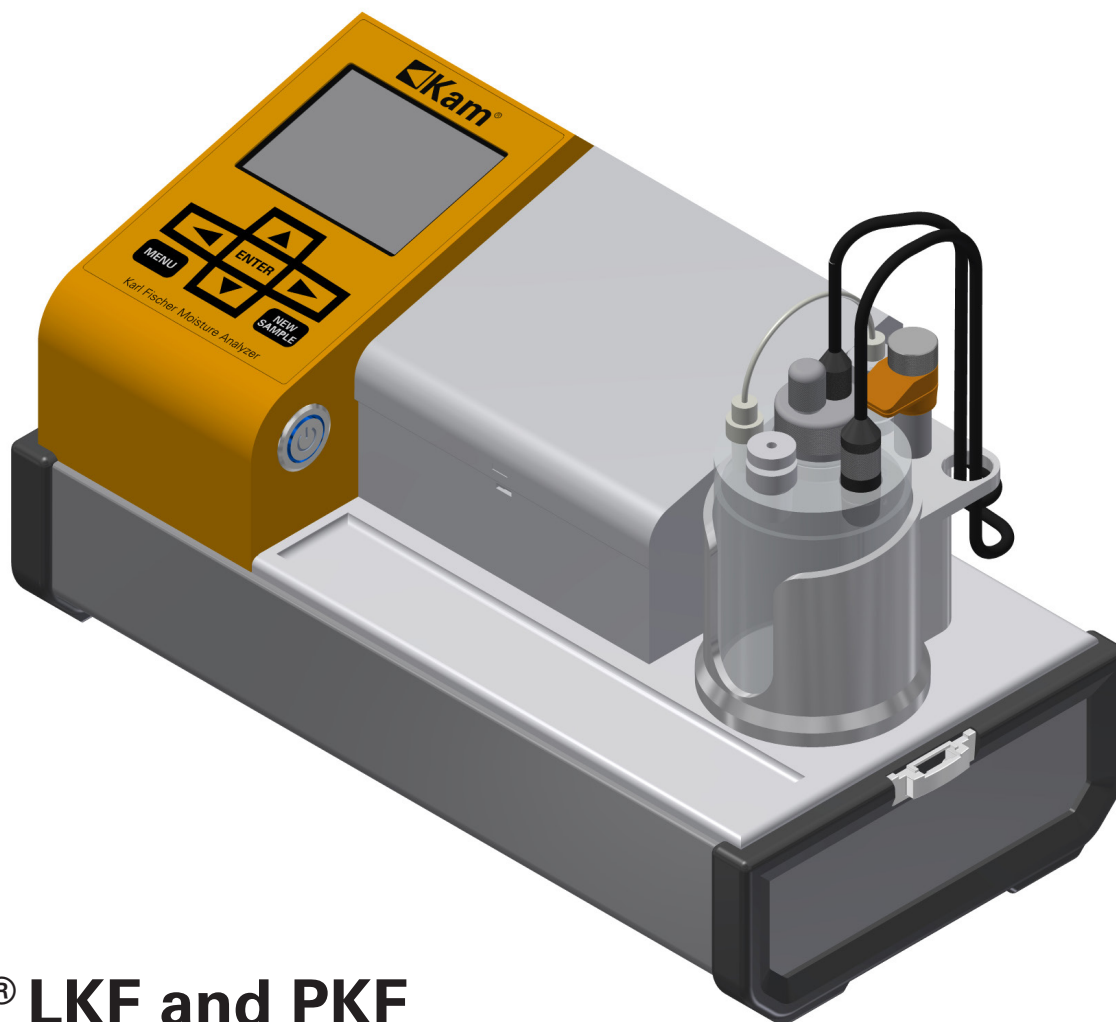




Simple Precision™



KAM® LKF and PKF Karl Fischer Moisture Analyzer

User Manual
KFMANUAL0623

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1. INTRODUCTION

AVAILABLE MODELS



KAM® LKF Karl Fischer
Moisture Analyzer Lab Model

KAM® PKF Karl Fischer
Moisture Analyzer Portable Model

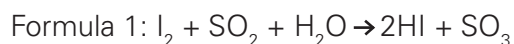
For a full list of consumables, accessories, and parts, including KAM® Reagents and Homogenizer see page 21.

THEORY OF OPERATION

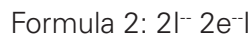
KAM® Moisture Analyzers incorporate the coulometry principle applied to Karl Fischer titration to totally eliminate the troublesome procedures involved in conventional water determinations. Available in a lab model as well as a portable, KAM® Moisture Analyzers are easy to use and fully automatic. The portable model has a rugged case for field usage and the capability to operate continuously for 10 hours on battery power before needing recharging.

KAM® KF units can be used to rapidly and accurately determine the water content of liquid hydrocarbons for all custody transfer operations: pipeline, marine, or truck. The Moisture Analyzer can also be used to analyze crude oils, distillates, transformer oils, jet fuels, chemicals, and most other liquids. In the plant, it can monitor the moisture content of streams during start-ups, shutdowns, upsets, and normal operations. This can be especially important on units where expensive catalysts can be damaged by excessive moisture. The unit also can be used by machinists as part of a preventive maintenance program. By analyzing lube oil on compressors, turbines, etc., the Moisture Analyzer can detect cooling water leaks before they become severe enough to damage equipment.

Karl Fischer titrimetry is an accurate moisture measurement method utilizing the quantitative reaction of water with iodine. In coulometric Karl Fischer titration, the sample is added to the Karl Fischer Reagent (iodine ion and sulfur dioxide as principal components). Iodine, generated electrolytically at the anode, reacts with water in the sample as shown in Formula 1. Iodine is generated in direct proportion to the quantity of electricity according to Faraday's Law.



One mole of iodine reacts quantitatively to one mole of water; therefore, 1 mg of water is equivalent to 10.71 coulombs (Formula 2). Based on this principle, water content can be directly determined from the quantity of electricity required for electrolysis. This eliminates the need for addition of Reagent and tedious standardization procedures.

