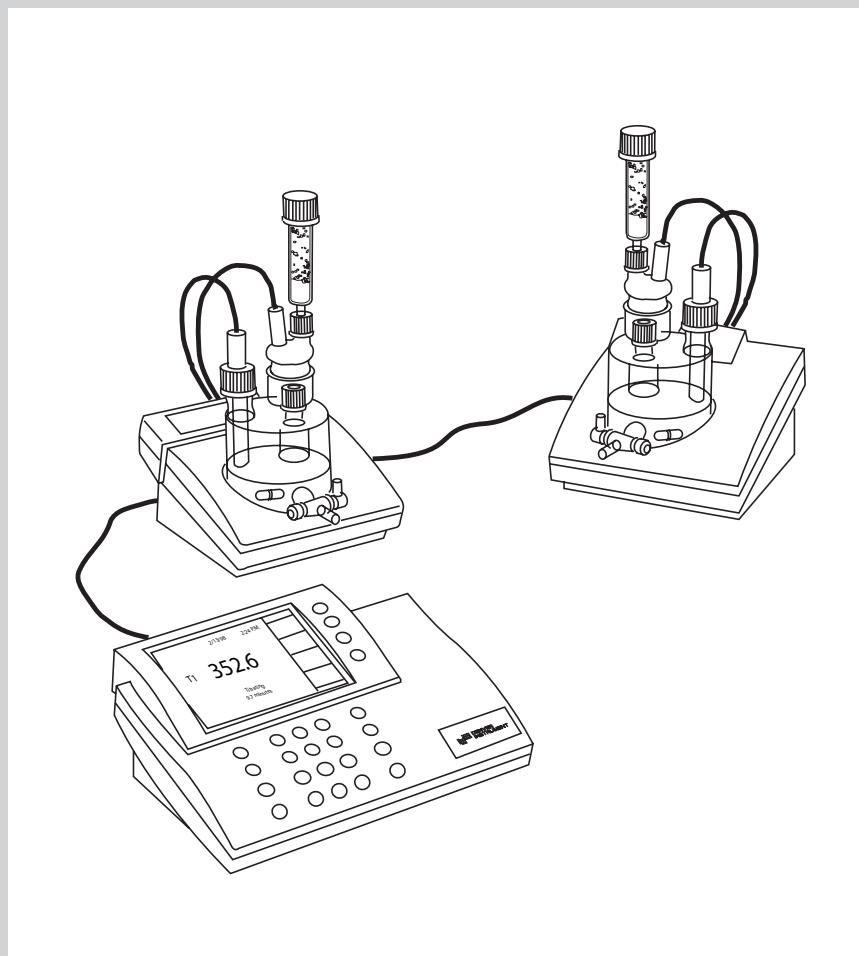


# 260 Titration Controller

## Operation Manual



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## Specifications

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### Model 260 Titration Controller Specifications

Display	4.8"W x 3.6"H Backlit VGA resolution with full-screen display of titration progress.
Keypad Controls	Sealed; audible entry
Data Memory Points	620
Power-on Self-test	Yes
Error Messages	Yes
Data Output	Print key; at end of titration; custom time intervals
Alarm	High/low set points for all modes
I/O	RS-232C to computer or printer; serial network to titrator modules

### Model 275KF Titration Specifications

Range	10 $\mu$ g to 20mg H <sub>2</sub> O
Accuracy	$\pm$ 2 $\mu$ g or $\pm$ 0.5%
Resolution	0.1 $\mu$ g
Rate	3500 $\mu$ g H <sub>2</sub> O/min. (maximum)
Endpoint Control	0 to 99 sec. persistence time and 0 to 9.9 $\mu$ g/sec. slope (programmable)
Capacity	1000mg H <sub>2</sub> O (for single charge reagents)

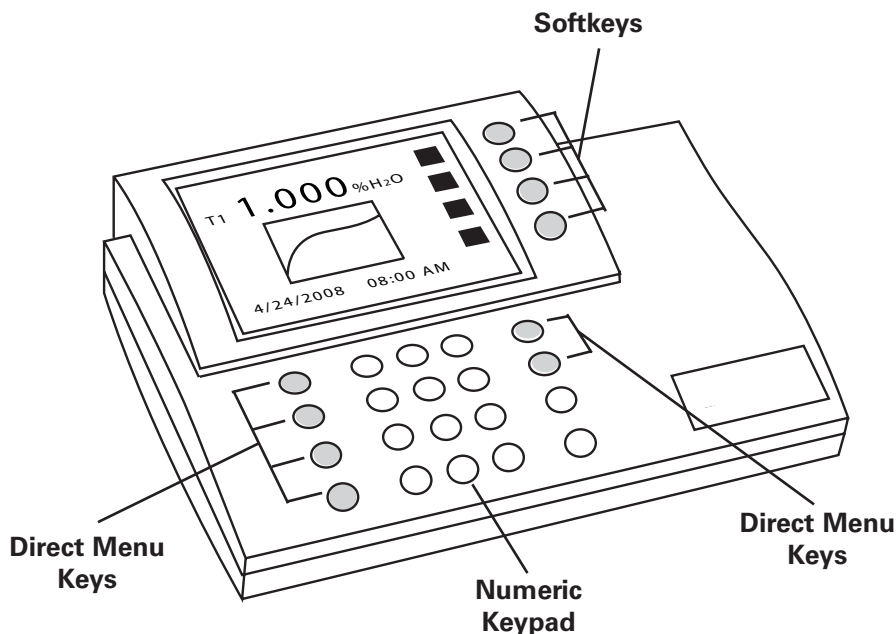
# Introduction

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The **Denver Model 260 Titration Controller** is a powerful, versatile and accurate instrument offering many advanced options, programmable standardization, quick update rates of twice per second for all channels, programmable data logging of 620 data points and a superb RS-232 serial interface for obtaining data.

## Direct Menu Keys, Softkeys and Display

The Model 260 uses six **Direct Menu** keys to access the menus and operations



(such as cal data, standardize protocols, select titration protocol, and select channels).

There are four **Softkeys** that provide additional operations; these Softkeys change their function as needed and each Softkey has an icon to indicate its current function (start a titration).

