 25.4 x 40.6 x 35.6 cm (L x W x H)			
Weight	12.5 lbs; 5.67 kg			
Power Requirements	100 to 240 V, 50/60 Hz			
Warranty	1 year			

Customer Services

Warranty Information

Thermo Fisher Scientific warrants to the original purchaser of any new merchandise that all items will be free of defects in material and workmanship for the periods set forth below, when used under specified and normal operating conditions, in accordance with the operating limitation and procedures given in the instruction manuals, and when not subjected to accident, alteration, abuse or misuse of Thermo Fisher Scientific's products in unspecified applications, for unauthorized procedures, or with third-party products may void the warranty.

Thermo Scientific Orion Star T900 series titrators are warranted as follows:

Orion Star T900 series titrators are warranted for a period of one (1) year from the date of purchase. This warranty covers the instrument (including display, touchscreen, connections, boards) and integrated dispensing components (including burette drive assembly, valve assembly, burette). All consumable parts (including tubing, dispensing probe, reagent bottle cap) in contact with the sample are warranted for a period of ninety (90) days from the date of purchase. Sample must be chemically compatible with the product. If parts are not compatible or if a question exists regarding compatibility, notify the factory before placing the product in service to maintain the warranty.

THE WARRANTIES DESCRIBED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESSED OR IMPLIED. ALL OTHER WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, EXCEPT TITLE, ARE HEREBY OVERRIDDEN AND EXCLUDED. NO LIABILITY SHALL ATTACH TO THERMO SCIENTIFIC EITHER IN CONTRACT OR IN TORT, FOR ANY PERSONAL INJURY, DEATH, DAMAGE TO PROPERTY, LOSS OF PROFITS, DAMAGES, COSTS, CHARGES, LIABILITIES OR EXPENSES, WHETHER DIRECT OR INDIRECT, CONSEQUENTIAL OR OTHERWISE, WHICH ARISE OUT OF OR IN CONJUNCTION WITH THE SALE OR USE OF THIS PRODUCT.

The customer's sole and exclusive remedy is the return of defective components or sub assemblies to Thermo Fisher Scientific for repair or replacement or, at Thermo Fisher Scientific's option, refund of the purchase price.

For the most current warranty information, visit www.thermofisher.com/water

Warranty Shipments/Returns/Adjustments

A warranty claim must be made promptly and must be received during the applicable warranty period by Thermo Fisher Scientific or your authorized Thermo Fisher Scientific distributor. If it becomes necessary to return a product for repair and/or adjustment, prior authorization from Thermo Fisher Scientific or your Thermo Fisher Scientific- authorized distributor must be obtained. Instructions as to how and where these products should be shipped will be provided by Thermo Scientific or your Thermo Scientific-authorized distributor.

Any product or component returned for examination and/or warranty repair shall be sent to Thermo Fisher Scientific in MA, or any of their authorized representatives. All items must be returned at the customer's cost (freight prepaid), quoting a return authorization number that is available from the Service department. All products or components repaired or replaced under warranty will be returned to the customer at Thermo Fisher Scientific's cost using UPS (United Parcel Service) or an equivalent service.

In all cases, Thermo Fisher Scientific or your Thermo Fisher Scientific-authorized distributor has sole responsibility for determining the cause and nature of failure, and Thermo Fisher Scientific's or the distributor's determination with regard thereto shall be final.

All parts that are replaced under warranty will become the property of Thermo Fisher Scientific.

Replacement Parts

Replacement parts can be ordered from Thermo Fisher Scientific or your Thermo Fisher Scientific-authorized distributor. Use only Thermo Fisher Scientific products or Thermo Fisher Scientific-approved products. Thermo Fisher Scientific shall not be liable for damage to or malfunction of the system, which it deems was caused by the use of unauthorized materials.

Assistance

For any questions or if you require assistance, contact our Technical Support Specialists:

- Email WLP.techsupport@thermofisher.com
- Within the United States, call 1-800-225-1480
- Outside the United States, call +1-978-232-6000

For additional product information, contact your local authorized dealer, Thermo Scientific Orion technical sales representative or contact us using the WLP information on the page back of this user manual.

Visit www.thermofisher.com to view Thermo Scientific Orion products and download product literature, user manuals and manuals, software updates, and additional application and technical resources.

Regulatory Statements

FCC USA

“This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.”

Industry Canada

“This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada

Korea EMC Warning

Warning Statement

EMC Registration is done on this equipment for business use only. It may cause interference when the product would be used in home.

This warning statement applies a product for business use.

사용자안내문

사 용 자 안 내 문
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※ 사용자 안내문은 “업무용 방송통신기자재”에만 적용한다.

Water Analysis Instruments

North America

Toll Free: 1-800-225-1480
Tel: 1-978-232-6000
info.water@thermofisher.com

Germany

Tel: (49) 6184-90-6000
info.water.uk@thermofisher.com

India

Tel: (91) 22-4157-8800
wai.asia@thermofisher.com

Japan

Tel: (81) 045-453-9175
wai.asia@thermofisher.com

China

Tel: (86) 21-68654588
wai.asia@thermofisher.com

Singapore

Tel: (65) 6778-6876
wai.asia@thermofisher.com

Australia

Tel: (613) 9757-4300
In Australia: (1300) 735-295
InfoWaterAu@thermofisher.com

Find out more at thermofisher.com/water

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