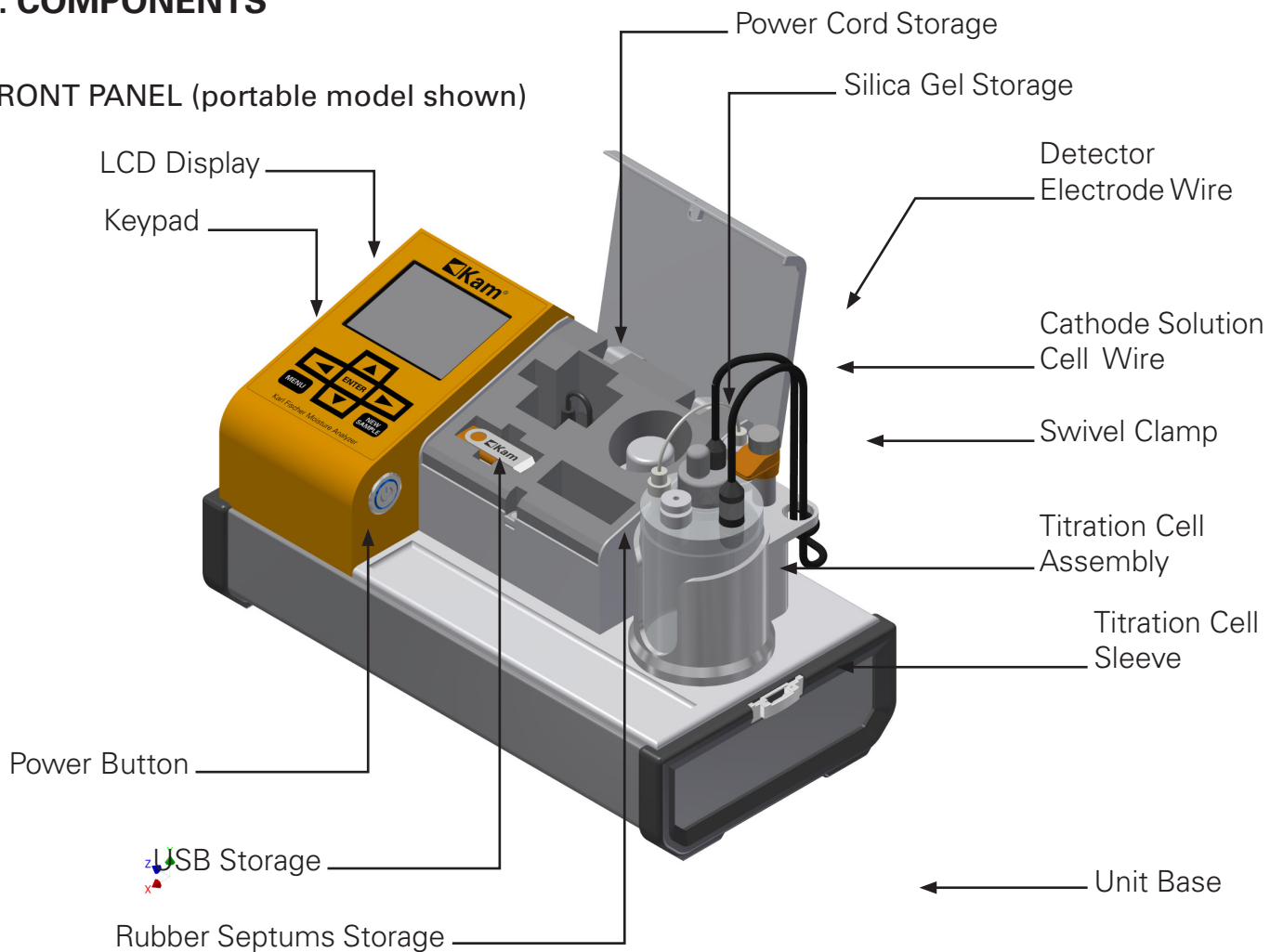


2. SPECIFICATIONS

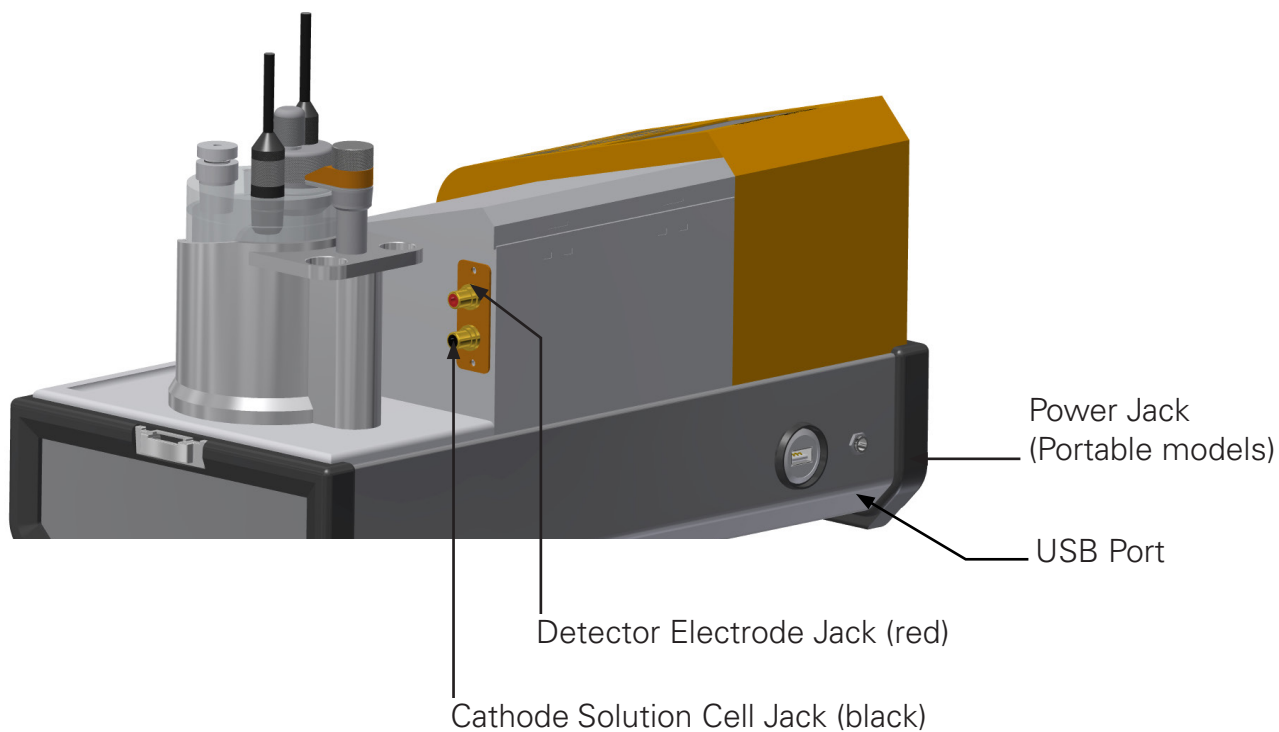
Method:	Coulometric Karl Fischer titration
Detection:	Polarization detection
Control:	Automatic electrolysis current control
Display:	320 x 240 pixel LCD
Sample size:	0.1, 0.25, 0.5, 1.0 ml or less than 2 grams (or ml)
Range:	10 µg- 100,000 µg H ₂ O
Sensitivity:	1 µg H ₂ O
Accuracy:	±5 µg for 10 µg- 1000 µg, 0.5% (C.V.) for over 1000 µg (meets or exceeds API MPMS 10.9, ASTM D4928, ISO 12937, and EI 386)
Generator electrode config.:	With diaphragm
Titration speed:	1000 µg H ₂ O/min. (max. at high H ₂ O concentrations)
Power requirements:	Operates on either AC or DC. AC- 110/120, 220/240 V, 50/60 Hz 12 V rechargeable lithium battery
Ambient Temperature	5°C – 40° C
Communication:	USB port, BlueTooth®, Windows® based software
Printer:	Optional
Dimensions:	Portable 15.5" x 8" x 10" (394 mm x 203 mm x 254 mm) Lab 10.5" x 8" x 9" (267 mm x 203 mm x 229 mm)
Weight:	Portable approx. 20 lbs. (9 kg) Lab approx. 10 lbs. (4.5 kg)

3. COMPONENTS

FRONT PANEL (portable model shown)