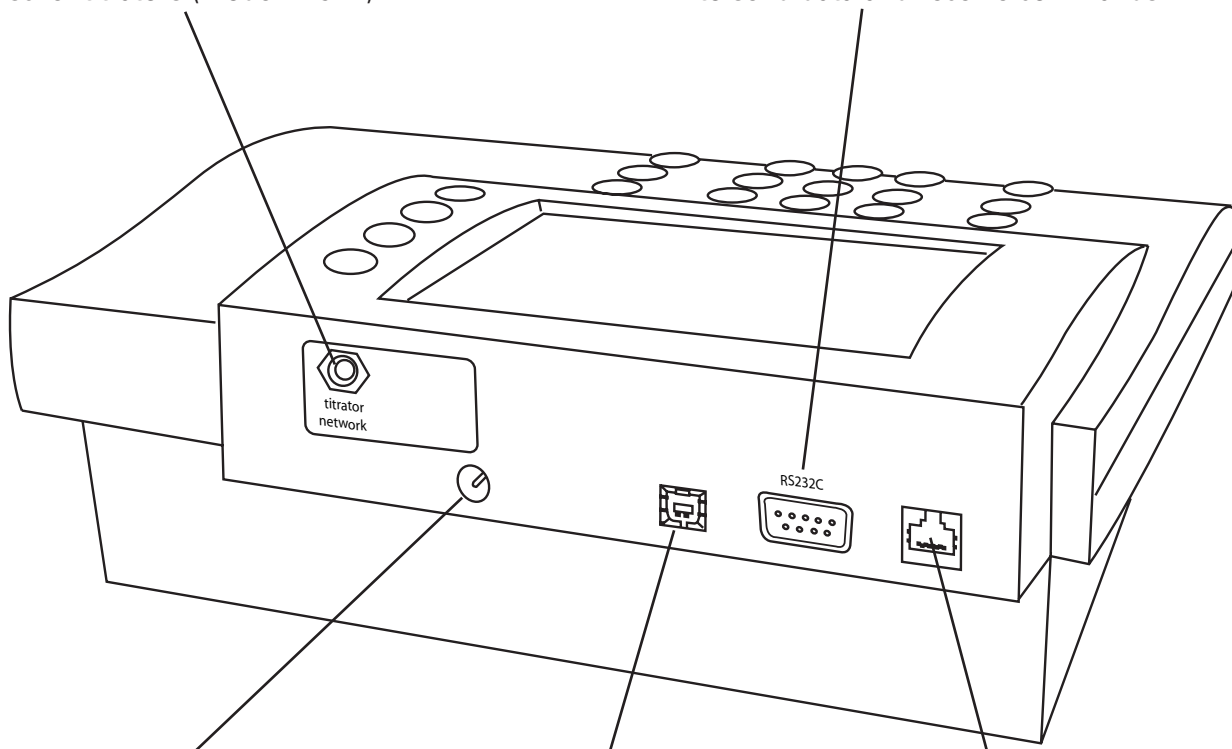
The display is a backlit quarter-VGA screen capable of displaying up to four Karl Fischer titrators (Model 275KF) simultaneously. The backlight will turn off after a period of non-use (the default is 45 minutes) and pressing any key will automatically turn the display backlight on again.

## Connectors and Inputs

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**Titration Network Connector:** use to connect up to four Coulometric Karl Fischer titrators (Model 275KF).

**Serial port ("RS232") DB-9 connector:** Connect a serial printer or computer to send data and receive commands.



**Power connector:** Connect a 5.5mm OD x 2.1 ID coaxial connector with 15VDC at 700mA (center pin negative).

**USB Port:** non-functional on Model 260

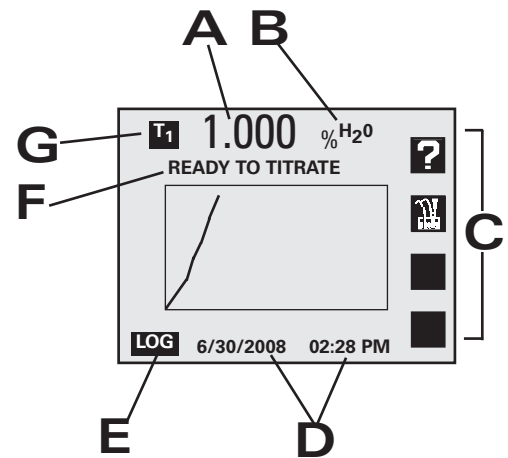
**RJ-11:** non-functional on Model 260

# Display

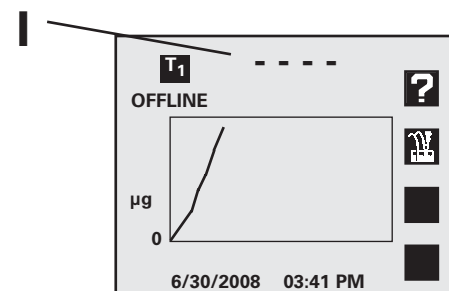
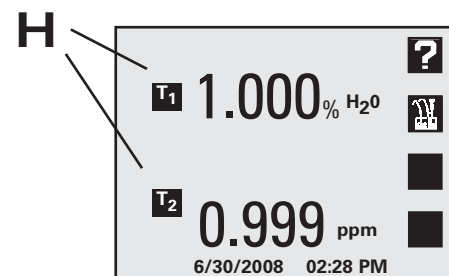
Note: Not all of the following will display at the same time.

- A. Result:** current measurement.
- B. Units:** displays the units for the current measurement. Examples: ppm, % H<sub>2</sub>O.
- C. Softkey icons:** show the current function assigned to each softkey.
- D. Date and time:** ability to display in different formats.
- E. Datalogging:** the **LOG** icon indicates datalogging is active.
- F. Titration Status:** indicates when ready to titrate. Will indicate error messages.
- G Channel:** Channels T1 through T4 indicate individual KF titrators (Model 275KF)
- H. Multiple Channel:** Model 260 can display four KF titrators simultaneously.
- I. Out-of-range or non-valid reading:** dashes indicate a measurement is not available. This usually means the reading is out of range..

