

# QC-Titrate™ / PC-Titrate™

More than just Titration Systems...

Automation  
Is Our  
Strength

Titration



Leading the Way in Automated Solutions

Ion Analysis



# It Began with a Vision...

**Man-Tech Associates Inc. began with a far-reaching vision: to develop the first software-based autotitration system in the world!** With the idea firmly implanted, we immediately sought to find automation capabilities for our titration products and to develop robotic autosamplers with the flexibility needed to help create our revolutionary system. Our strength in software and automation coupled with our customer service excellence has enabled us to flourish globally. With hundreds of installations already performed, Man-Tech continues to grow and we make our presence felt by fulfilling our vision.

## In Pursuit of Excellence in Automation...

- 1993 • Introduced the first commercially available software-based titration system in the world
- 1994 • First X,Y,Z robotic autosampler for titration system
- Added ion selective measurement to a titration system
- 1996 • Introduced the TitraSip™ - integrated pipettor, rinse pump, analysis vessel and drain valve in one module
- 1997 • First 48,000-step buret drive - highest resolution in the industry
- 2000 • Introduced the TitraValve™ - multiple titrant/reagent delivery from a single buret drive or reagent addition pump
- 2001 • First automated direct injection coulometric Karl Fischer system
- 2002 • Introduced the Turbidity AssayPlus™ - automated NTU turbidity analysis
- 2003 • Introduced TitraSip™ SA - unattended operation with stand alone PC-Titrate™ or QC-Titrate™ system (without autosampler)
- 2004 • Introduced the Color AssayPlus™ - UV/Vis spectrophotometers completely controlled by a titration system
- Added capabilities to connect TitraSip™ to QC-Titrate™ system with autosamplers - focuses on economical, high-end titration and ion analysis
- Introduced BOD/Titrate™ - 2 in 1 automated system combining both BOD and titration in one integral unit

....AND SO MUCH MORE IN THE FUTURE!



"The precision was superior on the PC-Titrate™ system."

David M. - Supervisor, Quality Control, Chemical Industry

# QC-Titrate™ and PC-Titrate™

## Application-Driven Solutions for Your Industry!

Most of our systems combine titration analyses with other analysis types such as ion selective electrode (ISE) direct measurement, conductivity, turbidity and/or color. Based on the modular concept, hundreds of configurations exist and one is sure to fit your requirements exactly. No extras needed! We cater to a large number of applications in many industrial sectors.

## Applications available for your specific requirements

### Agriculture / Environmental



**Large capacity autosamplers are ideal for unattended runs plus the TitraSip™ allows for multi-parameter analysis from a single sample. The sample analysis is cost-effective, providing excellent return on investment with decreased turnaround time.**

*pH, EC (conductivity), alkalinity (p&m alkalinity, bicarbonate, carbonate, hydroxyl), F, Cl, hardness (Ca<sup>2+</sup> & Mg<sup>2+</sup>), NH<sub>3</sub>, NH<sub>4</sub><sup>+</sup>, SO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, I, CN<sup>-</sup>, SiO<sub>2</sub>, PO<sub>4</sub><sup>-</sup>, S<sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>, TKN, residual chlorine, color, turbidity, Grans alkalinity, Grans acidity, soil pH, EPA, ASTM and Standard Methods. Request your free copy of the Man-Tech approved methods list.*

### Electroplating



**Imagine technician-free automation. Load. Start. Done. The system pipettes, analyzes, rinses and waits for the next sample. No titrant switching! It can even schedule the analysis for you and complete multiple parameters from one single sample.**

*pH, free acid, cyanide, nickel, caustic & more...*

### Pulp & Paper



**The first automated and accurate Kappa titration system endorsed by Paprican\*. It utilizes smaller sample sizes and reduces chemical reagent requirements. Add to this liquor analysis, alkalinity analysis etc. and your pulp and paper titration needs are completely automated!**

*Kappa numbers, K numbers, ABC liquors, white, black and green liquors, caustic, chlorine, TAPPI methods*

### Petrochemical



**A wide variety of system configurations is available. Large throughput for an impressive automated capacity (Example: TAN/TBN systems that can handle up to 179 samples in a single batch) all following ASTM methodologies**