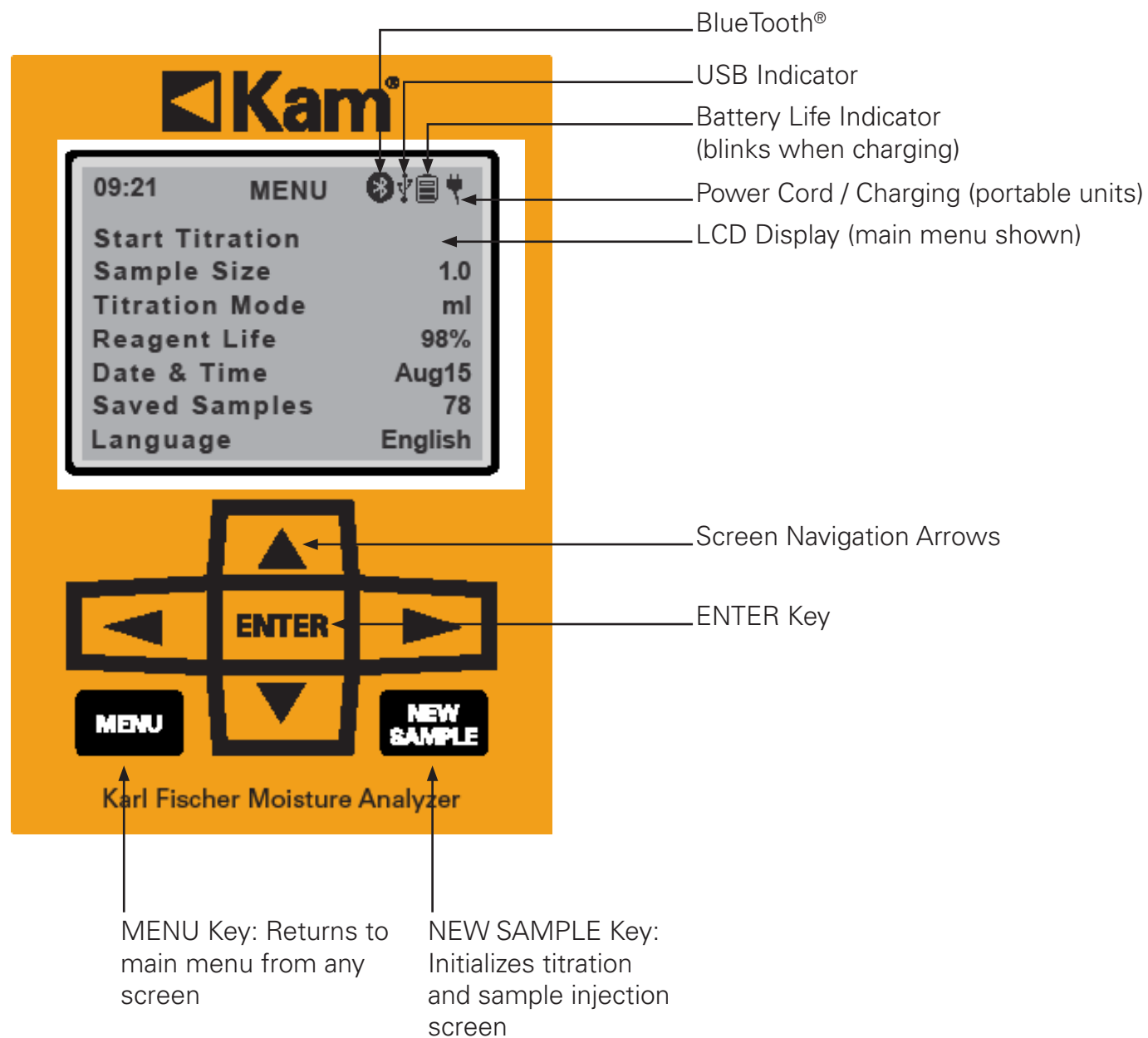


REAR PANEL (portable model shown)



3. COMPONENTS continued

DISPLAY and KEYPAD



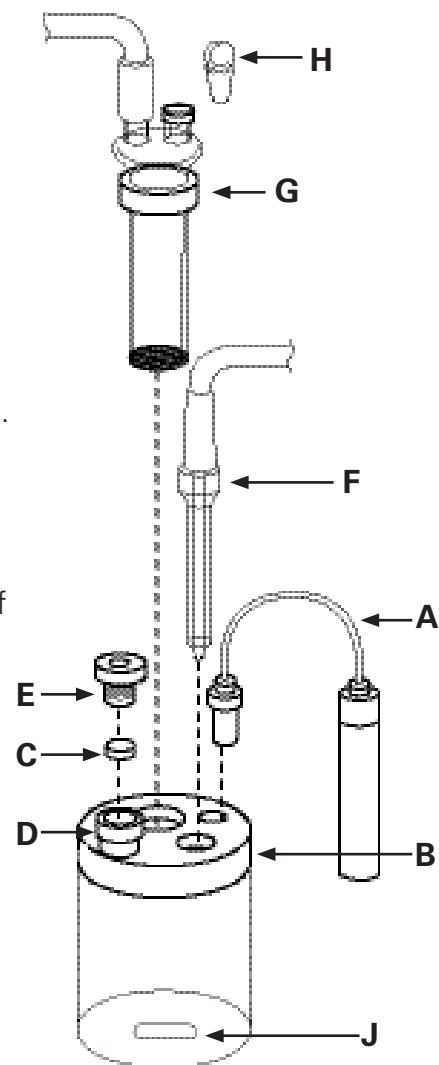
4. OPERATION

GLASSWARE ASSEMBLY

CAUTION: PROTECTIVE GEAR SHOULD BE WORN DURING ALL REAGENT HANDLING.

NOTE: Starter Kit, including reagents, consumables and accessories, sold separately. See page 21 for details.

1. Remove glassware (Titration Cell Unit) from packaging or base. Glassware should be assembled and disassembled separately prior to installation on the unit base. This prevents the possibility of spilling reagents on the base electronics.
2. If assembling a new unit, remove the Silica Gel from packaging and pour into the Drying Tube **(A)**, or verify that the existing Silica Gel inside the Drying Tube is blue. If not, replace. Insert Drying Tube Assembly into the smallest opening of the Generator Solution Cell lid **(B)**.
3. Unscrew Injection Port **(D and E)** and place a new rubber Septum **(C)** in the base of the Injection Port **(D)**. Screw the top of the Injection Port **(E)** into the base and place the Injection Port into the indicated opening on the Generator Solution Cell lid **(B)**.
4. Apply a thin layer of Special Grease to the neck of Detector Electrode **(F)** and place in the remaining small opening of the Generator Solution Cell lid **(B)**. Do not apply pressure to the Electrode. Rather, let it seat under its own weight. Rotate it half a turn backward and forward to ensure the grease is spread evenly and a seal has been created.
5. Drop the ceramic Stir Bar **(J)** into the Generator Solution Cell.
6. Apply a thin layer of Special Grease to the neck of Cathode Solution Cell **(G)** and its Stopper **(H)**. Set aside.
7. Pour entire contents of KAM Generator Solution A (100 ml) into the Generator Solution Cell through the remaining hole (should be the large hole near the center of the lid). The Generator Solution A (100 ml) is pre-measured to the appropriate volume.
8. Place the Cathode Solution Cell **(G)** into in the Generator Solution Cell lid **(B)**. Do not apply pressure. It will seat under its own weight. Rotate it half a turn backward and forward to ensure the grease is distributed evenly around the circumference of the seal. The sooner the hole is covered, the less moisture will be absorbed by the chemicals.