## Single channel display



## Dual channel display











## Function Keys

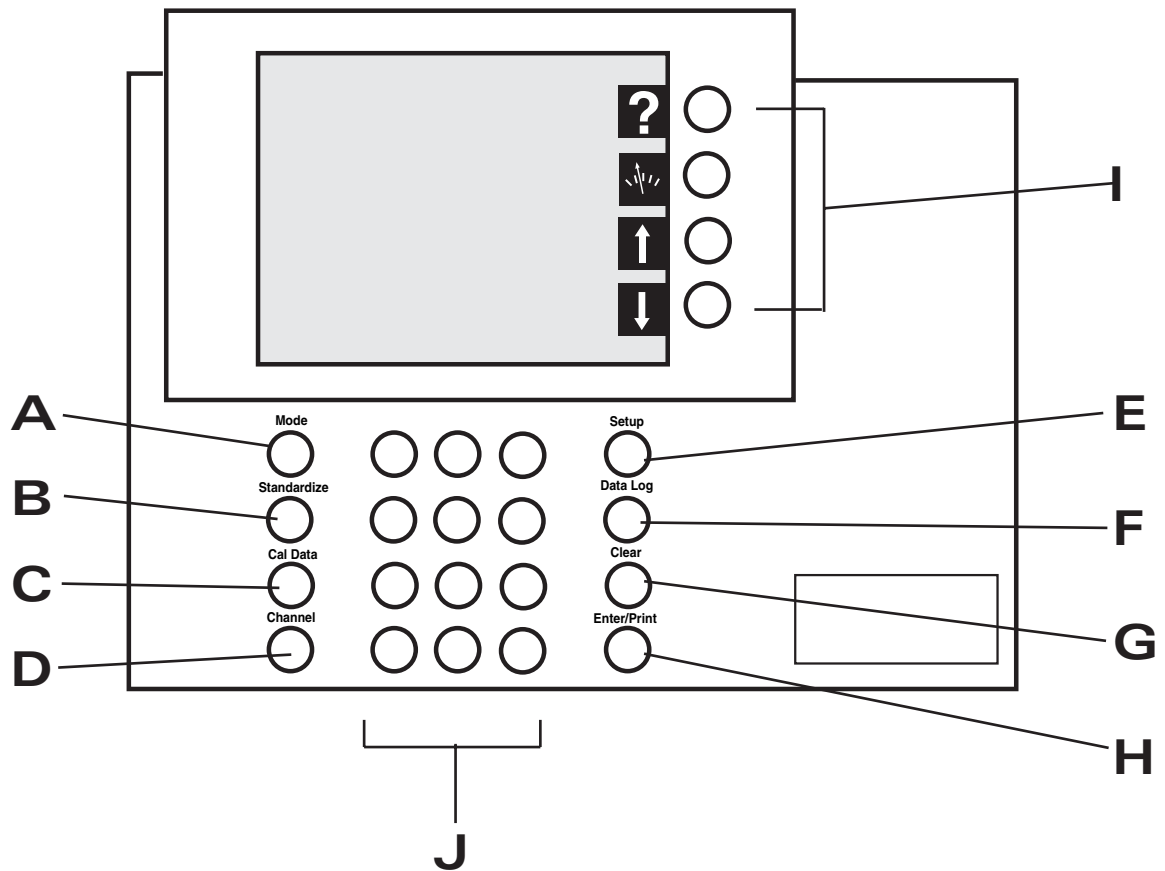
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- A. Mode:** Selects the mode. Select KF protocol for selected titrator
- B. Standardize:** Use to modify a KF titration protocol. Also used to change other settings which affect the measurement.
- C. Cal Data:** Shows KF titrator operating data such as drift rate, reagent condition, and statistics on the last titrations.
- D. Channel:** Channels T1 through T4 indicate individual KF titrators (Model 275KF).
- E. Setup:** The Setup menu is used to set various general settings, such as date and time, display contrast, keypress beep and serial port. Use Titration setup menu to access titration protocols and control titrators (stirrers on/off).
- F. Data Log:** Displays the datalogging menu used to view and print the stored Data Log (see Datalogging).
- G. Clear:** Exits from the current menu and returns to the previous menu, cancels the current operation or clears a number entry.
- H. Enter/Print:** Accepts numeric values, menu selections or pending operations. In the main measure screen, acts as a Print key, sending all current measurements to a printer/ computer through the serial port and stores the measurements in the Data Log.
- I. Softkeys:** These four keys access different operations at different times. Most menus offer a "Help" softkey and the "Measure" softkey, which allows a direct return to the main measuring screen, exiting all menus immediately. The "Up Arrow" and "Down Arrow" softkeys offer one way to select a menu item. The "Left Arrow" key is a backspace, active during number entry.
- J. Numeric Keys:** Pressing a number key selects a numbered item in a menu. The number keys also allow entering values for various settings.

### Softkeys

-  Help
-  Measure
-  Scroll up
-  Scroll down
-  Backspace
-  Graph
-  Titrator Start/Stop
-  Statistics

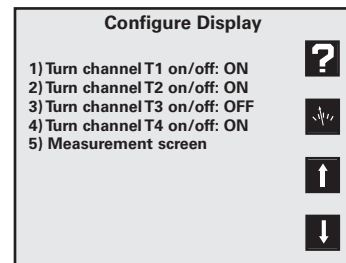
# Function Keys



## Channels

The Channel key is used to turn on or off each available channel. In single-channel operation, additional information for the selected channel is provided, including a display list of titration protocols. In multi-channel operation, the Mode, Standardize and Cal Data menus ask for the channel before accessing the menu.

## Model 260 Select Channel screen



 Channel

# Setup

## Setup Menu

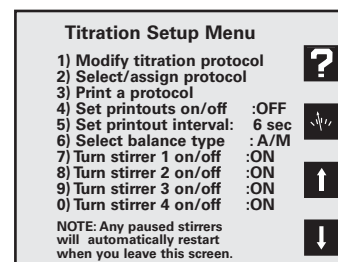
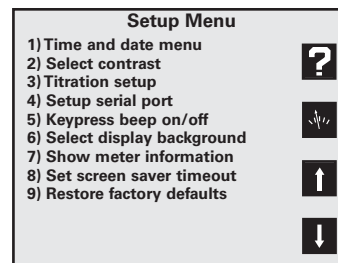
Press **Setup** to access the Setup menu:

1. **Time and date menu:** use to set the time format (HH:MM AM/PM or HH:MM:SS), set the time, set the date format (MM/DD/YY, DD-MM-YY or YYYY.MM.DD), and set the date.
2. **Select contrast:** use to select the display contrast, making the displayed characters lighter or darker. Select setting "5" for typical conditions.
3. **Titration Setup Menu:** use to modify, select and print titration protocols, set titration intermediate results printout, select balance type for the titrators, and control titration stirrers.
4. **Setup serial port:** use to set the serial RS232 port settings. To configure the serial port baud rate, data bits, stop bits and parity setting user must match the baud rate setting of the printer or computer being used with the system.
5. **Keypress beep on/off:** use to turn on or off a "beep" upon each keypress as an audible signal that a key has been pressed.
6. **Select display background:** use to set the display to black characters on a white background or white characters on a black background.
7. **Show meter information:** use to show the meter model, software version and serial number.
8. **Set screen saver timeout:** use to set a time for the backlight to turn off and the screensaver to activate.
9. **Restore factory defaults:** use to reset all settings to factory defaults. On occasion it may be useful to completely reset the controller, for example, if other users have changed a setting.



### Warning!

**A reset erases all saved titration protocols and restores the original factory settings**

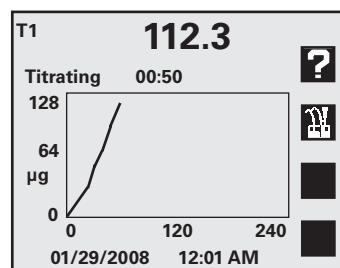
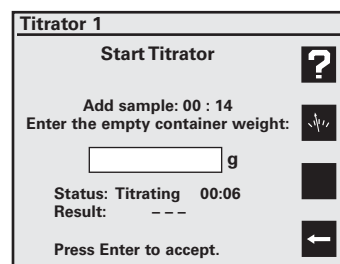
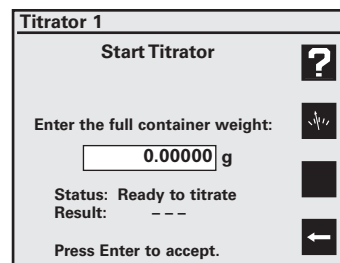
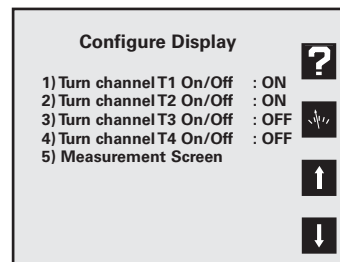


# Quick Start Guide

1. Turn Titrator 1 on for active display using the **Channel** key (see Function keys). If a Titrator is selected for single channel display, a real-time titration curve will be displayed during each titration.
2. Select the KF titration protocol to be used for your analysis by pressing **Mode**, and selecting the protocol closest to your needs. Modify the selected protocol by pressing **Standardize** and selecting each parameter to modify.
3. A. Obtain the sample to be analyzed, typically in a syringe if a liquid. Place the syringe on a balance and either note the weight or tare the balance to show zero.  
 B. Press the **Titration** softkey [the key with an icon beside it that looks like the KF titration cell].  
 C. Select which Titrator to use if there are multiple channels turned on for display.  
 D. Enter the weight of the container (syringe) and sample and press **Enter**. Usually this is entered as zero.  
 E. Immediately add the sample to the cell, usually by injecting the sample through the septum into the sealed cell. Carefully allow a final drop to fall off the needle and pull back slightly on the syringe after the desired sample volume has been introduced. Carefully remove the syringe from the cell.