*TAN, TBN, H<sub>2</sub>S/mercaptan, caustic, MEA, MDEA, bromine number, chloride, ASTM and UOP methods*

### Pharmaceutical



**Multiple methods and/or multiple samples are automated eliminating the use of labor intensive exchange units and utilizing a flexible, large capacity autosampler for unparalleled accuracy and precision! All this plus the software enables 21 CFR Part 11 compliance.**

*Vitamin C, pKa, chloride, redox, acid/base, Ca<sup>2+</sup>, Mg<sup>2+</sup>, pH, I, non-aqueous, USP and AOAC methods*

### Wine Analysis



**High throughput solutions for the busy winery laboratory. Automate only pH and total acidity or everything including total and free sulfite. An autosampler with a capacity of up to 179 samples can analyze all parameters from a single sample cup!**

*pH, total acidity, free & total SO<sub>2</sub><sup>-</sup>, F, AOAC methods*

### Food Analysis



**Automated solutions that include sample preparation for the high throughput food laboratory. Automate from 18-179 samples in a single run with flexibility in rinsing protocols!**

*pH, total acidity, chloride (salt), peroxide value (PV), free fatty Acid (FFA), sulphite citric acid, phosphoric acid, AOAC methods*

Choose a system based on your industry's workflow requirements using our customized Selection Guide at [www.mantech-inc.com](http://www.mantech-inc.com)

[www.mantech-inc.com](http://www.mantech-inc.com)

\* Paprican - Pulp and Paper Research Institute of Canada

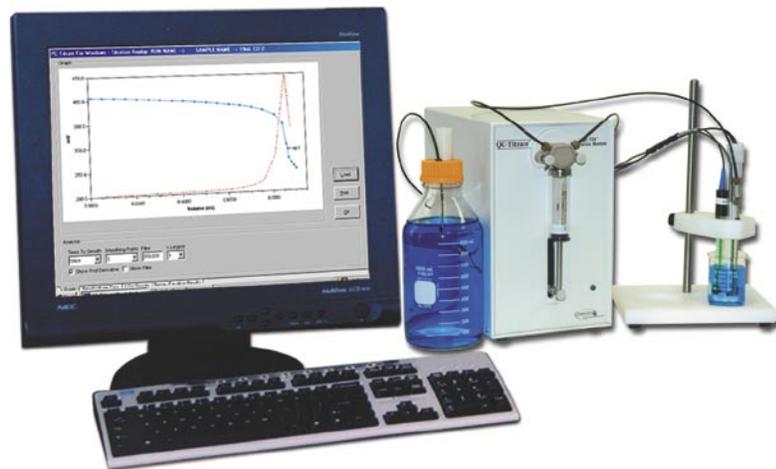
## The Value of QC-Titrate™

The QC-Titrate™ system is a fully capable automated system economically designed for high end titration and ion analysis capabilities only. This easy-to-use system fulfills all the needs of a laboratory where extensive capabilities are not required.

What is the  
betw  
QC-Titrate™ and a

### Capabilities

- Includes built-in 1 x 48,000-step buret drive
- 2 separate measuring electrodes
- Titration
- Ion analysis
- Back titration
- Connect up to 4 reagent addition pumps
- Connect a temperature control device
- Connect any beaker or TitraSip™ autosampler
- Thermistor connection for automatic temperature measurement and compensation