4. OPERATION continued

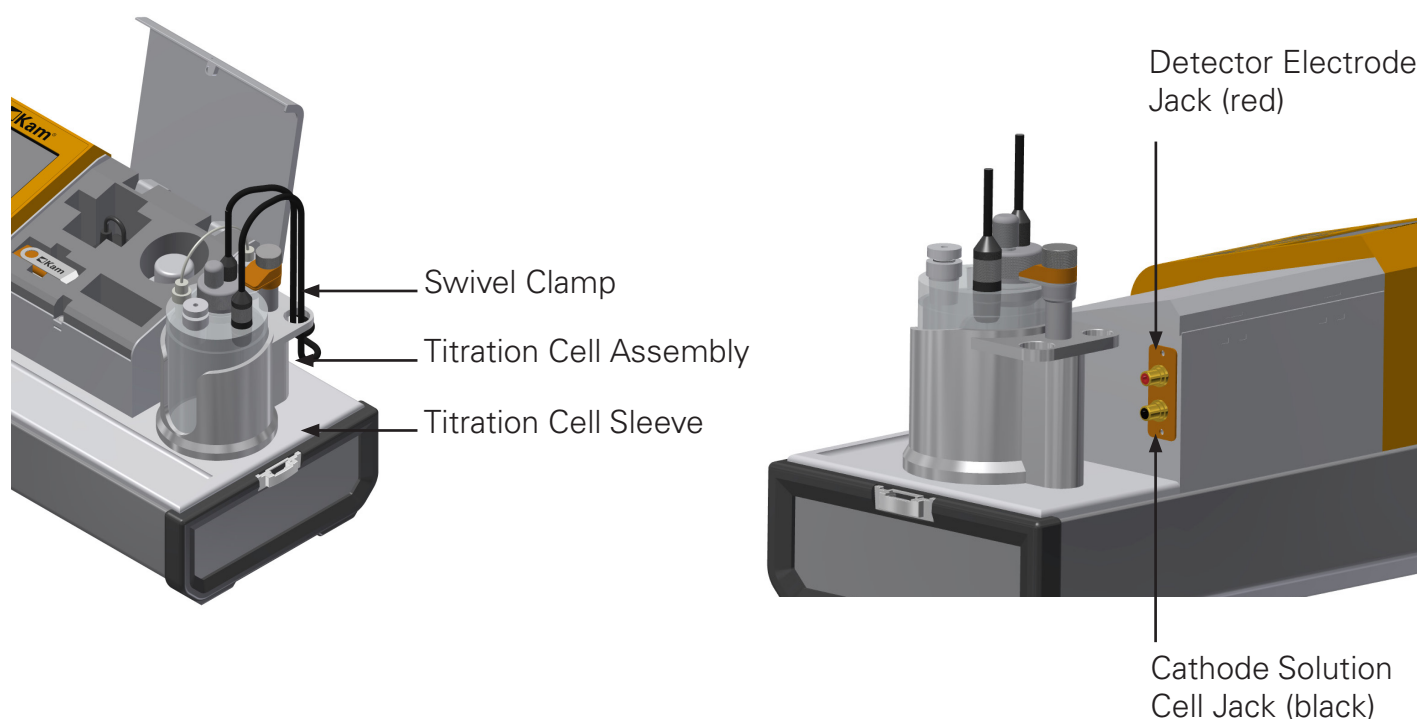
- Place a funnel in stopper hole at the top of the Cathode Solution Cell **(G)** and pour entire contents of KAM® Generator Solution C (5 ml) ampoule into the Cathode Solution Cell **(G)**. Remove funnel and place the glass Stopper **(H)** in place.

NOTE: Generator Solution C ampule is glass. To open, hold the ampule in a paper or cloth towel, and apply pressure to the top of the ampule just above the small dot. Top should cleanly snap off the base of the ampule.

BASE ASSEMBLY

NOTE: Before assembling the base unit and glassware, ensure that the unit has been turned off.

- Turn the swivel clamp toward back of KF unit and place the entire Generator Solution Cell assembly into the Titration Cell Sleeve. Turn Swivel Clamp over the top of the cell and secure by hand tightening the screw on top of the clamp. Do not over tighten.
- Plug the free end of the Cathode Solution Cell Wire into the black colored jack on the side panel of the base unit, and the free end of the Detector Electrode Wire into the red colored jack.
- If using a portable unit, remove the power cord from packing or storage compartment and plug into the power jack on the back of the base. Plug unit into power source and press power button.
- The power button should glow blue. If you are using a portable unit, the light will blink when the battery is charging. The LCD display should show the Main Menu.

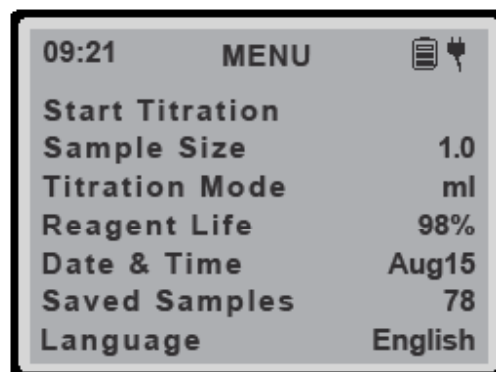


4. OPERATION continued

SET DATE AND TIME

When power is first turned on, the Main Menu will appear on the screen. If date and time are not correct, this should be the first step in the initial titration sequence.

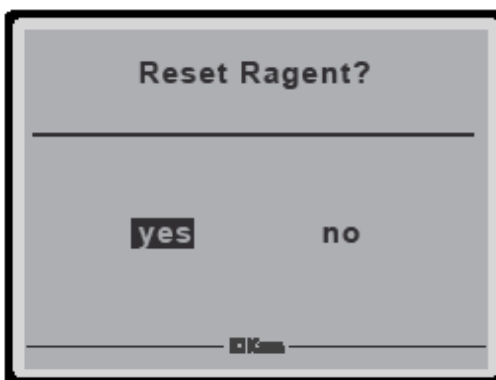
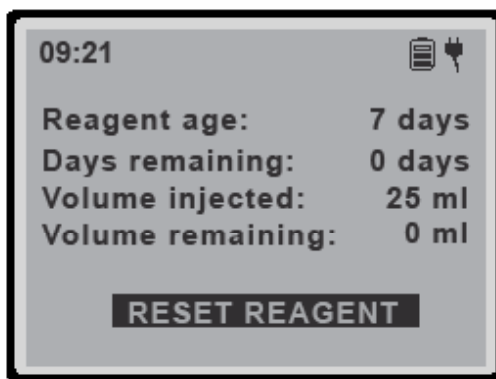
1. Using the navigation arrows, scroll down to Date & Time and press ENTER.
2. To set date, use the RIGHT/LEFT arrows to navigate to date indicator and use the UP/DOWN arrows to change the month, day, and year.
3. To set time, navigate to time indicator and use the UP/DOWN arrows to change the hour (24-hour clock), and use the RIGHT/LEFT arrows to move between fields.
4. Press ENTER to save values and return to Main Menu.



RESET REAGENT LIFE

After initial assembly and each time after reagent has been replaced, the reagent life must be reset.