**Note:** You must begin adding sample before the sample introduction time elapses, or the Titrator may end the titration before you add the sample. The sample introduction time can be programmed.

- F. Place the container (syringe) back on the balance and obtain the weight. Enter the "empty container weight" (if you used zero for the "full container weight", then use a negative value for the second tare weight) and press **Enter**. This second weight must be less than the first weight.
  - G. Watch the titration progress. When the titration completes a beep will sound, the status changes from "Titrating" to "Done", and then to "Ready to titrate". A checkmark symbol beside the "T1" channel indicator means the titration is done. The result is automatically sent to the printer/computer serial port and stored in the Data Log.
4. Repeat the titration. For best results, it is recommended to calculate the average of two or three titrations. Once you have more than one titration result on a sample, the Controller will calculate statistics on the results. Press Cal Data, Select Channel if necessary, and press the X-bar Statistics softkey. The average, standard deviation and other statistical information is displayed for the selected Titrator, for the most recent "N" number of analyses with the current units. Press Clear or the Graph softkey to return to the reagent condition bar graph screen, or press the Measure softkey to return to the main measure screen.



## Connecting To A Titration Module (Model 275KF)

The Model 260 Titration Controller operates one to four attached Coulometric Karl Fischer Titrators (Model 275KF). Each Titrator operates independently, so up to four KF titrations can be run simultaneously. The Coulometric KF method is a sensitive and specific method for the determination of water at low levels. Samples are introduced into a sealed titration cell where the water in the sample undergoes a chemical reaction (the Karl Fischer reaction) with the KF reagent in the cell. The Titrator senses that water is present and passes a quantity of electricity ("coulombs") through the cell to electrochemically generate iodine, which reacts with water. The Titrator determines when the titration is complete (all water has been consumed).

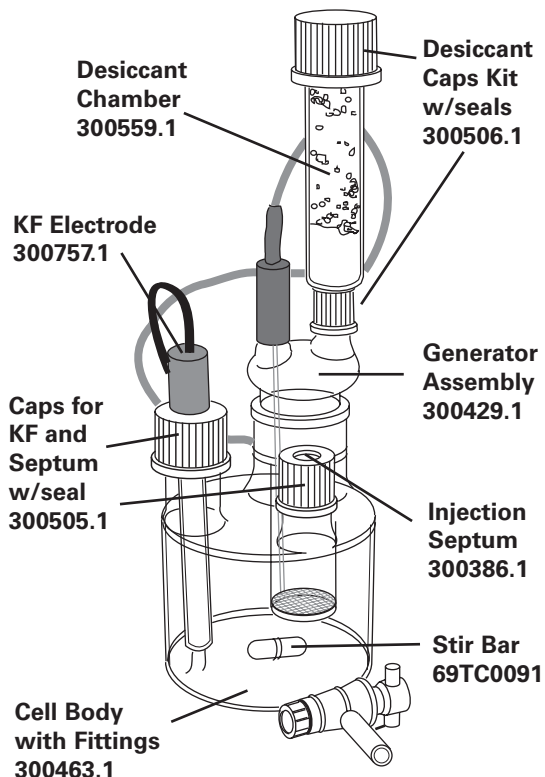
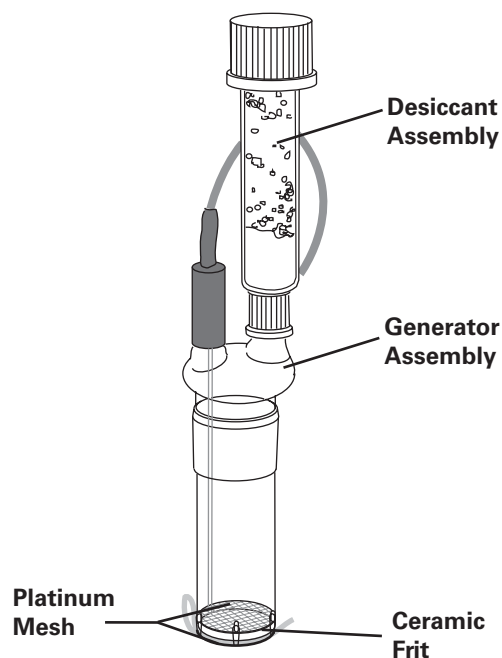
### Preliminary Titrator Setup - Setting up and Connecting the KF Titration Cell

1. **Important!** If unpacking the Titration Cell, remove the shipping spacer between the platinum outer electrode and the glass frit.
2. Make sure the Titration Cell is clean and **DRY**. If the cell is dirty, especially the glass frit in the Generator Assembly separating the anode and cathode, it must be thoroughly cleaned and dried before filling being put in service. See Cleaning the Cell.
3. Prepare the Desiccant Assembly used to prevent room water vapor from entering the cell. Remove the Parafilm wrap over the ends used for protection during shipping. If needed, to replace the desiccant, unscrew the Desiccant Assembly from the cell top, place a plug of cotton or glass wool in the tube bottom, fill the tube with dry Indicating "Drierite" or 4A molecular sieve desiccant (like "KF Dri-Alert") and close the top cap.
4. Insert the KF Electrode into the compression fitting cap with the open hole in the top of the cell. Make sure the two platinum rods are straight and not touching each other, and are clean. Carefully insert the electrode down until the rods nearly touch the cell bottom. Tighten the fitting firmly.
5. Carefully place a 5/16" X 1" magnetic stir bar in the cell.
6. Use a Teflon sleeve on the ground glass joint of the Generator Electrode or apply a high-vacuum stopcock grease to the joint. Remove sleeve when cleaning generator.



#### Warning!

Failure to use either stopcock grease or a Teflon sleeve may result in the glass joint freezing together causing breakage. Do not place teflon parts in oven when cleaning.



## Connecting To A Titration Module (Model 275KF)

7. Add approximately 150 mL of the analyte reagent into the outer cell compartment. The reagent to use varies with sample type, but typical reagents include Hydranal Coulomat AG, AG-H, A or AK; EM Science AquaStar Coulomat AN, A or AK; or GFS Watermark vessel solution (#1612).
8. Quickly place the Generator Electrode into the cell to prevent further water vapor absorption by the reagent.
9. Add catholyte reagent to the inner chamber of the Generator Electrode until the outer and inner reagent liquid levels are even, typically 5 to 10 mL. Immediately place the Desiccant Assembly on top of the generator. The catholyte reagent to use generally matches the analyte reagent used, such as Hydranal Coulomat CG, C or CK; EM Science Coulomat CN, C or CK; or GFS Watermark generator solution (#1613).
10. Place the Titration Cell in position on top of the Titration module.
11. Plug the Generator Electrode (phone plug) into the "Generator" connector on the back of the Titrator.
12. Plug the Indicator Electrode (dual pin plugs) into the "Indicator" jacks on the back of the module.