## The economical choice for high-end titration

### Standard QC-Titrate™ Configurations

System Type	Description	Common Applications
<b>QC-Titrate™ Stand Alone</b>	<b>Analyzes one sample at a time.</b> No autosampler attached. Includes titration stand. Options include sample aspiration pump, reagent addition pumps and back titrations.	<b>Environmental:</b> pH, alkalinity, fluoride, ammonia, residual chlorine <b>Petrochemical:</b> TAN, TBN, H <sub>2</sub> S/mercaptan <b>Food/Wine:</b> pH, total acidity, salt <b>Pharmaceutical:</b> pH, vitamin C, chloride
<b>QC-Titrate™ TitraSip™ SA</b>	<b>QC-Titrate™ with TitraSip™ module and sample loading station.</b> Sample may be loaded by operator or automatically loaded by QC-Titrate™ from a feed source. Analyses may be scheduled through the software for operator-free operation (i.e., near-line analysis).	<b>Environmental:</b> pH, alkalinity, fluoride, residual chlorine <b>Food/Wine:</b> pH, total acidity, salt <b>Electroplating:</b> free acid, zinc, nickel
<b>QC-Titrate™ Beaker Autosampler</b>	<b>The QC-Titrate™ Beaker Autosampler performs the titration or ion analysis directly in the sample cup.</b> Since larger diameter sample cups/beakers are used, the probe holder will accommodate 2 electrodes, stirrer, 5 dispense tips and thermistor. This allows titration and ion analysis to be completed in the same batch run. The sample is measured directly in the sample cup by the operator followed by titration and/or ion analysis. Rack capacities range from 18-65 samples.	<b>Environmental:</b> pH, alkalinity, fluoride, ammonia, residual chlorine <b>Petrochemical:</b> TAN, TBN, H <sub>2</sub> S/mercaptan <b>Pharmaceutical:</b> acid/base, vitamin C, chloride, non-aqueous
<b>QC-Titrate™ Tubes Autosampler</b>	<b>To increase autosampler capacity for routine titrations and ion analysis,</b> Man-Tech designed a probe holder that accommodates 1 regular size electrode, stirrer, 1 dispense tip and thermistor. All of this fits into a standard 50ml centrifuge tube. The sample is measured in the tube by the operator and the titration or ion analysis occurs directly in the tube. Rack capacities range from 55 to 179 samples.	<b>Environmental:</b> pH, alkalinity, fluoride residual chlorine <b>Petrochemical:</b> TBN <b>Food/Wine:</b> total acidity, chloride
<b>QC-Titrate™ TitraSip™ Autosampler</b>	<b>Analysis occurs directly in the TitraSip™ analysis vessel or in both the sample cup and the analysis vessel.</b> Since pipetting of the sample is performed by the TitraSip™, this configuration has the capability of multi-parameter analysis from a single sample cup. It also includes capability for immediate repeat analyses and autodilutions. Up to 179 samples may be analyzed in a single batch.	<b>Environmental:</b> pH, alkalinity, fluoride, ammonia <b>Food/Wine:</b> pH, total acidity, salt <b>Pharmaceutical:</b> pH, vitamin C, chloride <b>Electroplating:</b> free acid, zinc, nickel

"The technical (methodology, software, etc.) support you have supplied us with has helped this instrument to evolve from a "nice to have" addition to our regular analytical routine to a "critical workhorse" instrument."

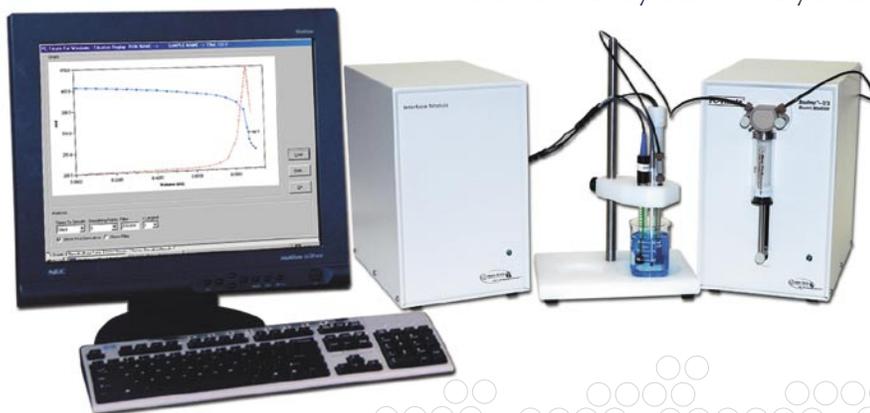
Frank B.- Analytical Laboratory Supervisor - Environmental Laboratory

What is the difference between a PC-Titrate™ system?

## Capabilities

All the capabilities of the QC-Titrate™ system plus...