1. From the Main Menu, navigate to Reagent Life and hit ENTER.
2. The display will indicate the following:
 - Current reagent life in days (max 7)
 - Remaining days in current reagent life
 - Total volume of samples already run (max 25 ml)
 - Remaining volume of samples allowed
3. "RESET REAGENT" will be highlighted at the bottom of the screen. Hit ENTER.
4. A confirmation screen will appear and "Yes" will be highlighted. Hit ENTER again to reset the reagent life.
5. The display will return to the Main Menu and Reagent Life should be 100%.



4. OPERATION continued

SET SAMPLE SIZE and TITRATION MODE

From the Main Menu, check Sample Size and Titration Mode readings. Titration mode options are: % (gives results in percent water), μg (gives results in μg water), and Dil (Dilution mode - see page 12 of this manual). If Sample Size reading does not match your intended syringe/ sample volume, navigate to Sample Size and use RIGHT/LEFT arrows to change sizes. Options in % mode are 0.1, 0.25, 0.5, and 1.0 ml. Options in μg and dilution modes are .5 and 1.0 ml. See table from API MPMS Chapter 10.9 below to select the appropriate sample size based on anticipated water content.

% Mode (water content below 5%)

ESTIMATED MOISTURE CONTENT	SAMPLE SIZE g or ml
0.02-0.1%	1.0
0.1-0.5%	0.5
0.5-5%	0.25

Dilution Mode (water content above 5%)

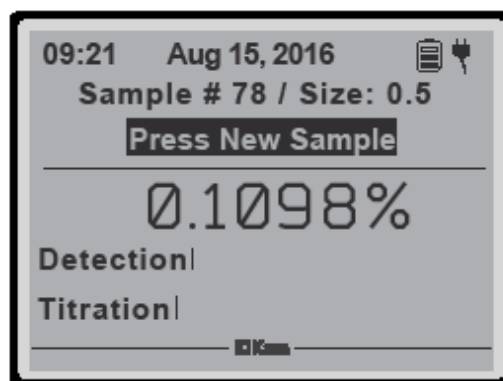
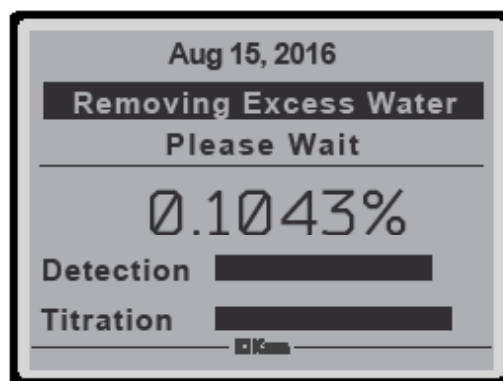
ESTIMATED MOISTURE CONTENT	SAMPLE SIZE g or ml
0-20%	1.0
20-50%	0.5

INITIAL TITRATION

After long periods without use, the unit has been turned off, and/or each time the reagents have been replaced, you must run an initial titration to remove any ambient moisture from the reagents and cells.

1. From the Main Menu, navigate to Start Titration and press ENTER.
2. The stir bar should begin to spin and the display will show "Removing Excess Water." This may take several minutes after reagents have been changed or if the instrument has been out of the titration mode for a long period of time.
3. When all excess water has been removed, the unit will beep and the display will alternate between "Analysis Complete" and "Press New Sample."

NOTE: Prepare physical sample in accordance with instructions on page 11 of this manual prior to pressing the NEW SAMPLE button.

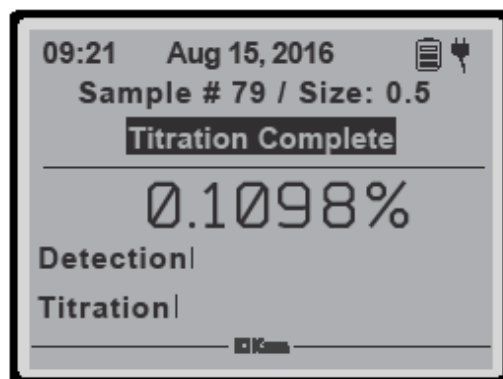
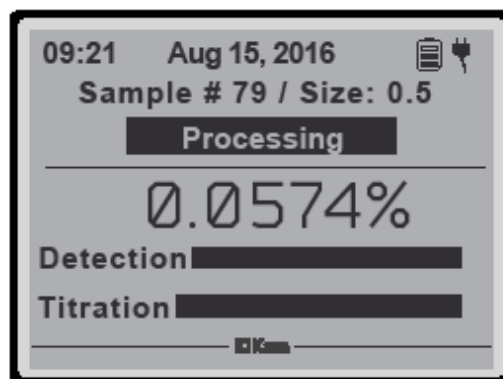
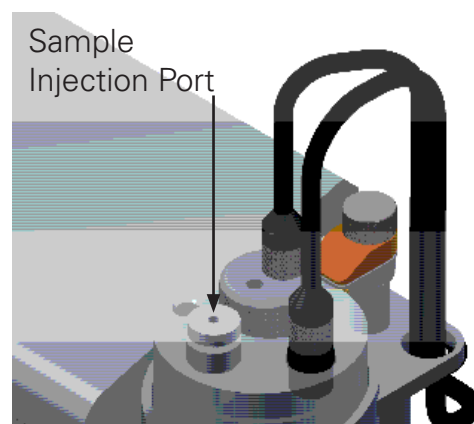
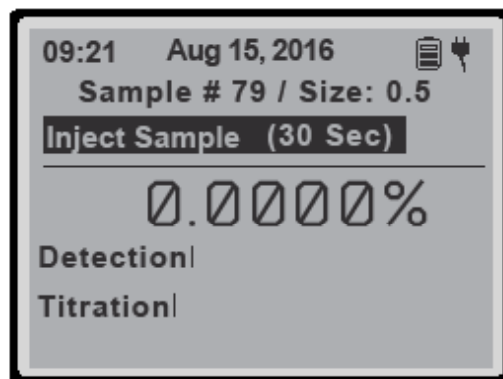


4. OPERATION continued

RUNNING SAMPLES / MOISTURE CONTENT DETERMINATION

Sample preparation and methodology must conform to the standards dictated in API MPMS Chapters 8.3 and 10.9.

1. To draw a sample, first flush the syringe with sample fluid. Draw this sample into the syringe and discharge the sample into a waste container a minimum of three times.
2. After the syringe has been properly flushed, draw a new sample in to the syringe. The sample volume drawn should be slightly larger than the desired amount.
3. Invert the syringe so that the needle end is pointing up. Wrap the needle in a paper towel (to absorb discharged excess fluid) and hold syringe by needle end. Tap the body of the syringe to allow any air bubbles to rise to the top. Slowly press plunger to discharge air bubbles and excess sample fluid from the inside of the syringe. The tip of the plunger should exactly align with the sample volume marking.
4. Press NEW SAMPLE key on Keypad.
5. The display will read "Inject Sample" and a thirty-second countdown will begin.
6. Insert syringe needle through the Sample Injection Port, piercing the Septum and continuing into the cell until the needle tip is fully submerged in the Reagent.
7. Inject the sample into the Reagent. This should be done in a single, swift movement, but do not allow the sample to splash up against the wall of the Generator Solution Cell or the needle to touch the sides of the cell.
8. Electrolysis begins automatically by the injection of the sample. When the analysis is completed, the unit beeps and the results will be displayed on the Titration Complete screen.