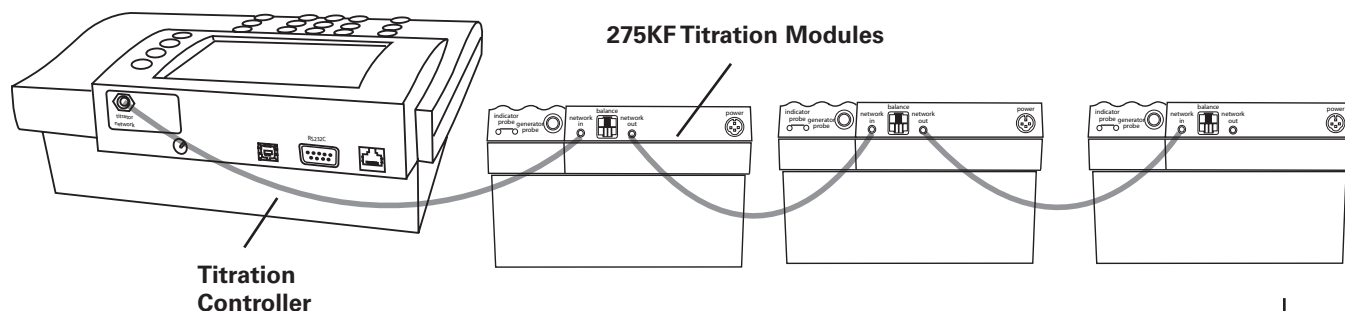


### Note:

If reagent spills on the titration module, wipe up immediately, as reagent will destroy the plastic cover.

### Preliminary Titrator Setup - Connecting the Titrator(s) and Controller

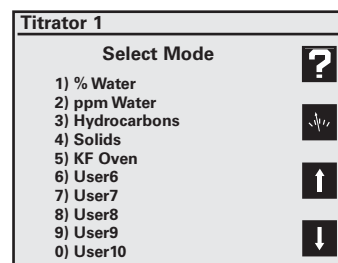
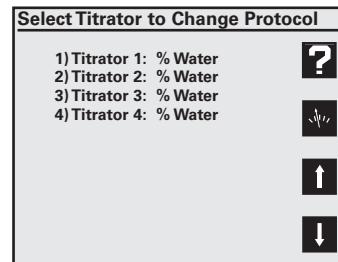
1. Place the Titrator(s) beside the Controller. Connect the serial cable to the Controller connector "titrator network" and to the first Titrator ("Titrator 1") connector marked "network in". If more than one Titrator is connected, connect the second Titrator ("Titrator 2") by connecting a serial cable between Titrator 1 "network out" and Titrator 2 "network in". Connect up to four Titrators by daisy-chaining in this fashion.
2. Plug the 3-pin DIN power connector into each Titrator, and plug the line cord(s) from the transformer(s) into wall outlets. Plug the power connector for the Model 260 into the back of the Controller where marked "power", and plug the transformer into a wall outlet.
3. Verify the Titrators are communicating with the Controller by turning on the Titrator channel for each attached Titrator. Press **Channel**, then press the number for each titrator channel to toggle the channel ON, then press the number key for **Measurement screen**.
4. With the Titrator(s) and Controller set up, the Titrator(s) will automatically begin drying the cell and reagents. When the cell and reagents are dry, the solution should be pale yellow. If the solution is dark yellow to brown, it is over dry; add a very small quantity of water to the reagent until it goes colorless.



# Coulometric Karl Fischer Titration

## Running a Titration

1. Select one or more titrator channels for active display by pressing **Channel** and pressing the number key for each titrator channel to toggle ON or OFF. When all channels have been set, press the number key for **Measurement screen** or press the **Measure softkey** (the softkey with the meter and needle symbol).
2. Press **Mode** and select one of the 10 stored KF titration protocols (protocols are methods) to use for the selected Titrator. If multiple channels are active, Select the Titrator to change mode (protocol).
3. Modify the protocol if necessary by pressing **Setup, 3) Titration setup menu, 1) Modify titration protocol**, and select the protocol. Any changes made to this protocol are immediately stored for the protocol and are automatically sent to all Titrators using that specific protocol. The Titrators using any given protocol are displayed at the top of the screen.
4. Press the Titration softkey to start the titration. If multiple titrators are turned on, select the titrator to start.
5. If micrograms or milligrams water are the selected units, the Add Sample reminder and countdown will begin and the titration will start immediately. After adding the sample press Enter.  
If % or ppm water are the selected units, enter the weight for the sample and container (usually a syringe). Type in the weight value, or use automatic transfer from a balance, then press Enter. Common practice is to tare the balance with the sample/syringe on it, and enter this weight as zero.
6. Immediately add the sample to the cell. The Controller will display "Add sample: 00:20" and countdown the programmed sample introduction time. Be sure to begin adding the sample within this time period, or the Titrator may end the titration before the sample is added to the cell.
7. If % or ppm are the units, enter the empty container weight. If the balance was tared with the syringe and sample, when the syringe is placed back on the balance the weight is displayed as a negative value. Enter this negative value using the  $\pm$  key. If weight transfer from a balance is set up, the weight appears in the display automatically, just press Enter.
8. The Controller returns to the main measure screen. In single channel display, a full screen real-time titration curve is displayed, showing the progress of the titration. In multiple channel mode there is no titration graph. The status of the Titrator is displayed ("Titrating"), and when the titration is complete the status changes to "Done" briefly, then a "checkmark" appears by the titrator channel indicator to show the titration is done and the data is ready. The status changes to "Ready to titrate", or the appropriate status.



# Coulometric Karl Fischer Titration

## Titration Status and Operating Data

Press Cal Data, select the Titrator if displaying multiple channels, to see that Titrator's current operating data, including status, current result, background drift rate, and reagent condition.

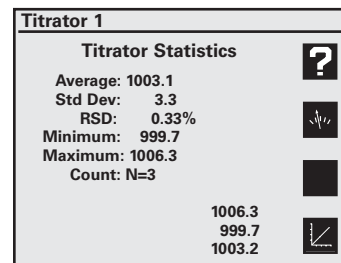
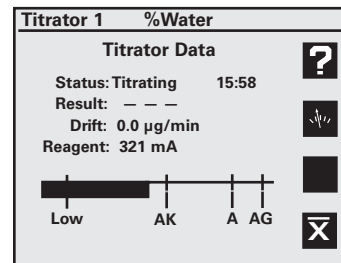
Background drift rate is an important parameter to monitor. It is also displayed for each titrator in the main measure screen. If the Titration Cell is sealed well to prevent ambient water vapor from entering the cell, and if there are no Karl Fischer reaction byproducts or sample components that are causing side reactions in the cell, then the background drift rate should be a low number, typically less than 6  $\mu\text{g}/\text{min}$ . The best results will be obtained when the background drift rate is low and stable. For maximum accuracy, the Titrator automatically subtracts the background drift from the titration result throughout the titration. Large drift rates may be reduced by checking the desiccant, the cell seals and joints, cleaning the cell and replacing the reagents.

Reagent condition is indicated by the titration current, displayed in milliamperes (mA), and shown by the bar graph. The marks on the bar graph indicate the full current obtained with fresh reagents of the AG/AN, A or AK types. As the reagents become exhausted the current will decrease and titrations will take longer. At 90 mA the error message "Reagents low/exhausted" appears, and reagents must be changed.

Statistics on the previous titration results are available by pressing the X-bar softkey. The average, standard deviation, Relative Standard Deviation, minimum, maximum and count (the number of data points used) are displayed. The number of values used, "N", can be set by pressing the N softkey. Many analysts use the average three KF titrations to increase their accuracy. Obtaining precise results, especially on a water standard, is a useful check on the analytical technique of the analyst. Good technique usually leads to repeatable, precise results with a low standard deviation.