- Connect up to 4 x 48,000-step buret drives
- Connect up to 4 x TitraValve™ systems
- Connect multiple TitraSip™ modules
- Connect up to 25 reagent addition pumps
- Connect up to 4 different measuring electrodes
- Connect Conductivity AssayPlus™
- Connect Turbidity AssayPlus™
- Connect Color AssayPlus™



## The PC-Titrate™ Advantage

The PC-Titrate™ system is a fully capable automated system designed to combine titration-based analyses with other analysis types such as conductivity, turbidity, color, etc. It is the most powerful titration system in the world and yet still so easy to use.

PC-Titrate™ ...trust in the power and flexibility

### Standard PC-Titrate™ Configurations

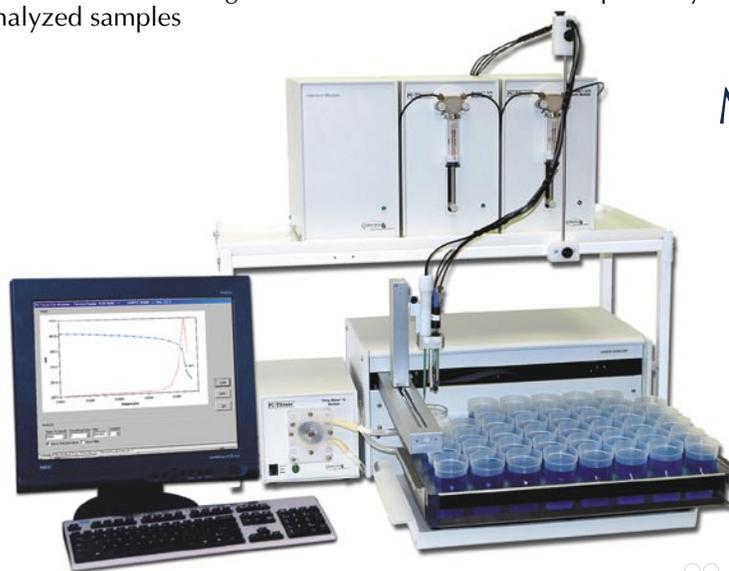
System Type	Description	Common Applications
PC-Titrate™ Stand Alone	<b>Analyzes one sample at a time.</b> No autosampler attached. Includes titration stand. Options include sample aspiration pump, reagent addition pumps, back titrations and multiple burets.	<b>Environmental:</b> pH, conductivity, alkalinity, hardness, chloride, fluoride, ammonia, turbidity, color <b>Petrochemical:</b> TAN, TBN, H <sub>2</sub> S/mercaptan, caustic, MEA <b>Food/Wine:</b> pH, total acidity, salt <b>Pharmaceutical:</b> pH, vitamin C, chloride
PC-Titrate™ TitraSip™ SA	<b>PC-Titrate™ with TitraSip™ module and sample loading station.</b> Sample may be loaded by operator or automatically loaded by PC-Titrate™ from a feed source. Analyses may be scheduled through the software for operator-free operation (i.e., near-line analysis).	<b>Environmental:</b> pH, conductivity, alkalinity, hardness, chloride, fluoride, ammonia, turbidity, color <b>Food/Wine:</b> pH, total acidity, salt <b>Electroplating:</b> free acid, zinc, nickel
PC-Titrate™ Beaker Autosampler	<b>The PC-Titrate™ Beaker Autosampler performs the titration or ion analysis directly in the sample cup.</b> Since larger diameter sample cups/beakers are used, the probe holder will accommodate 2 electrodes, stirrer, 5 dispense tips and one thermistor OR 3 electrodes, stirrer, 4 dispense tips and thermistor. This allows titration, ion analysis, turbidity, color, etc. to be completed in the same batch run. The sample is measured directly in the sample cup by the operator followed by titration and other analyses. Rack capacities range from 18-65 samples.	<b>Environmental:</b> pH, conductivity, alkalinity, fluoride, ammonia, turbidity, residual chlorine, total hardness <b>Petrochemical:</b> TAN, TBN <b>Pulp &amp; Paper:</b> Kappa number, alkalinity, liquors <b>Chemical:</b> caustic, acid/base <b>Pharmaceutical:</b> Acid/base, vitamin C, chloride, non-aqueous <b>Food/Wine:</b> pH, sulfite, total acidity, chloride
PC-Titrate™ Tubes Autosampler	<b>To increase autosampler capacity for routine titrations and ion analysis,</b> Man-Tech designed a probe holder that accommodates 1 regular size electrode, stirrer, 1 dispense tip and Turbidity/Color Analysis tip. All of this fits into a standard 50ml centrifuge tube. The sample is measured into the tube and the titration or ion analysis occurs directly in the tube. Turbidity or Color Analysis occurs from the tube as well. Rack capacities range from 55 to 179 samples.	<b>Environmental:</b> pH, alkalinity and turbidity or color
PC-Titrate™ TitraSip™ Autosampler	<b>Analysis occurs directly in the TitraSip™ analysis vessel or in both the sample cup and the analysis vessel.</b> Since pipetting of the sample is performed by the TitraSip™, this configuration has the capability of multi-parameter analysis from a single sample cup. It also includes capability for immediate repeat analyses and autodilutions. Up to 179 samples may be analyzed in a single batch.	<b>Environmental:</b> pH, conductivity, alkalinity, hardness, chloride, fluoride, ammonia, turbidity, color <b>Food/Wine:</b> pH, total acidity, salt <b>Pharmaceutical:</b> pH, vitamin C, chloride <b>Electroplating:</b> free acid, zinc, nickel