4. OPERATION continued

SAMPLE DILUTION METHOD

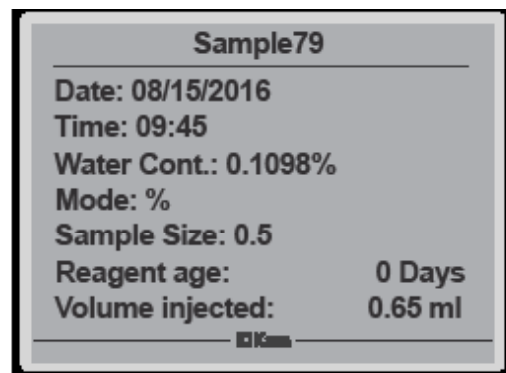
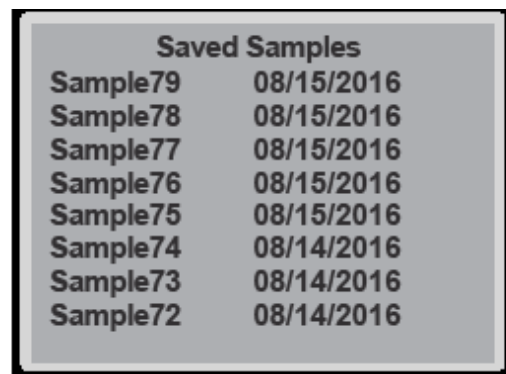
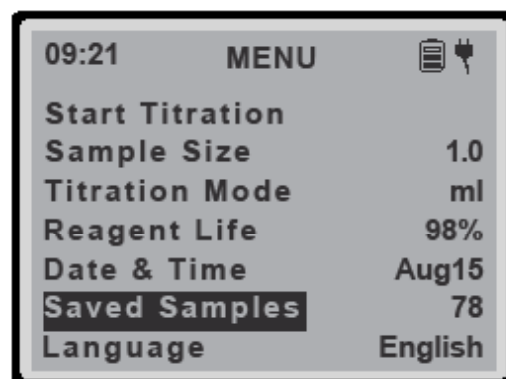
In cases where the viscosity of the sample is such that it cannot be pulled into a syringe or when the anticipated water content is higher than 5%, users may dilute the sample according to the following steps.

1. From the Main Menu scroll down to Titration Mode and use RIGHT/LEFT arrows to switch to Dilution Mode indicated by "Dil".
2. Dilute (mix) the sample with a ratio of 1 part (1 ml) sample to 99 parts (99 ml) of reagent-grade xylene.
3. The analyzer automatically adjusts for the dilution factor based on the sample size.

ACCESSING SAMPLE DATA

The KAM® KF saves data for up to 100 samples in internal memory. Samples are automatically time stamped and numbered in chronological order. Saved sample data can be retrieved at any time by following the steps below.

1. Return to the Main Menu by pressing the MENU key on the keyboard.
2. Use the UP/DOWN arrows to navigate to Saved Samples and press the ENTER button.
3. The sample log will display samples in chronological order.
4. Use LEFT/RIGHT arrows on keyboard to page through sample log.
5. Data for any individual sample can be retrieved by using the UP/DOWN arrows to navigate to the desired sample number and pressing ENTER. The display will show the date, time, water percentage, and sample size of the sample in question. The next or previous sample can be viewed using the UP/DOWN arrows.
6. Hit ENTER to return to Sample Log/Saved Samples.



4. OPERATION continued

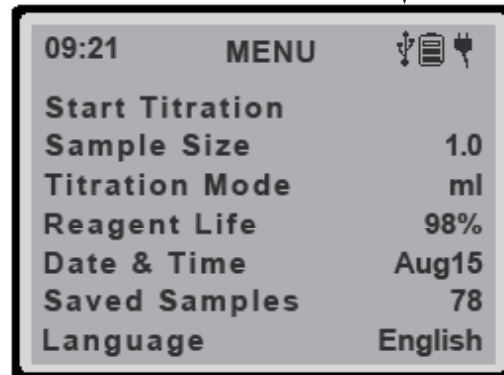
USB DATA RETRIEVAL

1. Ensure that the USB drive is formatted FAT32.
2. Press the MENU key on the keypad to return to main menu.
3. Plug the USB drive into the Karl Fischer (USB port is on the back panel near to the power jack).
4. If properly connected, a USB icon will blink on the main menu, indicating that files are transferring.
5. Once transfer is complete, the USB icon will turn steady.
6. Remove the drive and plug into a PC. The files will be located in the folder "KAM" with extension *.KFF and can be downloaded to a desktop or accessed directly from the USB.
7. Open the KAM® KF Windows® program on your computer.
8. There are two options for data access: Download via BlueTooth® and Download from Files.
9. Click on Download from Files.
10. A dialog window for saving the file will appear. Type in the desired name for the output file in the format "<Filename>.xls" and hit save. Example "August titrations.xls."
11. A window will open with all the sample files listed. Select all the *.KFF files from the drive and click open.
12. The MS Excel (*.xls) file will be created at the specified location.

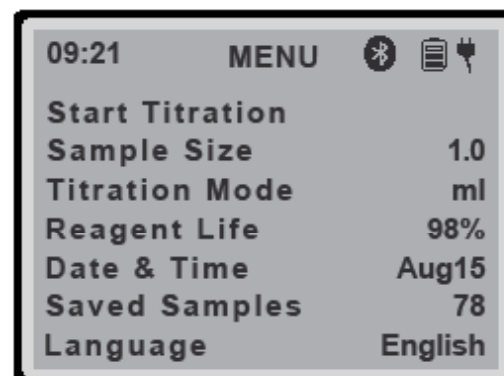
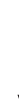
BLUETOOTH® DATA RETRIEVAL

1. On your computer the KF unit will appear as a BlueTooth® device named with its KF serial number. Once connected, the BlueTooth® icon will appear in the upper right hand corner of the printer menu.
2. Open the KAM® KF Windows® program.
3. There are two options for data access: Download via BlueTooth® and Download from Files.
4. Click on Download via BlueTooth, and follow steps 10-12 above.

USB icon



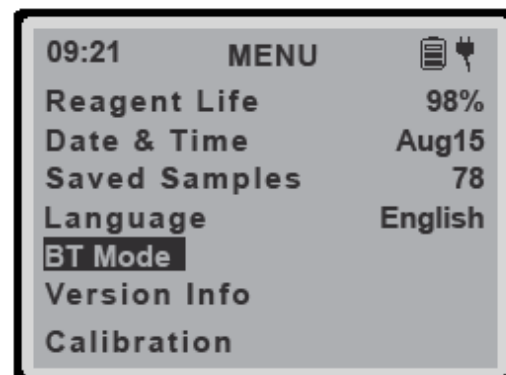
BlueTooth®



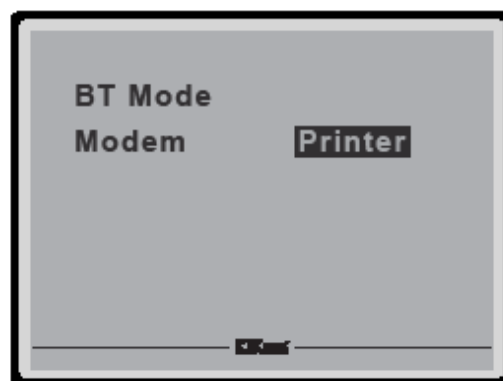
4. OPERATION continued

PAIRING WITH THE OPTIONAL BLUETOOTH® PRINTER

1. If not already on, turn on the KAM® KF unit.
2. Turn on the printer by pressing the power button on the side of the printer once. Do not hold the button. The printer will take approximately 10 seconds to warm up.
3. From the Main Menu on the KAM® KF, use the navigation arrows to scroll down to BT Mode and press ENTER.