When using the average be sure to have the last "N" results for the selected Titrator are results from the same sample or standard. Example: if N is three, and only two titrations have been run on a sample, then the third previous result was from a different sample and the statistics will be not be correct!




# Coulometric Karl Fischer Titration






## Titration Setup Menu

Press **Setup, 3) Titration setup menu** to access KF titration protocols, intermediate result printout, select balance type, and control the Titrator stirrers.

1. Modify titration protocol: use to modify the 10 stored KF titration protocols.
2. Select/assign protocol: use to select a protocol for a Titrator.
3. Print a protocol: use to print hardcopy of a stored protocol.
4. Set printouts on/off: use to turn on or off printing intermediate titration results out the serial port to a printer/computer. Useful for monitoring the rate of titrating water in a sample when developing the optimal protocol for a specific sample.
5. Set printout interval: use to set the time interval in seconds for printing intermediate titration results.
6. Select balance type: use to set the balance attached to Titrator 1 for automatic weight transfers. The output string of the balance must match the type selected in order for the Titrator to use the balance data.
7. Turn stirrer 1 on/off: use to temporarily turn off a Titrator stirrer in order to replace the cell onto the Titrator and have the stirbar magnetically couple. The Titrators are designed to maintain an equilibrium in the cell, and so continuous stirring is required. All paused stirrers are automatically turned back on when this Setup menu is exited.

 **Note:** Do not pick up cell body off the module without turning off the stirrer

**Titration Setup Menu**

- 1) Modify titration protocol 
- 2) Select/assign protocol
- 3) Print a protocol 
- 4) Set printouts on/off :OFF
- 5) Set printout interval: 6 sec 
- 6) Select balance type : A/M
- 7) Turn stirrer 1 on/off :ON 
- 8) Turn stirrer 2 on/off :ON
- 9) Turn stirrer 3 on/off :ON
- 0) Turn stirrer 4 on/off :ON 





NOTE: Any paused stirrers will automatically restart when you leave this screen.

**Select Titrator to Assign Protocol**

- 1) Titrator 1: % Water 
- 2) Titrator 2: % Water 
- 3) Titrator 3: % Water
- 4) Titrator 4: Solids 



**Set Balance Type**

- 1) Denver TL, TR or TC 
- 2) Denver A or M 
- 3) Denver DI
- 4) Denver AB
- 5) Denver AE 
- 6) Denver Pinnacle 

# Cleaning the Titration Cell

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## General Cleaning

Large cell body - wash with a detergent solution, rinse with de-ionized water and rinse with methanol or acetone. Do not add reagents until the cell is dry. If drying in an oven, remove all plastic components including the stopcock.

KF electrode and stir bar - wipe with Kimwipe being careful not to bend Pt wires.

## Cleaning the Generator Assembly

1. Block the hole in the upper glass portion of the Generator Assembly, this is where the platinum wire goes from the inside to the outside of the assembly. A recommended method is to wrap a piece of Parafilm around the Generator Assembly. When covering the hole be sure that the wrap is not long enough to reach the solvent level as the vacuum created can pull liquid between the Parafilm and the generator and in through the wire hole.
2. Have a vacuum source available. One method is to use a vacuum aspirator.
3. Attach the aspirator to a faucet and connect the Generator Assembly to the aspirator. (See Diagram)
4. Place the Generator Assembly into a beaker of the appropriate solvent that the samples analyzed are known to dissolve in. Typical solvents include hexane, methanol, acetone, chloroform and toluene.
5. Apply the vacuum and draw the solvent up through the frit.
6. Repeat until the frit appears to be clean. This includes the removal of any discoloration that may have accumulated from sample analysis. The solvent being drawn through should appear clear and clean, the absence of an oil layer in the solvent drawn through or any precipitate on the frit, and are indications the frit is clean. The solvent is drawn through the frit easier.
7. More than one reagent may be drawn through the frit for cleaning purposes. (Typically concentrated nitric acid is used second).
8. The last solvent to be drawn through the generator assembly should be either methanol or acetone.
9. Final cell drying should be done in an oven at 60°-75° C overnight and cooled in a dessicator.



**Note:** Do not clean generator assembly with water or solutions diluted with water.



**Warning!**

**Do not heat the Generator Assembly above 80° C.  
Damage will result.**



**Caution!**

**Let the cell cool before filling it with fresh Karl Fischer reagent, which is mostly methanol and is flammable!**

## Cleaning the Titration Cell

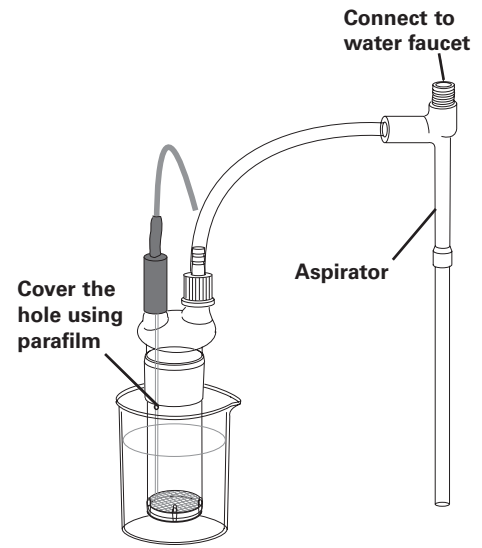
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- Place fresh coulometric Karl Fischer reagents in the cell and Generator Assembly, place the cell on the Titrator and begin the automatic cell and reagent drying process. It may take a newly cleaned frit some time for reagent to diffuse into the frit and provide full titration current.
- If the above procedure does not clean or unclog the glass frit, it may be necessary to use strong cleaning agents for your sample type. For severely clogged frits, a chromic acid or concentrated nitric acid cleaning process is recommended.



**Caution!**

**These are strong acids and must be used with appropriate care and safety protection!**



### Reagent Selection

Coulometric Karl Fischer reagents are available from several manufacturers, including Riedel-de Haen Hydranal, EM Science AquaStar and GFS Watermark. The reagent is chosen so that its polarity will dissolve the samples. The most common reagent type is the "AG" or "AN" methanol based, next is the non-polar chloroform or long-chain alcohol based "A", "AG-H" types for oils and other hydrocarbons, and samples with ketones or aldehydes must be run in the special ketone reagents "AK". Contact Denver Instrument Electrochemistry Technical Support, or the various reagent manufacturer's Technical Support for additional assistance.

# Interfacing a Balance to the Titration System

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## Balance interface

Weight based measurements are the most accurate, and using a three- or preferably four-place balance is recommended. Automatic weight transfer from the balance to the Titrator is a fast, error-free way to enter weights. The Titrator supports most Denver Instrument balances. The balance is attached to the balance port on Titrator 1, and serves for all Titrators. The balance type must be set in the Controller, and the balance must be set to 4800 baud, parity off, continuous once per second output. For exact settings for each Denver Instrument balance, contact Technical Support at 800-321-1135.