# Beaker Autosamplers

**The Beaker Autosamplers may be connected** to QC-Titrate™ or PC-Titrate™ systems. Analysis of the sample is completed directly in the sample cups. A variety of sample cups may be used including 50ml tubes and 125ml beakers. The probe holder used in the system is dictated by the sample cup selected and by the number of electrodes required. For example, when analyzing in 50ml centrifuge tubes, only one 12mm electrode may be accommodated. However, in a 125ml sample cup, either the 2- or 3-electrode probe holder may be used.

## Advantages

- True X,Y,Z random access, robotic autosamplers completely controlled by the software (no keypads required)
  - define sample rack positions within sample table or method
  - define different arm travel heights for separating conductivity measurements from other electrodes
  - define travel only over unanalyzed samples
- Large unattended runs, e.g. operates overnight analyzing multiple parameters in the same batch run
- Active IntelliRinse™ system with the ability to set values (e.g. rinse to a user-specified conductivity value) or to adjust rinse intensity based on previous concentration, before moving onto the next sample  
e.g. if sample concentration was high - use 3 rinse routines vs. only 2
- Define multiple rinse stations for aggressive rinsing, for example, a combination of solvent and water rinses to clean electrodes of oil and automatically re-hydrate the electrode before the next sample
- Define batch sizes larger than rack size since new samples may be added in place of analyzed samples



PC-Titrate™ System with Large Beaker Autosampler

Man-Tech makes  
the Automation  
Process as Easy  
as Possible with  
Results you can  
Count on.

Minimize Analysis Cost - Maximize Personnel Time

"We are extremely happy with Man-Tech and our PC-Titrate system, and would not hesitate to do business with Man-Tech again."

Chad M. - International chemical manufacturer for titrants and standards

Autosamplers

# QC-Titrate™ / PC-Titrate™

## Standard



### Probe Holders

3 types available to hold:

1 stirrer, 2 electrodes, 1 thermistor & 5 dispense tips  
OR

1 stirrer, 3 electrodes, 1 thermistor & 4 dispense tips  
OR

1 stirrer, 1 electrodes, 1 thermistor & 1 dispense tips

Custom probe holders available

### Standard Beaker Autosampler

#### Standard Rack Includes:

18 x 300ml beakers

OR

28 x 125ml beakers

OR

55 x 50ml sample tubes



## Large



### Rinse Station (connected to pump)

Uses IntelliRinse™ system

Active pump system controlled by software



### Large Beaker Autosampler

#### Standard Rack Includes:

25 x 250ml beakers

OR

43 x 125ml sample cups

OR

104 x 50ml sample tubes

## Mega



### Mega Beaker Autosampler

#### Standard Rack Includes:

44 x 300ml beakers

OR

65 x 125ml beakers

OR

179 x 50ml sample tubes

### Rack with Beakers

Additional rinse stations may be added:

1,2,3,4,5... or as many as required

# TitraSip™ Automation

Man-Tech incorporated this revolutionary concept into titration systems almost 10 years ago. The innovative design of the Titrasip™ autosampler allows for the pipetting of a sample kept in its original state into a separate analysis vessel for the intent of multi-parameter analysis. Today, this unrivaled and proven tool developed and perfected by Man-Tech means tremendous labor savings. Laboratory researchers are able to witness and reap a wealth of benefits: decreased turnaround times, better precision, larger batch sizes, unattended analyses and autodilution. The result is an excellent return on investment.

## Advantages

- True X,Y,Z random access, robotic autosamplers
  - define sample rack positions within sample table or method
  - define different arm travel heights for pipetting at different locations within sample ( e.g. supernatant only)
- Large unattended runs, e.g. operates overnight
- Operates by itself or with an autosampler
- Multiple parameter analysis from a single sample
- Capability to autodilute for highly concentrated samples
- Capability to run duplicates from the same sample cup
- Pays for itself in months, not years!
- Conductivity measurement is separated from the pH electrode
- Analysis vessel is completely drained prior to rinsing and prior to pipetting of next sample (i.e., the sample is drained from the bottom, rather than pumped out, which could leave residual sample in the cup)
- Uses low-cost disposable sample tubes (50, 75, or 125ml)
- Completely controlled by the software (no keypads required)
- Capability to create standards for ISE calibrations automatically
- Active IntelliRinse™ system
- Defines travel only over unanalyzed samples
- Create calibration zones

## Autosampler Rack Capacities

Standard TitraSip™ Autosampler	Large TitraSip™ Autosampler	Mega TitraSip™ Autosampler
<b>Rack Sizes:</b> 28 x 125ml 55 x 50ml - Custom rack sizes available - Flowing rinse station is independent from the rack	<b>Rack Sizes:</b> 43 x 125ml 104 x 50ml - Custom rack sizes available - Flowing rinse station is independent from the rack	<b>Rack Sizes:</b> 65 x 125ml 179 x 50ml - Custom rack sizes available - Flowing rinse station is independent from the rack

"Thank you for your prompt service. This is what makes your company sit above the rest."

Gyan M. - Agriculture Industry

# QC-Titrate™ / PC-Titrate™

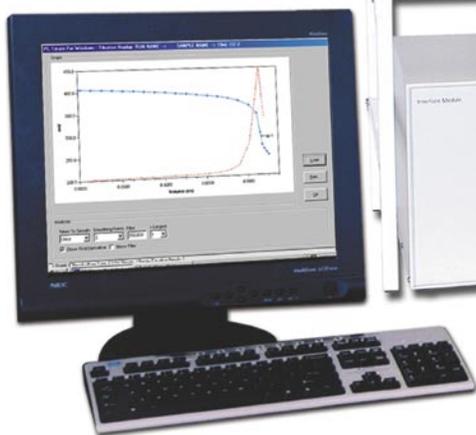
While the “sipping” idea may have been imitated, its equal cannot be found. This stand-alone module can operate as a self-contained unit or can connect to any autosampler. It is composed of a pipetting pump, a rinse pump, an analysis vessel, an active IntelliRinse™ system and a valve activated evacuation system.

PC-Titrate™ software controls all of these modules and any one PC-Titrate™ system can connect up to 4 different TitraSip™ modules to a single autosampler system (the QC-Titrate™ can connect to 1 TitraSip™ module). This allows for the repeated measurement of different parameters in the same sample at the same time. For example, alkalinity and fluoride can be tested simultaneously.

## Integrated sample transfer pump, rinse pump, analysis vessel and drain valve, all in one!

### Analysis Vessel

- Drains from the bottom!



### TitraSip™ Module

- With or without autosampler!