4. Use the RIGHT/LEFT arrows to navigate to Printer and press ENTER.



5. The display will show "Scanning for Printer." This may take up to 30 seconds.



6. If a BlueTooth® connection cannot be made, the display will show "No Printers Available. Press Menu to Exit." Press the MENU button and return to step 3 above. Ensure that the printer is turned on.



4. OPERATION continued

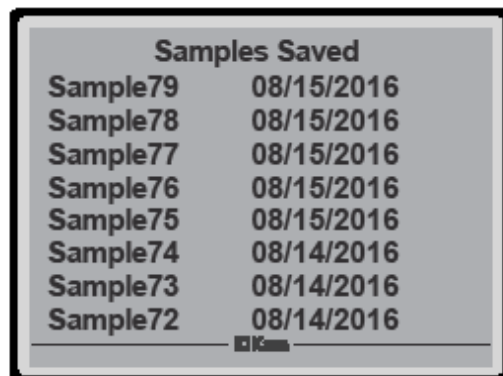
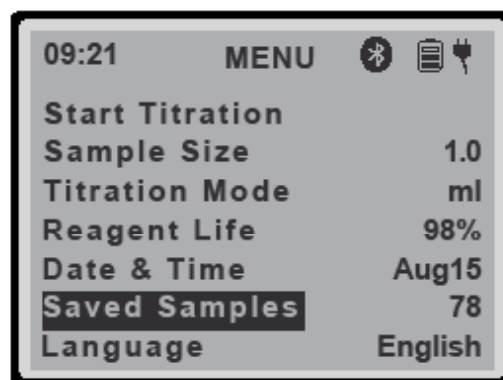
PAIRING continued

- Once the printer is located, the screen will display "MYPrinter" in the upper left hand corner. Use the navigation arrows to select MYPrinter and press ENTER.
- The LCD display should show the Main Menu and the Bluetooth® icon will appear at the top of the screen. This indicates the devices have been paired successfully.



PRINTING

- To print, from the MAIN MENU use the navigation arrows to scroll down to Saved Samples and press ENTER. This display will show a list of samples.
- Use the navigation arrows to choose the sample record to be printed and press ENTER.



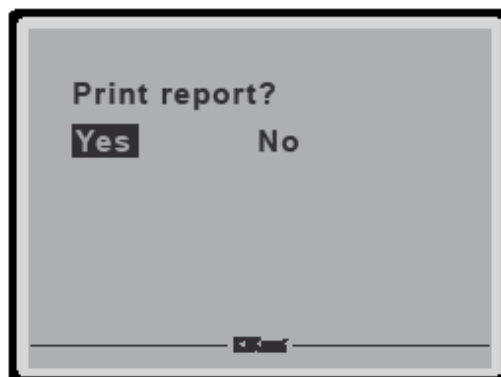
4. OPERATION continued

BLUETOOTH® PRINTER continued

3. A confirmation screen will appear and “Yes” will be highlighted. Hit ENTER to print the selected record.
4. Once Print Report has been confirmed, the selected sample record will be printed. Two dotted lines will indicate the end of the record and a new record can then be sent to the printer.
5. If not ready to print, use the navigation arrows to highlight “No” and the display will return to the selected record.

NOTE: Please print one record at a time. Do not send another record to the printer while a record is still printing.

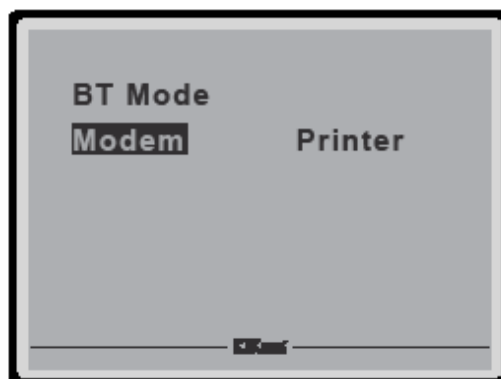
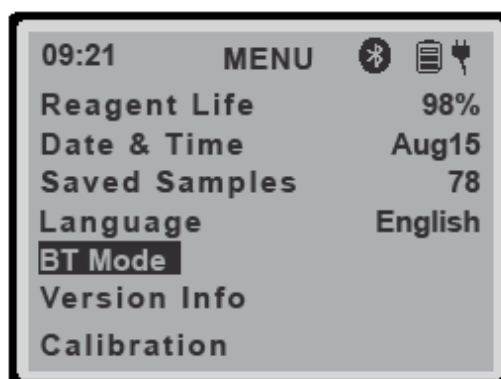
NOTE: if at any time the KF unit is turned off, you must turn off the printer, then follow the steps on page 14 of this manual to reconnect to the printer.



UNPAIRING WITH THE BLUETOOTH® PRINTER

NOTE: To use the KF unit with other BlueTooth® devices, you must first unpair with the printer.

1. From the Main Menu on the KAM® KF, use the navigation arrows to scroll down to BT Mode. Hit ENTER.
2. Use the RIGHT/LEFT arrows to select Modem under BT Mode. Hit ENTER
3. The LCD display should show the Main Menu and the BlueTooth® icon will no longer be at the top of the screen.



4. OPERATION continued

PRINTER TROUBLESHOOTING

If the printer fails to print a sample record, the Bluetooth® connection with the KAM® KF unit might be lost.

- 1.** Turn off the KAM® KF unit.
- 2.** Press the power button on the side of the printer two times in quick succession.
The printer will shut down.
- 3.** Wait until the blue light on the printer stops blinking and turns off. Then, press the power button once more. The printer should turn on. It will take approximately 10 seconds to warm up.
- 4.** Turn on the KF unit and repeat the Pairing Process instructions starting from step 3 on page 14 of this manual.

5. MAINTENANCE

REAGENT REPLACEMENT PROCEDURE

Both time of use and total volume of samples affect reagent life. The KAM® KF unit automatically notifies you when reagents need to be replaced. Current reagent life is indicated on the Main Menu, and when the reagents have expired a warning will appear on the display for a few seconds between each sample analysis until reagents have been replaced. To change reagents, follow the steps below.

Refer to pages 7-8 for part images.



1. Unplug Detector Electrode and Cathode Cell wires from their respective jacks.
2. Loosen screw on the top of the swivel clamp and turn clamp toward back of unit.
3. Carefully remove entire glassware unit and place on a clean surface.
4. Remove Glass Stopper from the Cathode Solution Cell and wipe free of grease. Also remove grease from opening at the top of the cell.
5. Remove the Cathode Solution Cell from the Generator Solution Cell by gently twisting and lifting. DO NOT pull using the wire. Remove grease from the exterior of the Cathode Solution Cell and opening in the Generator Solution Cell opening.
6. Remove Detector Electrode (do not pull by wire), Sample Injection Port, and Drying Tube from the Generator Solution Cell.
7. Remove the Glass Stopper from the Cathode Solution Cell.
8. Empty contents of Cathode Solution Cell by pouring into a suitable container or aspirating from the cell. Dispose of fluids according to SDS sheet(s).
9. Empty contents of Generator Solution Cell by pouring into a suitable container or aspiration. Dispose of fluids according to the SDS sheet.
10. Thoroughly wash the Generator Solution Cell with water and dish soap, then rinse with water and dry by inserting a paper towel in large hole in lid and wiping down inside walls of the cell.
11. Follow steps for Glassware Assembly and Base Assembly on pages 7-8 of this manual.
12. Follow steps to Reset Reagent Life on page 9 of this manual.
13. Follow steps for Initial Titration on page 10 of this manual.