## Interfacing a Denver Pinnacle Balance to Model 275KF

### Required Items:

Denver Pinnacle Series analytical balance (P-114, 214, 314)

Denver interface cable, part number 601493.1

Adapter - DB25 Female to DB9 Male

Adapter - 9-pin null-modem

1. Attach the 9-pin null-modem adapter to the balance.
2. Attach the 25 to 9 pin adapter to the 9-pin null-modem adapter.
3. Attach the 601493.1 cable to the 25 to 9-pin adapter.
4. Attach the phone plug end of the 601493.1 cable to the

### Select the balance type on your Titration Controller

1. Press the Setup Menu Key
2. Select Titration Setup Menu, #3
3. Select Balance Setup, Menu # 6 to assign balance.
4. Select Denver Pinnacle Series.
5. Configure the Pinnacle balance settings on the balance to match the Model 275KF Module.
  - a) Select Print> Mode> Interval > Custom > set 0 sec
  - b) Select Print> Format>Type 1 format
  - c) Select the following: System> RS-232>Baud rate> Set at 4800
  - d) Select Bits/Parity> Select 8/None/1 parity

Please refer to your Pinnacle Series owners manual for step-by-step instructions in modifying interface settings.

Please call 1-800-321-1135 for additional assistance.

# Troubleshooting Guide

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## Common Errors and Solutions

### Indicator error

- Check the KF electrode (dual platinum) to see if it is plugged in.
- Check that the KF electrode connectors are intact.
- Check that the platinum tips are not touching each other or the cell.
- Check for crack(s) in the electrode.
- Verify that the reagents are not over dry (dark in color).
- Clean the platinum tips thoroughly.

### Generator error

- Check the Generator Assembly to see if it is plugged in at both ends.
- Check the platinum grid at the bottom of the Generator Electrode.

### Drying reagents

- If there are bubbles rising in the Generator Electrode, it is drying. There is water trapped in the cell and it must be titrated before continuing.
- Add a small amount of Composite 5 reagent to the cell to help dry the cell more quickly.
- If it is not bubbling and the reagents are getting darker, unplug the module and controller and replug back in while adding a drop of water.
- If reagents smell like sulfur, dispose of them. The cell then needs to be cleaned and dried in an oven (See Cleaning Instruction).

### Over dry

- Add a drop of water.
- Keep adding a drop at a time until the solution goes clear and Controller displays "Ready to titrate" or "Drying reagents".
- Check continuity of generator electrode using an Ohm meter.

### Titration off-line

- Reconnect all serial cable connections.
- Verify serial cables go to correct connections ("in" and "out"). Press the **Titration** softkey, then select 6) reinitialize network'.
- Unplug power to the Titrators and Controller and replug them back in.

### Stir bar not spinning

- Check to see that the module is plugged in.
- For further information contact Technical Assistance, a replacement motor kit may be necessary.

### Low Results

- Verify after injecting the sample, no sample is left on the end of the needle prior to pulling it out.
- Change the desiccant and cotton, also inspect the septum and replace as necessary.
- Verify that the drift rate is normal (<10 µg/min).
- Calibrate balance.
- Clean the cell and frit.
- Replace reagents.

### High results

- Verify that when injecting, that all of the sample was injected into the reagents and not on the side of the reaction cell.
- Verify that the drift rate is normal
- Check all seals on the reaction cell, and secure as needed.
- Calibrate the balance.
- Clean the cell and frit.
- Replace reagents.

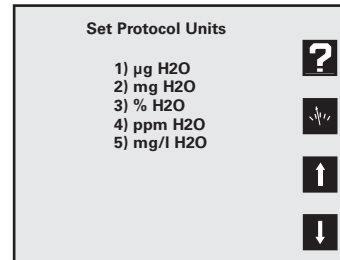
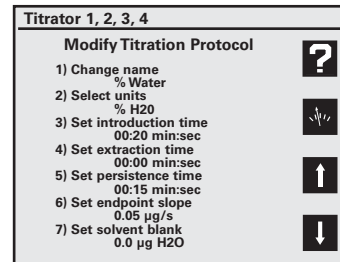
# Modifying Titration Protocols

Each Titrator runs one of the 10 stored protocols. The protocol controls all parameters of the titration, including the units, sample introduction time, sample extraction time, endpoint persistence time, endpoint slope, and a solvent blank.

Stored protocols include typical titration protocols for measuring water content in easily analyzed liquid samples in % and ppm units, for measuring water in hydrocarbons, water in slower to release solids, and water in plastics being introduced by a KF oven/vaporizer. These protocols can be modified and renamed, and five additional protocols are available for users.

A generic protocol often provides good results, but occasionally must be modified for a specific sample. Examples of modifications include changing the time for a titration, either as additional "up-front" time with introduction time, or as additional post-endpoint time with persistence time, or using a low endpoint slope value like 0.05 to force a titration to continue longer.

1. Each protocol has a user-entered name.
2. Units of micrograms, milligrams, %, ppm, or mg/l can be selected. % and ppm are weight:weight water:sample. The mg/l unit is weight:volume.
3. Sample introduction time should provide ample time to get the sample into the cell. Sometimes a little extra time is helpful, and can be set.
4. Extraction time allows time for a slow dissolving, slow water releasing, or slow mixing sample to release water to the reagent system for titration.
5. Endpoint persistence time is additional time after first reaching the endpoint that the titrator continues to titrate; use to ensure complete recovery of water from difficult samples.
6. Endpoint slope is the primary endpoint control. The titrator will titrate until the set slope (rate of water recovery from the sample in micrograms water/second) is reached; use to ensure complete recovery of water from slowly releasing samples such as solids or crystalline materials. This has little effect on miscible liquid samples which usually release water quickly.
7. Use a solvent blank to subtract water present in a solvent used to dissolve otherwise insoluble solid samples. The sample is dissolved in a fixed volume of a solvent, then that solvent is injected into the cell. Determine the water content of the fixed volume of solvent in micrograms, then set that value as a blank to be subtracted.



Unit's % and ppm are W:W (g of water to g of sample). Unit mg/L W:V (g of water to L of sample).

# Data Logging

The meter will store up to 620 data points in an internal data log. Pressing **Print** outputs this data through the RS232 serial port. All channels displayed are printed and data logged at all times.

## Data Log Menu

Press **Data Log** and the Data logging menu will appear.

1. **View data log:** Shows the stored data, one screen at a time. Press the arrow soft keys to page up and down through the stored data. Press **Clear** or **Enter** to return to the menu.
2. **Clear data log:** Clears all stored data points from memory.
3. **Print data log:** Use to send all data points in the Data Log to the RS232 serial port.



### Warning

The Data log is kept in instrument RAM (Random Access Memory), which is powered by the external power supply. Removing power from the meter will lose the stored data in the Data log.

**Data Log Menu**

- 1) View data log
- 2) Turn logging On/Off: ON
- 3) Set logging interval
- 4) Clear data log
- 5) Set sample number
- 6) Set sample label
- 7) Print data log

Number of points in log:  
350

**T<sub>1</sub> 0.099% H<sub>2</sub>O**

**T<sub>2</sub> 0.100% H<sub>2</sub>O**

**T<sub>3</sub> 1.000 ppm**

**Printing Log**

Points remaining:  
321

Press any to abort printing.