PC-Titrate™ system with standard autosampler, TitraSip™ and TitraValve™

### Rack with Disposable Tubes

- Economical



### Probe Holder

- Rugged
- Custom designs available



# Your Edge in Automation

# Accessories for Your System

There are various modules and accessories available for different analyses on your PC-Titrate™ or QC-Titrate™ system. All accessories are completely controlled by the software. Modules and accessories are as described below.

## Your system can grow... ...as your needs grow!

### TitraValve™

Multiple titrant/reagent delivery from a single buret drive or a reagent addition pump

- Eliminates exchange units

- Select 4 or 8 titrant/reagent model
- Air-water-air routine for titrant or reagent interchange ensures effective titrant switching
- Connect up to 4 TitraValve™ modules for a total of 32 different titrants/reagents available on-line



### Peristaltic Pump

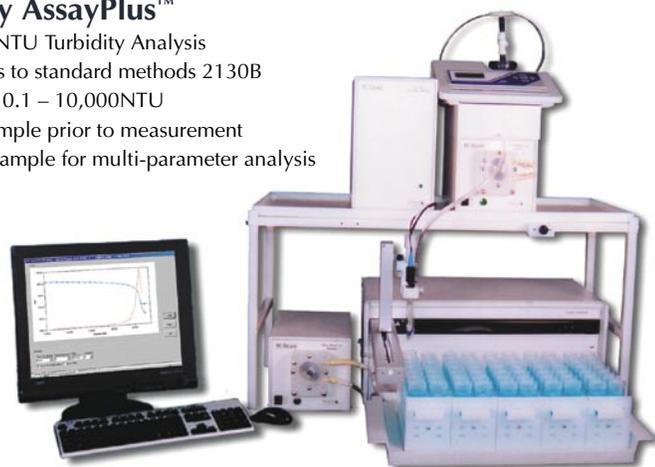
- General reagent addition pump
- Two models: high speed and low speed
- Frees up buret position
- Used for IntelliRinse™ system

**Examples of use:** TISAB addition for fluoride ISE analysis, pH adjustments, buffer addition for hardness titrations

### Turbidity AssayPlus™

Automated NTU Turbidity Analysis

- Conforms to standard methods 2130B
- Range of 0.1 – 10,000NTU
- Mixes sample prior to measurement
- Returns sample for multi-parameter analysis



### Temperature Controlled Rack

- Controls the temperature of your samples



### Dosing Pump

- Accurate reagent addition pumps
- Available for aqueous and non-aqueous reagents
- Frees up buret position for titrations

**Examples of use:** iodine addition for sulfide, solvent addition for TAN/TBN



### Color AssayPlus™

A diode array spectrophotometer completely controlled by the PC-Titrate™ software

- Wavelength range 300-900nm
- Typical applications include color, phosphate and silica
- conforms to EPA and standards methods
- Returns original sample for additional testing if no reagents are added

Thanks for all the work you put into setting things up for us. It certainly has made a difference already in turn-around time for analysis. What a great instrument!

Tonya Y. - Chemistry Lab - Aerospace Industry

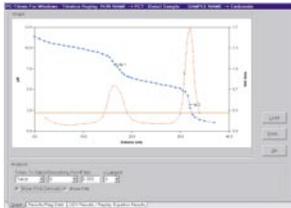
ACCESSORIES

# Software

There are many software capabilities available for your PC-Titrate™ or QC-Titrate™ system. A PC-Titrate™ software package is included with the purchase of every system and controls the entire system, including autosamplers and accessories.

## Click start... and walk away.

### Titration Curve



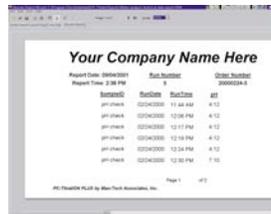
- Set endpoints
- Inflection endpoints
- Audit trail
- Raw data saved
- Up to 4 electrodes monitored simultaneously

### Ion Measurements

F<sup>-</sup>, NH<sub>3</sub>, etc.