MAINTENANCE continued

STORAGE

The unit can be stored for up to 1 week without use without needing to remove the reagents or disassemble. Do not disconnect any of the attachments on the Generator Solution Cell and keep all parts mounted to prevent moisture absorption in the reagents. If the cell is left standing with the drying tube removed, the ceramic frit on the Cathode Solution Cell will absorb moisture.

For storage/no usage for over 1 week, the unit needs to be disassembled and all glass needs to be cleaned with soap and hot water, rinsed, and dried. Leaving the reagents in for an extended period of time can lead to crystallization.

SPECIAL GREASE

To keep the Generator Solution Cell performing accurately and effectively be sure that a thin layer of Special Grease is applied to all glass tapered joints each time the Reagents are replaced. Frequent greasing will prevent the glassware from seizing and causing damage to the cell. The Special Grease does not absorb moisture, so it will not hinder the results of the analysis.

NOTE: No other grease should be used with a KAM® KF Karl Fischer Moisture Analyzer due to the potential for the other types of grease to absorb moisture and interfere with titration if it is silicon based. KAM CONTROLS is not responsible for problems resulting from the use of improper grease.

CATHODE CELL ELECTRODE CLEANING PROCEDURES

Dirty electrodes (platinum grids) usually result in the following problems:

- A decrease in titration efficiency resulting in a longer measuring time
- An increase in the blank (residual) value of titration current due to absorption of moisture in the dirty area
- Unstable titration current and lack of reproducible results
- Staining on the ceramic frit at the bottom of the Cathode Solution Cell

NOTE: KAM® recommends the use of chromic sulfuric acid (3 g of potassium dichromate + 400 ml of reagent grade sulfuric acid). Because the acid produces corrosive fumes, be sure and conduct all parts of this procedure in an appropriately ventilated environment.

Acid should NOT be reused. Follow appropriate disposal procedures.

KAM® performs this service as a part of annual unit recertification and highly recommends end users send unit to factory for electrode cleaning if a suitable environment and/or chemicals are not available.

Follow steps for glassware disassembly on page 18 of this manual.

MAINTENANCE continued

1. Remove any exterior contamination from Cathode Solution Cell with tissue paper and acetone being careful not to damage the platinum wires and screen on the outside of the cell.
2. Fill the Cathode Cell with acetone and stopper the inlet joint. Shake the unit until any dirt is removed. This should be repeated several times. Pour out and discard acetone.
3. Wash the outer surface with acetone.
4. Pour approximately 5 ml of acid into the Cathode Solution Cell.
5. Place the cell in a 50 ml beaker and fill the beaker with acid to the same level as is in the cell. Secure the Cathode Solution Cell so that it will not fall over. Allow the cell to remain in the solution overnight.
6. After the cell has stood overnight, discard the acid in the cell, and rinse the inside and outside of the cell with running tap water until the yellow color disappears.
7. Place distilled water in the cell and place it in a 400 ml beaker filled with distilled water.
8. Place the beaker on a hot plate and bring the water to a slow boil for at least one hour.
9. Repeat this operation until there is no coloration of the water.
10. Remove the Cathode Solution Cell from the water and fill it with acetone to overflowing, flooding the outside of the cell as well. Shake the cell, dump out the acetone, then refill and repeat.
11. Dry the cell with a forced air dryer.

NOTE: Do not use compressed air as the increased pressure could damage the components.

12. Place the entire assembly in a laboratory oven and continue to dry it for several hours at 120° F.

NOTE: The Detector Electrodes can be cleaned in a similar manner if required.

ORDERING INFORMATION

KAM® KF KARL FISCHER MOISTURE ANALYZERS

P# 09100 KAM PKF PORTABLE KARL FISCHER MOISTURE ANALYZER: Battery powered Analyzer includes Recharger (120 VAC), Titration Cell, Electrodes, Stir Bar, Drying Tube, and Carrying Case.

P# 09150 KAM LKF LAB KARL FISCHER MOISTURE ANALYZER: includes Titration Cell, Electrodes, Stir Bar, Drying Tube, and 120 VAC Power Adapter.

P# 09041 STARTER KIT: Contains all required items for analysis, including: Generator Solution A (1), Generator Solution C (1), Calibration Verification Check Solution (1), 1 ml and 10 µl Gastight Syringes, 14 and 19 gauge Needles, package of rubber Septums (100), Funnels (2), Special Grease (1) and Silica Gel (1).

REAGENTS and CONSUMABLES

P# 09004 GENERATOR SOLUTION A (Anode): pack of 6, 100 ml bottles

P# 09006 GENERATOR SOLUTION C (Cathode): pack of 6, 5 ml ampoules

P# 09032 CALIBRATION VERIFICATION CHECK SOLUTION: box of 10, 4 ml ampoules (1% water content), certificate included

P# 09013 SILICA GEL: 100 ml bottle

GLASSWARE

P# 09052 COMPLETE TITRATION CELL ASSEMBLY: includes Generator Solution Cell, Cathode Solution Cell, Detector Electrode, Drying Tube, Sample Injection Port, Stir Bar

P# 09064 DETECTOR ELECTRODE

P# 09063 CATHODE SOLUTION CELL

P# 09062 GENERATOR SOLUTION CELL

ORDERING INFORMATION CONTINUED

SYRINGES AND NEEDLES

P# 09010 GASTIGHT SYRINGE, 10 µl

P# 09023 GASTIGHT SYRINGE, 50 µl

P# 09021 GASTIGHT SYRINGE, 250 µl

P# 09022 GASTIGHT SYRINGE, 500 µl

P# 09008 GASTIGHT SYRINGE, 1 ml

P# 09001 GASTIGHT SYRINGE, 2.5 ml

P# 09002 NEEDLE, 19-gauge, 4"

P# 09003 NEEDLE, 14-gauge, 4"

SPARE PARTS

P# 09049 SAMPLE INJECTION PORT

P# 09044 STIR BAR

P# 09050 DRYING TUBE

P# 09029 RUBBER SEPTUM, pack of 100

P# 09015 SPECIAL GREASE, 25 g tube

P# 370420 REPLACEMENT RECHARGEABLE BATTERY (for model 09031)

P# 370400 POWER ADAPTER, 110/120 or 220/240 VAC

ACCESSORIES

P# 09014 HOMOGENIZER DRIVE UNIT, 110/120 or 220/240 VAC with speed control

P# 09019 DISPERSING TOOL FOR HOMOGENIZER, 18 mm (for 50-2000 ml volume)

P# 09009 DISPERSING TOOL FOR HOMOGENIZER, 25 mm (for 500-4000 ml volume)

P# 09018 HOMOGENIZER STAND