# Menu Tree Diagram

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## Mode (T<sub>1</sub>, T<sub>2</sub> & T<sub>3</sub>)

- 1) % Water
- 2) ppm Water
- 3) Hyrdocarbons
- 4) Solids
- 5) KF oven
- 6) User 6
- 7) User 7
- 8) User 8
- 9) User 9
- 0) User 10

## Setup Menu:

- 1) Time and date menu
- 2) Select contrast
- 3) Titration setup menu
- 4) Setup serial port
- 5) Keypress beep on/off
- 6) Select display background
- 7) Show meter information
- 8) Set screen saver timeout
- 9) Restore factory defaults

## Titration Standardize Menu:

- 1) Change name
- 2) Select units
- 3) Set introduction time
- 4) Set extraction time
- 5) Set persistence time
- 6) Set endpoint slope
- 7) Set solvent blank

## Titration Setup Menu

- 1) Modify titration protocol
- 2) Select/assign protocol
- 3) Print a protocol
- 4) Set printouts on/off
- 5) Set printout interval
- 6) Select balance type
- 7) Turn stirrer 1 on/off
- 8) Turn stirrer 2 on/off
- 9) Turn stirrer 3 on/off
- 0) Turn stirrer 4 on/off

## Channel Menu:

- 1) Turn channel T<sub>1</sub> on/off
- 2) Turn channel T<sub>2</sub> on/off
- 3) Turn channel T<sub>3</sub> on/off
- 4) Turn channel T<sub>4</sub> on/off
- 5) Measurement screen

## Data Log Menu:

- 1) View data log
- 2) Clear data log
- 3) Print data log

# Maintenance

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This product contains no user serviceable parts. All replacement parts should be obtained from the manufacturer or an authorized distributor.

## **Cleaning**

The exterior surfaces of this product may be cleaned with a damp cloth or with mild detergent.



## **Caution**

Changes or modifications not expressly approved by the manufacturer will void the user's warranty for this equipment.

# Warranty Instructions

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1. Please return the prepaid, pre-addressed Purchase Registration Card to Denver Instrument Company promptly upon your purchase of the Denver Instrument product. The return of the card is not a condition precedent to warranty coverage.
2. If you have any questions about a Denver Instrument product, please contact the nearest Denver Instrument office as listed below.
3. If it becomes necessary to return your Denver Instrument product for service, you must obtain a "Return Authorization Number". Please pack the product securely in its original approved packing carton or an other suitable container. Include your Return Authorization Number on the shipping label. Shipping charges must be fully prepaid.

Return to authorized distributor or :

*North and South America:*

**Denver Instrument Company  
1401 17th St. Suite 750  
Denver, Colorado 80202  
1-800-321-1135  
Tel: 303-431-7255  
Fax: 303-423-4831**

*U.K. and Ireland:*

**Denver Instrument Company  
Denver House, Sovereign Way  
Trafalgar Business Park  
Downham Market  
Norfolk PE38 9SW England  
Tel: 44 136 63862 42  
Fax: 44 136 63862 04**

*Europe, Asia and Australia:*

**Denver Instrument GmbH  
Robert-Bosch-Briete 10  
37079 Gottingen Germany  
Tel: 49 551 20977 31  
Fax: 49 551 20977 39**

# RS-232 Serial Interface Meter Command Set

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The Denver Instrument Series 200 meters have a bi-directional RS-232 serial port, which can be used to send commands to the meter and output data from the meter. Special characters (w, μ, é) are coded using ASCII (not ANSI); use an ASCII font like "Terminal". Also use a terminal emulation like TTY or ANSI, not VT100.

Serial commands follow either "keystroke" mode or high level command mode consisting of "SET", "GET" and "DO" instructions.

(Note: "GET" and "DO" are optional).

## Keystroke instructions

KEYS	M	Mode
	Z	Standardize
	C	Cal Data
	H	Channel
	S	Setup
	L	Data Log
	R	Clear
	N	Enter/Print
	[0 to 9]	Equivalent to pressing a numeric key
	-	+/- key
	.	Decimal key
	E	Used within a number to enter values in exponential form
	!	Press softkey #1 (at top, usually Help)
	@	Press softkey #2 (usually return to measuring screen)
	#	Press softkey #3 (usually up arrow)
	\$	Press softkey #4 (at bottom, usually down arrow)

**Notes:** Key commands are acknowledged by the meter with a reply  
Keys = COMMAND\_RECEIVED. Multiple keys can be concatenated together into a single command, for example, Keys Z413@  
(Standardize, options, resolution, set to 3, main), or Keys Z4721.2-N@  
(Set manual temperature to -1.2).

## High level instructions

Use commands SET, GET, DO.

Follow command by a keyword like MODE, STDZPH, STDZCONDO, CALDATA, STDZCLEAR, CHANNEL, DATETIME, TIMESTAMP, DISPLAY, READ, INFO

Typical Syntax: [command] [keyword] [channel] [variable(s)]

Error conditions are replied to with an Error response; for example:

"Error: Need channel", "Error: Need mode", "Error: Unspecified"

Accepted commands have a response; indicated below for each command.

## Mode operations

**set mode "channel character" "mode id"**

Examples:           SET MODE A PH  
                      SET MODE B MV  
                      SET MODE B ION  
                      SET MODE C CONDUCTIVITY

Returns confirmation; for example "SET MODE A PH" returns "A mode = PH".  
Valid modes are (depending on the meter model) PH, MV, CONDUCTIVITY, RESISTIVITY, PRAC\_SALINITY, NACL\_SALINITY, DISSOLVED\_SOLIDS.

# RS-232 Serial Interface Meter Command Set

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**[get] mode "channel character" "mode id"**

Examples: [GET] MODE A

Returns mode information on selected channel;  
"A Mode = MV".

## Channel operations

**set channel "channel character" "on|off"**

Examples: SET CHANNEL A ON  
SET CHANNEL C OFF

Returns confirmation; for example "A Channel = ON".

**[get] channel "channel character"**

Example: [GET] CHANNEL B

Returns channel information; "A Channel = OFF".

(DO) READ "channel character" (Take reading w/temperature  
without sending to data log).

## Standardization operations

**[DO] STDZPH "channel character"**

**[DO] STDZCLEAR "channel character"**

**[DO] STDZCONDO "conductivity standard value"**

**[DO] CALDATA "channel character"**

[DO] STDZPH A [Auto-enter a buffer]

Returns "Stdz pH = COMMAND\_RECEIVED", followed by the Calibration  
Data printout.

[DO] STDZCLEAR A [Clear all buffers/standards.]

Returns "Stdz Clear = COMMAND\_RECEIVED".

[DO] STDZCONDO 1000 [Enter a standard of 1000 uS/cm.]

Returns "C Stdz Condo = COMMAND\_RECEIVED", followed by the  
Calibration Data printout.

[DO] CALDATA A

Returns "A Cal Data = COMMAND RECEIVED" followed by the Calibration  
Data printout.

## General meter setup operations

SET DATETIME MM/DD/YYYY HH:MM:SS [Leading 0's required, 24  
hour time]

[GET] DATETIME Returns: "MM/DD/YYYY  
HH:MM:SS"

[GET] INFO Returns Model, Version,  
Serial#.

(DO) DISPLAY display\_text\_string (at 0, 0) [x = pixel from left, 0 - 319]

(DO) DISPXY x y display\_text\_string [y = pixel from top, 0 - 239]

Example: DO DISPXY 15 0 Device ready, press any key.

SETTIMESTAMP # (Set date/time using 'unix'  
(GET)TIMESTAMP seconds).



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*[www.denverinstrumentUSA.com](http://www.denverinstrumentUSA.com)*