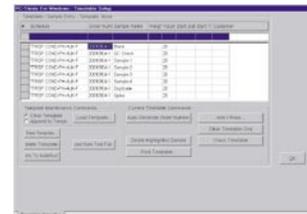
- Concentration value (in mg/L, ppm, etc.)
- mV value at time of measurement
- Temperature at time of measurement
- Total stability time recorded

### Flexible Reporting



- Choose from predefined reports or...
- Create customized reports
- Print and export to LIMS, Excel, etc. simultaneously

### Sample Table



- Create batch tables (e.g. blank, QC check, sample 1, 2, etc., duplicate, spike, etc.)
- Import sample list directly from LIMS
- Priority sampling
- Schedule daily automated startup
- Define rack position within table

## Superior software ensures accurate, defensible results!

### Scheduler



- Set up order of events
- Decision-making capabilities e.g. IF, ELSE
- Subroutines/snippets
- User-defined comments for every step

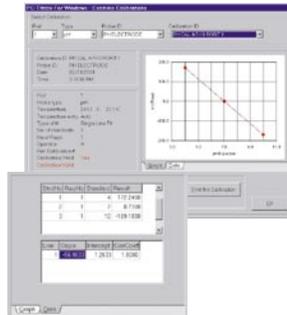
### Autorun Buttons



SAMPLE ANALYSIS

- User-defined quickstart icons
- Easy as 1, 2, 3...
  1. Click AUTORUN
  2. Click START
  3. Walk away

### Calibration



- Linear, point-to-point and quadratic
- Up to 16 points
- Time, mV/s and delta mV/delta time stability
- Used for ISE, conductivity, turbidity, and color calibrations

### Quality Control



- Track electrode and standard performance
- Trend analysis
- Spike AND duplicate (RPD) analysis
- Out of range flags
- SPC chart and user-defined min/max target values

## Plus

- Multi-level programmable password protection
- Complete audit trail
- Electrode database
- Enables 21 CFR Part 11 compliance

Superior Software  
is the Key

# Other Solutions to Meet Your Needs

## BOD AssayPlus™

- Automated system for measuring dissolved oxygen, calculating BOD and reporting results
- Integrated package of software and hardware
- Features active rinse station, streamlined sample entry, integrated QC charting and flexible reporting



BOD AssayPlus™ System

## BOD/Titrate™

- BOD AssayPlus™ + PC-Titrate™ or QC-Titrate™ or AssayPlus™ system in 1 automated unit
- Titration and Ion Analysis capabilities allow for unattended, overnight titration-based analyses. The perfect system can be designed for your specific needs

## PC-Automoisture™

- Automated solution for Karl Fischer analysis
- Designed around the direct injection method offering automated sample dissolution
- Sample can be placed directly on autosampler rack without fear of contamination
- Designed to enable 21 CFR Part 11 compliance

## AssayPlus™

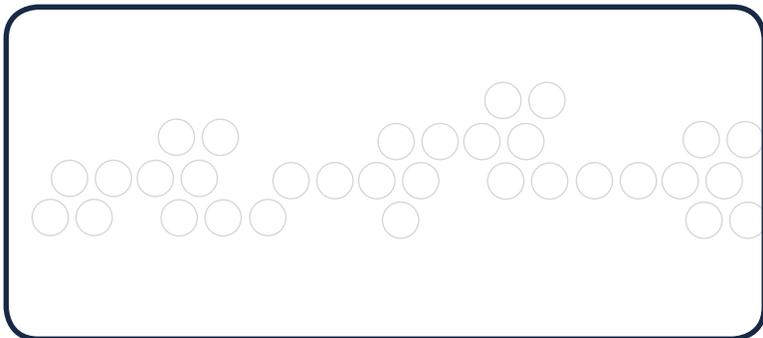
- Automated system designed for discrete, non-titration based measurements
- Economically automates pH, ISE, conductivity, turbidity and color analyses in any combination required



pH AssayPlus™ System

Minimize Analysis Cost - Maximize Personnel Time

Your local Man-Tech distributor is:



Man-Tech offers

Automated Solutions for:

- Titration
- BOD
- Turbidity
- Color
- Ion Analysis
- pH
- ISE
- Conductivity
- Moisture

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